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THE CONCEPTUAL DESIGN OF AN E-FITNESS COACHING SYSTEM
電子健身教練系統之概念設計

WU WAI KIT
吳偉杰

Data of submission: 9th April, 2010

A Final Year Project report submitted in partial fulfillment of the requirements for the degree of Bachelor of Engineering (Honours) in Industrial Engineering and Engineering Management.
ABSTRACT

While people claim that technology leads to sedentary lifestyle, technology also opens the door for all kinds of health-related gadgets. This project sets out to develop such an e-fitness gadget and its complementary sub-systems. We term this system SelFit. Chapter 4 of this report details the idea generation and conceptual design of this personal e-fitness coaching system for physical fitness training. SelFit is conceived as a contactless smart card based system, which aims to physically and psychologically support user’s fitness training program. SelFit can act as a virtual personal tutor to coach user, and plays a role of virtual training partner to give support and motivation throughout the training period. SelFit is equipped with various features, which improve user’s exercising experience and make physical training more interesting. Furthermore, SelFit is a smart system that can help to enhance the efficiency and convenience of the training centre with RFID technology. It can perform the functions of access control and e-payment. Chapter 5, 6 and 7 of this report document the SelFit system analysis, design process and considerations using Use Case Diagram and Structured Analysis and Design Technique (SADT). A waterfall system development life cycle model is followed to handle the complexity of this development work. The complete SelFit system is presented in a Three Tier Model, namely the Presentation Tier of S-Coach, S-Reader and web-interface; the Logic Tier of a Host Computer and the complementary Data Tier of a SelFit database. This conceptual study demonstrates the feasibility as well as a sound basis for the physical development of the SelFit system.
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# TABLE OF CONTENTS

**ABSTRACT** .......................................................................................................................................... I

**ACKNOWLEDGEMENTS** .................................................................................................................. II

**TABLE OF CONTENTS** .................................................................................................................... III

**LISTS OF FIGURES** .......................................................................................................................... VI

**LISTS OF TABLES** ............................................................................................................................ IX

**CHAPTER 1 INTRODUCTION** ........................................................................................................... 1

1.1 **BACKGROUND TO THE PROJECT** ......................................................................................... 1

1.2 **AIM, OBJECTIVES & SCOPE** .................................................................................................... 3

    **AIM & OBJECTIVES** .................................................................................................................. 3

    **SCOPE** ........................................................................................................................................ 4

1.3 **PROJECT REPORT OUTLINE** ..................................................................................................... 5

**CHAPTER 2 LITERATURE REVIEW & MARKET SURVEY** ................................................................. 6

2.1. **LITERATURE REVIEW** ................................................................................................................. 6

    **TRAINING TOWARDS PHYSICAL FITNESS** .................................................................................. 6

    **FORMATION OF DEVELOPMENT METHOD** .............................................................................. 11

2.2. **MARKET SURVEY** ..................................................................................................................... 19

    **SMART FITNESS PRODUCTS FOR TRACING DAILY ACTIVITIES** ........................................... 19

    **SMART FITNESS PRODUCTS FOR TRAINING PROGRAM** ...................................................... 21

    **COMPARISION OF SMART E-FITNESS PRODUCTS** .............................................................. 27

**CHAPTER 3 METHODOLOGY** ........................................................................................................... 30

3.1. **BRAINSTORMING AND MARKET SURVEY APPROACH** ....................................................... 31

3.2. **LITERATURE REVIEW** ................................................................................................................. 31

3.3. **FOCUS GROUPS** ......................................................................................................................... 31

3.4. **THREE TIER MODEL** .................................................................................................................... 31

3.5. **UML: THE USE CASE DIAGRAM** ............................................................................................... 32

3.6. **STRUCTURED ANALYSIS AND DESIGN TECHNIQUE** .......................................................... 33

3.7. **SEVEN-POINT PROTOCOL** ....................................................................................................... 34

3.8. **SYSTEM DEVELOPMENT LIFE CYCLE** ....................................................................................... 34
CHAPTER 4 IDEA GENERATION ................................................................................................................................. 36

4.1 FOCUS GROUP SUMMARY ................................................................................................................................. 36

4.2 GENERAL IDEA OF THE SYSTEM .................................................................................................................... 38

4.3 COMPONENTS OF THE SYSTEM ...................................................................................................................... 43

INSIDE THE GYM ROOM ........................................................................................................................................... 43

OUTSIDE THE GYM ROOM ........................................................................................................................................ 44

4.4 FUNCTIONAL FEATURES ................................................................................................................................... 46

USER IDENTIFICATION ............................................................................................................................................... 46

MOTION TRACKING: .................................................................................................................................................. 47

AUDIBLE COACHING AND MOTIVATION ............................................................................................................. 49

ONLINE APPLICATIONS .......................................................................................................................................... 51

EXTRA VALUE-ADDED FUNCTION ....................................................................................................................... 52

4.5 SUMMARY OF IDEA .......................................................................................................................................... 54

CHAPTER 5 SYSTEM ANALYSIS .................................................................................................................................. 56

5.1 SYSTEM ARCHITECTURE: THREE TIER MODEL ............................................................................................ 56

PRESENTATION TIER ................................................................................................................................................ 56

LOGIC TIER ............................................................................................................................................................. 57

DATA TIER ............................................................................................................................................................... 57

5.2 OVERVIEW OF SelFit FUNCTIONALITY: USE CASE DIAGRAM ........................................................................ 59

SelFit IN GYM ROOM .............................................................................................................................................. 59

SelFit OUTSIDE GYM ROOM ................................................................................................................................. 62

CHAPTER 6 SYSTEM DESIGN: SADT .................................................................................................................................. 66

NODE DIAGRAM ....................................................................................................................................................... 66

TOPMOST LAYER OF SelFit ..................................................................................................................................... 67

E-FITNESS COACHING ........................................................................................................................................... 68

6.1 DATA COLLECTING SYSTEM ............................................................................................................................ 69

USER IDENTIFICATION SYSTEM .......................................................................................................................... 70

MOTION TRACKING SYSTEM .................................................................................................................................. 71

6.2 REAL-TIME COACHING SYSTEM .................................................................................................................... 72

HEART RATE MONITORING SYSTEM ..................................................................................................................... 73

MOTION ANALYZING SYSTEM ................................................................................................................................ 74

VISUAL COACHING MODULE ................................................................................................................................... 75

AUDIBLE COACHING MODULE ................................................................................................................................ 76
6.3 ONLINE APPLICATIONS.................................................................................................77
   FITNESS MONITORING SYSTEM..................................................................................78
   ONLINE MOTIVATING SYSTEM...................................................................................79

CHAPTER 7 SYSTEM DEVELOPMENT..............................................................................80

7.1 SEVEN-POINT PROTOCOL.......................................................................................81
   SYSTEM DEVELOPMENT............................................................................................81
   PROJECT MANAGEMENT..............................................................................................82
   QUALITY MANAGEMENT.............................................................................................83

7.2 SYSTEM DEVELOPMENT LIFE CYCLE....................................................................85

CHAPTER 8 CONCLUSION AND RECOMMENDATION .....................................................90

8.1 CONCLUSION.............................................................................................................90

8.2 RECOMMENDATION..................................................................................................90
   FOR FOLLOW-UP PHYSICAL DEVELOPMENT OF SelFit SYSTEM..........................91
   FOR FUTURE DEVELOPMENT OF E-FITNESS SYSTEM..........................................92

REFERENCES ..................................................................................................................I

APPENDICES..................................................................................................................V

APPENDIX A. FOCUS GROUP SUMMARY .....................................................................V
LISTS OF FIGURES

CHAPTER 2

FIGURE 2-1: THE BASIC PARADIGM DEFINING THE PATHS FROM PHYSICAL ACTIVITY LEVELS TO HEALTH OUTCOMES .................................................................................................................................................................................. 6
FIGURE 2-2: A SIMPLIFIED VERSION OF THE HEALTH BELIEF MODEL ........................................ 11
FIGURE 2-3: THE SEVEN-POINT PROTOCOL .................................................................................. 12
FIGURE 2-4: THE AD-HOC PROCESS MODEL ................................................................................. 15
FIGURE 2-5: THE WATERFALL MODEL .......................................................................................... 15
FIGURE 2-6: THE PROTOTYPING MODEL ....................................................................................... 16
FIGURE 2-7: THE SPIRAL MODEL .................................................................................................. 18
FIGURE 2-8: FITBIT WIRELESS PEDOMETER AND THE BASE STATION ........................................... 19
FIGURE 2-9: 3 STEPS OF USING FITBIT ......................................................................................... 20
FIGURE 2-10: WATERPROOF DIRECTLife ACTIVITY MONITOR .................................................... 20
FIGURE 2-11: 5 STEPS OF USING DIRECTLife TO MONITOR DAILY ACTIVITIES ......................... 21
FIGURE 2-12: POLAR WATCH AND FOOT POD SET FOR RUNNING ........................................ 22
FIGURE 2-13: 5 STEPS OF USING POLAR ProTRAINER 5 IN SUPPORTING PERSONAL TRAINING PROGRAM ........................................................................................................................................................................ 22
FIGURE 2-14: POLAR F-SERIES WRIST UNIT DISPLAY FOR PHYSICAL FITNESS TRAINING ........ 23
FIGURE 2-15: ADIDAS miCoach PACER .......................................................................................... 24
FIGURE 2-16: ADIDAS miCoach ZONE ......................................................................................... 24
FIGURE 2-17: ADIDAS miCoach TRAINING ZONE ........................................................................ 24
FIGURE 2-18: 4 STEPS OF USING ADIDAS miCoach PACER FOR RUNNING ............................ 25
FIGURE 2-19: SAMSUNG ADIDAS miCoach F110 FITNESS PHONE WITH OTHER RELATED DEVICES ........................................................................................................................................................................ 25
FIGURE 2-20: NIKE+, SENSOR AND IPOD PERSONAL TRAINING SET ......................................... 26
FIGURE 2-21: NIKE+ SportBAND AND SENSOR TRAINING SET ................................................... 26
FIGURE 2-22: 3 STEPS OF USING NIKE+iPOD FOR RUNNING ......................................................... 26
FIGURE 2-23: COMPARISON OF DIFFERENT PRODUCTS ON ENTERTAINMENT AND SPORTS FUNCTIONALITY .................................................................................................................................................. 29
CHAPTER 3

FIGURE 3-1: METHODOLOGY USED OF THIS FINAL YEAR PROJECT ............................................ 30
FIGURE 3-2: EXAMPLE OF THE THREE TIER MODEL ................................................................ 32
FIGURE 3-3: EXAMPLE OF USE CASE DIAGRAM ..................................................................... 33
FIGURE 3-4: BASIC ELEMENT OF SADT .................................................................................. 34
FIGURE 3-5: TOP DOWN DECOMPOSITION STRUCTURE OF SADT ........................................ 34

CHAPTER 4

FIGURE 4-1: BACKGROUND INFORMATION OF RESPONDENTS OF FOUR FOCUS GROUPS .............. 36
FIGURE 4-2: CONCEPTUAL IDEA OF SELFit .................................................................................. 38
FIGURE 4-3: BASIC REQUIREMENTS OF SELFit USERS ............................................................... 39
FIGURE 4-4: FLOWCHART OF STARTING USING SELFit ............................................................... 40
FIGURE 4-5: EXAMPLE OF RF FIELD OF S-READER ................................................................. 41
FIGURE 4-6: FLOWCHART OF EXERCISING WITH SELFit IN GYM ROOM ................................. 41
FIGURE 4-7: FLOWCHART OF USING SELFit TO MANAGE THEIR TRAINING PROGRAMS ............ 42
FIGURE 4-8: FIVE COMPONENTS OF SELFit .............................................................................. 43
FIGURE 4-9: TAG-READER-HOST COMMUNICATION FOR USER IDENTIFICATION .................... 46
FIGURE 4-10: INERTIAL SENSOR BASED SYSTEM FOR MOTION TRACKING ............................. 48
FIGURE 4-11: SCENARIO OF AUDIBLE COACHING OF CARDIO-TRAINING ............................... 49
FIGURE 4-12: FUNCTIONS OF ONLINE APPLICATIONS .............................................................. 51
FIGURE 4-13: SAMPLE OF ONLINE APPLICATIONS ................................................................. 52

CHAPTER 5

FIGURE 5-1: CONCEPTUAL STRUCTURE OF SELFit IN THREE TIER MODEL ................................. 56
FIGURE 5-2: RELATIONSHIP DIAGRAM OF THE FIVE COMPONENTS OF SELFit .......................... 58
FIGURE 5-3: USE CASE DIAGRAM OF SELFit IN GYM ROOM .................................................... 59
FIGURE 5-4: USE CASE DIAGRAM OF SELFit OUTSIDE GYM ROOM ........................................ 62
CHAPTER 6

FIGURE 6-1: NODE DIAGRAM OF SELFIT COACHING SYSTEM .................................................. 66
FIGURE 6-2: SADT SHEET NO. 1: TOP VIEW OF SELFIT ........................................................ 67
FIGURE 6-3: SADT SHEET NO. 2: E-FITNESS COACHING ...................................................... 68
FIGURE 6-4: SADT SHEET NO. 3: DATA COLLECTING SYSTEM ............................................. 69
FIGURE 6-5: SADT SHEET NO. 4: USER IDENTIFICATION SYSTEM ........................................ 70
FIGURE 6-6: SADT SHEET NO. 5: MOTION TRACKING SYSTEM ................................................ 71
FIGURE 6-7: SADT SHEET NO. 6: REAL-TIME COACHING SYSTEM ....................................... 72
FIGURE 6-8: SADT SHEET NO. 7: HEART RATE MONITORING SYSTEM .................................. 73
FIGURE 6-9: SADT SHEET NO. 8: MOTION ANALYZING SYSTEM ........................................... 74
FIGURE 6-10: SADT SHEET NO. 9: VISUAL COACHING MODULE .......................................... 75
FIGURE 6-11: SADT SHEET NO. 10: AUDIBLE COACHING MODULE ....................................... 76
FIGURE 6-12: SADT SHEET NO. 11: ONLINE APPLICATIONS .................................................... 77
FIGURE 6-13: SADT SHEET NO. 12: FITNESS MONITORING SYSTEM ...................................... 78
FIGURE 6-14: SADT SHEET NO. 13: ONLINE MOTIVATING SYSTEM ....................................... 79

CHAPTER 7

FIGURE 7-1: SYSTEM DEVELOPMENT LIFE CYCLE OF SELFIT ............................................... 85
FIGURE 7-2: ACTIVITY-ORIENTED GANTT CHART SAMPLE ......................................................... 86
FIGURE 7-3: FLOW DIAGRAM OF CONCEPTUAL DESIGN PHASE ............................................. 86
FIGURE 7-4: FLOW DIAGRAM OF ANALYSIS PHASE .............................................................. 87
FIGURE 7-5: FLOW CHART OF DESIGN PHASE ......................................................................... 88
FIGURE 7-6: FLOW CHART OF DETAILED DESIGN PHASE ....................................................... 88
FIGURE 7-7: FLOW CHART OF TEST AND IMPLEMENTATION PHASE ....................................... 89

CHAPTER 8

FIGURE 8-1: IMAGINING IDEA OF CAPTURING MOTION ............................................................. 91
LISTS OF TABLES

CHAPTER 2

TABLE 2-1: DIETARY REFERENCE INTAKES FOR MACRONUTRIENTS .................................................. 8
TABLE 2-2: SUMMARY OF ELEMENTS ABOUT SEVEN-POINT PROTOCOL........................................ 13
TABLE 2-3: COMPARISON OF THE 5 MENTIONED PRODUCTS ON THEIR PURPOSE AND TARGET
   ACTIVITIES ........................................................................................................................................ 27
TABLE 2-4: SUMMARY OF THE STRENGTHS AND WEAKNESSES ON THE 3 E-FITNESS PRODUCTS .. 29

CHAPTER 4

TABLE 4-1: BRIEF IDEA SUMMARY OF SELFIT .................................................................................. 38
TABLE 4-2: REQUIREMENTS OF RFID TAGS FOR USER IDENTIFICATION IN CONCEPTUAL DESIGN
   PHASE ................................................................................................................................................ 46
TABLE 4-3: REQUIREMENTS OF RFID READERS IN CONCEPTUAL DESIGN PHASE ......................... 47
TABLE 4-4: TARGETED TRAINING EQUIPMENTS WITH S-READER INSTALLED ................................. 48
TABLE 4-5: PURPOSE OF COLLECTED DATA OF DIFFERENT EQUIPMENTS ..................................... 48
TABLE 4-6: AUDIBLE COACHING OF VARIOUS SCENARIOS FOR STRENGTH TRAINING ............. 49
TABLE 4-7: ROLE PLAY SOUND RECORDING FOR RUNNING AND CYCLING .............................. 50
TABLE 4-8: SUMMARY OF DESIGNED FEATURES, WHICH MEETS THE KEY OPINIONS OF FOCUS
   GROUPS .............................................................................................................................................. 54
TABLE 4-9: SUMMARY OF DESIGNED FEATURES, WHICH MEETS THE HYPOTHESIS OF HEALTH
   BELIEF MODEL .................................................................................................................................. 55

CHAPTER 7

TABLE 7-1: DEFINITION OF SYSTEM DEVELOPMENT METHODOLOGY .......................................... 80
TABLE 7-2: BRIEF DEVELOPMENT ACTIVITIES OF SELFIT ............................................................ 81
TABLE 7-3: BRIEF TECHNOLOGIES AND TOOLS NEEDED FOR DEVELOPMENT OF SELFIT .......... 82
TABLE 7-4: BASIC QUALITY REQUIREMENTS OF SELFIT ............................................................... 83
TABLE 7-5: BRIEF IDEA ABOUT SEVEN-POINT PROTOCOL ............................................................ 84
CHAPTER 1 INTRODUCTION

1.1 BACKGROUND TO THE PROJECT

According to the survey conducted by Kaiser Family Foundation in 2007, in one country out of two, health-related issue, such as personal illness, health-care costs and so on is the top personal concern of over one third of the population surveyed (Kaiser Family Foundation, December 2007). Concern has been expressed about the increasing obesity (Stamatakis E., Primatesa P., Chinn S., Rona R.J., Falascheti E., 2005). After the outbreaks of different flu in recent years, health becomes a more popular issue around the world. Scientific evidence has demonstrated that sedentary lifestyle is one of the leading causes for most of today’s health problems and chronic diseases. There is no question that technology has changed our lives. Lots of physical activities are eliminated and that means technology is one of the causes of today’s sedentary lifestyle and health problems.

