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[ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Health Safety of Sewageworkers Using Raspberry Pi Controller

Rajesh Kumar Kaundal<sup>1</sup>, Shashi Prabha<sup>2</sup>

Director (Design), Military Engineering Services, Pathankot, India<sup>1</sup>

Head, Department of Electrical Engineering, Mahatma Gandhi Mission's College of Engineering & Technology, Navi Mumbai, India<sup>2</sup>

**ABSTRACT:** A large number of sanitation workers die every year due to lack of facilities available, and harmful toxic gases released while cleaning the sewage. In this paper the model will monitor the health of the worker by continuously monitoring the underground toxic gases and pulse rate of the workers. If the pulse rate goes below the threshold level or the level of the toxic gases increases beyond the average level this device will alert the worker by vibrating and indicating through LED. It alerts the exterior emergency unit by alarm using Wi-Fi module and send an emergency message.

**KEYWORDS:** Raspberry- pi 3, Gas sensor-MQ4, MQ7, Heart rate sensor, Temperature Sensor, GSM, Wi-Fi module, LED, Buzzer.

## I. INTRODUCTION

In INDIA most of the people are below the poverty line and part of them are working in sewage cleaning process for their daily needs. But sewage cleaning is not a easy job, manual scavenging refers to the practice of manually cleaning, carrying, disposing or handling of any sewage waste. It often involves using the most basic of tools such as buckets, brooms and baskets. Exposure to wastewater may result in number of illnesses, some of which include: Gastroenteritis (cramping stomach pains, diarrhea, and vomiting), caused by E. coli and other bacteria, protozoans such as Giardia and Crypto sporidia, and some viruses. Sewage cleaning is the process of workers entering into the manhole manually and cleaning them. In this case workers are affected due to the toxic gases released and temperature variation in the underground.

By noticing these problems the Supreme Court of India in 2013, made a decision that all such jobs should be done by machines wherever human involvement is needed, proper safety equipment's should be provided to the workers[1]. But small manhole cleaning is done by local people without giving any safety equipment.

The main problem for the workers includes fire or explosion, poisonous gas inside the sewer. For the above problems, the harmful gases involved are Methane (CH<sub>4</sub>), Carbon Mono oxide (CO) and Ammonia (NH<sub>3</sub>). These harmful gases are released during the underground cleaning operation. These gases are largely released in closed areas like manholes, gutters and drainages etc. Other than these gases, many toxic gases are released during the cleaning process, this can cause severe health issues and also responsible for fire accidents in the sewer.

The main object of the proposed system is to develop a device which would continuously monitor the health condition of the worker by detecting the heart rate, surrounding temperature and detection of hazardous gases and provide these health parameter are supplied to the concerned unit in case of emergency[2].

## II. EXISTING METHODOLOGY

To monitor the worker health, the existing device consists of two Arduino micro controllers for computing and processing purpose. They have been used in the display and sensor unit. The sensing module consists of pulse sensor, methane sensor and oxygen sensor. The pulse sensor senses the pulse rate of the worker in BPM (Beats Per Minute) which is then transmitted to the display unit. The gas sensor is a MQ4 sensor which detects the natural gas mainly of methane, which is present in large amount in sewage[3].

Oxygen sensor detects the atmospheric oxygen level and is transmitted to display unit. The display unit consists of OLED, LED and a push button. The values of all the sensors should be displayed in the OLED. The device also consists of alarm button which is used in case of emergency. In emergency LED system, the red-light blinks to



indicate when any of the parameter is not in safe range. The green light blinks to indicate all the parameters are in safe range.

Whenever the sensor detects any of the parameters in critical range it alerts the worker by sending haptic signal to the workers, so he can press the alert switch provided with the unit which in turn sends signal to the sensing unit. The person with display set may examine the value and communicate to the other person for further operations.

### III. PROPOSED METHODOLOGY

The proposed system based on GSM and Wi-fi module. Which includes gas sensor, heart rate sensor, temperature sensor and LED along with buzzer, Raspberry pi, it is the heart of the proposed system.

