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ACCESSING YOUR FARM ANYWHERE AND ANYTIME

BY

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A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION TECHNOLOGY (HONS)

COMMUNICATIONS AND NETWORKING

Faculty of Information and Communication Technology

(Perak Campus)

JANUARY 2011

DECLARATION OF ORIGINALITY

I declare that this report entitled "**Accessing Your Farm Anywhere and Anytime**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature: _____

Name : _____

Date : _____

ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to my supervisor, Mr Goh Hock Guan who has given me this bright opportunity to engage in “Accessing Your Farm Anywhere and Anytime” project. It is my first step to establish a career in Mobile modification and update. A million thanks to you.

Finally, I must say thanks to my parents and my family for their love, support and continuous encouragement throughout the course.

When I asked for strength, God gave me more burdens to carry.
When I asked for love, God sent me people with problems.
When I asked for wisdom, God gave me more problems to solve.
I see that I did not get the things I asked for but I have given all the things that I needed. Thank God.

ABSTRACTS

This project is a mobile-based farm accessing in anywhere and at anytime project for "Accessing Your Farm Anywhere and Anytime (M-Farm)". M-Farm is enabling the farmer to know the extreme problems in the farm by the farmers. The problems that the farmers need to face include bad weather, water supply and diseases. A study of the technologies of mobile devices carried out, initiated in the hope of understanding the existing technologies in monitoring such as Wireless Application Protocol (WAP), General Packet Radio Service (GPRS) and 3 Generation (3G). Those existing technologies, which implemented in farm monitoring, are Personal Digital Assistant (PDA) and Global System for Mobile Communications (GSM). We will analysis on the technologies and make modification and update for the technologies of WAP, GPRS and 3G so that farm accessing can be in anywhere and anytime. Compare and contrast among those three technologies are used to figure out the most suitable technology to be modified. The methodology, concept and design in M-Farm accessing carried out such as waterfall, v model and prototyping. Hybrid of waterfall and prototyping has chosen as the model in this project because the model can have additional modification during the implementation process. Since 3G, mobile application technology has high performance for farm accessing compare to WAP and GPRS, therefore implemented in the project.

Lastly, M-Farm offers an alternative way in the modern farming. We hope it will benefit the farming community with the implementation of this M-Farm in their farm so that farmers can access their farm in anywhere and at anytime.

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LIST OF ABBREVIATIONS

M-Farm	Accessing Your Farm Anywhere and Anytime
WAP	Wireless Application Protocol
GPRS	General Packet Radio Service
3G	3 Generation
PDA	Personal Digital Assistant
GSM	Global System for Mobile Communications
POS	Point of Sale
GUI	Graphical User Interface
JTWI	Java Technology for the Wireless Industry
MIDP	Mobile Information Device Profile
MS	Mobile Station
CDMA	Code Division Multiple Access
TDMA	Time Division Multiple Access
ANSI-I36	American National Standards Institute
IP	Internet Protocol
APN	Access Point Name
MMS	Multimedia Messaging Service
HTML	Hypertext Mark-up Language
WML	Wireless Mark-up Language
PoC/PTT	Push to talk over cellular

PRDS	Record-keeping and Decision-support System
GIS	Geographic Information System
FVMIDS	Farm Vehicle Monitoring and Intelligent Dispatching System
FTP	File Transfer Protocol
ECG	Electrocardiography
SIM	Subscribers Identity Module
SMSC	Short Message Service Centre
GPA	Global Positioning System
SDLC	Software Development Life Cycle
MIDP	Mobile Information Device Profile
UML	Unified Modelling Language
PMA	phpMyAdmin

1-0 Introduction

Mobile and wireless technologies are rapidly increasing in the industrial world include agriculture farm. Most of the farmers are having a mobile device, which can enable them to communicate with each other. Mobile device has become an important communication tool. Mobile device nowadays provide many function including voice communication, messaging, and access to any corporate data in anywhere and at anytime. The mobile device enables the farmers able to communicate with the crops and the farm as well. For the real time, this applied if the systems are all properly set up including the interface, the networks and the mobile devices. We are able to set an agriculture world by combining the mobile communication networks, Internet, and agricultural accessing. These combinations sure will enable the mobile device farmers to monitor their farm directly from their devices. Nowadays, wireless device based on mobile access through cellular network and Internet has emerged as a practical and common mean to collect the real time sensor data and information in anywhere and at anytime as compared with computer based web access. The most important, mobile devices should ensure the farmers could access the devices smoothly and receive the information.

1-1 Background

In the 21st century, high speed, high performance, and convenience have become a common demand for each one of us in the fast development social economy environment. So as to existing wired communication technology cannot yet meet the need of getting communication and information at anytime anywhere (Qian, 2003). Moreover, the integration of Internet and wireless communication technique make many applications change from ideal into reality, such as vehicle guiding, remote monitor, wireless Internet, wireless Point of Sale (POS), logistics control, etc. In a word, more and more devices are required to own the ability of wireless communication. (Zeng, 2003)

That is why the agricultural world also has experienced several stages of development. At the primitive stage, which called human agriculture, stage, human was using stoneware for farming. During the traditional agriculture stage, human just

start to invent and produce ironwood tools for farming purpose. We are living in modern agriculture stage where information and knowledge applied in farming activities. For example, modern technologies invented for agricultural monitoring and observing the farm. Currently, concepts such as precision agriculture (De Baerdemaeker, 2001), digital agriculture (Tang, 2002), and agroinformatics start to exist. The application of the Wireless Sensor Network (WSN) (Akyildiz, 2002) is contributing toward the realization of those agriculture concepts.

Agriculture actually includes the growing of crops (including fruits, vegetables, grains, flowers and plants), keeping track of farm animals, dairy farming and cultivating soil. We need to use different parameter in monitoring for different agricultural activities. For the crops, they are very sensitive to weather and climate changes. The production that we manage to harvest during the yield period, productions are influencing by those changes. The farm animals are interrelated with the environment of the farm because any diseases, which strike on particular animals, may spread to whole farm and cause a huge loss to the farmers. For example, the "Bird Flu" that occurred in many Asian countries in 2005 has caused losses of millions of dollars (Reed Business Information, 2005). For the dairy farming, it needs a clean and fresh environment to plant the entire dairy. If minor changes occur, the production of the dairy affected. For farmers, soil cultivation means running a tractor over their field with a plow to break up the soil's surface. Normally, soils under bad conditions may become compacted, the soils loses its structure. Therefore, water and nutrients no longer move through the soil and these affect the roots to grow.

1-2 Problem Statement and Motivation

Crops are the major staple food for the human population in the world. However, farmers are facing many problems when growing all the crops. The problems that the farmers need to face are bad weather, water supply and diseases. Most of the time the crops are facing problem with the extreme climate change. Crops destroyed by the sudden change in temperatures or sudden arrival of rains. There are also flash floods and other natural calamities affect the crop. The heavy rains in the areas are getting unpredictable. Sometimes, the crops also affected by months of rainfall. Therefore,

farmers need to ensure that their crops are in good wealth condition in anywhere and at anytime.

Traditionally, farmers are using their traditional method. They are going down the farm and observe the crops, soils and weather. The farmers are spending plenty of time manage and monitor their farm. Besides, the farmers are spending most the time in taking care of the farm with lots of effort and lastly many man powers used and spent. Some farmers are staying very near their farm in order to have a quick look of their farm condition within the fastest time. Most of the farmers determine those crops, weather and soils humidity depends to their limited knowledge and experiences. Sometimes, it will have some incorrect prediction about the weather and lastly causes a permanent loss for the farmers. The farmers are using traditional way to water the crops and sometimes the water are too much and actually this method is not precisely and inefficient as well. Besides, using traditional method is time consuming where farmer spent many times and may need few days to observe the crops. There are in all probability some of the crops are already lack of water or too much water. Usually, the farmers are facing lots of problem because of late prevention, late observation, late action taken for all the crops and these have cause loss in crops.

Lastly, most of the farmers are lacking of the actual knowledge for handling the crops well and produce a high quality of crops. It is because most of them find it difficult to use the technology for monitoring all the crops. They do not have chance to get the latest information about the crops condition, the weather and get some relevant expert information about how to handle their crops. By using the mobile devices in monitoring, farm information can exists in anywhere and at anytime. We should fully make use of the mobile device in the agricultural monitoring since we need to connect to the database and a real time monitoring done conveniently.

1-3 Objectives

This final year project is proposing a system called mobile based farm accessing in anywhere and at anytime named "Accessing Your Farm Anywhere and Anytime (M-Farm)" which will use mobile technology to solve agricultural information accessing. The system can help farmers to make an agricultural monitoring in anywhere and at anytime by using their mobile devices whenever it is necessary. The system can help the farmers make an observation and actions to take in way that is more efficient.

Furthermore, the aim of this system is providing a professional and accurate solution for the farmers to handle their farm. The mobile Internet can assist the farmers to get better yearly yield and managing the farm when the farm is facing extreme climate change. This application will help to observe and manage the farm and enhance a better and high quality crops.

Here are the objectives of using M-Farm for agricultural monitoring:

1. Allow farmers to access their farm in anywhere and at anytime.
2. Allow farmers to monitor their farm using mobile devices.
3. Provide recommendations to farmers to allow necessary actions taken when the farm is facing extreme climate change.
4. Enable farming information to be stored into a database that allows farmers to access.
5. Create a web based for the farmers to access the farm information.
6. Demonstrate the functional of accessing farm using M-Farm to the farmers.

1-4 Project Scope and Direction

In this system, farmers need to access the pictorial information on farm climate and the information on status by using their own mobile device. Based on the information provided by the user, M-Farm will analyze the result and provide recommendations to farmers to allow necessary actions taken. All the information about the farm conditions provided such as temperature, image of the weather condition, and action taken displayed on farmer's mobile phone automatically when the analyzing process is complete.

Other than that, the mobile device that M-Farm prefers is 3G. 3G networks allow high data rates per packet transmission and allow large transmission of data such as graphics and data. M-Farm implemented using the 3G mobile device as an emulator. The GUI for 3G mobile applications will display both the graphics and data in different GUI interface, which received from the database. Moreover, a database server will be set up for storing the farm data. The mobile devices will enable farmers to access the database of the server to receive the information. This will help the farmers communicate "anywhere and anytime" to know the farm condition. The device used to connect the database in anywhere and at anytime.

1-5 Dissertation Summary

This project is a mobile-based farm accessing in anywhere and at anytime project for "Accessing Your Farm Anywhere and Anytime (M-Farm)". M-Farm is enabling the farmer to know the extreme problems in the farm by the farmers. The problems that the farmers need to face include bad weather, water supply and diseases. Crops destroyed by the sudden change in temperatures or sudden arrival of rains. Therefore, farmers need to ensure that their crops are in good wealth condition in anywhere and at anytime. It will provide us with the methodology, concept and design in M-Farm accessing. This will illustrated through the application of the M-Farm accessing using mobile devices. Since 3G, mobile application technology is fitting for farm accessing, therefore implemented in the project. Actually, 3G networks allow high data rates for packet transmission. Besides, it allows a large transmission of data such as graphics and audios. From the processing system point of view, emphasis laid overall network connection system. A whole network connection system exists because it needs an intelligent processing system. A numbers of wireless sensors deployed in the farm for agricultural monitoring to collect parameters that would affect the growth of the crops. The readings from the sensors collected and sent to a server over the Internet for data processing. The farmers are able to receive the results in real time together with suitable message and recommendations based on the readings of sensors and information that compiled by the server side. For a farmer, raw data are meaningless. Therefore, 3G mobile application must have good graphic or animation presentation design. These graphical interfaces will make the farmers familiar with the system. The interfaces that implemented are using JTWI MIDP 2.0 (Sun Microsystems, Inc.2007). Since the mobile devices have limited screen size during the user display, several considerations need taken during the development of mobile applications. These mobile applications (M-Farm) mainly designed for the farmers. During the GUI interface design, several requirements need taken into consideration:

1. Numerical data presentation has to be minimised
2. Graphical presentation of the agriculture field
3. Status of the agriculture after the analysis of the raw data has been done
4. Recommended actions that need to be taken when facing extreme climate change

Lastly, M-Farm offers an alternative way in the modern farming. We hope it will benefit the farming community with the implementation of this M-Farm in their farm so that farmers can access their farm in anywhere and at anytime.

2-0 Literature Review

Many mobile technologies found in this era. Mobile technologies have become part of the lives for most the people. We take it for granted that we can talk to other people in anywhere and at anytime. We can start to use the mobile technologies to access the information, take photo, recording, sharing information with friends all over the world. With these new technologies, we are in the beginning to experience those high tech technologies without any location specification. The challenge right now to have a high requirement mobile devices and it used for modification and update so that it can be used in accessing farm in anywhere and at anytime.

2-1 Mobile Technologies

The wireless mobile markets are witnessing unexpected growth in term of information explosion and a technology revolution at the start of 21st century. The trend in the radio frequency is moving from narrowband to wideband with a family of standards customized to a multiplicity of application needs. That is why third-generation systems are greatly improving in such efficiency because of the advancement of technology. Now, the trend in the mobile area network is moving from traditional circuit-switched systems to packet-switched programmable networks. Both voice and packet services integrated. Sooner, the mobile area network will evolve toward an all-IP network. Wireless mobile Internet is expected to provide services that can be provided to users in anywhere and at anytime with the wireless mobile allocation technology. The main problem that we are taking into consideration is wireless mobile communications may not overcome the weakness of well-established wire line network. Therefore, it may become a competitor with wire line network in years to come.

This chapter is concentrating in mobile-based farm accessing in anywhere and at anytime project for "Accessing Your Farm Anywhere and Anytime (M-Farm)" which will focus in a few mobile technologies. These technologies, which well known by most of the users. The mobile technologies which are existing such as Global System for Mobile Communications (GSM), Personal Digital Assistant (PDA), Wireless Application Protocol (WAP), General Packet Radio Service (GPRS), and 3

Generation (3G). In this chapter, we are making compare and contrast for a suitable mobile technology to modify and update so that it applied in accessing the farm in anywhere and at anytime. In current state, these technologies has been implemented in home environment monitoring, farm vehicle monitoring, monitoring life function, personalized health care services and video monitoring. GSM and PDA applied in farm monitoring. We will analysis in WAP, GPRS and 3G technologies since these technologies not yet applied in accessing the farm. We will compare advantages and disadvantages, data rate, user friendly, coverage between those three technologies and choose a suitable mobile technology to modify for implementation of the M-Farm. Lastly, the farmers use the M-Farm system when it is developed. Figure 2-1-F1 shows the GSM and PDA to 3G.

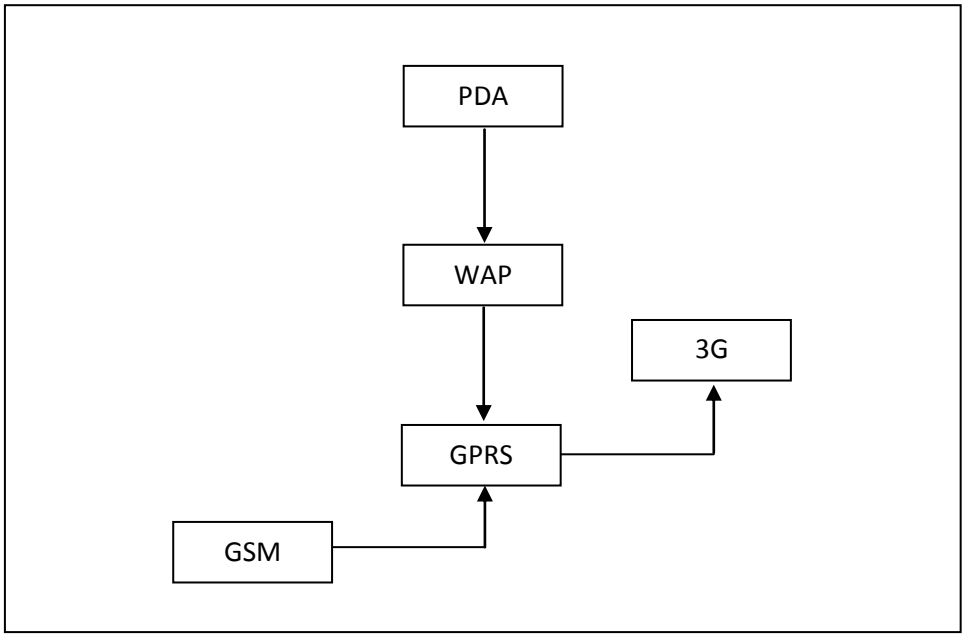

Figure 2-1-F1: GSM and PDA to 3G

2-1-1 Wireless Application Protocol (WAP)

In these few years, wireless positioning has become an important research area. WAP is a potential application, which expanded to be so numerous and location based services. The Mobile Station (MS) users can use the connection through the mobile network. The MS users' life style change after the WAP enables Internet browsing using the MS and the MS users can easily access Internet. This is sure to benefit all the MS users because new set of services developed such as location based information browsing, navigation aid, tracking a MS user, and locating the emergency caller.

Besides, the mobile positioning algorithm can be executed within the MS (without WAP) and the location of MS can be found (Wong, 2000). Normally for a WAP based MS, it is possible to send these required parameters received by the MS to a WAP server to compute the location. For example, the WAP server database easily updated to reflect the changes and the required information for position computation. The information is available to all users if there are some changes in the nearby environment. Before this, the users have to look up a map for details local information because the former approach only returns the coordinates of the MS. After the WAP released, the local information kept in WAP server and the information presented to the users automatically. The positioning using WAP exploited to provide more innovative location related the interactive information services.

WAP is not depending in the specific wireless networks and terminals, so it used in variety of the communication networks and it is possible to connect to wireless network.

2-1-2 General Packet Radio Service (GPRS)

GPRS is a step patch to 3G so it known as 2.5G. GPRS expected profoundly change the mobile data services that GSM, CDMA and TDMA (ANSI-I26) network operators can offer (Usha Communications Technology, 2000). GPRS try hard to increase the chances in income, make renew, differentiated services and dimensions offered in a large passion to increase the data rate transferred. Mobile access with Internet protocol (IP) based services combined together in GPRS. The radio spectrum used efficiently by packet data transmission that will enable high data speeds. The users will feel the bandwidth is increasing, as long as the cost is low and the connection is constant for the send and receive data in text, graphics and video.

GPRS is a packet based data carrier service for wireless communication services that delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. A packet radio principle applied in GPRS to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. The data split into packets that transmitted separately and then reassembles at the receiving end named as packet switching. Now, GPRS support the world's leading packet based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that used mainly in Europe. GPRS also enables any existing IP or X.25 application to operate over a GSM cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet.

GPRS is providing a direct and continuous connection to the Internet almost all the time. This will enable the GPRS users able to log on to an APN (Access Point Name) and have access to many services or an office network (without the need to dial up). The connection will disconnected until the users log off. The payments calculated according to the actual data that are transmitting. Besides, the physical end-to-end connection is not required. When the data transferred, network resources and bandwidth are only used and this makes extremely efficient use of available radio bandwidth. For that reason, GPRS packet based services should cost users less than circuit switched services since communication channels shared. The services provided for dedicated user at a time but the packet used when needed. The mobile users can easily make applications available because the faster data rate means the middleware

currently needed to get used to applications from fixed line rates to the slower speed of wireless systems no longer needed.

GPRS data speeds will be in the range from 14.4 kbps 1 radio timeslot and 115kbps for amalgamating timeslots. Internet for mobile phone and computer users can enjoy the continuous connection offered by GPRS. GPRS allow data speeds likely to average at about 56kbps, with between 28 and 40 kbps initially. Users are allow to take part in video conferences and interact with multimedia web sites and similar applications using mobile handheld devices as well as notebook computers with higher data rates.

In the nutshell, GPRS will promote advanced services that enable mobile operators to combine wireless networks with public and private/corporate networks. GPRS paves the way for migration to 3G that will enable high speed, universal communication services regardless of the terminal.

