

UNDERGROUND DRAINAGE MONITORING USING RASPBERRY PI AND IOT

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

BY

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **R. ASWIN RAJ (39140005)** and **V. KARTHIK VISHVA (39140005)** who carried out the project entitled **"UNDERGROUND DRAINAGE MONITORING USING RASPBERRY PI AND IOT"** under our supervision from November 2022 to April 2023.

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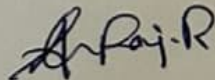
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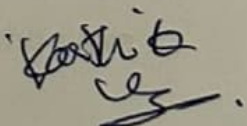
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DECLARATION

We **R. ASWIN RAJ** (Reg. No. 39140005) and **V. KARTHIK VISHVA** (Reg. No. 39140022) hereby declare that the Project Report entitled "**UNDERGROUND DRAINAGE MONITORING USING RASPBERRY PI AND IOT**" done by us under the guidance of **Dr. V. SENTHIL NAYAGAM** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

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ABSTRACT

The recurrent deaths of sewage workers make surveillance of sewage an urgent activity. Therefore, in order to ensure the health of workers working under these harsh conditions, there is a need to develop technologies. In this paper, we intend to provide a system that can quantify and analyze the amount of harmful gasses in real time and send an warning message when the levels are beyond the threshold. This project attempts to device an IoT technology using Raspberry Pi, Thing Speak platform, and Pushover application. The gas levels along with humidity and temperature shall be observed. The experimental results show that whenever the gas levels exceed the threshold, the authorized individuals receive an alert on the connected mobile devices. In addition, the device offers live streaming of video to check blockages, if any. The directions for future research have been included at the end of the conclusion.

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LIST OF ABBREVIATIONS

BW	-	Bandwidth
COPD	-	Chronic Obstructive Pulmonary Disease
CORD	-	Chronic Obstructive Respiratory Disease
LoRa	-	Long Range
SF	-	Spreading Factor
SSOs	-	Sanitary Sewer Overflows
UDMS	-	Underground Drainage and Manhole Monitoring System

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Sewage pipelines are filled with toxic gases, inhaling these gases for a long duration can lead to various chronic diseases. High concentrations of gases like Hydrogen Sulfide, Ammonia, Carbon Dioxide, Methane often leads to deaths. The lack of treatment and protection leads to the deaths of many sewage cleaners throughout the year. Manual system installation and data generation is both difficult and dangerous each time, as shown in the Figure. 1.1. So, there is a growing need for automated data generation and monitoring. In this paper we suggest sewage tracking using IoT technology. The developed system will help to track the sewage environment 24/7 by the authorities that employ those workers. They will be able to analyze and take precautions in real-time, based on the system-generated graphs. The system comprises gas sensors namely methane and carbon monoxide, apart from which an additional sensor that will measure the humidity and temperature is connected. The IoT analytics platform produces graphs and sends warnings whenever the gas values go beyond the standard limits. The attached camera can provide live video on the HTTP server, which can be used to identify blockages that guide workers to take the appropriate precautions. The proposed prototype can be changed based on the requirement of the industry. It can be used for monitoring the sewage conditions at different locations.



Figure. 1.1: Sewage leakage

CHAPTER 2

LITERATURE SURVEY

2.1 MAJOR FINDINGS FROM LITERATURE SURVEY

Varieties of the sewage inspection method have been used to save the lives of employees in hazardous environments. It sends an alert to the organizations that hire these staff, when the ppm levels of particular gases go over the strict limitations.

Ioannis Manisalidis proposed a mainly focused on the worker's ventilation capacity, smoking habits, and work duties. The differences in ambient air pollution between new and old sewage plants clarified the variation in the health problems observed among the sewer workers. Survey Anthropogenic air pollution is one of the biggest public health hazards worldwide, given that it accounts for about 9 million deaths per year

Without a doubt, all of the aforementioned are closely associated with climate change, and in the event of danger, the consequences can be severe for mankind . Climate changes and the effects of global planetary warming seriously affect multiple ecosystems, causing problems such as food safety issues, ice and iceberg melting, animal extinction, and damage to plants.

Air pollution has various health effects. The health of susceptible and sensitive individuals can be impacted even on low air pollution days. Short-term exposure to air pollutants is closely related to COPD (Chronic Obstructive Pulmonary Disease), cough, shortness of breath, wheezing, asthma, respiratory disease, and high rates of hospitalization (a measurement of morbidity).

The long-term effects associated with air pollution are chronic asthma, pulmonary insufficiency, cardiovascular diseases, and cardiovascular mortality. According to a Swedish cohort study, diabetes seems to be induced after long-term air pollution exposure. Moreover, air pollution seems to have various malign health effects in early human life, such as respiratory, cardiovascular, mental, and perinatal disorders, leading to infant mortality or chronic disease in adult age.

In developing countries, the problem is more serious due to overpopulation and uncontrolled urbanization along with the development of industrialization. This leads to poor air quality, especially in countries with social disparities and a lack of information on sustainable management of the environment. The use of fuels such as wood fuel or solid fuel for domestic needs due to low incomes exposes people to bad-quality, polluted air at home. It is of note that three billion people around the world are using the above sources of energy for their daily heating and cooking needs. In developing countries, the women of the household seem to carry the highest risk for disease development due to their longer duration exposure to the indoor air pollution. Due to its fast industrial development and overpopulation, China is one of the Asian countries confronting serious air pollution problems. The lung cancer mortality observed in China is associated with fine particles. As stated already, long-term exposure is associated with deleterious effects on the cardiovascular system. However, it is interesting to note that cardiovascular diseases have mostly been observed in developed and high-income countries rather than in the developing low-income countries exposed highly to air pollution. Extreme air pollution is recorded in India, where the air quality reaches hazardous levels. New Delhi is one of the more polluted cities in India. Flights in and out of New Delhi International Airport are often canceled due to the reduced visibility associated with air pollution. Pollution is occurring both in urban and rural areas in India due to the fast industrialization, urbanization, and rise in use of motorcycle transportation. Nevertheless, biomass combustion associated with heating and cooking needs and practices is a major source of household air pollution in India and in Nepal. There is spatial heterogeneity in India, as areas with diverse climatological conditions and population and education levels generate different indoor air qualities, with higher PM_{2.5} observed in North Indian states (557–601 µg/m³) compared to the Southern

States (183–214 $\mu\text{g}/\text{m}^3$). The cold climate of the North Indian areas may be the main reason for this, as longer periods at home and more heating are necessary compared to in the tropical climate of Southern India. Household air pollution in India is associated with major health effects, especially in women and young children, who stay indoors for longer periods. Chronic obstructive respiratory disease (CORD) and lung cancer are mostly observed in women, while acute lower respiratory disease is seen in young children under 5 years of age.

