TEMPERATURE DETECTION FOR FEVER PATIENT USING RFID AND GSM MODEM

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ABSTRACT

Life-threatening fever such as Malaria and Typhoid are treated manually at most of the hospitals nowadays. The nurses have to check the temperature and pulses of suspected victims at certain hours in a day. What makes it dangerous is that in between the interval hour, the patient is all alone without supervision from the nurse or the doctor. If at this time the temperature of the patient is suddenly rising over 39˚C, it can be fatal. Besides, patient's blood sample needs to be taken when his/her body temperature is at the highest level to confirm the diagnosis of the disease and identify the infectious parasites. This project "Body temperature detection system for malaria and typhoid fever patient using RFID and GSM network" comes into picture. As the temperature of the patient exceeds the limits, RFID active tag will be triggered, communicate with the RFID reader at nurse's station, notify nurse through alert popup and then, nurse will SMS to the doctor on duty using GSM Modem. With this, the patient will receive the right treatment at the right time.

INTRODUCTION

1.1 Background Study

This project is basically about a system that can notify nurses immediately after temperature rise from remote location involving Malaria and Typhoid fever patients in the hospital and also alerting the ideal time to take blood sample for diagnosis. These patients are known to have irregularities in body temperature. The ideal time to take blood sample from them is when the temperature is at its highest level. By using the system, whenever the body temperature is exceeding the limit that has been set, the system will be activated. The system uses Radio Frequency Identification (RFID) and GSM network for the project to achieve its objectives.

RFID is a wireless technology that has an ability to identify, locate, track, and monitor people and object between the tag antennas and the reader. RFID reader obtains the information of objects and surrounding through communication with RFID tag antennas. These antenna and transceiver read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted.[1]

So, for this project, the RFID tag will include temperature sensor on it and having a dedicated threshold value. Whenever temperature is exceeding the threshold value, it will be triggered and responding to the RFID reader. Then, RFID will send signal of the triggered location to the PC and alert the nurse. From here, GSM modem will take charge where nurse will send notifications via SMS to doctor's on duty.

1.2 Problem Statement

Malaria and typhoid fever patient suffers from fever spikes; where the body temperature rise and fall in a sudden. Patients of these two fevers need extra supportive care and the only physical sign that doctor can have from a suspected patient is fever. The fever is initially persistent. The doctor or nurse usually has to check the patient every four hours to take their temperature. When the temperature of the fever is around its peak (39-40°C), that is the time to take blood sample to check whether there are active parasite or bacterium that related to malaria or typhoid. At that temperature, the patient is potentially to get unconscious and the body may become over- hydration or under-hydration. So, nursing care is important at that time. The late and lack of treatment at that period of time may become life-threatening to the patient.

The main concern here is that the doctor cannot predict when the temperature of the patient exceeds its limit and the patient are all alone when his or her temperature is over the limit. So, by creating this new system, it will solve this problem where it can assure that the patient will receive the quickest treatment as notifications via SMS to the patient's doctor and alarm at the nurse's station whenever the patient's body rises over its limit. Besides, the system will ease the nurse from attending to the patients to take their body's temperature.

1.3 Objective

The main objective of this project is to focus on application of RFID and GSM in medicine. The other objectives are to design a system that can;

1 automatically measure body temperature for certain preset threshold value and record them into patient's database for monitoring purposes.

2 alert the nurse at her station and send SMS to the doctor whenever patient's core body temperature reach the peak of the fever (39°C).

1.4 Scope of Study

2.1.1 Analysis the symptom of Malaria and Typhoid fever

In developing this system, the author needs to understand theoretically and also the manual process involve at the hospital for these two types of fever. From here, the author will know about things and information needed to develop the system.

2.1.2 Perform analysis of RFID tag and reader suitable for the project

In designing the system, the author should know about the current manual set up work used in hospital nowadays. In designing this system, some criteria should be considered. The first one is the range of communication between the tag at the patient and the receiver at the nurse's station. The second one is the ability of the system to operate between the ranges of temperatures and detect the rise of the temperature from normal condition.

2.1.3 Built a suitable GUI with Visual Basic (VB) and database system with MySQL

A suitable database is needed besides the communication technologies used. Database with doctor's and patient's information must be clear and easy to retrieve by VB. Thus, GUI of the system need to be user friendly so that the nurse can easily adapt with this new system.

1.3.4 Test at the hospital

After developing the prototype, this system will be tested at hospital. From there, further integration and modification will be made to make the system runs smoothly.