2-1-3 3 Generation (3G)

First, the third generation of standards of accessibility and speed for mobile devices is referring to "Third generation" 3G technologies. 3G is the next generation mobile device based on GSM that has high-speed mobile system. 3G allows broadband, text, multimedia, packet-based transmission of voice, and video data at rates from 384 kbps to 2 Mbps. Broadband is offering a high speed services which is mainly for the users of 3G. After the users have a 3G, they can access Internet with high speed, video conferencing, and watch basic video/TV services.

3G allows a minimum of 2Mbps or higher for indoor use, 384 kbps for pedestrians and 144 kbps for fast-moving vehicles. In ideal conditions, 3G service provides download speeds of 14.4 Mbps. Upload speeds range around 5.8 Mbps. 3G was developed to deal with the huge consumer demand for mobile network capacity and services. For example, the youth are inspiring with the SMS services full with excitement while they are travelling; users have embraced the benefits of mobility. The main component that 3G provide is mobile-to-mobile voice transfer. During this process, three layers of information sent. The first layer is the actual voice

information. The second layer is a control transmission to keep the quality high. The last layer is basic connection information that prevents dropped calls.

MMS provided in the 3G application and this enables the users to record text messages synchronized with audio and video. Besides the packet, based services are having the billing problem because they need to measure and track the packets used based on time and distance.

Nevertheless, these enhanced service-level strategies are still in development, operators will need to tighten their agreement with infrastructure suppliers to try to distribute the initial costs of their spectrum investment. What the operators concern is about the limitation for the cost of the construction for a new network and the network can supports up to three times the transmission capacity of their existing 2G infrastructure.

Parallel network used for 3G network to support higher capacity. This is sure the 3G network is requiring different base stations and many new and additional sites. For instance, 3G base stations will be co-located with existing lower-capacity GSM base stations, thereby leveraging existing sites, towers and backhaul links.

Besides, microwave radio can be installed to solve interconnect between base stations, commissioned and redeployed easily and quickly, and provides a high degree of flexibility in terms of distance and traffic capacity. By the way, wireless can enable newly licensed operators to self-provide backhaul links. This can be done without depending on leased circuits from competitive and current operators.

There are a number of similarities and differences between Wi-Fi technology and 3G services. Wi-Fi created to allow high-bandwidth data transfer over a short-range transmission for local connectivity to larger networks. 3G networks use large satellite-driven connections that connect to a system of telecommunication towersand and let the range of technolohies is far greater than other technologies.

In the conclusion, we know that 3G supports the needs of a growing mobile workforce, including the typical "road warrior," as well as those working from home, a satellite office, or commuting. Besides, 3G also have extends the office LAN to these mobile workers, providing access to email, corporate networks, and the Internet.

There are many personal-use applications being applied, ranging from "smart" appliances to e-commerce and multimedia applications. In addition, as 3G technology evolves, advanced applications beyond recent applications will keep upgrading during new modification and update made. Table 2-1-T1 shows the comparison technologies between WAP, GPRS and 3G.

Systems / Features	Wireless Application Protocol (WAP)	General packet radio service (GPRS)	3G or 3rd Generation (3G)
User friendly Services	SMS	SMS, MMS	SMS, MMS
Voice Services	Circuit switched, Packet switched	Circuit switched, Packet switched	Packet switched
Data Services	Voice	Voice, Data	Graphics and Audios
Packet Data (Internet Browsing)	WAP gateway, HTML (Hypertext Mark-up Language) or WML (Wireless Mark-up Language) retrieved from host server.	HTML (Hypertext Mark-up Language)	HTML (Hypertext Mark-up Language)
Multicast Service (Group Call-Voice Broadcast)	-	Push to talk over cellular (PoC/PTT)	-
Data rates	14.4kbps Dial up -56kbps	56-115kbps	384kbps-2Mbps
Advantages	✓ Portability ✓ Easy to use ✓ Capable of Internet connectivity ✓ Personalised services	✓ Flexibility to add new functions ✓ High speeds for data	✓ Provide voice data and non-voice data ✓ High speed Internet, ✓ Video conferencing,

	✓ Fast, convenient and efficient ✓ Available in variable form: pager	transactions ✓ Cost effectives ✓ Constant connectivity ✓ Simultaneous voice and data communication	basic video/TV services ✓ Teleconference while on the road. ✓ Mobile staff access to critical applications ✓ Enable access to traffic-view cameras
Disadvantages	Limited graphics presentation, low speed	Slow connection speed and charged by kilobyte for billing Itself does not have mechanism to browse Internet	-

Table 2-1-T1: Comparison Technologies between WAP, GPRS and 3G

2-2 Existing Monitoring Application

Here are some examples of existing monitoring application. These monitoring systems used in the home environment, farmland, forest and human beings as well. Those monitoring application designed and implemented in the actual scenario. These applications help to improve the efficiency, decrease the costs, reduce destructive, etc.

2-2-1 PDA-Based Mobile Robot System with Remote Monitoring for Home Environment

PDA used in the home automation system. The whole idea based on the intelligent robot system architecture, which consists of three layers such as user layer, manager layer, and action layer (Ho, 2009). Users are able to manage and control the robot at the user layer and get visual information via the remote monitoring system. Synchronization is very important condition because the status of the robot should work in real time. Three parts in the manager layer are server part, home appliances part, and storage part. The server part will manage all the status information in the house. For the home appliances part, it will control all appliances and the storage system stores and store all the status information in the house. The main robot system uses a PDA instead of a computer in the action layer. Since the PDA has limited performance, simple algorithms are required. It has an intelligent functional engine for SLAM (Simultaneous Localization and Mapping) and vision processing.

2-2-2 PDA-Based Record Keeping and Decision Support System for Traceability in Cucumber Production

PDA is providing a new way for agricultural information collection. It helps to increase the efficiency in record keeping and decision support using PDA. The PDA based for Record-keeping and Decision-support System (PRDS) for traceability in cucumber production developed on Windows Mobile platform invoking a Geographic Information System (GIS) control (Li, 2010). In order to improve the efficiency and decision making of the PRDS, so the idea of fertilization and pesticide usage model developed. The architecture of PRDS is providing which contains all the classes,

interface and modelling type. Eventually, the PRDS have the functions such as system setup, map management, data management, production record keeping and decision-support and query. Two agriculture production companies are chose to test on the system. The results show that the PRDS has improved the efficiency and it is a user-friendly system.

2-2-3 GSM-Farm Vehicle Monitoring and Intelligent Dispatching System

There are more and more large farms introduce precision agriculture technology in China. Farm Vehicle Monitoring and Intelligent Dispatching System (FVMIDS) for a large farm developed to monitor the large farm, which owns large land and has the most advanced agricultural mechanism in the world (Wu, 2004). The system design and development of FVMIDS based on the principle, method and existing technology of GPS, GIS, GSM and operational research. The system is able to do the following tasks such as vehicle dispatching, vehicle monitoring, vehicle inducing, farming operation analyzing and statistics, means of production dispatching. The system is mainly used to solve the "transportation problem" which is vehicle dispatching. After the system implemented, the system can meet all the requirements of the farm and help to decrease vehicle-dispatching cost largely.

2-2-4 GSM-Remote Monitoring System of Temperature and Humidity

It is important to monitor the temperature and humidity in a high level of observation for obtaining a high quality environment. For the traditional monitoring system in wired has many shortcomings, such as hard wiring, high transmission bit error rate, high costs and small coverage. The introducing of remote monitoring system of temperature and humidity based on GSM (Ding, 2009). Temperature sensor, humidity sensor and GSM communication technology used in the system, which performs data acquisition and transmission, and implements remote monitoring. The system advanced in some fields, such as low transmission bit error rate, low costs and wide range of signal coverage. This system can collect the data regarding the temperature and humidity about the remote side condition. Besides, the system will receive

instructions and upload the real time information between GSM and the monitoring centre station.

2-2-5 GPRS and ZigBee Wireless Sensor Network -Forest Fire Monitoring System

The significance of forest fire monitoring determined by the importance of forest resource and the destructive of forest fire. According to the limitation of traditional forest fire monitoring schemes, a new wireless network implementation scheme oriented to forest fire monitoring presented based on GPRS communication technology and ZigBee technology (Wang, 2010). With the ZigBee network, the forest environmental information collected and transmitted to FTP server using public network IP on the internet through GPRS, network by GPRS module, which controlled by coordinator node. The relative experts and decision maker wait for the information got the data. Later, FTP server is going to implement the achievement of remote data from monitoring region. The right judgement made according to the historical data and real time data. This system is significantly help in forest fire monitoring and reduces the destructive.

2-2-6 WAP-Physiological Monitoring

Mobile technologies and Internet practiced in telemedicine. Telecommunication is the convergence of wireless communication and computer network technologies in the current trend. WAP device is one the technology. In the future standard feature, WAP is a communication device that used in telemedicine. Recently, the implementation and experiences with some of the WAP-based physiological monitoring applications are developed. Wireless Mark-up Language (WML), WML Script, and Perl used to write the system. A database using MySQL used to store blood pressure and heart rate readings, patient records, clinic and hospital information, doctors' appointment with patients, and ECG data. A wireless ECG subsystem built for recording indoor ambulatory ECG and for storing ECG data into the database (Hung, 2001). By the way, the data can retrieve from the database and displayed on the phone. The system

benefices the patient because it can use in patient data retrieval and remote patient monitoring.

2-2-7 WAP-Based Personalised Health Care Services

There is also a new approach in the field of mobile access to web-based health-care services (Eija, 2000). Then, a web-based health-care system designed (Petsas, 2001). It implemented to support not only web-access and used by the mobile devices to access using the WAP protocol. Either the Web or WAP based access tools are able to access to the system. This will enable the modern tools to access the e-health services. From the databases, the medical body can gain information regarding the patients. The medical body can communicate with the patients and know the patients' condition although the patient is staying away from the clinic. This is very useful for a person to update the health information anytime and anywhere.

2-3 Mobile Technologies that related to Agriculture

GSM and PDA are two technologies, which are providing the farm monitoring. These two technologies can enable in monitoring the farm. These applications help to improve the efficiency, decrease the costs, reduce destructive, etc. The GSM can gain access the farm information by the SMS services provided. PDA used for monitoring the growing process and the environment of the greenhouses. Further information elaborated as below:

2-3-1 Global System for Mobile Communications (GSM)

High speed, high performance, and convenience have become a very common demand of people in the 21st century. The existing wired communication technology still is not able to get communication and information at anytime anywhere.

Recently, there are several kinds of communication modes. Communication modes classified into two parts that are wired communication and wireless communication according to transmission medium. In the case of farm information

acquisition, wired measurement mode is suited for fixed measuring points and persistent monitoring. The more the measuring points scatter, the higher the costs of information acquisition. A survey showed that costs for communication in large farmland and data scattered acquisition system were higher than the costs for monitoring (Zhang, 2004). As a result, wired communication is not suitable for the farm to conduct mobile measurement and far away field measurement. It will bring financial problem and many techniques problem in deploying.

There are several reasons that are unique for farm information acquisition.

1. The farmland information is mass and manifold and the measuring coverage is huge.
2. The field works have special needs on data acquisition device, such as power, volume and weight.
3. The system is required to have multi-channel measurement ability together with the possibility to obtain and handle multiplex signal at the same time.

Wireless radio used to solve the problems using traditional method. However, there are still deficiency in acquisition of farmland information, such as the costs of device is high, communication distance is short, using wireless frequency resource, easy to be interfered and etc (Zheng, 2003). In order to receive farm information acquisition of large quantity information, real time and working in field, a combination between the GSM module with farm information acquisition and advanced a new farm information measurement using wireless communication technology namely GSM technology.

GSM or global system for mobile communication is a digital cellular system, which is one of the most important technologies in wireless communication system. Besides the farmland using GSM, many people are using GSM to talk with relatives and friends. The use of GSM is possible due to the SIM **(**Subscribers Identity Module**)** GSM is easy to use, affordable and helps you carry your cell phone everywhere. GSM also named as 2G technology. There are many frequency ranges for GSM however 2G is the most used frequency. GSM offers moderate security. It allows for encryption between the end user and the service base station. The use of various forms of cryptographic modules is part of GSM technology.

The GSM provides three main services such as short message, speech communication and data communication. Because service of short message makes the wireless communication module more popular used, wireless communication module called GSM short message module (Liu, 2003). Always online, no dialling, low price, and large coverage are the characteristics of the GSM short message. For GSM technology, short message service is the only one that need not set up end-to-end channel and provide service when the mobile device is in point-to-point communication. One sentence per each message only can be send by short message service so it is an asynchronous communication. Each message handled as individual time and transmitted by SMSC (Short Message Service Centre) in the GSM system.

GSM system can offer speed of 9.6 kbps data communication service when on-line. GSM short message service is suitable to use for transmitting data in large-scale field measurement system after considering the feature of farm information acquisition and the cost for communication. The short message service are categorize into two forms. One is point-to-point, where the message transmits from one user to another. The second one is plot radio, where the message sent to all registered users by SMSC. Due to point-to-point, short message need not set up specialized communication channel and the cost is cheap, GSM is accepted. This means each short message can transmit 160 coded data of 7 bits or 140 coded data of 8 bits or 70 UNICODE code. Therefore, GSM short message could be used to transmit data and command in measurement and control systems that have low demands in real-time and transmitting speed, so virgin investment for building wireless communication network could be saved (Qiu, 2003).

Traditionally, the measuring device has to connect with a computer, which used to save data and do data processing. This method may cause two problems. One is the farmland is too large and it will took lots of time by carrying the computer from one point to another point. Besides, the computer is large and heavy and the power supply only last for 2-3 hours.

After the GSM technology deployed in the field, the measurement system has become more convenient. The new measuring system could solve the traditional problems that faced. The GSM system directly sends the farm information to the computer. The GSM system includes GPS receiver, moisture sensor, a device that

designed by programming of single chip computer to measure soil moisture sensor and positioning, two GSM wireless communication modules and a computer. The test proves that the measurement system is workable and has advantage of low cost, broad coverage and the data transmission distance is nearly unrestricted. Therefore, it is a very effective way to measure farm information. The system could realize the function of transmitting the farm information to laboratory in the forms of GSM short message, and solved the problem of limitation of information storage and the inconvenience of carrying a data logger device to the farmland.

2-3-2 Personal Digital Assistant (PDA)

In these modern years, the aspiration to connect all electronic computing devices together has increased. It is more convenient and more effective to use wireless links when we need to consider large number of pervasive devices in environment if compare to the wired lines that we are using most of the time in recent days. In order to monitor and control the environments and a management sub-system to manage the WSN (Wireless Sensor Network) and provide various convenient services to consumers with hand held devices in the farmland. PDA technology used in the farming village for observing the growing process and monitors the environment of the greenhouses.

PDA is a handheld device designed to facilitate organizational ability from a mobile platform. At first, the original PDAs were designed rather limited to keeping address, phone, and calendar. Today the PDA can function as a cellular phone, fax, and provide Internet connectivity. There are many different types of PDAs in the market and these PDAs are able to interface with a laptop and desktop system. This digital device has one popular feature that is the synchronization between computer and PDA.

Besides, a PDA might include some other features such as handwriting recognition software, voice recognition, and a digital voice recorder. The PDAs model may offer a suite software programs preinstalled or optional programs if desired. PDA might also have as a feature cellular phone functionality and wireless local area network (LAN) capability. It helps the user to connect to the Internet to check email,

send messages, or observe the farmland. With flash card ability, a PDA can store, access, and transfer virtually any kind of data, including maps, spread sheets, and presentations. A PDA can even function like a mini-computer or helping the user to make those last minute changes while travelling to the office or meeting with clients. If you have leisure time, use your PDA to listen to your favourite music, watch videos, and play games.

` A mobile PDA is a portable, hand-held communication device. Generally, they are small and powered by rechargeable batteries that can last a day or more. Many individuals rely on mobile PDA's on a day-to-day basis for use in both business and personal communication. The combinations of communication functions are very useful and it makes the business decisions to make more easily.

As hard drive technology is constantly improving, it is no longer difficult to find a mobile PDA that can also serve as an audio and video player. In many cases, one can download music and videos from the Internet directly to the mobile device. This wide range of functions reduces the number of devices that one must carry at any given time. There is a variety of other capabilities that a mobile PDA can have which though many are not equipped with these. Some can serve as global positioning systems, or GPAs. Others have significant international capabilities and can be used effectively almost anywhere in the world. There are some other applications. For example, calculators and e-book readers that added.

A mobile PDA does have some limitations because of its size. There is little room for internal components, so small components used. This tends to result in a slow processor, small hard drive, and low memory, limiting the speed and storage capacity of the device. Multi-tasking, in particular, is usually difficult on a PDA because of the speed of the device's processor. These limitations, though, are becoming less and less of an issue as technology improves. Table 2-3-T1 shows the comparison technologies between GSM and PDA.

Features \ Systems	Global System for Mobile (GSM)	Personal Digital Assistant (PDA)
User friendly Services	SMS	-
Voice Services	Circuit switched	-
Data Services	Low to medium speed	-
Packet Data	Internet Browsing	Internet Browsing
Multicast Service	Group Call-Voice Broadcast	Records video Take photo
Data rates	9.6kbps	-
Advantages	✓ Ready used worldwide over millions of subscribers ✓ Availability of Subscriber Identity Modules (SIM)	✓ Portable ✓ Handheld service communication device
Disadvantages	✓ Low data rate	✓ Size limitation

Table 2-3-T1: Comparison Technologies between GSM and PDA

2-4 Selected Mobile Technology for Agriculture

In this project, we consider the requirements, the data rates, the voice services, data services and packet data among the three mobile technologies, which are WAP, GPRS and 3G. The 3G mobile technology is suitable and efficient compare to the WAP and GPRS. 3G mobile is the most modern generation mobile technology. 3G is the mobile technology that we are looking so that we can modify and update. We can use it as a farm accessing mobile technology in current state.

First, 3G networks allow high data rates for packet transmission. It allows transmission of 144kbps in vehicles, 384kbps for pedestrians, and 2Mbps or higher for indoor use. Compare this to rates of 9.6 - 40 kbps for 2G and 2.5G systems. 3G service is providing high-speed access to voice and data technology. It offers advancements on the 1G and 2G networks such as multimedia applications like video and broadband services. This will allow a large transmission of data such as graphics and audios. 3G mobile applications is offering a good graphic or animation presentation design. The 3G mobile device also can surf the Internet with high data rates. The device that we have chosen should be suitable for the farmers in farm accessing. Most people own a 3G mobile device. This make the modification easier since the technology current in the market mostly is 3G.

As a conclusion, 3G is providing all the features that needed in the modification of the mobile devices into M-Farm. WAP and GPRS are not providing the latest features that needed for the farm especially better graphics.

2-5 Summary

The use of communication tools such as the e-mail, bulletin board, and chat line are very important in these days. New technologies such as WAP, GPRS and 3G technologies offer additional tools that allow users access to the internet in anywhere and at anytime, with mobile devices. Comparison made between the new technologies to choose a better technology to modify and implement in farm accessing. Since there are many existing technologies in the home monitoring, health care monitoring, forest monitoring etc. We can have farm monitoring using the mobile devices. It makes the farmer life easier because they can use their mobile devices to monitor their farm.

3-0 Research Methods and Development Tools

In this chapter, we are discussing the methods that we want to implement to modify the mobile devices. Several types of model discussed and a model is chose to use. The development tools that we used in this project listed in the technologies involved. The whole planning for developing this project discussed in the following sub title.

