SMS Fire Alert System

Erman Hardy Bin Mokhtar
Faculty of Electrical Engineering
Universiti Teknologi MARA Malaysia
40450 Shah Alam, Selangor, Malaysia
e-mail: 3rmanhardy@gmail.com

Abstract –Fire hazards are considered to be a nightmare when working in the power plant. Fire hazards in the power plant usually due to fire prevention methods which are not efficient in the working place. Fire hazards will cause damage and million dollars losses as well as reduce spin-national reserve by loads and eventually affect electricity consumers throughout Peninsular Malaysia. Since disasters are considered dangerous to the country, the appropriate response which are efficient or warning system must be implement to inform the unit operator at an early stage so that precautionary measures can be taken to avoid any circumstances. This paper presents the temperature level alarm system that was developed by using the thermocouple and GSM technology. The system focuses on remote monitoring of temperature levels and uses the connection of Global System Mobile (GSM) and Short Messaging System (SMS) to deliver data from the sensors to the users via their mobile phones, respectively. Hardware systems including recorder unit, three (3) thermocouple, and a GSM module. Software used for the system is Gammu thru (ATtention) AT commands. It is hoped that this project will benefit power plant workers and the country and will act as a precautionary measure in case of fire hazards. With early detection, the unit operator can take action quickly when there is a drop in temperature and stop the fire disaster to avoid higher losses.

Keywords: GSM Module, SMS, Thermocouple sensor and recorder.

I. INTRODUCTION

Recently, mobile phones are vital in modern day communication. For communication community, mobile phones act as a medium to communicate, interact or as a device to gain knowledge. Mobile phone is defined as a communication device used to interconnect between different geographical areas. There are many features available in modern mobile phones nowadays that would satisfy the needs of the users. Among the most popular applications in a mobile phone is Short Messaging System (SMS).

Based on a research by Mr. Hillebrand and Mr. Trosby in the book "SMS the creation of Personal Global Text Messaging" (published by Wiley 2010), SMS text messaging is the most widely used data application in the world, with 2.4 billion active users, or 74% of all mobile phone subscribers [2]. Based on this fact, SMS application can also be applied to other form of information in order to help mankind. One of the ideas is to connect a sensing system and send alert or warning SMS indicating any mishaps to the user.

SMS can be exploited to be used by using a system in accordance with proper sensing system. Usually, the fire disaster cases caused by the default of operator unit level rise in temperature due to the power plant. A proper warning system must be implemented to inform the unit operator at an early stage so that precautionary measures can be taken to avoid any accidents.

Warning system implement at the early stage will pass the warning through the alarm system to indicate the area affected. However, it may fail to warn those affected due to ineffective information or late warning in certain area. With the rapid development of technology, continuous system monitoring and reliability needed to protect the power plant from any disaster. By imagining a thermocouple and GSM technology, this paper seeks to build a reliable response and the actual temperature level alarm system that will detect the response of the temperature level in the power plant and send an alarm SMS to the mobile phone unit operator and fire unit in the power plant .

SMS has been proven to be a reliable source of information recently. During Fukushima Japan nuclear power plant 2011 disaster, it has been found that most landlines were cutoff during that period. Most of the information was gathered using SMS as the lines are congested at that moment. This shown the reliability of SMS as it works on different band and can be used even though the lines are congested [1].

II. SYSTEM STRUCTURE AND WORKING PRINCIPLE

The structure of the system is shown in Figure 1. The system consists of three sensors, one based on the recorders, GSM modules and mobile phones. Sensor used is the k-type thermocouple temperature range -200 °C to 1250°C [6]. It works as a sender by sending a signal 5V to the recorder for data analysis. Temperature sensor has been used for this project because of its unique capabilities for the detection of low and high temperatures.

Recorder model used is the dx2000.Dx2000 was chosen because it is able to read data at high speed. Since the project is carried out at the gammu program, it is best to use this recorder. Other special feature includes a 30 input and 30 output, it's latest in the power plant industry.