1.5 Output of the system

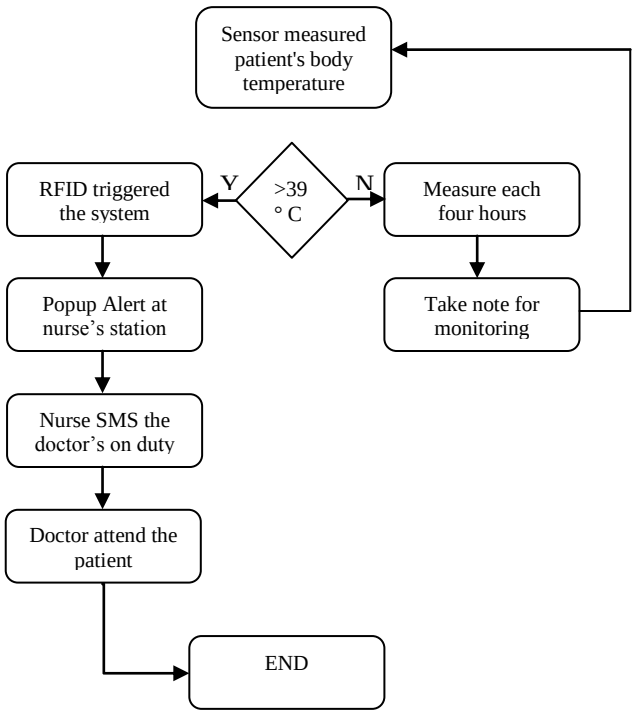

Figure 1: Flow of the System

LITERATURE REVIEW

2.1 Malaria

What is malaria? Malaria is one of the planet's deadliest diseases and one of the leading causes of sickness and death in the developing world. It is a disease caused by a parasite called as *Plasmodium*, which infects red blood cells. There are four species of malaria; the serious type is *Plasmodium falciparum* malaria. It can be life-threatening. The other three species of malaria (*P. vivax*, *P. malariae*, and *P. ovale*) are generally less serious and are not life-threatening. [2]

How we can be infected by these parasites? The infection involves two hosts; humans and mosquitoes. The disease is transmitted to humans when an infected mosquito bites a person and injects the malaria parasites into the blood. This parasites travel through the bloodstream to the liver, multiply there and then infect the human red blood cells. [3]

Symptoms of malaria include fever as high as 39° to 40° C, headache, pains elsewhere in the body and also vomiting; usually appear between 10 and 15 days after the mosquito bite. On physical examination, fever is the only sign to detect malaria patient. If the doctor missed the physical sign and the patient is not treated, malaria can quickly become life-threatening by disrupting the blood supply to vital organs. [4]

According to the Ministry of Health Malaysia [5], the incidence rate (per 100 000 populations) of malaria as below:

Table 1 : Table of Malaria cases reported in Malaysia

Year	No of case
1999	25.90
2000	57.20
2001	53.22
2002	44.91
2003	25.28
2004	24.56
2005	21.31
2006	19.87

2.2 Typhoid

The second disease that we will discuss and research in the project is typhoid or also known as enteric fever. It is a serious infection that is caused by the bacterium *Salmonella typhi* (S. Typhi). [6] This bacterium only lives in humans.

How can a person get this disease or in other word, how the disease is transmitted? Anyone can get typhoid fever if they eat food or drink beverages that have been handled by a person who is shedding *S. Typhi* or if sewage contaminated with *S. Typhi* bacteria gets into the water used for drinking or washing food. [7]

Once *S.* Typhi bacteria are eaten or drunk, they multiply and spread into the bloodstream. The body reacts with sustain fever as high as 39° to 40° C and other signs and symptoms. The other sign and symptoms are; constipation or diarrhea, loss of appetite, rose-colored spots on the trunk, and an enlarged spleen and liver. Relapses are common. Symptoms are generally appearing one to three weeks after exposure.

According to the Ministry of Health Malaysia [5], the incidence rate (per 100 000 populations) of Typhoid as below:

Table 2 : Table of Typhoid cases reported in Malaysia

Year	No of case
1999	3.70
2000	3.40
2001	2.89
2002	3.48
2003	3.13
2004	1.93
2005	4.10
2006	0.77

2.3 Overview of RFID

For this project, RFID is one of the main technology that being used. RFID is the member of Automatic Identification and Data Capture (AIDC) technologies. It is fast and reliable means of identifying just about any material object. There are three basic components in RFID system, which are tags, readers, and antenna.