3-1 Research Methodology

In this project, we are going to study, design, develop and utilize the 3G mobile devices into the farm monitoring. In order to make the mobile devices implementation to have a proper planning and development, there are several methods we can use and choose. The Software Development Lifecycle (SLDC) used in developing the model, methodologies and make analysis on the process on creating the systems. Each of the stages of the development lifecycle follows five standards internal processes. These processes set up a pattern of communication and documentation intended to familiarize all participants with the current situation, and thus minimize risk to the current project plan. This generic stage description provided to avoid repetitive description of these internal processes in each of the following software lifecycle stage. The five standard processes are Kickoff, Informal iteration, Formal iteration, In-stage assessment, and Stage exit. Figure 3-1-F1 shows the SDLC Stage.

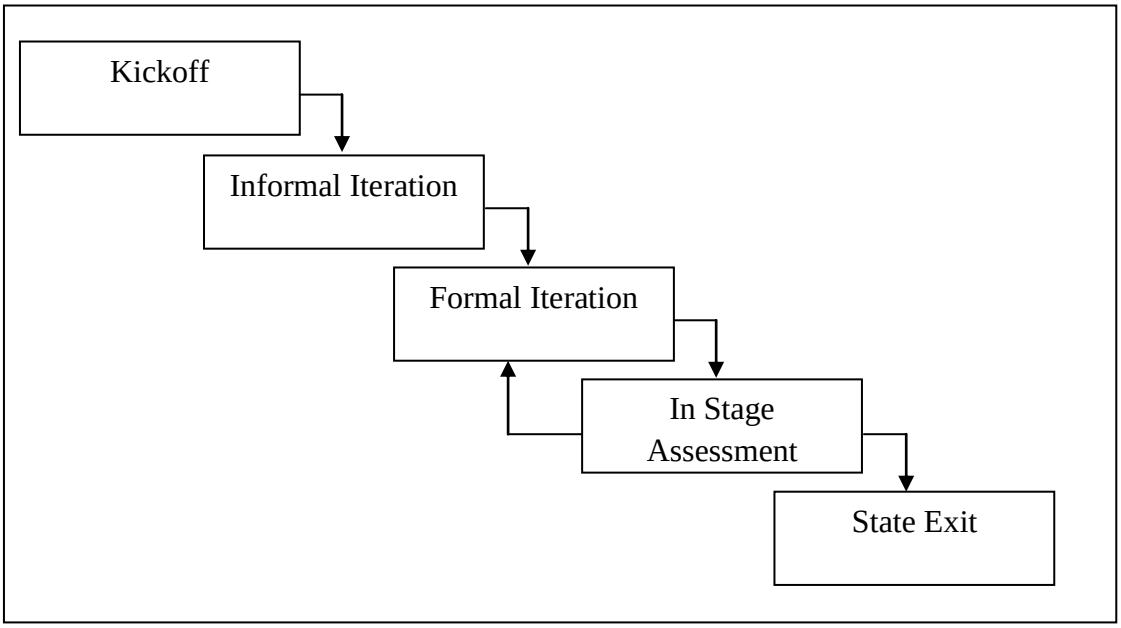

Figure 3-1-F1: SDLC Stage

3-2 System Development Life Cycle

The SDLC relates to models or methodologies that people use to develop systems, generally computer systems. Note: the acronym sometimes thought of to represent SDLC and sometimes the process or model simply referred to as the SLC. Computer systems have become more complex and usually (especially with the advent of Service-Oriented Architecture) link multiple traditional systems often supplied by different software vendors. To handle this, a number of SDLC models created such as waterfall, rapid prototyping, and V Shaped Model.

SDLC remains the important phases that are essential for developers, such as planning, analysis, design, and implementation, and are better explain in the section below. The oldest model is the waterfall model, which originated from "SDLC": a sequence of stages in which the output of each stage becomes the input for the next. These stages generally follow the same basic steps but many different waterfall methodologies give the steps different names and the number of steps seems to vary between 4 and 7.

There is not a definitive correct model, but the steps characterized and divided as follows:

• Project planning, feasibility study, Initiation: To generate a high-level view of the intended project and determine the goals of the project. The feasibility study sometimes used to present the project to upper management in an attempt to gain funding. Projects typically evaluated in three areas of feasibility: economical, operational, and technical.

• Requirements gathering and Systems Analysis: The goal of systems analysis is to find out where the problem is in attempt to fix the system. This step involves breaking down the system in different pieces and drawing diagrams to analyze the situation. Analyses project goals, breaking down functions that need to create, and attempts to engage users so that definite requirements defined.

• Systems design: Functions and operations are describing in detail, including screen layouts, business rules, process diagrams and other documentation. The output of this stage will be to describe the new system as a collection of modules or subsystems.

• Implementation: Modular and subsystem programming code accomplished during this stage. This stage is intermingling with the next in that individual modules will need testing before integration to the main project.

• Testing: The code tested at various levels. Unit, system and user acceptance testing performed. This is a very grey area, as many different opinions exist as to what the stages of testing are and how much if any iteration occurs. Iteration is not generally part of the Waterfall model, but usually some occurs at this stage.

• Installation, Implementation or Deployment: The final stage of a project or the initial development, where the software put into production and is used by the actual business.

(A2Z.net One Stop @ Solution, 2008)

3-2-1 System Development Life Cycle Models

There are three models discussed in this section such as Waterfall development methodology, Prototyping model and V-model and a selection chosen to use in this project.

3-3 Waterfall Model

The oldest model and which is well known SDLC model. It is very simple to use and understand. Each phase completed in order for the next phase to begin. A review done to determine the project is on the right path. Compare and contrast of the method listed in Table 3-3-T1 and Figure 3-3-F1 show the waterfall methodology (Ragunath, 2010).

Advantages	Disadvantages
Simple and easy to use	Adjusting scope during the life cycle can kill a project
Easy to manage due to the rigidity of the model – each phase has specific deliverables and a review process	No working software is produced until late during the life cycle
Phases are processed and completed one at a time	High amounts of risk and uncertainty
Works well for smaller projects where requirements are very well understood	Poor model for complex and object-oriented projects
-	Poor model for long and ongoing projects
-	Poor model where requirements are at a moderate to high risk of changing

Table 3-3-T1: Advantages and Disadvantages of Waterfall Model

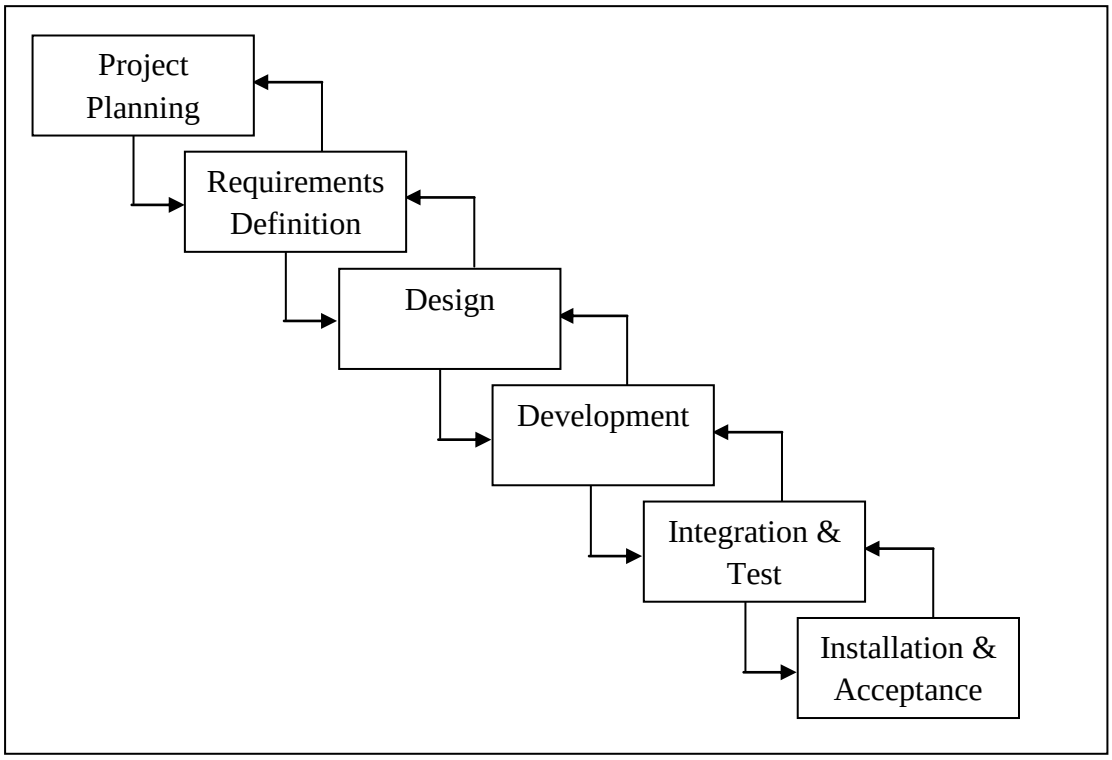

Figure 3-3-F1: SDLC Waterfall Methodology

3-4 Prototyping Model

Prototyping is usually can be changed during the project proceeds and new changes added in. The analysis, design, testing and implementation phases perform concurrently the system prototype that will be review. This prototyping model will start with the requirements gathering. The users and developer will define the objectives and the further acknowledgement. The clients often have the general view of what is expect from the system and no details consideration about the system. This model can reflect the flexibility of the development process. Table 3-4-T1 and Figure 3-4-F1 show the prototyping model and the advantages and disadvantages of the model.

Advantages	Disadvantages
Serve as the first system	Users believe the prototype as working version
No need to wait long time	Developer could make the implementation compromises where he could make quick fix on the prototype as a working version
Feedback from the users won't be so surprise	Users expect that few changes to the prototype is more sufficient to the system

Table 3-4-T1: Advantages and Disadvantages of Prototyping Model

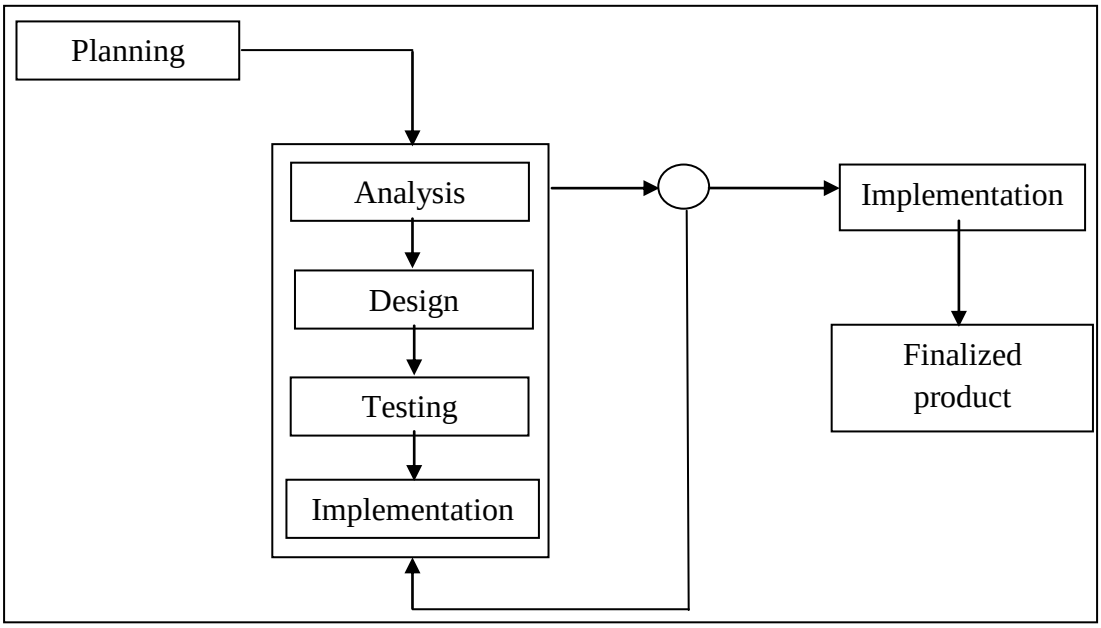

Figure 3-4-F1: SDLC Prototyping Model

3-5 V Model

The Verification and Validation model commonly known as V Model considered an extension of the Waterfall model. The waterfall model is well-structured method in which the different phases progress in a sequential or linear way. Each phase begins only after the completion of the previous phase. Table 3-5-T1 shows the diagram of it model and Figure 3-5-F1 shows the advantage and disadvantage of V model (Ragunath, 2010).

Advantages	Disadvantages
Use in simple and easy.	Very rigid, like the waterfall model
Each phase has specific deliverable	Little flexibility and adjusting scope is difficult and expensive.
Higher chance of success over the waterfall model due to the development of test plans early on during the life cycle	Software developed during the implementation phase, so no early prototypes of the software produced.
Works well for small projects where requirements are easily understood	Model doesn't provide a clear path for problems found during testing phases

Table 3-5-T1: Advantages and Disadvantages of the V Model

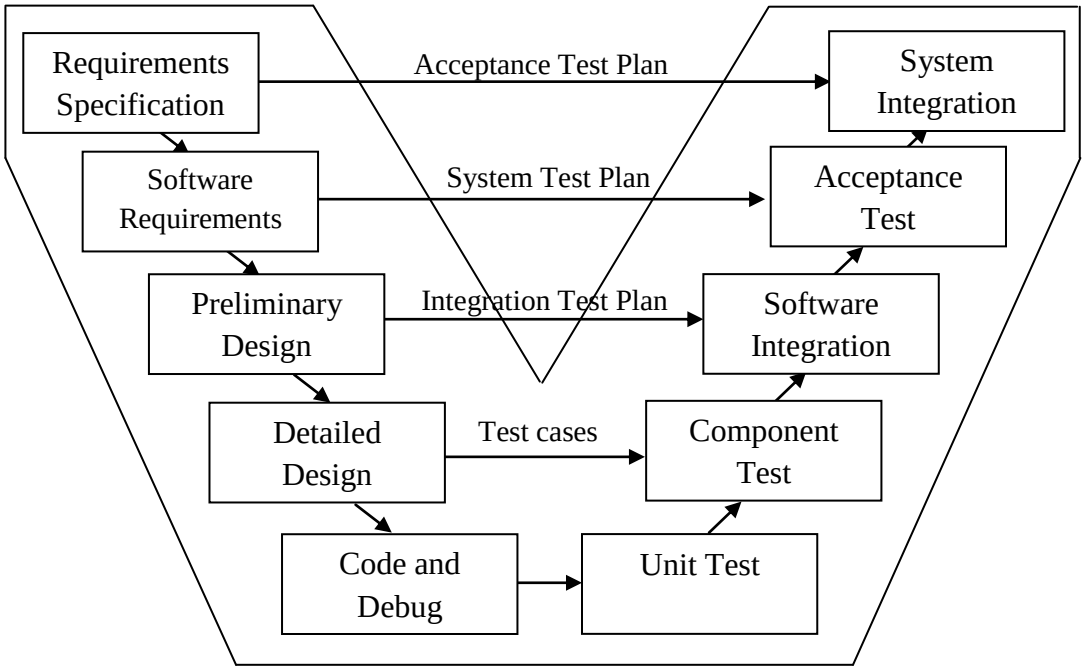

Figure 3-5-F1: SDLC V Model

3-6 Project Design of the Relevant SDLC Model

After review and compare among the model, the combination between the waterfall model and prototyping model is suitable for the development of this project. The disadvantages of the prototyping are eliminating by the advantages of the waterfall model. With the combination, the system development allowed to plan the resources and the efforts required in the development and no need to continue with the poor model. Figure 3-6-F1 shows the diagram of the waterfall and prototyping model.

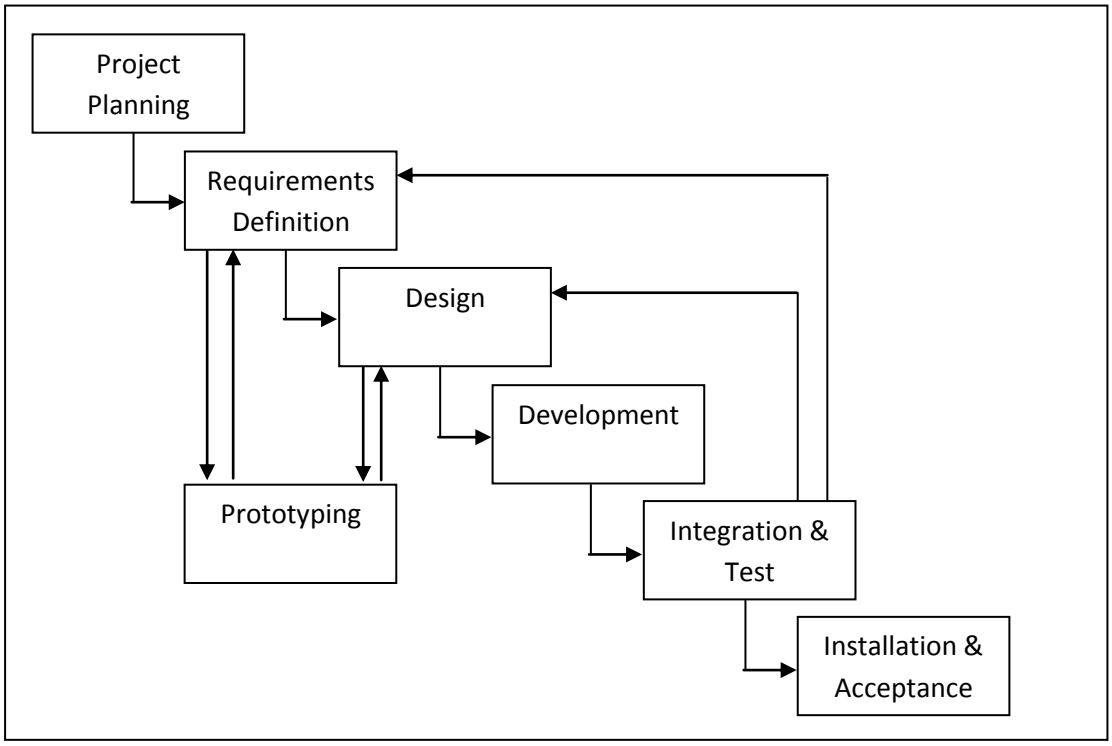

Figure 3-6-F1: Hybrid of Waterfall and Prototyping Model

3-7 Technologies Involved

3-7-1 Hardware Specification

In order to develop and test the developed system, the minimum requirements needed:

- A personal computer with the minimum requirements:
  Processor: 2.0 GHz Pentium III+
  Disk Space: At least 150GB of free disk space
  RAM: 1.0 GB of available physical RAM
- GSM modem
  2.5G
- Cisco Switch and Router
- Network cables
  Cross cable Cat-5 or Cat-6
  Straight through cable Cat-5 or Cat-6

3-7-2 Software Specification

Several software that used during system development process, which are:

- Microsoft Window Server 2003
- Microsoft SQL Server 2008
- Wireless Toolkit 2.5.2 (Emulator)
  Target Platform: Java Technology for the Wireless Industry (JTWI)
  Profiles: Mobile Information Device Profile (MIDP) 2.0
  Configurations: Connected Limited Device Configuration (CLDC) 1.1
  Required: Wireless Messaging API 1.1 (Java Specification Request 120)
  Optional: Mobile Media API (Java Specification Request 135)
  Required: MIDLet-Vesion 1.0

3-8 Project Activities and Milestones

This project starts with articles review on the journal and articles. Then, identify the problem statements, which will help to understand the whole project well. Collect all the sufficient information such as journals and articles written by experts the entire world is very crucial to the start of the project. The project plan defined as the following:

- Project purpose
- Project goals and objectives
- Scope and expectations
- Roles and responsibilities
- Assumptions and constraints
- Ground rules for the project
- Cost and Budget
- Project timeline
- The conceptual design of modification technology

The project will ensure that the end users be able to use the mobile devices. The goals and objectives also need define the budget and the time parameter to finish. The project will introduce the modified mobile devices, which used to access the database to get the information. The project should not beyond the scope that defined. The devices roles and responsibilities should remain the objectives that have been set. The projects may face some technical issues to solve and the project is progress is too slow from the schedule. The project should start right away as soon as possible since the time given to finish the project is limited. This project given a semester (12 weeks) to implement and the milestones used as a guideline for the progress of the project. The management allocates the cost and budget and all the networking stuffs used borrowed from the management. The most important is to get familiar with concept of this project in order to have the whole idea on how to implement the technology. All the planning planned according to the SDLC. First, decide the planning should go ahead or terminate. If the project plan has been proceed, budget estimations and future steps taken into consideration. Then, gathers the required information about the system and design and analysis for the modification system.