GSM Module is a device used to transmit SMS signal to the intended users. By using GSM module, GSM network can be used since it is much more accountable during a fire.

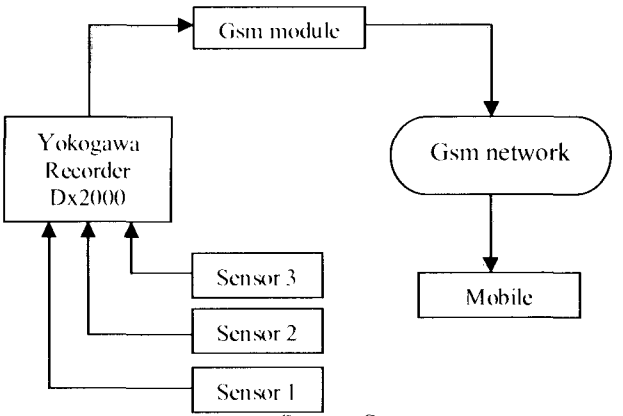

Figure 1. System Structure

TABLE I: SMS CONTENTS BASED ON CONDITIONS

Condition	SMS contents
Level One (Alert)	Temperature at Alert level
Level Two (Warning)	Temperature at Warning level
Level Three (Danger)	Temperature at Danger level

The working principle of the system is based on sensor detection shown in Table I. Level One sensor would be the lowest part of all sensors. When Level One sensor receives a signal from any of the sensor that receives the signal, It is means that the temperature has reached 65°C. Upon reaching the recorder, program would identify it as Alert trigger. Hence, recorder would send AT command of "Temperature at Alert level" to GSM module. Level Two sensor would be positioned higher than first sensor, which means the temperature has reached 75°C hence the SMS display would be "Temperature at Warning level'. The highest positioned sensor which is Level Three would send SMS of "Temperature at Danger level' if the temperature has reached 85°C.

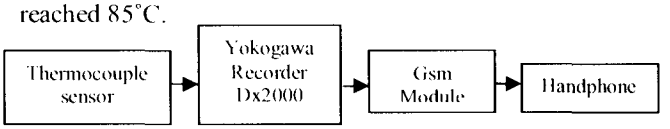

Figure 2. Block Diagram

From Figure 2, the block diagram shows the system consists of thermocouple sensors, a Recorder, GSM module and hand phone. Three (3) thermocouple sensors would be used to differentiate the escalation level. The data send by the sensors will be handled by the recorder. The recorder has been pre programmed for different input and would send different output through transmission pin. Commands are send using gammu program with relevant AT commands.

The transmitted output from the recorder will be conveyed through to the GSM module. By doing this, SMS alarm could be sent to respective users. Then, the users will receive different SMS depending on the level of sensors' detection. GSM network is being exploited to convey data to the users via short message alarm. SMS via GSM network is proven to be reliable due to it capability to works on a different band and can be sent or received although the phone lines are congested. It also has the advantage of sending data to multiple users (SIMO).