Ritika Nayak proposed a system called "Polluino" that monitors air pollution via Arduino. It is a cloud-based platform that manages the data from air quality sensors. It focuses on the ground-level ozone and particulate matter might cause asthma and respiratory diseases. The level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. In order to monitor In this project we are going to make an IOT Based Air Pollution Monitoring System in which we will monitor the Air Quality over a web server using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. We have used MQ135 sensor which is the best choice for monitoring Air Quality as it can detects most harmful gases and can measure their amount accurately. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile. This paper assumed completely wrong assumption where they have showed the output 997PPM as the fresh air, where Delhi which is the most polluted city recording 350PPM. Its clear understanding that they haven't calibrated the sensor and didn't even convert the raw sensor data into PPM using derivations we did. They have used Local Host which is limited where they are able to see the output only on the laptop within the experimental setup connected. But we have used premium iot platforms which are highly secured and open source IoT platform.

In this method is the identification of blockages in advance. The Problem: Conventional Practices Are Not Working With sewer blockages from grease, roots, sediment and debris being a leading cause of Sanitary Sewer Overflows (SSOs), utilities turn to a cleaning regimen. Typically, the total system is cleaned on a long-term basis while selected “hot spot” locations, each with regularly occurring build-up, are aggressively cleaned at high frequency. High-frequency cleaning reduces SSOs, but it comes with the unintended consequence of overcleaning. Utilities are challenged to stay on schedule with limited resources. Moreover, flow behavior changes between cleanings are not detected. Aging pipes raise another concern when regularly exposed to high pressure sprays.

Underground Drainage and Manhole Monitoring System (UDMS). In many places sewer level detection is being carried to detect the level of the fluid in advance to overflow problems. In recent years Japan has often experienced unexpected intense rain due to the development of cumulonimbus clouds; these are frequently occurring torrential downpours. According to the Meteorological Agency, in 2014 short period heavy rainfall exceeding 50 millimeters per hour occurred 237 times (at 1,000 observation points). The long-term statistics from 1976 clearly shows this as an increasing trend [6]. Due to relentless downpours, sewer systems have overflowed and numerous instances of flood damage have been experienced mainly in cities [5]. Equipping manholes in sewer line infrastructures with sensors can measure water levels and accurately detect early signs of overflow. However, the operating cost for each sensor is expensive, making it difficult to install sensors across a wide area. For this reason the number of sensors installed needs to be minimized. However, the effective installation of sensors was largely dependent on intuition and experience of the workers and now "there are growing expectations on ICT" to achieve this.

In 2020 He-sheng Zhang; Lei Li; Xuan Liu worked on Development and Test of Manhole Cover Monitoring Device Using LoRa and Accelerometer. The monitoring device is installed under the manhole cover, three key problems, how to measure the tilt angle or state of resources $\hat{\alpha}$. For the second problem, long range (LoRa) is adopted. A 433-MHz whip antenna is designed to overcome the shield of manhole cover and the absorption of electromagnetic waves of the earth.

The field tests show that the effective communication distance has been extended more than 700 m by using the whip antenna. In addition, the parameter spreading factor (SF) and bandwidth (BW) are configured. For the third problem, sleep mode is used and input output (IO) pin is configured

In 2018 W.Z.Black; Robert E.Snodgrass; Bryan P. Walsh worked on Thermodynamic Analysis of Explosive Events in Manholes and Electrical Vaults. A computer code is used to simulate the conditions that exist during a manhole event consisting of an electrical fault and a gas explosion. When energy is generated within the structure, pressures can reach levels sufficient to propel the cover from its frame. The code quantifies the effects of the event and provides guidelines for the design of safety devices that can minimize the potential danger of the event. Differences between chemically-driven and electrically-driven events are shown to require different design criteria for cover restraint systems. Devices designed to restrain the cover must be able to withstand explosive forces and react in sufficient time to reduce internally generated pressure.

In 2019 Glen Bertine worked on Manhole explosion and its root causes. The phrase manhole events is a euphemism for fires and explosions that occur in utility man holes in urban areas. All fires and explosions require three elements: fuel, oxygen (or another oxidizer), and an ignition source. Further, the fuel and oxygen must be within a specified range of concentrations to support combustion. Figure1 lists most of the significant compounds (flammable or not) that are likely to be encountered in a manhole environment and, where applicable, their upper and lower explosive limits (UELs and LELs, respectively).

In 2016 Sugato Ghosh; Indranil Das; Deepan Jana Adak; Nillohit Mukherjee; Raghunath Bhattacharyya worked on Development of selective and sensitive gas sensors for manhole gas detection. Worked on Loss of life of the workers inside manhole is a common problem for many parts of the world. To resolve this issue a portable, low cost, simple manhole gas detection unit has been designed and developed which is capable to detect the poisonous gases like carbon monoxide, hydrogen sulfide, and explosive gas like methane within a

minute and raise alarm if the concentration of any gas is beyond the threshold limit.

In 2018 N Nataraja; R Amrutha Varshini; N L Chaitra; K Jyothi; N Krupa; S S M Saqqaf worked on Secure Manhole Monitoring system Employing sensor and GSM Techniques. Nowadays manhole problems in the populated cities is the major issues. Opening of manholes due to breakage of manhole cover, manhole explosions are major threat in recent days. Manhole cover opening leads to accidental fall of vehicles, pedestrians leading to accidents or loss of life. Manhole opening detection and alerting is mainly based on detecting the manholes which are opened due to overflow of sewage / rain water during heavy rainfall and alerting when a manhole opening is detected either due to overflow of sewage water, increase in pressure or temperature, it leads to the breakage of the manhole lids. To avoid such incidents even before it could affect the public, an alerting system is built wherein the buzzer alerts the surrounding and sends the sensed data to the managing authorities using GSM techniques. So, they can take precautionary action to close the manhole considering public safety.

