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Smart Monitoring of Carbon Monoxide using Internet of Things

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Abstract: ***Every year, it is noted that at least 430 people die from accidental Carbon monoxide poisoning. Carbon monoxide is an odourless, colourless and toxic gas formed by the incomplete ignition of fossil fuels. It is also called as "silent killer" as it is difficult to detect by humans without using some detecting technology. When people are exposed to carbon monoxide gas, the carbon monoxide molecules will displace the oxygen in the body and lead to poisoning. Thus, the concentration of CO overtime passes a threat which may even lead to death. To overcome this, a smart device is designed to monitor the carbon monoxide level overtime and sound an alarm before dangerous levels of CO accumulate in an environment. The sensor MQ7 senses CO gas and once it reaches the threshold limit 35ppm(parts per million) as per U.S standards, the control passes to the Arduino indicating the seriousness through the alarm. Once the indication is done the immediate measure is to provide ventilation in the particular area.***

Keywords: carbon monoxide poisoning, ppm, silent killer, threshold.

I. INTRODUCTION

A carbon monoxide finder or CO identifier is a gadget that identifies the nearness of the carbon monoxide (CO) gas so as to avert carbon monoxide harming. CO wellbeing cautions satisfy the UL 2034 guideline; anyway, for aloof markers and framework gadgets that meet UL 2075, UL alludes to these as carbon monoxide identifiers. Raised degrees of CO can be risky to people contingent upon the sum present and length of introduction. Littler fixations can be hurtful over longer timeframes while expanding focuses require lessening presentation times to be unsafe. CO indicators are intended to quantify CO levels after some time and sound a caution before risky degrees of CO gather in a situation, giving individuals satisfactory cautioning to securely ventilate the zone or clear.

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Some framework associated finders additionally alert a checking administration that can dispatch crisis administrations if fundamental.

A. Effects of CO poisoning

Carbon monoxide harming is the most widely recognized sort of deadly air harming in numerous nations.
Carbon monoxide is retained through breathing and enters the circulatory system through gas trade in the lungs. CO consolidates with hemoglobin to create carboxyhemoglobin, which usurps the space in hemoglobin that typically conveys oxygen, however is ineffectual for conveying oxygen to substantial tissues. This prompts oxygen hardship, which can be lethal.

B. Concentrations of CO

CO is measured in parts per million (ppm). To give some perspective, the natural atmosphere is composed of 0.1ppm. The average level in homes is 0.5-5ppm. The level near properly adjusted gas stoves in homes and from modern vehicle exhaust emissions is 5-15ppm. The exhaust from automobiles in Mexico City central area is 100-200ppm. The amount of CO that can be created from the exhaust from a home wood fire is 5000ppm. Concentrations as low as 667 ppm may cause up to 50% of the body's hemoglobin to convert to carboxyhemoglobin. A level of 50% carboxyhemoglobin may result in seizure, coma, and fatality. In the United States, OSHA limits long-term workplace exposure levels above 50ppm.

II. PROBLEM STATEMENTS

The problems which are identified in the previous identification system are:
- Visual warning of the problem
- Only concentration function
- Expensive electrolytic sensor
- Lack of level indication

III. OBJECTIVE OF THE PROJECT

The objectives of this study are as follows:
- To reduce fatality due to carbon monoxide poisoning.
- To design a smart device which detects the carbon monoxide level in home.
- To display the concentration of carbon monoxide in home.
- To sound an alarm when the concentration is dangerous.

IV. LITERATURE SURVEY

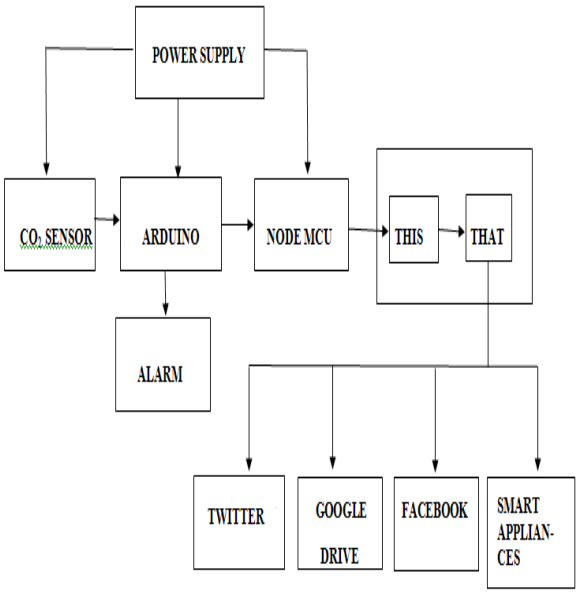
This In paper [1], the analysis of carbon monoxide poisoning was done.

It was known that eight died from carbon monoxide poisoning for the past 3 years and nearly 170 were treated. So, to solve this the project was implemented. In paper [2], the most important actual problem in gas detection field, the strong demand for CO detection to prevent explosions or CO poisoning accidents was known. The detection method is also studied.