The tag contains at least two parts; Integrated Circuit (IC) and antenna. IC is for storing and processing information, modulating and demodulating a radio frequency (RF) signal while antenna is for receiving and transmitting the signal. There are two types of RFID systems, passive and active.

The reader is a device that provides network connectivity between tag data and interface. The reader is also known as an interrogator and it communicates with the RFID tags within its field of operation, performing any number of operations including simple continuous inventorying, filtering (searching for tags that meet certain criteria), writing to selected tags, etc.

2.4 RFID-Tags

RFID tags can be classified into three different types; active, passive and semi passive. All of these types have their own operating characteristics and the means by which they receive power for transmission determines their type.[8]

Active RFID Tags are powered by an internal battery and are typically read/write, where tag data can be rewritten and/or modified. It has a long range communication approach that has a reading distance between 50 to 100 m (150 to 300 feet). The battery supplied power of an active tag generally gives it a longer read range. The trade off is greater size, greater cost, and a limited operational life.[9]

Passive Tags operate without a separate external power source and obtain operating power generated from the reader. The advantages of passive tags are lighter than active tags, less expensive, and offer a virtually unlimited operational lifetime. The disadvantages are that they have shorter read ranges**,** typically a few feet at most than active tags and require a higher-powered reader. Read-only tags are typically passive and are programmed with a unique set of data (usually 32 to 128 bits) that cannot be modified.

Semi passive tags use battery to run the chip's circuitry, but communicate by drawing power from reader [10]. Once triggered by the reader's RF signal, these tags employ their own powers drained from the battery to perform their task.

Basically there are five differences in characteristics between active and passive RFID tags which are [11];

i. Differences in the Technical Characteristics

Active tag features two additional components compared to a passive tag that are, an on board power supply and on board electronics. The on board electronics consisting of sensors, microprocessors and I/O units are powered by the on board power which enables it to transmit the data to the reader on its own. With a continuous availability of tag power, the required signal strength from the reader to the tag is lower than what is required for a passive RFID tag. Also, the available signal strength is higher from a tag to a reader in an active tag.

On the other hand, Passive tags contain an integrated chip or circuit to absorb radio frequency waves from reader's signals and to send and receive data, low frequency or high frequency antenna and a plastic or mylar substrate which holds the pieces of the tag together. Since there is no battery, the power is supplied by the reader which draws the radio waves through the antenna forming a magnetic field. This allows the supply of the power to the tag which is restricted to the field of the reader.

ii. Communication Range

Passive RFID tags are constrained by the need for strong signals to power the tag and the small amount of power to respond to the reader, the communication range of a passive tag is limited to 3 meters or less. Active tags do not have the constraint of power and can thus transmit to as far as 100 meters or more.

iii. Data Storage

Active RFID tags have large read and write data storage almost 128 kilobytes and sophisticated data search and access capabilities while passive RFID, the data storage is less than 128 bytes with no search capabilities or data manipulation features.

iv. Multi Tag Collection

Passive RFID tag can collect 100 or so tags, at the range from only a single reader while an active tag can collect more than 100 tags from a seven acre region using a single reader.

2.5 Reader/Antenna

RFID reader is used to interrogate with RFID tags. It contains a module (transmitter and receiver), a control unit and a coupling element (antenna). The functions of the reader are: energizing, demodulating and decoding. Energizing is a process when an RFID reader emits a low-power radio wave field which is used to power up the tags. Demodulation is when the reader extracts the original information-bearing signal from modulated carrier wave by RFID tags. Decoding is the process where turning the raw incoming data received from RFID tag into meaningful context information for further processing and subsequent actions. It can be fitted with an additional interface that converts the radio waves returned from RFID tag into a form that can be passed on to another system such as computer or any programmable logic controller. [12]

RFID reader has anti-collision algorithms that permit simultaneous reading of large number of tagged objects while ensuring that each tag is read only once. RFID reader obtains the information of objects and surroundings through communication with RFID tag antennas.

The reader uses its antenna to send digital information encoded in a modulated waveform as well as the tone that the tag uses to power itself. A receiver circuit on the tag is able to detect the modulated field, decode the information, and use its own antenna to send (backscatter) a response. Readers may be fixed

(dock door or shelf installations), mobile (installed on a forklift or hand-held), or in the form of a module contained within a printer/encoder.

An antenna converts electrical current into electromagnetic waves that are then radiated into space in a particular pattern at a given level of intensity. A linearly polarized antenna radiates entirely in one plane in the direction of signal propagation, while with a circularly polarized antenna, the plane of polarization rotates in a circular fashion (effectively a corkscrew when considered in time), making a complete revolution during one period of the wave. Below figures shows the basic configuration of reader and tag antenna in any RFID application [13] and RFID reader itself.

