Microcontroller based Fire Extinguisher with Bluetooth Operated LPG Gas Leakage Detection and Prevention System

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Abstract: Everything is getting automatic and smarter with the passing of days. It is time to make our homes smarter and automated. This system includes Arduino based fire extinguisher and Bluetooth based gas detection to make the daily life easier. Here we used two Arduino, one flame and gas sensor, three servo motors and one Bluetooth module. Gas sensor detects all type of gas and fire sensor detects flame spectrum.
Bluetooth module is used to send message to consumer about the gas exceeded gas concentration and motors to serve our desired purposes like switch off the gas not, switch off the MCB and sprinkle water from fire extinguisher. With the help of all of these we made an automated system to detect any danger and to prevent it safely. The system detects the LPG leakage using a gas sensor and flames by a flame sensor.
When the LPG concentration in the air exceeds the certain level, the Gas sensor detects the leakage and then it immediately alert the consumer by showing a message to specified mobile and turn off the gas regulator automatically. When fire catches inside a room, flame sensor detects it and automatically MCB will turn off and fire extinguisher automatically gets activated. In addition to this user can install IP webcam in their smart phones.
It has unique IP address. Whenever he/she is outside from their places, they can easily monitor their places by just googling that unique IP address. For this purpose, user has to attach Arducam with the microcontroller.
Keywords: Arduino Uno, Bluetooth Module, Flame sensor, Gas sensor, Jumper wire, Servo motor.

I. INTRODUCTION

Gas leakages and fire outbursts in industries as well as households have led to extensive damage and harms in the past. Gas leakages and fire outbursts both spread broadly and lead to even countless loss of life and belongings if suitable action is not taken on time. So here we suggest a system that senses gas as well as fire outbursts and alert us accordingly so that user can take appropriate action to control it without even being present at that place.

Fire and Gas Sensing Systems (FGS) are important tools for protecting our home and other amenities that handle flammable and toxic materials.

All such amenities have inherent fire threat that cannot be fully diminished with instrumented defensive function, in some cases these amenities require the fixing of fire and gas sensing systems to diminish these threats. Suitable design of fire and gas sensing systems starts with the selection of a performance target for tasks employed by the fire and gas sensing system. Performance of a fire and gas sensing system is mainly characterized by the system's capability to sense threats (detector coverage) and the system's capability to diminish threats.

Determination of the essential coverage, mitigation effectiveness necessities for a FGS is an exercise in threat analysis. A well designed fire and gas sensing system is intended to identify and in some cases automatically diminish fire, flammable gas and deadly gas hazards. Proper placement of detectors is critical in the design of a fire and gas sensing system to certify that coverage is sufficient to identify threats at their developing stage, in order to prevent increase. The gas detection system can identify a leakage of combustible or poisonous gas and take action to diminish or prevent it from increasing into a fire or outburst. If a fire results in, systems can be attached to extinguish the fire and protect other areas from the actions of the fire. The same system, usually with different detectors and principles, can be used to identify poisonous gases, give warning to people and deliver the probability of taking involuntary actions. Fires in process plants may be either like any other industrial fires, for example electrical fires in utility or an ignited leak of a product from the process.

II. HARDWARE REQUIREMENTS

A. Arduino UNO board

Arduino is an open-source electronic device based on easy-to-use hardware and software. Arduino boards are able to read inputs i.e. light on a sensor, a finger on a button etc. and convert it into an output i.e. activating a motor, turning on an LED etc. You can tell your board what to do by sending a set of commands to the microcontroller on the board. To do so you have to use the Arduino programming language and the Arduino Software (IDE).
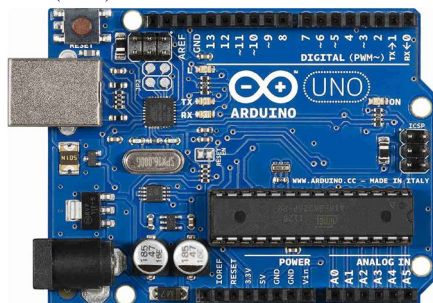

B. Gas Sensor Module

Gas Sensor MQ-2 is a sensor for combustible gas and smoke. It works by detecting the concentration of flammable gas in the air. They are used in gas detecting apparatus for smoke and combustible gasses in households, industries or automobiles.