III. METHODOLOGY

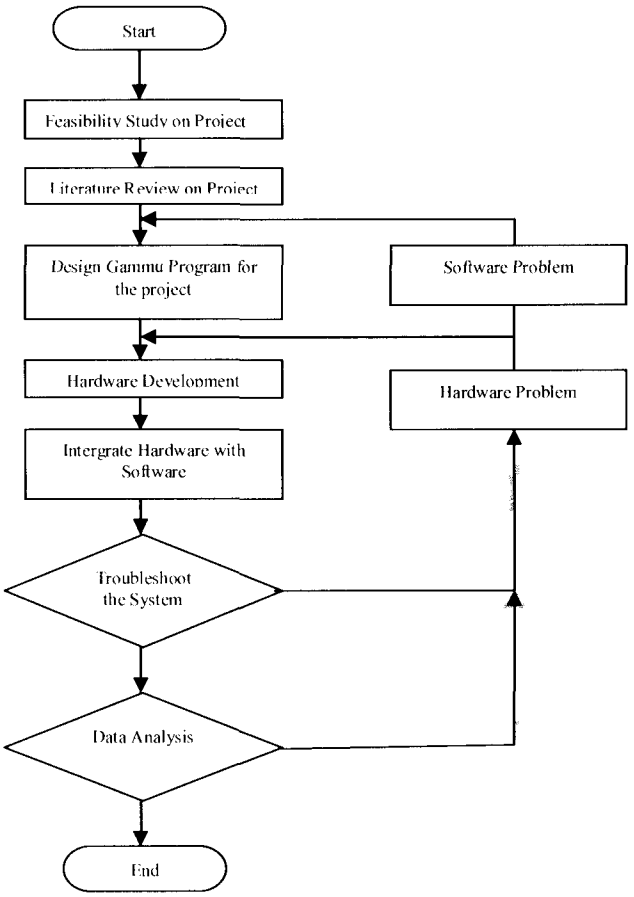

Figure 3. Flowchart

The project is based on the flowchart in Figure 3. Initial Feasibility Study was done to check whether the project is able to fulfill the objective in giving early warning whether a fire disaster has occurred or not. After that, Gammu program

need to be prepared for this project. Gammu program is chosen due to the ability of the system to use AT commands. Once the Gammu program has completed, hardware modeling is prepared for prototype purpose. Integrating Gammu program with hardware is done to check the viability of the project. During this period, any problems encountered will have to be adhered and amendments must be rectified. The last step is to do analysis for the system to ensure it is working properly.

IV. DESIGN OF SYSTEM SOFTWARE

System software is developed together with Gammu program. It has two segments, the input segments which control the data from the sensors and the output segment; which control the data send to GSM module.

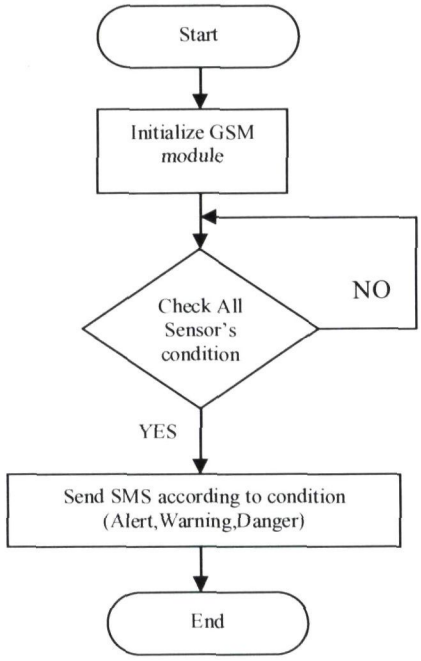

Figure 4. Software Flowchart

System is based on software flowchart shown in Figure 4. In the Gammu program, GSM module will be initialize first. It is the most critical step as this will allow GSM module to establish connection with GSM network. After initialization, all sensors' condition would be check. This is a loop process, as this step will be continuously checked throughout the program. If there are any changes to the sensors, SMS signal would be send to the users based on the conditions. Conditions are applied according to which sensors detect the first variations.

IV. DESIGN OF SYSTEM HARDWARE

Prototype system has been created for this system. As mentioned above, recorder dx2000 was chosen as it is the most common and widely used recorder available in the market. Besides that, it can be used with gammu program. Gammu program was downloaded using appropriate downloader to the recorder. Three sensors had been selected as the inputs for the system and Easygate GSM module as the output. 240Vac power supply is used to supply voltage to the system.

