UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PET FEEDING SYSTEM USING RASPBERRY PI AND GSM

This report is submitted in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree of Electronic Engineering Technology (Telecommunications) with Honours

by

CHAN WEI NICK

B071210113

921209-14-6737

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This report is submitted to the Faculty of Engineering Technology of UTeM as one of the requirements for the award of Bachelor's Degree of Electronic Engineering Technology (Telecommunications) with Honours. The following are the members of supervisory committee:

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ABSTRACT

All pet owners have one common responsibility; to maintain their pet's wellbeing every day. One straight forward approach is to make sure that the pets are being fed at regular intervals. Even so, the pet owners often find that even this simple responsibility is hard to fulfil due to tons of reasons; even when they are around the neighbourhood earning a living. The pet feeding system; generally known as the automatic pet feeder, is introduced to counter this problem exactly, making both the pet owners and their furry little companions happy. In this project, it introduces one of the many applications of Raspberry Pi and GSM, combining the two makes an automatic pet feeder with flexible feeding time plausible. With that said, this project focuses mainly on the compatibility of Raspberry Pi and GSM by evaluating and analysing their performances, and not evaluating the hardware components of the pet feeder itself.

ABSTRAK

Pemilik-pemilik haiwan pemeliharaan mempunyai suatu responsibiliti yang sama; memastikan haiwan kesayaang mereka sihat setiap hari. Bagi mengekalkan kesihatan haiwan pemeliharaan mereka sihat, haiwan-haiwan wajib diberi makan dalam tempoh masa yang tertentu. Walaubagaimanapun, bagi pemilik-pemilik yang berkerja, mereka tiada cara penyelesaian yang berkesan bagi memberi makanan kepada binatang pemiliharaan setiap hari. Tujuan *Pet Feeding System* diperkenalkan adalah untuk mengatasi masalah pemakanan pemilik-pemilik binatang. Projek *Pet Feeding System* ini mengunakan dua modal bernama *Raspberry Pi* dan *GSM* untuk menghasilkan *Pet Feeding System* yang berfungsi dalam tempoh masa yang tidak tetap. Pemilik haiwan kesayangan mempunyai peluang untuk memberi haiwan kesayangan mereka makan bila-bila masa sahaja. Projek ini berfokus pada keserasian *Raspberry Pi* dan *GSM* dengan menilai dan menganalisasi prestasi *Raspberry Pi* dan *GSM*, dan tidak akan fokus kepada prestasi hardware komponen *Pet Feeding System* ini.

DEDICATIONS

To my parents,

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for raising me become who I am today.

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LIST OF ABBREVATIONS, SYMBOLS AND NOMENCLATURES

A	-	Ampere
AC	-	Alternating Current
AuC	-	Authentication Centre
BSC	-	Base Station Controller
BSS	-	Base Station Subsystem
BTS	-	Base Transceiver Station
CEPT	-	European Conference of Postal and Telecommunications
DC	-	Direct Current
DTMF	-	Dual Tone Multi Frequency
EIR	-	Equipment Identity Register
ETSI	-	European Telecommunications Standards
GMSC	-	Gateway Mobile Switching Centre
GPIO	-	General Purpose Input Output
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile Communication
HD	-	High Definition
HDMI	-	High Definition Multimedia Interface
HLR	-	Home Location Register
ME	-	Mobile Equipment
MMS	-	Multimedia Messaging Service
MOD	-	Module
MoU	-	Memorandum of Understanding
MS	-	Mobile Station
MSC	-	Mobile Switching Centre
NOOBS	-	New Out Of the Box Software

NSS	-	Network and Switching Subsystem
OS	-	Operating System
OSI	-	Open System Interconnection
OSS	-	Operation Subsystem
PCB	-	Printed Circuit Board
PSTN	-	Public Switch Telephone Network
RSS	-	Radio Subsystem
SCM	-	Single Chip Micyoco
SIM	-	Subscriber's Identity Module
SMS	-	Short Messaging Service
SMSC	-	Short Messaging Service Centre
SS7	-	Signalling System No. 7
TCP/IP	-	Transmission Control Protocol/ Internet Protocol
TS-xx	-	Teleservices no. xx
USB	-	Universal Serial Bus
V	-	Volt
VLR	-	Visitor Location Register

CHAPTER 1
INTRODUCTION

This chapter introduces the project with its background, problem statement, objectives, scope and project significance, to provide a sense of purpose and reasons to proceed with this project.

