

EFFICIENT MANHOLE MANAGEMENT SYSTEM: A COMPREHENSIVE SOLUTION

¹Dr .Y Srinivasulu,²A Rajesh,³L Sunitha,⁴Bandlamudi Maneesh

¹Professor,²Associate Professor,³Assistant Professor⁴Student

Department of ECE

G V R & S College of Engineering & Technology, Guntur, AP

ABSTRACT

A smart city is the future goal to have cleaner and better amenities for the society. Smart underground infrastructure is an important feature to be considered while implementing a smart city. Drainage system monitoring plays a vital role in keeping the city clean and healthy. Since manual monitoring is incompetent, this leads to slow handling of problems in drainage and consumes more time to solve. To mitigate all these issues, the system using a wireless sensor network, consisting of sensor nodes is designed.

The project aims in designing a manhole management system using IOT which alerts the managing station through web page when any manhole crosses its threshold values and also the system monitor the sensors data on LCD module. This system reduces the death risk of manual scavengers who clean the underground drainage and also benefits the public.

The project makes a use of water level sensor, water flow sensor, Temperature sensor, Gas sensor and raspberry pi zero w processor. The controlling device of the whole system is raspberry pi processor. In this rise in temperature, explosion due to toxic gases, overflow, manhole lid left open is detected by the sensors. The signals from the sensors are fed to the raspberry pi, which is programmed to generate alerts. In this we use sensors to detect blockage, floods, and gases. The sensors will identify the clogging inside the drainage system and will give information to the user through email and further actions will be taken care by the municipal.

Nowadays, accidents due to broken and missing manhole covers are quite frequent. Manholes are not monitored properly in developing countries. These accidents can lead to serious injuries and also death.

Hence, here we propose a system to overcome this problem. We have included an array of sensors for complete monitoring of the manhole cover so that such accidents can be prevented. This project includes a gas cover to monitor the gas emitted from the sewage systems so that toxicity can be monitored, the internal temperature is also monitored if a check for a change in the temperature as the property of manhole

change with temperature which could need to crack formation, Also, a float sensor is used to indicate when the water level goes beyond a certain level, in case of any alert due to any of the parameters we check on the IOT website. Also, all the parameters are continuously updated on the website.

I. INTRODUCTION

1.1 INTRODUCTION OF THE PROJECT:

For a clean and healthy environment, many Indian cities have an underground drainage system that is controlled by the Municipal Corporation. The water in the drainage system is occasionally mixed with pure water due to poo upkeep Infections and diseases can be spread through the drainage system. Because of climate change, drainage is affected throughout the year, and the environment is dynamic, people's daily lives are disrupted. To fix all drainage system concerns and to send notifications to the municipal corporation through web page informing them of the state of the drainage system so that officials can take the necessary steps to restore the drainage system. A gas sensor was used to detect the gas produced within the bio-waste drainage system, preventing it from escaping. The pressure inside the drainage system produced an explosion. The purpose of this design is to track the drainage system using the sensor. When the sewage system is obstructed, water overflows, or the drainage lid is removed, sensors monitor the drainage and send the data to a nearby municipal corporation official via integrated Wi-Fi, where the water overflow and gas value are presented live in the cloud for later examination. The sewage system exhibits instability and uncertainty due to multivariable, nonlinear, temporal variation, and random treatment processes. This model's purpose is to create a low cost, customizable solution for detecting obstructions and stinky or foul-smelling gases. Sensors detect the water level, and if the difference between the two levels exceeds the threshold value, Raspberry pi pico w is connected to the sensors' output. It looks at the previously set threshold level which is tracked via IoT. Thing speak, an IoT server analytics solution, gas detection on the monitor. The most significant benefit of this

technology is that it can save sewage workers from dying from harmful gas exposure.

