Dr.C.S.Ravichandran, et. al. International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 11, Issue 5, (Series-VI) May 2021, pp. 08-13

RESEARCH ARTICLE OPEN ACCESS

IOT Based Sewer Clogging Prediction System For Smart City

Dr.C.S.Ravichandran* , T.Naveen Prasath** , S.Nikil Kumar** , S.Naveen Kumar**

**(Professor, Department of Electrical and Electronics Engineering, Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India ,*
***(Final Year B.E, Department of Electrical and Electronics Engineering, Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India)*

ABSTRACT
Water plays the most vital role within the regular life. The water metering system is employed to manage the water within the house in order to control the water wastage and water use for a people can be measured by a municipal corporation. Any leak on your plumbing will be arduous to notice. Sewer leaks will typically be mistaken for a leak on a water line. A Sewer leak on your drain line can even injury your property. Standing or ponding water from a leaky sewer pipes also are a risk to you and to Leaky drain pipes can even undermine your drain system and cause sags and separations. Hence in order to solve this problem, the water flow monitoring sensor helps in detecting the water flow. Water leakage or overflow can be identified and solved. In addition to this feature, the volume of water flow can also be calculated with the help of water flow, water level, rain drop, gas sensors and Arduino . All the parameters values monitored by the webpage and LCD display

Date of Submission: 15-05-2021 Date of Acceptance: 31-05-2021

I. INTRODUCTION

In effective and improper sewage system pose strong risk of water and land pollution and diseases, with the climate change, its effect has been visible with longer monsoon season burdening the existing sewage system with increase influx which the infrastructure is unable to tackle and needs proper planning and management of Sewerage Systems. Sewerage systems are sewer networks for the collection of waste water, conveying it via pipes, conduits and ancillary works from its point of origin to treatment works prior to discharge back into the environment. Indian sewerage system has deeply hit by increasing population, infrastructure restrictions, rains and poses human, economic assets, infrastructure and the environment threats. Measures need to be adopted to cope with storm water volumes and prevent urban areas from sewer flooding. Flooding from overflowing manholes (wet weather overflow) or chamber gullies, results from excessive discharge after heavy rainfall events, as a consequence of blockage, storm water infiltration, engineering malfunction. The discharge from Combined Sewer Overflow directly into the environment due to overflow or excessive wastewater is extremely hazardous and preventable, by smart planning. CSO pollutes the environment especially cause water pollution through direct discharge of untreated wastewater, after heavy rainfall. Also presence of any blockage or obstruction can cause severe impact on sewerage operation management, increase concentration of poisonous gases which could cause leakage and fatality if inhaled in large volume.

This project aims at developing an affordable autonomous sewerage system using IoT and without human intervention. For proper operation of sewage 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 if a smart system that detects both the water level and accordingly redirect water using sensor-controlled gates is deployed. Sewerage network is man-made system into any catchment hydrological cycle and is expected to receive water that didn't percolate to groundwater. Hence the intensity of flow in sewerage network is subjected to vary a lot depending on the rainfall, permeability of the infrastructure in the area, so the hydraulic flow could vary from open channel flow to pressurized conduit flow

Internet of things and Data Science possess an immense scope in field of sewerage management system for both collection and analyze the data related to environment and physical parameters and

their effects. These advancements could be implemented through the use of Wireless Sensor Network, which would generate critical data of various factors (environmental and others) could be properly visualize using Geographic Information System and appropriate data science model to proactively perform required changes without human involvement.

II. EXISTING SYSTEM

Sewer 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.They applied the random forest algorithm to model pipe condition and assess the variable importance using the Boruta algorithm.They analyzed the impact of predictor variables on poor condition using partial dependence plots, which are a valuable technique for this purpose.

III. 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 & humidity sensor 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 sewer. The sensor values are fed to PIC Microcontroller, which is 8 – bit programmable microcontroller. This project aims at developing an affordable autonomous sewerage system using IoT and without human intervention. For proper operation of sewage 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.

