# IoT based Underground Drainage Monitoring System using Pic Microcontroller

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***Abstract*:- India has announced a project of making 100 smart cities. As most of the cities in India have adopted underground drainage system, it is very important that this system should work in a proper manner to keep the city clean, safe and healthy. So different kind of work has been done to detect, maintain and manage these underground systems. The proposed system represents the implementation and design functions for monitoring and managing underground drainage system with different approaches. It also gives a description of water wise system and detection method to detect blockage in drainage pipeline. Also, some part of condition rating model for underground-Infrastructure Sustainable Water Mains and Intelligent system for underground pipeline assessment, rehabilitation and management are explained.**

## I.INTRODUCTION

Drainage is the natural or artificial removal of a surface's water and sub-surface water from an area with excess of water. These are carriers which carry water from river, streams and lakes. So, the commonly found wastes are plant waste, plastics and some scums. Function of the drainage system is to collect, transport and dispose of the water through outlet. It is a large network which is to be maintained and monitored properly.

The underground drainage system is an important component of urban infrastructure [1]. It is considered to be city's lifeline. Most management on underground drainage is manual therefore it is not efficient to have clean and working underground system also in such big cities, it is difficult for the government personnel to locate the exact manhole which is facing the problem [2]. Therefore, it is essential to develop a system which can handle underground drainage without human intervention. Underground Drainage involves drainage system, gas pipeline network, water pipeline, and manholes [3]. It describes about various functions used for maintenance and monitoring of underground drainage system. It provides a system which is able to monitor the water level, atmospheric temperature, water flow and toxic gasses. If drainage system gets blocked and water overflows it can be identified by the sensor system. And that sensor sends information via the transmitter which is located in that area to the corresponding managing station.

Without a proper drainage management system, our society can be exposed to extensive damage to our lives [4]. Some of the areas to be concerned based on top of economic, social aspects for maintaining sustainability in the drainage design are the requirements of energy and control of odor. The stability of such infrastructure is getting affected for many decades in India which has given the unaccountable effects on human and economic costs related for the infrastructural improvement[5].

## II.LITERATURE SURVEY

A Fiber Bragg Grating (FBG) based monitoring system for continuous humidity and temperature measurement has been designed and evaluated experimentally in a drainage environment with high corrosion rates, humidity and the presence of gaseous hydrogen sulfide. The monitoring system has been designed specifically for field use, including packaging prepared for the harsh environment and the challenges of the operation. The system is battery powered and has hardware for controlling the interrogation equipment, power management, data logging and 4G connectivity [6]. Results obtained show the long-term performance, over a 6-month period of non-stop monitoring of real-time data using the same probe. The data acquired was compared to the environmental data of temperature and precipitation for this period from the same location, which showed a good correlation between the expected and the measured data values [7]. The data obtained point to the success of the optical fibre-based sensor system for monitoring in these harsh environments over long periods [8].

Clogged drainage pipelines are one of the main problems that cause Sanitary Drainage Overflow ( SSO) which leads to serious environmental issues and property damage. This existing work presented clogged pipe detection and monitoring methods based on acoustic analysis to identify pipe clogged occurrence and degree of blockage that can be mitigating the risks from SSO's problem.[12] The existing

technique is to attached with the vibration speaker on the pipe as an acoustic source. The clogged by blockage will be detected by reading the change in the pipe resonance frequency via the microphone installed on the other side of the pipeline. The resonance frequency of the measured signals was characterized by Fast Fourier Transforms (FFT). Compensation based line was used to normalize the frequency responses for easier acoustic analysis. The experiments have indicated the resonance frequency shifting down and Sound Pressure Level (SPL) decreasing when pipe clogged [4].
Due to the unavailability of sensors to monitor concrete drainage surface moisture conditions, water utilities use surrogate measures such as relative humidity of the air as an observation for the model. Hence, the corrosion predictions are often hampered and associated with prediction uncertainties. In existing paper presented the development and successful evaluation of an electrical resistivity-based sensor suite for estimating the surface moisture conditions of concrete drainage pipes. The sensor was deployed inside a municipal drainage pipe of Sydney city, Australia to carry out field measurements. The post-deployment studied revealed the survival of the sensing system under hostile drainage conditions and demonstrated their suitability for long-term monitoring inside drainage pipes[11].

## III.EXISTING SYSTEM

Drainage condition is commonly assessed using closed-circuit television (CCTV) inspections.

In existing system, they combine inspection results, pipe attributes, network data, and data on pipe environment to predict pipe condition and to discover which factors affect it.

DISADVANTAGES:

CCTV inspection is not suitable for drainage clogging prediction in India.