For a clean and healthy environment, many Indian cities have an underground drainage system that is controlled by the Municipal Corporation. The water in the drainage system is occasionally mixed with pure water due to poo upkeep. Infections and diseases can be spread through the drainage system. Because of climate change, drainage is affected throughout the year, and the environment is dynamic, people's daily lives are disrupted. To fix all drainage system concerns and to send notifications to the municipal corporation informing them of the state of the drainage system so that officials can take the necessary steps to restore the drainage system. A gas sensor was used to detect the gas produced within the bio-waste drainage system, preventing it from escaping. The pressure inside the drainage system produced an explosion. The purpose of this design is to track the drainage system using the sensor. When the sewage system is obstructed, water overflows, or the drainage lid is removed, sensors monitor the drainage and send the data to a nearby municipal corporation official via integrated Wi-Fi, where the water overflow and gas value are presented live in the cloud for later examination. The sewage system exhibits instability and uncertainty due to multivariable, nonlinear, temporal variation, and random treatment processes. This model's purpose is to create a lowcost, customizable solution for detecting obstructions and stinky or foul-smelling gases. Two ultrasonic sensors detect the water level, and if the difference between the two levels exceeds the threshold value, an alert message is delivered to the web server.

1.2 BLOCK REPRESENTATION:

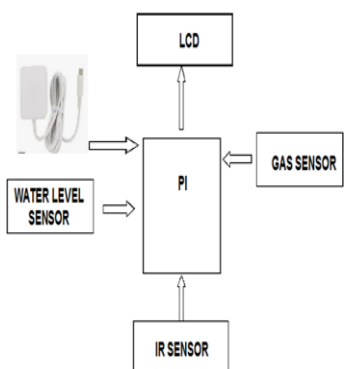


Figure 1: BLOCK DIAGRAM

1.3 WATER LEVEL SENSOR:

The water level sensor is used to determine how much water is in the manhole. If the water has increased from its original level, a notification will be sent to the authorities.

Water level sensor can be used with a microcontroller to actuate a pump, an indicator, an alarm, or another device. Can use them with hydroponics, saltwater tank, freshwater tank, gardening, aquariums for power head control, pet bowls, fish tanks, filtration, heating, pumps, ponds, basement alarms, boats, air condition drain pans, pressure washers, carpet cleaning machine, reef aquarium, fluid control, ice machines, coffee pots, marine, automotive, automobiles, tropical fish tanks, evaporator coils, etc. The best thing about this water level sensor is this is compact and lightweight. Though you can't measure a large water depth i.e., 4 cm maximum, but the reading will be linear, i.e., the output to analog signal is directly proportional to the water level.

Water level sensor in India and worldwide is popularly used for DIY student projects. As the output voltage is linear, it finds some applications in the industries.

1.4 GAS SENSOR:

Gas sensor is used widely in various applications to sense whether the gas is present or not, so that gas sensor is used to check whether the harmful gas presence in the manhole. If it detects any harmful gas, the message will be sent to the corporation office. The MQ-6 sensor is a sensitive component and it is adjustable on the board and also it is a protection resistor. LPG, isobutene, and propane are particularly sensitive to the MQ-6 gas sensor, whereas alcohol is less sensitive.

A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

The type of gas the sensor could detect depends on the sensing material present inside the sensor. Normally these sensors are available as modules with comparators as shown above. These comparators can be set for a particular threshold value of gas concentration. When the concentration of the gas exceeds this threshold, the digital pin goes high. The analog pin can be used to measure the concentration of the gas.

These sensors are normally available as modules (shown right), these modules consist of the gas sensor

and a comparator IC. Now let's see the pin description of the gas sensor module which we will generally use with an Arduino. The gas sensor module basically consists of 4 terminals

Vcc – Power supply

GND – Power supply

Digital output – This pin gives an output either in logical high or logical low (0 or 1) that means it displays the presence of any toxic or combustible gases near the sensor.

Analog output – This pin gives an output continuous in voltage which varies based on the concentration of gas that is applied to the gas sensor.



Figure 2 GAS SENSOR

A basic gas sensor has 6 terminals in which 4 terminals (A, A, B, B) acts input or output and the remaining 2 terminals (H, H) are for heating the coil. Of these 4 terminals, 2 terminals from each side can be used as either input or output (these terminals are reversible as shown in the circuit diagram) and vice versa.

The ability of a Gas sensor to detect gases depends on the chemiresistor to conduct current. The most commonly used chemiresistor is Tin Dioxide (SnO₂) which is an n-type semiconductor that has free electrons (also called as donor). Normally the atmosphere will contain more oxygen than combustible gases. The oxygen particles attract the free electrons present in SnO₂ which pushes them to the surface of the SnO₂. As there are no free electrons available output current will be zero. The below gif shown the oxygen molecules (blue colour) attracting the free electrons (black colour) inside the SnO₂ and preventing it from having free electrons to conduct current.

