# Recognition and Detection of Manhole by using IoT Monitoring System

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**ABSTRACT**
The project is utilised to continuously monitor manholes, which drainage specialists use as entry points to check infrastructure and carry out essential maintenance and repairs. Manholes are an essential part of our ecosystem and a successful city. Our primary system is built to keep an eye on the water level, the temperature within the manhole, the condition of the manhole cover, and the creation of harmful gases in order to handle them appropriately. A microcontroller board called Arduino makes use of the ATmega328p chip. Digital input and output pins on the Arduino may be utilised to link to various expansion boards and circuits. Temperature sensors are used to keep track of any temperature rises brought on by subterranean electrical cables. Gas sensors are used to prevent manhole explosions by monitoring the quantity of subsurface gases and detecting the presence of combustible gases. Ultrasonic sensors beneath the cover employ a threshold value to detect changes in water level. Tilt sensor used to signal the tilt of the cover is open. With the help of the Ethernet W5100 module, all of the above data is delivered to the authorities (server) automatically and without any human intervention. The technology used for this design is IOT, HTML (HYPERTEXT MAKEUP LANGUAGE) and WEB SOCKET protocol (used for full-duplex real time communication between web server and its clients). This makes it easier to establish multiple manhole monitoring systems and leadstoanerror free transmission of the information.
**Keywords:** Ethernet module, WEB socket, HTML(HyperText MAKEUP LANGUAGE), IOT (Internet Of Things).

## 1. INTRODUCTION

A properly maintained manhole is a sign of an efficiently run city. In today's smart cities, manholes and their upkeep have grown to be a significant problem [1]. Negative effects, such as the explosion of potentially dangerous gases trapped inside the manhole or the overflow of drainage water may come from improper drainage system management. The overall health and hygiene of the populace may suffer as a result. A structure known as a sewage manhole provides access to the underground wastewater collecting system. Manholes are not intended to be regularly worked in, but it may be necessary for workers to enter one to perform maintenance, repair, or inspection work. [9]. Thousands of sewage cleaners die each year from accidents and diseases such as hepatitis and typhoid as a result of sudden or continuous exposure to toxic gases such as carbon monoxide, hydrogen sulphide, and methane due to a lack of preceding sewage job care [6].

Manholes are manually monitored, and India has a considerable number of sewage workers in comparison to other countries [5]. In addition to the fact that bad manhole management is not a good thing, sewage workers entering manholes is dangerous and could result in death. According to the data, around 1000 sewage employees died last year after falling down manholes. The opening of manhole covers is another issue linked with manholes. This has resulted in countless road accidents, as well as the spilling of all drainage waste, resulting in infections [8].

Our project provides a low-cost, effective circuit that aids in manhole management and prohibits personnel from entering manholes. The appropriate analysis of this design is that it is low-maintenance,

quick to install, has a large number of sensors, a long lifespan, and a high level of service quality. It primarily focuses on informing people about the deadly gas explosion, the rise in drainage water levels, and the breaching of the manhole cover [3,4].Gas sensors are used to prevent manhole explosions by monitoring the quantity of subsurface gases and detecting the presence of combustible gases. It is mostly caused by the release of harmful organic and inorganic compounds, as well as faulty wiring. The installation and effective operation of a split transferring and receiving framework for subterranean water drainage and sewer hole monitoring [2,3]. Temperature sensor for the manhole system to keep the temperature stable. The water level is determined using an ultrasonic sensor. When the lid is lifted, the tilt sensor detects it and sends the information to authorities via the RF tag beneath the manhole cover [1].

The above-mentioned characteristics are detected using four different sensors, and the information is displayed on a web page using an ethernet module [7]. The municipal authorities have access to this information, and by monitoring the parameters, they can take appropriate action. This project's operation and implementation will be extremely beneficial to society.

## 2. PROPOSED BLOCK DIAGRAM

Here we have interfaced ethernet module to Arduino uno board for the webpage to display the sensor detected values that are present in the manhole system. The digitals pins 10,11,12,13 are used for interfacing Arduino and ethernet module. The four sensors are used to detect and monitor the manhole system. Ultrasonic sensor is used for detecting water level in manhole system. MQ2 sensor is used for detecting gas in manhole system. The LM35 sensor is used to measure the temperature of the system. Tilt sensor is used to detect if the manhole cover is open. The value is monitored by the authorities via website.

