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Home Automation using SCADA & IOT

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***Abstract*— This paper explores the possibility of providing home automation which is not a recent boom in smart-home and has thrust it straight into the spotlight. It involves the control and automation of lighting, heating, air conditioning and security. Often Wi-Fi is used for the remote monitoring and control most of the devices. Here we monitor and control the system via a server with the help of internet. It is connected to a centralized hub as a gateway from which a system is controller with a user interface. The devices status is monitored throughout the functioning of the system and the same information is indicated and displayed on the LCD screen for monitoring purpose in case of any changes in the status of the devices. The same information is updated in the server. Here we are using three sensors for monitoring, Gas sensor for LGP leakage, PIR sensor for intruder detection and FIRE sensor for fire in the premises. Along with this if any one of the sensor triggers the information is sent to the owner via GSM modem. Each individual sensor has its own priority and depend on the status the necessary action is taken.**

Index Terms—Microcontroller, LCD display, Motor, GSM, Buzze

I. INTRODUCTION

Early home automation system began with labor saving machine which had self-contained electric or gas powered home appliances and later in 1957 home automation network technology was developed which had an electronic device. Control and automate every device and appliances within home or far away. Just imagine adjusting the temperature from your bed or controlling the lights brightness and heating or cooling the room with in 5min before you enter in to it. Most of the automated system provides security, safeguarding your house. From a security camera to water sensor that can alert you automatically will keep your home property under surveillance therefore you'll be able to react at a moment's notice. A Smart phone is used to control the devise which are connected to the server via internet. Each information is updated in a fraction of second so that microcontroller and we can react if any event occurs. The same can be monitored via a system far away from the premises. Here the system can control eight devices and monitor three sensors. Each sensor information is updated for its threshold value, if it reaches that value pertaining to the sensor an action will be taken to solve that problem via the microcontroller[1]. Let us say if a Gas sensor is used it can monitor the Gas leakage that is gas PPM in the air. Same way a PIR sensor is used to identify if any human radiation is present in the premises in the absence of the owner and finally but not the least FIRE Sensor is used to identify the temperature and fire in the inside premises If so the microcontroller will act to shut of the fire by switching on the water sprinkler system.

Twenty first century homes are self- controlled and automated, provide more comforts. The existing home automation system are based on well -established wired communication. Problem does not arise until the system is planned in advance and installed during the physical construction of the building. Cost goes high for already existing buildings. Wireless system is used in are day today life and provided great help for automation system.

II.LITERATURE SURVEY

[1] Basma M. Mohammad El-Basioni, Sherine M. Abd El-kader and Mahmoud Abdelmonim Fakhreldin This paper the proposed method, a new design for the smart home using the wireless sensor network and the biometric technologies. The system employs the biometric in the authentication for home entrance which enhances home security as well as less difficulty in entering to the home. The entire system is described and the incorporated communications are analyzed, also the cost estimation for the whole system is given which is something lacking in other smart home designs. The paper ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form.

[2] Sirsath N. S, Dhole P. S, Mohire N. P, Naik S. C & Ratnaparkhi N.S. In this paper, we have seen that it

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employs that integration of multi-touch devices with some cloud networking along with this they user power line communication to provide the user the remote-control access to many devices with in a house. It has a mobile application, handheld wireless remote and a pc based program to provide user interface to control over the devices by the consumer.

[3] Deepali Javale, Mohd. Mohsin, Shreerang Nandanwar. The main objective of this paper is to assist the handicapped or old aged people. It provides a basic idea how to control various home appliances and provide security for the same using the smart phone. The design consists of a mobile phone with android as os, with this a Arduino UNO board is used. The user can interact with the android phone and send control signal to the Arduino UNO which in turn will control other appliances or get the information from the sensors.

[4] Basil Hamed. In this paper the main objective of this paper is to design and implement a control and monitor system for smart house. With this, the system supports remote control to access the devices status and have a control over it. This is done by using with the help of internet. From anywhere the customer can access the devices remotely by using this software.