When the sensor is placed in the toxic or combustible gases environment, this reducing gas (orange colour) reacts with the adsorbed oxygen particles and breaks the chemical bond between oxygen and free electrons thus releasing the free electrons. As the free electrons are back to its initial position they can now conduct current, this conduction will be proportional the number of free electrons available in SnO₂, if the gas is highly toxic more free electrons will be available.

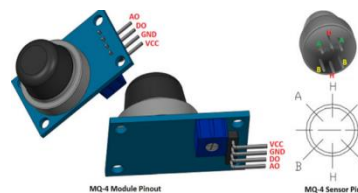


Figure3.SENSOR PINOUT

II. LITERATURE SURVEY

2.1 LITERATURE REVIEW:

The design space of wireless sensor networks, Wireless Communications Author:

Romer, K. Mattern Description: In the recent past, wireless sensor networks have found their way into a wide variety of applications and systems with vastly varying requirements and characteristics.

As a consequence, it is becoming increasingly difficult to discuss typical requirements regarding hardware issues and software support. This is particularly problematic in a multidisciplinary research area such as wireless sensor networks, where close collaboration between users, application domain experts, hardware designers, and software developers is needed to implement efficient systems. In this paper we discuss the consequences of this fact with regard to the design space of wireless sensor networks by considering its various dimensions. We justify our view by demonstrating that specific existing applications occupy different points in the design space.

Towards the Implementation of IoT for Environmental Condition Monitoring in Homes Author: Kelly S.D.T, Suryadevara, N.K, Mukhopadhyay S.C Description: In this paper, we have reported an effective implementation for Internet of Things used for monitoring regular domestic conditions by means of low cost ubiquitous sensing system. The description about the integrated network architecture and the interconnecting mechanisms for reliable measurement of parameters by smart sensors and transmission of data via internet is being presented. The longitudinal learning system was able to provide self-control mechanism for better operations of the devices in monitoring stage. The framework of the monitoring system is based on combination of pervasive distributed sensing units, information system for data aggregation, reasoning and context awareness. Results are encouraging as the reliability of sensing information transmission through the proposed integrated network architecture is 97%. The prototype was tested to generate real-time graphical information rather than a test bed scene

III. RASPBERRY PI PICO W

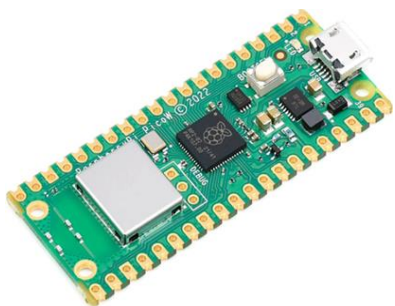


Figure 4: RASPBERRY PI PICO W

Raspberry Pi Pico W is a low-cost, but flexible RP2040 development platform officially designed by Raspberry Pi. It is a wireless upgrade version of Raspberry Pi Pico. It has all the features of Pico and has a 2.4GHz wireless interface.

On the 21st of January, 2021, the Raspberry Pi Foundation released its own microcontroller board called the Raspberry Pi Pico. Despite its name, the Pico is a microcontroller, not a small microcomputer (i.e., a Single Board Computer or SBC) like the raspberry pi, uses a different CPU chipset (the RP2040, a proprietary design by the Raspberry Pi Foundation), and is significantly smaller and cheaper than any Pi at US\$4.

It comes with a C SDK, a GCC-based toolchain, Visual Studio Code integration, and can be programmed in Micro python. The RP2040 CPU is currently available in the Pico form factor as released by the Raspberry Pi Foundation, but announcements have been made by many vendors like Adafruit and Pimoroni for Feather, Itsy Bits, QT, Tiny, and other familiar designs

The Raspberry Pi Pico is the first microcontroller board from the Raspberry Pi Foundation. It has their own RP2040 microcontroller and 2 MB of external Flash memory.

The RP2040 chip has two ARM Cortex M0+ CPU cores running at up to 133 MHz (before overclocking). Each core also has an integer division unit and interpolator.

There are two programmable I/O modules (PIO), capable of communicating with addressable LEDs, among many other things. The board is however not 5V-capable.