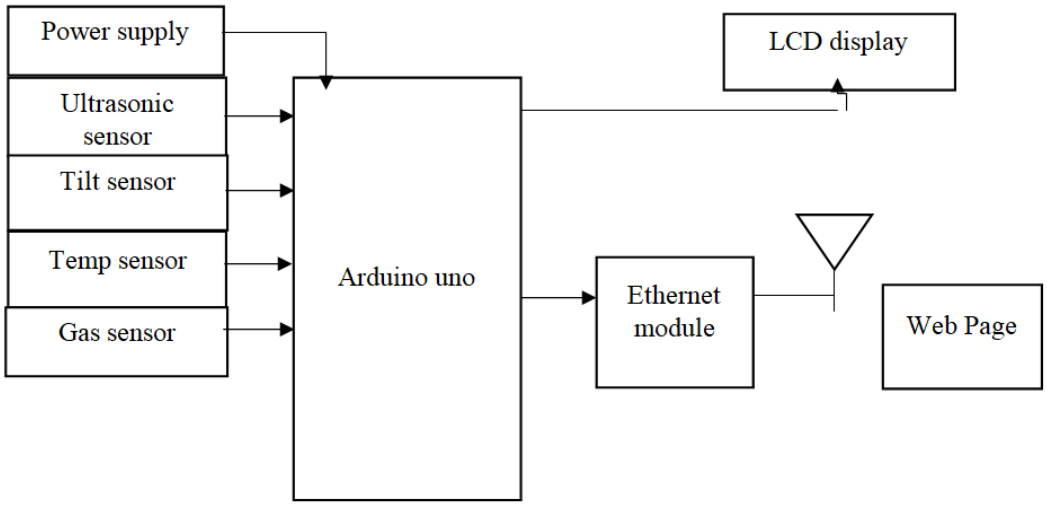


Figure 1. Block diagram of manhole detection and monitoring system

## 3. METHOD AND METHODOLOGY

To interface temperature sensor, gas sensor, tilt sensor, water level sensor for real time monitoring applications and to design and develop an IOT architecture for manhole monitoring system using Arduino and Ethernet.

### 3.1 ARDUINO Uno R3

Arduino Uno R3 is an 8-bit, open source, microcontroller board. It is based on Microchip ATmega328p. It has 14 digital input output pins (out of which 6 pins are capable of PWM output) and 6 analog pins that are used to interface various expansion boards. It is programmable with Arduino IDE using type B USB. It can be powered by a USB cable or 9-volt battery (usually supports 7v to 20v). The board comes pre-programmed with a boot loader that allows uploading new code to it without the use of external hardware programmer (extra bit of hardware connecting PC and Arduino).Arduino software IDE includes a serial monitor that allows simple text data to be sent to and from the board. The Rx and Tx LEDs on board will flash when data

is transmitted from USB cable to serial chip and USB cable to computer (But not for serial communication on pins 0 and 1).

**3.2 MQ2 GAS SENSOR:**

The MQ2 gas sensor is a metal oxide semiconductor (MOS) type gas sensor. It is used to detect the concentration of gases present based on change in resistance of the sensing material. Due to this phenomenon these sensors are known as chemiresistors. The gas sensor works on 5v DC and draws around 800mw. It can detect gases like - LPG, smoke, alcohol, propane, hydrogen, methane and carbon monoxide.

**3.3 LM35 TEMPERATURE SENSOR**:

LM35 is a temperature sensor whose output is in analog form and is proportional to the instantaneous change in temperature. Its measuring range is between -55 degrees centigrade to 150 degrees centigrade. Its accuracy level is very high if operated at optimal temperature and humidity levels. The conversion of the output voltage to centigrade is also very easy and straight forward.The input voltage to LM35 can be from +4 volts to 30 volts. It consumes about 60 microamperes of current.