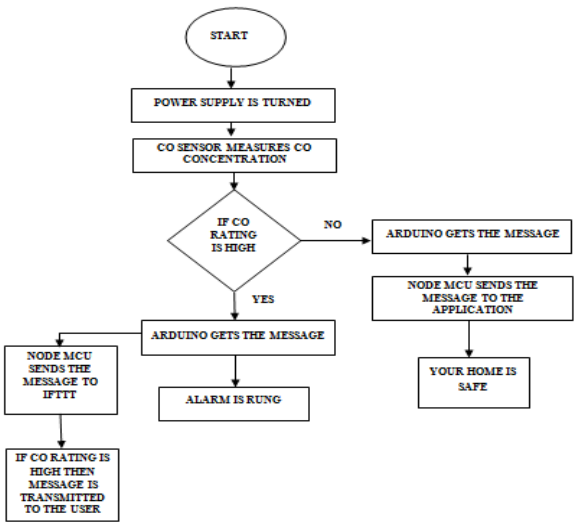
In the paper [3], the reasons for carbon monoxide poisoning and the effects of this was studied.

V. BLOCK DIAGRAM

The design of the project is done in two stages, the hardware part and the software part. The software part is achieved using Arduino UNO software. The system block diagram and the system circuit diagram are shown. The hardware comprises of Arduino, Carbon monoxide sensor, Liquid Crystal Display (LCD), Buzzer.



The above diagram shows the block diagram of the system.



The above diagram shows the flow chart of the monitoring process.

VI. METHODOLOGY

The carbon monoxide sensor used is the MQ-7 sensor. This is a sensor that is sensitive to effects of CO. Normally, the level of carbon monoxide is minimum may be 0.5-5 ppm. When there is smoke due to burning of fuel or wood the carbon monoxide content will be increased. The sensor senses the carbon monoxide and it gives the analog output voltage. This is converted to parts per million. Once the threshold is reached it sets the DOUT high, then the Arduino triggers all the output devices (Buzzer, LED). The concentration is displayed in the LCD so that people in homes can check this periodically.

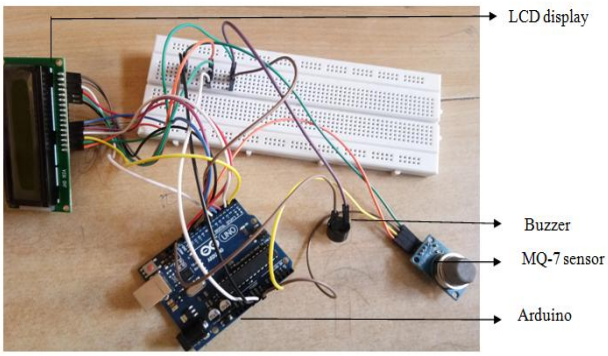
A. Process and Working

- MQ7 sensor acts as the input. It senses the carbpn monoxide.
- LCD, Buzzer, LED and GSM acts as the output.

In sensor, there 4 leads are +5V, AOUT, DOUT, and GND. The +5V and GND leads establishes power for the carbon monoxide sensor. The other 2 leads are AOUT (analog output) and DOUT (digital output). How the sensor works is the terminal AOUT gives an analog voltage output in proportion to the amount of carbon monoxide the sensor detects. The analog voltage is converted into parts per million. Once the threshold is reached, it will send the digital pin DOUT high. Once this DOUT pin goes high, the Arduino will detect this and will trigger the LED to turn on, signaling that the CO threshold has been reached and is now over the limit. It also triggers the buzzer and sounds an alarm with a delay of 10 seconds. The concentration of carbon monoxide present in that particular area will be displayed in parts per million using Liquid Crystal Display (LCD).

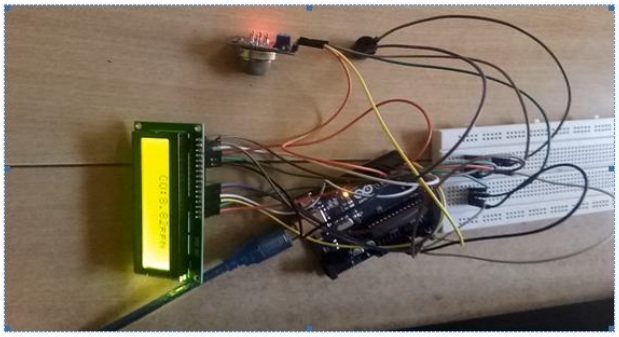
VII. RESULT AND ANALYSIS

By using this project, the "Smart carbon monoxide detector" is designed and finally, the problem of sufferings and death rate due to carbon monoxide poisoning can be minimized. Awareness can be created to people on carbon monoxide poisoning so that everyone will maintain the safety precautions. If there is more amount of carbon monoxide, the alarm will indicate the seriousness so the people can immediately move away from home and further ventilation can be provided.



Simulation of this project has been achieved with the following devices:

Microcontroller (AtMega 328) embedded in Arduino UNO, regulated DC power supply, Buzzer, LCD and Carbon monoxide sensor.