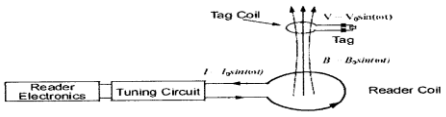

Figure 2: Basic Configuration of Reader and Tag Antenna in RFID Application.

Figure 3: RFID Reader

2.6 Operating Principles of RFID

2.6.1 Inductive Coupling

Inductive coupling means that the tag and the reader's antenna are coupled by the magnetic flux through both coils. Inductively coupled transponders are almost always operated passively where all the energy needed for the operation of the microchip has to be provided by the reader. For this purpose, the reader's antenna coil generates a strong, high frequency electro-magnetic field, which penetrates the cross -section of the coil area and the area around the coil. Electro-magnetic field may be treated as a simple magnetic alternating field with regard to the distance between transponder and antenna due to the wavelength of the frequency range used (< 135 kHz: 2400 m, 13.56 MHz: 22.1 m) is several times greater than the distance between the reader's antenna and the transponder.

This inductively coupled system is based upon a *transformer-type coupling* between the primary coil in the reader and the secondary coil in the transponder. This is true when the distance between the coils does not exceed 0.16 l, so that the transponder is located in the *near field* of the transmitter antenna.[14]

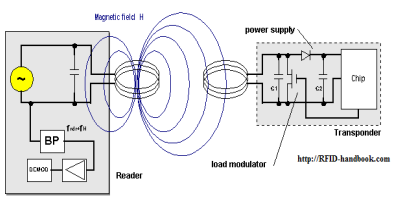

Figure 3: Operation Principle of Inductive Coupling

2.6.2 Backscatter Coupling

The electromagnetic waves from reader are reflected by objects with dimensions greater than around half the wavelength of the wave; in this case transponder. The efficiency with which an object reflects electromagnetic waves is described by its reflection cross-section. Objects that are in resonance with the wave front that hits them, as is the case for antenna at the appropriate frequency for example, have a particularly large reflection cross-section.

As in Figure 5 below, power P1 is emitted from the reader's antenna, a small proportion of which (free space attenuation) reaches the transponder's antenna. The reflected signal travels into the antenna connection of the reader in the backwards direction and can be decoupled using directional coupler.

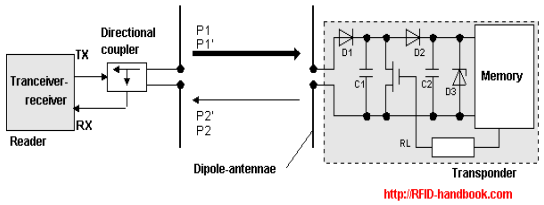

Figure 5: Operation Principle of a Backscatter Transponder

2.7 Operating Frequencies

RFID operates in unlicensed spectrum space, where its operating frequencies are refers to the size of the radio waves used to communicate between the RFID systems components. It is generally safe to assume that a higher frequency equates to a faster data transfer rate and longer read ranges, but also more sensitivity to environmental factors such as liquid and metal that can interfere with radio waves.

The operating frequencies are divided into several ranges or bands. With the exception of the lowest-frequency segment, each band represents an increase of frequency corresponding to an order of magnitude (power of 10). Table 3 depicts the eight bands in radio frequency spectrum, showing frequency and bandwith ranges [15].

Table 3: Eight Bands in Radio Frequency Spectrum

Designation	Abbreviation	Frequencies	Free-space wavelength
Very Low Frequency	VLF	9kHz-30kHz	10km-100km
Low Frequency	LF	30kHz-300kHz	1km-10km
Medium Frequency	MF	300kHz-3MHz	100m-1km
High Frequency	HF	3MHz-30MHz	10m-100m
Very High Frequency	VHF	30MHz-300MHz	1m-10m
Ultra High Frequency	UHF	300MHz-3GHz	10cm-100cm
Super High Frequency	SHF	3GHz-30GHz	1cm-10cm
Extremely High Frequency	EHF	30GHz-300GHz	1mm-10mm

RFID systems currently operate in the Low Frequency (LF), High Frequency (HF) and Ultrahigh Frequency (UHF) bands. Each frequency has advantages and disadvantages relative to its capabilities. Table 4 shows a quick cross-section of the types of RFID technologies out there, their uses and their typical read ranges [16].