Fortunately, while technology indeed has many negative impacts on people's physically active lifestyle, it can also play a positive role in our life. Scientists now try to integrate technology and science into our daily life for improving the health level. There is an increasing trend of people choosing physical fitness centres as a place for them to exercise. Nowadays, people not only seek for a healthier body, but also pursue a better body sharp. It is a trend for people who are living in such a busy, competitive city. Physical fitness centres provide a full-equipped indoor area and experienced coaches for people to have a better exercising experience. No matter in a windy or rainy day, people can keep exercise in a comfortable centre. That is why physical fitness becomes more and more popular.

Some physical fitness companies provide a personal training program. There are exercise experts helping and giving people advice about their training. Besides, technology plays an important role in training program. No matter you are a starter, or a gym room veteran, a clear analysis is helpful in achieving your training goal. It is important for you to understand what your body response to your training rather than keep exercise blindly.

In a traditional way, people who want to plan and record their training plan or schedule, had to write them in a notebook or their personal diaries, which is an old style of recording. Since computers become more and more popular, these kinds of recording method are converted into an electronic form. People start to type their training plan and records into their computers. However,
the recording methods still have lots of inadequate parts that obstruct people to achieve better training results. For instance, it is not convenience that they have to memorize what kinds and the duration of used training equipments everytime. Nowadays, some companies offer self-designed software for planning, with electronic devices to record the body response. An e-fitness Coaching System is a tool for people using internet to manage their training program and to analyze their body response. People can access the Coaching System everywhere and manage their training plan by simply using a web-enabled device. As a result, e-fitness coaching system helps to improve the efficiency and convenience of gym room training.
AIM & OBJECTIVES & SCOPE

AIM & OBJECTIVES

This Final Year Project aims to conceptually develop an e-fitness Coaching System, including the e-fitness gadgets and system, which is used in gym room. In this Project, it will talk about the feasibility and the conceptual design of an e-fitness coach in Gym room. It targets to design a tool for fitness trainer to achieve a better result of their training plan by oneself, instead of employing a personal coach one by one.

This project has three objectives, which cover the physical aspect and psychological aspect.

Firstly, it aims to design a system **physically assisting in training**. SelFit captures and provides relevant information for individuals, who look for a better monitor of training program in gym room. The main focus of SelFit is to act as a personal tutor who coaches them to become fit. Users can manage their training program easier with the support of valued physical data and information. The training data is recorded automatically with the help of different devices. SelFit helps users to know more about the response of their bodies. It guides them to monitor and provide enough information for them to modify their exercising schedule.

Secondly, it aims to design a system **psychologically helping in training**. SelFit is designed to be a training partner, who supports people in fitness training. It targets on motivation of fitness training. Getting fit is not an effort of couple of months, it requires a perseverance in putting effort continuously. One of the reasons of failure is many people feel boring about exercising with machines, which they will not give any responses. Another reason is that most people do not know how much they have improved until they have a huge visible improvement. This leads to discouragement before they recognize any change on their body. That’s why SelFit targets to continuously motivate people and encourage them to keep exercising. SelFit tries to bring fitness training in gym room to a new level and becomes part of their life.

Thirdly, it intends to **increase the level of efficiency and convenience** of using a fitness centre. It is an advanced use of SelFit. By wearing the wristband with a registered RFID Tag, users can use it as a key for entrance or lockers. It can also act as an electronic-payment device for paying the charge of using different services in the fitness centres. As a result, center users can access everything in the fitness centre with a built-in RFID tag.
SCOPE

In this Final Year Project, it will mainly focus on the feasibility and conceptual design of an e-fitness gadget and system. It is a product feasibility study and conceptual development project for a personal e-fitness coaching system. For the technical parts of developing different components of the System, this project will not go deep into it.
1.3 PROJECT REPORT OUTLINE

This report records the conceptual design and the system development of SelFit. To start with, Chapter 2 covers two parts, which are the literature review and market survey. Literature about training behavior and the system development methodology are reviewed, while five famous existing e-fitness products are examined. Then, the methodology used in this report is outlined in Chapter 3. After that, Chapter 4 gives an overview about the idea generation of SelFit. It introduces the components and the functional features of the system. This is followed by the description of system analysis in Chapter 5. The system architecture and the overview of the system functionality are presented in this chapter. Moreover, Chapter 6 discusses the system designed of the system and is followed by Chapter 7, which is about system development of SelFit. Finally, the report concludes in Chapter 8 and recommendation is examined.
CHAPTER 2 LITERATURE REVIEW & MARKET SURVEY

In this chapter, it consists of two main sections. The first one is Literature Review, which aims to review the critical points of existing methodology. The second one is Market Survey, which targets to discuss about current products in the today’s market.

2.1. LITERATURE REVIEW

In this section, I first review some fitness-related literatures for idea generation of an e-fitness coaching system, and then the next part is about the existing methodology that related to System Development and Project Management.

TRAINING TOWARDS PHYSICAL FITNESS

Physical fitness is defined as a set of attributes that people have or achieve relating to their ability to perform physical activities (Caspersen C.J., Powell K.E., Christenson G.M., 1985). It is about to be healthy, to resist diseases, and to meet emergency situations. Physical fitness comprises two related concepts: General Fitness and Specific Fitness. General Fitness is the state of health and well-being, while Specific Fitness is a task-oriented definition based on the ability to perform specific aspects, like sports, occupations, and so on. Overall fitness is made up of five main components: Cardio-respiratory endurance, Muscular strength, Muscular endurance, Body composition and Flexibility. Various technologies are developed to help promote physical activity and change exercise behaviors. As shown in Figure 2-1, Bouchard illustrated that there are two paths linking physical activity to health outcomes (Bouchard, 2001). The first one is the physical activity level directly influence health, while the second one is an indirect path. It assumes that the variation in physical activity level leads to changes in health-related fitness, which will then affect health outcomes.

Figure 2-1: The basic paradigm defining the paths from physical activity levels to health outcomes (Bouchard, 2001)
Electronic Gauges for training

There are various electronic devices designed and developed for monitoring physical activities by detecting and processing the mechanical movement or the bio-electronic signals of body movement. Heart rate monitors, pedometers and accelerometers are the three most popular health-related electronic gauges.

**Pedometer** is a step counter, which is used to record the walking steps taken. It is the oldest and most popular device for measuring and recording physical activities (Bassett, D.R. and Strath, S.J., 2002). The first development and usage of pedometers for measuring and promoting physical activities is in Japan in the 1960s. Yamasa developed and released the first calorie-meter type of pedometer in the 1980s. It is an integration of steps and energy burnt. Pedometers were picked up by the U.S. researchers in the late 1980s and started to become more and more popular in 1990s. Nowadays, millions of pedometers is using in the U.S. alone. Furthermore, it can also be a motivation tool. According to two recent reviews, pedometer-based walking has been shown to be associated with significant increases in physical activities and reduces in body mass index (BMI) and blood pressure (Bravata D. M., Spangler C.S., Sundaram V., Gienger A.L., Lin N., Lewis R., Stave C.C., Olkin I., Sirard J. R., 2008). It also resulted in a modest amount of weight loss (Richardson P., Pivkin I. Karniadakis G., 2008).

**Accelerometer** is a small portable electronic device, which is used to record minute-by-minute data of body acceleration, so that the activity counts per minute can be shown. It is usually worn on the waist and stores the data with flexible recording intervals. It can sense and record movement during a variety of activities and provide detailed information on frequency, duration, intensity and the pattern of all activities conducted by users. Accelerometers have been accepted as an accurate objective field measure for most of the physical activities (Freedson P.S., Miller K., 2000). Specifically, the AntiGraph accelerometer was included in the National Health and Nutrition Examination Survey to measure and monitor physical activities objectively among the U.S. population. However, because of the limitation of high cost, accelerometers have been used mainly in research studies, rather than other large scale application.

**Heart rate monitor** is an electronic device, which is used to measure heart rate. Heart rate is a physiological variable that is highly related to the intensity of activities. Heart rate is the earliest measuring parameter of physical activities and it has been widely applied in estimate energy burnt since 1907 (Montoye H.J., Kemper H.C.G., Saris W.H.M., Washburn R.A., 1996). Heart rate is closely related to age, gender, emotional stress and so on. That is why Energy burnt estimation by
using heart rate may be biased (Renni e K., Rowsell T, Jebb S.A., Holburn D., Wareham H.J., 2000). The heart rate monitor has been used in physical activities for monitoring exercise intensities for highly active individuals.

Technology has already changed our lives and it has been used in physical exercise for a long time. Newly developed technology try to change people’s attitudes and behaviors using technology in training. Various factors, such as design, cost, integration of technology with behavior change theories and so on, should be pursued (President's Council on Physical Fitness and Sports, Sept. 2008).

ii. Nutrition for training

There is no doubt that the amount, type, composition and timing of food intake can influence the health. More precisely, the importance of nutrient intake and adequate energy become more critical when physical work increases for more than an hour per day. As stated in the 2000 Position Statement on Nutrition and Athletic Performance, “any active individual who wants to optimize health and exercise performance needs to follow good nutrition and hydration practices, use supplements and ergogenic aids carefully, minimize severe weight loss practices, and eat a variety of foods in adequate amounts.” (American Dietetic Association, Position of The American Dietetic Association, Dietitian of Canada, and the American College of Sports Medicine, 2000)

The Food and Nutrition Board (FNB) of the Institute of Medicine (IOM) published new dietary reference intake (DRIs) for energy, macronutrients (Institute of Medicine, 2002). The DRI are a set of reference values for energy and specific nutrients designed to be the guidelines for individuals or groups to make dietary recommendations.

Energy balance is achieved when the energy expenditure equals energy consumed (Swinburn B., Ravussin E., 1993). More precisely, if one is in energy balance, his/her weight should be maintained. Conversely, if one is not in energy balance, his/her weight will properly lose or gain. Furthermore, macronutrient, such as carbohydrate, protein and fat, are important for active people and the amounts of intake will depend on one’s exercise of intensity, duration and frequency of the exercise. It also closely relates to the individual’s health, age, gender and size of body. Several guidelines, as shown in Table 2-1, are established in the past few years, such as the one suggested by IOM in 2002 (Institute of Medicine, 2002) and the one created by Food and Nutrition Board in 1989 (Food and Nutrition Board, 1989).

Table 2-1: Dietary Reference Intakes for macronutrients
**Nutrient** | **New Guidelines (Institute of Medicine, 2002)** | **Old Guidelines (Food and Nutrition Board, 1989)**
---|---|---
**Carbohydrate** | 45-65% of total energy | ≤ 50% of total energy
**Protein** | 10-35% of total energy; 0.8g/kg of body weight | 10-15% of total energy; 0.8 g/kg of body weight
**Fat** | 20-35% of total energy | ≤ 30% of total energy

Beside the three macronutrients mentioned before, there are some elements, which is also important for exercise. Water and electrolyte is one example, it is because active individuals need to refill the water and electrolytes lost in sweat. Besides, micronutrient, such as vitamins and minerals, also play an important role in maintaining health. They are involved in various functions of human beings, such as energy production, building and repair of muscle tissue and so on (American Dietetic Association, Position of The American Dietetic Association, Dietitian of Canada, and the American College of Sports Medicine, 2000).

Compared to the sedentary individuals, an active person consumes more and requires different nutrient additionally. Eating and drinking do have significant impact on health and exercise performance. A healthy diet supplies the needs for individuals to carry out various physical activities, which finally leads to a healthier life.

### iii. Psychology of training

Besides the technology development and nutritional research contribute to training, psychology aspect is also studied for improving training performance and results. The psychological and behavioral factors play an indispensable role in physical fitness study. The study of human motivation has been central to psychology and has developed through various perspectives (Weiner B., 1992). Four important components are defined by Maehr and Braskamp in 1986 (Maehr M.L., Braskamp L.A., 1986): Choice, Persistence, Continuing motivation and Intensity.

**Choice** is the first indicator of motivation described by Maehr and Braskamp. It is as simple as the decision-making about the individuals whether to be active or not. For instance, there is a choice for individuals to decide what activities to do in their leisure time. After the person desire to be active, various decision-making processes follow. For instance, kind of activities, time of exercise, duration of activities and so on.

**Persistence** is the second motivating factor introduced. It is refers to the degree of sustained concentration on a task. It is closely related to importance of the thing to the individual. For
instance, individual will become much persistent in exercising since he/she desire to be an active person. It can be a source of motivation for user to become persistent in training.

**Continuing motivation** is described as, “if a certain exists when a task is left incomplete and the person simply cannot leave it alone,” by Maehr and Braskamp (Maehr M.L., Braskamp L.A., 1986). Szabo shows that a few individuals feel highly committed in the way to structured exercise (Szabo A., 2000). At a moderate level, lots of people said that they feel good from physical activity and feel less good after they missed theirs for a few days.

**Intensity** is another behavioral indicator of motivation. It is important in relation to the discussion about the intensity level of the physical activity that leads to health gains. It is because more and more moderate forms of activity require less intensive levels of motivation, while “Vigorous” exercise is promoted in the past.

U.S. Public Health Services introduced the Health Belief Model (HBM) in 1950s (Rosenstock I.M., 1974). It is a health behavior change and psychological model for studying and promoting the uptake of health services. As shown in Figure 2-2, there are total four perceptions serve as the main constructs of the model: Perceived Seriousness, Perceived Susceptibility, Perceived Benefits and Perceived Barriers. Recently the model has been expanded to include cues to action, motivating factors and self-efficacy.

Perceived Seriousness represents an individual’s belief about the seriousness or severity of a disease. This perception can be influenced by anything surrounding us. Perceived Susceptibility is an individual’s assessment of the risk of getting the condition. It is only logical that when individuals believe they are at risk for a disease and people will be much willing to do something to prevent it from happening. Perceived Benefits is a person’s opinion of the value of a new behavior in decreasing the risk of developing a disease. People tend to adopt healthier behaviors if they believe that the new behavior benefits to them. Perceived Barriers is about the resistance to change. Among all, it is the most significant in determining behavior change (Janz N.K., Becker M.H., 1984).

The Demographic Variables include age, gender, occupation and so on. These do influence the perception of threat of disease. Cues to Action are events, people, or things that move people to change their behavior. For instance, Advice, reminder from the others and any health warning labels affect people’s mind. Self-Efficacy is the belief in one’s own ability to do
something (Bandura A., 1977). As a conclusion, these facts affect our perception of susceptibility, seriousness, benefits and barriers, which final leads to our behavior.

Figure 2-2: A simplified version of the Health Belief Model

This model hypothesizes that people will not seek for health behaviors unless:

- they possess minimal levels of health motivation and knowledge
- view themselves as potentially vulnerable
- view the condition as threatening
- are convinced of the efficacy of the training
- see few difficulties in undertaking the action towards health

FORMATION OF DEVELOPMENT METHOD

Steven Alter describes an ideal development situation which has the least risky development process as follow:

“The system is to be produced by a single implementer for a single user who anticipates using the system for a very definite purpose that can be specified in advance with great precision. Including the person who will maintain it, all parties affected by the system understand and accept in advance its impact on them. All parties have prior experience with this type of system, the system receives adequate support, and its technical design is feasible and cost-effective.”