Take into consideration about what the programs needed, how the interface going to look like, what data are required in the design. The hardware and software that are used defined. In the implementation phase, the designs translated into code. Mobile device program are wrote using the programming language and the programming tools act as a compiler, interpreters and debuggers. The right programming language implemented and used. During the testing, the whole system tested to ensure the interfaces are working. The system is fulfilling the users' requirements. The system installed and used for connecting the database for receiving the information. The milestones of this project will be shown in Table 3-8-T1 and Table 3-8-T2.

Project Activities	**Jun,2010**				**Jul,2010**				**Aug,2010**				**Sept,2010**				**Oct,2010**			
Gather information & research on the articles and journals	■	■	■	■																
Identify development tools and write project 1 report				■	■	■	■	■	■	■										
Familiarize with the development tools														■	■	■	■	■	■	■
Modification and testing the 3G and setting up the network																				
Validation and Verification																				

Table 3-8-T1: Accessing Your Farm Anywhere and Anytime Project Milestones

Project Activities	Nov,2010				Dec,2010				Jan,2011				Feb,2011				Mac,2011			
Gather information & research on the articles and journals																				
Identify development tools and write project 1 report																				
Familiarize with the development tools																				
Modification and testing the 3G and setting up the network																				
Validation and Verification																				

Table 3-8-T2: Accessing Your Farm Anywhere and Anytime Project Milestones

The schedule is an important timeline for a project. It is a deadline for the project to be finished and enable the project designer to finish the work in the as stated in the milestones. This will enable the milestones become a checklist for the designer in order to carry out duty as schedule.

3-9 Project Design

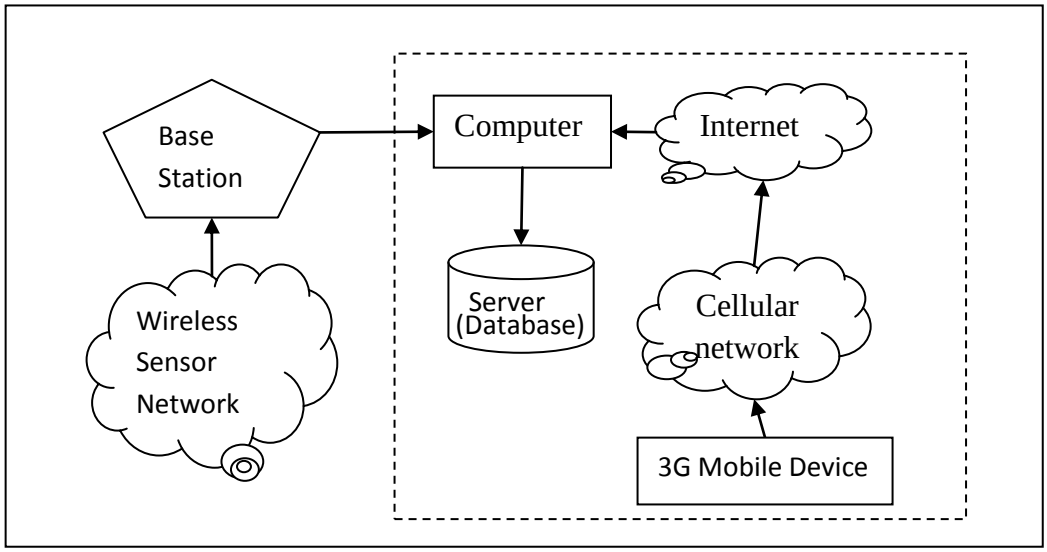

Figure 3-9-F1: Project Design

In this project design, it is showing the whole idea of the project. The "Accessing Your Farm Anywhere and Anytime" will be start up from the server to the 3G Mobile device and connect to the Wireless Sensor Network. The mobile device used to connect to the cellular network and through the Internet to access the database to get the information about the farm condition. From the Figure 3-9-F1, it shows that the WSN is sending the raw data to the base station. Then, the raw data sent to server for data processing. Result sent out to the farmers' mobile devices together will the information.

3-10 Summary

SDLC is a good model for implementing in the project because the whole idea and the process flow are inside the model. The model enables the designer to understand the whole idea of the project and the time taken to handle the project estimated. The main problem that we may face in this project is time constraint and a proper planning is required. This will enable the timetable is tightly followed so that the project do manage to finish in time.

4-0 System Analysis and Design

This chapter outlines the functional system and system requirements specification and describes the system's scenarios using UML diagrams (use cases, activity, class, and collaboration where appropriate). All the structure and design of the system will be design according to structure and the needs of M-Farm. The justifications and description about the system architecture solution and the design of each part of the system deployed.

4-1 Functional System and System Requirements Specification

Functional System defines what function does a system have or its component should perform. Functional System supported by System Requirements Specification that defines how the function performed. For example, System Requirements Specification imposed by quality requirements on the implementation or design.

4-2 Functional System Specification

1. The system provides network login username and password for the user to access M-Farm.
2. The system provides two type of accessing farm method, which is search by Graphical M-Farm and Numerical M-Farm.
3. User can access the farm condition based on the different node number, which deployed in the farm.
4. The system will list out all the farm condition, the status and advice given.
5. Action is taken listed when the farm condition having extreme climate change.
6. The system provides the graphical feature which enable user to see the farm condition through the camera deployed in the farm.
7. The system should provide the farm information.
8. User can retrieve information from database on mobile device using application installed.
9. User can access the farm using mobile device.
10. User can view date and time of each captured data.

4-3 System Requirement Specification

4-3-1 Efficiency Requirements

Type of speed	Requirements
Response time	• The system must respond directly after the user finish enters the network username and password in order to go into the system. • The system must respond directly after the user finish enters the node number of the sensor node. • The response time should not more than 5 seconds.
Refresh time	• The refreshing rate must be fast after each change in the database done. • The refresh time is done every 5 seconds.
Processing time	• The processing process must be fast so that the user no needs to wait so long time for the respond.

Table 4-3-T1: Efficiency Requirements

4-3-2 Applicability Requirements

- ✓ The system is user friendly so that user does not take long time to learn how to use the system.
- ✓ The system provides all the tickers, which will guide the user.
- ✓ The system must be simple and equipped with the function needed.
- ✓ The system can enable the user to connect to the Internet by accessing the farm anywhere and anytime to the farm condition.
- ✓ The interface of the M-Farm kept as simple and neat as possible.

4-3-3 Security Requirements

- ✓ The information of the farm condition can only change and updated by the administrator of the system.
- ✓ Only the administrator can give the professional advice and action taken for the farmer to take immediate action for the farm.
- ✓ The system must secure from unauthorized access, meaning that parts of the system should be available to users who has a valid network username and password.
- ✓ The network login username and password, which are stored in database, cannot expose to others.

4-3-4 Reliability Requirements

- ✓ The system must provide the most recently information regarding the farm condition to ensure the consistency of the result. The information will be updated, if the farm condition having climate change.
- ✓ The system can update all the node number information which have climate change and the information will be updated from time to time when it is necessary
- ✓ The rate of failure of the system is low as it can update the information from time to time

4-3-5 Robustness Requirements

- ✓ Time to recover after the failure of the system will be around 1-2 minutes.
- ✓ After that, the system can continue to operate as usual.

4-4 Unified Modeling Language (UML)

UML is a standardized general purpose modeling language in the field of software engineering. UML is a tool-supported modeling language, tools are readily available to support the application of the language to specify, visualize, construct, and document systems (Sinan, 2011).

There are some important diagrams are:

1. The Use Case Diagram: How the systems interact with the outside world/user

2. The Class Diagram: What objects do we need and how they be related

3. Activity Diagram: How the activities carried out

4. Collaboration Diagram: How the objects interact

4-4-1 Use Case Diagrams

Administrator is able to login the MySQL database named phpMyAdmin (PMA). PMA is a tool that will help to administer database. Administrator creates a database to view the data, insert, create and delete the database information. Figure 4-4-F1 shows the administrator node data use case.

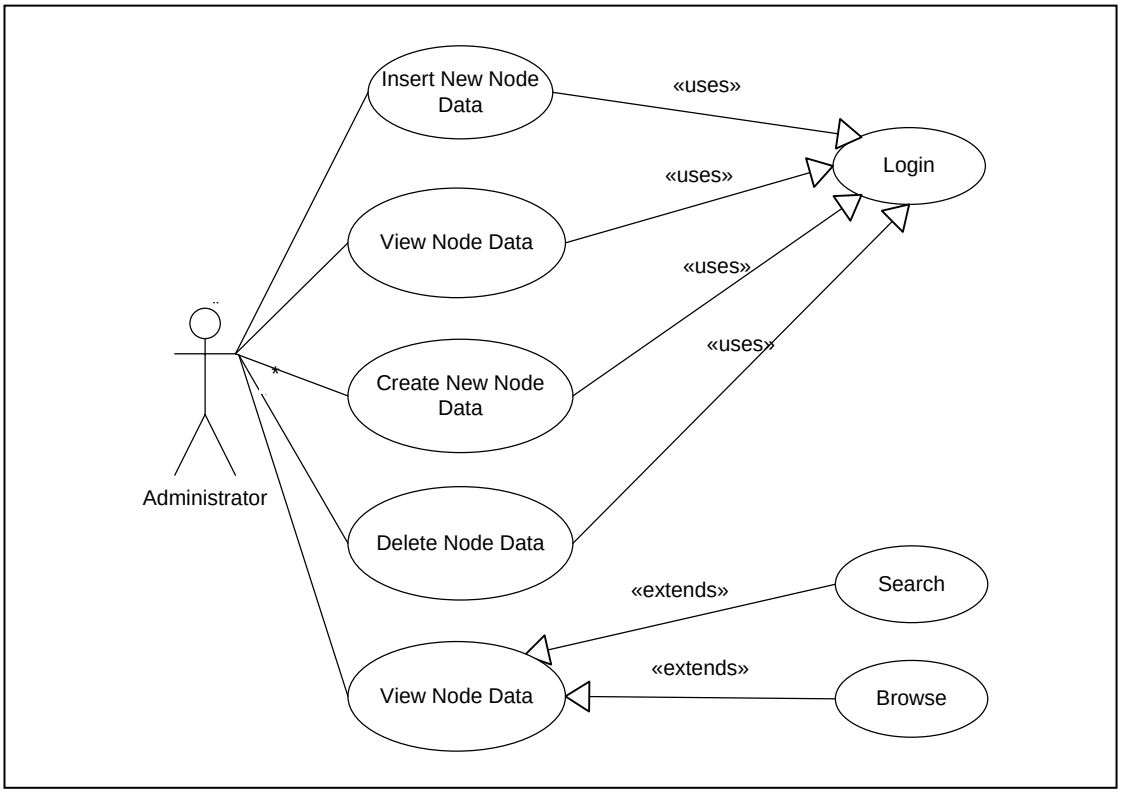

Figure 4-4-F1: Administrator Node Data Use Case

1. Administrator is able to login the database PMA to view the users, add and delete username and password. Figure 4-4-F2 shows the administrator users use case.

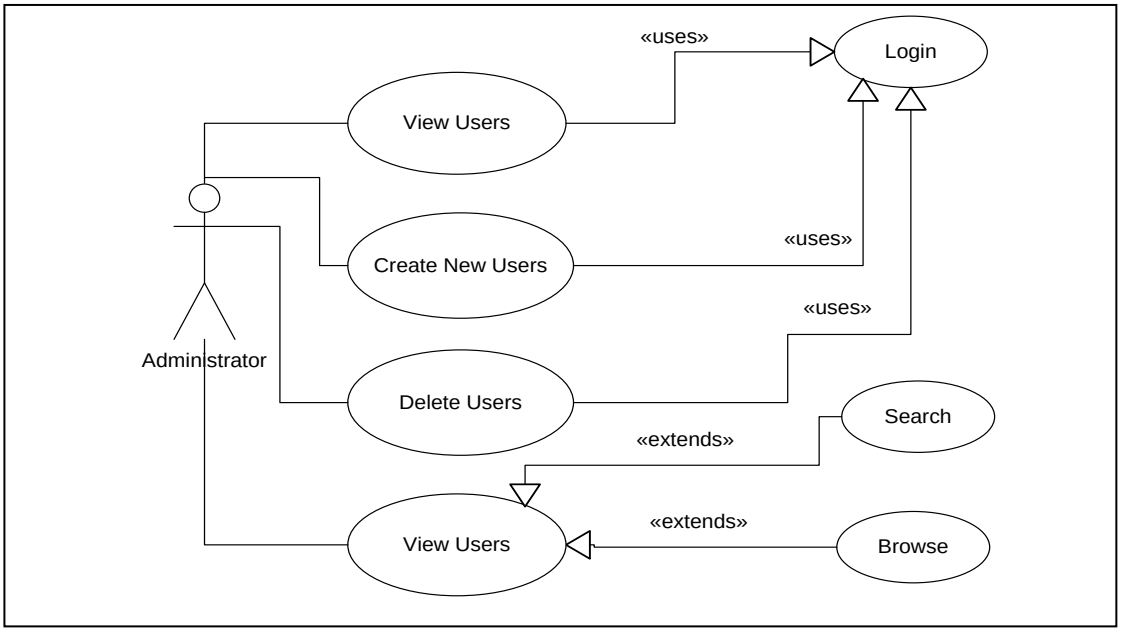

Figure 4-4-F2: Administrator Users Use Case

2. Administrator is able to login the Web based FTP client (FTP server) to view the PHP information and the way the user select the information from the database. Figure 4-4-F3 shows the administrator web based FTP use case.

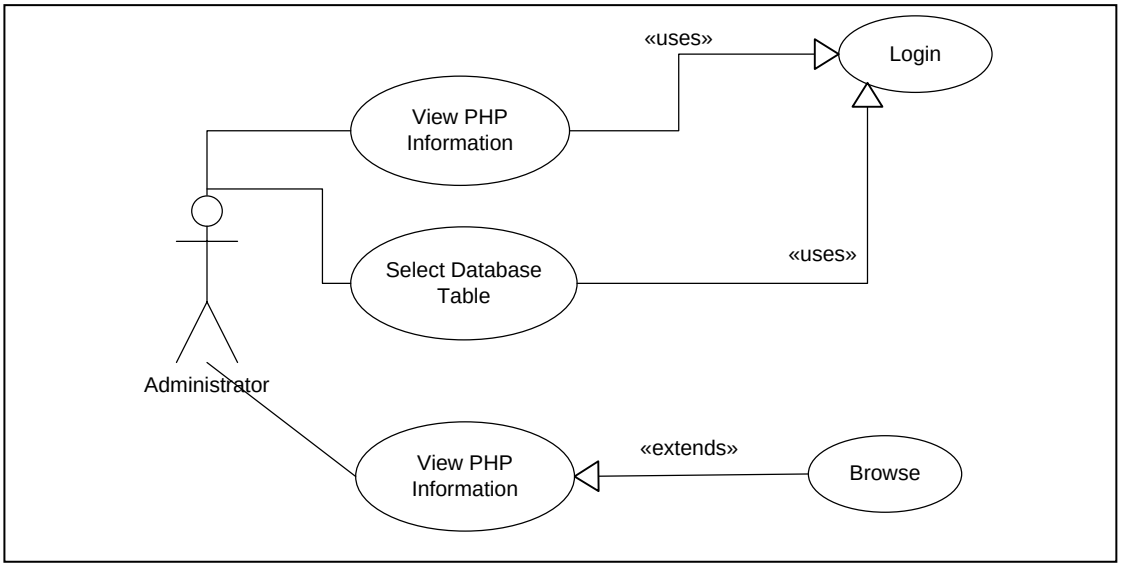

Figure 4-4-F3: Administrator Web based FTP Use Case

3. Web based FTP client system is the interface which can view by the administrator for the design and creation of the database table. It may link to mobile-based application for user to access the farm. Hence, the mobile can retrieve the information from the database as in Figure 4-4-F4.

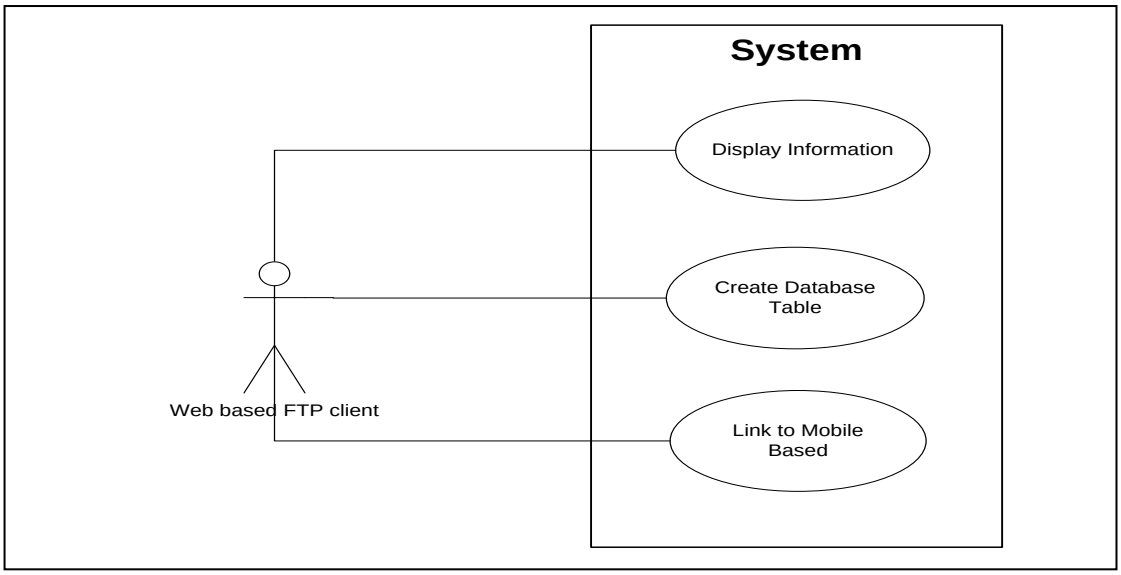

Figure 4-4-F4: Web based FTP Client Use Case

4. Mobile Application System is able to interface with PHP and select the farm information from the PMA database. The design of the M-Farm is enable the user to login into the network, browse and search farm information in Figure 4-4-F5.

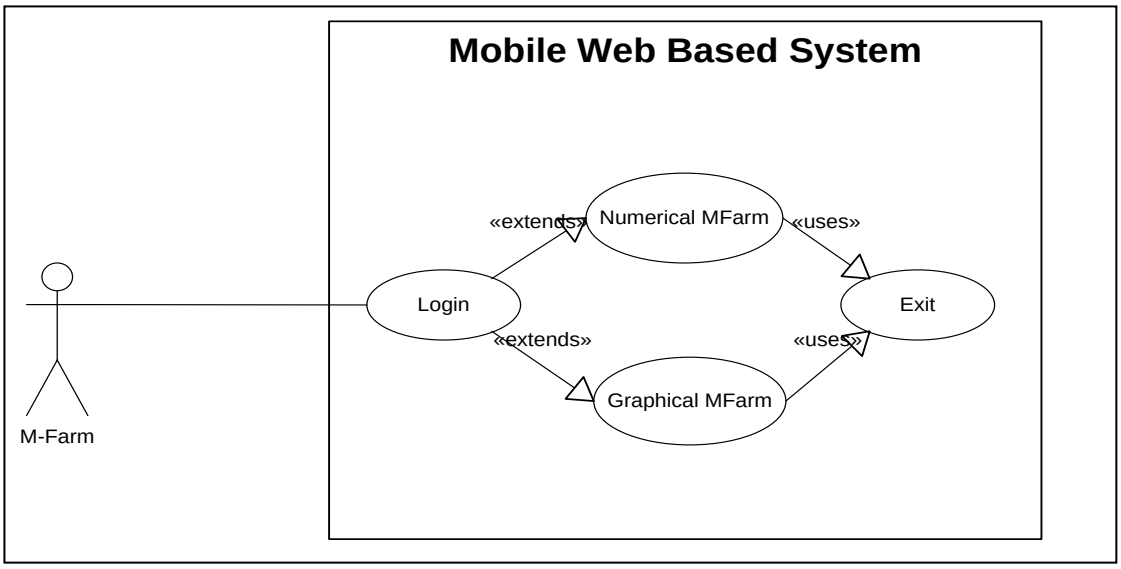

Figure 4-4-F5: Mobile Application System Use Case

4-4-2 Class Diagrams

The structures of the classes are the class of the java program for the JTWI of the mobile device project and the database entities are shown in Figure 4-4-F6.

