CHAPTER 2

THEORETICAL FOUNDATION

2.1 Mobile Phone / Hand Phone

2.1.1 Mobile Phone Explanation

A mobile phone or hand phone is an electronic device used for long-range telecommunication purposes such as making phone calls, sending SMS (Short Message Service) or transferring data over a cellular network. As opposed to a satellite phone which is mobile but not cellular, most current mobile phones connect to a cellular network owned by a mobile network operator that consist of switching points and cell sites (base stations). [2]

There are two types of current mobile phones which are:

- Global System for Mobile communications from Group Spėcial Mobile originally (GSM).
- The mobile phone standards called cdmaOne and CDMA2000 which are often referred as CDMA (Code Division Multiple Access).

Mobile phone works by sending and receiving radio signals with any base stations using low-power transmitter that have the same frequencies with microwaves antennas. Mobile phone and its base stations receive and transmit signals using electromagnetic waves which are produced by natural and man-made sources. So, radio signals are

broadcasted from mobile phone to the nearest base station and then the signals are sent from the base station to the mobile phone at a slightly different frequency. When the mobile phone moves to other location then the network will automatically switch the network of the mobile phone to other nearest base station. [4]

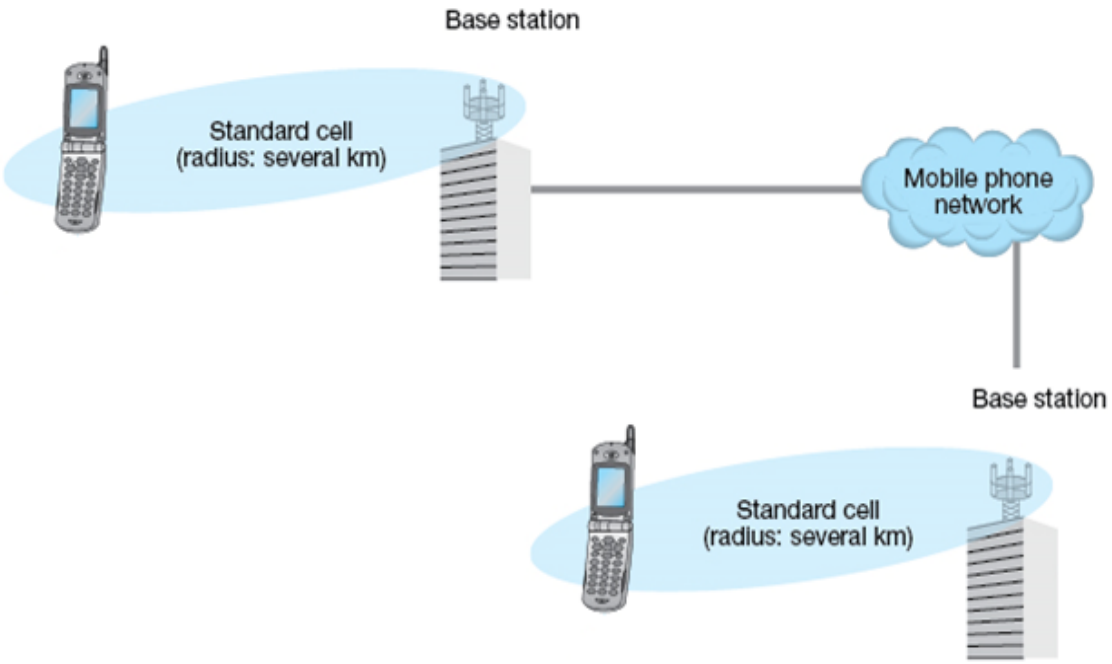

Figure 2.1 Mobile Phone Structure

2.1.2 SIM (Subscriber Identity Module) Card

A SIM card is needed to use a mobile phone. The SIM card holds a microchip allowing you to access a mobile phone network. Each SIM card contains unique serial number,

international unique number, security authentication, temporary information related to the local network, and two passwords; PIN for usual use and PUK for unlock use. [5]

The SIM card operating systems come in 2 main types: Native and Java cards. Native card is based on vendor specific software whereas java card is based on standards. Java card permits the SIM card to contain programs which are hardware independent and interoperable.