(Alter, 1980)
Steven Alter claims that the more condition differs from the ideal case, the greater the risk of failure in the system implementing process. The development approach should be carefully chosen and designed according to the intensity and source of risk.

i. Seven-point Protocol

Gertjan Vlasblom, Daan Rijsenbrij and Matthijs Glastra introduce the Seven-point Protocol (Gertjan Vlasblom, Daan Rijsenbrij and Matthijs Glastra, 1995) for people to understand their project deeper. They said that people should address seven points before starting any projects. As shown in Figure 2-3, every system development project can be managed on three dimensions, which are Project Management Aspect, Quality Management Aspect and System Development Aspect. Take System Development Aspect as a main development dimension, it mentions about all related elements for developing the system. Additionally, Quality Management and Project Management are two aspects supporting the System Development Dimension. Quality Management aims to ensure the system meet the user requirements, while Project Management targets to keep tracking about the progress of the project.

Firstly, “Products” of System Development is about what the products are and what target customer groups are being focused. Planner should outlines all related products, which are needed to be produced during the system development project.

Secondly, “Quality Requirement” of Quality Management considers all the requirements of the system. These requirements includes the user requirements about the function of the system and the quality requirements about the performance of all sub-systems. At the stage of conceptual design,
basic quality requirements are stated and the detailed quality requirements will be defined at the analysis phase of the project.

Thirdly, “Activities” of System Development indicates the development activities, which must be carried out to develop the system. Moreover, it also includes the target responsible groups, who will be involved in each particular activity. The development activities will further breakdown into smaller size and be carried out one by one.

Forthly, It includes “Development Strategy” of Project Management and “System Orientation” of System Development. The former is about what development strategy will be used in managing the system development project. And the latter is about the development orientation that the system be designed and built. The development focus point should be carefully studied.

Fifthly, “Technology and Tools” of System Development is about the technology and tools that will be used for development of the system. It forces planner to think carefully what are the needs for developing the system.

Sixthly, “Activities” and “Products” of Project Management means that what activities and products can be used in supporting project management. For an instance, regular reporting meetings can help in understanding and tracking the project progress. Existing products, such as Microsoft Project software, help in project management of developing SelFit.

Finally, “Activities” of Quality Management is about the quality assurance and quality audit activities that will be used in the project. For an instance, audit plan and internal project quality can be used for independent verification for the system development. It is very important that the type of activities for quality audit should be carefully designed and planned. Those quality requirements for each stage of different components should be checked before it goes to the next stage of development.

The Seven-point protocol is a methodology for planners to consider more comprehensively before starting planning the development method. It tries to question the planners in different aspects and allows them to design a optimal tailored development project. Table 2-2 summarizes the elements about Seven-point Protocol.

Table 2-2: Summary of elements about Seven-point Protocol
## System Development Methodology

System Development Methodology (SDM) is primarily about planning and organizing. It helps people to foresee various events in a system development and to adopt methodology to the development. SDM is used as a guideline suit for most system development. It focuses on both system elements and the human beings. SDM illustrates various typical processes that are involved in developing a particular system. These processes cover a wide range of complex subjects under constraints of different requirements. The life cycle of a system is a vital important part of SDM. This cycle begins with various requirements, and it undergoes the developing stage, the implementing stage and maintaining stage.

Various frameworks have evolved and each has its strength and weaknesses. There are three main system development Process Models, which includes three primary approaches: the Ad-hoc Process Model, the Waterfall Model, the Prototyping Model and the Spiral Model.

The **Ad-hoc Process Model** is an early systems development, which take place in a chaotic and haphazard manner. It relies on the experience and skills of the individual staff who is involved in the project. Nowadays, it is still used in some small projects. The Software Engineering Institute at Carnegie Mellon University points out that with Ad-hoc Process Models, “process capability is unpredictable because the software processes are constantly changed or modified as the work progresses. Schedules, budgets, functionality, and product quality are generally (inconsistent). Performance depends on the capabilities of individuals and varies with their innate skills,
knowledge, and motivations. There are few stable software processes in evidence, and performance can be predicted only by individual rather than organizational capability.” (Mark C. Paulk, Charles V. Weber, Suzanne M. Garcia, Mary Beth Chrissis and Marilyn W. Bush, February 1993) However, large projects may have more chance to be failure if the Ad-hoc Process Model is adopted. The main reason is that Ad-hoc Process Model has the least supporting stage for system development. As shown in Figure 2-4, the Ad-hoc Process Model relies on involved people’s individual skills and experience.

![Figure 2-4: The Ad-hoc Process Model](image)

The **Waterfall Model** is the earliest method of structured system development methodology. It is widely used, because it is attributed with providing the theoretical basis for other Process Models. As shown in Figure 2-5, it consists of the five typical steps:

![Figure 2-5: The Waterfall Model](image)

System Conceptualization refers to the consideration of all aspects of the targeted business function or process, with the objectives of determining how different aspects relate to each other, and which aspects will be connected into the system.

Systems Analysis refers to gather the requirements of the system, with the target of determining how these requirements will be adapted in the system. That is why communication between the customer and the developer is vital important in Japan.

System Design is conducted once the requirements have been collected and analyzed, it is essential to identify in detail how the system will be constructed to perform various tasks. More precisely, it is focused on what information will be processed in the system, which means the data requirements. It also emphasizes on the method for construction. Furthermore, the look and feel
of the system will also be constructed in this phase.

System Detailed Design, which is also known as programming, involves the creation of the system software. Most of the requirements and systems specifications from the System Design step are translated into machine readable computer code.

System Testing occurs after the system is built and all components are integrated. It is performed to ensure that it works correctly and efficiently. Testing is generally focused on efficiency and external effectiveness. The objective of internal testing is to make sure that the programming code is efficient, standardized, and well documented. The external effectiveness testing aims to verify that the software is functioning according to system design and to ensure all necessary functions can be performed. That is why Testing can be a labor-intensive process due to its iterative nature.

However, the Waterfall Model was being challenged in recent years. It is because of its rigid design and inflexible procedure. People claimed that real projects rarely follow the sequential flow, while some said that the requirements and goals always have lots of uncertainty at the beginning of most projects, and so that it is difficult for users to identify their needs on a detailed level. The Waterfall Model does not accommodate these challenges very well. Furthermore, it is time-consuming to develop a system using the Waterfall Model.

The Prototyping Model is applied when it is difficult to know all of your requirements at the beginning of a project. Typically, users know various objectives for the system, but without detailed data. The Prototyping Model allows for these conditions, and offers a development approach that yields results. When using the Prototyping Model, the developers first build a simplified version of the proposed system and present it to the users for consideration as part of the development process. Users provide feedback to the developer and the developer goes back to refine the system requirements with the additional information.

As shown in Figure 2-6, the Prototyping Model has six different stages. The first one is the Initial Investigation.
Investigation. It is similar to the System Conceptualization of the Waterfall Model, but it is not as comprehensive as that phase. The collected information is usually limited to confirm the complete system requirements.

Then the model goes as a cycle with Requirements Definition, System Design and Coding & Testing. In some huge projects, this cycle may need to be repeated several times. Usually, it depends on the complexity and the fluctuation of the users’ requirements. Developers try to gather all the user requirements as much as they can in the Requirement Definition stage. Once the initial layer of the requirements is collected, it is rapidly used for designing a simplified proposed system for the first trial in the System Design stage. The next step is the Prototype Creation stage, which means to translate the paper information into system coding. The first trial model is constructed based on the designed trial model in the previous stage. In the Testing & Review stage, the system is being tested and Users are involved in the review process of the model. Comments and suggestions from the users will be collected for modification of the system requirements.

After one cycle, the system goes again into the Requirements Definition stage and newly information is gathered. The new requirements are rapidly integrated into the prototype and then continuous onto the next two stages again. The cycle repeats several times until the version of the system is finalized. Once the final version of the system fulfills users’ requirements and passes all testing processes, the system will go to the next stage, which is the Implementation stage. The last stage is the Maintenance stage and the system will be run until it has to be turned down.

However, there are challenges associated with the Prototyping Model. The worst case is that prototyping can lead to false expectations. In some cases, customers may mistakenly think that the system is “finished” when in fact it is not ready. More precisely, it is because users may not able to discover the insufficient aspects of the underlying sub-systems. Moreover, prototyping can lead to poor designed system. The system prototype can sometimes suffer because the system is built in a series of various layers without a global consideration of the integration of all other sub-systems due to the rapid development of the prototyping model.

Rapid Application Development is a popular variation of the Prototyping Model. It introduces strict time limits on every phase of development. It also relies heavily on rapid application tools which allow for developing in a quicker way.

The Spiral Model is an integration of the Waterfall Model and the Prototyping Model. It gathers
the best features of these two models and introduces a new element, the Risk-assessment. Similar to the Prototyping Model, an initial version of the system is designed and developed. It relies on the evaluations from the customers. However, the development of each version of the system is using the steps of the Waterfall Model. As shown in Figure 2-7, starting from center to outward, the system becomes more complete versions progressively.

Figure 2-7: The Spiral Model

The Spiral Model is made up of four steps. The first one is Project Objectives Definition, which is similar to the conceptual design phase of the Waterfall Model. Objectives are determined, while some possible constraints are identified. Potential alternatives are suggested in this step. The following step is Risk Assessment, which is a means of evaluating alternative each version of the system. In this step, the developer determines whether the development should be continued. Resolution of the risk is evaluated and sometimes prototyping is used to clarify needs. Then, the next step is Product Development, which the detailed requirements are determined and the system is developed. After that, it comes to Planning and Management, which the customers are offered an opportunity to analyze the results of the developed prototype that created in the previous step. Feedback is collected by the developer. By consulting with the customers’ comments, the developer has to plan the prototype modification development and it comes to the Project Objectives step again and so on. The risk assessment step provides both the developers and customers with a measuring tool that the previous two may not clearly define. This tool helps to make the Spiral Model a more realistic process model that the other two.
2.2. MARKET SURVEY

Recently, the development of smart fitness products is rapidly expanding. In today’s market, there are various “e-fitness” related products and software. Some of them aim to trace people’s daily activity, while some of them target to monitor people training program. Philip’s DirectLife and Fitbit Tracker are the examples of smart fitness products, which are providing fitness information about users’ daily activities. Moreover, there are some smart fitness devices, which focus on regular exercising activities. Polar Electro Limited is famous in designing Wrist Unit and Heart Rate Transmitter. Adidas and Nike, two famous global sport brands also designed different e-coaching system. It seems that “e-fitness coaching” is one of the hot topics in sport activities in the coming few years. In this chapter, it attempts to summarize some existing products that are related to the concept of “e-fitness”.

SMART FITNESS PRODUCTS FOR TRACING DAILY ACTIVITIES

In this section, I will mainly talk about products, which help people in monitoring daily life activities. Fitbit Tracker and DirectLife try to build a smart fitness gadget into people’s life. No matter the users mow the lawn or take the stairs, the Fitbit Tracker and DirectLife try to capture data about their daily activities. They focus on how users can stay active and be healthy by fitting in small activities into their daily routine.

i. FITBIT – Fitbit Tracker

Fitbit, as shown in Figure 2-8, is a wireless-enabled wearable device, which uses a three-dimensional accelerometer to sense user movement. Inferring behavior from the accelerometer output, it measures steps taken, distance walked, calories burnt, activity duration and intensity. It can be worn on the waist or be put in the pocket. Besides tracking steps, caloric burn, and
distance, Fitbit can be clipped to a wristband in order to monitor sleep duration and habits. After the function of sleep cycle was started, the device then waits for you to stop moving to begin its count. It also keeps track of any movements during the night, such as sleepwalk or get up to go to the bathroom. Installed software on personal computer allows users to sync it up with Fitbit's site. Fitbit tracks activity during the day, and can show you highpoints of when you were burning the most calories or taking the most steps. Figure 2-9 shows the 3 steps of using Fitbit to trace daily activities.

Furthermore, Fitbit's site also lets users track their nutrition. On the Web site, users can enter the food they have eaten to get a fuller picture of health and calorie count. It calculates things like calories, carbs, fat, and other nutritional information based on the general serving size. Along with users’ own daily progress, the site offers goals for users to meet. It comes with a stock goal of 10,000 steps a day, which can be adjusted manually. Users can set how many miles they want to walk, how much they want to weigh, and how many calories they want to consume and/or burn. As a conclusion, Fitbit helps to trace the activity of a person’s daily activities.

\textbf{ii. PHILIP – DirectLife}

DirectLife is also based on the technology of 3D accelerometer and can also easily be clipped onto any piece of clothing. This device tracks your base level of fitness over an initial period and then incrementally increases your targets for the following weeks to motivate you to improve your fitness over the long-run.
The Activity Monitor, as shown in Figure 2-10, can measure all the movements of the users. The measurements are combined with user’s gender, age, height and weight and then converted to the calories burnt in every activity. The Activity Monitor is based on the Philips Tracmor, which was developed by Philips Research and Maastricht University. It can be worn as a necklace or be put in the pocket. To start with, Users have to assess their how active they current are with the help of the Activity Monitor for one week. The computer will analyze the current physical level. Then, based on the assessment, users will get a personal plan with targets and goals. After that, users have to plan activities for the coming week, in order to meet the targets. After finished planning, users keep carrying the Activity Monitor with them and they can check their progress by connecting the Monitor to their personal computers. Finally, it is time to maintain the plan day by day. Figure 2-11 shows the 5 steps of monitoring active life with DirectLife.

Figure 2-11: 5 steps of using DirectLife to monitor daily activities

SMART FITNESS PRODUCTS FOR TRAINING PROGRAM

Apart from those products mentioned in the previous section, there are some products which are focused on monitoring people’s training regime. They emphasize more about the accurate heart rate measurement, which is closely related to training. In this section, I am going to talk about three famous gadgets: the Polar Wrist Units, the Adidas miCoach and the Nike+.

i. POLAR ELECTRO LIMITED – Wrist Units

Polar Electro Limited, the leading brand in sports instruments and heart rate monitoring category, was famous in developing Wrist Units. It aims to take people’s training to the highest level by understanding their own body response. Polar’s products cover various kinds of sport activities, such as running, cycling, fitness and cross-training. It segments the products into different categories, “Get active”, “Improve fitness” and “Maximize performance”, to suit for different type of users. The Polar Wrist Units and the Heart Rate Transmitters are the two important sport instruments developed. The Polar Wrist Units act as the intermediate to display useful information, while the Heart Rate Transmitters continuously measures the heart rate of the users. Furthermore, different accessories are available for enhancing people’s experience and achieving
a more complete understanding of their performance. For instance as shown in Figure 2-12, a Foot Pod for running helps to measure factors, like speed, distance traveled, and so on for having a more comprehensive analysis about the performance.

![Figure 2-12: Polar Watch and Foot Pod set for running](image)

Furthermore, Polar also offers some Training Software to support users’ training program. It is a comprehensive set of plans for all its users. It covers all levels of users, from beginners to top athletes and everyone in-between. The Polar ProTrainer 5 is one of the software that give people a deeper understanding of their training based on several factors: the heart rate zone, speed, distance traveled, time taken and the variation of heart rate. It can be used to support training via five simple steps: plan, train, upload/download, analyze and follow. Figure 2-13 shows the 5 steps of using ProTrainer 5 in supporting personal training program.

![Figure 2-13: 5 steps of using Polar ProTrainer 5 in supporting personal training program](image)
Take running as an example. To start with, User has to plan for his training, from setting goal to planning the training schedule. After finished planning, the user wears the wrist unit, HR transmitter or even the Foot Pod and starts his training. During training, user can have a look on various information, such as lap time, heart rate, distance and so on. All this data is recorded and are stored in the memory zone of the wrist unit. After finishing the training, user can review the recorded data on the wrist unit display immediately after training. In a more professional way, the recorded data can be transferred to the Polar Pro Trainer 5 software manually. It helps to have a comprehensive analysis of the training results with versatile graphs. It helps user to have a deeper understanding of different aspects of training section in exacting detail. Finally, it is time to take action about what user learnt from the analysis and improve the training program. It allows user to use his/her training history as a tool for future goal setting and planning.

More specifically, Polar also offers Wrist Units for physical fitness training. It displays information, as shown in Figure 2-14, for users to improve their fitness and strength. Similar to the example mentioned above, this information can be planned by using the software, and then transfer to the wrist unit before training. It acts as a training partner to increase the efficiency of both cardio and strength training.

![Figure 2-14: Polar F-series wrist unit display for physical fitness training](image)

**ii. ADIDAS – miCoach**

Adidas, the global leader in running and technology-driven innovation brand, developed miCoach as an interactive personal coaching and training system with real-time audible training. miCoach is an interactive training platform to provide personal coaching services. It aims to help users improving various aspect of their training and leads them to be a better runner. It is an interactive training service developed to motivate, inspire and enable users to become fitter and reach their training goals. miCoach includes two separate products: the miCoach Pacer and the miCoach Zone, as shown in Figure 2-15 and Figure 2-16.
The miCoach Zone is a wristband device with a colour coded LED display. It provides accurate and real-time coaching visually, which ensures users conduct their training at the right intensity with the help of a heart rate monitor. It calculates users’ target training zones by simply input their age before starting exercising. It communicates wirelessly with the Heart Rate Monitor to display heart rate, calories burnt and elapsed workout time.

