

WSN-BASED FIRE, SMOKE & NATURAL GAS OUTFLOW DETECTION AND PREVENTION SYSTEM

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ABSTRACT—In our daily life, tools of fire and gas are compulsory parts of our lives, thus prevention against fire and gas leakage hazards is one of the essential requirements of every individual. For this purpose, there are many smoke and gas detectors being developed and under use. But normally they detect only smoke and gas leakage and turn on the alert systems. But for complete safety, in addition to this, there is higher demand of advanced tools and gadgets which should take automatic preventive steps too, to curtail destructions and hazards scale.

Now the project we developed consists of an efficient smoke and gas detector, which beside detection of smoke and gas leakage, also takes automatically preventive measures to cope up the blowing fire and leaked gas hazards.

Mechanism we used for this constitutes of sending information to the control room wirelessly in order to take some precautionary measures. In addition to this, cutting off the main power and gas supply at the time of detection of any danger is also done in this project.

Keywords—Wireless sensor network, gas detector, smoke detector, fire detector.

I. INTRODUCTION

In modern age of advance technology, where tools of fire and gas are compulsory parts of our lives, prevention against fire and gas leakage hazards is one among the essential requirements of every individual. There are many smoke and gas detectors which are being built and used for this purpose. But normally they detect only smoke and gas leakage and switch on the alert systems. But for complete safety, additionally to the present, there's higher demand of advanced tools and gadgets which should take automatic preventive steps too, to curtail destructions and hazards scale.

This paper focuses on designing a solution that has the capability to detect any sort of fire blown, gas leakage or smoke due to fire and turning on the alert system to alarm the humans nearby through buzzer and emergency lights, furthermore it sends an alert message to control room or emergency centre wirelessly within seconds of time to buckle up for rapid response, beside it, it has an edge of automatically

cutting off the main gas and power supply to avoid and curtail high scale of devastation.

Either it is industry or domestic zones like houses, security against fire is always important and priority. For humans or precious assets in house, apartments, industries or any other public place, immunity against fire hazards is becoming mandatory, to have perfect immune system against fire and gas leakages hazards is installed, to ensure safety of precious lives and assets.

In this pretext, our proposed solution focuses on to provide immunity and security against fire and gas leakages hazards for all sort of domestic, industrial, commercial and residential spots through integration of wireless sensing system and cutting off mechanism.

The main control unit of our proposed model is “Arduino” which is interfaced with sensors to detect fire, smoke or gas leakages.

In addition, our proposed solution is very economic, both in cost and power consumption with advantage of user friendly. Fire threats of different nature, such as smoke due to fire, fire ablaze or gas leakages can be detected through this system and safety steps would be taken by it.

II. LITERATURE REVIEW

From the earliest starting point of written history individuals have discovered that early reaction to fire had positive outcomes in controlling fire. At the point when somebody found a fire the fire units and fire offices were alarmed by wandering guardians utilizing hand chime ringers or church sextons ringing church ringers or processing plant steam whistles. Lamentably, these frameworks didn't give a lot of detail and regularly guided the local group of fire-fighters to wrong location. Yet, with the coming of the messaging through telegram, created in the mid (1840) by Samuel F. B. Morse, firemen were given a quicker and more exact fire announcing framework.

In (1847), New York turned into the main American city to start development of a civil alarm framework needed by statute to build a line of transmit, by setting posts in the ground, for imparting alerts of fire from the City Hall to various fire stations, and to teach the unique chime ringers in the utilization of said development.

The Automatic Fire Alarm Telegraph is worked by any hazardous Heat, and identifies the presence of fire at its beginning. The device, typically set at 125 Fahrenheit, is put on the roof at ordinary stretches in each room, office, storeroom, and lift in the Building the caution is given straightforwardly to the Insurance watch and local group of fire-fighters. It tells the specific area of the fire to the organizations before they leave their station, giving the specific structure and floor. Each instrument plays out the administration of a consistent, careful guardian, prepared to act in season of risk in all aspects of the structure.