2.1.3 Global System for Mobile (GSM)

GSM is the most popular standard for mobile phones. Market Data and Analysis Services (GSM Association) conducts a survey about global mobile user on July 8th, 2009. The result of the survey is 80% of the global mobile user uses GSM. [3]

Connections by Bearer Technology

	Number	Percentage
Total	4,310,311,592	
cdmaOne	2,512,409	0.06%
CDMA2000 1X	309,507,900	7.18%
CDMA2000 1xEV-DO	121,821,983	2.83%
CDMA2000 1xEV-DO Rev. A	13,912,386	0.32%
GSM	3,449,010,903	80.02%
WCDMA	255,773,412	5.93%
WCDMA HSPA	132,079,727	3.06%
TD-SCDMA	825,044	0.02%
TDMA	753,411	0.02%
PDC	2,752,436	0.06%
iDEN	21,361,981	0.50%

Connections by World Region

	Number	Percentage
World	4,310,311,592	
Africa	421,450,167	9.78%
Americas	477,727,711	11.08%
Asia Pacific	1,894,751,422	43.96%
Europe: Eastern	459,394,583	10.66%
Europe: Western	509,980,691	11.83%
Middle East	245,411,903	5.69%
USA/Canada	301,595,115	7.00%

Data supplied by GSMA Mobile Infolink on 08/07/09

Figure 2.2 Market Data Summary

GSM is considered as a second generation (2G) because both signaling and speech channel for GSM are digital, while radio signal on first generation (1G) networks are analog. The second generation or 2G introduces a new data services for mobile like SMS text messaging.

GSM network has several different cell sizes; micro, macro, femto, pico and umbrella cells. Each cell has different coverage area depending on the implementation environment. Micro cells are cells whose base station antenna is installed on a building under average high. Macro cells are cells whose base station antenna is installed on a building above average high. Femto cells are cells for use in residential areas. Pico cells

are small cells which coverage diameter is a few dozen meters. And umbrella cells are cells for use to cover shadowed regions.

Those are 3 systems for the operation and support system for GSM network [6]:

- The Switching System (SS).

  The switching system is a very effective system where many crucial operations are conducted. This system has five databases inside it which perform different functions. These five databases from switching system are Home Location Register (HLR) which holds very important information of subscribers, Mobile Services Switching Center (MSC) which handles technical end of telephony, Visitor Location Register (VLR) which performs very dynamic tasks, Authentication Center (AUC) which handles the security end of the system, and Equipment Identity Register (EIR) which handles crucial information regarding mobile equipments.

- The Base Station System (BSS)

  The base station system has very important task in mobile communication. In further development, the base station system is divided in two systems. These two systems are The Base Transceiver Station (BTS) which handles radio communication using radio signals with mobile phone, and The Base Station Controller (BSC) which controls many cells, registers subscribers, creates physical link between subscriber mobile phone and BTS, and helps connecting to the nearest BTS.

- The Operation and Support System (OSS)

The operation and support system helps in mobile networks to control and monitor the complex system. The basic reason for developing OSS is to provide subscribers a cost effective support and solutions.