#### GAS SENSOR:

The gas sensor consists of MQ4, MQ7 sensor. It senses toxic natural gases produced in the sewage. The natural gas mainly consists of methane, carbon monoxide. The methane gas sensor detects the concentration of methane gas in air and outputs its reading as an analog voltage. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection. This sensor detects methane from 200ppm to 10,000ppm. Gas sensor detects the concentration of methane gas in the air and outputs its reading as an analog voltage up to 5 Volt. A resistive load between the output pins and ground sets the sensitivity of the detector.

#### TEMPERATURE SENSOR:

The DTH22 acts as the temperature and humidity sensor. The sensor can measure temperature from  $-40^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  and humidity from 0% to 100% with the accuracy of  $\pm 1^{\circ}\text{C}$  and  $\pm 1\%$ . The sensor is factory calibrated and hence easy to interface with other microcontrollers.

#### HEART RATE SENSOR:

The basic heartbeat sensor consists of a light emitting diode and a detector like a light detecting resistor or a Photo diode. The heart beat pulses causes a variation in the flow of blood to different regions of the body. When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue. The detector output is in form of electrical signal and is proportional to the heart beat rate. The heart rate sensor detects the pulse rate of the worker. An algorithm is used to detect the pulse rate and count the number of readings for 5 seconds. Then the reading obtained is multiplied by 12 to get the readings for 60 seconds. This reading is in BPM (Beats Per Minute), which is then transmitted the signal to the Led.

#### LED INDICATOR

An LED light bulb is a solid-state lighting (SSL) device that fits in standard screw-in connection but uses LEDs (Light Emitting Diodes) to produce light. LED light bulb are a more environment friendly alternative to incandescent bulbs. LED bulbs uses semiconductors device that emits visible light when an electric current pass through it.

#### WIFI MODULE

The ESP8266 Wi-Fi module is self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

#### VIBRATION MOTOR

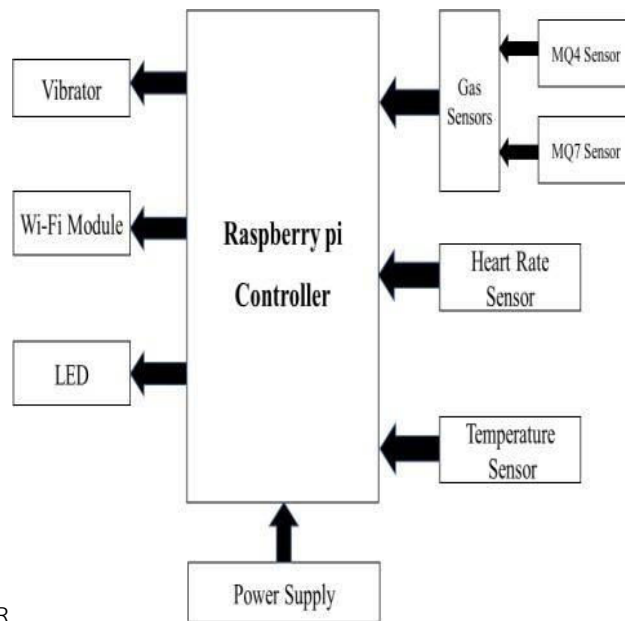
It is a small built in vibration motor module. After inputting 5V power you can control ON/OFF or vibration intensity of motor through digital signal or PWM signal. The vibration effect is evident it is amplified and it works



and the vibration intensity of the motor can be controlled by PWM. The module can easily complete the conversion of the electric signal to mechanical vibration.

**BUZZER**

A **buzzer** is a small yet efficient component to add sound features to our project/system. It is very small and compact 2- pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.