Fire and smoke spread inside the structure can be influenced by different factors, for example, the math, measurement, design and use of the structure. To give fire assurance in the structure, it is very critical to identify fire at its beginning phase. The most well-known fire and smoke

discovery techniques incorporate the utilization of point type locators (for example ionization smoke alarms, photoelectric finders, heat identifiers), line type identifiers and so forth. These discovery strategies dependent on the utilization of fire marks such smoke and heat.

Fire is a synthetic response known as burning. It is characterized by the quick oxidation of a flammable material joined by arrival of energy as warmth. With the goal for start to happen, the presence of both a fuel and a warmth fuel source is required. At the point when the two meet up, with the proper extents, either by an absence of division or by some sort of dynamic connection, a fire happens.

This paper proposes automatic fire and gas leakage detection system, its composition and working principle. The rule of the proposed circuit is gotten from the actual standards of ionization.

Fire locators utilizing two-wire technique to lessen the divider arrangement, improve dependability, and simplicity of development and establishment. This depicts the general structure of the fire discovery framework and control programming in the plan.

Minimal effort fire location and control framework dependent on smoke and warmth recognition is proposed. It is included a mix of electrical/electronic gadgets/hardware's working together to identify the presence of fire and ready individuals through sound or visual medium after identification. These alerts might be actuated from smoke alarms or warmth indicators which, when recognizes fire. At that point, it naturally works a transfer which can be utilized to send Short Message Service (SMS) to the enlisted versatile numbers and turns off power and gas supply through relay and solenoid valve respectively to curtail large destruction level.

III. DESIGN DESCRIPTION AND METHODOLOGY

This section explains the design of our device and methodology adopted. It is additionally separated into following subsections. Section A clarifies the proposed model of our detector and Section B clarify the model description.

Toward the end, there is a block diagram that quickly sums up the whole section.

A. Proposed Model

The methodology or mechanism of our proposed system is as follow:

The smoke, gas and temperature sensors are connected to Arduino at pin number A5, A4 and A0. Whenever these sensors detects any inappropriate change in the environment such as smoke due to blowing fire or gas leakage then the system performs the following functions:

- It will turn on the alert system constitutes of buzzer and LED blinking. The LED is red in case of threat and is green at normal situation.
- It display's the updated temperature readings in degree Celsius on the LCD.
- It also activates the GSM module which will send 3 messages to: a) Control room, b) Emergency center, c) Security operation center.
- In addition to this, the system will cut off the main power and gas supply to avoid further fire destructions and curtail devastation scale.

B. Model Description

Prevention against fire hazards is one of the essential requirements of every individual. Beside there were higher demands to have tools or gadgets which can automatically take advance preventive steps too, to curtail higher scale of destruction and devastation scale.

Now our proposed model has an edge and advantage over already developed gadgets and tools that it meets those demands of advance higher preventive measure in form of:

1) Alert System

The first very step our developed project will take in case of any threat like gas leakage or fire blowing or smoke to fire blowing is to turn on alert system, which constitutes of buzzer and LEDs, where stable green LED is glowing in case of normal situation and in case of any threat as described above, it will turn ON red LED to give signal of emergency or risk to people in surrounding.

The feeding source of LEDs and buzzer are two sensors i.e.: MQ2 gas sensors and MQ5 smoke sensors, which will remain active round the clock in installed area, and in case of any threat it will forward signal as per pre-programmed criterion towards LEDs and Buzzer and will make it active.



Fig. 1: Green LED, Red LED, Buzzer

2) Temperature Display

Another feature of our proposed model is that has capability to continuously monitor the temperature of the surrounding area within particular range where it is installed, and will show the monitored result at LCD display, which may be set at particular control room to have check and balanced and eliminate threat before it really get materialized. For this purpose, we are using LM35 temperature sensor, which will monitor the surrounding temperature and send the result via Arduino to linked LCD, where result will be displayed consistently updated.