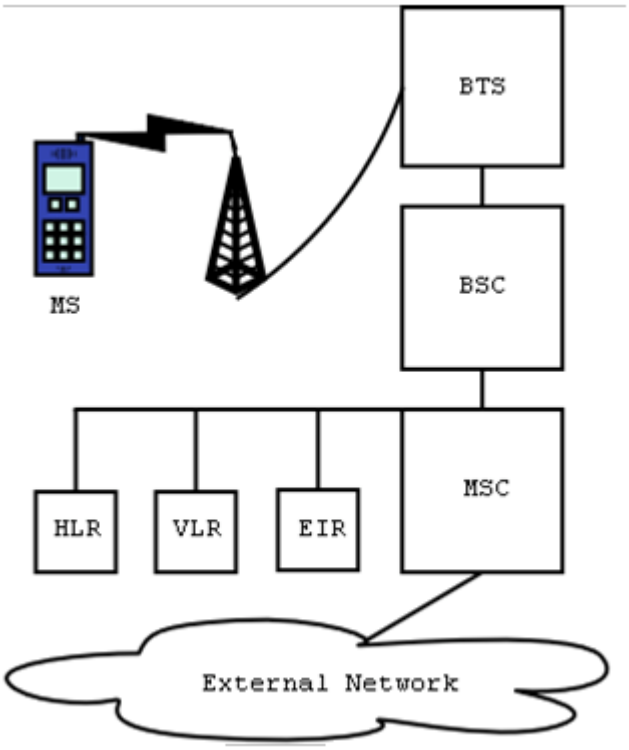

Figure 2.3 GSM Network

2.1.4 Short Message Service (SMS)

Short Message Service or SMS is a standard function on mobile phone for sending text message using some communication protocols. The SMS text messaging has been widely used worldwide. SMS was invented in Europe in 1992. It was used in the GSM standards. Later it was implemented in CDMA technology. The text in SMS can contain words or numbers or an alphanumeric combination. Each SMS is up to 160 characters

when Latin alphabets (7-bit character encoding) are used and only 70 characters in length when non-Latin alphabet (16-bit Unicode UCS2 character encoding) are used like Arabic and Chinese alphabets. [7]

SMS is a very appropriate technology for sending notifications and alerts of important events because:

- A mobile phone is a standard device for most people around the world. It has become a must or basic need for most people. Moreover, people carry their mobile phone most of the time. So, the message can be checked immediately.
- SMS technology permits the 'push' of information. The 'push' model is different with the 'pull' model where the mobile phone has to poll the server regularly to check whether there is new message or not. The 'pull' model enhances server loads and wastes bandwidth.

Not only text message, an SMS text messaging can also carry binary data such as ringtones, pictures, wallpapers, animations, business cards, and many others binary data. An SMS is a forward and store service. So, the SMS message is not send directly from the sender mobile phone to the recipient mobile phone but through an SMS center. Each mobile phone network has one or more SMS center to handle and control the SMS messages.

An SMS is essentially like paging but the different is SMS does not require the mobile phone to be active or within range. An SMS message is stored in the SMS center temporarily if the recipient mobile phone is offline and then the SMS message will be forwarded to the recipient mobile phone when he is online. It is possible that the SMS

message will be deleted from the SMS center after some periods and the recipient mobile phone will not receive the message.

To anticipate the failure in sending SMS because the recipient mobile phone is turned off or out of service then some people want to know whether an SMS has been sent to the recipient mobile phone successfully or not. To get this status report, mobile phone users need to set a flag in the SMS message to alert the SMS center that they want a report about the status of an SMS. The report is sent to the sender in the form of an SMS message. The SMS center not only send SMS message to the recipient or status report to the sender but also checks the SMS message whether there are any errors. If there is error in the SMS message then the SMS center will send an error report to the sender automatically.

One drawback or disadvantage of SMS technology is that each SMS can only hold a limited amount of data. Many researches were held to anticipate this drawback. One of the researches is to use an extension called ‘concatenated SMS’ or ‘long SMS’. A concatenated SMS can hold more than 160 characters because the sender’s mobile phone breaks down the message into smaller parts and sends each of these parts as a single SMS message. At the recipient’s mobile phone, these smaller parts will combine them back to one long message. Unfortunately, the concatenated SMS is less widely supported. [8]

2.1.5 Short Message Service (SMS) Prospect

Mobile phone becomes an important need for people in big cities like Jakarta. Almost everyone in Jakarta has mobile phone. This condition makes text messaging (SMS) an important way of communicating between people. People choose to use an SMS over a telephone because people in Indonesia are highly influenced by the public perception that SMS is the cheapest and most efficient means of communicating. This perception allows people of all economic class, from the lowest to the highest class to use text messaging services with no hesitation. According to the current survey, Indonesia is currently ranked as the second country with the highest SMS traffic (1,193 billion) after Philippines (2,36 billion). [19]

2.1.6 Intra-Operator SMS Messages

Only one SMS center involves in the transmission of intra-operator SMS. From the sender mobile phone, the intra-operator SMS message goes to SMS center. After that, SMS center transports SMS message to the recipient mobile phone. If the recipient cannot receive the SMS message or were offline then the SMS center keeps the SMS message but the SMS message will be remove from the SMS center after the validity period expired. The SMS center will send a notification report to the sender whether the message has been sent or the recipient cannot receive the message. [9]