III.SYSTEM ANALYSIS

A. Problem Definition

The main aim of this paper is to design and implement a home automation using SCADA & IOT that can face the challenges like high cost, poor manageability, security, inflexibility and provide automating the house appliances through the server.System description

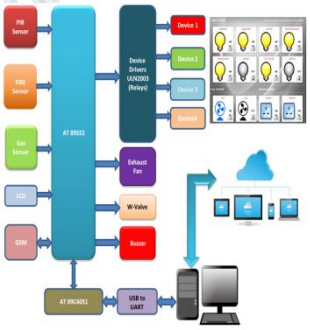

Fig. 1: Block diagram of Home Automation System

In the above proposed system, the heart of the system is the Atmel microcontroller. It controls the entire devices which are connected to the system. It also detects any change in the environment using some sensors which are used to detect the events. The block diagram comprises of following parts shown in figure below. It consists of microcontroller (AT89C51), gas sensor (MQ4), weight switch sensor (Load Cell-L6D), GSM module (SIMCOM 900), and display(s). Microcontroller 89C51 is the base of the system. The inputs given to the AT89C51 are the output of gas sensor MQ-4, contactor and load cell L6D. The output of AT89C51 are given to the SIMCOM 900 and LCD 16×2 display.

1) Microcontroller:

An economical and quick response controller is required to incessantly sense the LPG gas and its level (weight) sensor's output. Also, a quick reply is desired once leak is found. Together with this a system should possess capability to store some info which may be used for any process. The AT89C51 is a low-power, superior CMOS 8-bit microcomputer with 4 Kbytes of Flash Programmable and erasable read only Memory (PEROM) that is employed this method[2]. Its price effective makes the entire system much cheaper than the systems that are available within the market now a day.

The device is manufactured by Atmel's high density non-volatile memory technology it is compatible with the industry standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a traditional non-volatile memory coder.

2) Gas Sensor:

Sensitive material of MQ-4 gas device is SnO2, that with lower conductivity in clean air. The sensor is made of small AL2O3 ceramic tube, Tin dioxide (SnO2) sensitive layer, the measuring conductor and heater are mounted into a crust created by plastic and stainless-steel net. The heater provides necessary work conditions for work of

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sensitive parts. The enveloped MQ-4 have 6 pin, 4 of them are used to fetch signals, and alternative 2 are used for providing heating current. once the target flamable gas exists, the sensor's conduction is higher along with the gas concentration rising. We use straightforward electro circuit, convert change of conductivity to correspond output signal of gas concentration. Once the target flamable gas exists, the sensor's conduction becomes higher beside the gas concentration rising. Convert amendment of conduction to correspond sign of gas concentration.

3) Weight Sensor:

For booking of refill from a distributor, we should be aware in advance of quantity of gas within the cylinder, and for this purpose the level of gas present within the cylinder should be monitored unceasingly. The load cell having required weighing capacity for domestic cylinder is employed and for calibration purpose the weight device module is employed along with the load cell. L6D weight device module is enforced within the system. The load cell output drives a relay circuit which gives 2 logic pulses (for <=7 kg and <= 0.5 kg) which are further connected to microcontroller port pins to find the gas level. A leaf switch in addition is utilized in case the weight device fails to find the empty cylinder which in turn the leaf switch is closed to indicate a pulse to the microcontroller and also the action is taken as per the user requirement.

4) GSM Module:

Gas device detects the presence of gas, weight device provides the gas level in cylinder, and microcontroller can take corrective or necessary actions. The status of all these must be sent to the owner or housemates. GSM module is employed to send an SMS to the user mobile phone. Once the gas leak is detected by the gas sensor, microcontroller sends a signal to GSM module, within which one in every of the tasks is to send the text SMS. GSM module needs one SIM card. This module is capable to just accept any network SIM card.