V. RESULTS AND DISCUSSION

Several tests had been conducted to verify the condition of SMS Fire Alert System. The tests were conducted to accomplish the objective of the project that the system able to give SMS alert whenever the sensors detected changes of temperature level. The tests that have been done are:

a) SMS alert receive by the user according to the conditions
b) Recorder Check for variations at sensors Signal point
c) Test at Coal slot bunker Stesen Janaelektrik Sultan Salahuddin Abdul Aziz, Tenaga Nasional Bhd.

A. SMS Alert receive by the users according to the conditions

For this test, system was tested to check whether SMS sent to users are according to the flowchart. Sensor's signal which has been set using 5V for each signal. The system has been connected to detect signal from the lowest sensor (Sensor 1) and gradually to the highest sensor (Sensor 3).

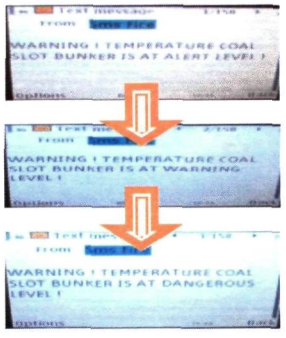

Figure 5. Sequence of SMS to user

Figure 5 shows the SMS that the users will receive when the sensors detect changes at its parameter. The sequence has been programmed to be in the state as described in block diagram in Figure 6. Based on the result, the system shows that it is capable to send SMS based on the flowchart in Figure 6.

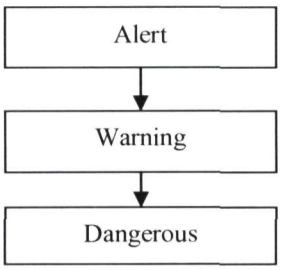

Figure 6. Block Diagram of SMS to user

B. Oscilloscope Check for variations at sensors Signal point

Oscilloscope test was done to check condition of sensors when there are changes to its present state. Oscilloscope test is important to check whether the signal that passed through the signal is correct based on the gammu program. From the test, users would be able to identify whether the sensors are working accordingly with the system.

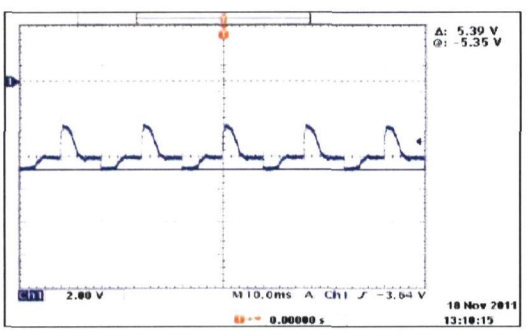

Figure 7. Signal of Sensors (without detection)

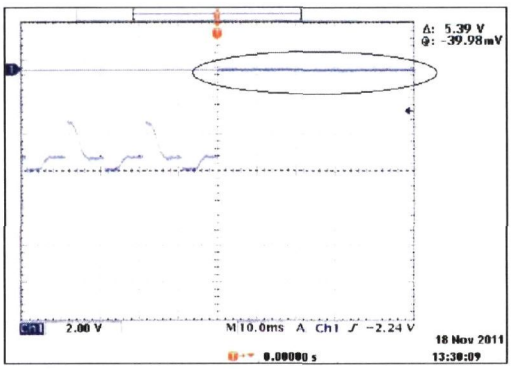

Figure 8. Signal of Sensors (with detection)

From Figure 7, it shows that the signal is a sinusoidal wave. Voltage applied during this condition is 0 V. After the sensor sense changes, it changes the state to 5 V. This can be seen in Figure 8, which indicates the voltage applied has been changed to 5 V.Gammu program were set using reverse condition, which means that HIGH input would send data to transmission pin as LOW. The output to RS232 is changed again from LOW to HIGH due to GSM Module only receive HIGH signal for transmission of SMS. The process of changing the state was done by using Inverter.

