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Development of intelligent fire detecting and authentication framework using IoT

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Abstract-*Ensuring minimum rights and safety of the garment workers has become a burning issue nowadays. The workers of garment factories are facing some labyrinths and broken out of fire is surely one of them. The investors are losing their interest and the prominence of this sector is getting toneless. In this paper, we have propounded a system which is capable to detect fire and can provide the location of the affected region. Raspberry Pi 3 has been used to control multiple Arduino which are integrated with a couple of sensors and camera. A 360° relay motor is assembled with the camera so that it can snap the image in whatever angle the fire is detected. We have provided a confirmation of the fire suspecting system to avoid any false alarm. The system will immediately send a message along with the image of the affected spot and Arduino's location. An admin can confirm or deny the impeachment and if the admin confirms the situation as a breaking out of fire, then the system will immediately raise an alarm and an automatic message will be sent to the nearby fire brigade.*

I. INTRODUCTION

Fire causes huge loss of lives and properties every year in Bangladesh. Analyzing past fire incidents, facts are revealed. Some of the main causes are insufficient fire defense materials, electric short circuit from faulty electrical wiring, presence of inflammable materials, violation of fire safety and lack of adequate awareness etc. Some factories and recent buildings have proper installation and fire safety arrangements such as fire alarm, fire extinguishers, water supply system etc [3, 4]. But the argument is these conventional fire extinguishing systems are not enough to take prompt action during fire and save life. Traditional manual system does not ensure 24/7 monitoring from fire protection. Moreover, existing fire protection system could spread panic inside the whole building since it does not announce the location of fire or intensity. It only raises alarm whenever fire is detected at any place.

Integrating fire alarm systems with building automation systems can result in many economic and operational benefits. Such integration requires communication standards and careful design practices [5, 6]. BACnet™ is an internationally recognized communication protocol standard specifically designed for integrating building automation and control systems. Thousands of BACnet systems can be found around the world, and its popularity is growing. Newly proposed additions to BACnet make it very well suited for integrating fire alarm systems with building automation systems [7].

Modern detection and signaling systems vary in complexity from those that are simple to those that incorporate advanced detection and signaling equipment. Such systems are typically designed and installed by qualified individuals as determined by the AHJ. The design, installation, and approval of a fire detection and alarm system may also require acceptances testing by regulatory agencies before new buildings are occupied or the system is placed in service. The design and installation of the fire detection and alarm system should conform to applicable provisions of NFPA® 70, National Electrical Code®, and NFPA® 72, National Fire Alarm and Signaling Code, and locally adopted codes and ordinances. Other standards also apply to the installation of these systems and are addressed later in this chapter within the discussions of the various types of systems. Each of the following sections highlights a basic component of a fire detection and alarm system.

Over the past decade the RMG sector of Bangladesh has been through a number of tragic accidents. The majority of those accidents were caused by fire. On 24 November 2012, fire took 117 lives in “Tazreen Fashion factory” in capital Dhaka [1]. 8 lives were lost when a fire broke out at a textile factory in the Mirpur industrial district on May 9, 2013. On 14 December 2010, 30 people died and 200 were seriously injured when fire broke out at the garment factory, “That’s It Sportswear Ltd" in Ashulia, Dhaka. Twenty two lives were lost when a deadly fire broke out at the "Garib and Garib" factory in Gazipur, Dhaka on February 2010 [2]. This incident shows that many garment factories do not have proper fire prevention and rescue system. Hundreds of factories are vulnerable to fire broke out because the factories are very old and lack fire detection technology.

II. PROPOSED SYSTEM

The propounded autonomous system uses Raspberry Pi 3 as main device, Arduino Mega as secondary device and consists of couples of sensors and module which are the Light intensity sensor, Gas sensor, ESP-8266 Wi-Fi Module, Servo motor, Camera module, GSM module and Relay module. The light intensity sensor has a photo-resistor \that can detect the intensity of light in the particular place or environment. The output signal of this sensor is analog value. The value of the sensor depends on the brightness of light. Gas sensor can detect the existence of gas in a particular area. The Camera module takes the shot of the limited place and the servo motor rotates the camera module. The ESP-8266 module helps to send data to the Raspberry Pi 3 by wireless communication system. The Relay module is used to activate the alarm and the GSM module helps to notify the master user or the admin. If the light intensity and gas sensor have desire value, then the camera module takes snap of the location and sends it to the Arduino. The camera Module can rotate 360° by using a servo motor. After this condition is true the fire alarm will trigger by the help of the Relay module. Arduino Mega can send this data to the Raspberry Pi by using ESP-8266 module. When Raspberry Pi receives the data, then it will send the data to the admin by using GSM module and an admin will check the validity of the warning message of our system and confirm or deny any suspect.