1.1 Background

Pet feeding system was introduced to compensate with the many excuses of why "responsible pet owners" are hard to come by, especially when everybody is spending most of their time out of their premise finding a living to sustain their family. Raspberry Pi will be used in the system to function as its core; modules like Global System for Mobile Communications (GSM) and sensors will be used to provide inputs to the Raspberry Pi in order for the system to communicate with the environment. The pet feeding system will then be tested with domestic pets to verify the functionality and the flaw of the system itself.

1.2 Problem Statement

Pet owners around the world are aware of that having a pet means having extra commitment to provide the best care and support to them (Dog Boarding Malaysia, 2015). It is unfortunate that not all pet owners have the time or energy to provide their pets' basic needs such as food and water due to reasons like working and travelling, sometimes both at the same time. This problem faced by the pet owners may lead to unintentional animal abuse due to lack of feeding. Often the pet owners find themselves troubling their friends and families to babysit their pet while they are away, which may be inappropriate after some frequent requests. The pet feeding system is designed to counter the problem that all pet owners are facing.

1.3 Objectives

The main objective of this research is deeply concentrated on aspect as listed below:

i. To analyse existing techniques available on long distance pet feeding systems.
ii. To suggest, develop and implement a long distance pet feeding system using Raspberry Pi and GSM.
iii. To evaluate and analyse the performance of the developed system.

1.4 Project Scope and Limitations

Project scope is a part of project planning that includes a list of goals, deliverables and tasks (Rouse, 2015). This project involves in programming on Raspberry Pi and GSM, along with testing on domestic pets on its functionalities and its flaws.

The pet feeding system produced needs both Raspberry Pi and GSM to communicate with each other to perform the system's desired task. A good programming will allow the modules to send information to each other with minimum delay.

The functionality of the pet feeding system will be verified by testing on different domestic pets with the cooperation of neighbours who owns a pet. The possible flaws of the system will also be verified at the time and improvements will be made if possible.

Since the project focuses on the performances of Raspberry Pi and GSM, the durability of the hardware itself will not be evaluated as much as the programming.

1.5 Project Significance

Living in the globalisation era, most of the people are spending most of their time out of their home to earn a living for themselves. As stress takes a toll on our life, a companion like a pet is needed to reduce part of the daily stress. It is such an irony that, while a pet can provide what their owners needed, the owners themselves are not able to provide them basic necessities such as food. The pet feeding system will be able to help both pets and their owner happy. With the opportunity that similar pet feeding systems are not common in Malaysia, this project will create awareness to the pet owners' of its feasibility and advantages it may provide in the future.

1.6 Summary

In a nutshell, the pet feeding system uses Raspberry Pi and GSM along with some sensors that will help the system to perform better. The purpose of this project is to eliminate the problem that all pet owners are facing; feeding their pet while they are unavailable like working or travelling.

CHAPTER 2
LITERATURE REVIEW

This chapter provides understandings of theories and previous researches that are related to this final year project. This includes an overview of GSM, the specifications of Raspberry Pi, similar products from all kind of sources, and more.

2.1 Global System for Mobile Communications

Figure 2.1: Official Logo of GSM

Figure 2.1 illustrates the latest and official logo of GSM Corporation. Cellular technology is one of the fastest growing telecommunication applications. Prior to GSM, the cellular technology evolved so independently, it causes many problems such as the compatibility of different technologies without the standardized specifications. Hence GSM was founded to provide specifications that define the function and interface of different technologies. The idea of GSM is to minimize the limitation in technological design but still maintain a wide range of applications (TelecomSpace, 2010).

Since then, GSM has been the most widely used and the most successful communication system of all time, enabling over four billion subscribers to

communicate with virtually everyone from every corner of the world (Saily, *et al.*, 2011).

2.1.1 History of GSM

Table 2.1 shows the timeline of GSM evolution throughout the history. In 1982, a standardization group, the Groupe Speciale Mobile (GSM) was started by Conference for European Post and Telecommunications Administration (CEPT) in order to formulate a specification of a common European telecommunication service around 900 MHz for a mobile cellular radio system. This system introduces a new opportunity for users to be able to use their phone anywhere within Europe at that time.