C. Test at Coal Slot Bunker Stesen Janaelektrik Sultan Salahuddin Abdul Aziz.

In order to prove the system is capable of functioning in real condition, the system has been applied to coal slot bunker Stesen Janaelektrik Sultan Salahuddin Abdul aziz. Threshold level of temperature coal slot bunker is 50%. Since this system will take effect after the threshold, sensors are placed at 65, 75, and 85 feet above the threshold. System will send SMS of any changes of temperature level above the threshold; which is 50°c. Based on the observation, the systems able to send correct SMS if the temperature level reaches above the threshold level. System were able to detect variations of temperature level from 0°c to 85°c and send correct SMS to users.

TABLE II: DATA COLLECTION AT Coal Slot Bunker Stesen Janaelektrik Sultan Salahuddin Abdul Aziz.

Temperature Level (°C)	SMS Code
65	Alert
75	Warning
85	Danger

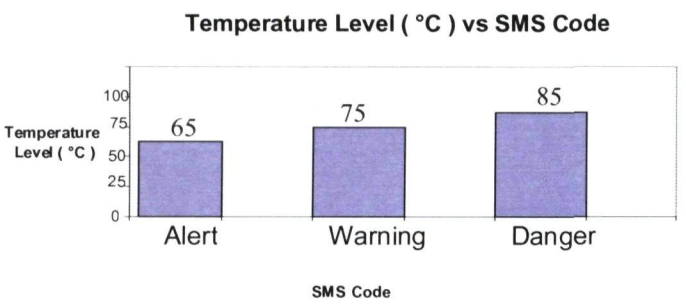

Figure 9. Graph of Water Level (feet) vs SMS Code

Based from result in Table II, graph of Figure 9 was able to be extrapolated. From the graph, it shows the system sent correct SMS to the users based on diversify conditions. By applying this system, engineers of Operation Department of Stesen Janaelektrik Sultan Salahuddin Abdul Aziz were able to monitor the condition of temperature level whenever there are any changes to the sensors. The system proved to be useful for the engineers and would help them in remotely monitoring the temperature coal slot bunker.

From the tests that have been done on the system, it is proven the system is capable to perform based on its criteria. The system is able to execute commands of gammu program according to the specification expected and accordingly to the flowchart. The output SMS alerts were in correct order and thus proven that the system is functioning well.

VI. CONCLUSION

In conclusion, the project SMS Fire Alert System is deemed as a success. The project is able to integrate between software development and hardware modeling. The system is also able to detect any increasing of temperature level and would send SMS alert to the respective users. The system also has been tested under several conditions to check the viability and ease of usage.

The system could be place at boiler system and turbine system. It can also be place in coal slot bunker since it has been tested at Stesen Janaelektrik Sultan Salahuddin Abdul Aziz. The SMS alert received by the users is on real time basis and this feature will allow users to take early preve ntive measures.

REFERENCES

[1] Www.guardian.co.uk/news/18/japan-nuclear-**power**-plant-updates.13rd april 2011,20:18

[2] Hillebrand & Trosby, "SMS The Creation of Personal Global Text Messaging", Wiley, 2008

[3] H Huang S Xiao X Meng & Y Ziong, "A Remote Home Security System Based on Wireless Sensor Network and GSM Technology", Southwest Jiaotong University, IEEE, 2010

[4] Dennis Rhody, "Satellite Communication 4th Edition", McGraw Hill, 2007

[5] Dr SK Bhattacharya, DR S Chatteri, "Projects in Electrical, Electronics, Instrumentation and Communication Engineering", S Chand & Co, 2008

[6] Http://www.omega.com/prodinfo/thermocouples.html.24th july 2011,17:30

[7] Http://wammu.eu/docs/manual.30th july 2011,15:00

[8] Stephen F. Jenks, Kane Kim, "A Linux-Based Implementation of a Middleware Model Supporting Time-Triggered Message-Trggered Objects", University of California, 2005

[9] Tae-seok Lee, Yuan Yang, "A SMS Based Ubiquitous Home Care System", University of Korea, 2005