2.2 PROBLEM IDENTIFICATION

Blockages in drains are an issue that affects every property owner at one time or another. Blocked drains can come on slowly, often taking years to be noticeable. Ground movement, usually caused by ground instability, subsistence and increasing traffic levels, can cause a displaced or open joint in your pipes. Fractures occur due to the excessive 'wear and tear' that drain pipes go through. They are often found near the pipe joints but it's not uncommon to see further down the pipework. Roots are always searching for water, oxygen, and nutrients. Pipes – especially sewer systems – contain plenty of these, so roots will often penetrate any opening they find to get through.

2.3 SCOPE OF THE PROJECT

However, due to difficult in application of monitoring of drainage system the system may provide the automatic process of removal of waste. When the flow level get increased is detected, the flow path can be directed through another way

of automatic solenoid valve function. From this flow is directed to another way so flood may restrict. Another idea of collecting the drainage in underground and the useful gases can be collected for any uses.

2.4 OBJECTIVE

Cleaner cities and intelligent management of drainage in the city. Detection of drainage water level and blockages in the drainage. Checking water flow rate continuously, as well as sending automatic mail, display on the monitor if the water level is outside of an expected normal range. The main objective is to obtain an effective low-cost and flexible solution for condition monitoring and infrastructure management in the city. Sensing the temperature and leakage of gas and updating it in real time through IoT.

2.5 METHODOLOGY

Calibrating the sensors: The MQ-4 sensor analog output pin is connected to the RXI of Logic Level Converter and RXO is connected to Channel 0 pin of MCP3008 IC. The sensor itself produces an analog voltage, which can be transformed with an ADC. The transformed value can be used to obtain the ppm value of the sensed gas. MQ-4 digital pin to GPIO pin 6 MQ-7 digital pin to GPIO pin 26 DHT11 data output pin to GPIO pin 4 LLC configuration: The HV and LV is connected to 5v and 3.3v of raspberry Pi. Gnd to Gnd pin of Raspberry Pi. MCP3008 IC Configuration: VCC and Vref pins are connected to 3.3v pin of Raspberry Pi. Gnd pins are connected to the Gnd pin of Raspberry Pi. CS to GPIO pin 8 DOUT to GPIO pin 9 DIN to GPIO pin 10 CLK to GPIO pin 11 The Pi has a separate slot for inserting the camera board ribbon. The camera can be enabled by clicking on the 'Enable' option available in 'Interfaces' settings on Pi desktop. Install the Autoconf package on Rasbian and download the Motion deb file. Change the start_motion_daemon to yes and add the Ip address along with port number. The command "sudo service motion start" when run on the terminal will start the camera. Now, the live video will stream on Ip address/portnumber.

2.6 APPLICATION

By using this idea such as 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 able to take particular action on the problem as we will receive the early alerts of blockage as well as increase.

CHAPTER 3

HARDWARE AND PROJECT DESCRIPTION

3.1 EXISTING BLOCK DIAGRAM AND EXPLANATION

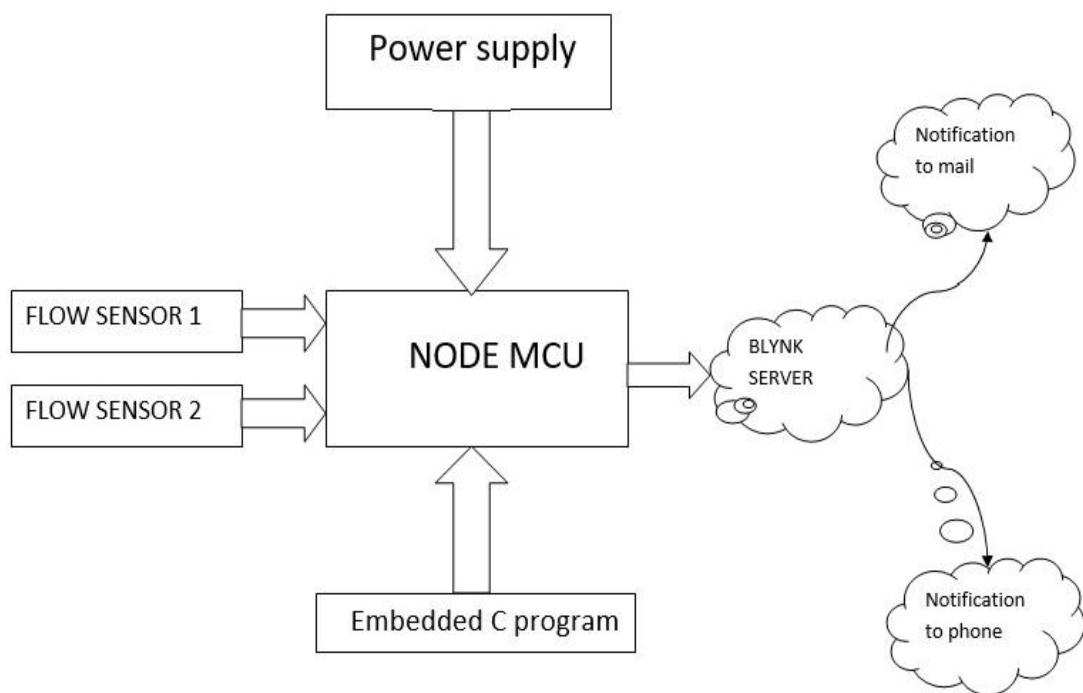


Figure. 3.1: Existing Block diagram

In Figure 3.1 Existing Block diagram consists of two flow sensors, one for each drain, node mcu and blink application. The main theme is to identify any drainage clogs. Therefore, here we use the flow sensors to check the regular flow of the sewage fluid and if there are any abnormal flows then it will send the corresponding information to nodemcu.

3.2 DISADVANTAGE OF EXISTING SYSTEM

This system will give the data of the sensor only. The harmful gases cannot be calculated.