**3.4 ETHERNET SHIELD W5100:**

The Arduino ethernet shield v1 connects arduino to the ethernet within few minutes.It is based on the WIZNET W5100 ethernet chip. The wiznet W5100 provides a network (IP) stack capable of both TCP & UDP. It supports up to four simultaneous socket connections. The shield has a standard RJ-45 connection with an integrated line transformer and power over ethernet enabled. The module contains an onboard micro-SD card slot (accessible through SD library) which can be used to store files. It also has a reset controller to make sure that the module is properly reset when power is on.

**3.5 ULTRASONIC SENSOR:**

An ultrasonic sensor is used to detect the presence of an object or a target by sending ultrasonic sound waves of frequency 40khz i.e., above human hearing level.It uses a transducer to send and receive ultrasonic pulses. The time lapse between sending and receiving of the waves determines the distance of the object. For presence detection, ultrasonic sensors detect objects regardless of the color, surface or material (unless the material is very soft like wool, as it would absorb sound).These sensors are also known as proximity sensors because of their ability to detect the presence of nearby objects without any contact.

**3.6 SW-520d TILT SENSOR MODULE:**

The tilt sensor module is a device used for detecting the planar movement. They detect the change in movement from horizontal to vertical direction and send the information signals. They are cheap, affordable and are of a small size which makes them easier to install. There are two metallic balls inside the sensor, whose movement helps in determining the change in angle/position. There are two terminals that are projected inside. When the sensor lies horizontal to the plane, the two metallic balls are in horizontal position i.e., they are not touching the two terminals. So, there will be no detection of tilt as the terminals are open circuited. When the sensor is in vertical position, in such a way that the two balls are touching the two terminals, the two terminals are short circuited and tilt is detected.

## 4. FLOWCHART

The Arduino reads the values from the sensors and then uses the ethernet module to communicate the data to the webpage.

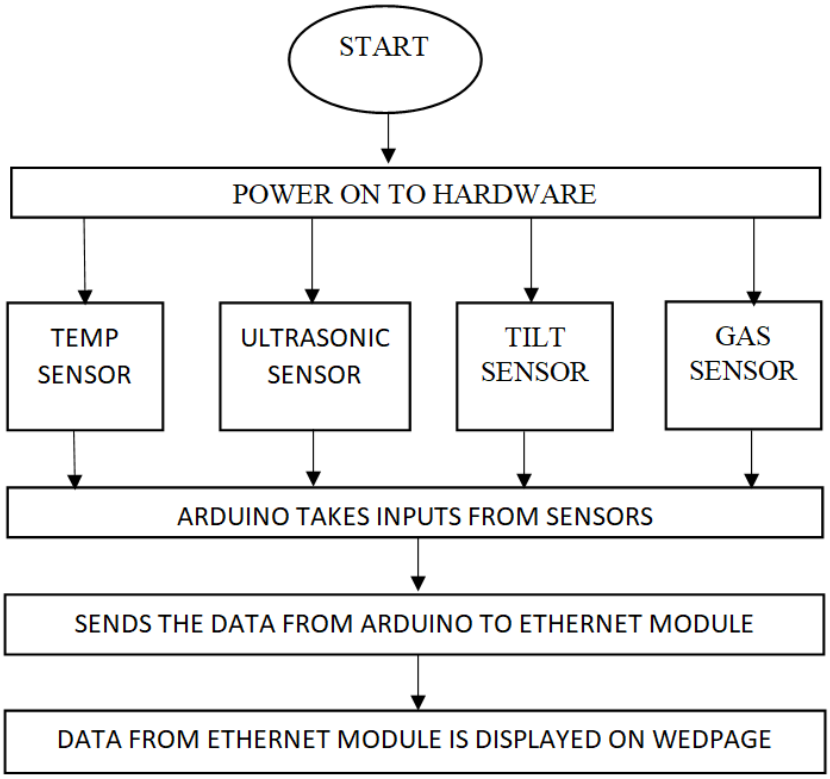


Figure 2. flow chart of manhole detection and monitoring system

## 6. OVERALL INTEGRATION, TESTING&VERIFICTION:

We have interfaced the components with the Arduino and the ethernet module, and we have given the ethernet module a mac address, gateway, subnet, and Ip address to connect the webpage. The Arduino has been given sensor inputs. The Arduino collects the data and sends it to the ethernet. Ethernet modules display sensor values on a webpage using the mac, gateway, subnet, and Ip address. To connect to the webpage, the Ip address is used.