IV. BLOCK DIAGRAM

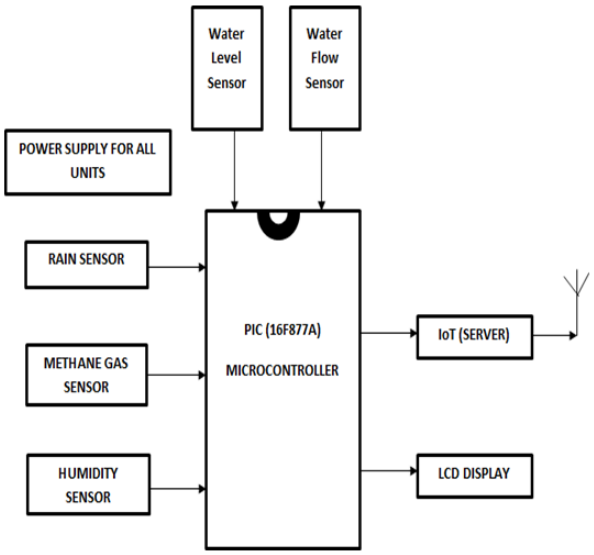

Fig.1 Block Diagram

TIMER MODULE

The PIC16F877A incorporates timer modules for the purpose of producing software interrupts. These interrupts are part and parcel of microcontroller programming. There are three timers available. They are:

- Timer0 module
- Timer1 module
- Timer2 module

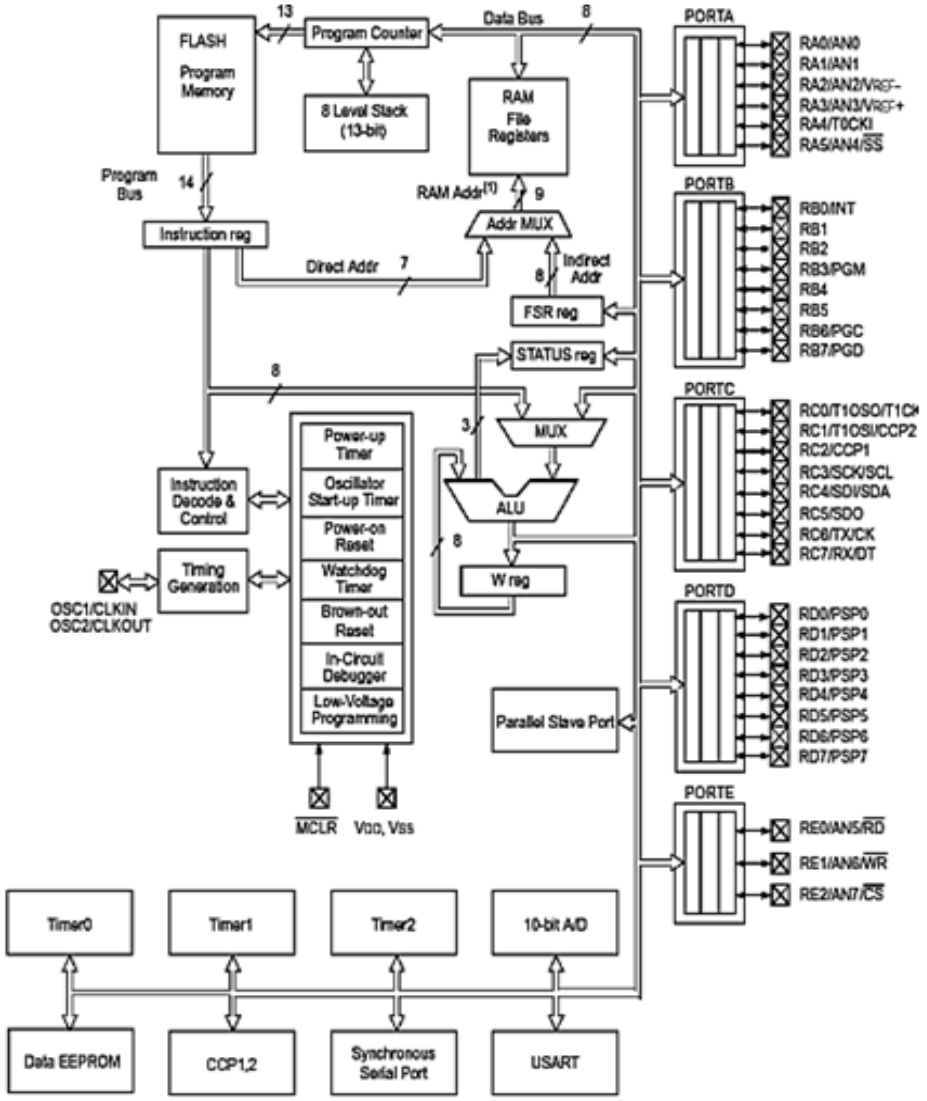

Fig.2 Timer Module

V. HARDWARE DESCRIPTION

1. WATER FLOW SENSOR

Water flow sensors are installed at the water source or pipes to measure the rate of flow of water and calculate the amount of water flowed through the pipe. Rate of flow of water is measured as liters per hour or cubic meters.