Table 4: RFID Frequencies, Uses and Typical Range

Frequency	Use	Pros and Cons	Range
125 kHz- 148 kHz Low Frequency (LF)			
Type: Passive	Animal Tracking, access control and Original Equipment Manufacturer (OEM) Applications	Signal negotiates liquids and metals fairly well. Higher tag cost due to long length solid copper antennas	½ to 4" is typical. 6" to 12" or maybe possible with specialized equipment.
13.56 MHz High Frequency (HF)			
Type: Passive	Anti-theft, document management, access control and OEM Applications	Antennas can be printed on substrate/labels, lowering tag costs. Serious interference from metals.	Can range from inches to several feet depending on reader hardware and tag type.
433 MHZ (and 2.5 Ghz) Ultra High Frequency (UHF)			
Type: Active	Highway toll payment systems, vehicle management, asset tracking, etc.	Very long range. Very high tag cost. Uses battery, so tags have finite lifespan (typically 5 years)	Typically around 30 feet, but can range up to hundreds of feets.

2.4 Overview of GSM Modem

Global System for Mobile Communication (GSM) modem is a wireless modem that works with GSM network. Wireless modem behaves like a dial-up modem but the main difference between them is that dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The number of SMS messages that can be processed by a GSM modem per minute is very low, which is only about six to ten SMS messages per minute[17].

A GSM modem can be an external device or a PC Card / PCMCIA Card. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the AT commands, this modem can have a function as below;

i. Read, write and delete SMS message
ii. Send SMS messages
iii. Monitor the signal strength
iv. Monitor the charging status and level of battery
v. Read, write and search phone book entries

2.5 RFID Application

2.5.1 RFID temperature/ID tags could help spot bird flu [8]

Company named, Digital Angel Corporation had introduce its patented 'Bio-Thermo' temperature-sensing, implantable RFID chip and identity system to international poultry/bird markets with an initial geographic emphasis in Asia - with a view to helping poultry breeders spot early signs of disease such as Avian Flu. This company for now has focused its implantable RFID temperature sensing system on the pets and horses.

The identity system includes the Bio-Thermo chips and related ID and temperature-sensing RFID scanners that aim to provide early identification of temperature increases in individual birds. With this, it may in turn help with the identification and control of outbreaks of avian diseases.

With early detection of temperature increases, identifying and controlling disease outbreaks become important; such monitoring could help farmers avoid the complete destruction of their stock by identifying, quarantining and monitoring suspected cases at an individual level.

Besides using it for the birds, this Bio-Thermo is also being used in pets. The chip will be put into the pet's body and be registered specifically to the owner. The benefit is that it can take accurate reading of the pet's core body temperature.

2.5.2 Application in monitoring and traceability of hemoderivates [9]

There is a system used by hospitals to secure and monitor the temperature of their blood bank. Whenever the temperature of the blood bank is over its limit, the system will send alarm for the hospital to take action. It is also used in blood bag that they wanted to be transfer to somewhere else. This system provides product quality assurance before the blood bags are used by discarding the ones that turn out to be defective because of insufficient conservation standards. So, the design of this new system is for hemoderivate product storage and production technology. In effect, this will avoid many blood transfusion risks.

2.5.3 Trailer temperature alert [10]

This temperature alert is mainly used in chilled or refrigerated trailer. It has an in-can cab radio receiver incorporating a clear four digit LED display and temperature alert, linked to a temperature transmitter fitted within the trailer. The receiver is preprogrammed with 'acceptable temperature' parameters within the range –20°C to +55°C. This temperature alert can therefore be used with both cold and warm produce.

Received temperature data outside the programmed parameters (typically 0°C - +5°C) will activate the alert function and cause the display on the truck dashboard to flash on and off until the temperature returns within limits, when the unit will resume a steady display; or until the receiver is turned off. With this, the driver will alert with any changes and manage to take action when anything goes wrong with the temperature of their trailer.

2.5.4 RFID Pill Monitors Body Temperature [11]

Researchers in The Netherlands were able to monitor the body temperature by swallowed an RFID-based temperature sensor that measured their internal temperature. This will helped researchers identify potential health issues. This RFID technology has been used by volunteer participants at the world's largest marching event in the annual Four Days Marches of Nijmegen. With this pill, the researcher can monitor the marcher's core body temperatures so that they will not exceed recommended levels and prevent them from exhaustion or overheating.