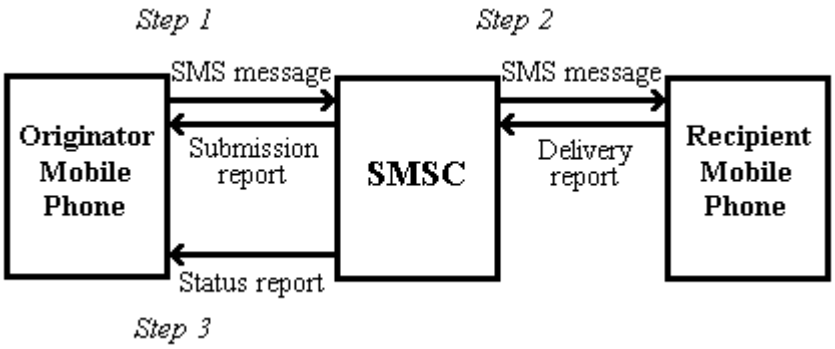

Figure 2.4 Intra-Operator SMS Message

2.1.7 Inter-Operator SMS Messages

Inter-operator SMS messages involves not only one SMS center but can be many SMS centers. The transmission of inter-operator SMS messages can be divided into 2 different ways:

- The connection signals are set up between two wireless networks. The originator SMS center gets the recipient wireless network when it receives an inter-operator SMS message. This can be done if there are two wireless networks involved in the transmission of inter-operator SMS message.
- The second way is used if there are not two wireless networks involve. This condition happens when an SMS is sent from GSM network to CDMA network. First the message reaches the originator SMS center then the originator SMS center forwards the SMS message to the recipient SMS center which will be responsible for sending the SMS to the recipient. If the recipient is offline, then the recipient SMS center will keep the message until the valid period. After the

valid period, the recipient SMS center will send a report back to the originator SMS center if the recipient is still offline and then send a report to the sender.

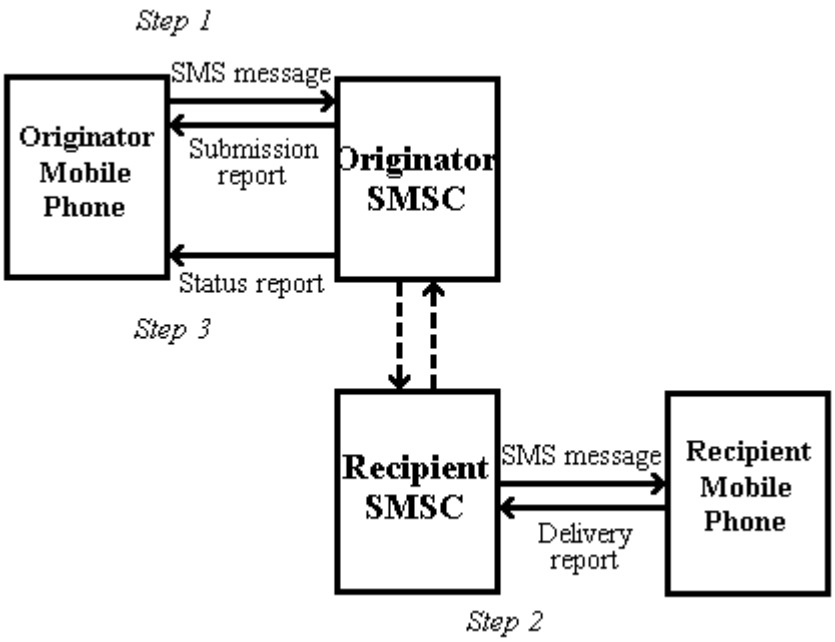

Figure 2.5 GSM to CDMA

2.2 Framework

2.2.1 PHP Hypertext Preprocessor

PHP, which stands for "PHP: Hypertext Preprocessor" is a widely-used Open Source general-purpose scripting language that is especially suited for Web development and can be embedded into HTML. Two most famous examples of PHP are phpBB and MediaWiki. It is mainly used in server-side scripting, but can also be used from a command line interface or in standalone graphical applications. Its syntax draws upon C, Java, and Perl, and is easy to learn. The main goal of language is to allow web

developers to write dynamically generated web pages quickly. PHP was originally created by Rasmus Lerdorf in 1995. Today the main implementation of PHP is now produced by the PHP Group and serves as the standard for PHP since there is no formal specification. PHP is a free software since it is released under PHP License. [15]

PHP script is started by adding '<?php' tag and closed by '?>' tag. It has modules to connect with any kind of database starting from MySQL, MS SQL and others. [16]

2.2.2 CodeIgniter

CodeIgniter is a toolkit for people who build web application using PHP. Its goal is to enable system developers to develop projects much faster than writing code from scratch by providing a rich set of libraries for commonly needed task, as well as simple interface and logical structure to access these libraries.