3.3 PROPOSED BLOCK DIAGRAM AND EXPLANATION

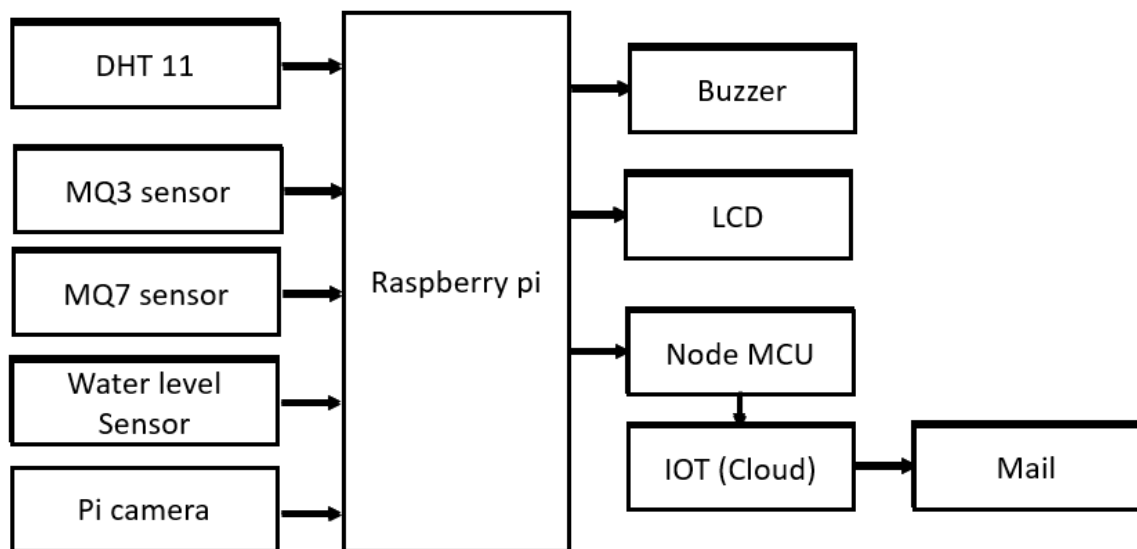


Figure. 3.2: Proposed block diagram

In the current proposal as shown in the (Figure 3.2 Proposed block diagram), we prefer to use various gas sensors, such as MQ4 (methane sensor) and MQ7 (carbon monoxide sensor) to measure the quantity of toxic chemicals in waste, as well as humidity and temperature sensor (DHT 11). One receiver end is provided at completely different nodal locations for management of the current system. The system provides a large volume of data from the sewage to the control panel. These data are stored in the form of graphs on the Ubidots IoT database. The React application is used to set thresholds, HTTP is linked to the Pushover Application to receive messages if the values are above the normal survival rates.

If the operators want to understand the changes in the amount of sewer gas, humidity, and temperature over time, the graphs on the Ubidots IoT platform can be analyzed. Additionally, the Raspberry Pi camera provides the live video

streaming feature to detect blockages so that it helps the sewer workers take the required equipment.

3.4 HARDWARE PARTS

3.4.1 RASPBERRY PI

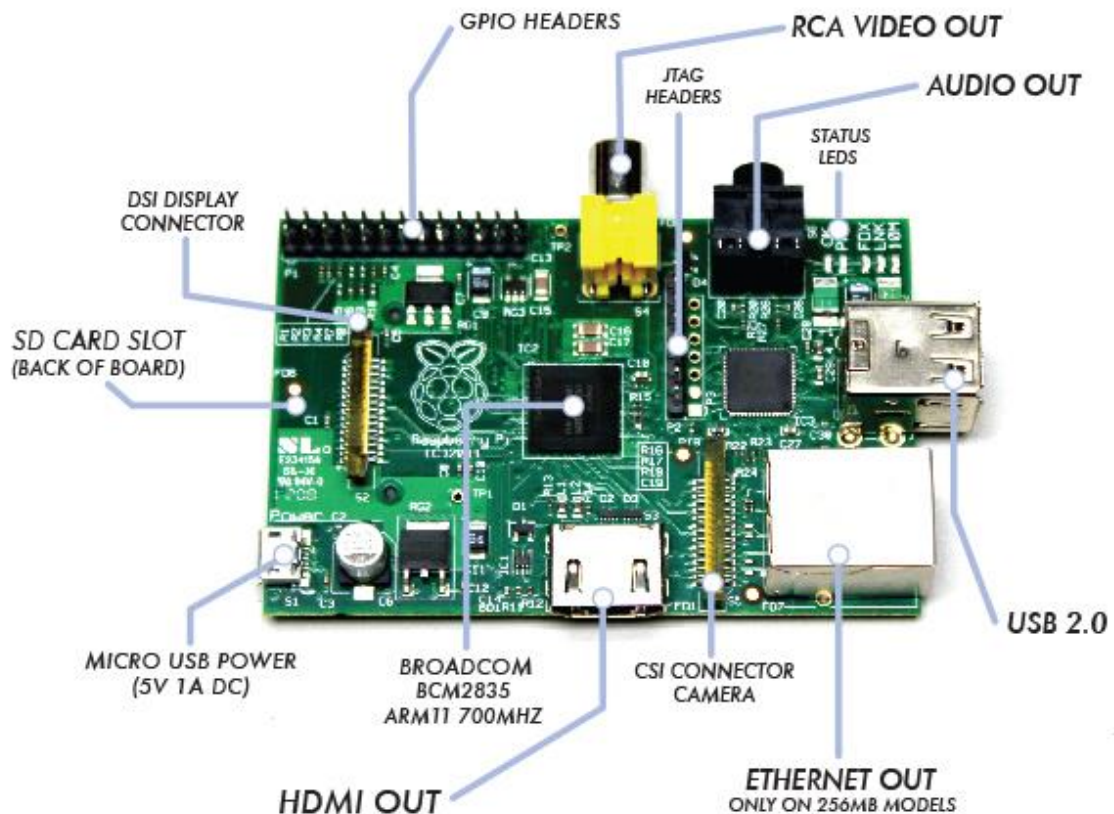


Figure. 3.3 Raspberry Pi

The following are essential to get started:

1. SD card containing Linux Operating system
2. USB keyboard
3. TV or monitor (with HDMI, DVI, Composite or SCART input)
4. Power supply

5. Video cable to suit the TV or monitor used Recommended optional extras include:
6. USB mouse
7. Internet connection, Model A or B: USB Wi-Fi adaptor
8. Internet connection, Model B only: LAN (Ethernet) cable
9. Powered USB hub are all shown in the (Figure. 3.3 Raspberry Pi).