The miCoach Pacer is a more advanced device that delivers real-time audible coaching, when users are exercising, via headphones or combined with their own MP3 player. It is designed to help motivate and coach users verbally, such as “speed up to Red Zone”, “slow down to Blue Zone”, and so on. Figure 2-17 shows the training zone used in miCoach. It ensures that the users are staying within their targeted heart rate zone and keep them running at the right personal level. Combining the real-time coaching with a web application, miCoach Pacer provides a direct personal coaching experience, as shown in Figure 2-18. To start with, user has to plan the schedule at micoach.com, and then transfer it to the miCoach Pacer. During exercising, the miCoach Pacer communicates wirelessly with the Heart Rate Monitor and Stride Sensor to record the workout stats. On the other hand, verbal advice is given via headphones. Data, such as calories burnt, heart rate, stride rate and so on, will be recorded and can be synchronized manually with the website, so that users can track improvement. Finally, the user can manage the record through the web application.
The Samsung Adidas miCoach F110 fitness phone, as shown in Figure 2-19, is another device for assisting people about running. The idea of the phone is to monitor body’s key functions. It acts as a presentation device with both Heart Rate Monitor and Stride Sensor. These two devices enable the phone’s software to monitor owner’s workouts and advise him with a voice-simulating personal coach. It is similar to the idea of Adidas miCoach Pacer that a dedicated website is available for users to plan their fitness regime, log their results and track their progress.

**Figure 2-19: Samsung Adidas miCoach F110 fitness phone with other related devices**

iii. **NIKE – Nike+**

Nike, another famous global band in developing sport instruments, designed a coaching system for running with Apple, an American multinational corporation that designs and manufactures consumer electronics, computer software and commercial servers. They bring sport and music together with the launch of innovative Nike+iPod products. Nike+iPod Sport Kit, a wireless system that allows Nike+ Sensor to record time, distance, calories burnt and pace, while the info is displayed on the iPod nano’s screen. It allows users to hear a real-time audio feedback via headphones, while he is listening to his favorite music.
For those using iPod nano, what they need are an in-shoe sensor and a receiver that attaches to the iPod nano, as shown in Figure 2-20. A nikeplus.com personal service website is designed to help users achieve the optimum Nike+iPod personal running and workout experience. Nike+iPod aims to offer a different experience of running and provide a personal coach or training partner motivating users during the workout. Furthermore, iPod Touch and iPod 3GS also have a built-in application and support Nike+. For those who do not enjoy listening to music during running, Nike+ is going to launch the Nike+ SportBand in 2010, which can be used without the iPod devices. Similarly, it functions with the Nike+ Sensor and Nike+ SportBand, as shown in Figure 2-21. It offers runners real-time performance feedback and is designed to allow users to glance the information easily during running. In addition, User gains access to all of the features and tools on nikeplus.com. Besides tracking owner’s distance, calories burnt and other performance information, it provides a simple link to the world's largest running club.

Another feature of using Nike+ is runners can connect to the global Nike+ Community via nikeplus.com where they can track their workouts individually or alongside other runners from around the world. The Nike+ website not only helps runners in monitoring with dynamic graphs, but also provides a platform to share their running experience on the internet. The additional community features at nikeplus.com include the "Challenges" section. By using this function, runners can push themselves in competitions. It motivates users to keep running and enhancing the running experience. For those who are outdoor runners, a Google mapping tool illustrates individual running routes, which they can share with others on the internet.
Taking Nike+iPod as an example with the help of Figure 2-22, users should first customize the setting before starting workout. In order to have a better accuracy in calculating calories burnt, weight should be updated if it have any changes. Users have to set target distance for themselves and then start exercising. After that, users can activate the sensor and then start running. Info about the run can be viewed on the iPod nano device during running. After finished the workout, the recorded data should be sent to nikerunning.com. The record will be shown in a graphical way and improvement can be conducted.

As a conclusion, Polar offers an intermediate for different trainers to record and understand their own body response. Warning signal is available, when the users’ heart rate is in a dangerous level. However, it does not have some encouraging massage for user during exercising. Adidas miCoach and Nike+ have a much similar idea. Both of them are focused on running and are designed to have verbal coaching system for motivation. All these devices record training stats and first store in the memory of the different devices. After completed the training, users have to manually transfer recorded data to the computer or internet. More specifically, for the users who want to focus on strength training in gym room may find that Adidas miCoach and Nike+ are not suitable for them.

**COMPARISON OF SMART E-FITNESS PRODUCTS**

In this section, I am going to discuss and compare some smart e-fitness products. As I mentioned before, I separate the smart e-fitness products into two categories. One is the e-fitness products focus on daily activities, while another is focus on particular training activities. Fitbit and Philip’s DirectLife belong to the former. Polar Wrist Unit, Adidas miCoach and Nike+ belong to the latter. Table 2-3 shows what the purpose is and what the target activities are for the 5 famous e-fitness products.

<table>
<thead>
<tr>
<th>Products</th>
<th>Purpose</th>
<th>Target activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitbit</td>
<td>Track users’ the daily calories burnt, steps taken, distance traveled and sleep quality.</td>
<td>Daily activities</td>
</tr>
<tr>
<td>Philip’s DirectLife</td>
<td>Create awareness of users’ activity levels and patterns and help them become more active.</td>
<td>Daily activities</td>
</tr>
<tr>
<td>Polar Wrist Units</td>
<td>Help users to find the best by understanding their body response</td>
<td>Running, cycling &amp; fitness</td>
</tr>
<tr>
<td>Adidas miCoach</td>
<td>Help motivate and coach users towards reaching their fitness goals.</td>
<td>Running</td>
</tr>
<tr>
<td>Nike+</td>
<td>Trace users’ calorie burnt, pace and distance run and create a “running community”</td>
<td>Running</td>
</tr>
</tbody>
</table>
According to the aims of this Final Year Project, I focus on the comparison of the e-fitness products, which are targeted on the specific training exercise rather than those used to measure data of daily activities. The three training gadgets have their strengths and weaknesses on the functions.

Polar electro limited provides an accurate real-time measurement of the user’s heart rate data. The training data can be shown on the display of wrist units clearly. Also, Polar developed a comprehensive monitoring system. It helps users to track and monitor their training regime in an advanced level. However, it may be too complicated for the starters to use. Also, it has a few coaching features. Moreover, the wireless link of the footpod may be interference when there is another footpod locate closely. It causes the trouble if the users want to train with partners, who has the same footpod.

Nike+ has a reasonable price and audio feedback is provided during the workout. The audio feedback will inform the user the completed miles and a countdown of four 100-meter increments at the end of the workout. In addition to the in-workout audio feedback, there are pre-recorded congratulations provided by some famous athlete while the personal best is achieved or the milestone is reached. Another interesting function is the “Challenge”. Nike+ integrates with NikeRunning.com, which acts like a social network. It provides a platform for people to “challenge” others on the internet. However, Nike+ also has little coaching features. It is mainly to inform users the information about the run. The stride sensor need accessory to properly be secure on the shoes or placed in a Nike+ shoe.

Adidas miCoach is a more advanced gadget for monitoring running. It coaches users base on the heart rate zone. Audible feedback about distance run or real-time heart rate information is available. In addition of audible feedback, it has a frequent audible coaching to help users maintaining their heart rate in a suitable heart rate zone. The miCoach can be connected to any MP3 player for those, who like to run with music. Besides, different training plan is available for starters to provide an easier start point. Comparatively, miCoach do much better on the aspect of coaching. However, it is relatively expensive than other e-fitness products. When it is compare to “challenge” function of Nike+, miCoach has lesser interaction with other users via the internet.
Table 2-4: Summary of the strengths and weaknesses on the 3 e-fitness products

<table>
<thead>
<tr>
<th>Products</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
</table>
| Polar Wrist Units | ➢ Heart rate monitoring.  
➢ Clear information displayed on the wrist units  
➢ Comprehensive monitoring system | ➢ Too complicated for starter to use  
➢ Little coaching features  
➢ Wireless link of footpod may be interference when training in group |
| Nike+          | ➢ Priced just right  
➢ Audible feedback  
➢ “Challenge” function | ➢ Doesn’t really coach, just inform user about the run  
➢ Need accessory to properly secure the sensor (or a Nike+ shoe) |
| Adidas miCoach | ➢ Heart rate monitoring.  
➢ Frequent audible feedback  
➢ MP3 player is optional  
➢ Stride Sensor is suited to different sport shoes  
➢ Different training plans is available to download for starters | ➢ Relatively expensive  
➢ No way to replace a single component if it gets broken.  
➢ Little interaction with other users via the micoach.com |

Table 2-4 shows the summary of the strengths and weaknesses on the three mentioned e-fitness products. According to Figure 2-23, it indicates the comparison of different e-fitness products on two dimensions: Entertainment and Sports Functionality. As mentioned before, Nike+ has a better development in integration of music and sport. Its “Challenge” function on the internet also make it becomes more entertaining. Adidas miCoach has stronger functions in playing the role of coaching, but it is relatively less entertaining and less network connection when compare to Nike+. Last but not least, Polar’s Wrist Units is the best in the aspect of sport functionality among three products. It has various accessories to provide lots of different information for outdoor training exercise. For instance, the GPS Sensor captures the training route and allows user to review it on the internet. In conclusion, those three products have their specific features in helping people to do better in their training regime.

Figure 2-23: Comparison of different products on Entertainment and Sports Functionality
CHAPTER 3 METHODOLOGY

In this chapter, I am going to talk about the methodology used in this Final Year Project. As you can see in Figure 3-1, this project was separated into four dimensions: Idea Generation, System Analysis, System Design and System Development. Various methodologies are used in each dimension.

Figure 3-1: Methodology used of this Final Year Project

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Idea Generation</th>
<th>System Analysis</th>
<th>System Design</th>
<th>System Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Brainstorming</td>
<td>Three Tier Model</td>
<td>Structured Analysis &amp; Design Technique</td>
<td>Seven-point Protocol</td>
</tr>
<tr>
<td></td>
<td>Market Survey</td>
<td>Use Case Diagram</td>
<td></td>
<td>System Development Life Cycle</td>
</tr>
<tr>
<td></td>
<td>Literature Review</td>
<td>Idea confirmed?</td>
<td></td>
<td>Decision made?</td>
</tr>
<tr>
<td></td>
<td>Focus groups</td>
<td>Idea generated?</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Idea generated?</td>
<td>Idea confirmed?</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Idea confirmed?</td>
<td>Structure confirmed?</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>System Development Life Cycle</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Seven-point Protocol</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>System Development Life Cycle</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Seven-point Protocol</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>End</td>
<td>System Development Life Cycle</td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

Life Cycle:

- Idea generation
- System analysis
- System design
- System development

Start:

Yes

No
3.1. BRAINSTORMING AND MARKET SURVEY APPROACH

To start with, the idea of the project was generated by using the brainstorming approach and the market survey approach, which is mentioned in Chapter 2. In the stage of idea generation, various ideas about features of the e-fitness coaching were generated and some existing e-fitness products were reviewed. Total five main e-fitness gadgets were reviewed in this stage. Three of them are e-fitness gadgets aims to be used in a particular exercise, while two of them targets to be used in daily life. All the generated ideas were gathered and were used as materials for organizing focus groups.

3.2. LITERATURE REVIEW

Two main topics had been reviewed in Chapter 2. The first one is related to fitness training, which includes the technology review about the electronic gauges, the importance of nutrition intake and the psychology aspect of training. These three fitness-related topics were taken into consideration of the system design. The second one is about the development of the system. It reviewed the methodology, which is used in system development.

3.3. FOCUS GROUPS

After gathered the generated ideas and the information of the market products, four focus groups were organized in October of 2009. The purpose of organizing focus groups is to provide a two-way communication approach to collect user opinions about e-fitness coaching system. Some idea is present in the focus group for stimulating the mind of respondents. Also, some questions were designed to ask in focus group for obtaining particular information, which is related to e-fitness. Total fifty people were invited to join and opinions about the e-fitness coaching system were obtained. The critical opinions are summarized in Chapter 4.

3.4. THREE TIER MODEL

After the collected opinion was taken into consideration, the main conceptual system functions were defined and it came to the next stage, which is the System Analysis Stage. The Three Tier Model is used to describe the system architecture base on three different layers: the Presentation Tier, the Logic Tier and the Data Tier. Figure 3-2 shows an example of Three Tier Model.
### Figure 3-2: Example of the Three Tier Model

![Three Tier Model Diagram](image)

The Presentation Tier is the most obvious layer that interacts with the users directly. It is the top-most level of the system and usually it is the user interface. The main function of this interface is to translate tasks and results to things that the user can understand. The Logic Tier is used to process data between the Presentation Tier and the Data Tier. It coordinates the application, process commands, logical decision making and evaluation, and performs calculations. Another function is that it moves and processes data among the Presentation Layer and the Data Layer. The Data Tier is used to store the raw data of the system, and so that it consists of Database Servers. Information is stored and retrieved. It is important that it keeps data neutral and independent from the Logic Tier. Information is passed back to the Logic Tier for processing and then eventually back to the users. It improves scalability and performance of the system once the data is given its own tier. The Three Tier Model of SelFit is shown in the section of system analysis, which is Chapter 5.

### 3.5. UML: THE USE CASE DIAGRAM

After describing SelFit e-fitness coaching system with the three tier model, use case diagram of SelFit is illustrated in later section of Chapter 5. The Unified Modeling Language (UML) is a family of graphical notations, backed by single meta-model, that help in describing and designing software systems with object-oriented style. The Use Case Diagram is one of the diagrams in the family of UML. It is a type of behavioral diagram defined by and created from Use-case analysis. Use Case Diagram is used to present the graphical overview of the functionality in a particular scenario of using SelFit in terms of actors, use cases and the dependencies among those use cases. It is a technique for capturing the functional requirements of a system. By describing the typical interactions between the users and the system itself, the Use Case Diagram provides a narrative of how a system is used.

As you can see in Figure 3-3, actors of system may include users, system administer, and so on, which means an actor can be any kinds of physical or abstract parties. Actors carry out use cases and a single actor may perform various use cases. Actors do not have to be human. If the system
provides services for another computer system, then the computer system can be an actor. A use case captures a contract between the stakeholders of a system about its behavior. The use case describes the behavior of the system under different conditions. Each step in a use case is an element of the interaction between an actor and the system.

![Figure 3-3: Example of Use Case Diagram](image)

### 3.6. STRUCTURED ANALYSIS AND DESIGN TECHNIQUE

In the System Design stage, Structured Analysis and Design Technique (SADT) is used as a tool for describing the functionalities of the coaching system. SADT is an engineering methodology for describing systems as a hierarchy of functions (D. Marca, C. McGowan, 1987). It is a diagrammatic notation designed specifically to help people describe and understand systems. Building blocks are used to represent entities and activities with various arrows representing input, output, control, and mechanisms. In this project, SADT is used to describe the system functions in a hierarchy way. It defined different requirements for the process of SelFit. Functional relationships were shown and the data flow relationships were outlined between different functions.

SADT diagrams contain various boxes, which representing the name of the process or the action. On the left-hand side of the box, an incoming arrow means the inputs of the action, while an outgoing arrow on the right-hand side represents the outputs of the action. The data necessary for the action is represented by incoming arrows on the upper part of the box. The incoming arrows on the bottom of the box represent the means used for the action. Figure 3-4 shows the basic elements for construction of the diagram of SADT. SADT uses decomposition with the top-down approach as shown in Figure 3-5. A box in one diagram becomes a diagram in its own right with its own internal structure. As a conclusion, SADT is used to describe the SelFit e-fitness coaching system from a more general level to a more detailed level. The SADT diagrams are described in the section of system design, which is Chapter 6.
3.7. SEVEN-POINT PROTOCOL

After the conceptual idea of SelFit is finalized, it came to the next stage, which is about the System Development of SelFit. In order to understand the SelFit system deeper, the Seven-point Protocol (Gertjan Vlasblom, Daan Rijsenbrij and Matthijs Glastra, 1995) is used. As shown in Figure 2-3 in Chapter 2, the development project of SelFit was decided to separate into three dimensions, which are Project Management Aspect, Quality Management Aspect and System Development Aspect. The seven sub-elements of the Seven-point Protocol was studied and defined. It is prepared for selecting a suitable system development lifecycle. A more detailed description of the Seven-point Protocol is shown in the section of system development, which is Chapter 7.

3.8. SYSTEM DEVELOPMENT LIFE CYCLE

Finally, the development of the e-fitness coaching system was studied. After conducted the Seven-point Protocol of the system, a specific view of the project is understood. A suitable system development methodology was chosen from the four typical models, which are the Ad-hoc Process Model, the Waterfall Model, the Prototyping Model and the Spiral Model. Development approach was suggested according to the needs of the system development life cycle. Different phases of the lifecycle will be discussed in the section of system development, which is Chapter 7.
As a conclusion, this project started at the Idea Generation Stage using brainstorming, market survey, literature review and focus groups; then System Analysis Stage with Three Tier Model and Use Case Diagram; then System Design Stage using SADT; and finally it came to System Development Stage using Seven-point Protocol and SDLC. The detail of each part is discussed from Chapter 4 to Chapter 7.
CHAPTER 4  IDEA GENERATION

SelFit is an e-fitness Coaching System, which is a contactless smart card based system for individual to manage his/her fitness regime. The designed e-fitness Coaching System is named “SelFit”, which has a meaning of “Getting FIT by one-SELF”. This e-fitness Coaching System aims to provide gadgets helping people to achieve the concept of fitness by planning and managing their training regime themselves. From planning to analyzing, it guides and provides relevant information about individual training regime by using the resources on the internet. SelFit acts as an e-coach to help and guide people on gym room training program. In the whole e-fitness coaching system, it is about how users enjoy using technology to assist them in order to get reach to their goals or even to obtain better results. In this Chapter, I first describe the general idea of SelFit, followed by the important components which make SelFit function. The later part illustrates the key functional features of the system.