5) Displays:

As the system performs controlling and watching operations, it's primary demand to show the infromation within the system that shows varied message like gas leak detection, booking of cylinder just in case of refill of cylinder and can show actions taken by microcontroller. The system uses (LCD) one in every of 16X2 characters in operation on +5 potential unit and operated in 8 bit mode is implemented for the task of displaying required messages.

6) Relay Driver:

Here the ULN2003A is used which is an array of seven NPN Darlington semiconductor device capable of 500mA, 50V output. It features common-cathode flyback diodes for change inductive loads. Here flyback, which is that the unexpected voltage spike seen across an inductive load once its supply current is suddenly reduced or interrupted. Generally, it can even be used for interfacing with a stepper motor, wherever the motor needs high ratings that can't be provided by alternative interfacing devices.

IV. BASIC CONCEPT & THE IMPLEMENTATION OF THE SYSTEM

The concept is implemented using the microcontroller module which is originally designed by intel but the chips that we are using were manufactured by the Atmel Corp. Although any other microcontroller could be used without any major change. The only direct impact will be only in the software or the assembly code written for the microcontroller.

As seen from the block diagram from figure 1, there are three sensors used to detect the event. There are three events which has to be considered here, one is the intruder detection, next is the fire detection and finally the gas leakage detection. The PIR sensor is used to detect if any unauthorized user is present at home when no one is in that place. As soon as it detects, it triggers the microcontroller informing that somebody has entered the premises.

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In the first implementation, a push button is used to generate the logic level and the respective output is noted. A 16x2 LCD is used and a small message is displayed in the 1st implementation. Further the required message is changed and this is invoked when a sensor detects the GAS molecules in the surround air. Furthermore, the PIR sensor is used to detect any intruder is present in the absence of owner, later a Fire sensor is also used to sense any fire due to short circuit or due to accident. Here we are achieving three types of information which are from the three senors.

(i) Case 1: In the first case the MQ-4 sensor is used to detect the LPG gas density in the surrounded area. As soon as the density of air and gas ratio changes the MQ-4 detects and triggers the microcontroller for further functions. The same information is displayed on to the LCD screen and sends an SMS to the user who is not in reach and has an audible information to the user.

The microcontroller detects this event and sends the signal to logic controller and to the relay driver by which in turn activates the exhaust fan to remove the gas from the surrounding. The relay used here is a solid-state device which will never produces sparks which is seen in a normal mechanical relay. This is the safest way to get rid of the gas molecules from the air.

(ii) Case-2: In the second case the PIR sensor is used to detect intruder and sends the signals to the microcontroller which takes the decision. The microcontroller detects the event with the help of the sensor and it displays the same information on the LCD and also sends the information to the user via SMS.

(iii) Case-3: In the third case the fire sensor is used to detect any fire in the premises, if so then it sends the information to the user via SMS, later it activates a water valve to spray water where the fire is present, this is done by the fire sensors deployed as well as the water spraying system which are present in the premises.

V. EXPECTED RESULTS

There are three conditions to be considered in the implementation of this system.

(i) In the first case the gas sensor detects the gas

leakage and gas valve is activated to stop the gas leakage. The flow diagram shows how the simple sensor detects leakage of gas from the sensor, the same is sent to the microcontroller for further action her an SMS is sent and exhaust fan is switched ON[5].

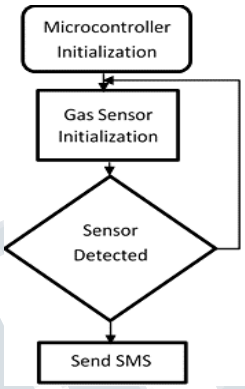

Fig. 2: Flow diagram for the Gas leakage detection

The figure 2 shows the flow diagram of gas detection based on the threshold of the sensor during the gas leakage. Initially all the ports are initialized then the sensor is initiated to sense the gas leakage, as soon the gas is detected the exhaust fan is switched ON.