1. The main program of the mobile application in the JTWI

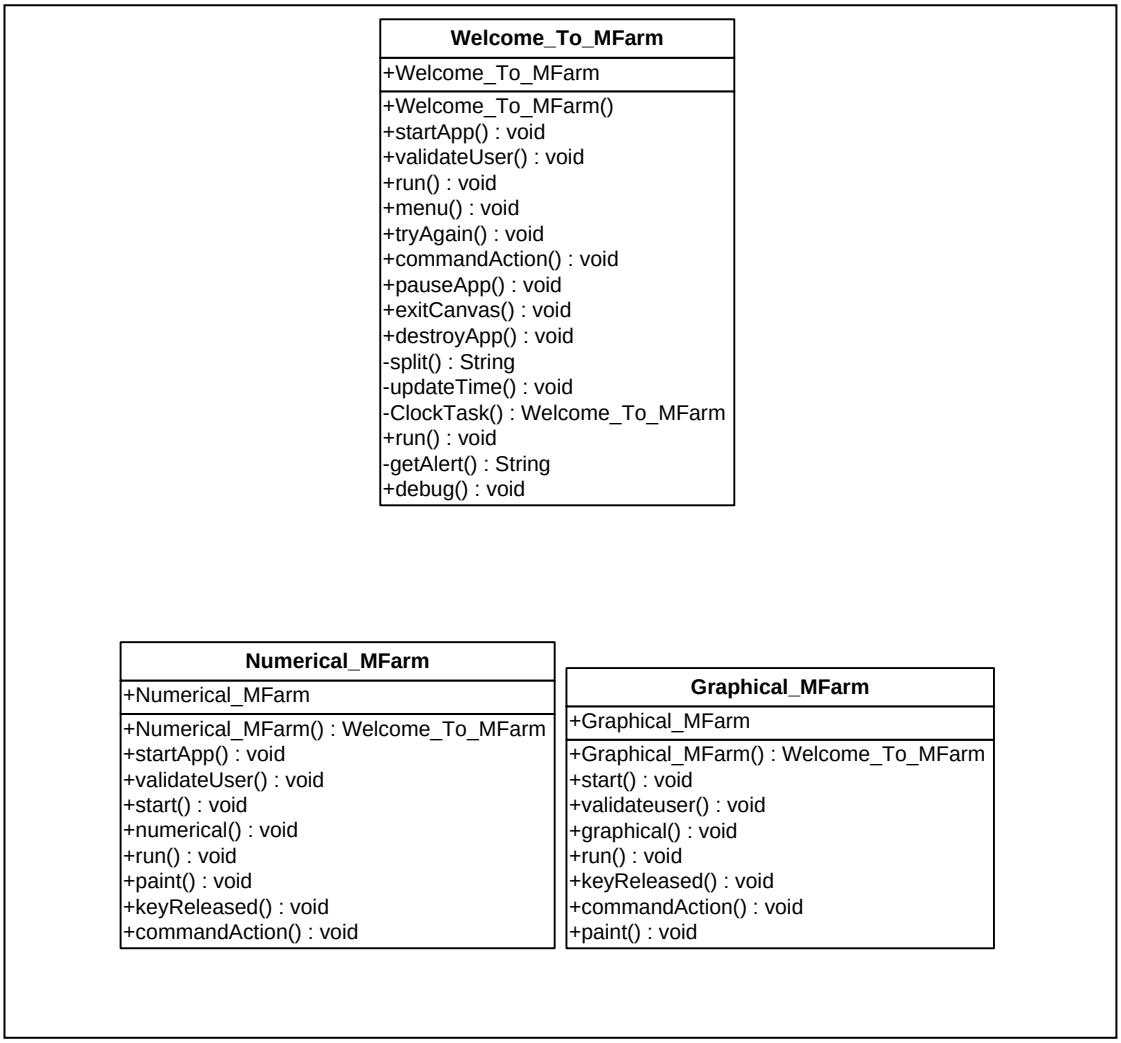

Figure 4-4-F6: Main Program Class of the Mobile Application in the JTWI

1. The database entities in the PMA are shown in Figure 4-4-F7.

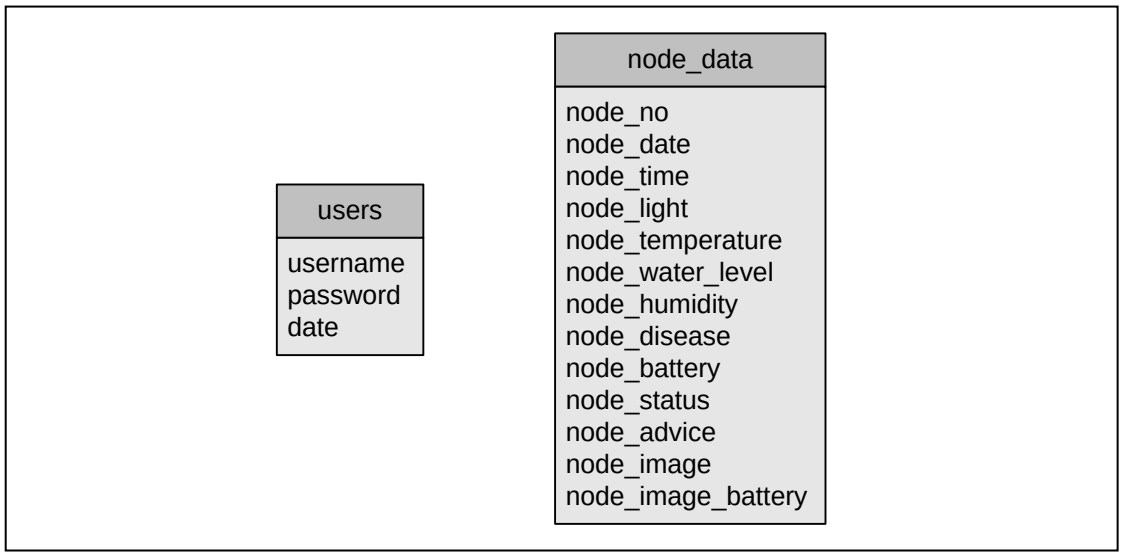

Figure 4-4-F7: Database Entities in the PMA

4-4-3 Activity Diagrams

1. Administrator Activity is shown in Figure 4-4-F8.

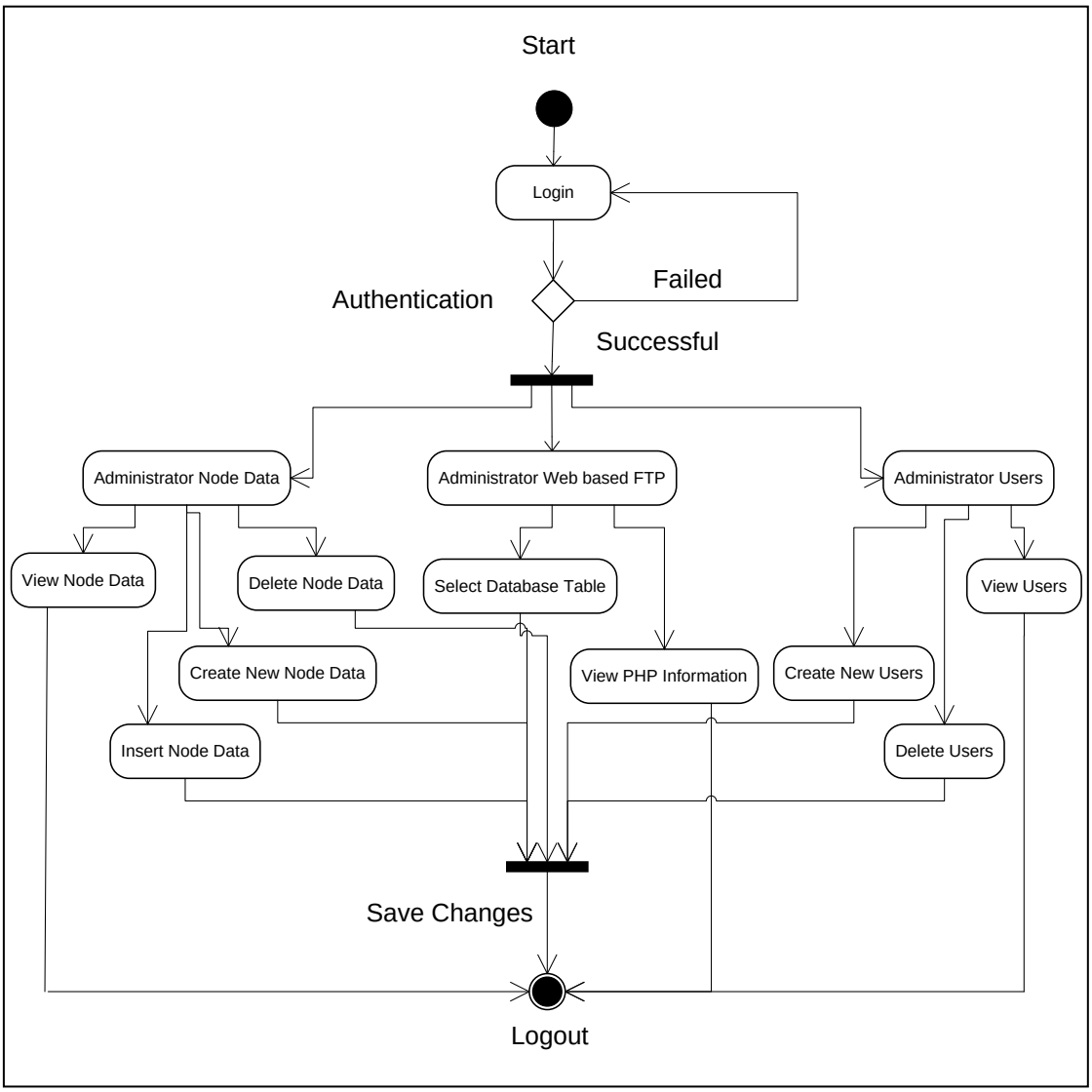

Figure 4-4-F8: Administrator Activity

2. Web based FTP client system is shown in Figure 4-4-F9.

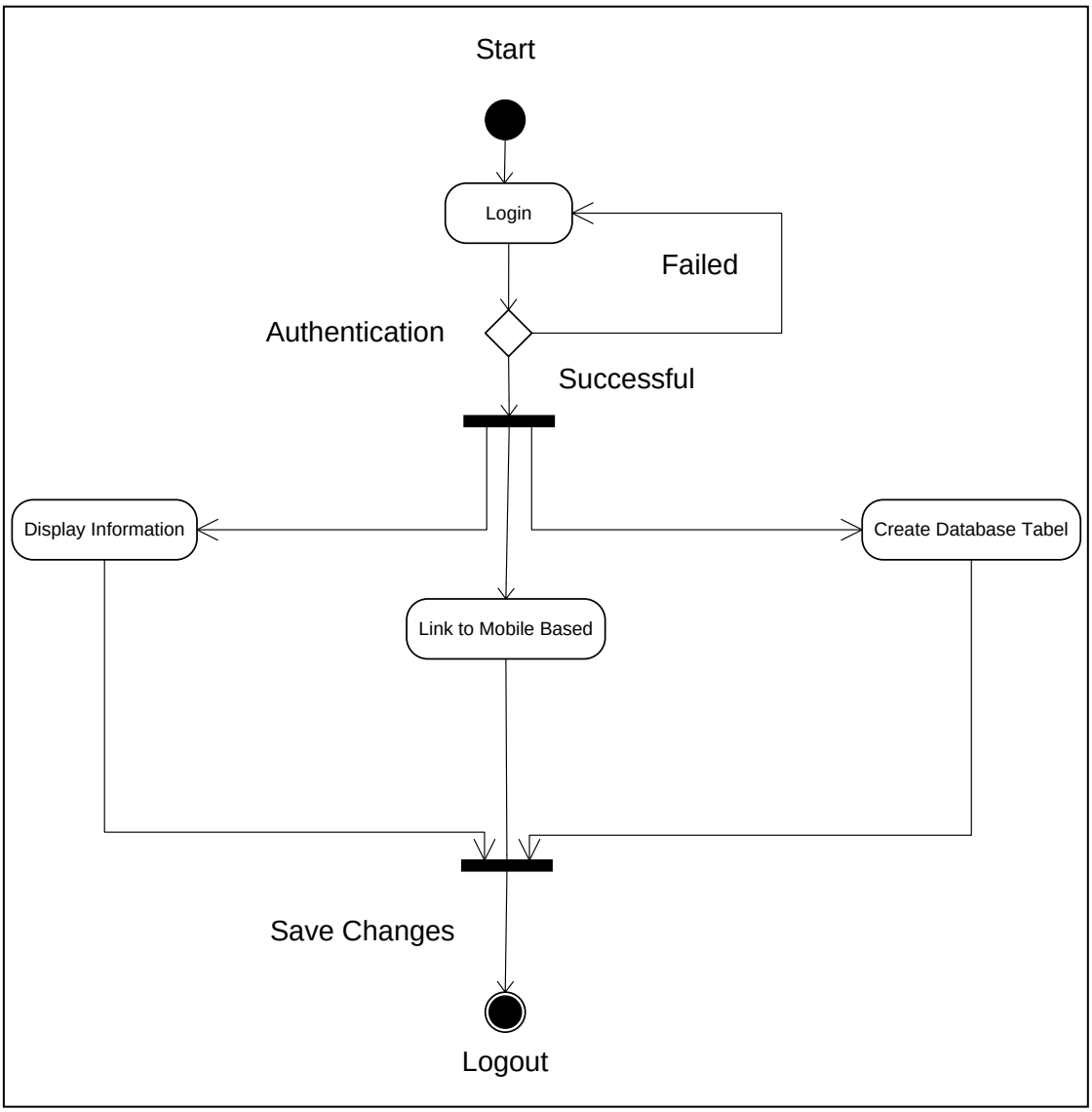

Figure 4-4-F9: Web based FTP Client System

3. Mobile Application System is shown in Figure 4-4-F10.

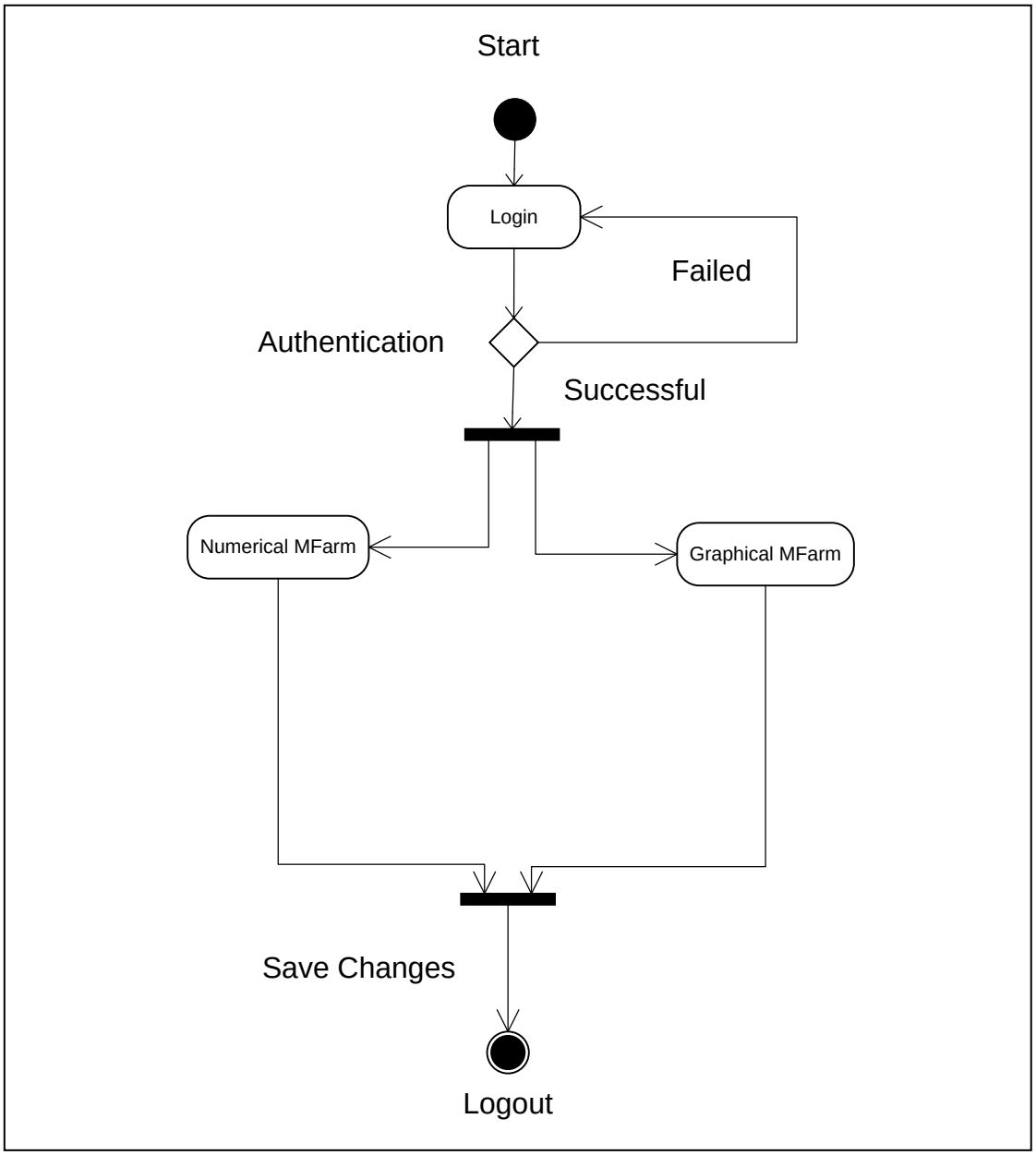

Figure 4-4-F10: Mobile Application System

4-4-4 Collaboration Diagrams

1. User Login shown in Figure 4-4-F11.

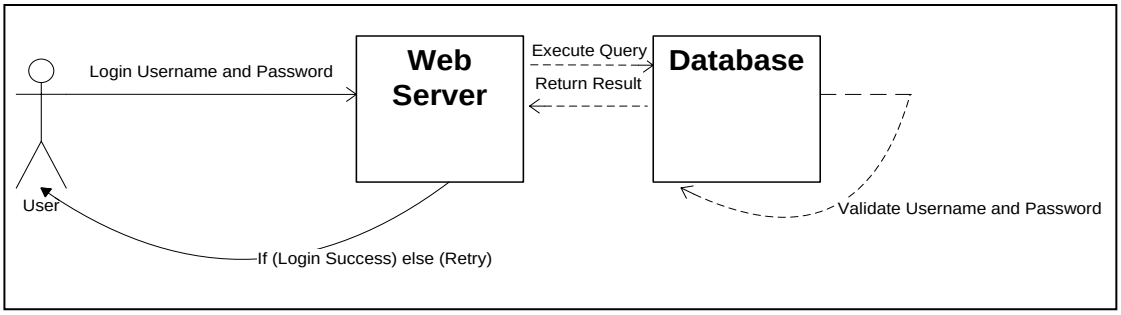

Figure 4-4-F11: User Login Collaboration

2. Option selection for Numerical M-Farm and Graphical M-Farm shown in Figure 4-4-F12.

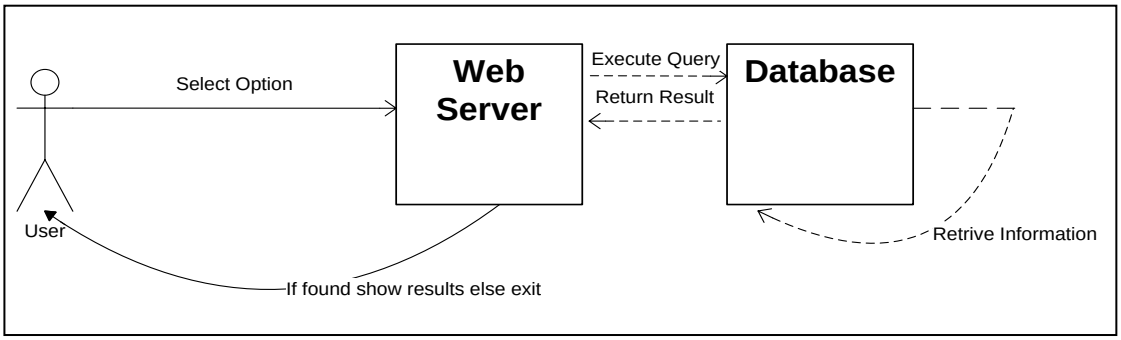

Figure 4-4-F12: Option Selection Collaboration

3. Administrator to access the database and the web server shown in Figure 4-4-F13.

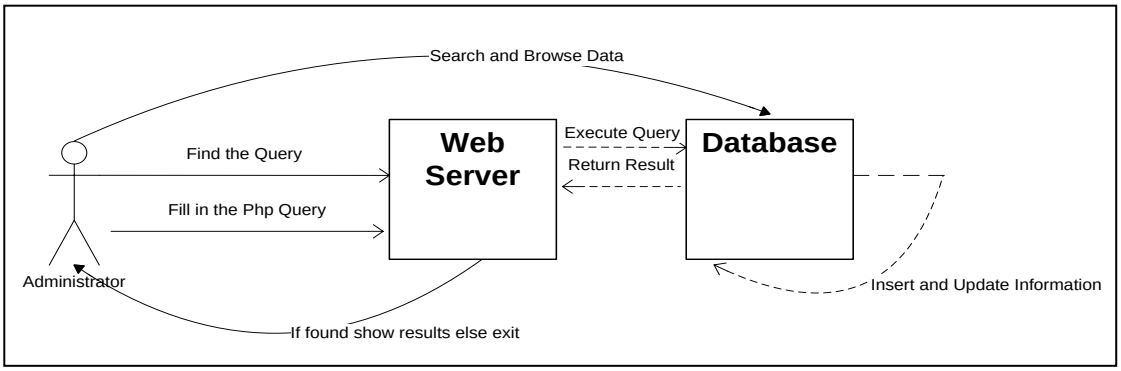

Figure 4-4-F13: Admin Access Collaboration

4-5 Structure of the M-Farm System

The M-Farm mobile application based on the idea that farmers need to monitor the farm in anywhere and at anytime and provide a fast and accurate farm accessing system that can help the farmer.

4-5-1 Knowledge Base

The knowledge base also called as the memory of the information and it will match with the information in the database. It contains the domain knowledge which will provide the information for the farmer to access the farm data with the knowledge which representing the farm condition.

4-5-2 Database

The database is a storage, which includes a set of raw data, which used to match against the data (node number and the user information provided). This will enable the system to provide the correct information for the system during the farm accessing.

4-5-3 Advice Facilities

The facility is able to explain the system come with the status of the farm and the action taken if the farm is facing extreme climate change. The farm needs to give the advice and some information to the farmer.

4-5-4 User Interface

The user interface is the mechanism that the user and the system communicate. It is the interfaces where an end user seeks information about the farm condition by enter the farm login system and check the farm condition by entering the appropriate username and password and the node number into the system. This will enable the farmer to access the information regarding the farm at anywhere and anytime.