Fig.3 Water Flow Sensor

2. WATER LEVEL SENSOR

Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Such meaurements can be used to determine the amount of materials within a closed container or the flow of water in open channels.

Fig.4 Water Level Sensor

3. GAS SENSOR

Gas sensor is one which comes handy in applications where we have to detect the variation in the concentration of toxic gases in order to maintain the system safe and avoid/caution any unexpected threats.

Fig.5 Gas Sensor

There are various gas sensors to detect gases like oxygen, Carbon Dioxide, Nitrogen, methane etc.

4. RAIN SENSOR

Rain water detector will detect the rain and make an alert; rain water detector is used in the irrigation field, home automation, communication, automobiles etc. Here we have used the rain sensor for the detection of rain to monitor the overflow of sewer in advance which can be constructed at low cost.

Fig.6 Rain Sensor

5. PIC16F877A MICROCONTROLLER

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology.

Fig.7 PIC16F877A Microcontroller

It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have much application in digital electronics circuits

6. IOT BASED NODE MCU

NodeMCU is a low-cost open source IoT platform. It initially includedfirmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added

Fig .8 PIC16F877A Microcontroller

VI. RESULTS

The readings are collected from the device to webpage by IOT server. The IOT Server is provided by Cayenne IOT Solutions.

1. GAS SENSOR

Whenever the gas sensor detects the presence of methane or any other sewer gases the gas sensor starts to increase from 0 to 1 upon the intensity and amount of gases present. We can track Live gas levels and intensity.

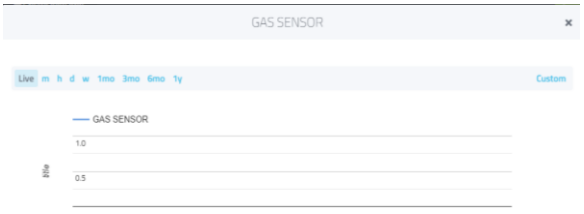

Fig .9 Result of Gas sensor

2. WATER FLOW SENSOR

Water Flow Sensor detects the flow of sewer water. Water flow sensor have a valve in which sample water flows. If there is a block the flow gets disturbed and water becomes stagnant. So the flow stops. Whenever the flow stops, the device indicates the disturbance in flow.

Fig .10 Result of Water flow sensor

3. WATER LEVEL SENSOR

Water level sensor is attached to the top of sewer and connected to device. When there is block there will be high chances for sewer to get overflow. So the Water level sensor keeps updating the water flow. When the water level reaches a threshold, the system sends a threshold message to the admin. Threshold value depends upon the size , width , and rate of water flow.

Fig .11 Result of Water level sensor

4. RAIN SENSOR

Rain sensor is a additional sensor which helps to keep ready when there is chances of rain. When rain occurs there Is high chance that sewer gets clogged. By rain sensor we can be alert and make precautionary thing before the sewer gets clogged.

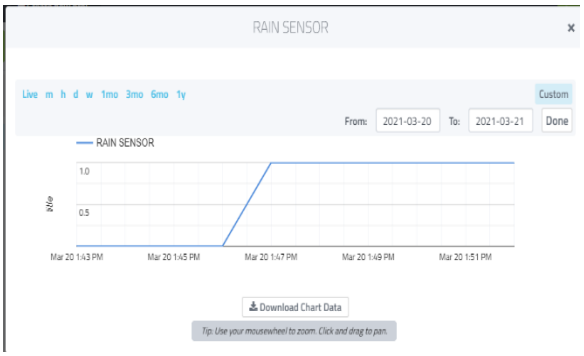

Fig .12 Result of Rain sensor

VII. CONCLUSION

The development of a sensor suite and predictive analytics enabled anomaly detection model for smart monitoring of sewer conditions. The automated response, by the system without the need for external intervention would be on-time, less risk prone and more calculated. The proactive action would ensure that the CSO don't overflow neither there's reverse discharge of wastewater through manhole. After the long-term data being collected a data. The collected will be stored the IoT webpage

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Dr.C.S.Ravichandran, et. al. "IOT Based Sewer Clogging Prediction System For Smart City." *International Journal of Engineering Research and Applications (IJERA)*, vol.11 (5), 2021, pp 01-07.