[1] Case 1.2. Connecting Everything Together

[2] Plug the preloaded SD Card into the RPi.

[3] Plug the USB keyboard and mouse into the RPi, perhaps via a USB hub. Connect the Hub to power, if necessary.

[4] Plug a video cable into the screen (TV or monitor) and into the RPi.

[5] Plug your extras into the RPi (USB Wi-Fi, Ethernet cable, external hard drive etc.). This is where you may really need a USB hub.

[6] Ensure that your USB hub (if any) and screen are working.

[7] Plug the power supply into the mains socket.

[8] With your screen on, plug the power supply into the RPi micro-USB socket.

[9] The RPi should boot up and display messages on the screen. It is always recommended to connect the MicroUSB power to the unit last (while most connections can be made live, it is best practice to connect items such as displays with the power turned off). The RPi may take a long time to boot when powered-on for the first time, so be patient!

3.4.1.1 OPERATING SYSTEM SD CARD

As the RPi has no internal mass storage or built-in operating system it requires an SD card preloaded with a version of the Linux Operating System. • You can create your own preloaded card using any suitable SD card (4GBytes or above) you have to hand. We suggest you use a new blank card to avoid arguments over lost pictures. • Preloaded SD cards will be available from the RPi Shop.

3.4.1.2 KEYBOARD & MOUSE

Most standard USB keyboards and mice will work with the RPi. Wireless keyboard/mice should also function, and only require a single USB port for an RF dongle. In order to use a Bluetooth keyboard or mouse you will need a Bluetooth USB dongle, which again uses a single port. Remember that the Model A has a single USB port and the Model B has two (typically a keyboard and mouse will use a USB port each).

3.4.1.3 DISPLAY

There are two main connection options for the RPi display, HDMI (High Definition) and Composite (Standard Definition). • HD TVs and many LCD monitors can be connected using a full-size 'male' HDMI cable, and with an inexpensive adaptor if DVI is used. HDMI versions 1.3 and 1.4 are supported and a version 1.4 cable is recommended. The RPi outputs audio and video via HDMI, but does not support HDMI input. • Older TVs can be connected using Composite video (a yellow-to-yellow RCA cable) or via SCART (using a Composite video to SCART adaptor). Both PAL and NTSC format TVs are supported. When using a composite video connection, audio is available from the 3.5mm jack socket, and can be sent to your TV, headphones or an amplifier. To send audio to your TV, you will need a cable which adapts from 3.5mm to double (red and white) RCA connectors. Note: There is no analogue VGA output available. This is the connection required by many computer monitors, apart from the latest ones. If you have a monitor with only a D-shaped plug containing 15 pins, then it is unsuitable.

3.4.1.4 POWER SUPPLY

The unit is powered via the microUSB connector (only the power pins are connected, so it will not transfer data over this connection). A standard modern phone charger with a microUSB connector will do, providing it can supply at least 700mA at +5Vdc. Check your power supply's ratings carefully.

Suitable mains adaptors will be available from the RPi Shop and are recommended if you are unsure what to use.

Note: The individual USB ports on a powered hub or a PC are usually rated to provide 500mA maximum. If you wish to use either of these as a power source then you will need a special cable which plugs into two ports providing a combined current capability of 1000mA.

3.4.1.5 CABLES

You will need one or more cables to connect up your RPi system.

1. Video cable alternatives: o HDMI-A cable o HDMI-A cable + DVI adapter o Composite video cable o Composite video cable + SCART adaptor
2. Audio cable (not needed if you use the HDMI video connection to a TV)
3. Ethernet/LAN cable (Model B only) connected as shown in the (Figure 3.4 Raspberry pi GPIO Layout).