Program code (firmware) is loaded from a 2MB Flash chip on the board. There is a 16 KB SRAM cache which allows *execution In Place* (XIP) as if all the program memory was in RAM — albeit with a performance hit on cache misses. Code can also be

loaded into internal SRAM and run from there. If all code is run from SRAM, the cache could be reused as additional SRAM instead.

3.1 IR SENSOR:

The IR sensor or infrared sensor is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation. These sensors can also be used to detect or measure the heat of a target and its motion. In many electronic devices, the IR sensor circuit is a very essential module. This kind of sensor is similar to human's visionary senses to detect obstacles.

The sensor which simply measures IR radiation instead of emitting is called PIR or passive infrared. Generally in the IR spectrum, the radiation of all the targets radiation and some kind of thermal radiation are not visible to the eyes but can be sensed through IR sensors.

In this sensor, an IR LED is used as an emitter whereas the photodiode is used as a detector. Once an infrared light drops on the photodiode, the output voltage & resistance will be changed in proportion to the received IR light magnitude.

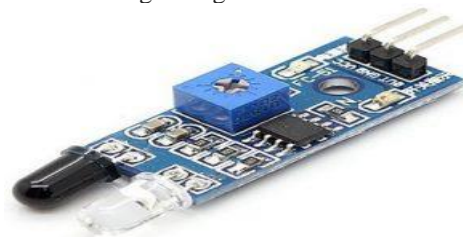
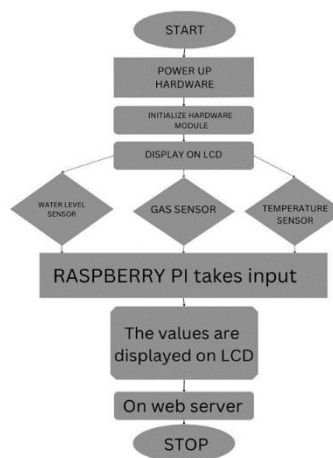


Figure 5: IR Sensor Module

IV. FLOW CHART:



V. CIRCUIT DESCRIPTION AND RESULT
5.1 CIRCUIT DIAGRAM:

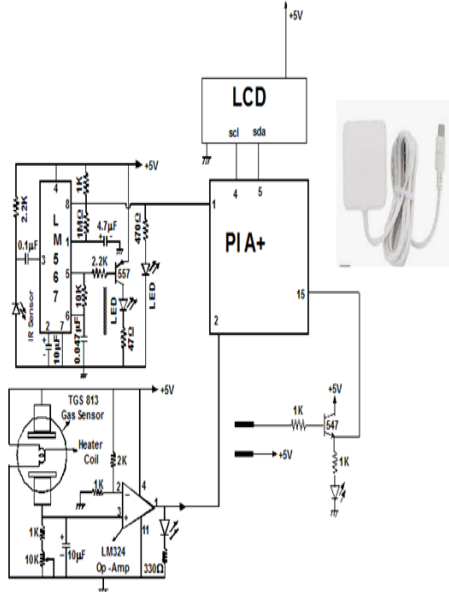


Fig 6: Circuit Diagram

5.2 RESULT:

Within the manhole and convert those inputs into electric output, this electric output acquired as a enter to Raspberry pi pico w embedded with Wifi modules and programmed in this sort of manner that each one the records is ship to server in precise time periods then the internet site presentations all stay readings of each node and the alert records into readable textual content .Offline textual content are also are dispatched to the given predefined LCD.

5.3 RESULT WINDOW:

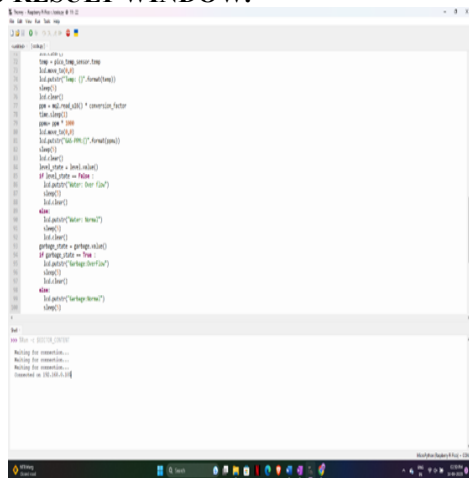


Fig 7 Result window stage I



The above picture represents the stage I result of the project. In this stage, the parameters- Gas, temperature, water level and garbage level are displayed on the LCD.