4.1 FOCUS GROUP SUMMARY

In October of 2009, four focus groups were organized and total fifty people were participated. Figure 4-1 shows the background information of the fifty respondents. The respondents are aged from eighteen to thirty-three, with 62% male and 38% female respectively. 10% of them never use the gym room, while the rest “sometimes”, “always” and “often” use the gym room for exercising. 36% of them have experience in using any kinds of e-fitness gadgets and the rest do not have any experience. In this section, I summarized the five key opinions that was obtained in the focus groups and was taken into consideration for the idea generation. More detail about focus groups is shown in Appendix A.

Figure 4-1: Background information of respondents of four focus groups
For the first important opinion, those who are using gym room for exercising said that it is difficult for them to mark their training record time by time. It is because the training program normally involves several types of training equipments, and it is hard to memorize the sequence and the repetition they have done each time.

Secondly, most of them do not take nutrition intake as consideration when they plan to get fit. They have no idea how important the diet balance is. This leads to reduction of the training outcome. Some respondents claimed that they gain weight even they keep on exercising.

Thirdly, respondents found that it is difficult for them to and evaluate how well they have done. They have no methods in assess their training outcome and difficult to know their training progress.

Fourthly, respondents, especially the female group, claimed that it is boring to exercise in gym room since they are facing different kinds of non-interactive machine. They suggested inserting more interactive elements to training equipments.
Fifthly, all the respondents express that the design of fitness gadget has to be simple. It should not be too complicated and cause any inconvenience to the user when they are using the training machine.

Generally speaking, it is positive to development a coaching system for the use of gym room. Technology helps to promote gym room exercise and improve the training result of the user. These five important points are addressed in the design of SelFit and is discussed in the next section.

## 4.2 GENERAL IDEA OF THE SYSTEM

Five key opinions were taken into consideration in the conceptual design of SelFit. As shown in Figure 4-2, by setting the training plan, inputting the meal record, performing training activities and with the support of relevant information about training, SelFit provides useful fitness evaluation report for the users to understand their training more. Furthermore, SelFit offers audible coaching when user is carrying out his training regime. It is supposed that user can have a better guideline about training with the support of the various data. In addition, SelFit also inserts some motivating elements for encouraging users to exercise in gym room.

Table 4-1 summarizes the brief idea about SelFit in five dimensions.

![Figure 4-2: Conceptual Idea of SelFit](image)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What</strong></td>
<td>An e-fitness coaching system: a virtual personal coach and training partner</td>
</tr>
<tr>
<td><strong>When</strong></td>
<td>During training and monitor anytime</td>
</tr>
<tr>
<td><strong>Who</strong></td>
<td>Gym room users</td>
</tr>
<tr>
<td><strong>Where</strong></td>
<td>Gym room and monitor anywhere</td>
</tr>
<tr>
<td><strong>Why</strong></td>
<td>Fulfill the needs of the gym room user in monitor their training regime and motivate people to exercise more.</td>
</tr>
</tbody>
</table>
How

By implementing technologies into gym room exercise, it provides a platform for users to monitor their training regime themselves.

- RFID technologies for identification.
- Heart rate monitoring and motion tracing for capturing training data.
- Web applications for accessing and increasing training experience
- Processing systems for manage all functions and data
- Database management for data storage

Apart from the main idea of SelFit, it offers a much effective and convenient way of using the Fitness Centres. Since S-Coach contains a personal RFID tag with a unique identification code. It allows S-Coach to have an enhanced function as an access control device and it can also be used as e-payment device.

As shown in Figure 4-3, all they require are an S-Coach, a Heart Rate Monitor, an optional wireless headphone and a web-enabled device. S-Coach is a small electronic device that has a built-in RFID tag, which is used as a personal identification card in the coaching system for recognition. It also contains a built-in micro-processor, which helps to perform simple functions. The S-Coach is designed to be a wristband and be worn when the user is exercising. Another important component is the Heart Rate Monitor. It helps to capture the real-time heart rate data and transfer it to the S-Coach for further processing. Real-time audible coaching is based on the simultaneous heart rate data of the user. Furthermore, a wireless headphone can be used to play the user’s favorite songs and receive the audible coaching message. It is optional for those who do not like audible coaching. Finally, a web-enabled device is needed to access users’ personal account on the Official Website. It provides a platform for people to re-view the training record and monitor their training program.

To start with, People can simply visit the SelFit Official Website and then register a personal account of SelFit. Some basic information is required for the registration. A unique S-ID code will be assigned to the registered users. It acts as a personal ID within the coaching system. After the account is created, some health-related information, such as height, weight and so on, is required to be inputted. On the other hands, he/she will receive an S-Coach and a Heart Rate
Monitor after they successfully registered. After that, the user should go training as usual with the S-Coach and the Heart Rate Monitor. The first trial is considered to be an assessment, which aims to estimate the user’s present fitness level.

After finished the first assessment, user can now logon at SelFit.com and start planning his/her training regime. People always have better performance after they set a target for them selves, so that SelFit suggests users to set training goal for the m. Even a simple sentence can have unexpected effect in motivation. For instance, “I would like to lose 5 kg within 4 weeks”. This statement can be the destination or milestone for user to strike for. The measured data of the first assessment provide information for user to figure out the most suitable training plan. He/she should plan his/her training schedule which leads him/her to achieve their goal. SelFit provides some reference information for starters to plan their training program. Finally, he/she can start training in a particular Gym Room. Figure 4-4 shows how users start using SelFit.

![Figure 4-4: Flowchart Of Starting Using SelFit.](image)

After plan the training schedule, user goes to a SelFit-enabled gym room with the S-Coach worn on his/her wrist and Heart Rate Monitor worn on his/her chest. User can first use the Testing Machine to measure the data about his/her body instead of inputting them by hands. The Testing Machine is used to measure personal data, like height, weight, blood pressure and so on. This aims to record the body information, in order to evaluate the result of training program. He/she can use the Testing Machine every time he/she go training or once per several time of trainings. It depends on the needs of different users.
After targeted on a training machine, He/she, who is wearing S-Coach, can simply sit on the chair of the equipment and hold for about 2 seconds. As shown in Figure 4-5, the S-Reader has a limited RF field, which covers the normal training seat. After the S-Reader successfully recognized the user, he/she can start exercising in a usual way. During using those training equipments, training data such as heart rate, mass block weight will be recorded by the Data Collecting Gadgets. All these data will be sent to the Host Computer for further processing and then store in the Database. Some relevant information will be shown on the touch-screen of the S-Readers. Real-time audible coaching will be performed based on the physiological data. After finished a set of training, he/she should take a short break. The S-Coach suggests when the user can start the next set of training. He/She move to another machine for another set of training. These procedures repeat until the training is over. Figure 4-6 shows how users exercise with SelFit in gym room.

After the training is over, he/she can review and manage his/her training program by using an electronic device, which is connected to the internet. He/she visits the SelFit Official Website and then login his/her personal account. The Website provides a user-friendly interface for him/her reviewing the training records. It also provides analysis for him/her to know more about how his/her body response to the training plan. Evaluation of his/her training performance will also be shown on the Website. If it is necessary, he/she can adjust his/her training plan and start training.
again on the next day. Figure 4-7 shows how users use SelFit to manage their training programs after training.

![Figure 4-7: Flowchart Of Using SelFit To Manage Their Training Programs](image)

Furthermore, SelFit is not only an e-fitness coaching system, but also it can be used in an advanced ways. The RFID tag can be a personal identification for using different services in the training centre. For instance, it can be the access control of the Centres. For a particular fitness centre, reception counter can be replaced by the gates. As a result, man-power can be reduced and efficiency can also be increased by a faster identification process. SelFit can also improve the security level, such as using the RFID tags as the switches of the lockers, instead of using a key. In order to further increase the security level, the contactless smart card and the biometrics, such as fingerprint identification, can be integrated. That means there are two levels of identification. In addition, SelFit can also be a rechargeable contactless stored value smart card used to transfer electronic payments in the centres. It has functions similar to the Octopus Card. The S-Coach can be value added and use for e-payment. Centre users do not need to bring along lots of belongings with them in the fitness centres. It provides a more convenient environment for people in the fitness centres.
4.3 COMPONENTS OF THE SYSTEM

As shown in Figure 4-8, SelFit contains five different main components: S-Coach, S-Reader, Host Computer, Online Applications and Database. I am going to discuss the components in the gym room first, and then followed by the components outside the gym room. There are total two components located in gym room, which are the S-Coach and the S-Reader. For the Host Computer, Database and Online Applications, they were connected via internet with the components inside the gym room. All of them plays an important role in SelFit and co-operates together to make SelFit work.

INSIDE THE GYM ROOM

The S-Coach is an electronic device that used to be identified and present information to the users. It is designed to be a wristband. It has its own micro-processor, memory space, battery and a built-in RFID tag. One important function is to perform real-time audible coaching to user via wireless headphone. It also receives coaching massage from the Host Computer via S-Readers and presents accordingly to the user. Another function is to receive the heart rate from the Personal Heart Rate Monitor. The Heart Rate Monitor is worn on the user’s chest to collect...
accurate heart rate data. The processor will send out audible coaching message based on the received heart rate. The RFID tag is used as an identification and data carrier of the user. It is used to perform contactless communication with the S-Reader in form of radio frequency. Furthermore, S-Coach has MP3 player compatibility for those who enjoy listening music during workouts.

The **S-Reader** is a small computing device, which contains a RFID reader, motion sensors and a computing system. The S-Readers with touch screens are installed on various training equipments. For user identification, the RFID readers are used for both read data from and write data to RFID tags. S-Reader also communicates with the sensors and transfers the recorded data to the Host Computer for further processing. It is used as motion tracking, which aims to collect data about the motion of the machine’s components. Inertia sensors are attached on different parts of the physical fitness equipments externally, and measure the motion data automatically. The data can be used to analyze the training performance of the users. Take the Strength Training Machine as an example, S-Reader can be used to record motion of the mass block and the handles. The Host Computer calculates and translates the motion data into meaningful information, such as which mass block is being used, what the lifting frequency is and time taken for each lift. It functions to provide enough physiological data for further processing.

**OUTSIDE THE GYM ROOM**

The **Host Computer** is the “brain” of SelFit. It is the main computer connected to all other terminals. It aims to provide computing services via internet and handle all the involved users. It is responsible for various functions. For instance, it is used to analyze the training data, recognize different user base on the S-ID and so on. All the devices, which is connected to the host computer is known as a client.

The **Online Applications** are the applications that are accessed via a web browser over the internet. It provides an interactive intermediate for users to monitor their training program. Users can access their fitness account by simply logon to the Website of SelFit with a user-friendly interface. It is convenience that the user can access the service anywhere if they have a web-browser-enabled device.

The **Database** is an integrated collection of logically-related records and files, consolidated into a common space that provides raw data for multiple uses. All the raw data, like user account information, measured training data, and so on are transferred and be stored in the Database as
A Database Management System (DBMS) is available as an intermediate between the Database and the Host Computer. It consists of software that organizes the storage of data. It controls the creation, maintenance, and the use of the database storage structures of SelFit.

As a conclusion, all the five components act as a team to support the complete functions of SelFit. Apart from the other components, S-Coach can still maintain limited functions when it is not connected with other components. In any time, it has function of monitoring heart rate together with the Heart Rate Monitor. The measured heart rate data can be temporary stored in S-Coach and then upload to the Host Computer once they are connected. That means people can take S-Coach for heart rate monitoring when they are exercising outdoor.
4.4 FUNCTIONAL FEATURES

In this section, critical functional features of SelFit are introduced. User identification is first described and the motion tracking is demonstrated. After that, audible coaching and motivation is discussed and follow by online applications. Finally, some extra value-added function is presented.

USER IDENTIFICATION

User Identification System adopts the Radio-frequency Identification (RFID) technology. The function of User Identification System is to identify individuals and then give initial signal to the Motion Tracking System to start recording data after successful identification. It comprises three principal components, as shown in Figure 4-9. The S-Reader with built-in RFID Reader is installed, while S-Coach has a built-in RFID tag. It communicates with RFID tag for obtaining the personal unique S-ID. It is used to query a tag and receive data from it. Communication is conducted through RFID induction technology, without any physical contact being made. S-Reader interacts with the Host Computer for checking the S-ID with the registered information. The advantage of using the contactless interacting technology is to ensure the identification process is quick enough and convenient for users during their training. Another benefit is that the maintenance cost of the Identification System can be reduced by using the contactless design. Table 4-2 and Table 4-3 outline the requirements of the RFID tags and RFID readers in Conceptual Design Phase.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size and Form Factor</td>
<td>Small chip</td>
</tr>
<tr>
<td>Active versus Passive tags</td>
<td>Passive RFID transponder</td>
</tr>
<tr>
<td>Requirement for human-readable information</td>
<td>No special requirements</td>
</tr>
<tr>
<td>Durability</td>
<td>Plastic protection against moist environment</td>
</tr>
</tbody>
</table>
Reusability | Non-reusable  
---|---  
Orientation Sensitivity | (To be studied in the detailed design phase)  
Supported Communication Standards and Protocols | (To be studied in the detailed design phase)  
Storage Requirements | Have a potential of enhancement of the requirement of data storage  
Tag Performance | Evaluation Factors  
> The distance at which tags can be read  
> Speed of data transfer  
> Failure rate  
> Chance of mis-identification when two or more Tags are close the same reader  
Security Requirement | Security technology required  
Commission | Rewriteable tag  
Capabilities and Functions | (To be studied in the design phase)  
Cost | Low cost for each tags  

### Table 4-3: Requirements of RFID Readers in Conceptual Design Phase

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
</table>
| Antenna Attachment and Control Options | Built-in antenna  
(To be further studied in the detailed design phase)  
Tags to Be Read | Several tags have to be read together.  
Connectivity and Power Requirements | (To be studied in the design phase)  
Ability to Be Upgraded | Upgradeable by reprogramming the chip or software  
(To be studied in the design phase)  
Control Functions | Browser interface for control functionality.  
Function of synchronization is needed  
(To be studied in the detailed design phase)  
Total Cost of Ownership | (To be estimated in the design phase)  

### MOTION TRACKING:

Motion Tracking System adopts the technology of inertial sensors. For strength training machine, inertial sensors are attached on the handles and each mass block of the training equipments as shown in Table 4-4. For cardio-training machine, they are attached on either belt or pedals of the training equipments. The affixed inertial sensor measures 3D motion and transmitted to S-Reader for further processing. The concept of motion tracking is depicted in Figure 4-10.
Once the user is successfully identified, the S-Reader will start receiving data from sensors. This data is analyzed and the motional information about training can be estimated. As Table 4-5 shows, the location of tags is fixed to collecting different data for different purpose.