C. Flame Sensor Module

Flame Detection Sensor Module is sensitive to the flame. It is usually used as a flame alarm. It is sensitive to flame spectrum. Its spectrum range is 760nm~1100nm.
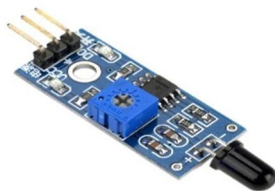
D. Bluetooth Module

Bluetooth module is used for connecting two devices at a time. Bluetooth module is used to move an object by giving instructions by using integral functions or using an application through devices which will help the user to interconnect between two devices and help to move an object through commands.
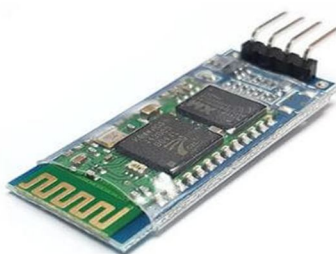
E. Servo motor

Servo motor is used to rotate an object with a precise angle or location. The motor helps to rotate the blades to a particular angle or distance with the help of servo mechanism. It is an electrical device which can rotate one object with great precision. If the used motor is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. Due to these properties, they are being used in many applications like toy car, RC Helicopters and planes, robotics, machines etc.


F. Jumper Wires

Jumper wires are simply wires that have connector pins at each of the ends, which allow them to be used to attach two points to each other without soldering. Jumper wires are usually used with breadboards and many other prototyping tools so that a circuit can be easily manipulated if needed. Though the jumper wires come in a variety of colours, the colours don't really mean anything. This means that a red jumper wire is exactly the same as a black one. But the colours can be used to your benefit in order to distinguish between the types of connections, such as ground or power.
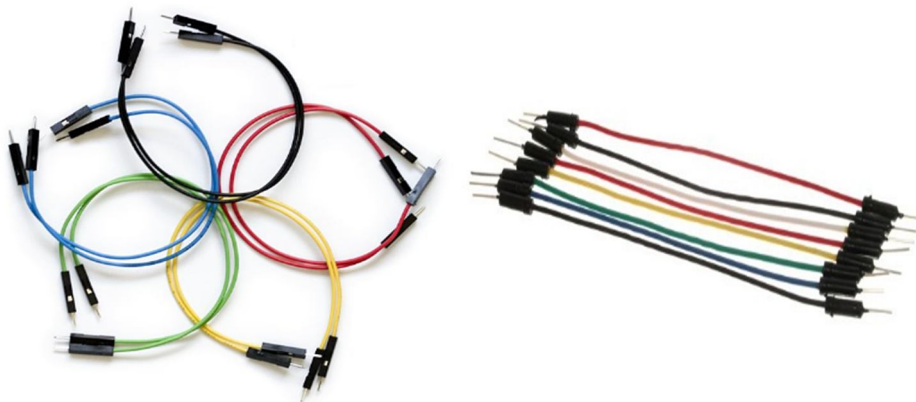
III. OUR PROPOSED WORK

Our proposed system incorporates multiple features within a single frame. First one is Arduino based fire extinguisher where we can use a flame sensor to detect fire sensing signal from the room and after detection at first Arduino-Uno microcontroller can turn-off MCB switch by rotating Servo motor 180 0 at once. Another Servo motor has to be used as a fire extinguisher by rotating servo blade knob continuously clockwise and anticlockwise after a certain delay and finally push the pressure nozzle of extinguisher bottle. On the other hand we proposed Bluetooth based gas detection and prevention system. In case of detection we can use MQ-2 gas sensor module and with the help of that module we get the signal and transfer it to the microcontroller i.e. Arduino-Uno. Finally microcontroller can rotate the servo motor 90 0 and control the regulator of LPG gas cylinder by transferring Bluetooth notification to the user. Gas sensor detects all type of gas and fire sensor detects flame spectrum. Bluetooth module is used to rotate Gas regulator and also send message to consumer about the gas exceeded gas concentration and motors to serve our desired purposes like switch off the gas not, switch off the MCB and sprinkle water from fire extinguisher. With the help of all of these we made an automated system to detect any danger and to prevent it safely.