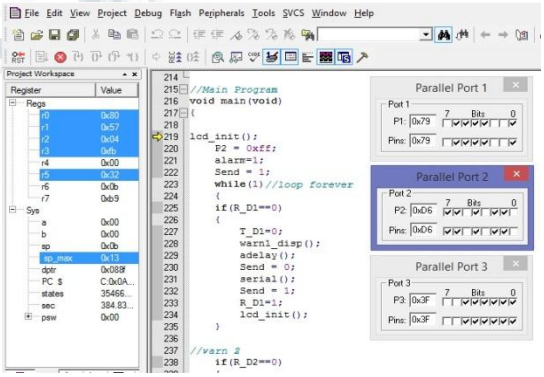

Fig. 3: Gas Detection Situation

In figure 3, as soon as the gas sensor detects the gas leakage, the port 2 bit P1.0 becomes low indicating the presence of gas as seen from the above figure. The low triggers the microcontroller to take necessary actions to stop the gas leakage. The other port bits of P1 are in same condition until it is triggered by the specific sensor.

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Each of the conditions are created as a function which are called whenever the event occurs, this method allows the microcontroller to work less compared to other type of programming method.

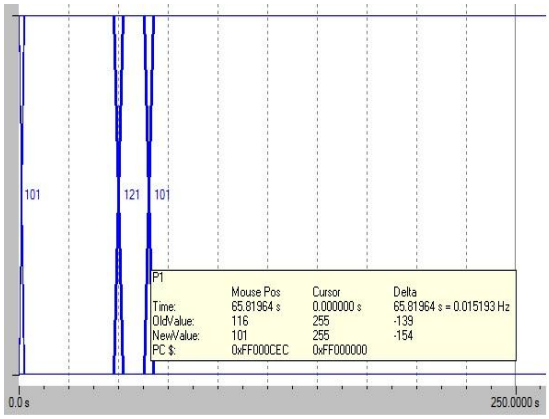

Fig. 4: Gas Detection trigger pulse

In figure 4, the trigger pulse from the port P1, bit P1.0 shows the actual triggering value for a event which we have considered that as a gas leakage pulse from the sensor.

(ii) In the second case the PIR sensor detects the presence of intruder in the premises, where the sensor senses for the sensor output changes are compared with the predefined value which we call it as the threshold value. If the sensor detects the change in the premises which may cross the threshold value in turn triggers the microcontroller port bit that is P2.1 to high to low pulse. Now the microcontroller takes necessary actions as designed to do the work. Here it is programmed to send the SMS to the owner regarding the intruder present in his premises with his permission.

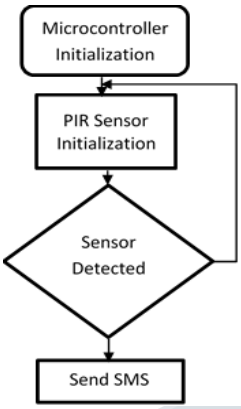

Fig. 5: Flow diagram for PIR Sensor.

The figure 5 shows the flow diagram of PIR detection based on the threshold of the sensor. Initially all the ports are initialized then the sensor is initiated to sense the presence of any intruder, as soon as it reaches to the predefined value the microcontroller will send SMS to the owner via GSM modem.

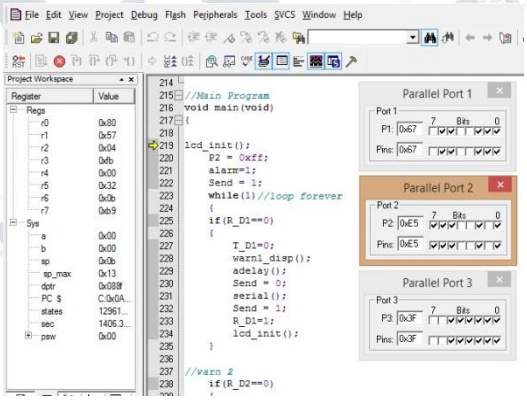

Fig. 6: PIR Sensor Detection Simulation

A Passive Infrared Sensor [PIR sensor] is used in this project to detect the human presence, which is connected to port 2.4 pin of the microcontroller.