It has capability to send message to various sources at single time, as in our project we have taken three sources only to be send message to but it can be increased or decreased as per requirement conveniently.

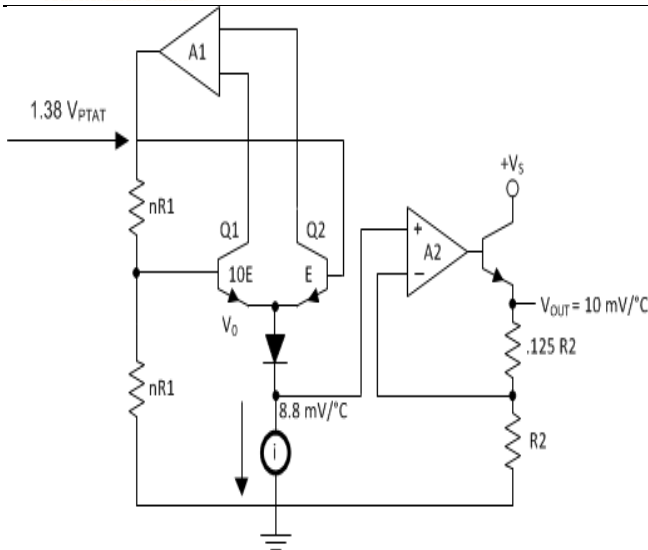


Fig. 2: Functional Diagram of Temperature Sensor



Fig. 4: GSM Module

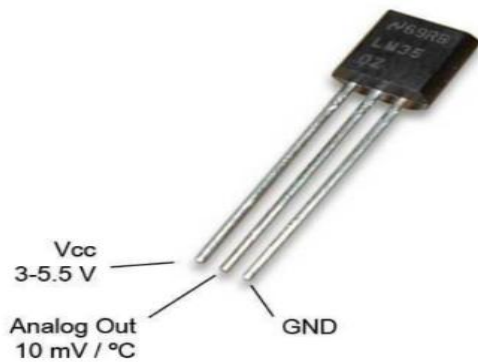


Fig. 3: LM35 Sensor

3) Wirelessly Intimating

Another feature of our project, which is rather advance feature is it informing or intimating particular sack holders in case of any threats like some due to fire, fire blowing or gas leakages. For this purpose, we have used GSM Module (GSM 900A), which is connected to Arduino and it received signal according to pre-programmed criterion, as Arduino is further linked with MQ2, MQ5 and LM35 sensors, which are acting as feeding sources, and in case of threat detecting, GSM Module receives signal from Arduino and it takes its action in form of sending alert message to different stack holders like: 1) Control room, 2) Emergency control room, 3) Emergency police.

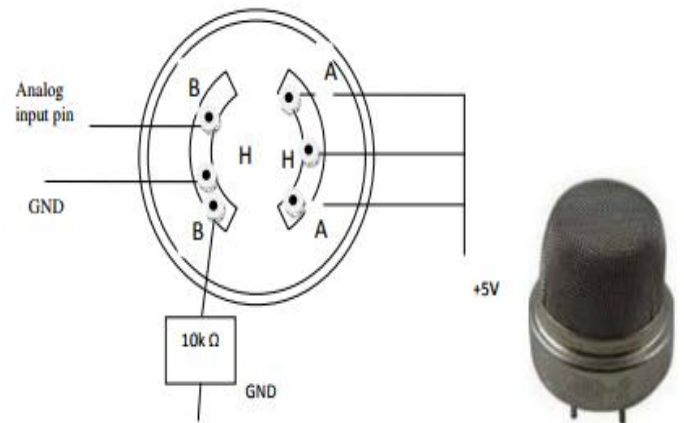


Fig. 5: MQ2 Sensor

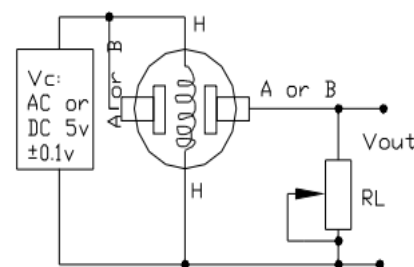
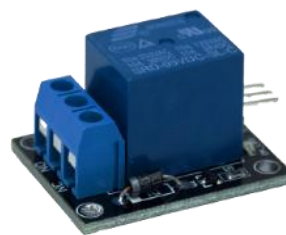