Using complex event processing (CEP) technology, researchers were able to monitor and record the temperatures via a signal transmitted every ten seconds from the RFID "pill" to a receiving device in the volunteer's backpack. That data was then transmitted via Bluetooth to a GPS-enabled mobile phone to the operations center handled by the researcher themselves.

CEP is an event processing technology that allows an application to analyze multiple streams of event data, and then react to those conditions quickly. The CEP platform processed and analyzed the temperature data in real time. If a volunteer's body temperature was too high, officials could alert them to either rest or rehydrate using SMS text messaging, calling them on the mobile phone, or by alerting the onsite medical team to take action if needed.

METHODOLOGY

3.1 Methodology Overview

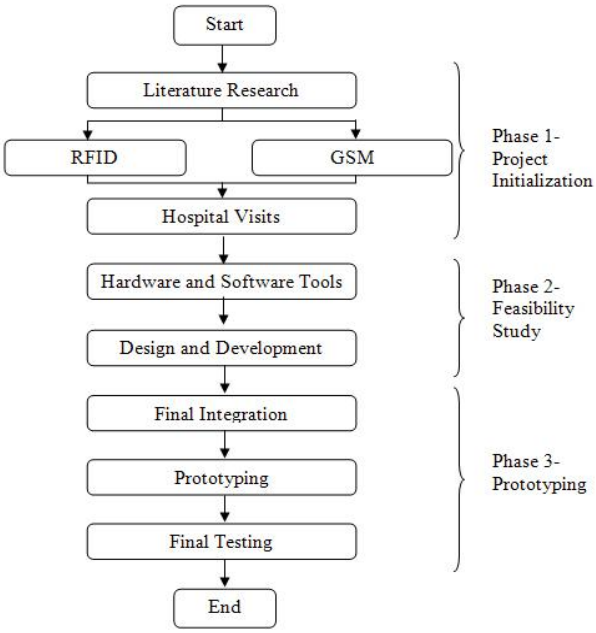

Figure 4 : Flow Chart

3.1.1 Phase one (Project Initialization)

Phase 1 is the early stage of the project development. Firm planning and understanding of the project is a must so that the project will be smoothly done. The understanding of the project is including the research on the technology that wants to be used that are RFID and GSM network.

Target hospital that will be implemented for this prototype is Hospital Sungai Buloh. The pioneer of this project; Mohamad Syukri Effendy has done this visit. The visit has given him the opportunity to meet the director of Hospital Sungai Buloh for professional opinion about the project and lots of advice given to see the project succeeded. This eventually will benefit the author as the successor for the project.

3.1.2 Phase two (designing)

Phase 2 is where the designing the layout and the process of the system will be done. Choosing the right hardware to be used and development of the software and the database must be ready within this phase. Researchers have been made for the hardware and software needed for the project. The hardware needed are RFID Active Tag Temperature Sensor, RFID reader, and GSM Modem.

3.1.3 Phase Three (Prototyping)

Last but not least is phase 3; it is the beginning of the fabrication for the prototype. The integration will be focusing on the interfacing between devices, hardware and system of the project. In final testing stage, the project should been tested for its completion after the prototype finished with the combining of all of the hardware and the software application. The final testing will be made by replacing actual Malaria and Typhoid fever patient with a device that can control temperature. This stage is to make sure that the system functions well before the actual testing will be done at Hospital Sungai Buloh.

3.2 Project Overview

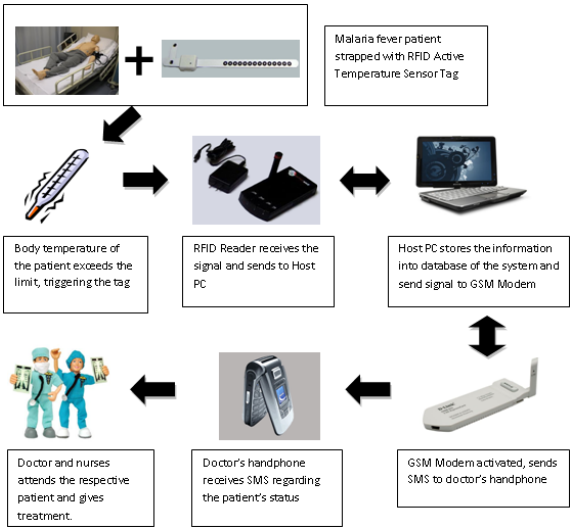

Figure 5: Project Overview

Patient will be strapped with the tag at his/her armpit to determine the body temperature. The limit for the temperature to exceed is 39^{o}C. Once the system triggered, the tag will send signal to the reader attached with the Host PC. Then Host PC will trigger alarm on it for nurses to be alert and send signal to GSM Modem for it to be activated. SMS will be sent to doctor's hand phone for him to be notified regarding the patient's status. The patient will be then receiving treatment from both of the nurses and doctor.