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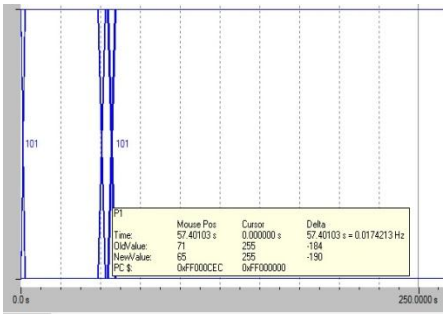

Fig. 7: PIR detection trigger pulse

(iii)In the third case the Fire sensor is used to detect the fire in the premises, the sensor output is fed to the microcontroller, as soon the controller is triggered the water spraying system comes into picture where it sprays the water. This is achieved by having number of different nodes of sensor and the spraying units.

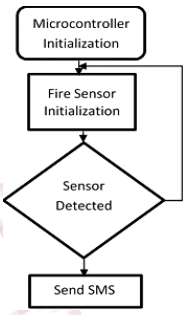

Fig. 8: Flow diagram for Fire Sensor

The figure 8 shows the flow diagram of a fire sensor. Initially all the ports are initialized then the switch connected to the Port P2 bit P2.2 is made to high always until the it is triggered by the sensor, this in turn sends the SMS to the user. The same information is displayed on the LCD screen.

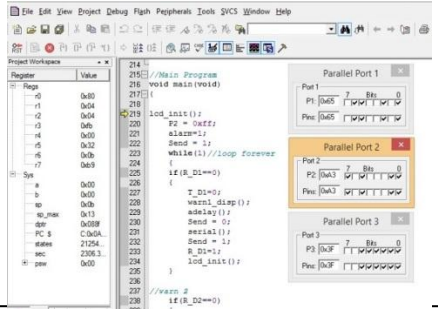

Fig. 9: FIRE sensor Simulation.

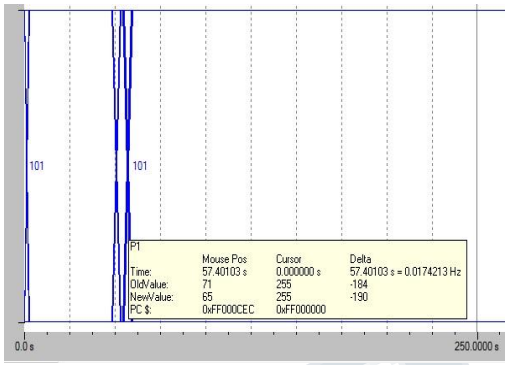

Fig. 10: Fire sensor trigger pulse.

VI. SIMULATION RESULTS

The main objective of this paper is to design and implement a control and monitor system for smart home. The design consists of microcontroller where user can interact with the system and can send control signals to controller which in turn control other embedded devices/sensors. As soon as microcontroller is powered on a message "WELCOME TO HOME AUTOMATION" is displayed on LED. If any event occurs say gas leakage, fire detection or intruder detected, all these information is updated on LCD along with activating buzzer. It takes immediate actions required and the information is sent through SMS via GSM. This information is updated to server also [8]. As shown in the figure 11, the circuit is build using 89S52 Microcontroller. The LCD is used to display the conditions based on the event from the sensors. Here the simulation shows the initial condition which displays welcome to gas monitoring system.

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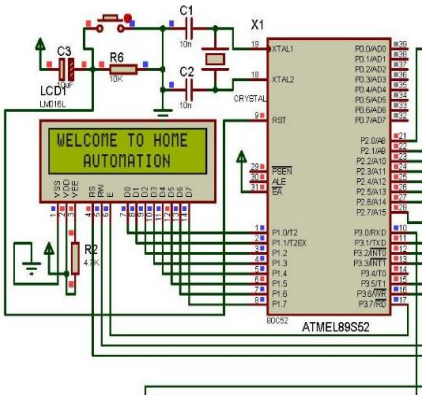

Fig. 11: Initial conditions and Normal Mode.