### Table 4-4: Targeted Training Equipments with S-Reader installed

<table>
<thead>
<tr>
<th>Categories</th>
<th>Examples</th>
<th>Location of tags</th>
<th>S-Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardio-training</strong></td>
<td>Machines</td>
<td>Treadmills, Total Body Trainers, Steppers, Bikes, Rowing Machines, etc</td>
<td>Belts or pedals</td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>Machines</td>
<td>Shoulder Press, Chest Press, Lat Pull down, Row, Deltoid Raise, Triceps Press, Biceps Curl, Leg Press, Leg Extension, Pull Lift, etc</td>
<td>Handles and mass blocks</td>
</tr>
<tr>
<td><strong>Free-weight</strong></td>
<td>Benches</td>
<td>Preacher Curl Bench Seated, Multi-Adjustable Bench, Flat Bench, Triceps Seat, etc</td>
<td>×</td>
</tr>
<tr>
<td><strong>Free-weight</strong></td>
<td>Training Tools</td>
<td>Dumbbell, Barbell, etc</td>
<td>×</td>
</tr>
</tbody>
</table>

### Table 4-5: Purpose of collected data of different equipments

<table>
<thead>
<tr>
<th>Categories</th>
<th>Location of tags</th>
<th>Purpose of collected data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardio-training Machines</strong></td>
<td>Belts</td>
<td>➢ Speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Distance finished</td>
</tr>
<tr>
<td></td>
<td>Pedals</td>
<td>➢ Pace</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Distance finished</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Speed</td>
</tr>
<tr>
<td><strong>Strength Training Machines</strong></td>
<td>Handles</td>
<td>➢ Posture of individuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Stability</td>
</tr>
<tr>
<td></td>
<td>Mass blocks</td>
<td>➢ Selected mass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Frequency of lifting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Repetition counting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Power generation estimation</td>
</tr>
</tbody>
</table>

Final Year Project Report: The Conceptual Design of an e-Fitness Coaching System

Submitted on 9th April, 2010

IEEM Full-time Student: Wu Wai Kit,
Department of Manufacturing Engineering and Engineering Management, City University of Hong Kong
AUDIBLE COACHING AND MOTIVATION

After analyzed the collected data, various audible message is presented via headphone according to different conditions. Some of them are telling user about the training information. Some of them are coaching user and some of them are motivating user. Every condition can be personalized to meet the needs of users. Table 4-6 shows some example of audible coaching for strength training and cardio-training respectively. Figure 4-11 demonstrates the scenario of audible coaching of cardio-training.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Strength training</th>
<th>Cardio-training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of workout</td>
<td>Workout start!</td>
<td>3, 2, 1, Go!</td>
</tr>
<tr>
<td>Finish of workout</td>
<td>Well done! / Good job! / Not bad!</td>
<td>You’ve finished. Good job!</td>
</tr>
<tr>
<td>Inconsistence posture</td>
<td>Keep your arm/leg constant!</td>
<td>---</td>
</tr>
<tr>
<td>Symptom of lack of power</td>
<td>Power! More power!</td>
<td>---</td>
</tr>
<tr>
<td>Finish one cycle</td>
<td>One cycle completed. Take a deep breath.</td>
<td>---</td>
</tr>
<tr>
<td>Time to load and unload the mass block</td>
<td>“Beep”</td>
<td>---</td>
</tr>
<tr>
<td>Three more repetition left</td>
<td>3 more to go!</td>
<td>---</td>
</tr>
<tr>
<td>Calorie burnt</td>
<td>XXX Calories burnt</td>
<td>XXX Calories burnt</td>
</tr>
<tr>
<td>Distance travel/left</td>
<td>---</td>
<td>XXX meters done/left</td>
</tr>
<tr>
<td>Heart rate over the training zone</td>
<td>---</td>
<td>Slow down, please</td>
</tr>
<tr>
<td>Heart rate lower the training zone</td>
<td>---</td>
<td>Accelerate, please</td>
</tr>
</tbody>
</table>

Figure 4-11: Scenario of audible coaching of cardio-training
The default sound recording includes both male and female voice, so that users can select their own choice. Moreover, it is possible to record users’ own sound track online. For instance, user can invite their parents to record the sound recording for them and use them as coaching or motivating audible message. Furthermore, role play scenarios can be chosen to make it becomes entertaining. For instance, a police-thief role play can adopt in cardio-training.

Table 4-7 outlines example of role play recording for running and cycling.

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Recording for running</th>
<th>Recording for cycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start of workout</td>
<td>Hey, the thief is there. Go and catch him.</td>
<td>Hey, the thief is there. Take a bicycle and catch him.</td>
</tr>
<tr>
<td>End of workout</td>
<td>Good job! You’ve caught the thief.</td>
<td>Good job! You’ve caught the thief.</td>
</tr>
<tr>
<td>Heart rate over the training zone</td>
<td>Too much children here, run slower.</td>
<td>Too many gravel on the road, slow down.</td>
</tr>
<tr>
<td>Heart rate lower the training zone</td>
<td>Run faster! You nearly miss the thief.</td>
<td>Speed on! You nearly miss the thief.</td>
</tr>
</tbody>
</table>
ONLINE APPLICATIONS

Online applications include all the accessing function of SelFit outside the gym. Users can access SelFit by simply use the web browser with a web-enabled device. As Figure 4-12 shows, there are three main functional categories: nutrition recording, fitness monitoring and online motivating.

Nutrition recording acts as an electronic daily food diary. The food diary track and determine user’s nutrient intake. It is easy to obtain the nutrition information from the food labels. If there is no food labels, SelFit have a nutrients database for estimating the value. The recorded data is then used in fitness monitoring.

Fitness Monitoring means to manage and evaluate the training program. There are total four functions. The first one is to schedule the training program. It includes planning and managing the training program. The second one is to summarize the training data and nutrition data. The balanced diet is determined after gathering this information. The heart rate record and training
performance are displayed graphically. After summarized all the information, it goes to the step of analyzing. According to the database of SelFit, it offers guidance for user’s reference. This information helps and advises users to meet or reach a better level of training.

**Online Motivating** illustrates the motivating elements of SelFit. There are total three modules. The first one is score ranking, which evaluate the performance of user’s training and give a particular score. The system ranks the user according to the score among all users. It offers an index the users to know how good they are doing when compare to others. The second one is challenge friends. Users can create competition program and play with their friends. The final one is Facebook game. It is a game application on Facebook website. The score is ranked according to the training performance and act as an element to improve the gaming experience. Figure 4-13 demonstrates the idea of Friend Challenge and Score Ranking.

![Figure 4-13: Sample of Online Applications](image)

**EXTRA VALUE-ADDED FUNCTION**

Besides health-related functions, SelFit can be used in other facilities in the training centres. Since each S-Coach wristband is assigned a unique S-ID. It can be used as access control. From the entrance of the training centre to the door of the lockers, all these facilities can install readers to obtain the S-ID of users. It can also be used as e-payment of using services in gym room. By adopting SelFit system into training centre, people only need to wear S-Coach instead of bring along their wallets and locker keys with them when they are exercising.

For the **access control of entrance**, an access control gate has to be installed at the entrance of centre. The concept for entrance control by using SelFit is to reduce the man-power needs at the
reception and shorten the time for checking the users’ identities. Furthermore, it increases the level of security of the centre. The access control gate allows only 1 person per authorized S-Coach and also ensures effective entrance control.

For the **access control of lockers**, no more keys are needed and people do not have to worry about missing the locker key. RFID Readers are installed on each door of lockers. The RFID tags act as an e-key to open and lock the door of the locker. It increases the level of convenient and security. It is because it reduces the chance of losing the key when doing exercise and eliminates the deposit of lockers. The maintenance cost of the locker is also reduced.

For the use of **e-payment**, the S-Coach contains a rechargeable contactless smart tag. It is used for payment of vending machines or other services. People do not need to bring along their wallets when they are exercise. It makes the use of gym room services become more convenient.
4.5 SUMMARY OF IDEA

The five key opinions from focus groups and the hypothesis Health Belief Model is the base of the design feature of SelFit. Several features are designed, in order to meet the users’ specifications. Table 4-8 summarizes the designed features, which meets the key opinions from focus groups. Automatic record the training data and manually input the nutrition information is designed to gather the data. The evaluation report is designed to present in a graphical way to make it easier to be understood. Various motivating features are designed to encourage users. The operation of SelFit is as simple as it can, to make it more convenient to be used.

Table 4-8: Summary of designed features, which meets the key opinions of focus groups

<table>
<thead>
<tr>
<th>Key opinions</th>
<th>Description</th>
<th>SelFit designed feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record training data</td>
<td>Cannot memorize the training detail after exercised.</td>
<td>Automatic record the training data, such as repetition and sequence of using training equipments.</td>
</tr>
<tr>
<td>Record nutrition intake</td>
<td>Have no idea in recording information of nutrition intake</td>
<td>Nutritional Recording Module is offered.</td>
</tr>
<tr>
<td>Difficult to evaluate training result</td>
<td>Do not know how to evaluate and assess their training result</td>
<td>Graphical evaluation about heart rate and strength training shows the changes throughout the long-term training period.</td>
</tr>
<tr>
<td>Lack of motivation of exercising in gym room</td>
<td>Feel boring and hard to maintain as a habit.</td>
<td>Encouraging feedback, theme coaching, score ranking, Facebook game and friends challenge are offered</td>
</tr>
<tr>
<td>Simple design of e-fitness gadgets is appreciated</td>
<td>The design of the gadget should not cause any inconvenience to users.</td>
<td>No extra action has performed when using SelFit in gym room, except wearing the S-Coach and a heart rate monitor.</td>
</tr>
</tbody>
</table>

Table 4-9 outlines the designed features, which meets the hypothesis of HBM. The online applications are designed to motivate users and allow them to see the achievement of their peers. Plenty of health-related information is available for users to understand their training program and the efficacy of being active.
Table 4-9: Summary of designed features, which meets the hypothesis of Health Belief Model

<table>
<thead>
<tr>
<th>Hypothesis of Health Belief Model</th>
<th>SelFit designed feature</th>
</tr>
</thead>
</table>
| they possess minimal levels of health motivation and knowledge | ➢ Three online applications is designed to make gym room training become more interesting.  
➢ Plenty training-related information is offered for user to understand how to get fit. |
| view themselves as potentially vulnerable | --- |
| view the condition as threatening | --- |
| are convinced of the efficacy of the training | ➢ Plenty health information is offered for user to understand the importance of getting fit. |
| see few difficulties in undertaking the action towards health | ➢ Score ranking system allows them to have a look on their peers’ achievements. |
CHAPTER 5 SYSTEM ANALYSIS

As mentioned in previous chapter, SelFit is combined by five main components: S-Coach, S-Reader, Host Computer, Online Applications and Database. This chapter attempts to describe the system architecture of SelFit and the functionality offered to user.

5.1 SYSTEM ARCHITECTURE: THREE TIER MODEL

In this system, it is divided into three main tiers: the Presentation Tier, the Logic Tier and the Data Tier. Each of them has independent function, but they are connected together as shown in Figure 5-1.

![Figure 5-1: Conceptual Structure of SelFit in three tier model](image)

PRESENTATION TIER

The Presentation Tier includes three main components: S-Coach, S-Reader and the Web interface. The S-Coach is a gadget that contains an RFID tag as the personal ID for identification. Besides, S-Coach presents the real-time heart rate and the coaching message to the users. As a conclusion, S-Coach is a portable device which interacts with user during exercising.

The next component is the S-Reader. It can be used to display some relevant information during training. After the user is being successfully identified, the display on the S-Reader shows the summary of the planned daily training regime. It prompts users what they have finished and what
they have to do for the rest of the training. It provides a platform for users to check their training progress.

Another important component is the Web interface. It is another essential intermediate for user to access their training regime and to view the evaluation result. It is flexible for users to access SelFit via web interface. The Web interface presents guideline, health-related resource to users and support them in training. Furthermore, the Web interface is one of the platforms to motivate user and support them psychologically.

LOGIC TIER

The Logic Tier includes the Host Computer, which contains most functions among all devices. It handles all the data collected by the Data Collecting Gadgets and finally store in the Data Tier. The Internal Management Systems act as a data processing subsystem, which is a system with data processing function, such as calculation, analysis function, and so on. The Web Application System is also a part of the Host Computer and is presented through the Web interface.

DATA TIER

The Data Tier is used to store the raw data of different users, which includes the Database of SelFit. Data, such as personal identification information, training records, training plan, is stored and can be retrieved in the Database servers of the whole system. The Database keeps data neutral and independent from other application servers. These data is handled and be applied by the Host Computer, and then present to the users. Performance, like the data transmission speed is very important for SelFit to have an accurate real time response.
Figure 5-2 summarized the relationship diagram of the components of SelFit. All the devices at the left hand side will mainly function inside the gym room, while the others can be located outside the training area. Except the connection within a component, all devices are connected wirelessly, which is represented by dotted line.
5.2 OVERVIEW OF SelFit FUNCTIONALITY: USE CASE DIAGRAM

In this section, I am going to describe the use cases that are involved when using SelFit as training tool. There are mainly two situations of using SelFit. The first one is using SelFit in the gym room, while the second one is accessing SelFit via Online Applications outside the gym room. I will first describe the scenario of SelFit in gym room, followed by the situation of SelFit outside gym room.

SelFit IN GYM ROOM

As you can see in Figure 5-3, there are total five actors in this situation. They are the User, Heart Rate Monitor, S-Coach, S-Reader and Server. Within the system boundary of SelFit in gym room, there are total eleven use cases describing the major functions, which are performed in the gym room by the system. More precisely, user obtains his/her heart rate data, get the resting signal, view the training status and receive audible coaching, when he/she is using the gym room with SelFit. The use cases will be described as followings one by one.

Figure 5-3: Use Case Diagram of SelFit in gym room
### Get training status

<table>
<thead>
<tr>
<th>Brief description</th>
<th>After user is identified by the system, user can view the plan and the progress of training on the touch-screen of the S-Reader.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>After the user is identified by the system</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Real-time heart rate data is recorded.</td>
</tr>
</tbody>
</table>

### Get heart rate data

<table>
<thead>
<tr>
<th>Brief description</th>
<th>User obtains the heart rate data for reference. It is useful for user to understand the response of body.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>When the Heart Rate Monitor and connected with S-Coach.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Real-time heart rate data is received from the Heart Rate Monitor and is displayed on the small display of S-Coach</td>
</tr>
</tbody>
</table>

### Get resting signal

<table>
<thead>
<tr>
<th>Brief description</th>
<th>It shows when the user needs to take a rest and when the user can start the next set of training according to the heart rate data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>When the Heart Rate Monitor and connected with S-Coach, especially the user is waiting for the next set of training.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Warning signal is shown when the user is expected to take a rest. Otherwise, a signal shows the user is ready for training.</td>
</tr>
</tbody>
</table>

### Receive audible coaching

<table>
<thead>
<tr>
<th>Brief description</th>
<th>The user received audible coaching via headphone. Some relevant information, such as the number of repetition, motivating message and so on, is given.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>The user is wearing a headphone during training.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Audible coaching message is performed via headphone to the user.</td>
</tr>
</tbody>
</table>

### Record heart rate data

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Measure real-time heart rate data of the user for reference.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>The user is wearing the Heart Rate Monitor and connected with S-Coach.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Real-time heart rate data is recorded.</td>
</tr>
</tbody>
</table>

### Check S-ID

<table>
<thead>
<tr>
<th>Brief description</th>
<th>The Coach receives the heart rate data from the Heart Rate Monitor and then analyzes the data. Suitable coaching message is performed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>The Heart Rate Monitor and headphone is connected to the S-Coach.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Suitable coaching message command is sent.</td>
</tr>
</tbody>
</table>
### Check S-ID

**Brief description**
The S-Reader obtains the personal unique S-ID from the RFID tag in S-Coach.

**Scenario**
When the RFID tag is placed in the field of reader and receives a request from command reader, then the RFID tag response to the RFID reader passively.

**Expected Result**
The personal unique S-ID is sent by RFID tag to the S-Reader.

### Identify user

**Brief description**
The S-Reader identify user based on the personal S-ID received from the RFID tag.

**Scenario**
When the RFID reader receives S-ID code, it compares the registered record through Host Computer.

**Expected Result**
Result of S-ID identification: Successful or Unsuccessful identification.

### Perform coaching

**Brief description**
S-Coach gathers all the coaching commands from the Host Computer and transfers them into recognizable message, such as visual signal and audible message.

**Scenario**
S-Coach is operating and the user is training.

**Expected Result**
Coaching message is given via headphone.

### Track motion

**Brief description**
After the user was identified by the Host Computer, S-Reader start tracking the motion of the sensors on the training equipments. It will be transferred to Host Computer for further processing.

**Scenario**
After the user was identified and he/she is exercising.

**Expected Result**
Motion data of the training equipments was recorded by S-Reader.

### Analyze motion data

**Brief description**
After the motion data is collected by the S-Reader, the data will then transfer to the Host Computer for analyzing. The analysis is based on the stability of the motion and the number of repetitions left. Coaching and Motivating message is selected and transfer to S-Coach for presentation.

