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# Wireless Based Fire Notification and Real Time Monitoring System

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***Abstract*: Lately, cases of fire-related accidents have increased, both in the industry and at home. Most of these incidents have resulted in damage and loss to the owner. Worse, it causes injuries and death to the residents. To minimize and prevent such accidents, early-warning systems through smoke or fire detection apparatus have been established. Most affordable fire detector systems work only as a warning system. To add a control function to the system, the cost of owning it is quite expensive. It is important, to have advanced technology on such system, for users to ease their burden and also reduce accidents. Most existing fire alarm systems do not fully assist in the event of a fire. These sensors only warn people at the scene, and cannot alert those outside the area. When the sensor detects a fire, the user has to enter the burning building to find the monitoring panel, in order to detect the exact location of the incident. The chance for the fire to spread is increased when no one is at home. This process will delay the early response time to prevent such accidents. As a solution to this problem, wireless real-time monitoring fire alarm systems need to be developed. By monitoring the system wirelessly, customers can observe the location of the fire remotely, without them being there. As a result, it can reduce fire rates and even protect people from unnecessary incidents in their homes.***

***Keywords* : *Sensor; Monitoring; System*.**

## I. INTRODUCTION

The use of wireless applications has been widely used today, such as in electronic devices, mobile phones, remote controls, and global positioning systems (GPS) [1]. It is part of Radio Frequency (RF) technology [2].Basically, RF technology uses radio frequency waves to transmit and receive the data signals [3]. The incidence of fires is increasingly being ignored, and the Government should take more serious action. There are various ways or approaches that can been taken to prevent fire [4]. The latest development is by using a multi-home alarm system based on GSM technology [5].

The system works by sending Short Message Service (SMS) to the user in case something dangerous happens at home. The principle of the system, when smoke or fire is detected, an alarm will be triggered to warn people in the area and at the same time, the owner, or fire fighter will received SMS of the incident remotely [6].

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The purpose of this project is to develop prototype of Wireless Based Fire Notification & Real Time Monitoring System at home by using Arduino Microcontroller [7], MQ2 Sensor [8], PIR Motion Sensor, Flame Sensor, Manual Call Point, XBee [9] and Graphical Programming Language [10] for monitoring and control.

The prototype of this fire alarm system is developed to give the public an overview of how the whole system works in actual environment. The system is expected to provide more security and environmental benefits.

## II. EXPERIMENTAL

This project consists of two parts, namely hardware and software. For the software implementation, it involves Arduino programming and XBee configuration. Each part of the project will be discussed in detail in this chapter. Figure 1 illustrates an overview of the proposed system in this project.

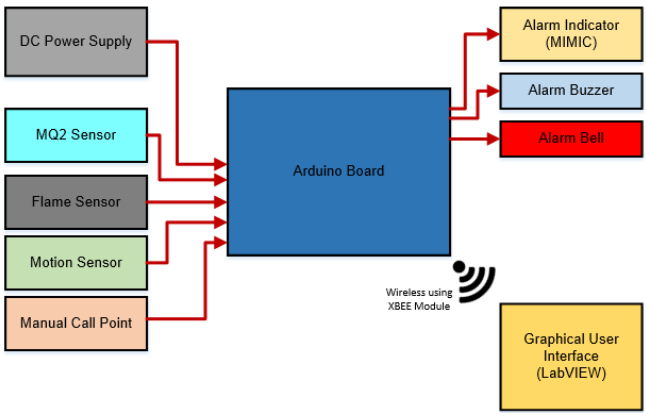


**Figure. 1 Project Overview**

The diagram above describes the THREE (3) types of sensors used as inputs to the Adruino board. These sensors are MQ2 sensor (which detect gas), flame sensor (which detect heat), and motion sensor (which detect movement). When the reading value of these sensors exceeds the set limit (denoting the presence of gas, heat and movement), the micro-controller will take over the system function by triggering the output signal to the alarm system. At the same time, the Adruino will transfer the information to the LABVIEW wirelessly using XBee module.

As seen from Figure 1, the brain of this system is the Arduino board. The Arduino will analyze all input signals according to sensor value detected. The detected value will determine the output of the LED indicator (MIMIC diagram) and then trigger the buzzer and alarm, to alert the user of the occurrence danger.