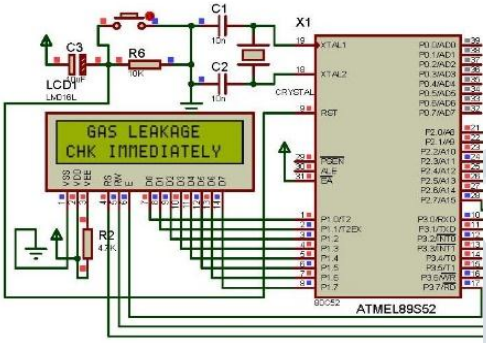

Fig. 12: Gas Leakage Mode.

As shown in the figure 12, here the LCD displays the condition of gas leakage which was sensed by the gas sensor MQ4. As soon the sensor detects the gas leakage the port bit 2.0 goes to low to high which gives the pulse to microcontroller and the gas leakage check

immediately is displayed on the screen with a audible sound and sending the SMS to the user. Along with this the microcontroller will close the gas valve to stop the leakage.

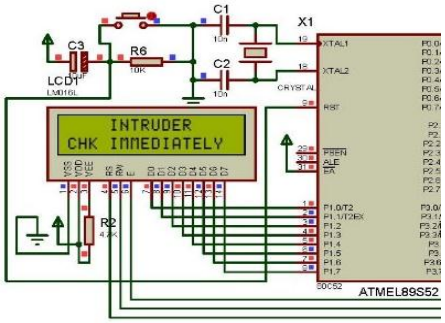

Fig. 13: PIR Mode.

As shown in the figure 13, here the LCD displays the condition of intruder which is sensed by the sensor. This is done by the level at which the trigger pulse is sent to the microcontroller. This high to low pulse will trigger the microcontroller as soon as the sensor detects the intruder and displays intruder on the screen with an audible sound and sends the SMS to the user. A Passive Infrared Sensor [PIR sensor] is used in this project to detect the human presence, which is connected to port 2.4 pin of the microcontroller. It gives an interrupt to the microcontroller when it detects the human presence at its field of view. The main aim is to develop an alarm based security system which takes power supply as input and the sensor will detect the motion and gives a message on LCD saying "INTRUDER DETECTED CHECK IMMEDIATELY" and this message will be updated to the person by SMS through GSM system. To indicate this, a buzzer is connected to same port 2.5 pin microcontroller.

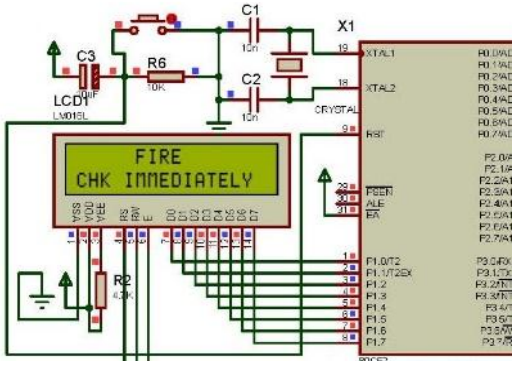

Fig. 14: Fire Sensor.