## IV.PROPOSED SYSTEM

The real-world data is collected from various sensors (water flow sensor, water level sensor, rain sensor, gas sensor & humidity sensor) this all data is in analog signal and converted to digital signal. The digital signal is fed to the controller which according to the set threshold, chooses whether there's need of action from its end i.e. if the sensor data suggest a possible blockage in the flow of conduit. Since all the data is available on the server it could be used to analyze and deduce the overall trend and generate more proactive mechanism which would be period dependent apart from dependency on real time data, for example during the month of monsoon, on basis of past detail of precipitation, humidity and gases amount detail an automatic signal would be sent to the controller to ensure that any probability of blockage in prevented by early application of pressure boosting pumps. In this proposed system consists of water flow sensor, water level sensor, rain sensor, gas (methane) sensor as indicated in figure 1 had been designed for use in-the-field in a remote location to measure water flow rate, water level, gas level & humidity in a working drainage. The sensor values are fed to PIC Microcontroller, which is 8 – bit programmable microcontroller. This project aims at developing an affordable autonomous drainage system using IoT and without human intervention. For proper operation of drainage system real time data predicting the level of sludge and water is very Important. Higher runoff volume, with large impervious ground, exponential population growth with intense rain has overwhelmed the drainage system causing inundation and blockage, this all could be avoided the data received by the controller would also be transmitted to the server through IoT wireless communication module. The database will store the detailed data of various physical and environmental factors received from the sensors, which is further analyzed to find the underlying relationship between various factors to blockage which eventually leads to flooding, using a linear regression model. Artificial Intelligence, IOT principles and with appropriate analysis of sensor data, a smart system could be used that would provide real time information monitoring and reporting the data to Municipality or concerning authority. This will prevent manual drain inspection and enables immediate response without human intervention or delay.
All the components are attached to the manhole cover with the calibration such that each part is able to perform its task correctly. The sensor data would be collected to check
1. Blockage in the pipes.
2. Whether the gases level have risen to hazardous level.
3. Whether the water level has risen to hazardous levels. The controller could be supplied with power either through battery or solar panel.

The database part of the system will use Geographical Information System , It contains three types of data :
1. Digital Map: It includes the topographical map of the city with drainage lines indicated.
2. Tabular Data: This would include the node (manhole) wise details of sensor data collected, which would be used for data analysis

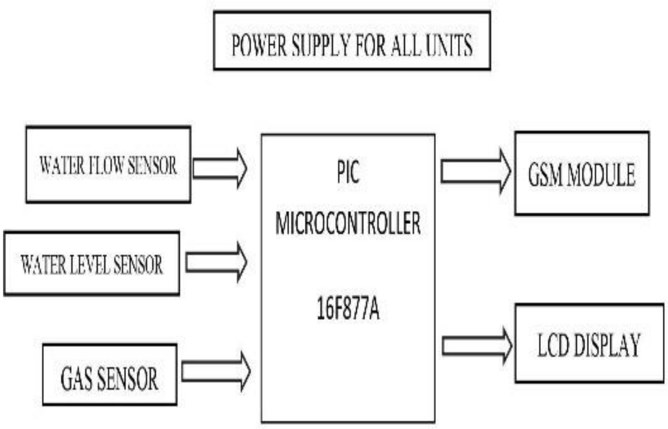


Figure 1. Drainage monitoring system.

## V.HARDWARE REQUIREMENTS

### *5.1 FLOW SENSOR*

Water flow sensor consists of a plastic valve body, a water rotor, and a hall- effect sensor. When water flows through

the rotor, rotor rolls. Its speed changes with a different rate of flow. The hall-effect sensor outputs the corresponding pulse signal. This one is suitable to detect flow in water dispenser or coffee machine.
Features:

- Compact, Easy to Install
- High Sealing Performance
- High Quality Hall Effect Sensor
- RoHS Compliant

### 5.2 LEVEL SENSOR

Level sensors detect the level of liquids and other fluids and fluidized solids, including slurries, granular materials, and powder that exhibit an upper free surface. Substances that flow become essentially horizontal in their containers (or other physical boundaries) because of gravity whereas most bulk solids pile at an angle of repose to a peak.

### 5.3 LCD (LIQUID CRYSTAL DISPLAY)

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi
segment LEDs) because of the following reasons:
1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few
characters.

### 5.4 PIC MICROCONTROLLER

PIC16F877A.It is a 40 pins  microcontroller. It can operate up to 20MHz frequency. The operating voltage is between 4.2 volts to 5.5 volts.

### 5.5GAS SENSOR

MQ 4-detects the presence of methane gas in the drainage. This semiconductor gas sensor detects the presence of methane gas at concentrations from 300 ppm to 10,000 ppm.

### 5.6 GSM MODULE

SIM900 GSM Module is the module that supports communication in 900MHz band. We are from India and most of the mobile network providers in this country operate in the 900 MHz band. If you are from another country, you have to check the mobile network band in your area. A majority of United States mobile networks operate in 850 MHz bands (the band is either 850 MHz or
1900 MHz). Canada operates primarily in 1900 MHz band.

## VI.RESULT

W_L: Water level W_F: Water flow G: Gas


Figure 2 When there is no

blockage in the drainage pipe, there will be a smooth flow of the drainage water. The water flow sensor will detect the

**Figure 3** When there is a blockage inside the drainage pipe,  the water level will increase. But there will not be the water flow. So either the flow will decrease or it will become 0 and only the water level increases.

water flow and the level sensor also measures the water level inside the pipe. 0 in the gas indicates there is no formation of methane gas inside the drainage pipe.

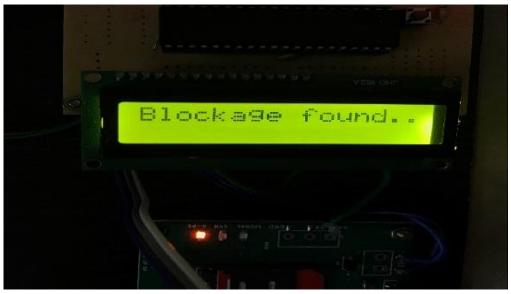


Figure 4 When the block occurs in the pipe it is detected and the display shows that blockage found.


Figure 5 After detecting the block, the message is sent to the higher authority in municipality.

## VII. CONCLUSION

Underground monitoring is challenging problem. The proposed idea gives different methods for monitoring and managing underground drainage system. It explains various applications like underground drainage and manhole identification in real time .Various parameters like 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 avoiding the hazards. This method can be used to guide the specification, optimization, and development of sensor network Platforms for other IoT application domains.

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