Fig. 6: MQ5 Sensor Circuit Diagram



Fig. 7: MQ5 Sensor



Structure of a GSM network

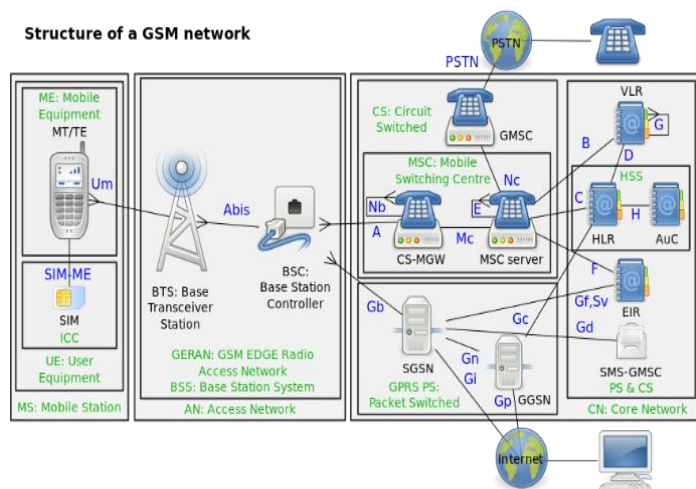


Fig. 8: GSM Network Structure



Fig. 9: Solenoid Valve, Relay

C. Schematic Diagram

The schematic diagram of natural gas outflow & smoke detection with auto cut-off of the gas and power supply using WSN in Proteus Software which explains the working of whole designed system in detail is given below:

4) AUTO CUTOFF OF THE GAS & POWER SUPPLY:

The most advance and unique feature of our project is its capability to cut off the main power and gas supply in case of detecting any threat as per criterion of pre-programmed standards.

As Arduino is acting as the central controlling unit of our project, which is efficiently and smartly programmed for purpose, and it takes several actions on basis of that programmed criterion, in which one is cutting off gas and power supply, for which the feeder sources are MQ5, MQ2 and LM35, which continuously monitor the surrounding and in case of any threat sends signal to Arduino, which beside taking several other actions, sends signals to two connected relays, where the one cut-off circuit of main power supply and second through solenoid wall cut-off the gas supply.

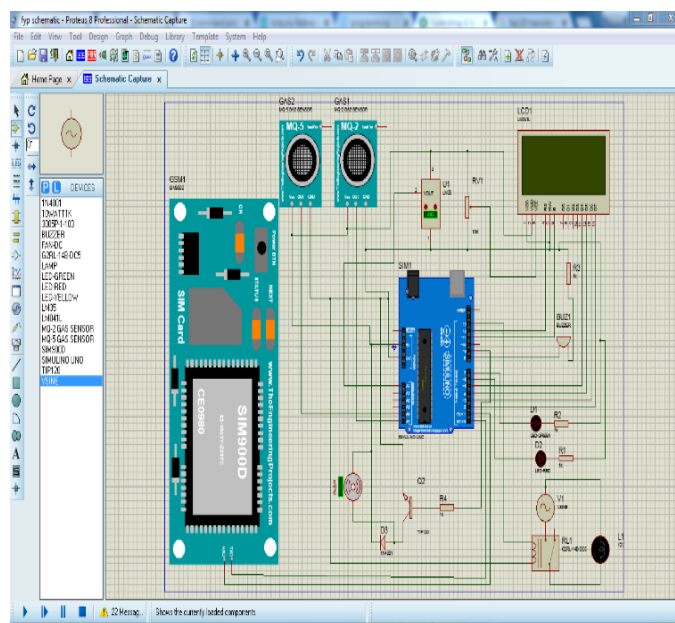


Fig. 10: Schematic diagram of natural gas outflow & smoke detection with auto cut-off of the gas and power supply using WSN in Proteus