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As shown in the figure 14, here the LCD displays the condition of fire detected which is sensed by sensor. This high to low pulse will makes the bit 1.2 low which gives the pulse to microcontroller and the fire is displayed on the screen with an audible sound and sends the SMS to the user. When a fire occurs, it takes just a minute for a place to become fully engulfed in flames. A key aspect of fire protection is to identify a developing fire emergency in a timely manner and to alert the building occupants and fire emergency organization. These device consists of two main component: a control unit that houses the detection chamber and a network of sampling tubes or pipes. They are line of sight devices that operate on either an IR, ultraviolet /combination principle. After sensing it sends a signal to the fire alarm panel. Automatic sprinkler system will notify occupants and another key function of the output function is emergency response notification saying "FIRE DETECTED CHECK IMMEDIATELY" SMS is sent to occupant through GSM system. It provides the best

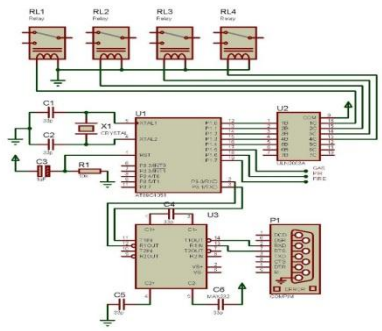

Fig. 15: PC Connectivity

As seen in the figure 15, the information of each sensor is updated in the cloud server with the help of a server and the user can control of the home appliances anywhere far away from his premises. Here the system updates the information and also sends an SMS to the user if any of the sensor detects event like gas leakage or it may be fire or any intruder present in the premises. The other part of the system is the user has a user interface where he can monitor the devices connected to this module to either switch it ON or OFF depend on the necessity of the user. This makes the user a very friendly system with two advantages that is one is to detect any event through the sensor and one more he can control the devices through remote place.

VII. REALTIME SETUP

1. Microcontroller 89S52.
2. Gas Sensor MQ4, PIR Sensor & Fire Sensor.
3. Relay Driver ULN2003A.
4. GSM Modem SIMCOM 900 Series.
5. LCD 16x2.
6. Relay 12v SPST.
7. Gas Valve 24v 6Watts.
8. Exhaust Fan 12v 0.5Watts.
9. SMPS 5V, 12V & 24V.

In the real-time setup, all the modules as well as the components are first rigged up using breadboard. The results are noted down and are compared with the simulation results. The microcontroller output is noted down from a CRO, the ADC values are tested by applying different analog values and the respective digital values are noted. Similarly, the Gas sensor MQ4 is tested using the nail polish remover which contains the traces of methane gas. The output is noted down, as we have seen the gas sensor needs 30 seconds' delay time for its normal operation, the time is crucial as it only detects after the coil gets heated as per the manufacturer specifications, with in that time the sensor will not give proper results. We consider all these information as highest criterial before rigging up the whole circuit. Further, LCD is used to display the information about the event as we have seen in this paper. The following modules are strictly kept at 5v from an SMPS which are as follows, LCD, GSM Modem, Gas Sensor MQ4, PIR sensor, Fire sensor & Microcontroller 89S52.

Table I: Voltage and Current ratings

Sl. No.	Name of Module	Voltage Rating		Current Ratings	
		Min	Max	Min	Max
1.	89S52	3V	6.6V	0.5mA	25mA
2.	ESP 8266	3.3V	3.6V	30mA	80mA
3.	MQ4	3V	5V	40mA	250mA
4.	ULN2003A	5V	50V	25mA	500mA
5.	LCD 16x2	4.5V	5V	0.25mA	25mA

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6.	Exhaust Fan	8V	16V	0.25mA	25mA
7.	SIMCOM 900	3V	12V	125mA	210mA
8.	SMPS	5V	24V	2A	3A
9.	Relay	8V	14V	80mA	300mA

The table 1 shows different voltage and current ratings of the modules used in this system, with its min and max voltage as well as current values.

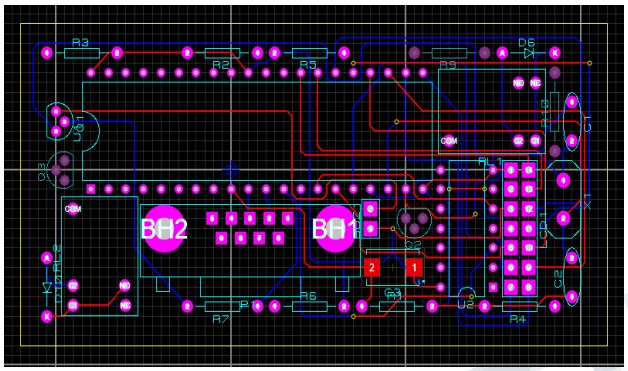


Fig. 16: PCB Layout of the entire module.