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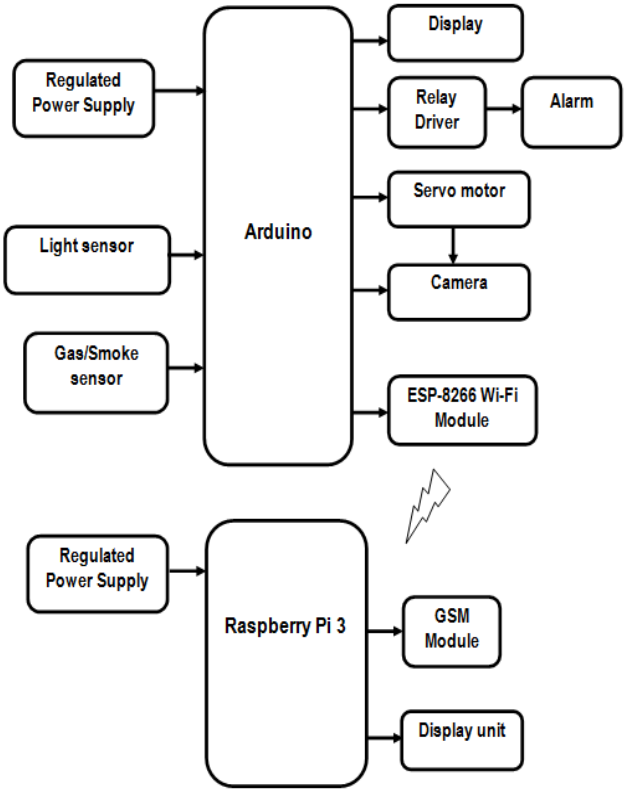

Figure 1: Block diagram representation of proposed system

III. WORKING PRINCIPLE

In this autonomous system the process occur in two parts. One part is Arduino read the data from sensors and the other part is Raspberry pi receive the data what was taken by Ardunio. Here, the system is using few sensors. One of them is Light intensity sensor module is denoted as A and the other one is Gas sensor module is denoted as B.

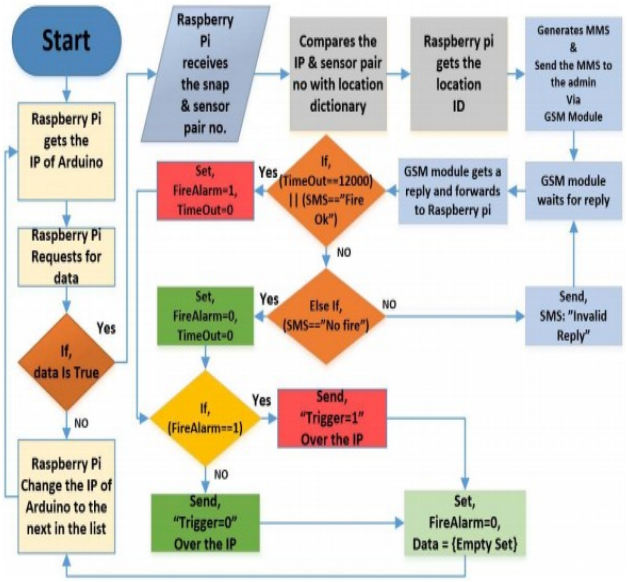

Figure 2: Logic diagram of controlling of Raspberry Pi

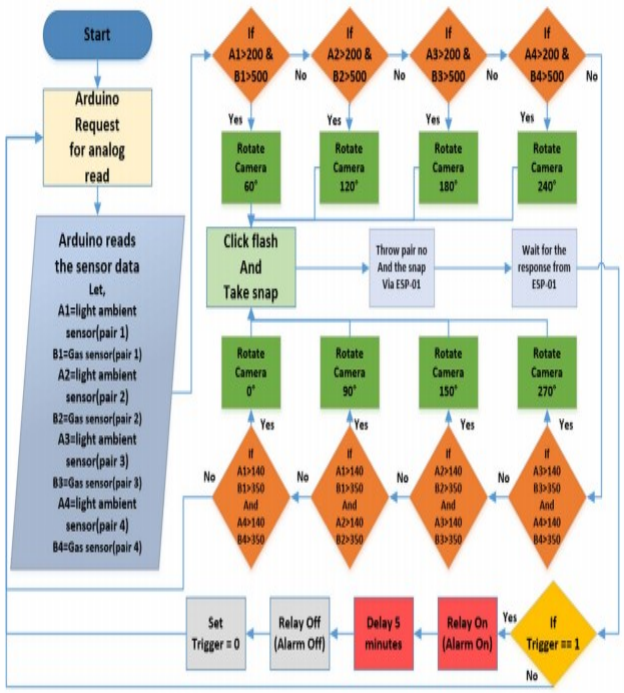

Figure 3: Logic diagram of operation of Arduino

If both the sensor value is hit up to mark that means A>200 and B>500, then the condition is true and the camera module will rotate 60° by