D. PCB Layout

PCB Layout of our proposed and developed model designed in proteus is given below:

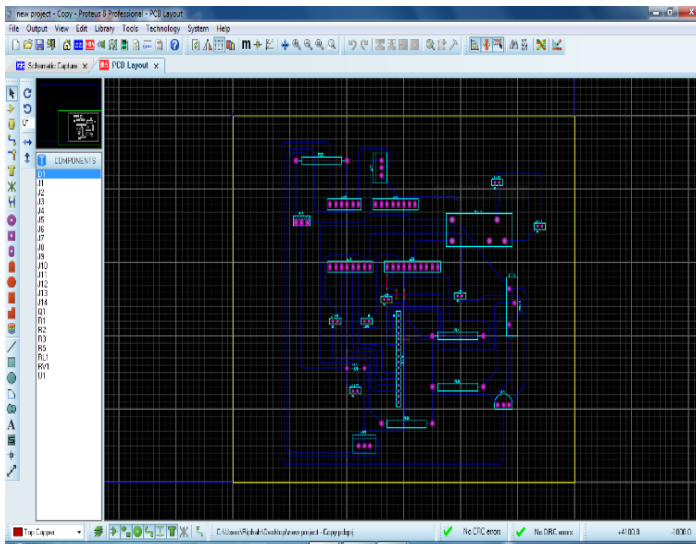


Fig. 11: PCB Layout of proposed and developed model in Proteus.

E. Block Diagram:

The block diagram of this project is given below which explains the whole mechanism in detail:

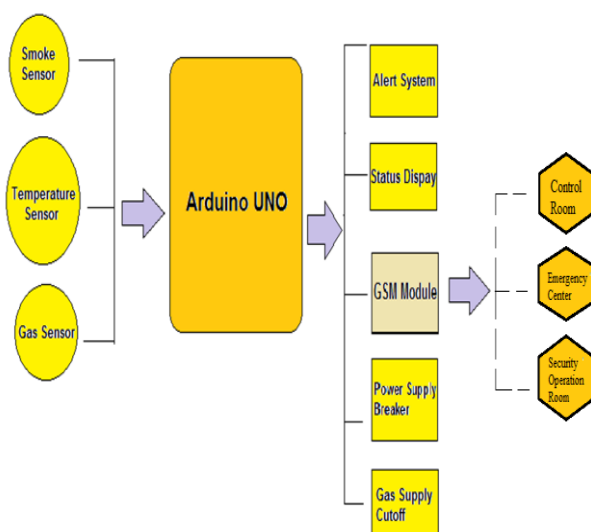


FIG: BLOCK DIAGRAM OF NATURAL GAS OUTFLOW AND SMOKE DETECTION WITH AUTO CUTOFF OF THE GAS AND POWER SUPPLY USING WSN

Fig. 12: Block Diagram

F. Prototype:

We successfully developed our proposed model into working model by implementing all the stuff mentioned in this paper into practical work, here is final image of our model prototype:

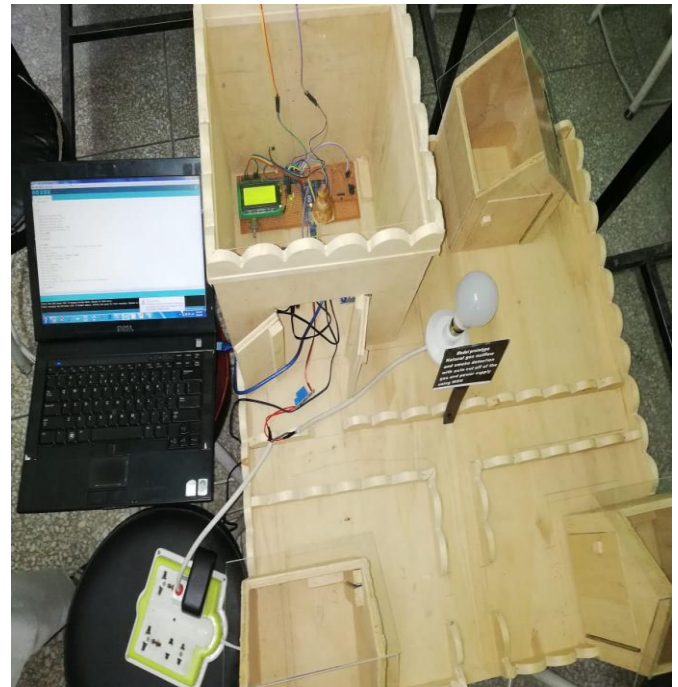


Fig. 13: Prototype of finally prepared model

IV. RESULTS

The objective of the proposed model was to introduce and design a system, which detects fire blown, or smoke due to fire or natural gas outflow using wireless sensor network integrated network, intimate the responsible and relevant of stakeholders of mishap, so that they becomes vigilant and active to take preventive measures and finally goes on one step further by automatically cutting off gas and power supplies to curtail risk level, all these objectives are met successfully by practically implementing our proposed model.

Arduino UNO, the main controlling unit of whole model, responded to the inputs sent by sensors (MQ2, MQ5) for gas and smoke respectively and successfully implemented the preventive mechanism by turning Green LED to Red LED, turning on buzzer for alerting, sending messages to relevant stake holders and meanwhile cutting off the main gas and

power supply to curtail the risk level and avoid further destruction.