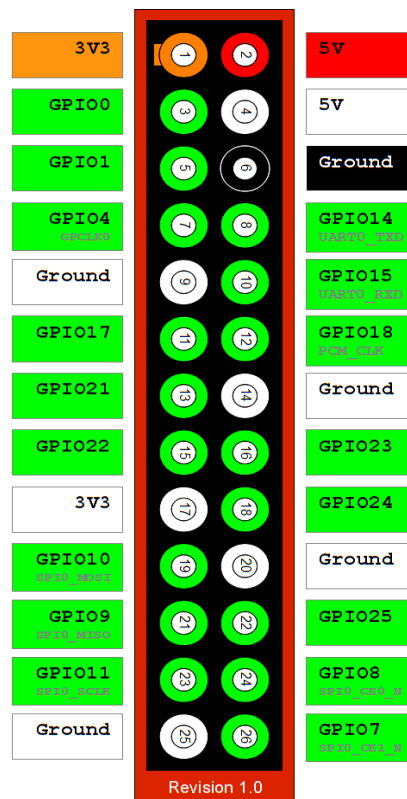


Figure. 3.4 Raspberry pi GPIO Layout

3.4.2 PI CAMERA

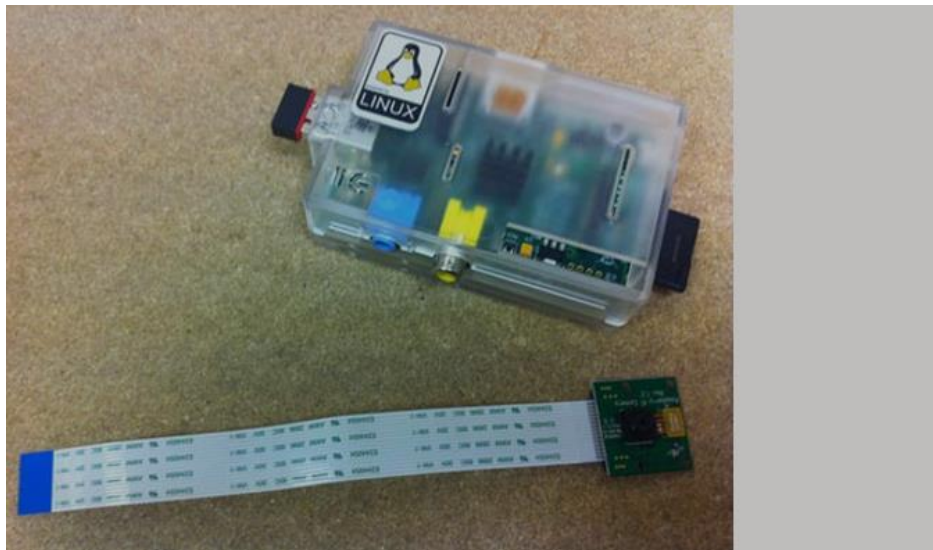


Figure. 3.5 PI Camera

1. Install the Raspberry Pi Camera module as shown in (Figure 3.5 PI camera) by inserting the cable into the Raspberry Pi. The cable slots into the connector situated between the Ethernet and HDMI ports, with the silver connectors facing the HDMI port.
2. Boot up your Raspberry Pi.
3. From the prompt, run "sudo raspi-config". If the "camera" option is not listed, you will need to run a few commands to update your Raspberry Pi. Run "sudo apt-get update" and "sudo apt-get upgrade".
4. Run "sudo raspi-config" again - you should now see the "camera" option as shown in the (figure 3.6 Camera Option).



Figure 3.6 camera option.

3.4.3 MQ4 GAS SENSOR

1. The **MQ4 methane gas sensor** as shown in the (Figure 3.7 MQ4 Gas Sensor) is extremely used for detecting gas leakage at home or in industries like Methane (CH_4) & CNG Gas. This gas sensor is highly responsive in very little time, so based on the sensitivity requirements; it can be adjusted through a potentiometer. This is an analog output sensor, used like a CNG (compressed natural gas) sensor within the series of MQ sensors.
2. So this sensor is suitable for detecting the concentration of natural gas like methane within the air. For this sensor, if the gas concentration increases then the output voltage will be increased. This sensor works with 5V DC and draws 750 mW around. This article discusses an overview of the MQ4 methane gas sensor and its working with applications.



Figure. 3.7 MQ4 GAS SENSOR

3. MQ4 methane gas sensor is a MOS (metal oxide semiconductor) type sensor, used to detect the methane gas concentration within the air at either home or industries & generates output like analog voltage by reading it. Here, the range of concentration for sensing ranges from 300 ppm – 10,000 ppm which is appropriate for the detection of a leak.
4. This gas sensor mainly includes a detecting element like ceramic based on aluminum-oxide (Al_2O_3), coated with Tin dioxide (SnO_2) and arranged within a stainless-steel mesh.

3.4.3.1 PIN CONFIGURATION

1. **Pin1 (H Pins):** These pins are two where one of them is used to connect supply and remaining pin is connected to ground
2. **Pin2 (A Pins):** Both the pins like A & B are interchangeable which will be connected to supply voltage.
3. **Pin3 (B Pins):** A & B pins are exchangeable where one pin acts like output and another pin will be pulled to the GND terminal.
4. The **pin configuration of the MQ-4 methane gas sensor module** includes four pins which are discussed below.
5. **VCC Pin:** This pin provides voltage to the module and the typical operating voltage is +5V
6. **GND Pin:** This pin is used to connect the sensor module to the GND terminal of the system
7. **DO (Digital Out) Pin:** This pin provides digital output by setting a threshold value with the help of the potentiometer
8. **AO (Analog Out):** This pin provides output analog voltage which ranges from 0 to 5V depending on the intensity of gas.

3.4.4 MQ7 GAS SENSOR

This sensor contains a sensing element, mainly aluminum-oxide based ceramic, coated with Tin dioxide (SnO_2), enclosed in a stainless-steel mesh. Whenever CO gas comes into contact with the sensing element, the resistivity of the element changes. The change is then measured to get the concentration of the gases present. The **MQ7 Sensor** in (Figure 3.8 MQ7 Gas Sensor) has a small heating element present which is needed to preheat the sensor to get it in the working window. It can detect **Carbon Monoxide Gas** in the range of 20 PPM to 2000 PPM in the air. It finds uses in Alarm application in case of CO gas concentration build-up in the home or your car as CO is a very harmful gas and can kill a person if present over 300PPM.

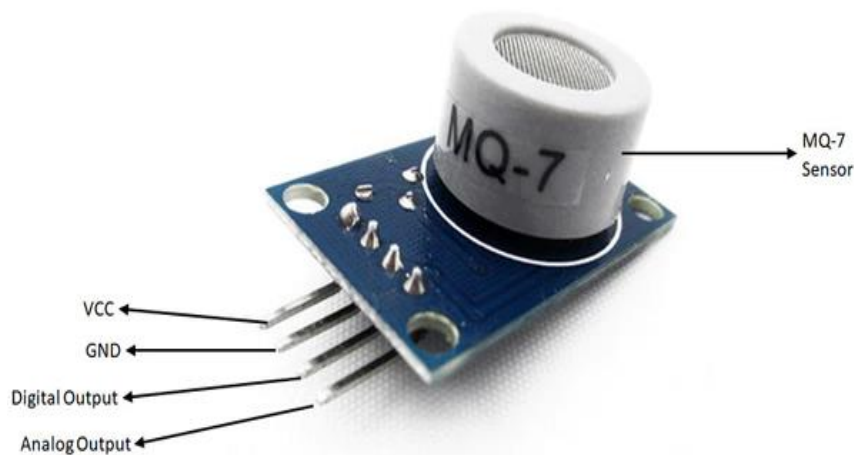


Figure. 3.8 MQ47GAS SENSOR

To use the Sensor Module, you have power the device with 5V supply and the Power LED will start to glow. To power it, you can use external supply or connect +5V and GND pin of Arduino. You should give it some preheating time before start reading the output. While measuring the gas present, the Output LED will glow in a specific concentration of the gas. You can change it by using the potentiometer. Else you can also use the Analog Output to see how your program reacts to different concentrations of gases present.