the help of servo motor. This condition will active when only a single pair of sensor value is true. But if the two pair are active at the same time, then the condition will be A>140 and B>350 for both pairs. After that camera module takes the snap, then it throws the pair no to the Raspberry Pi 3 by using ESP-01 used as Wifi module. When raspberry pi received the snap and sensor pair no then it will compare with IP and sensor pair no. If matched, then generate an MMS and send the MMS to the Admin via GSM module. The GSM module waits for reply. If the reply is "Fire OK" then it will trigger the alarm using relay. If the reply is "No fire" then it will stop the alarm. If the reply is unknown something, then it will return an invalid reply. After 5 minutes it will check the condition automatically. By using this single pair and multi pair sensor combination we can cover 360 degree and detect fire activity on a particular place.

IV. RESULTS

After assembling our system, the reading of the sensors has been checked. We have tested the system response in different situations. The sensor reading, auto snapping and sending that snap, authentication and current status of the place are displayed in fig. 4, smoke and light ambient data. After proper analysis, we found that the smoke Sensor gives a value 0~30ppm in normal state and raise from 500ppm upto 20000ppm on alarming situation.

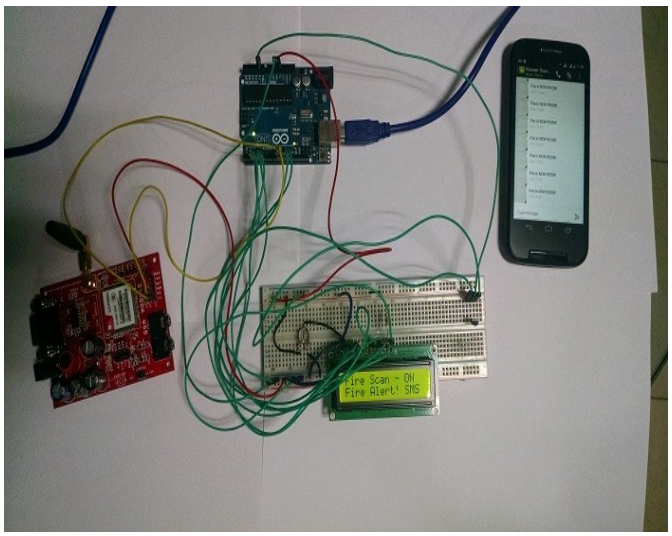

Figure 4: shows the triggering point of servo depending on

The light ambient also gives value within 60~80 on normal state and raise to 200~350 reacting on flaming light. According to experiment result, we found the threshold on 500ppm on smoke sensor and 200 for light ambient sensor.

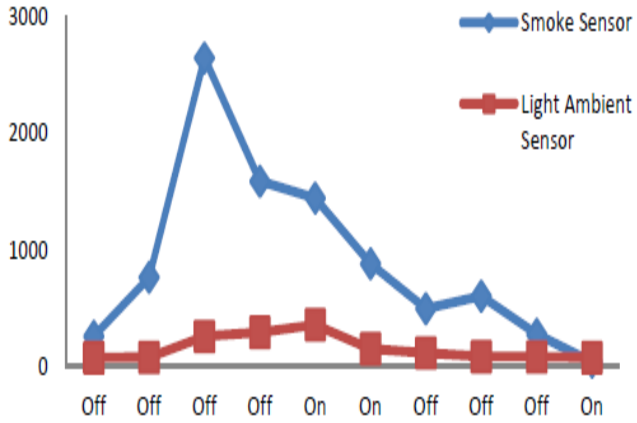

Figure 5: Triggering servo motor after sensing the state of smoke sensor and light ambient sensor

V. CONCLUSION

In this paper, we discussed the latest technology that can help to reduce catastrophic accidents

caused by fire. We designed the whole system and evaluated its effectiveness as well as scalability. With the improvement of sensor technology, the system will become more efficient and useful. If this system can be successfully integrated in every factories, then it is hoped that the loss of life and property due to the fire accidents will reduce remarkably and the country's economy will not be stumbled by such tragic accidents.

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