BLOCK DIAGRAM: TRANSMITTER

Fig.3.1 Block Diagram of Transmitter

**RECEIVER:**

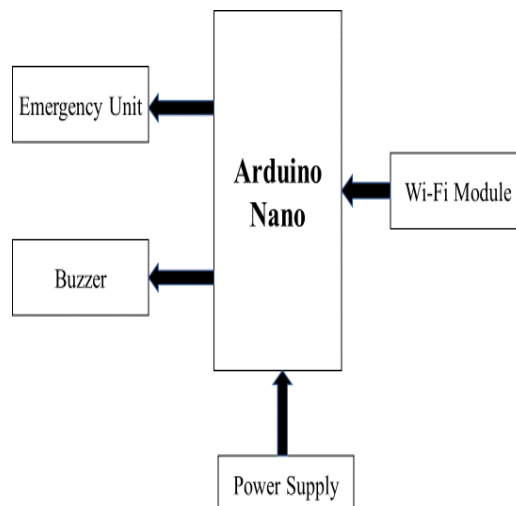


Fig.3.2 Block Diagram of Receiver

FLOW CHART:

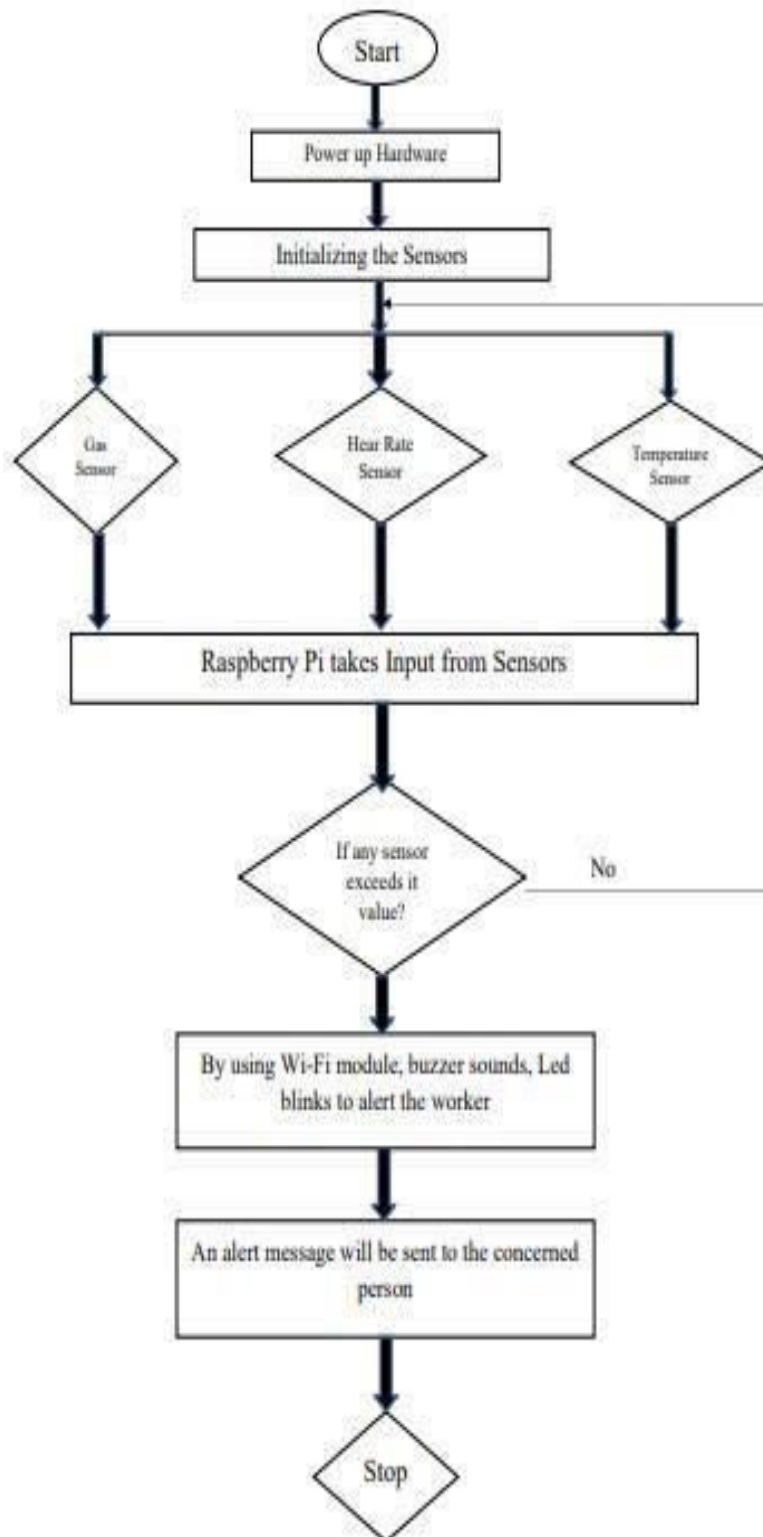


Fig:3.3 Flow Chart of the Proposed System

#### IV. PROPOSED EXPERIMENTAL WORK

Tests will be performed under normal environmental conditions. After initializing, when the gas sensor is continuously monitoring the toxic gases especially Methane wherever in the environment Fig:4.1. The proposed system is designed by keeping in mind to improve the safety of the sewage workers. This device is used to monitor the toxic gases in the sewer.

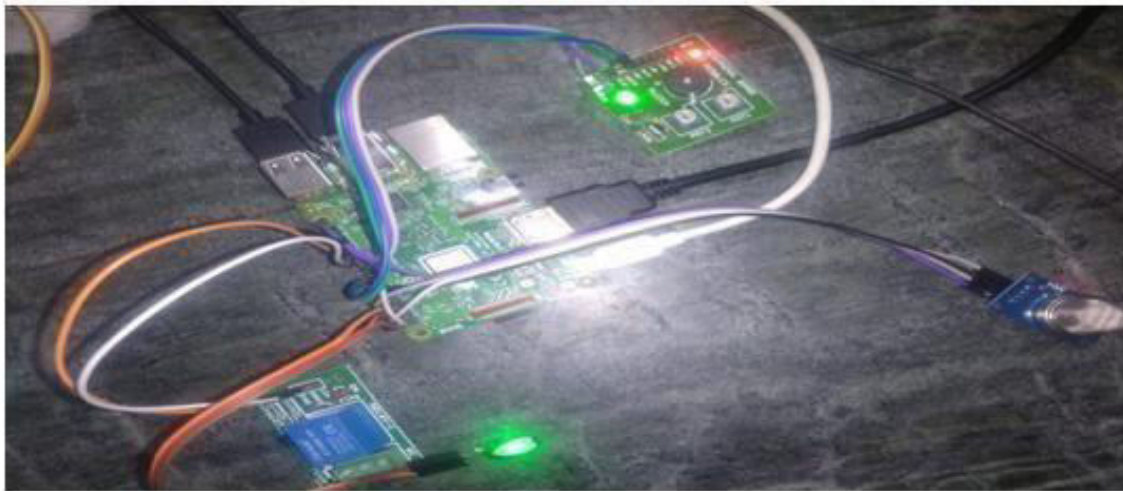


Fig:4.1 Raspberry-pi with Gas and Heart rate sensor

The basic knowledge about the toxic gases. In country like India, most of the manholes, sewages are cleaned manually, hence this device is very much helpful for the workers to work safely. When the sensor detects no toxic gases then it blinks green led light in-order to indicate the worker is in safe condition.

Two observations are proposed

1. **Average Oxygen concentration, Average Methane concentration and Average heart Beats Per Minutes for 2 minutes for three persons**
2. **Pulse rate (Beats Per Minute) for three persons.**

#### V. CONCLUSION

The proposed system is designed by keeping in mind to improve the safety of the sewage workers. This device is used to monitor the toxic gases in the sewer and the basic knowledge about the toxic gases. In country like India, most of the manholes, sewages are cleaned manually, hence this device is very much helpful for the workers to work safely. The main object of the project is to prevent the deep ground workers by monitoring their health and the presence of toxic gases in their atmosphere and alerts the emergency unit in case of emergency or danger. This project has been designed to replace the existing system which are effective in transmitting data to long range in order to attain the proper result the hardware and software components needs to be effective that's why our proposed system is a wireless system. And this project is very much helpful to save the workers who works in sewage and mine fields.



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