Figure 2 shows the workflow of the developed prototype system in this project. First, the Arduino will record the voltages from the Manual Call Point and smoke, flame and motion sensors. Manual Call Point works as a manual switch and requires human intervention to active the alarm system. These data is sent to desktop wirelessly by using XBee. LABVIEW is then used to display these value graphically. If the voltage recorded not exceeding the threshold values, the Green LED display in the LABVIEW panel representing these input will be in 'ON' state.

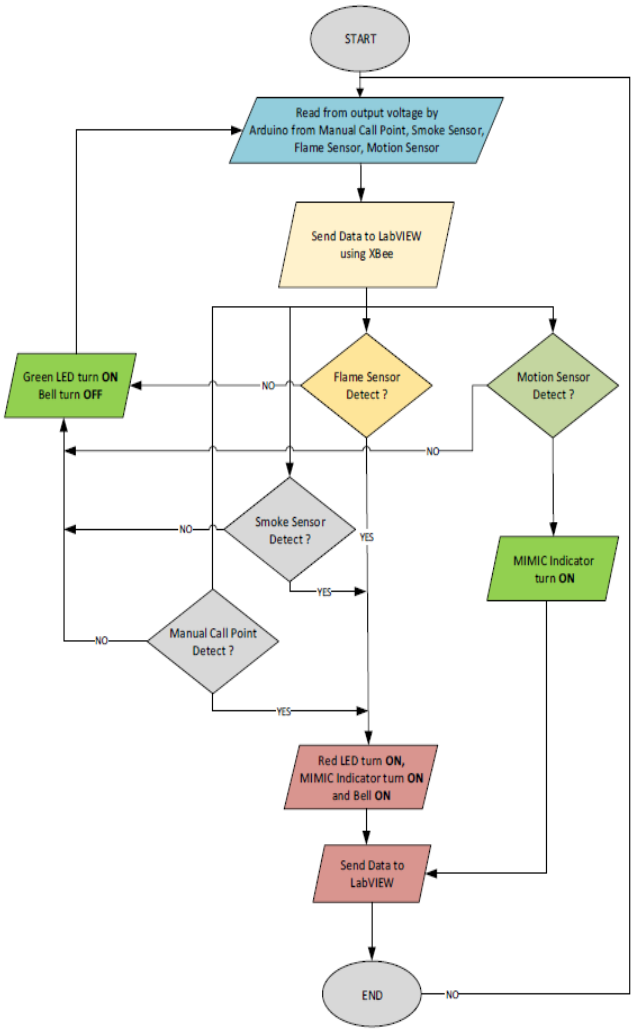


**Figure. 2. Project Flowchart**

When the values recorded by the Adruino from these sensors is greater than the threshold values, it indicates that flame, smoke and motion were detected or the Manual Call Point has been activated by someone. The Red LED indicator on the LABVIEW will be turn 'ON', and the alarm (from the bell and buzzer) will be 'ON'.

Figure 3 shows the circuit diagram for the hardware part. We used Adruino Uno as the main controller. The inputs of the Adurino Uno is wired to the sensors. We used XBee Shield and XBee Module to communicate with SKXBee module. The output from the Adruino UNO is connected to the MIMIC Indicator and Relay modules (which wired to alarm system (LED, Buzzer and Bell).