4-5-5 External Interface

The external interface allows the system to work with external data files and programs written in other languages. The system will communicate with PHP web server and PMA database.

4-6 M-Farm Architecture

In this part, there are some important topic such as knowledge representation and inner part design for "Accessing Your Farm Anywhere and Anytime (M-Farm)". The inner part of the program discussed in this part. Figure 4-6-F1 shows the architecture of M-Farm.

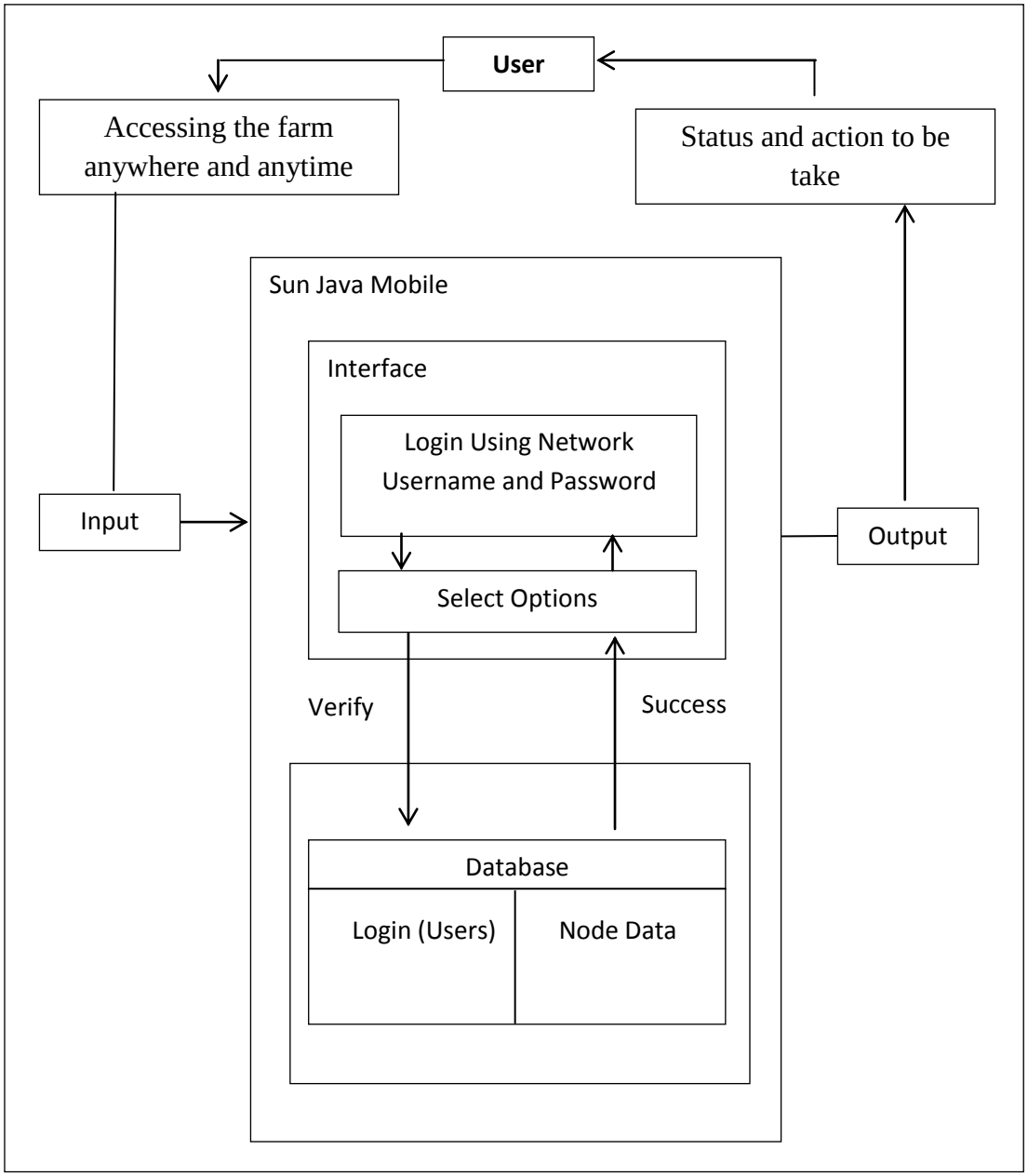

Figure 4-6-F1:

Architecture of "Accessing Your Farm Anywhere and Anytime (M-Farm)"

4-7 Farm Accessing Work Flow

Farm accessing is an important part in this system, M-Farm. The farmer will able accessing farm anywhere and anytime to access the farm condition, water level, temperature, humidity and observe the farm condition and the status of the farm is stated and action taken is given to the farmer as a reference to reduce the loss in the farm. The farmer needs to include the node number of the sensors which are deployed in the farm. With the information gathered, the system will return with result after the accessing. Work flow of Farm Accessing in Figure 4-7-F1.

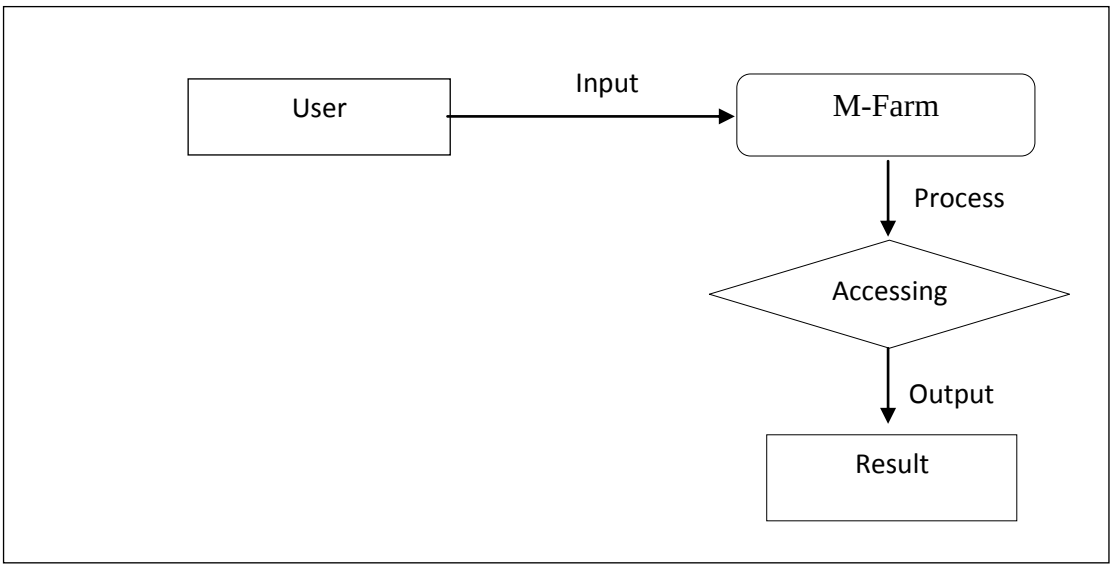

Figure 4-7-F1: Work Flow of Farm Accessing

4-8 Explanation and Suggestions

All the explanation and suggestions are given. The farm condition listed in the result and the suggestion given to the farmer. The detail includes the status of the farm and suggestions for the farm condition in Figure 4-8-F1.

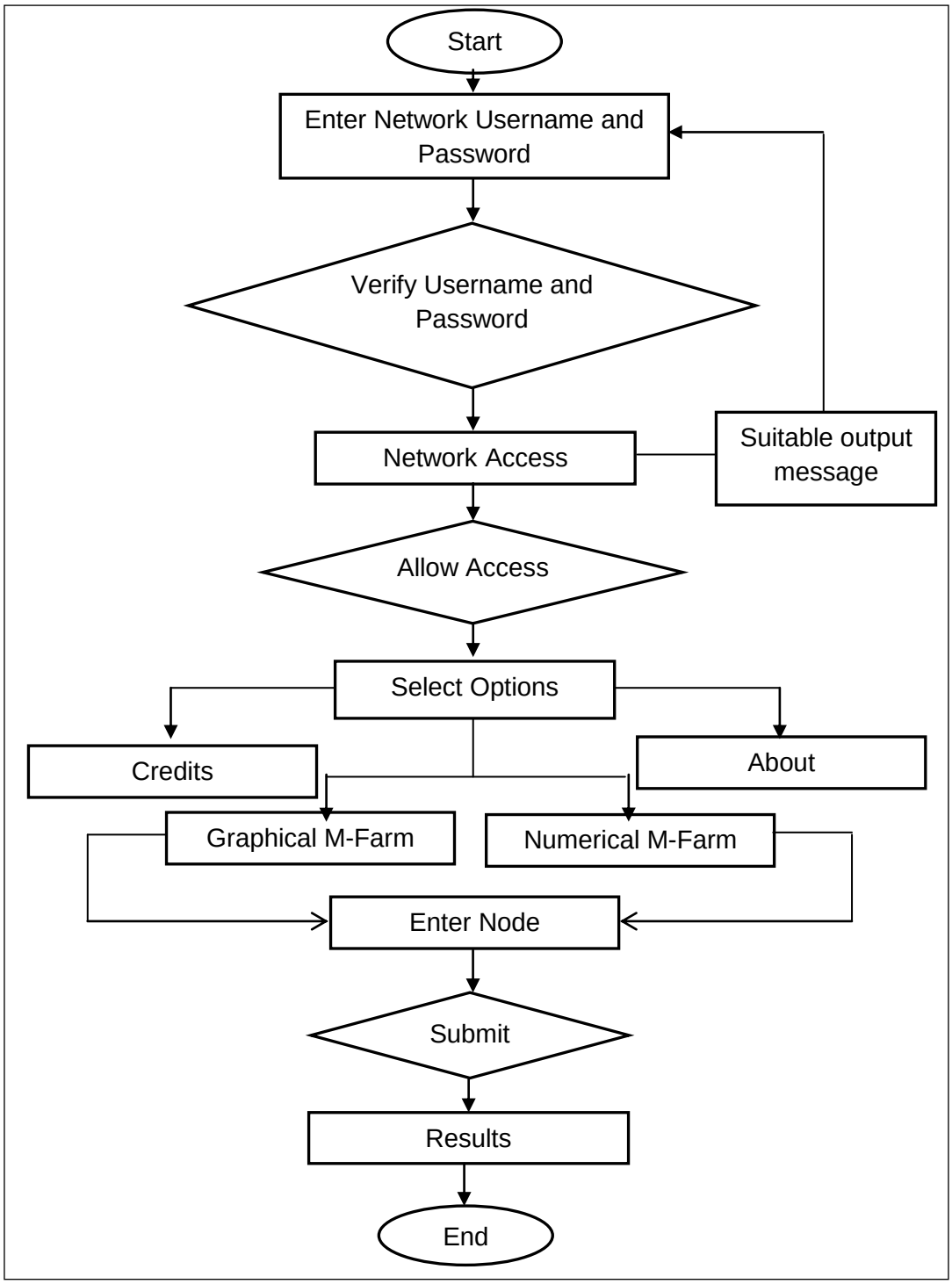

Figure 4-8-F1:

"Accessing Your Farm Anywhere and Anytime (M-Farm)"

4-9 Overall Process Flow of the M-Farm

The design phase for M-Farm system will go through several stages, which begin with knowledge acquisition until the very last stage, maintenance. The Figure 4-9-F1 is showing the flow chart of design in M-Farm. Knowledge in an M-Farm system are derive from many sources, such as books, reading documents, case studies, databases and human experts which based on personal experiences. In this system, knowledge acquired from journals and several websites from Internet.

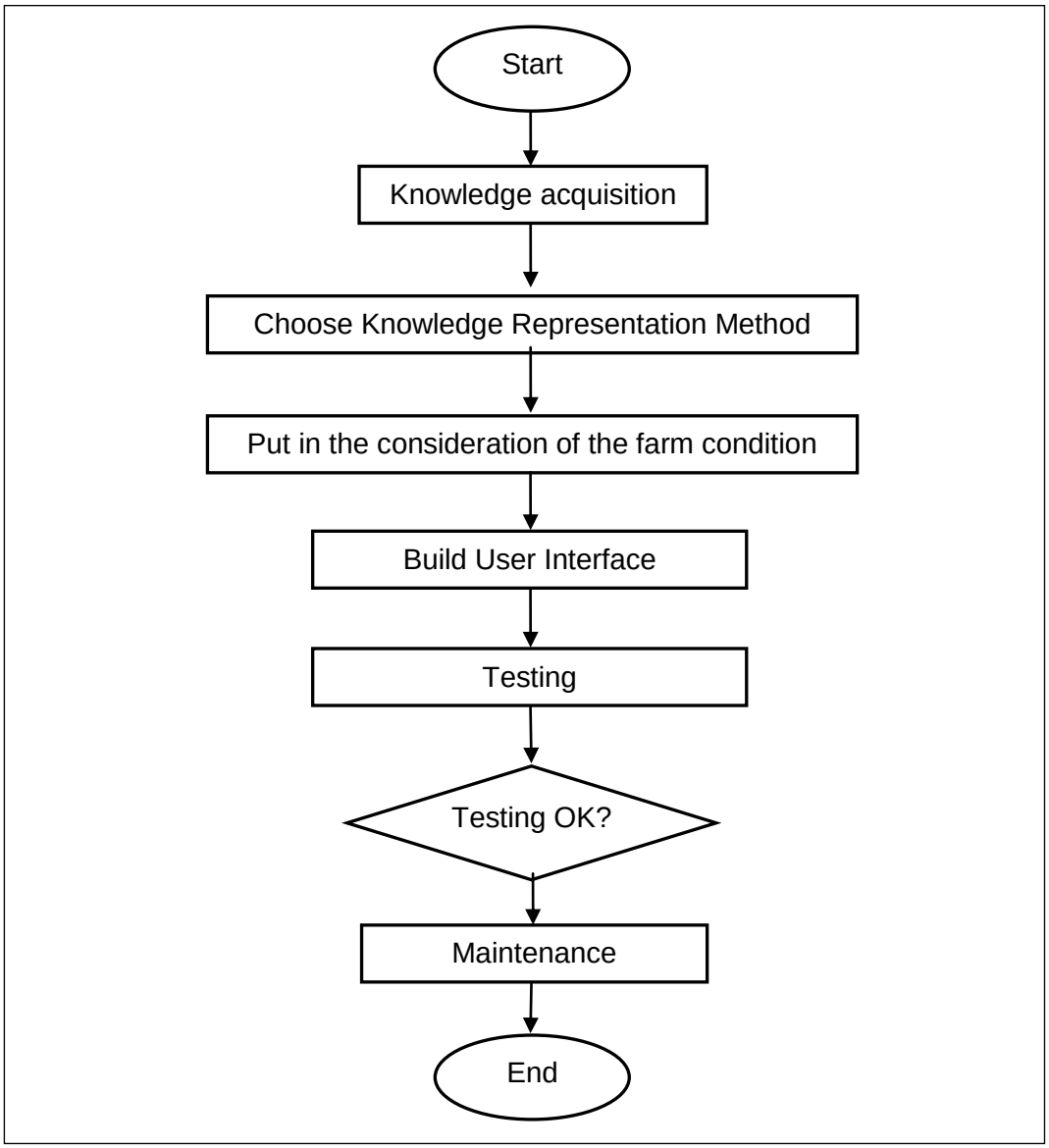

Figure 4-9-F1: Overall Process Flow of the M-Farm

5-0 Implementation Database to Mobile Devices

For this chapter, all the implementation from the database to the mobile devices will be elaborated. All the setting up and all the steps need to do are explain briefly in this chapter. This will enable the all the development part to be clear and precise.