Regulated DC power supply is used for powering the devices on the system and it has to be regulated to avoid too much power to burn the device and to be too low for it to be insufficient for the devices operations. Microcontroller, this is the heart of the whole system, it is there to facilitate the connection between devices, control the operation of every device connected on this system, it has clocking equipment that must be synchronized with the crystal clocking device to ensure precise operation of the system. The sensor is used as input device and buzzer and LCD is used as output devices.Node mcu can be used along with Arduino and IFTTT is used for publishing the data. **Internet of Things**

Internet of Things consists of connected sensor IoT devices. The major components required for the Internet of things application includes the thing, the gateway to collaborate and integrate the devices together, the cloud which will help for the analytics of data to be operated on and finally the user interface to visualise all the data.

Embedded system can be either standalone or combined relying on the applications. As the application to an embedded systems increases, the number of processors associated with it will increase. In addition to it if cryptographic computations are required in such sort of embedded devices it will again add to the processors intensively. For an embedded system to be a heart of web technology all is required is a browser, server and internet. Internet is a group of interconnected networks which is having layers under it to provide seamless transmission of data across the networks. To perform this seamless interaction IP address is required. TCP/IP helps in such kind of interaction. There are various layers which supports the internet. Right convention ought to be decided for right applications.

The protocol has to be properly selected for proper implementation and execution as the hardware is dependent on the protocol. Thus the protocol has to consider all aspects starting from deployment, operation its management along with its security.

Application layer

It is the layer in which the programs and services understand each other. When one application software in a system is able to communicate with application layer software it requires certain methods which is taken over by the application layer. While defining application layer the following are to be considered. First the message type has to be mentioned clearly stating what type of message it holds, whether request response or control message has to be justified clearly. The position and meaning of the message has to be defined clearly. The control and communication rules and regulations have to be stated clearly.

More the rules more compatible the implementation is. Html or hypertext mark-up language defines how the content or webpages should be formatted. Browser is essential to communicate to the html pages via http protocol. Http is a stateless protocol and will keep the session alive. In embedded system as subsequent request can be prevented the keep alive section can be disabled. In http the required sections are the Message type/command, URI and protocol version.

Parameters	HTTP	CoaP	MQTT	XMPP	DDS
Security	https	COAP-s	Low	High	High
Payload format	Flexible	Flexible	Flexible	Low	Flexible
Compatibility	High	Low	Low	High	Low
Qos	Low	Medium	High	High	Very high
Performance	Low	High	High	Low	Low
Deployment scenario	Web connectivity	Web connectivity,http gateway	Telemetry layer area network	Human to machine interaction	Military deployment.

To make the system avail the web services it is necessary that the system should be in either JSON or XML format. XML though complex is a open standard and used in MS office applications. To build a web service REST and SOAP can be made use.

REST being light weight and statless is suitable for embedded applications as it is light weight and power efficient. REST works along with http and supports CRUD.

So identification of the resource is made along with suitable URI and then mapping is done to make it availabke for interent. The analysis of data is made with the help of cloud. The sampled and processed data is sent to cloud wherein the analysis is carried out. If the data is processed at the end node it is known as fog computing.

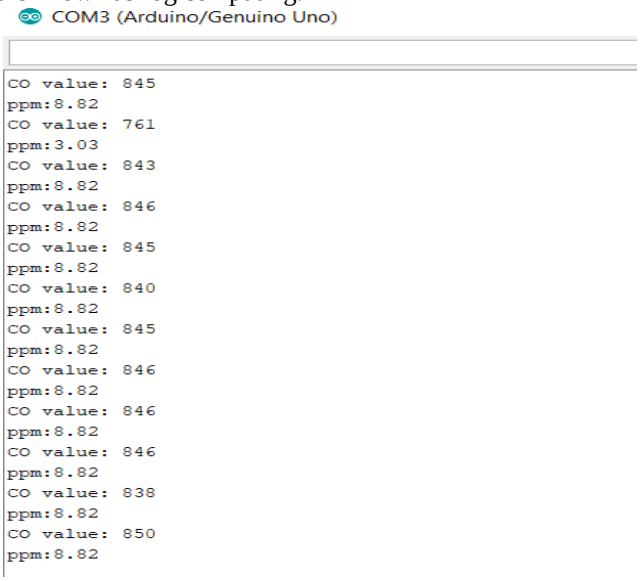


Fig. 1.Concentrations of CO

VIII. CONCLUSION

Since Carbon monoxide is responsible for many deaths the use of a detector and alarm is important for the overall health and safety of home. This project provides health and safety by detecting the dangerous carbon monoxide. Once it is detected the persons inside the home is warned to move away by an alarm. Through this, the harmful silent killer will be detected and the suffering of this gas can be reduced and awareness can also be created.

Poor ventilation is one of the reason for carbon monoxide poisoning. Hence proper ventilation is to be provided to exhaust carbon monoxide from the homes and to provide pure air for breathing.

Through this smart carbon monoxide detector, the death rate can be reduced.

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