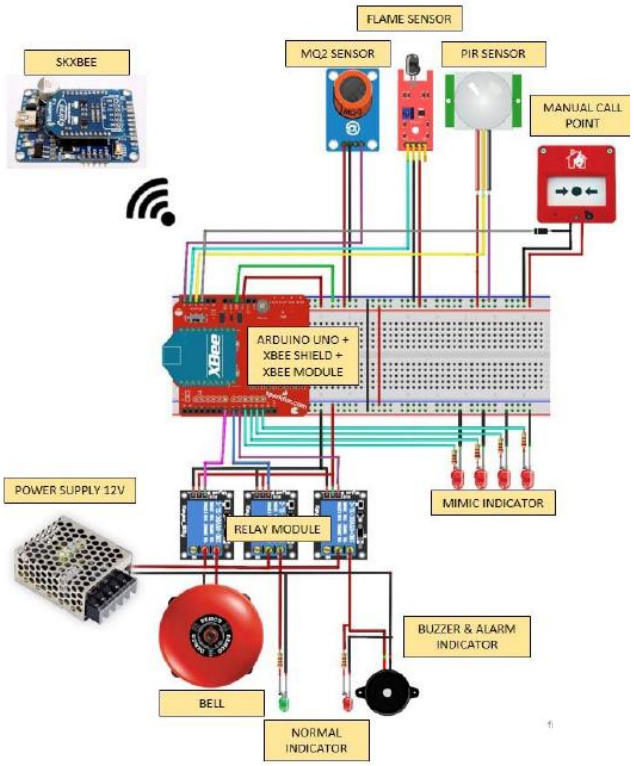


**Figure 3. Circuit Diagram**

The system design consists of Arduino IDE and LabVIEW programming. First, the Arduino and LabVIEW need to be validated, through LabVIEW block diagram and LINX base block diagram function.

In Figure 4, Graphical User Interface (GUI) for the front panel designed using LabVIEW is illustrated. It consist of Serial Port selection for SKXBee that specified by visa resources name to a specified setting and Port for Mimic Indicator on the Panel. The GUI also show the indicator and voltage in the present of smoke, flame, and manual call point when the fire occurs. This system also accompanied with toggle point, to isolate the sound on the GUI when the alarm is triggered.

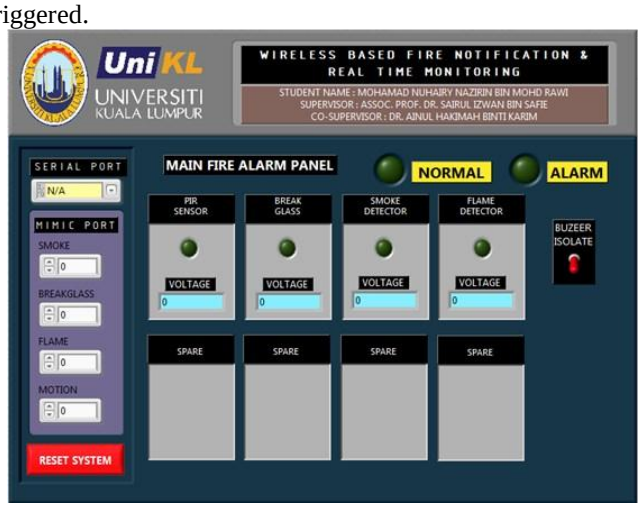


**Figure 4. Front Panel LabVIEW GUI**

Figure 5 shows the LABVIEW block diagram of the system.

This block diagram is important in monitoring and programming the system. From the figure, the LINX have three levels of interfaces, namely configuration serial port, read or write and close. This three interface must be set for interfacing the process. In this system, COM 22 has been selected as SKXBee in the serial port location. The default value of LINX establishes in communicating between Adruino and XBee module is using band rate of 9600.

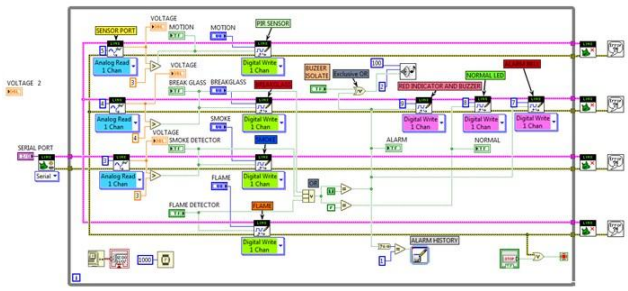

**Figure 5. Block Diagram**

## III. RESULTS AND DISCUSSION

As can be seen in Figure 6, the prototype of this Wireless-based Fire Notification and Monitoring System prototype has been fully developed, functioning and working as expected. This prototype is divided into (i) a fire alarm panel and (ii) a wireless monitoring system on LabVIEW interface. The MIMIC indicator acts as a monitor, to display the state of manual call point activation, motion, smoke and light sensors. This prototype uses 8mm thick plywood. It is sufficient to support the weight of all fire alarm equipment in this project. It took us 3 days to produce this prototype structure, which involved cutting, wiring, designing location panels and system sensors.