CodeIgniter uses the Model-View-Controller (MVC) pattern, which allows great separation between logic and presentation. [20]

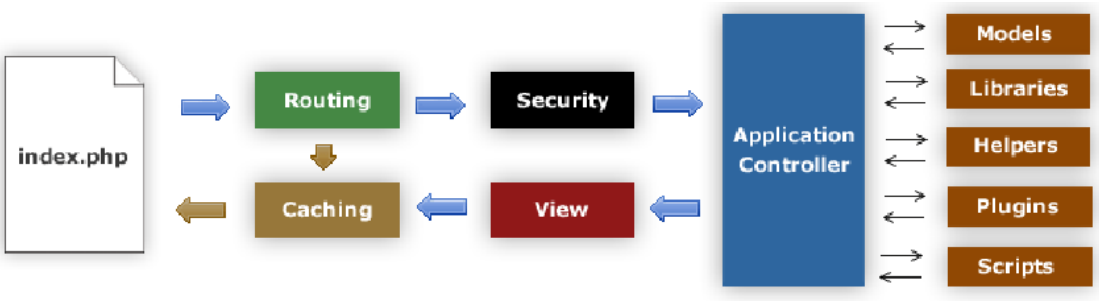

Figure 2.6 Data Flow in CodeIgniter Framework

2.2.3 MySQL Database Server

MySQL is an open source database software and the world's most popular software, with over 100 million copies software downloaded or distributed throughout its history. MySQL supports key subs key subsets of SQL on Linux and Unix systems. The programs can be written using C/C++, Java, Perl, Phyton, or PHP, either as a standalone application or through a web page. [17]

MySQL database is owned, developed and supported by Sun Microsystems, one of the world's largest contributors open source software. MySQL was originally founded and developed in Sweden by two Swedes and a Finn; David Axmark, Allan Larsson and Michael Monty Widenius, who had worked together since the 1980's. [18]

The advantages of using MySQL are:

- The best and the most-used database in the world for online applications
- Available and affordable for all
- Easy to use
- Continuously improved while remaining fast, secure and reliable
- Fun to use and improve
- Free from bugs

2.3 Supported Features

2.3.1 SMS Gateway

Each mobile telecommunication company has their own communication protocols which are implemented in their SMS centers. This condition leads to a problem of SMS

messaging. Two different SMS centers cannot be connected to one another if they do not support a common SMS center protocol. To handle this problem, a SMS gateway is implemented between two SMS centers. The SMS gateway acts as a pass on two SMS centers. [10]

Another problem is the SMS text messaging application may require to support some specifics SMS center protocols. This problem increases complexity of SMS text messaging application. This problem can be solved by using SMS gateway because SMS gateway will solve the connections between SMS centers. So, the SMS text messaging application only needs to know how to connect to SMS gateway.