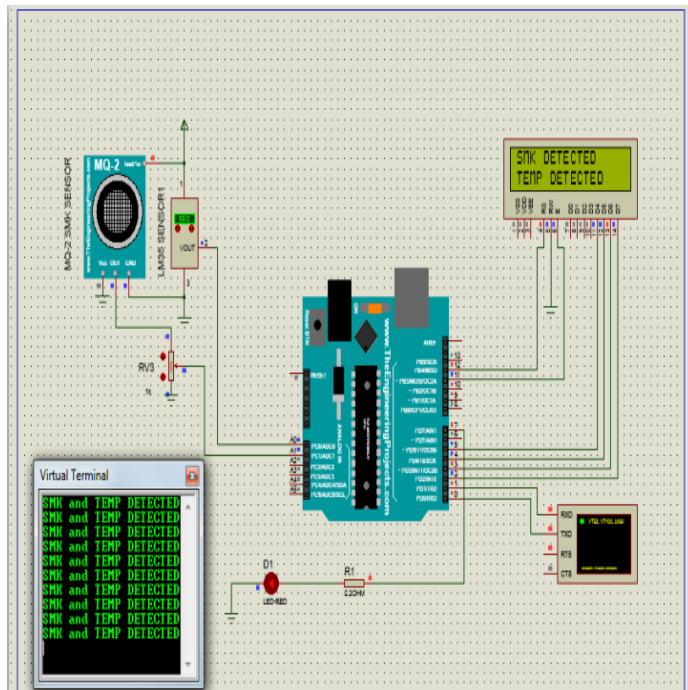


Fig. 14: Results of Smoke and Fire Detection

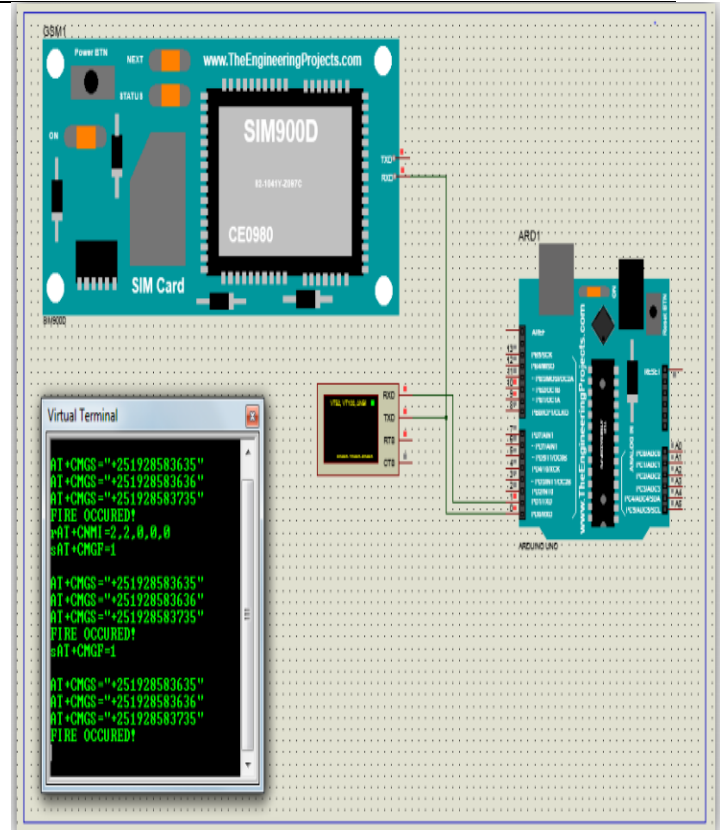


Fig. 15: GSM Activation in response to Smoke and fire detection and sending messages to relevant stake holders.

V. DISCUSSION

Advancement and success of technology has significant effect on life of human beings. It seems that survival of human beings without use of technology is impossible in this century as most of humans activities from daily life to working are bound to technology, besides technology has made human life much advanced as compare to previous century. Traditional lifestyle of people has been changed by modern technology. For example, an espresso machine has supplanted the conventional method of espresso making, unique mark and voice controlled electronic lock have supplanted conventional locks, electronic news and media have supplanted the conventional paper news and media, bank cards and web based shopping have supplanted the conventional money and shopping. The models referenced above are a couple of least progressed innovations supplanting the conventional way of life.

This task was a straightforward application venture showing an alarm and control framework. The developments and the temperature are distinguished by introducing sensors at various places. The temperature of the premises where the sensors are introduced can be known whenever prior to arriving at as far as possible set by the client. As this undertaking was an alarm and control framework exhibition venture, a couple of sensors and a LED light were utilized.

The task can be stretched out by expanding the quantity of sensors utilized alongside an increment in the quantity of establishment places. The far off administration of electronic gadgets can additionally be reached out with the utilization of various genuine electronic gadgets. The framework is actualized on Arduino stage utilizing the Arduino Uno Board. The entire framework is actualized utilizing the C code language composed on the Arduino stage. The product composed on the stage can be transferred to the microcontroller (for example The Arduino board) utilizing Arduino IDE programming.

The Arduino incorporated improvement climate (IDE) is a cross-stage written in Java, while the projects are written in C or C++. The stage accompanies a product library alongside the code manager with highlights, for example, linguistic structure featuring, support coordinating and programmed space. The entire program is written in the stage in the C language code which can be transferred to the board by a basic transfer button.

Fundamentally, the venture is the joining of the product (C language code) used to interface and actualize the sensors.

VI. CONCLUSION

The plan and development of a GSM – Based Fire, Smoke & Natural Gas Outflow Detection and Prevention System was effectively completed and tried successfully. The framework didn't present remarkable requirement and the parts and materials utilized adjust to engineering designing norm. All components used in developing this model were locally sourced. Special consideration were given to size (packaging) and cost with comparison to other available model in this line.

In circumstances where components couldn't be acquired precisely, standard qualities nearest to be determined should be picked in order to get ideal level of exactness and goal in the plan of the units of this gadget. Lastly, the development of our proposed model was challenging one as it give an exposure to solve problems by implementing theoretical knowledge to practical application.

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