### A. Project Results

This project has been created based on the objectives mentioned in the previous section. The sensor is used to convert the measured parameters to analog voltage and transmit them to the Arduino. The voltage output of the sensor is in the range 0 to 5V. Once the data is received, the Arduino micro-controller will read the data in the digital format. This is done by processing the analog voltage using Analog-Digital-Converter (ADC) from 0 to 1024 in 10 bits. In addition, this fire alarm system will transfer data in LabVIEW wirelessly using the Xbee Module to complete the alarm system.


**Figure 7. Normal Condition on Panel**

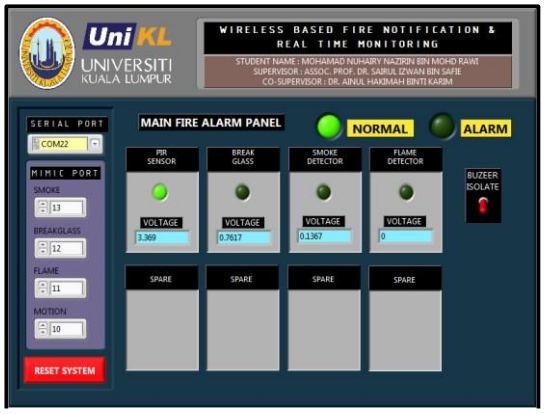


**Figure 8. Normal Condition on GUI LabVIEW**

Figures 7 and 8 above illustrate the panel fire alarm system in normal condition. In this case, no fire occurred while the system was running. The MIMIC LED indicator will turn on as shown above if the system detects a person's movement. In this case, the alarm is not triggered because the system only detects movement. He concluded that the situation was not dangerous. The sensor will trigger the MIMIC Indicator after the ADC voltage of the sensor exceeds 3V. It can be configured in the block diagram on the LabVIEW programming. The sensitivity and the motion sensor timers can be adjusted manually on the sensor module according to the customer's requirements.

Figure 9 illustrates example of the flame sensor detecting the presence of fire in this system. The flame and smoke sensor voltages are configured above 3V to trigger situations of fire and smoke. This flame sensor module has a photo diode to detect the presence of light from the fire. It generates logic '1' when fire is detected. Next, the alarm indicator, MIMIC indicator, bell, and alarm bell will be triggered. This GUI comes with a notification sound in the event of an alarm. In addition, this GUI also has buttons or toggles to disable or disable buzzer notifications on the LabVIEW.