IV. BLOCK DIAGRAM
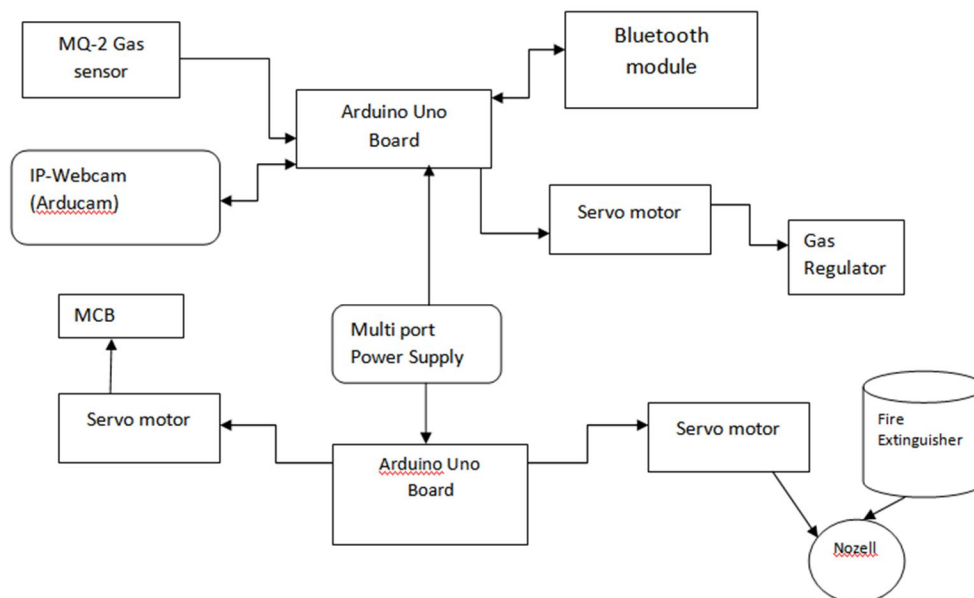
In Gas detection and prevention section, Gas Sensor can be connected to Arduino Uno where sensor Data transmitted to Arduino. Bluetooth module HC-05 can be connected with Arduino Uno to send the LPG gas concentration level and controlling the servo with Gas regulator when threshold detected. On other hand, Flame Sensor can be connected to Arduino Uno. Data transmitted from flame sensor to Arduino when fire detected. 2 corresponding Servo motor can be used to rotate a servo attaching with fire extinguisher nozzle and another one is attached with MCB switch.
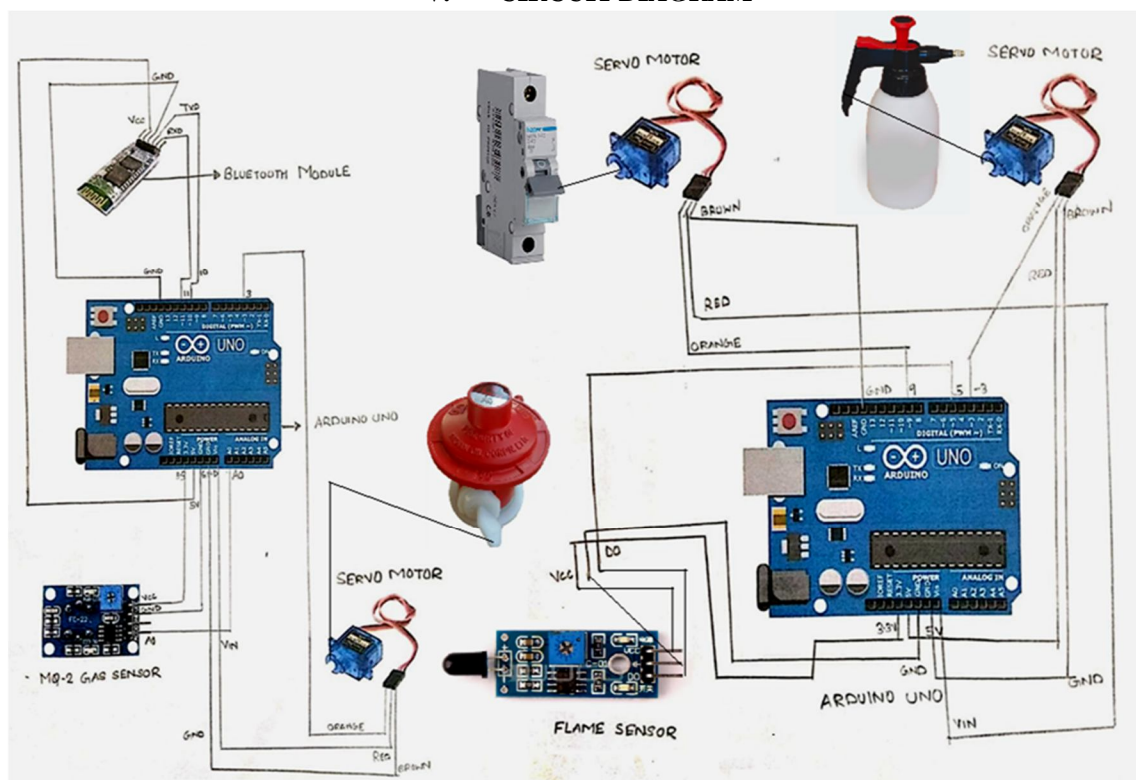
V. CIRCUIT DIAGRAM

Fig. 1 Circuit Diagram of Gas detection with prevention and MCB controlling with fire extinguishing

In Gas detection and prevention section, VCC pin of MQ-2 Gas Sensor can be connected to Arduino Uno with pin 3.3V. GND can be connected with GND of Arduino. Data transmitted to D0 pin of Arduino. Bluetooth module HC-05 can be connected with Arduino Uno via pin Tx, Rx, Vcc and GND to pin 10, 11, +5V and GND. Servo motor can be connected with Arduino via pin Vcc to Vin, GND to GND, Data to pin 3. That servo motor can be attached with LPG Gas regulator.