Table 2.1: GSM Evolution Timeline

Year	Description
1982	European Conference of Postal and Telecommunications Administrations (CEPT) created the Groupe Speciale Mobile (GSM) to develop a standard for voice telephonies
1987	Europe produced the first GSM Technical Specification
1989	Groupe Speciale Mobile transferred to European Telecommunications Standards Institute (ETSI)
1991	The first Short Messaging Service (SMS) was sent, GSM standard was expanded to 1800 MHz frequency band
1993	Telecom Australia became the first network operator outside Europe to implement a GSM network.
1995	New technologies like fax, data, and SMS messaging services were launched commercially
1996	Prepaid GSM SIM cards were launched and the subscribers exceeded 10 million.
2000	GPRS services were launched commercially. GSM subscribers exceeded 500 million in this year.
2002	Multimedia Messaging Service (MMS) were introduced.
2005	75% of the worldwide cellular network uses GSM network and GSM subscriber exceeded 1.5 billion subscribers.

In 1987, the GSM Association had decided on a standard that combined the best characteristics of different systems. At this time, 17 countries signed the Memorandum of Understanding (MoU) committing themselves to fulfil the 'GSM specifications' and confirmed their commitment to introducing mobile radio based on the recommendations from GSM.

Later in March 1989, the GSM Association was taken over by European Telecommunication Standard Institute (ETSI), and since 1991 has been called the Special Mobile Group (SMG). Since then, the abbreviation of GSM stands for Global System for Mobile Communication, thereby underlining its claim as a worldwide standard (Stuckmann, 2003).

2.1.2 GSM Logical Architecture

Figure 2.2 is the GSM logical architecture by hierarchy. GSM specifies that every technology is divided into the Radio Subsystem (RSS), the Network and Switching Subsystem (NSS) and the Operation Subsystem (OSS). Each of these systems contains an array of functions, where all system functions are combined together. The functional units are then implemented in various form of equipment uncontrolled by GSM themselves.

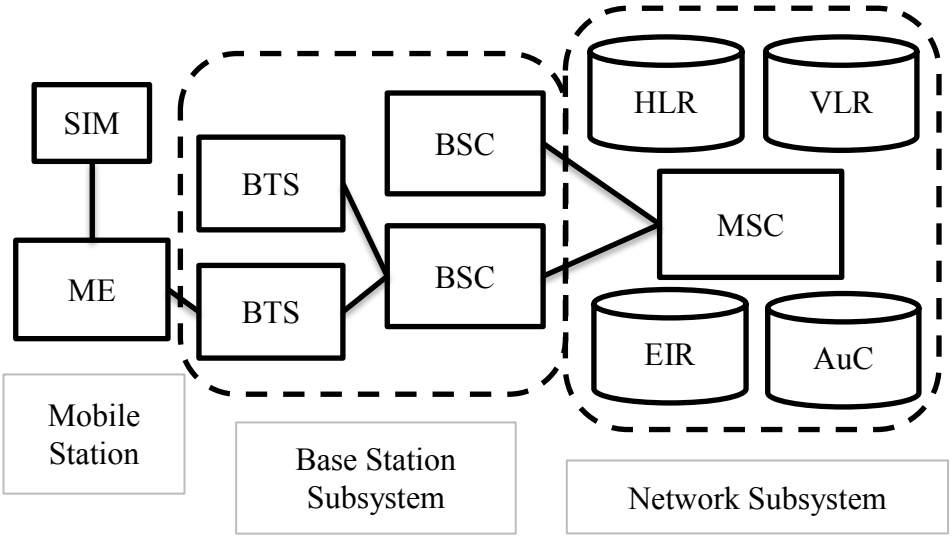

Figure 2.2: GSM Logical Architecture

2.1.2.1 The Mobile Station

A GSM Mobile Station (MS) consists of two parts. The first part contains all the hardware and software components relating to the radio interface. The second part, known as the Subscriber Identity Module (SIM), stores all subscribers' personal data. The SIM is either installed into the terminal or provided as a smart card, which has the function of a key. Once it has been removed, the device can only be used for emergency calls, with a requirement that the network coverage reaching that area. A mobile subscriber can use the SIM to identify himself over any mobile station in the network, and personalise their phone using the technology of SIM (Eberspacher, *et al.*, 2001).

2.1.2.2 Base Station Subsystem

The BSS is the connection between the Mobile Station (MS) and Network Switching Subsystem (NSS) through a radio interface. The BSS comprises of a Base Transceiver Station (BTS) and a Base Station Controller (BSC) that may control several BTSs (Lee, 2006).

GSM uses the Open System Interconnection (OSI). There are three common interfaces based on OSI namely air interface, interface A, and A-bis interface, making the connection between MS and BTS, MSC and BSC, and BTS and BSC respectively. The interface is important to connect different companies with different protocols. Protocols and interfaces are different in a way that interface represents the point of contact between two adjacent systems, and a protocol provides information flows through the interface. In a simpler term, an interface is the transit point to pertain several protocols (Lee, 2006).