3.4.5 WATER LEVEL SENSOR

Water Level sensor shown in (Figure 3.9 Water level sensor) are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Level measurements can be done inside containers or it can be the level of a river or lake. This **water level sensor module** has a series of parallel exposed traces to measure droplets/water volume in order to determine the water level. Very Easy to monitor water level as the output to analog signal is directly proportional to the water level. This output analog values can be directly read via ADC and can also be connected directly Arduino's analog input pins.



Figure. 3.9 WATER LEVEL SENSOR

SPECIFICATIONS:

- 1) Working Voltage : DC 3-5V
- 2) Working Current : <20mA
- 3) Sensor Type : Analog
- 4) Detection Area : 40 mm x 16 mm
- 5) Size : 65 mm x 20 mm x 8 mm
- 6) Humidity: 10% -90% non-condensing

3.4.6 HUMIDITY SENSOR

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor is shown in (Figure 3.10 DHT11 Sensor). It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data.

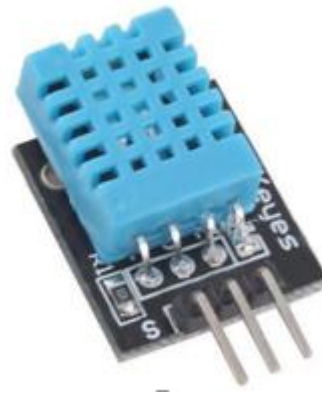


Figure. 3.10 DHT11 Sensor

This sensor is used for projects where accuracy and precision doesn't play big role. This comes in a blue perforated plastic enclosure. The sensor uses a capacitive humidity sensor and a thermistor based temperature sensor to measure the ambient humidity and temperature. The humidity sensing ranges from 20% to 90% with $\pm 5\%$ accuracy and the temperature sensing ranges from 0 degrees to the 50 degrees Celsius with $\pm 2^\circ\text{C}$ accuracy. The sampling time of this sensor is 2 seconds almost. This **Temperature and Humidity Sensor** uses digital pins to communicate with the microcontroller unit and does not have any kind of analog pins.

DHT11 Sensor Specifications:

- 1) Temperature measurement accuracy: ± 2.0
- 2) Output Signal Digital
- 3) Temperature Range 0 to 50°C
- 4) Humidity Range: 20 to 90% RH
- 5) Humidity Accuracy: $\pm 5\%$ RH

3.4.7 FLOW SENSOR

A flow sensor shown in the (Figure 3.11 Flow Sensor) is a device used to measure the instant flow rate or quantity of a gas or liquid passing through a

pipeline. Flow meters are also known to by other names, such as flow gauge, flow indicator, liquid meter, etc. depending on the industry.



Figure. 3.11 FLOW SENSOR

3.5 ADVANTAGE OF PROPOSED SYSTEM

By using this idea such as 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 able to take particular action on the problem as we will receive the early alerts of blockage as well as increase. Deaths can also be avoided.

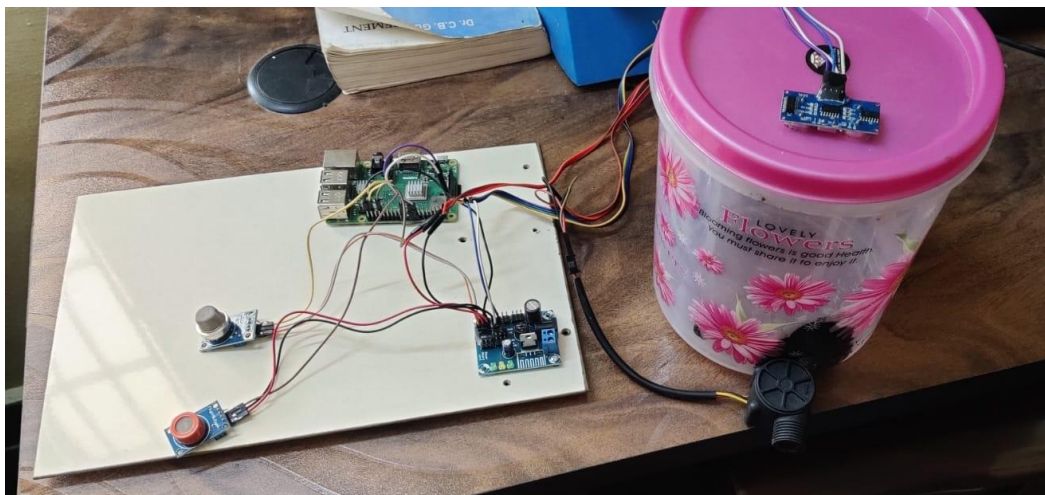


Figure 3.12 Hardware Kit

CHAPTER 4

SUMMARY AND CONCLUSION

4.1 SUMMARY OF THE PROJECT

This project involves the implementation of an IoT-based drainage monitoring system using Raspberry Pi, which is a small, affordable, and programmable computer that can be used for various IoT applications. The system will be designed to monitor and collect data on the level of water in drainage systems, which can help to prevent flooding and other related issues. The system will consist of a Raspberry Pi device, sensors, and a wireless network connection. The sensors will be used to measure the water level in the drainage system, and the data collected will be transmitted wirelessly to the Raspberry Pi device. The Raspberry Pi device will then process the data and send it to a cloud-based platform for storage and analysis. The system will also include a web-based user interface, which will allow users to monitor the drainage system in real-time and receive alerts when the water level reaches a critical level. To implement this project, it is important to follow relevant IEEE standards for IoT systems, such as IEEE 1888, IEEE 802.15.4, IEEE 802.11, and IEEE 802.3. Additionally, it is important to consider any relevant local or national standards and regulations for drainage monitoring systems to ensure the system is safe and compliant. Overall, this project can help to improve drainage system management and reduce the risk of flood and related issues.

4.2 IEEE STANDARDS FOLLOWED

There are a few IEEE standards related to the implementation of an IoT-based drainage monitoring system using Raspberry Pi:

1. IEEE 1888: This standard specifies a common framework for Internet of Things (IoT) systems to ensure interoperability and scalability. It defines a common set of protocols and data models that can be used to develop IoT applications.
2. IEEE 802.15.4: This standard defines the physical layer and medium access control (MAC) layer specifications for low-rate wireless personal area networks (LR-WPANs). This standard is commonly used for IoT applications.
3. IEEE 802.11: This standard specifies the physical layer and MAC layer specifications for wireless local area networks (WLANs). It is commonly used for IoT applications that require higher data rates.
4. IEEE 802.3: This standard specifies the physical layer and MAC layer specifications for Ethernet networks. It can be used for IoT applications that require wired connections.