On other hand, VCC pin of Flame Sensor can be connected to Arduino Uno with pin 3.3V. GND can be connected with GND of Arduino. Data transmitted from D0 pin of sensor to pin 9 of Arduino. 2 corresponding Servo motor can be used to rotate a servo attaching with fire extinguisher nozzle and another one is attached with MCB switch. Vcc, GND and Data of servo motor can be connected with Arduino Uno by pin +5V,pin-3 and GND. for fire extinguisher nozzle and for another hand Vcc, GND and Data of servo motor can be connected with Arduino Uno by pin Vin,pin-5 and GND. for MCB.

VI. OPERATIONAL STEPS

A. In first Arduino, gas sensor, Bluetooth module and one servo motor is connected. The system detects the LPG leakage using a gas sensor and flames by a flame sensor that alerts the consumer about the gas leakage by showing message about the concentration of gas with the help of Bluetooth module which is connected preprogramed microcontroller. When the LPG concentration in the air exceeds the certain level, the Gas sensor detects the leakage and then it immediately alert the consumer by showing a message to specified mobile and turn off the gas regulator automatically.

*1) Step 1:* Cylinder is on condition. Gas sensor did not detect gas leakage yet.
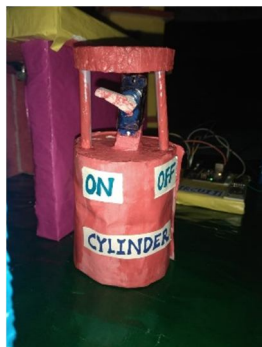
2) Step 2: In this step when the LPG concentration in the air exceeds the certain level, the Gas sensor detects the leakage and then it immediately alert the consumer.

3) Step 3: Cylinder is off now. As soon as the gas concentration exceeds the level, it will turn off the gas not with the help of servo motor.

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4) *Step 4:* As soon as the Gas sensor detects the leakage and then it immediately alert the consumer by showing a message to specified mobile by using Bluetooth HC–05.
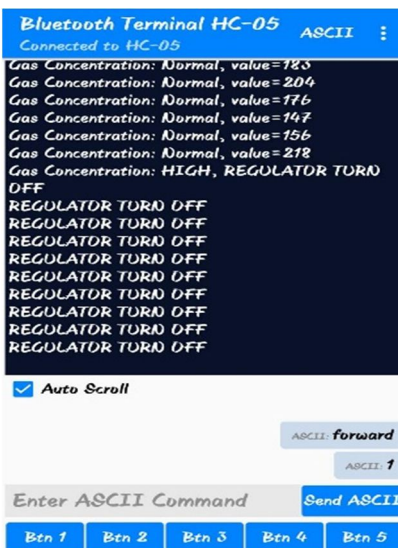
B. In 2nd Arduino two servo motors and one flame sensor is connected. When fire catches inside a room, flame sensor detects it and automatically MCB will turn off and fire extinguisher automatically gets activated. In addition to this user can install IP webcam in their smart phones. It has unique IP address. Whenever he/she is outside from their places, they can easily monitor their places by just googling that unique IP address.

1) *Step 1:* MCB is in ON condition.

2) *Step 2:* When accidentally fire catches, then flame sensor detects it.

3) *Step 3:* As soon as the flame sensor detects fire, automatically MCB will turn off.

4) *Step 4:* After MCB is turned off, fire extinguisher automatically get activated.

VII.   CCTV SURVEILLANCE

User can install IP webcam in their smart phones. It has unique IP address. Whenever he/she is outside from their places, they can easily monitor their places by just googling that unique IP address.

1) *Step 1:* When we are recording with IP webcam.

2) *Step 2:* When are searching that particular IP address in google.

VIII. ADVANTAGES

In this project the status of various devices can be monitored and controlled from anywhere. The operation of the system is very simple and can be used by anyone with a basic knowledge of operating the sensors, Arduino and servo motors. It is easy to upgrade as per the user requirement. It works well at constant humidity condition. It is easy to operate and it is low cost technology.

IX. APPLICATION

This system can be installed in household or any places like hotels, restaurants etc. It can help people from any kind of gas leakage. As we have motor system to lift MCB, so it will switch off the whole current system of any household and thus the electrical devices will remain safe.

X. CONCLUSION

This Bluetooth based security system is based on the fact that this system is able to detect any sort of gas leakage. In case there is a gas leakage in a house, hotel or restaurant, this security system will simultaneously complete three tasks, firstly switch off the gas nob, then lift the MCB of electricity meter then spray the extinguisher. Due to these simultaneous actions, accidents can be prevented.

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