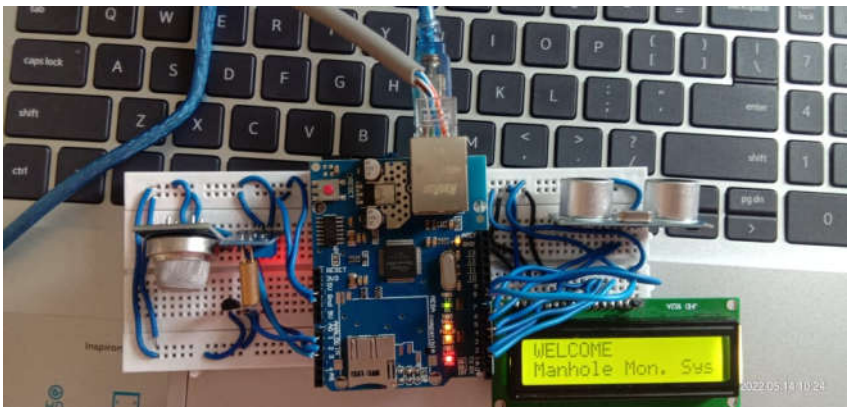


Figure 3. sensors interfacing with Arduino and ethernet module

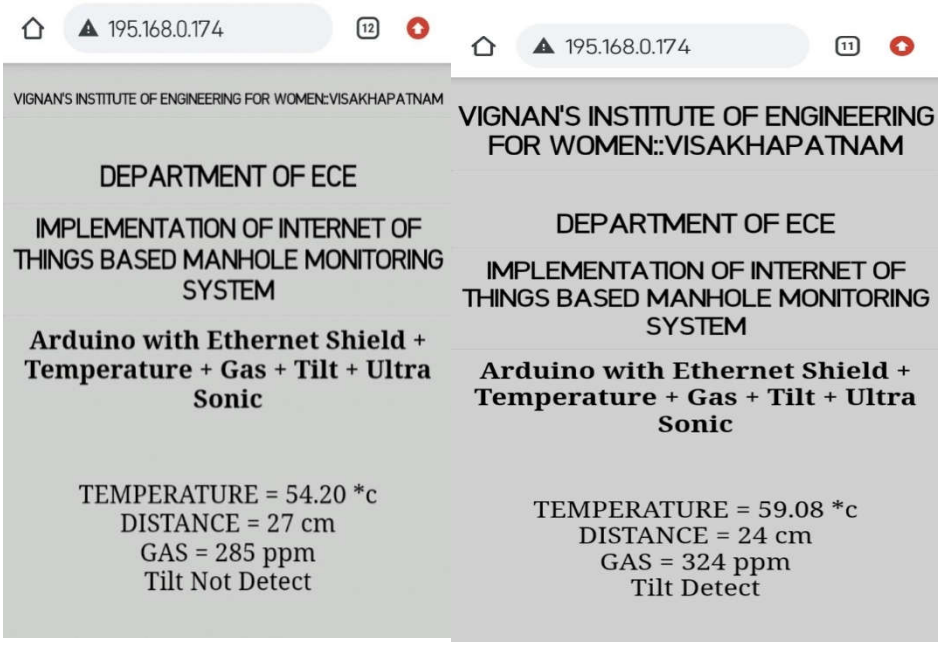

Figure 4. Webpage of manhole detection and monitoring system

## 6.CONCLUSION

Effective under-hole management is crucial. Without the necessity for sewage personnel to access manholes, this project simplifies the management procedure. Temperature, water level, gas, and tilt in the manhole cover are measured using various sensors, and information is disseminated using IOT on a web page. This shortens the total time needed to fix the issue thanks to ongoing observation and prompt information sharing. Our project is inexpensive to build and efficient. The society would benefit greatly from the implementation of this project by reducing the number of fatalities and accidents brought on by manholes.

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