When implementing a drainage monitoring system using Raspberry Pi with IoT, it is important to consider these IEEE standards to ensure interoperability and scalability of the system. Additionally, it is important to follow any relevant local or national standards and regulations for drainage monitoring systems to ensure the system is safe and compliant

4.3 CONSTRAINTS

There are several constraints that may affect the implementation of the "Drainage Monitoring System Using Raspberry Pi with IoT" project. Some of these constraints are:

- 1. Power supply:** The Raspberry Pi and the sensors require a stable power supply. In locations where there are frequent power outages, a backup power supply may be needed.
- 2. Connectivity:** The system requires a reliable and stable wireless network connection to transmit data from the sensors to the Raspberry Pi and the cloud-based platform. In remote or rural areas, connectivity may be limited or not available.
- 3. Sensor placement:** The placement of the sensors in the drainage system is critical to ensure accurate measurements. The sensors should be placed in a location where they are not affected by debris or blockages in the drainage system.
- 4. Data security:** The system should be designed to ensure the security of the data collected and transmitted. The use of encryption and secure protocols is recommended to prevent unauthorized access to the data.
- 5. Cost:** The cost of the system components, such as the Raspberry Pi device, sensors, and network connectivity, may be a constraint, especially in low-income areas.
- 6. Maintenance:** The system requires regular maintenance to ensure the sensors are functioning correctly and the data collected is accurate. This may require trained personnel and additional resources.

Overall, these constraints should be considered during the design and implementation of the project to ensure the system is effective and sustainable.

4.4 PREREQUISITES

There are several prerequisites that should be considered before starting the "Drainage Monitoring System Using Raspberry Pi with IoT" project. These prerequisites include:

- 1.** Knowledge of Raspberry Pi: A basic understanding of Raspberry Pi and its programming language (Python) is required to implement the project.
- 2.** Knowledge of IoT and wireless networking: A basic understanding of IoT and wireless networking is required to set up the system and connect the sensors to the Raspberry Pi device.
- 3.** Knowledge of sensors: A basic understanding of sensors and their calibration is required to select and install the appropriate sensors for the project.
- 4.** Knowledge of data storage and analysis: A basic understanding of cloud-based storage and analysis platforms is required to store and analyze the data collected by the system.
- 5.** Access to drainage systems: Access to the drainage systems where the sensors will be installed is required to properly install and calibrate the sensors.
- 6.** Compliance with regulations: Compliance with any local or national regulations related to drainage monitoring systems should be considered before implementing the project.
- 7.** Availability of resources: Adequate resources, such as funding, personnel, and equipment, should be available to ensure the successful implementation and maintenance of the system.

Overall, these prerequisites are critical to the success of the project and should be carefully considered before starting the implementation process

4.5 ASSUMPTIONS

There are several assumptions that can be made for the "Drainage Monitoring System Using Raspberry Pi with IoT" project. Some of these assumptions are:

- 1. Sensor compatibility:** The sensors selected for the project are assumed to be compatible with the Raspberry Pi device and can be easily connected and configured.
- 2. Stable power supply:** It is assumed that a stable power supply is available for the Raspberry Pi device and the sensors to operate without interruption.
- 3. Adequate wireless network coverage:** It is assumed that there is adequate wireless network coverage in the area where the drainage system is located to support the transmission of data from the sensors to the Raspberry Pi device and the cloud-based platform.
- 4. Accurate sensor readings:** It is assumed that the sensors provide accurate readings of the drainage system conditions and can detect changes in real-time.
- 5. Cloud-based storage availability:** It is assumed that a cloud-based storage and analysis platform is available to store and analyze the data collected by the system.
- 6. System maintenance:** It is assumed that the system will be regularly maintained to ensure the sensors are functioning correctly and the data collected is accurate.
- 7. User adoption:** It is assumed that the system will be adopted by the users, such as local authorities, for the management of the drainage system.

4.6 TRADE OFF

There are several trade offs to consider when implementing the "Drainage Monitoring System Using Raspberry Pi with IoT" project. Some of these tradeoffs are:

- 1. Cost vs. accuracy:** The accuracy of the data collected by the sensors can be improved by using more advanced and expensive sensors. However, this may increase the cost of the project and may not be feasible in low-income areas.
- 2. Wireless vs. wired connectivity:** Wireless connectivity is convenient and easy to install, but it may be less reliable and secure than wired connectivity. Wired connectivity may be more expensive and difficult to install but may be more reliable and secure.
- 3. Real-time vs. delayed data transmission:** Real-time data transmission provides immediate feedback and allows for quick action to be taken. However, it may require a more stable and expensive wireless network. Delayed data transmission may be less expensive and can still provide valuable insights but may not be as timely.
- 4. Cloud-based vs. local data storage:** Cloud-based storage is convenient and allows for easy access to data from anywhere with an internet connection. However, it may be more expensive and may raise data privacy concerns. Local data storage may be less expensive but may be less accessible and may require additional resources for maintenance.
- 5. User interface vs. simplicity:** A user interface that provides detailed information and alerts may be more useful but may require more resources and may be more complicated to use. A simpler user interface may be easier to use but may not provide as much detail or flexibility.

Overall, the tradeoffs will depend on the specific requirements of the project and the resources available. It is important to carefully consider these tradeoffs and choose the most appropriate options for the specific use case

4.7 CONCLUSION

There may be potential changes to enhance the overall efficiency of the proposed program. MQ- 135 Ammonia and Nitrous Oxide, MQ-136 Sulphide Hydrogen gas sensors are equally dangerous to human beings so can be added to the system. Chassis can be used to mount the designed prototype so that the camera can have broader coverage, and sensors can gather data as the system moves. An alarm/siren can be installed to warn people around the area of some unfortunate occurrence of an incident in and around the sewage for the sufferer's emergency rescue. With respect to, the values stored in the database with the corresponding date can be used as a dataset for the machine learning algorithms and the desired output can be obtained.

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