3.3 RFID Hardware and Specification

For this project, there are two most important things needed. They are RFID Active Tag Temperature Sensor and RFID reader.

Although active RFID need a power source compared to passive and semi-passive RFID tags, it can store much bigger data and information. It also can broadcast response signal to the reader. This active tag is typically more reliable as there are only fewer errors than passive tags due to the ability for it to conduct 'session' with the reader. The Active Tag Temperature Sensor used for this project has characteristics as below;

i- Long communication range (150 Meters)
ii- Having the capability of initiating communications (e.g. communicate with the reader each time patient having more than 39°C)
iii- Having the capability to perform independent monitoring and control
iv- Need battery power to function, which limit the lifetime and affect the cost for long-term maintenance.
v- Capable of perform independent monitoring and control

Second thing needed is RFID reader that used to interrogate an RFID tag. Readers communicate to the Host computer via an RS-232 cable or via an Ethernet network connection. Readers are used to read the tags and transmit the received data to the Host computer. Readers also used to enable, disable, wake up and program the tags. It has an antenna that emits radio waves while the tag responds by sending back its data. As in Figure 7, we can see that the RFID reader will use two frequencies that are 916.5 MHz and 433 MHz for transmitting and receiving signal. This is to avoid clashing of transmitting and receiving data from the tags. RFID reader for this project will be in beacon mode. Beacon mode is where the reader allowed the tag to continuously send the data to them in certain period minutes and place into the database.

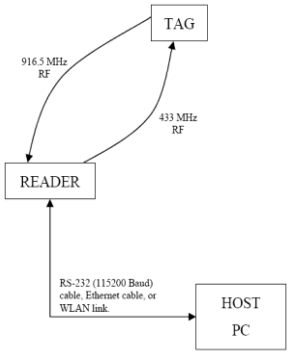

Figure 6: System flow for ActiveWave hardware used

Active Wave RFID reader field strength can be configured by ranging from 0 to 20. So, we can estimate the RF field from setting the strength ratio as shown in table

Table 5: Setting ActiveWave Reader field strength ratio corresponds to estimated distance

Field Strength Ratio	Estimated Distance (m)	Field Strength Ratio	Estimated Distance (m)
1	4.25	11	46.75
2	8.50	12	51.00
3	12.75	13	55.25
4	17.00	14	59.50
5	21.25	15	63.75
6	25.50	16	68.00
7	29.75	17	72.25
8	34.00	18	76.50
9	38.25	19	80.75
10	85.00	42.50	20

Figure 7 : Active Wave RFID Kit

Figure 6 shows the hardware tools that will be used for this project; manufactured by Active Wave.

RFID Kit Components:

I. 1 Active Wave Reader and Power Supply
II. 1 Active Wave RJ-45 Cable
III. 6 Active Wave Wristband Tags with Temperature Sensor
IV. 1 Programming Station Software Application

RESULTS AND DISCUSSION

4.1 Interface

4.1.1 Interface for System Login and Main Menu

The first step, user such as the nurse or doctors needs to login their username and password as in Figure 9 below. After the users succeed with the 'Login', 'Main Menu' will come up as Figure 10. 'Start' button must be clicked to start the program and switch the program on. Then, the user can choose to click either 'System Administration' to register a new user of the system or new patient, or 'Patient Record' to view specific patient with their temperature body.

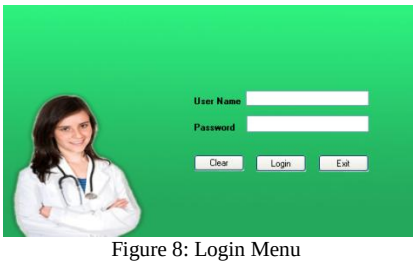

Figure 8: Login Menu

Figure 9: Main Menu

4.1.2 Interface for Administration

For administrator to register new patient or new user for the system, they just have to click 'System Administration' in Main Menu. This can be seen as in Figure 11. If they click on 'Add User', interface as in Figure 12 will come out while Figure 13 will come out if they click 'Add Patient'. They just need to complete the form and click 'Register' and then all of the information will be kept in database of the system.