**Scenario**
The motion data of the training equipments is obtained and the user is using the equipment.

**Expected Result**
Commands of coaching and motivating message are transferred to S-Coach.
Share training plan

<table>
<thead>
<tr>
<th>Brief description</th>
<th>After the user is identified by the system, his/her training plan will be shown on the screen of S-Reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>After the user is identified by the system.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Summary of training plan is shown on the screen of S-Reader.</td>
</tr>
</tbody>
</table>

SelFit OUTSIDE GYM ROOM

![Use Case Diagram of SelFit outside gym room]

As you can see in Figure 5-4, there are total two actors in this situation. They are User, Facebook and Server. Within the system boundary of SelFit outside gym room, there are total nine use cases describing the major functions, which are performed outside the gym room by the system. More precisely, user can record the nutritional data, monitor his/her fitness and be motivate by using SelFit via the internet. The use cases will be described as followings one by one.
**Record nutritional data**

<table>
<thead>
<tr>
<th>Brief description</th>
<th>One of the important functions of SelFit online applications is to record the user’s information of daily meal. It translates the meal information into the nutritional information and helps user to know more about health diet when they are conducting their training regime.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User desires to know the balance between training and diet, they can use this module as nutritional monitor.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Nutritional information about the daily intake.</td>
</tr>
</tbody>
</table>

**Monitor fitness**

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Another function of SelFit online applications is to monitor fitness of the user. User can review the training summary, manage their training plan and receive analysis about personal training regime.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>After the user decided to use SelFit as a coaching tool and would like to manage his/her program in a convenient way.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Summary of training, Scheduling of training, and analyzed report is received.</td>
</tr>
</tbody>
</table>

**Get Motivation**

<table>
<thead>
<tr>
<th>Brief description</th>
<th>Another function of SelFit online applications is to motivate user in maintaining his/her training behavior. SelFit try to add more elements for motivation and hope that people will much willing to training their body.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User feels boring and want to give up their training program.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Motivating effect such as achieve the goal successfully, win the challenge and gaming experience, is received.</td>
</tr>
</tbody>
</table>

**Review training summary**

<table>
<thead>
<tr>
<th>Brief description</th>
<th>It belongs to the module of monitor fitness. The online applications provide a platform for user to review their training record. It shows all the relevant information graphically.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User wants to know his/ her training after he/she conducts his training program.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Summary of training is provided as reference.</td>
</tr>
</tbody>
</table>
## Organize training schedule

<table>
<thead>
<tr>
<th>Brief description</th>
<th>One of the functions of monitoring fitness is to manage user's training schedule on his/her own. By setting target and training schedule, user can have a platform to organize the training schedule effectively.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User plans to manage their training regime through the applications of SelFit.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Better training schedule management</td>
</tr>
</tbody>
</table>

## Get fitness analysis

<table>
<thead>
<tr>
<th>Brief description</th>
<th>After recording the training data of each time, SelFit helps to analyze the recorded data and provide a graphical view for reference. It analyzes the body response and training performance of training regime. This module shows the evaluation of the training program.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User wants to understand more about their performance or body response during training.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Recorded data is analyzed and the evaluation of the training program is given.</td>
</tr>
</tbody>
</table>

## Rank score

<table>
<thead>
<tr>
<th>Brief description</th>
<th>One of the elements of Motivating Module. According to the analyzed performance of the training, SelFit gives a score for user performance and it is being ranked. The ranking result can be shared with friends and it can be ranked with some famous athletes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User decides to establish the score for ranking</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Ranking score will be given according to the performance of the training.</td>
</tr>
</tbody>
</table>

## Play Facebook game

<table>
<thead>
<tr>
<th>Brief description</th>
<th>One of the elements of Motivating Module. A Facebook application game is provided to have more fun. The ranking score can be translated into a gaming value to increase the gaming experience.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User runs the game application on Facebook via web browser.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>User received gaming experience from the Facebook application game.</td>
</tr>
</tbody>
</table>

## Challenge friends

<table>
<thead>
<tr>
<th>Brief description</th>
<th>One of the elements of Motivating Module. In order to increase fun of doing exercise, user can create a competition and challenge his/her friend via Facebook. The competition can be a single one or a group matches.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>User wants to create competition among friends.</td>
</tr>
<tr>
<td>Expected Result</td>
<td>Competition result is given after the challenging game is finished.</td>
</tr>
</tbody>
</table>
The most important part of these two use case diagrams is to graphically illustrate the functionality, which user can get from SelFit.

According to Figure 5-3, user mainly interacts with SelFit in the gym room with four objectives. User gets the heart rate data and the resting signal from S-Coach. Moreover, user receives audible coaching once he/she connect the headphone with S-Coach during exercising. He/she can also get the training status from the touch screen of S-Reader.

According to Figure 5-4, user interacts with SelFit outside the gym room via internet. There are three main objectives for using SelFit outside the gym room. He/she monitors the training program through the application. Furthermore, user records their daily nutrition data by using SelFit. He/she can also receive motivation from three different motivating modules.
CHAPTER 6 SYSTEM DESIGN: SADT

In this chapter, I describe the system in a hierarchical way with the help of the methodology of Structured Analysis and Design Technique (SADT). As mentioned in Chapter 5, SelFit is combined by five main components. In this section, I am going to demonstrate the system design in a more detailed way. I used Structured Analysis and Design Technique, which is a kind of graphical language, to describe SelFit’s presentation tier. This part will only focus on the presentation tier of the system.

NODE DIAGRAM

Figure 6-1: Node diagram of SelFit coaching system

Figure 6-1 illustrates the node diagram of SelFit. The system will be divided into three systems, which are the Data Collecting System, Coaching System and Online Applications, on the first level. And then it decomposes into a smaller sub-system.
TOPMOST LAYER OF SelFit

To start with, let’s have a look on the topmost view of the system which is shown in Figure 6-2. It described the input and output of SelFit with the necessary mechanisms and control, which has been introduced in Chapter 4. The function of coaching can be perform by inputting the meal record and training plan of the user, then the system will finally give out feedback, report of about training and the user can be motivated.
E-FITNESS COACHING

As shown in Figure 6-3, it shows the functional relationship of the three main systems. The Data Collecting System (Box A1) is used to measure the training data by using the Heart Rate Monitor and the S-Reader and then gives out the training record. The Real-time Coaching System (Box A2) will perform feedback based on the training plan and the training record. It is essential to set the target heart rate zone first and the headphone is connected with S-Coach. S-Coach, Wireless headphone and Host Computer work together to provide coaching to the users. The Online Applications (Box A3) is a web-enabled function, which needs a web-enable device and host computer. It requires the training plan, the training record and the information about meal to provide feedback, evaluation report and performs motivating elements. All parts will be discussed respectively according to the three main systems.
6.1 DATA COLLECTING SYSTEM

Figure 6-4: SADT sheet no. 3: Data Collecting System

Figure 6-4 outlines the functional relationship of the Data Collecting System. The Heart Rate Monitor is used to measure user’s real-time heart rate (Box A11). Once the Monitor is connected with S-Coach, the heart rate value transmits to S-Coach for further processing. The User Identification System (Box A12) is used to identify the user’s identity based on the registered personal data in the Database. The RFID reader in the S-Reader and the RFID tag in S-Coach are needed for user identification. If the user is successfully identified, an initial command will be sent to the Motion Tracking System for starting tracking motion of the equipments. Otherwise, the S-Reader will display a message telling user that he/she is a guest user. Motion Tracking System (Box A13) is used for measuring the motion data of the training equipments. Once it received an initial command from the User Identification System, S-Reader starts to measure the motion of the motion sensors, which is attached on the handles of the training equipments. Finally, it provides the motion record of the equipments.
USER IDENTIFICATION SYSTEM

As Figure 6-5 shows, it is about how the User Identification System functions. First at all, the RFID reader continuously sends out RF signal and seeks for response (Box A121). Once there has any RFID tag staying within the RF-field, the RFID tag is powered up (Box A122). Then the RFID tag sends out the unique S-ID to the RFID reader, and the reader verifies the SID with the registered data in the Database (Box A123). If the user is successfully identified, the Screen of S-Reader displays the user information (Box A124) and an initial command is sent (Box A125). Otherwise, the screen displays “Guest User” for failure of identification.
MOTION TRACKING SYSTEM

Figure 6-6: SADT sheet no. 5: Motion Tracking System

According to Figure 6-6, it shows the system flow of the Motion Tracking System. The inertial sensors start measuring the change of the internal sensor after it received an initial command (Box A131). Then the inertial sensors transmit measured data to the S-Reader (Box A132). The S-Reader then records the received data of location changes (Box A133) and sends them to Coaching System for further processing.
6.2 REAL-TIME COACHING SYSTEM

As you can see in Figure 6-7, it outlines the functional relationships of the sub-system in the Real-time Coaching System. The heart rate value, which is measured by the Heart Rate Monitor, is sent to the Heart Rate Monitoring System (Box A21) for analyzing. The real-time heart rate data is compared with the detail of target training heart rate zone and suitable coaching command is selected and is sent to Visual Coaching Module and Audible Coaching Module. On the other hand, the equipment motion record is sent to the Motion Analyzing System (Box A22) for analyzing. Similarly, suitable coaching command is selected and is sent to the Audible Coaching Module. The Visual Coaching Module (Box A23) receives information about training plan, heart rate value and displays them on the screen of S-Reader and S-Coach respectively. Also, it is used to present the visual coaching message, such as showing the resting signal on S-Coach. Furthermore, the Audible Coaching Module receives coaching command from Heart Rate Monitoring System and Motion Analyzing System and presents the coaching message via headphone.
Let’s look deeper into the Heart Rate Monitoring System. As shown in Figure 6-8, the system main monitor three aspects: monitor the training zone, monitor the resting zone and display real-time heart rate. First of all, during using the training equipments, the measured heart rate data is compared with the pre-set target heart rate training zone (Box A211). If the heart rate gets over the training zone, a “speed up” command is selected (Box A212). Conversely, if the heart rate drops below the training zone, a “slow down” command is selected (Box A213). Secondly, between the resting periods of training sets, the heart rate value is compared with the calculated target recovery zone (Box A214). If the heart rate is over the recovery zone, a “need rest” command is chosen (Box A215). Oppositely, a “Recovered” command is selected if the heart rate is lower than the recovery zone (Box A216). Finally the Heart Rate Monitoring System sends “display heart rate” command to inform S-Coach to show the real-time heart rate value for user’s reference. As a result, all the coaching commands are sent and were presented visually and audibly respectively.
MOTION ANALYZING SYSTEM

As shown in Figure 6-9, the Motion Analyzing System receives equipments motion record from the Data Collecting System. The data will be reviewed according to two aspects: stability and repetition counting. Firstly, it calculates the stability of the motion. Once the motion is not stable (Box A221), a “keep stable” command is sent (Box A222). For the function of counting repetition (Box A223), the recorded data will be compared to the plan. When there are three repetitions left, a “repetition left” command is sent to inform user that it is nearly to finish the training set (Box A224).
VISUAL COACHING MODULE

As Figure 6-10 shows, the Visual Coaching Module is used to perform coaching visually. The training plan summary will be shown on the screen of the S-Reader for reference (Box A231). In addition, the real-time heart rate value is shown on the display of S-Coach (Box A232). During the user is waiting for the next set of training exercise, a green color is shown on the S-Coach if the “recovered” command is received (Box A233), while a red color is shown on the S-Coach if the “need rest” command is received (Box A234).
AUDIBLE COACHING MODULE

Besides the Visual Coaching Module, there is an Audible Coaching Module, which is shown in Figure 6-11. In this module, it presents four categories of audible coaching if the wireless headphone is connected. The first one is monitoring the heart rate during exercise. The “speed up” or “slow down” sound recording is presented if a “speed up” command or a “slow down” command is received respectively (Box A241 & Box A242). It is a kind of soundtrack that tells user to increase or reduce the intensity level of exercise in different period of training. Another audible coaching is monitoring the resting heart rate between sets of exercise. The “recovered” sound recording is presented if the “recovered” command is received (Box A243). The next audible coaching is monitoring the stability of the motion of body parts. The “keep stable” sound recording is presented if the “keep stable” command is received (Box A244). The last one is used to inform user about the number of replicate left in each set of training. The “repetition left” sound recording is presented if the “repetition left” command is received (Box A245).
6.3 ONLINE APPLICATIONS

Figure 6-12 illustrates the functional relationships in SelFit Online Applications. To start with, there is a Nutritional Recording System, which is used to manage the data about nutrition information (Box A31). User can input their daily meal record and the system then estimate the nutritional information. Secondly, there is a Fitness Monitoring System, which is used to monitor all data physical training data (Box A32). The System requires training record, training plan and the nutrition information for analyzing the training result. An evaluation report about the summary of training is shown. Finally, the analyzed information is used in the Online Motivating System (Box A33). In this system, it is mainly used to provide motivation to user via internet.
FITNESS MONITORING SYSTEM

Figure 6-13: SADT sheet no. 12: Fitness Monitoring System

According to Figure 6-13, the Fitness Monitoring System has three main functions: Scheduling, Summarizing and Analyzing. Firstly, A Scheduling Module (Box A321) is used to manage all the function of scheduling, such as planning, checking progress, and so on. Secondly, another function is to show summary of the training (Box A322). It is used to gather and summarize the measured training data, such as the number of repetition done, sequence of training, and so on. It is used to show a record for user to review their training program. The last function is to analyze data (Box A323). The training record and nutrition information are required. It tries to evaluate the training result and the diet balance. It provides a graphical evaluation report for use to understand their performance in training. Once the user find that the training program is not good enough, he/she can modify his/her plan and prepare for the next training section.
ONLINE MOTIVATING SYSTEM

As shown in Figure 6-14, the analyzed information is used in three different modules. The first one is the Score Ranking Module (Box A331). A score will be given to user based on the analyzed information and it is used to rank with friends and some famous athletes. Another one is the Friends Challenge Module (Box A332), it is designed for challenging user’s friends via Facebook. It tries to create competition about training. The last one is the Facebook Game Module (Box A333). It is a Facebook gaming application, which offering gaming experience to attract youngsters to do more exercise.

As a conclusion, the previous paragraphs described the SelFit e-fitness coaching system in a graphical approach. The SADT graphically demonstrated the functional relationships among all sub-systems of SelFit. The function of SelFit is designed to meet the needs of the user in three different dimensions: physically assisting and psychologically supporting the user in using gym room for getting fit.
CHAPTER 7  SYSTEM DEVELOPMENT

There are various existing methods for the development of a system. They have been traditionally seen as models for system development. A system development methodology is defined as a combination of four elements: System Development Approach, System Development Process Model, System Development Method and System Development Technique (Magda Huisman, Juhani Iivari, January 2006). Table 7-1 shows the definition of system development methodology, which is defined by Magda Huisman and Juhani Iivari in 2005. In this chapter, I am going to describe the methodologies used to build up the coaching system.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Development Approach</td>
<td>Involves the philosophical view on which the methodology is built. It is the set of goals, guiding principles and beliefs, fundamental concepts, and principles of the systems development process that drive interpretations and actions</td>
</tr>
<tr>
<td>System Development Process Model</td>
<td>A representation of the sequences of stages. Some examples are the linear life-cycle model and the spiral model.</td>
</tr>
<tr>
<td>System Development Method</td>
<td>A systematic way of conducting at least one complete phase of systems development, consisting of a set of guidelines, activities, techniques, and tools, based on a particular philosophy and the target system</td>
</tr>
<tr>
<td>System Development Technique</td>
<td>Procedures, possibly with a prescribed notation, to perform a development activity.</td>
</tr>
</tbody>
</table>
7.1 SEVEN-POINT PROTOCOL

SYSTEM DEVELOPMENT

Firstly, “Products” is about what the products are and what target customer groups are being focused. For the e-fitness coaching system, it has five main parts including the S-Coach, Heart Rate Monitor, S-Reader, Host Computer & Database and the Web applications. The system is target on the people who conduct training in the gym room. No matter it is strength training or cardio training, SelFit covers the needs for coaching.

Secondly, “Activities” indicates the development activities, which must be carried out to develop SelFit. It also includes the target responsible groups, who will be involved in each particular activity. Table 7-2 outlines the main development activities for development the SelFit coaching system. The development activities will further breakdown into smaller size and be carried out one by one.

<table>
<thead>
<tr>
<th>Development Activities</th>
<th>Involved people</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engineer</td>
</tr>
<tr>
<td>Data Collecting System</td>
<td></td>
</tr>
<tr>
<td>Heart rate measurement</td>
<td></td>
</tr>
<tr>
<td>User identification System</td>
<td></td>
</tr>
<tr>
<td>Motion Tracking System</td>
<td></td>
</tr>
<tr>
<td>Coaching System</td>
<td></td>
</tr>
<tr>
<td>Heart Rate Monitoring System</td>
<td></td>
</tr>
<tr>
<td>Motion Analyzing System</td>
<td></td>
</tr>
<tr>
<td>Coaching System (Visual &amp; Audible)</td>
<td></td>
</tr>
<tr>
<td>Online Applications</td>
<td></td>
</tr>
<tr>
<td>Nutritional Recording System</td>
<td></td>
</tr>
<tr>
<td>Fitness Monitoring System</td>
<td></td>
</tr>
<tr>
<td>Online Motivating System</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Database development</td>
<td></td>
</tr>
<tr>
<td>System testing</td>
<td></td>
</tr>
</tbody>
</table>

Thirdly, “System Orientation” is about the development orientation that the system be designed and built. The development focus point should be carefully studied.
Forthly, “Technology and Tools” is about the technology and the tools for development of SelFit. For instance, in order to develop the identification system, RFID technology will be used to conduct the system. Some statistical tools may need to calculate the performance of the tag and reader during construction of the identification system. Table 7-3 shows the needs of technologies and tools what may used for development of SelFit.

<table>
<thead>
<tr>
<th>Table 7-3: Brief technologies and tools needed for development of SelFit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development Activities</strong></td>
</tr>
<tr>
<td>Heart rate measurement</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>User identification System</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Motion Tracking System</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>HR Monitoring System</td>
</tr>
<tr>
<td>Motion Analyzing System</td>
</tr>
<tr>
<td>Coaching System (Visual &amp; Audible)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Nutritional Recording System</td>
</tr>
<tr>
<td>Fitness Monitoring System</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Online Motivating System</td>
</tr>
<tr>
<td>Database development</td>
</tr>
</tbody>
</table>

**PROJECT MANAGEMENT**

Firstly, It includes “Development Strategy” is about what development strategy will be used in managing the project. According to the development of SelFit, A “Waterfall” style of System Development Life Cycle approach will be chosen for managing all project activities.