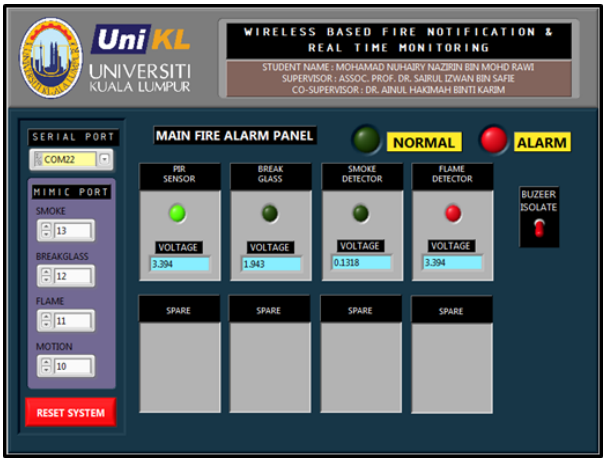


**Figure 9. Flame Sensor Detect on GUI LabVIEW**

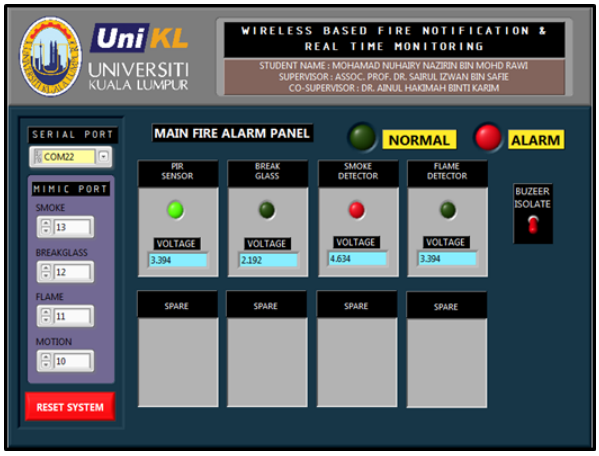


**Figure 10. Smoke Detect on GUI LabVIEW**

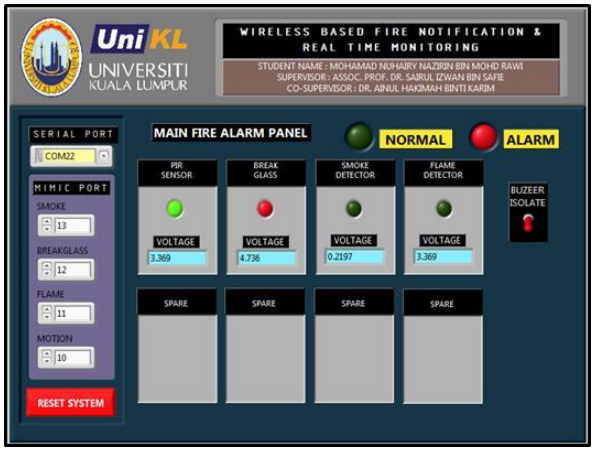


**Figure 11. Manual Call Point Detect on GUI LabVIEW**

Figure 11 above shows that the system detected human intervention in activating the alarm system. The Manual Call Point device requires humans or personnel to break the glass elements at the scene, in order to activate the alarm system.

### B. Data Collection of System

This system also generate data report every second while the system is fully functioning.

| Time | Event |
|---|---|
| Wednesday(08/05/2019 01:25 AM | 0 |
| Wednesday(08/05/2019 01:25 AM | 0 |
| Wednesday(08/05/2019 01:25 AM | 0 |
| Wednesday(08/05/2019 01:25 AM | 0 |
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**Figure 12. Data Report of Fire Alarm Panel Analysis of XBee**

**Table 1. Analysis of XBee Distance Range in Indoor**

| Distance (feet) | Transmitter and Receive Data of XBee | | | |
|---|---|---|---|---|
| | Test 1 | Test 2 | Test 3 | Test 4 |
| 10 | Yes | Yes | Yes | Yes |
| 20 | Yes | Yes | Yes | Yes |
| 30 | Yes | Yes | Yes | Yes |
| 40 | Yes | Yes | Yes | Yes |
| 50 | Yes | Yes | Yes | Yes |
| 70 | Yes | Yes | Yes | Yes |
| 80 | No | Yes | Yes | Yes |
| 90 | No | No | Yes | Yes |
| 95 | No | No | No | No |
| 100 | No | No | No | No |

These data are automatically saved in a computer in Microsoft Excel Worksheet (.xlsx) format. Based on Figure 12, value '0' in the event data report indicates that the alarm system is in normal condition while value '1' means the panel has detected a fire, smoke or the glass for the manual call point has been broken.

We then conducted experiments to determine the appropriate XBee distance that allowed it to send and receive data. These data are tabulated in Table 1. In general, XBee can work using two-way communication. Technically, the XBee data sheet states it can operate up to 100 feet (inside the building) and 300 feet (outside the building). In our experiment, the average distance we could communicate with each other was about 80 feet. Some of the important factors that affect the data transmission distances are the antenna and the size of the building. With the XBee Series 1 in this project, we found it is suitable for data transmission for distance under 90m.

## IV. CONCLUSION

In conclusion, the development of Wireless-Based Fire Alert Monitoring and Real-Time Monitoring Systems was fully implemented, and the objectives of the study were achieved. The objective of the project was to develop a prototype of a fire alarm control system, using an Arduino board, for home use.

The project also successfully used the XBee Module as a wireless device. Smoke, fire, motion and manual call points have been set as the input variables. Smoke sensors (MQ2) and flames have been selected based upon the specifications required for this fire detection system. The MQ2 sensor not only detects smoke, but also gas. In addition, the system also comes with a manual call point and a motion sensor, which users need in the event of a fire. These sensors are also easy to use and not easily damaged. Through this system, we can monitor the level of fire hazards at home without being there, by monitoring LabVIEW using the wireless User interface and displaying it on the internet.

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## AUTHORS PROFILE

**Safie S.I** received his Ph.D. degree in electronic and electrical engineering from the University of Strathclyde, Glasgow, United Kingdom. He is currently an Associate Professor and the Dean of Universiti Kuala Lumpur-Malaysian Institute of Industrial Technology. His research interest is in the big data, signal and image processing with application to biometric, psychological and physiological signal, image and video processing.

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