5-1 Implementation of the MySQL Database

In this chapter, we are implementing the whole project by setting up a MySQL database which is named phpMyAdmin (PMA). The administrator needs to register a valid free subdomain hosting on the Internet with the valid username and password. For example, the mfarm.orgfree.com was successfully activated on orgfree.com server. The address is http://mfarm.orgfree.com and we can visit or update the site. After we have hosted on orgfree.com server, Account Manager is located at http://orgfree.freewebhostingarea.com/. The database is set up by registering a free hosting on the Internet. Then, the administrator will be able to get a limited number of free databases per account registered. For a better view of the MySQL databases, the account manager must be activated by hitting a “Create DB” button. The MySQL host name is for “localhost” only and there are no external connections are allowed. The PMA is located at the URL which is registered.

In order to login to the database, login is required. A username and password are being requested by http://orgfree.freewebhostingarea.com. The site says: "phpMyAdmin localhost". The username and password for the database to login is the name of the database. For example, 378307 is the name of the database. The password is the password which is registered during the account registration. The authentication for database is shown in Figure 5-1-F1. In the database that we have created, we can add the table to store the data and let the user to retrieve. In the project, two tables are added which are node_data and users which is show in Figure 5-2-F2. After the node_data and users are created, click on the node_data or users to add in the structure. The structures are requiring the administrator input the field data which will be retrieved by the users. The Figure 5-1-F3 and Figure 5-1-F4 show the information store in database which belongs to users and node_data.

The Table 5-1-T1 and Table 5-1-T2 below are showing the structure of the database which is implemented for this project. In the Table 5-1-T1 and Table 5-1-T2, they are showing the field and the type used in developing the node_data table.

Field	Type
node_no	varchar(30)
node_date	date
node_time	time
node_light	int(100)
node_temperature	varchar(30)
node_water_level	varchar(30)
node_humidity	varchar(30)
node_disease	text
node_battery	int(11)
node_status	text
node_advice	text

Table 5-1-T1: Node_data Database Structure

Field	Type
username	varchar(30)
password	varchar(30)
date	date

Table 5-1-T2: Users Database Structure

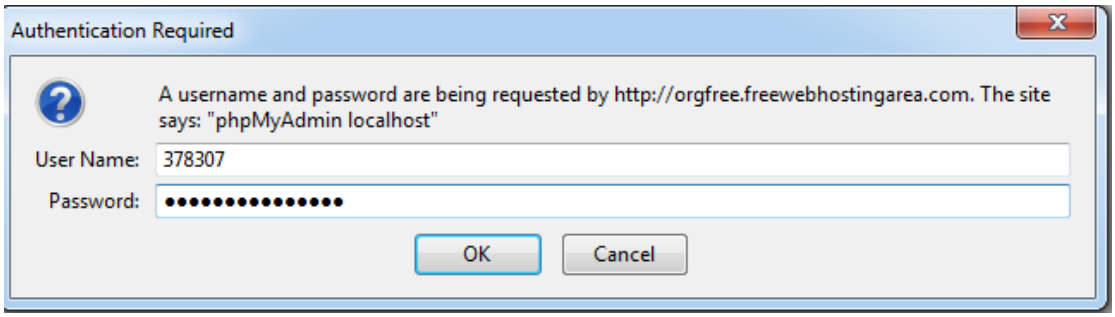

Figure 5-1-F1: The Authentication Required

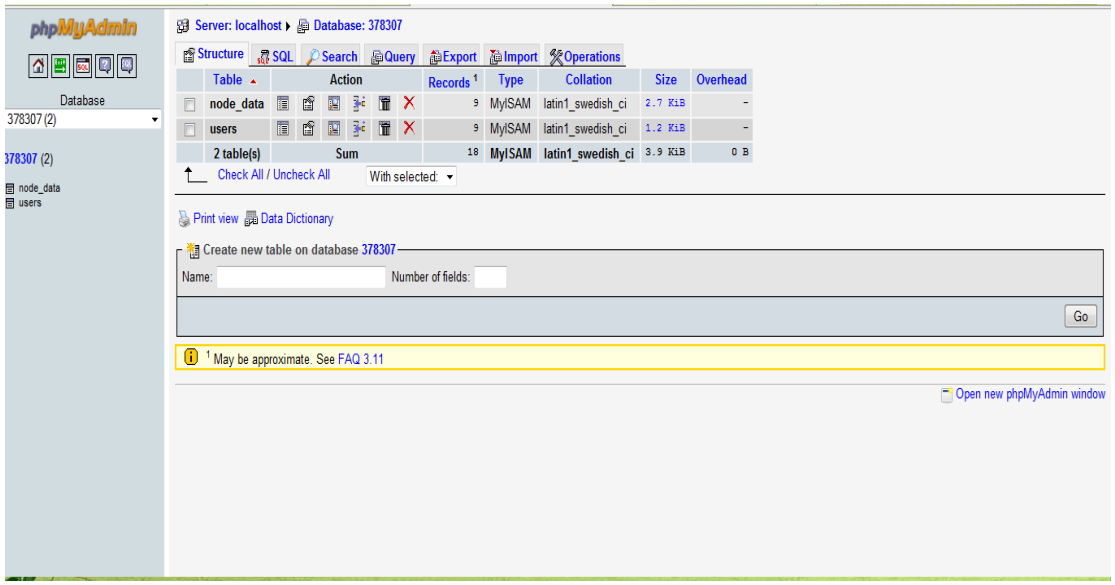

Figure 5-1-F2: Database Table

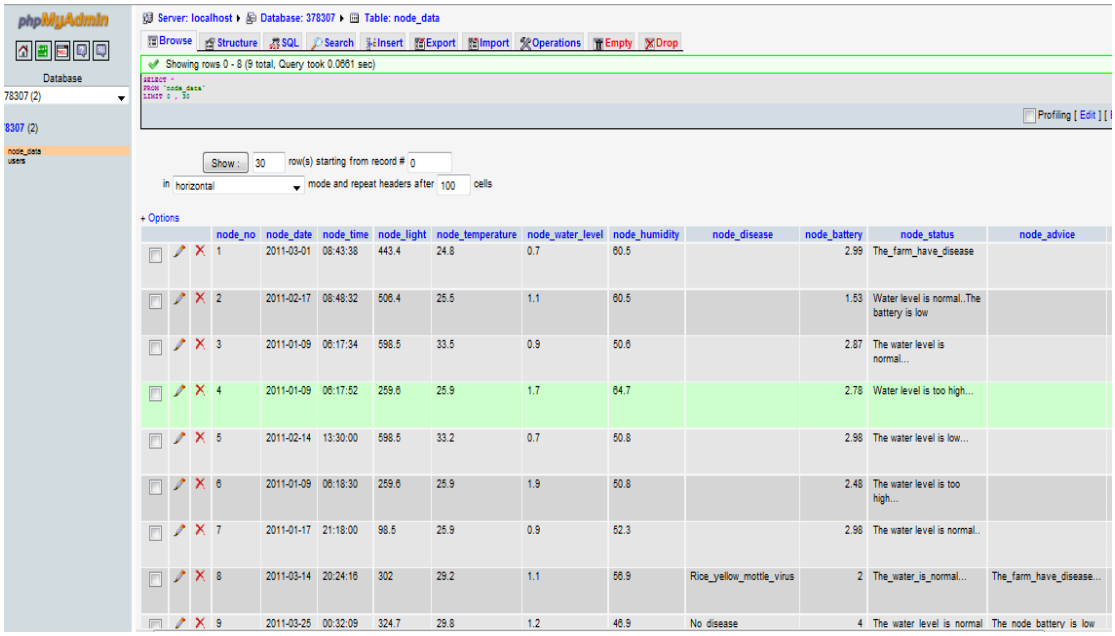

Figure 5-1-F3: The Information stored in Database from Node_data

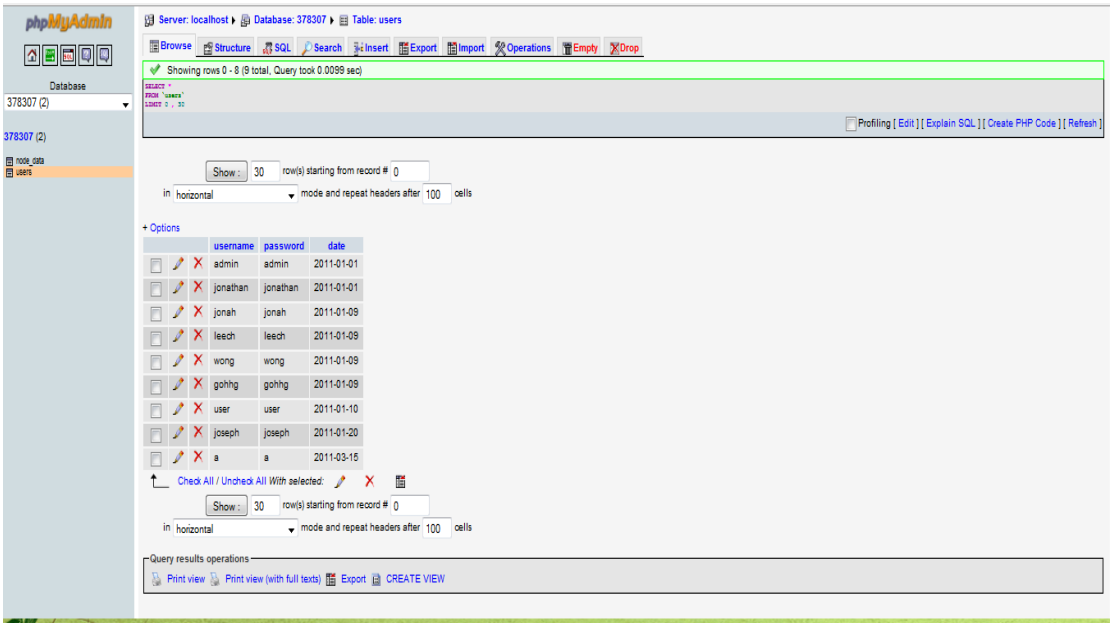

Figure 5-1-F4: The Information stored in Database from the Users

5-2 Implementation of the Web based FTP client

In the Web based FTP client, this is enable the admin to upload the file to the Internet which is located at http://orgfree.freewebhostingarea.com/ftp/. Only the admin can do the FTP login which is using to the server which is registered earlier which is called FTP server. For example, orgfree.com server is used. After enter the URL of the ftp, admin require entering the username and password which is the account that has been registered earlier. The authentication is show in Figure 5-2-F1. Once log in the FTP server, we are able to create a new directory, new file, upload file, edit file and select file. In this Web based FTP client, add in the PHP file which is login, numerical and graphical. These entire files are used to link the database and the mobile devices. The files are needed to select the database and the do the searching to match the data in the database. Login is requiring selecting from query which is from the users where name and username need to match. Numerical and graphical are requiring selecting from query which is from the node_data where node_no need to be match.

Figure 5-2-F1: Login for FTP Web Server

5-3 Implementation of the Whole M-Farm

In this part, we are implementing the whole network that we have design in the previous chapter. The system design, the functional of the system and the interface of the system will be discuss in the sub chapter as below. The purpose of the implementation if the whole network is to verify the project is fulfilling all the requirements, aims, and specification that have been mention in the previous chapter.

In order to implement M-Farm in the mobile device, we have installed a simulator which is named Wireless Toolkit 2.5.2 in the personal computer as testing for the M-Farm. The target platform used in this project will be JTWI, MIDP 2.1 and the CLDC is 1.1 and are shown in Figure 5-3-F1. Firstly, create a new project in the wireless toolkit which is name “Welcome_To_MFarm”. Go to the directory where the Welcome_To_MFarm directory created, input a java file (contain the source code of the project) into the j2mewtk\2.5.2\apps\Welcome_To_MFarm\src directory. The images of the M-Farm are inserted into j2mewtk\2.5.2\apps\Welcome_To_MFarm\res. The jar files are used to test in the real mobile devices which are created in the j2mewtk\2.5.2\apps\Welcome_To_MFarm\bin directory after the admin create the package for that particular project in the Figure 5-3-F2.. M-Farm is tested in the

Nokia 3120 classic V 06.20 by deploying the jar file into in the phone and it work as an application.

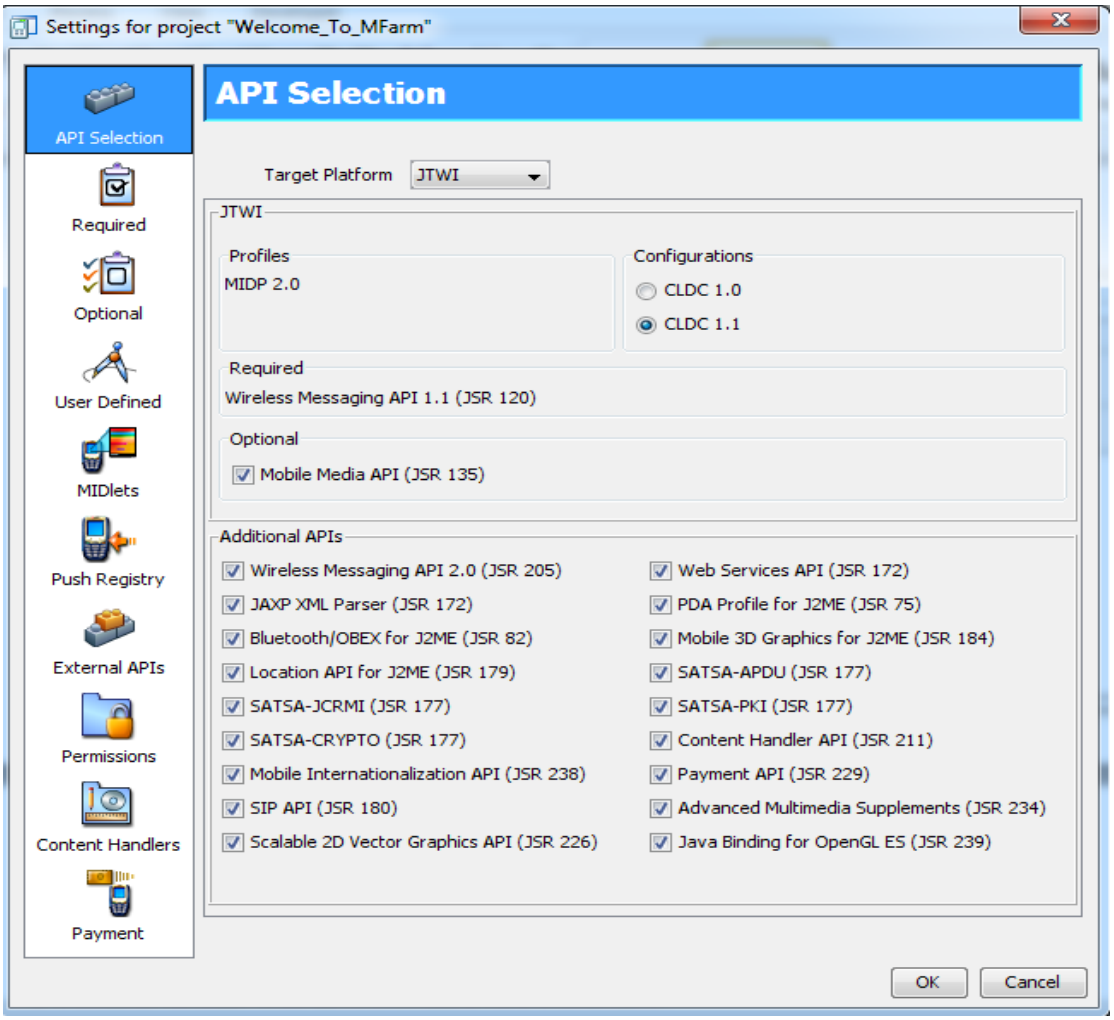

Figure 5-3-F1: API Selection

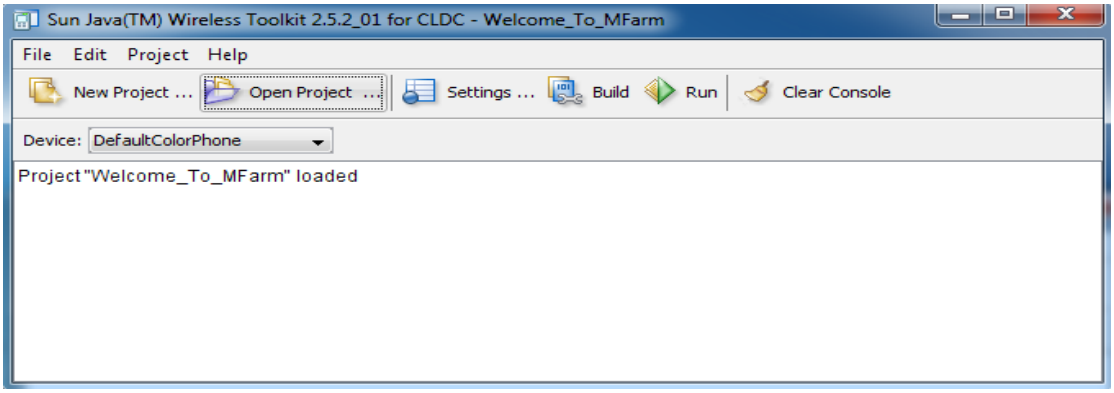

Figure 5-3-F2: Sun Java™ Wireless Toolkit 2.5.2 for CLDC

5-4 System Design, Functional Testing and Evaluation

This part is displaying all the results of M-Farm with appropriate screenshots. The system interface designs are shown in the part below. The system will start from the launching to the program exit.