Secondly, “Activities” and “Products” mean what activities and products can be used in supporting project management. For instance, regular reporting meetings can help in understanding and tracking the project progress. Existing products, such as Microsoft Project software, help in project management of developing SelFit.
QUALITY MANAGEMENT

Firstly, “Quality Requirement” considers all the requirements of the system. At the stage of conceptual design, basic quality requirements are stated and the detailed quality requirements will be defined at the analysis phase of the project. Table 7-4 shows the basic quality requirements of SelFit at the stage of conceptual design phase. It online all the basic requirements of different components of SelFit. The detailed technology designed will be conducted in the detailed design phase.

<table>
<thead>
<tr>
<th>Products</th>
<th>Basic quality requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S-Coach</strong></td>
<td>▶️ Size should be convenient to be carried on glove.</td>
</tr>
<tr>
<td></td>
<td>▶️ Able to be connected to wireless headphone.</td>
</tr>
<tr>
<td></td>
<td>▶️ High data transmission rate for real-time response</td>
</tr>
<tr>
<td>RFID tag:</td>
<td>▶️ Short range identification</td>
</tr>
<tr>
<td></td>
<td>▶️ Small in size to fill into S-Coach</td>
</tr>
<tr>
<td><strong>Heart Rate Monitor</strong></td>
<td>▶️ Accurate heart rate measurement</td>
</tr>
<tr>
<td></td>
<td>▶️ High data transmission rate for real-time response</td>
</tr>
<tr>
<td></td>
<td>▶️ Comfortability</td>
</tr>
<tr>
<td><strong>S-Reader</strong></td>
<td>▶️ High data processing rate for real-time response</td>
</tr>
<tr>
<td></td>
<td>▶️ High data transmission rate for real-time response</td>
</tr>
<tr>
<td>RFID readers:</td>
<td>▶️ Short range identification</td>
</tr>
<tr>
<td>Motion Tracking System:</td>
<td>▶️ Accurate motion tracking measurement</td>
</tr>
<tr>
<td><strong>Host Computer &amp; Database</strong></td>
<td>▶️ High data processing speed for real-time calculation.</td>
</tr>
<tr>
<td></td>
<td>▶️ High data transmission rate.</td>
</tr>
<tr>
<td><strong>Web applications</strong></td>
<td>▶️ User-friendly web interface.</td>
</tr>
<tr>
<td></td>
<td>▶️ Reasonable data accessing rate.</td>
</tr>
</tbody>
</table>

Finally, “Activities” is about the quality assurance and quality audit activities that will be used in the project. For an instance, audit plan and internal project quality can be used for independent verification for the system development. It is very important that the type of activities for quality audit should be carefully designed and planned. Those quality requirements for each stage of different components should be checked before it goes to the next stage of development.

The Seven-point protocol is a methodology for planners to consider more comprehensively before starting planning the development method. It tries to question the planners in lots of different aspects and allows them to design an optimal tailored development project. Table 2-2 shows the brief idea about using Seven-point protocol that is used for development of SelFit.
Table 7-5: Brief idea about Seven-point protocol

<table>
<thead>
<tr>
<th>No.</th>
<th>Dimensions</th>
<th>Elements</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System Development</td>
<td>Product</td>
<td>Kinds of components: S-Coach, Heart rate monitor, S-Reader, Host Computer &amp; Database and Web Application.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Target customer group: people in gym room.</td>
</tr>
<tr>
<td>2</td>
<td>Quality Management</td>
<td>Quality requirement</td>
<td>Basic quality requirements for different parts of the system. (Please refer to Table 7-4)</td>
</tr>
<tr>
<td>3</td>
<td>System Development</td>
<td>Activities</td>
<td>Define development activities and involved people. (Please refer to Table 7-2)</td>
</tr>
<tr>
<td>4a</td>
<td>Project Management</td>
<td>Development strategy</td>
<td>“Waterfall” style of System Development Life Cycle approach will be applied.</td>
</tr>
<tr>
<td>4b</td>
<td>System Development</td>
<td>Development Orientation</td>
<td>The development orientation for the system to be designed and built.</td>
</tr>
<tr>
<td>5</td>
<td>System Development</td>
<td>Technology and Tools</td>
<td>Technology and supporting tools used for development of the system. (Please refer to Table 7-3)</td>
</tr>
<tr>
<td>6a</td>
<td>Project Management</td>
<td>Activities</td>
<td>Activities, which is used in supporting project management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>➢ Regular reporting meetings, etc</td>
</tr>
<tr>
<td>6b</td>
<td>Project Management</td>
<td>Products</td>
<td>Products, which is used in supporting project management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>➢ Microsoft Project software, etc</td>
</tr>
<tr>
<td>7</td>
<td>Quality Management</td>
<td>Activities</td>
<td>Quality assurance and quality audit activities To be conducted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>➢ An audit plan and an internal project quality plan for independent verification.</td>
</tr>
</tbody>
</table>
7.2 SYSTEM DEVELOPMENT LIFE CYCLE

System development life cycle is a logical process used to develop the whole coaching system. It helps to meet the user expectations, reach completion within time and cost estimates, work effectively and efficiently throughout the whole developing process. Because of the complexity among the components of SelFit, it is vital essential to have a comprehensive planning for development. The development of SelFit follows a typical System Development Life Cycle as shown in Figure 7-1. There are total five phases: Conceptual Design Phase, Analysis Phase, Design Phase, Detailed Design Phase and Test & Implementation Phase.

In order to manage the complexity, a “waterfall” development lifecycle is used. Project is divided into sequential phases, with some overlap acceptable between phases. It emphasizes on planning, time schedules, budgets and implementation of the system at one time. The reasons of using this approach are it provides a clearer workflow step by step and it can be easily understood. Especially in such a complex system covers various components, it gives a clear sign-off points for every phase, so that the progress can be easily measured. An activity-oriented approach will be adopted. Then the functional activities will then separate into different related components. Every phase have to be completed step by step with periodical review at the end of the phases. Within different phases, the work will be broken down according to the functional activities. The reason of using activity-oriented approach is that it increases the collaboration among all related functional activities. Figure 7-2 shows a sample of activity-oriented Gantt Chart.
However, “Waterfall” approach does have disadvantages. Poor project management leads to serious time management problem, since work on the next development phase is dependent on the output of the previous one. The project duration can be easily enlarged because of any delay in different phases. So that a good project management is very important for the development of SelFit. Another reason is that it limits the involvement of the end-user at the early phases and it may lead to the problem of end-user dissatisfaction. Furthermore, any mistakes early in the project have a cascading effect of errors later in the project. As a result, a good quality management is also necessary for development of SelFit.

To start with, Conceptual Design Phase is the initial step of the system development life cycle. As shown in Figure 7-3, an innovative idea will be first created and be studied about the feasibility. Market survey is conducted to gather information about e-fitness system. It is important to find out the weaknesses of some existing products and then develop a much powerful system. In this phase, user requirements will first be conducted. SelFit’s objectives and business functions are stated in this phase in this phase. Similar to this report, it is mainly focus on the conceptual idea about an e-fitness coaching system. It is given that a brief idea about the

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**Figure 7-2: Activity-oriented Gantt Chart Sample**

<table>
<thead>
<tr>
<th>ID</th>
<th>Activities</th>
<th>Components</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conceptual Design Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Activities 1</td>
<td>Component A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Component B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Component C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Activities 2</td>
<td>Component A</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Component B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Component C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Phase Completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Analysis Phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Activities 3</td>
<td>Component A</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Component B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Component C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Activities 4</td>
<td>Component A</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Component B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Component C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Phase Completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Design Phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 7-3: Flow diagram of Conceptual Design Phase**
system should be shown and define at the beginning of the whole system development life cycle. With the help of some technical expert, they may provide opinion on the limits, constraints and feasibility of the system. The brief system architecture is determined in this phase. Then, it is time to plan the project schedule. Furthermore, it is necessary to define different milestone of the project. It helps to monitor the progress of the project. By setting different task duration and allocating different resources, all these should be discuss with those involved people. As least the team leaders should agree on the decided plan. Otherwise, conflict may occur easily due to different point of view of the schedule. The system plan should be compiled.

Then, it is time to go to the **Analysis Phase** as shown in Figure 7-4, which aims to determine the feasibility of SelFit. It is useful to analyze the requirements about the physical components of the system to see whether it is possible to meet the user specifications. A plan for analysis phase should be developed. All concerning information about the coaching system should be collected and analyzed. For instance, analysis about different existing technologies should be study in order to finalize the most suitable technology used in different components. Those analyzing process can also help to determine any difficulties in developing and implementing SelFit coaching system. In these phase, the best approach to develop SelFit should be determined. Setting guidelines will be useful to prevent the development taking too long, costing too much or even being failure. After that, the cost/benefit overview should also be prepared in this phase. Before move to the next step, a system requirement review report should be prepared and it shows the overall results of the work that is done in the Analysis Phase.

![Flow Diagram of Analysis Phase](image.png)
After that, it goes to the **Design Phase** as shown in Figure 7-5. The purpose of this phase is to refine the requirements and system design. It is time to make them detailed enough to proceed to complete the overall design. Another objective is to divide the system into smaller sub-systems, so that it can be separately developed and implemented. SelFit is divided into five components and that means five main groups of people will be assigned to different tasks respectively. All these people will co-operate together by segmenting into different functional features. In this phase, a framework for further system development is established. The subprojects should be sequenced according to dependency and priority. The detailed system development plan and the cost/benefit overview should be prepared. The final step is to prepare the system design report.

As you can see in Figure 7-6, it described the **Detailed Design Phase**. It defines requirements and design specification to the level necessary for starting programming, writing manual procedures and working with the development versions of both software and hardware. The development of SelFit's subsystems starts and the specific approach is chosen depends both on the characteristics of the system. When detailed design ends, the overall direction of subsystem development is nearly confirmed. The detailed test plan and implementation plan are prepared at the end of this phase. Furthermore, the detailed design report is documented.
Figure 7-7 shows the flow of **Test and Implementation Phase**. The purpose of this phase is to create the manual procedures and software. The SelFit hardware components’ design created in detailed system design is assembled. The physical design is turned into operating software, hardware, manual procedures and the test database is prepared. All these will then be tested by the developers and other related parties. Suitable training is offered for users to get familiar with the functions of SelFit. All the documents should be completed at the end of this phase. The implementation report is prepared as the final step of this phase.
CHAPTER 8  CONCLUSION AND RECOMMENDATION

8.1. CONCLUSION

In conclusion, SelFit is designed to integrate technology with physical fitness training. According to the obtained opinions of focus groups, it is designed to computerize the needs of users. The S-Reader and the Heart Rate Monitor collects data about motion of the posture and the real-time heart rate respectively. The measured data is analyzed for helping users to understand their training performance. By displaying the training information graphically, users make improvement in continuous modification of their training program. Moreover, it offers various features of motivation to address the psychological obstacles of performing physical activities. Audible message is presented via wireless headphone, which coaches and motivates users during exercising. Besides, the Score Ranking Module set the goal for users to achieve and the Friends Challenge Module create competitions among their social network. The Facebook Game Module is designed to encourage youngsters to become more active. Furthermore, SelFit plays an important role in improving the efficiency and convenience of training centre. It is used as access control of entrance and lockers, as well as contactless rechargeable e-payment of facilities in gym room centre. Overall, the complete SelFit system is presented in a Three Tier Model with S-Coach, S-Reader and web-interface as the Presentation Tier; Host Computer as the Logic Tier and Database as the complementary Data Tier. The hierarchic structure of SelFit is documented using the Structured Analysis and Design Technique.

Last by not least, the development of SelFit follows the methodology of system development life cycle. A “waterfall” approach is adopted to manage the complexity of the system. Besides carefully manage the aspect of System Design, Project Management and Quality Management of the system for developing such a complex system are of vital importance.

This conceptual study has fully demonstrated the technical feasibility of such a personal e-fitness gadget. The details documents also provide a sound and valuable basis for the follow-up physical development of this SelFit system.
8.2. RECOMMENDATION

According to this conceptual design report of e-fitness coaching system, recommendation for follow-up physical development of SelFit system and the vision about future development of e-fitness system are made as below,

FOR FOLLOW-UP PHYSICAL DEVELOPMENT OF SelFit SYSTEM

(1) The technology used in collecting data should be further investigated. Since this conceptual design of SelFit can only cover the cardio-training machines and strength training machines, there are several training equipments, such as the free-weight training gadgets, cannot be involved. In order to have a comprehensive monitoring of fitness training, it is important to develop new technology in capturing all the value training data.

(2) The motion tracking technology should be investigated in the future. Since the inertial sensors are used in measuring the motion of the training equipments and then to estimate the motion of user, it is not accurate to obtain actual motion of human. It is better to investigate other kinds of motion tracking technology to directly track the motion of human without using any on-body sensors as shown in Figure 8-1. The data can be computerized and the 3D-motion is simulated. It increases the accuracy of the captured motion and different part of the body posture can be evaluated.

(3) In the future, it is suggested that SelFit should be integrated with the computing system of training equipments in the future. According to the design of SelFit, different components, such as motion tracking of mass block and pedals, are externally installed on the training equipments. It is better to connect SelFit coaching system with computing system for data...
collection. More precisely, take cycling machine as an example, most of them have their own computing system to calculate various information, such as calories burnt, distance traveled and so on. It is useful for SelFit to connect to these systems and directly collect accurate information.

(4) Cost/Benefit analysis should be conducted, in order to make SelFit system worthy to be used. The cost of developing and maintaining the system should be acceptable for most of the people, even youngsters should also be able to afford it.

(5) Security issue of SelFit system should be carefully studied. Since the S-Coach contains personal identity and information for e-payment, this may lead to a further study about how to handle these kinds of personal information and commercial data securely.

FOR FUTURE DEVELOPMENT OF E-FITNESS SYSTEM

(1) It is possible to integrate SelFit with healthcare services in the future. SelFit creates a unique account for each user to store their training data. In order to enhance the use the information system of SelFit, the database can also store the healthcare record of the user. This data is shared among different medical parties. The system can also provide advice on healthy lifestyles, diets, habits and health-related products. For SelFit itself, it can have more information for suggesting user the most suitable training activities and nutrition intake. With globalization, increasing number of e-health resources should be developed for global audience. It is possible to create a comprehensive e-health system for everyone to manage their healthcare and fitness issues.

(2) However, when goes to the topic of global e-health system, there are several important issues have to be studied. Challenges, such as, ethical problem, security issue, global system standard and so on, always obstruct the development of e-health. Methodological and methodical studies of these challenges should be encouraged. All involved parties should have a common consensus for building a global e-health system. Furthermore, global e-health system is threatened in the backward countries. People who do not have money, skills, internet connections and even computers, cannot access e-health services. This is one of the challenging barriers to achieve the idea of “global” e-health system. It is important to ensure the equity to have health-care more accessible to all.
REFERENCES


APPENDICES

APPENDIX A. FOCUS GROUP SUMMARY

FOCUS GROUP INFORMATION

Date and time: 7th October, 2009 (Wednesday) 14:00-15:30
               9th October, 2009 (Friday) 15:30-17:00
               14th October, 2009 (Wednesday) 18:30-20:00
               16th October, 2009 (Friday) 21:00-22:30

Venue: City University of Hong Kong,
        Resident Hall 5, 13/F, Common Room

Host: Wu Wai Kit

Number of Respondents: Age between 19 and 33

Purpose: To understand the perception towards “fitness” & “e-fitness”
          To investigate the training obstacle
          To understand customers’ perception towards “e-fitness products”
          To collect idea about e-fitness coaching system
1. Background Information of respondents

Total fifty people participate in four focus groups.

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<th>User of any e-fitness gadgets</th>
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Summary

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2. Preparation of Focus Groups

Part 1: Introduction (2 mins)

Hello, everyone. Thanks you all come and join my focus group. I am a final year student from the Department of Manufacturing Engineering and Engineering Management. My name is Steven. Today, I am going to be the host of this focus group.

I am now working on my Final year project about e-fitness coaching system of physical fitness training. The purpose of today’s focus group is to share your experience and opinion about fitness training and e-fitness product.

All the information provided from you all will only be used for the purpose of research analysis. What you have to do is just share your point of view. Some question may be provided to guide the meeting. Please be reminded that there are no true or wrong answers for the questions.

Today’s focus group will be last for about 1.5 hours. Please feel free to express your opinion. Before we start, let’s first introduce ourselves to the others.

Part 2: Questions (88 mins)

Perception towards “fitness” & “e-fitness”.

- Could you share with us about your idea about “fitness”?
- Could you share with us about your idea about “e-fitness”?
- Anyone knows about “e-fitness system” and what are they?
- In previous year, what kinds of activities you have to get “fit”?

Obstacle of training.

- Could you share with us about the training obstacle?
- What motivate you to go for training?
- Why you don’t like physical fitness training? (For those who dislike or do not choose gym room training as exercise.)

Perception towards “e-fitness products” & idea generation

- What do you think an e-fitness product should be?
- What critical selection criterion for choosing an e-fitness product?
- Will you choose to use SelFit in gym room training and why? (with simple description about features of SelFit)
- Here are 3 types of training gadgets, which one will you prefer if their features are applied into gym room training? (Polar, Nike+ & Adidas miCoach)
- What elements do you think that should be involved?