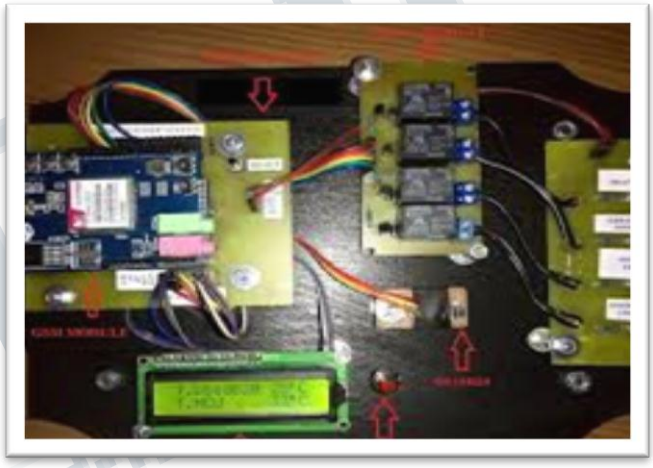
As shown in the above figure the PCB layout of the entire system excluding the GSM modem. The entire design is done using the proteus RRES.

Table II: Simulation Vs Real Time

Sl. No.	Task	Type	Simulation Results	Real-Time Results	Difference
1.	Sensor	Gas MQ2	0.74S	1.21S	0.47S
2.		PIRE	0.72S	1.44S	0.72S
3.		FIRE	0.82S	1.32S	0.5S
3.	Display	LCD 16x2	1.3S	1.75S	0.45S
4.	Buzzer	Piezo Electric	1.2S	1.73S	0.53S
5.	Relay	12V Relay	3.2S	4.56S	1.36S

The table 2 shows the simulation time and real time sensor and other modules reacting time. Here we can observe that as soon as the sensor detects the change in the environment it triggers the microcontroller to display as well as do the needful to stop the gas leakage. This is also seen in real time as well as in the simulation time. There is quite difference in the both which is noted down in the table 2.

VIII. SNAPSHOT OF THE MODULE



IX. CONCLUSION

This paper describes our proposed system for gas monitoring, leakage, automatic booking and manual booking. The main aim of the project is to reduce the deaths occurred due to the leakage of gas from the cylinder as well as negligence by the users. Here the system controls the flow of gas from the cylinder to the stove or any other devices in need for the LPG gas. As soon as the system comes to know if any gas leakage it will automatically shuts off the gas cylinder valve by using a solenoid valve, if this fails in case the controller will automatically switches on the exhaust fan to remove the gas from the surround place. The second advantage of this system is it can book for a new cylinder as soon as the cylinder weight is less than 20% of its total weight. The third advantage is it gives a convenient way for the user to manually book the cylinder by just clicking on a button. Further the entire circuit is designed

and tested using proteus design tool. Along with this the code is written using keil-c software.

The final module is designed and shown as 3D module as seen in this paper. Furthermore, the entire information is updated in the cloud sever where the information is gathered whenever it is necessary. The IOT techniques is used to do the same in the above said method. The system is built on proteus software which is simulator software. The proposed system is doing two type of task. It gives an interrupt to the microcontroller when it detects the human presence at its field of view. The main aim is to develop an alarm based security system which takes power supply as input and the sensor will detect the motion and gives a message on LCD saying "INTRUDER DETECTED CHECK IMMEDIATELY" and this message will be updated to the person by SMS through GSM system. To indicate this, a buzzer is connected to same port 2.5 pin of microcontroller.

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