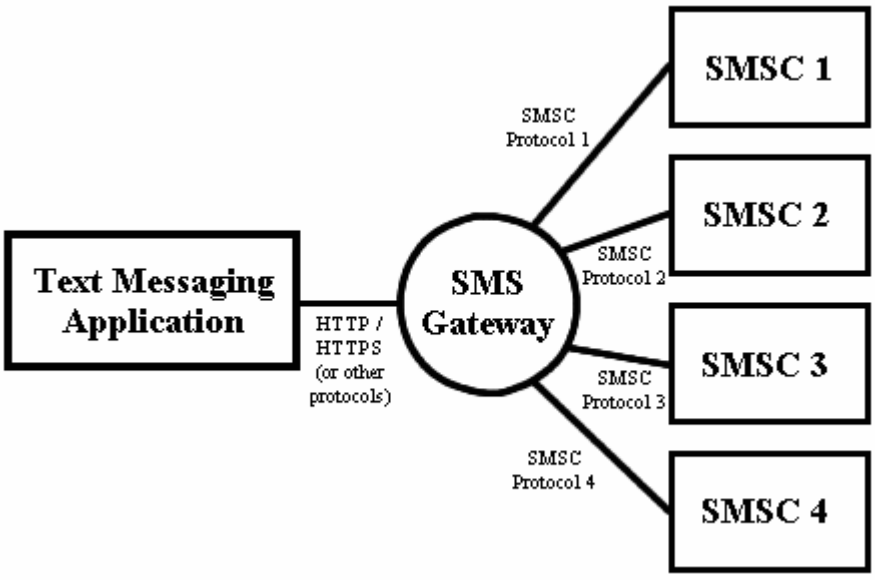

Figure 2.7 GSM Gateway

2.3.2 Gammu

Gammu is a software that gives access from PC to a variety of functions in connected mobile phone or cellular device such as sending and receiving SMS message, receiving MMS, making backup or restore for calendar or phonebook, uploading or downloading phone files and so on. Gammu is a stable and mature codebase supporting many types of mobile phones. In the first development, this software was named MyGnokii2. [11]

When gammu runs, it automatically retrieves SMS messages from mobile phone that has been connected and configured to the database (MySql). It is the same when sending SMS message from PC. The message is stored in the database automatically and then gammu will retrieve the message to be sent via mobile phone. Before the service is stopped, this condition will keep doing so.

2.3.3 Fuzzy Logic

Fuzzy logic is a mean of presenting problems to computers in a way similar to the way humans solve them. Fuzzy logic enables computers to pose and solve problems using linguistic terms similar to what users might use. For example, an AI in a game will chase enemy if the enemy is weaker than the AI itself and run if the enemy is stronger. In conclusion, fuzzy logic enables computers to think as users normally do. [14]

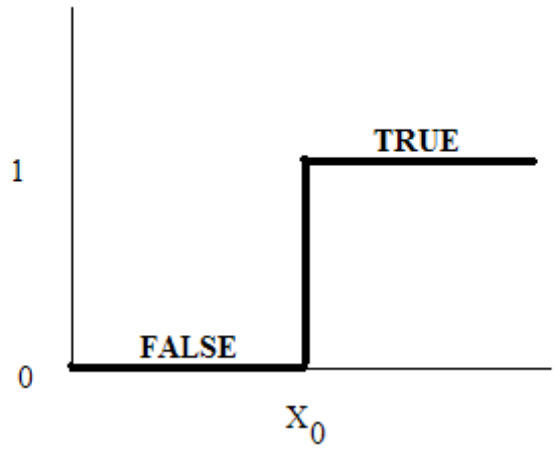

Figure 2.8 Boolean Logic

Fuzzy logic uses the Boolean logic to determine the calculation. Boolean logic forces users to define a point above which the users consider as 'true' for the result and below which the users consider as 'false' for the result.

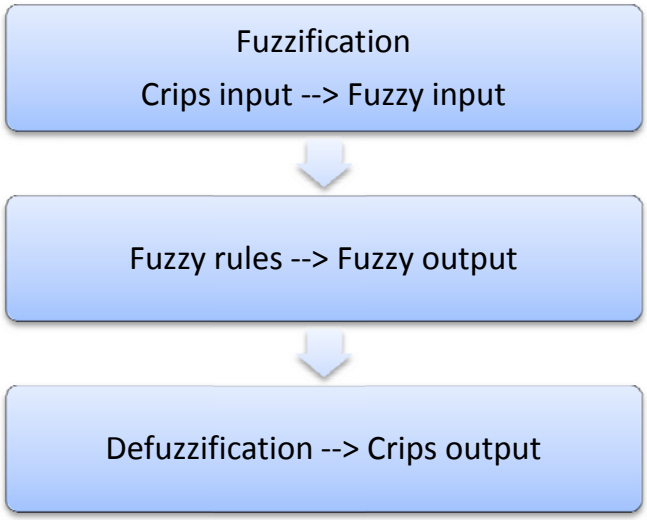

Figure 2.9 Fuzzy Control

The fuzzy control or inference process comprises three basic steps as illustrated in the picture above. The first part of the process is called the fuzzification process. In this step, a mapping process involves finding the input for the process. After all inputs have

been determined then some calculation will be conducted base on fuzzy rules and produce fuzzy output. Often, having a fuzzy output such as ‘frequent exercise’ is not enough. The users want a more precise output such as ‘three hours exercise per week’. This process is called deffuzzification.