Figure 10: Administration Menu

Figure 11: New User Registration Menu

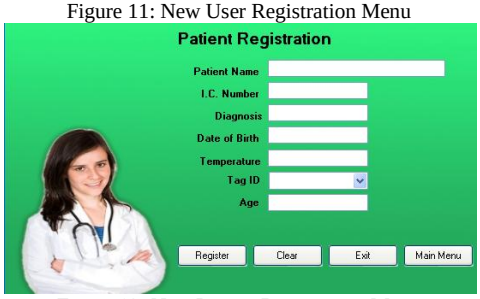

Figure 12: New Patient Registration Menu

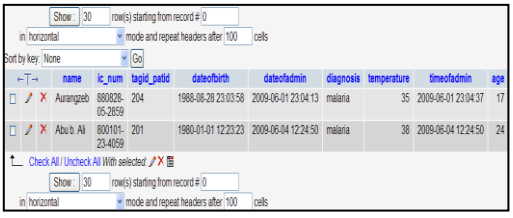

Figure 13: Database for New Patient Registration section

Figure 13 shows the Patient Registration Page for Add Patient section from previous Administration Page. The information required will include the patient's name, i/c no, diagnosis of disease, date of birth, temperature on admission, patient tag ID that the patient currently occupying and age. The submit section is where the information will be stored at the database of the system as shown in Figure 14.

4.1.3 Interface for Patient Record

When the nurse or doctor want to gather about their patient's information, they just have to click on 'Patient Record' on the 'Main Menu' and form as in Figure 15 will come out. When they enter patient ID and click 'Confirm Details', the patient's information gathered from related database will come out as history for them to analysis the trend of the patient's temperature.

Figure 14: Patient Record

4.1.4 Interface between Database and GSM Modem

Whenever there is an alert about any patient who reached high body temperature, the popup as in Figure 16 below will come out. Then the nurse will notify with it and when they click 'Ok' button, they have to click another icon at the desktop named 'SMS Alert'. The interface for this 'SMS Alert' is as in Figure 17. The nurse just has to fill the doctor's ID no and patient's tag no as indicate in popup (Figure 16) and click 'Check'. Once they did that, the interface will interact with the database and fill in the doctor's name, doctor's telephone number and patient's information and send the message once the nurse click 'SMS Doc'.

Figure 15: Alert Form

Figure 16: SMS Alert Form

4.2 Demo in front of Sg. Buloh Hospital's Director.

On 17th of September, the author and supervisor of this project, Ms. Hanita have made an appointment with Director of Hospital Sg. Buloh, Dr. Khalid Ibrahim. This appointment is made to have the first demo of the system and get feedback from him. Few feedbacks and information have been clarified further by him especially about the need of the system for Malaria and Typhoid fever patients. As being stated by Dr. Khalid, the bacterium of the fever is high when the body temperature is at its peak (39-40°C), and that is the time to take blood sample to check whether there are active parasite or bacterium that related to malaria or typhoid. So, this system has eased the doctor and nurse from checking the pattern of the patient's body temperature manually to have the diagnosis of the fever.

4.3 Testing the Device

4.3.1 Range between each tag and reader

This test needs to be done to check if any interference happened between each tag and reader that affects the efficiency of the system to send and receive the signal. If interference happened, it can defect the system where maybe the tag cannot send the signal to the reader although it has been triggered by the temperature of patient's body. The distance range from reader and the tag must also be tested to check for their capabilities of communicating with each other although at a long distance.

4.3.2 Time taken from the trigger time until message being send

This system has to be a fast system to make it efficient for the doctor and the nurse to take their action for the patients. So, the response time of the system must be tune when it is want to be implemented at the hospital.

4.3.3 User friendly interface

The system has been tested and demonstrated in front of few people just to get their opinion about the interface and adaptability of the system. It must be easy to use and user friendly.

. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

For this project, we can conclude that this system is essential for the doctors and nurses in detecting and serve the Typhoid and Malaria patient well. The systems that can measure and monitor the body temperature of the patient will ease the doctor to treat them quickly whenever a sudden rise of their temperature happened. Alarm at the nurse station and notifications via SMS to the doctor produce by the system definitely a good feature that can reduce the possibilities of fatal that can happen to the patient.

5.2 Recommendations

There are few of recommendations that can be done to improve this system better. They are as follows;

- The system can also be done to other type of fever or any temperature related disease such as dengue and cikunguya fever. This will benefit more people in wider cases of fever.
- Implementation of other RFID sensor than not only detects body temperature but also other necessary information such as blood pressure. This absolutely helps the doctor and nurses to act faster and more efficient.

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