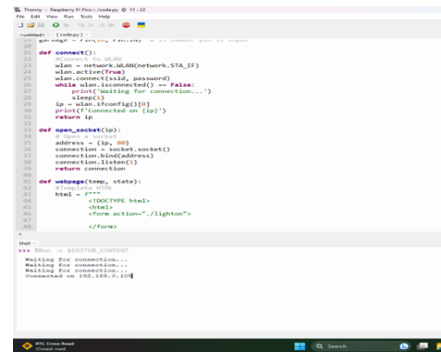


Fig 8 Result Window stage II

The above picture represents the stage II result of the project. In this stage, the connection for communication between the person and the server is established, The values of the parameters are displayed on the web server page

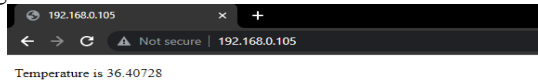


Fig 9 values displayed on web server



Fig 10 values displayed on LCD

5.4 WITH POWER SUPPLY:



Fig 11. Upload window and Project Kit with power supply

system. It explains various applications like underground drainage and manhole identification in real time. Various parameters like temperature, toxic gases, flow and level of water are being monitored and updated on the internet using the Internet of Things. This enables the person in-charge to take the necessary actions regarding the same. In this way the unnecessary trips on the manholes are saved and can only be conducted as and when required. Also, real time update on the internet helps in maintaining the regularity in drainage check thus avoid the hazards. This paper addresses all about smart and real-time Drainage monitoring system through IOT applications for metropolitan cities. By using various sensors such as gas detection, water level as well as blockage detection we can monitor the real time scenario of drainage system by for detecting the problems in drainage system. By doing this we can be able to take particular action on the problems as we will receive the early alerts of blockage as well as increase. This paper can be used to design the smart and real time drainage system for monitoring as well as troubleshooting purpose.

7.2 FUTURE SCOPE:

In the destiny after securing underground drainages from dangerous gases and different contaminants. We can visit paintings on some other difficulty this is sewage water overflows wherein divert wastages from the busiest sewage line to others which can be able to flowing that more sewage waste. In the destiny, our concept may be focusing on the intake of water that's different most important difficulty otherwise automating entire sewage cleansing device with assist of robotics and tracking wastes earlier than dumping it into sea whether or not it's far dangerous to marine flowers and fauna, If a person pass towards dumping regulations we are able to song them and penalty may be despatched with minimum guide assist

7.3 REFERENCES :

1. <https://create.raspberry-pi.cc/projecthub/sarful/raspberry-pi-workshop->
2. <https://www.PI.cc/education/science-journal>
3. <https://www.pico W.cc/en/Guide/Introduction>
4. <https://www.hackerearth.com>
5. <https://www.raspberrypi.com/documentation/microcontrollers/raspberry-pi-pico.html>
6. <https://thonny.org/>
7. <https://thonny.en.softonic.com/>
8. <https://mintbook.com/blog/digital-library-software-list/>
9. Muragesh S. K1 and Santhosha Rao "AutomatedInternet of Things for Underground Drainage and Manhole Monitoring System for Metropolitan Cities"November2014
10. Prof. S A.Shaikh 1, Suvarna A. Sonawane. "Implementing Smart City Concept with Various Application Using IOT Based Technique"June 2017
11. Yash Narale,Apurva Jugal,Himani Chowdhary,S.P Bhosale "Underground Drainage Monitoring System Using IOT" .International Journal of Advance Research Ideas And Innovations In Technology, Volume 4 Issue 1, January 2018
12. G. Gowthaman, K. Hari Haran "Automated Internet of Things for Underground Drainage and Manhole Monitoring System for Metropolitan Cities"ISSN 0974- 2239 Volume 4, Number 12 (2014), pp. 1211-1220
13. Retno Tri Wahyuni1* Yusmar Palapa Wijaya2 Dini Nurmalasari "Design of Wireless Sensor Network for Drainage
14. Wirawam, S., Pratoma, I., and Mita, Nagahisa. "Design of Low Cost Wireless Sensor Network-Based Environmental Monitoring System for Developing Country".Proceedings of APCC2008