5-4-1 System Interface Design

1. The Figure 5-4-F1 shows the main program for farmer to launch.

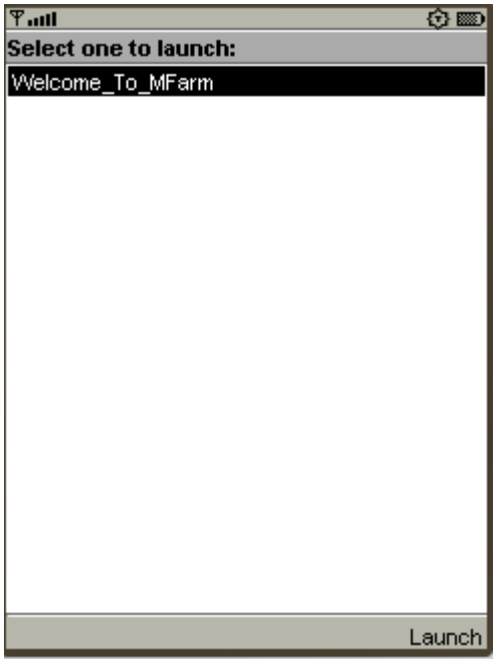

Figure 5-4-F1: Main Program for User to Select and Launch

2. The Figure 5-4-2-F2 shows the main page of M-Farm system after launching.

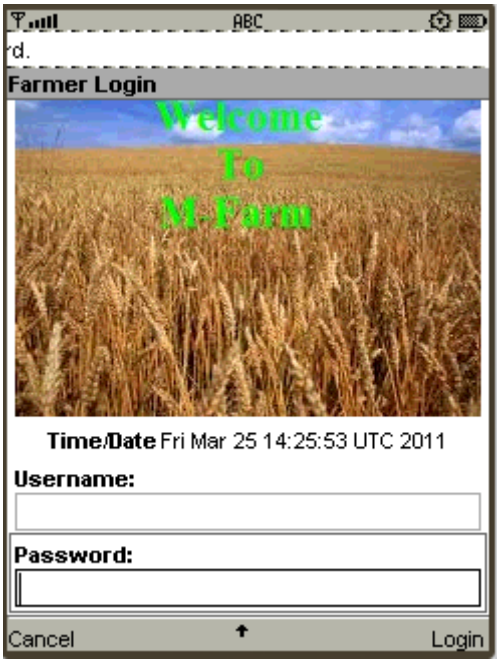

Figure 5-4-F2: Main Page of the System (M-Farm)

3. The Figure 5-4-F3 shows the farmers login using the network username and password and the "Login" button is clicked.

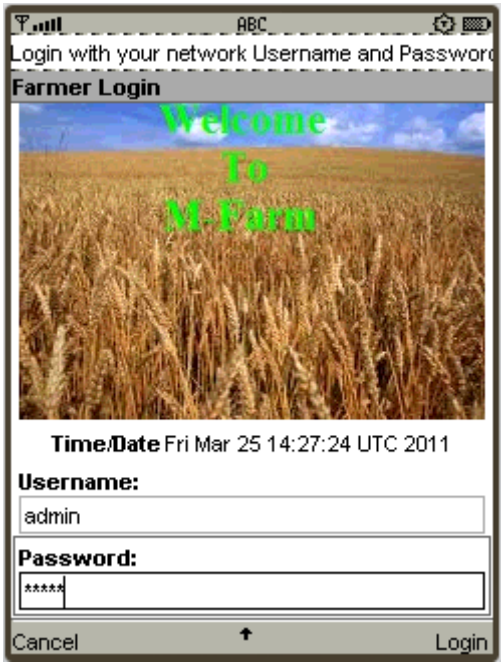

Figure 5-4-F3: Main Page of the System for Farmers to Login

4. The Figure 5-4-F4 shows the farmers login network username and password incorrect.

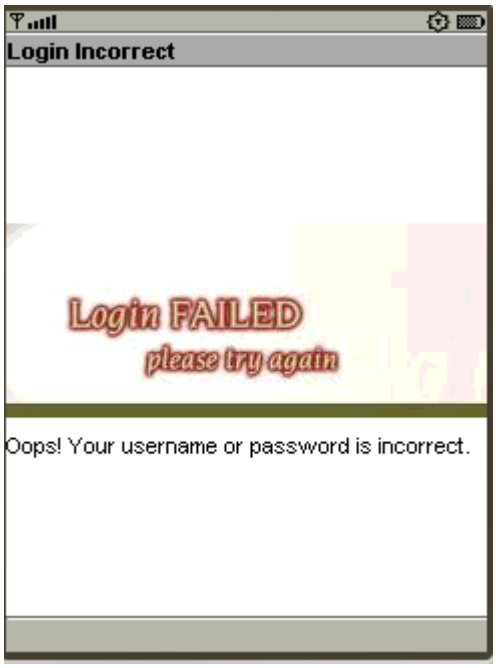

Figure 5-4-F4: Page Prompt Out when Login Incorrect

5. The Figure 5-4-F5 shows the farmers need to login to airtime for connecting to the database for information and the "Yes" button is clicked.

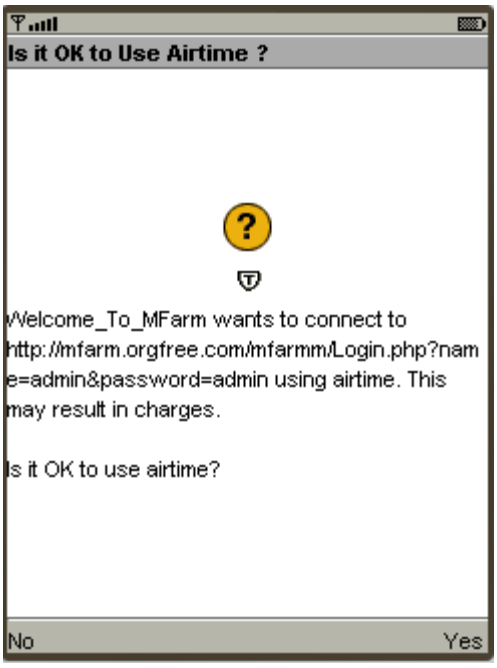

Figure 5-4-F5: Connect to the Internet

6. The Figure 5-4-F6 shows the page to select the option for farm accessing either Numerical M-Farm, Graphical M-Farm, about and credits after the button “Yes” is clicked.

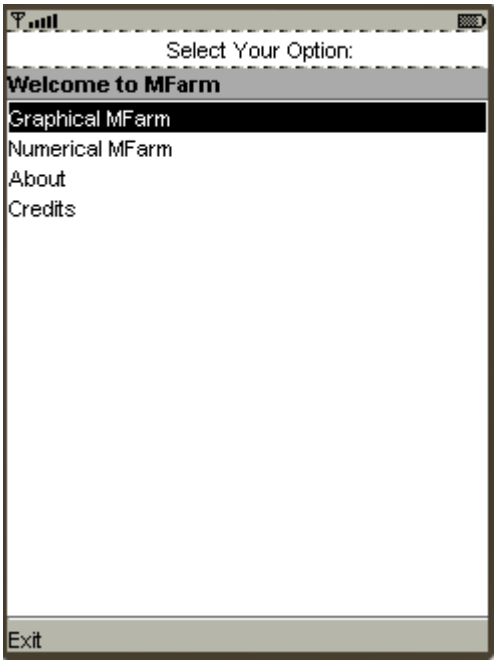

Figure 5-4-F6: Options Selection

7. The Figure 5-4-F7 shows the developer of the system and information after the button “Credits” is clicked.

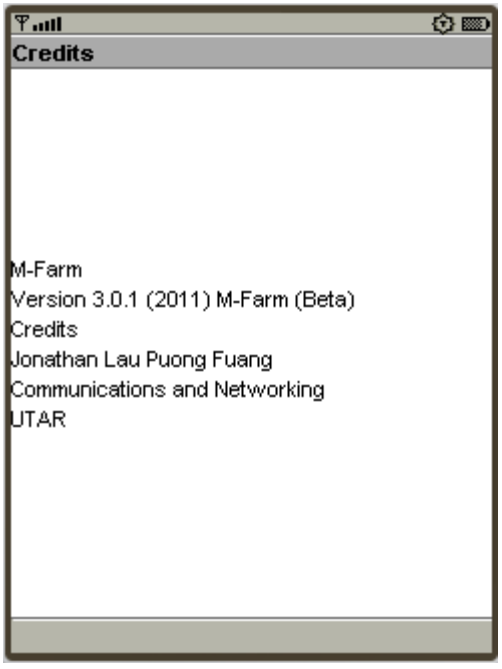

Figure 5-4-F7: Developer Information

8. The Figure 5-4-F8 shows brief description and introduction to the system after the button "About" is clicked.

Figure 5-4-F8: Brief Introduction about M-Farm

9. The Figure 5-4-F9 shows enter the node number to the system after the button "Graphical M-Farm" is clicked.

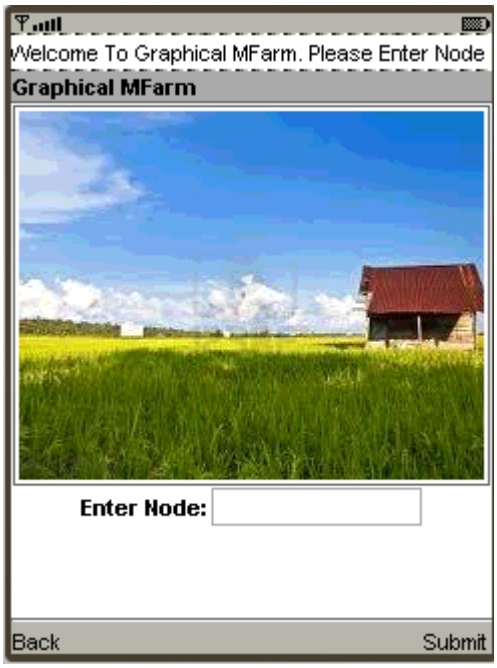

Figure 5-4-F9: Graphical M-Farm Enter Node

10. The Figure 5-4-F10 shows the node number after enter to the system; the button "Submit" is clicked.

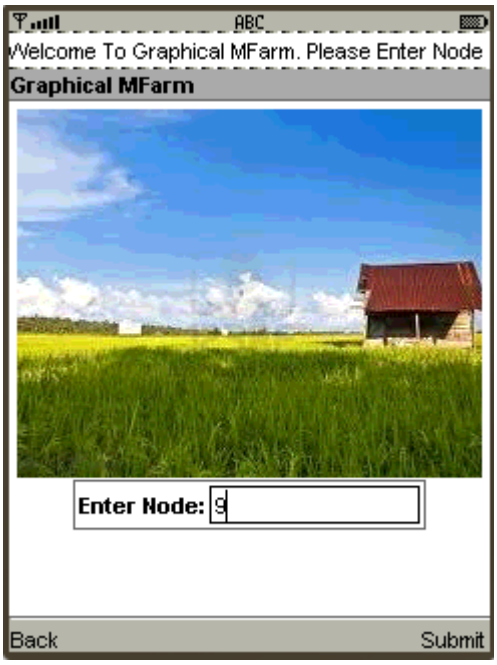

Figure 5-4-F10: Graphical M-Farm Node Entered

11. The Figure 5-4-F11 shows the result of Graphical M-Farm by the system after the button "Submit" is clicked.

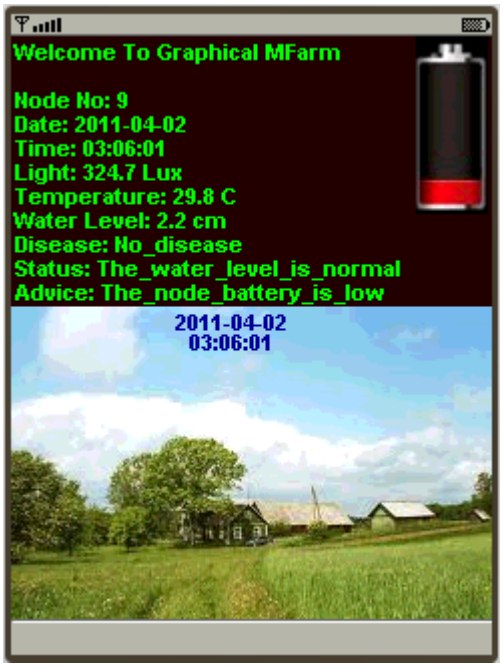

Figure 5-4-F11: Result for Graphical M-Farm

12. The Figure 5-4-F12 shows enter the node number to the system after the button “Numerical M-Farm” is clicked.

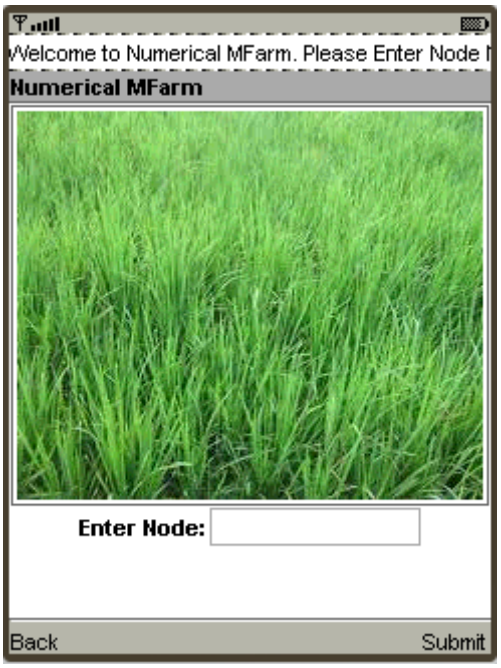

Figure 5-4-F12: Numerical M-Farm Enter Node

13. The Figure 5-4-F13 shows the node number after enter to the system; the button “Submit” is clicked.

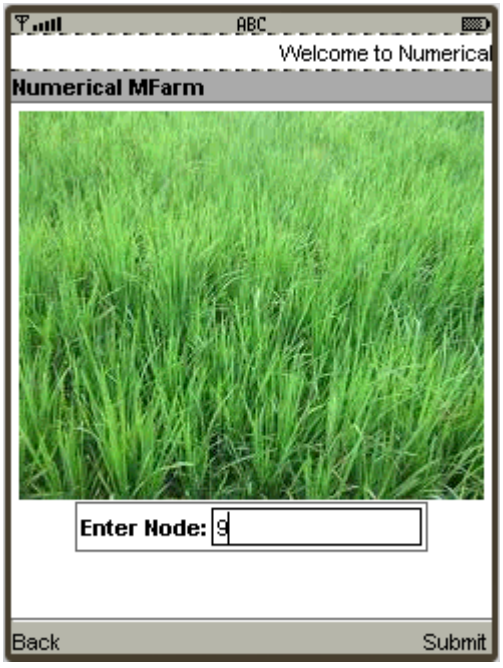

Figure 5-4-F13: Numerical M-Farm Node Entered

14. The Figure 5-4-F14 shows the result of Numerical M-Farm by the system after the button “Submit” is clicked.

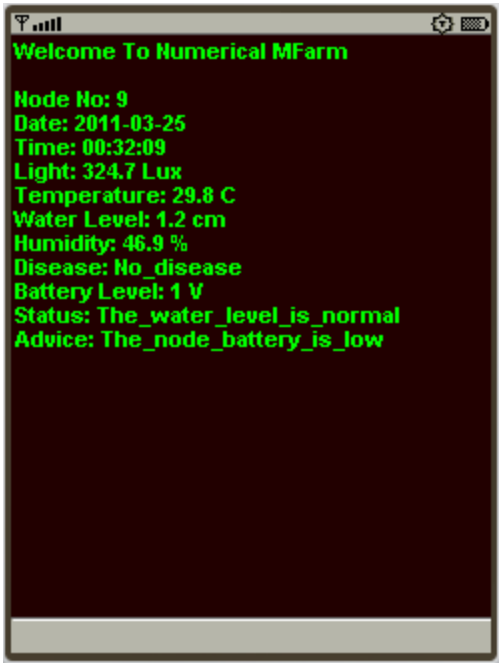

Figure 5-4-F14: Result for Numerical M-Farm

5-5 System Implementation

5-5-1 Ways to use the “M-Farm”

M-Farm can have the network login for username and password and the options to select either Numerical M-Farm or the Graphical M-Farm. Then, the user is able to enter the node number to find out the farm condition.

5-5-2 Description of the System Process

The M-Farm has the options to select Numerical and Graphical in Table 5-2-T1 and Table 5-2-T2. The system needs the user to select on the given options in order to view the farm condition. The farm condition information can be view after the user input the node number for the node number. The information given as followed.

1. Numerical M-Farm Information Guidelines

Node: Node number of the sensor node deployed
Date: Current date of the farm when database is updated
Time: Current time of the farm when database is updated
Light: The brightness of the farm in lux
Temperature: The temperature of the farm in Celsius
Water Level: The water level of the farm in centimetre
Humidity: The current humidity percentage in the farm
Battery: The battery voltage level
Status: The farm condition
Advice: Action to take

Table 5-2-T1: Numerical M-Farm Information Guidelines

2. Graphical M-Farm Information Guidelines

Node: Node number of the sensor node deployed
Date: Current date of the farm when database is updated
Time: Current time of the farm when database is updated
Temperature: The temperature of the farm in Celsius
Water Level: The water level of the farm in centimetre
Status: The farm condition
Advice: Action to take
Image: The image of the farm by the camera
Battery Image: The image is showing the battery level

Table 5-2-T2: Graphical M-Farm Information Guidelines

5-6 Problems Encountered

During the implementation of the system, some problems were encountered. The following session outlines the issue encountered. They differ in degree of difficulty and significance.

5-6-1 M-Farm Design Issues

The first problem was due to the use of a few types of class combine together so that the program is not in independent part. Due to the complexity of the combination, the design needs to call the numerical class and graphical class into the main function. The program is link using the MIDlets main. The main program will control the other two classes. The layout is design according to the sequence of the output.

The issue was a challenge rather than a problem because it was overcome and moreover it had its benefits:

- The layout will be arranged in sequence and in neat manner.
- It will give a better program connection for overall system.
- The design issue knowledge greatly helped to improve code generation of the java in mobile application and give a much better understanding about the control of the whole application.

5-6-2 Select the Information from Database

Another problem encountered is the selection information from the database using the mobile program in java. The main program should enable user to retrieve the information. The data which retrieved from the database are call inside the mobile device using the PHP server. The data should split according to the space so that the information can arrange in sequence.

5-6-3 Refresh the Information after the Database Changes without Logout

The next problem encountered is the refresh of the information after the administrator make changes in the database. This can avoid the user to exit and log in again the system in order to get the latest information regarding the farm condition and the action to take.

5-6-4 Enable the Users to Enter Node

In order to enable the users to enter node number, the GUI for the enter node should be create after the Options Numerical and Graphical. This will enable the user to enter node to retrieve the information that user want to access.

5-7 Summary

The whole system network from the database to the mobile device is listed as above. All the details are mention in order to have a good testing about this project. The testing of system is needed to ensure the system properly functioning as per the screenshots demonstrated. There are some bugs in the program. For further use of the system, the program should have the administrator password for admin purpose. Username: admin and Password: admin.

6-0 Discussions

This chapter is discussing M-Farm device from the point of view this M-Farm has been successfully achieved the objectives, the advantages and the weakness of M-Farm is discussed to improve the device.

6-1 What has been Achieved

Accessing Your Farm Anywhere and Anytime (M-Farm) is an useful system that can help in the growth of agriculture field especially in the farm monitoring for the extreme climate changes to make sure the farm can produce optimum production. This system is able to give the best farm accessing for the farmers that is M-Farm, which is providing the farmer monitor the farm from anywhere and anytime. Farmers' able access to the system anywhere and anytime using mobile devices when they think it is necessary. The farmers are given instructions and command (icons are shown) and easy to follow. Recommendations provided which can allow necessary actions taken when the farm is facing extreme climate change. M-Farm is providing a nice and attractive user interface. The graphic and wording are well organized. The farmers are easier to have better understanding about the functions because the icons shown. All the farming information is enable to be stored into a database named PMA that allows farmer to access. Web based created for the farmers to access the farm information. All the functional of an accessing farm using M-Farm are demonstrate to the farmers. These have achieved with a system that built and tested in the previous chapters of the implementation of the whole network. The testing results prove that the project has been a success whilst there being the potential for the system developed further.

6-2 What has not been Achieved

M-Farm system has not been integrated into the real Wireless Sensor Network data collecting from the farm. M-Farm is retrieving the data from the database which is created for testing purpose to make sure the M-Farm system is working well.

6-3 System Advantages

Mobile based M-Farm system is a farm accessing system that can be anywhere and anytime. Farmers can access to the system anywhere and anytime when they think it is necessary because the system can access to the Internet using the 3G mobile, which provide the network connection with high data rate in order to function. The system is user friendly. Besides, the inputs command and instruction are easy to follow as all the instructions shown in ticker. M-Farm provides nice and interactive user interface. The graphic and words are well structured. M-Farm provide exact and fast result when do the farm accessing. It is because farmers can use 3G to do the network access and the time taken is fast to make connection. The farmers can make the connection with the high-speed connectivity and fast data rate transmission in 3G mobile device. Extra information is given. There is information about the status of the farm, the action and suggestion of the farm given for the farmers to take action. There are images of the farm monitoring in the system so that farmers can have better understanding about the farm condition.

6-4 System Weakness

There is no information about the way to upgrade the system when the new version of the system is release. The farmers' choices are limited. The system provides more details information and the real time video about the farm.

7-0 Conclusions

Accessing Your Farm Anywhere and Anytime (M-Farm) has fulfilled the scope and the objectives of the system, which stated at the first chapter. The system is able to allow the farmers to access their farm in anywhere and anytime which is using the mobile devices. The recommendations are giving information for the status and action to take. The farming information is stored into a database that allows farmers to access. The functional are able to demonstrate the farmers to access the farm. M-Farm is playing an important role in the development of the farm monitoring in these days because of the extreme climate changes.

7-1 Recommendations

Accessing Your Farm Anywhere and Anytime (M-Farm) can be expanding in many ways such as:

1. Putting extra information about the farm condition.
2. Users are provided with the link to upgrade the system to a more stable system.
3. The system will be integrated with the real Wireless Sensor Network system and try to get the raw data from the base station.

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