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Sewage Monitoring and Maintenance Alert using IoT

Rohith Srivatsan B[1], Laxman K G[2], Sarveshwar Kumar Singh[3], Jegan Amarnath J[4]
[1, 2, 3, 4]*Department of Computer Science & Engineering Sri Sairam Engineering College, Chennai, Tamil Nadu, India*

Abstract: ***We're planning to create a smart gadget that can detect when the drainage system becomes clogged, and if water overflows as a result of this clogging, we'll notify the local authority so they can take the appropriate measures. Additionally, the Android application allows for real-time monitoring of the drainage system's status. Four sensors will be used as input devices for the project: a pH sensor to measure the acidity of the sewage water as accurately as possible so that the water can be treated in a wastewater treatment plant and can be reused; an ultrasonic sensor to detect blockages; a water level/float sensor to detect overflows of water; and a gas sensor to measure the to detect all toxic gases released from the sewage. Finally, by inputting the picture samples collected during sewage monitoring, we may use image processing to find fractures in the pipes. The ESP8266, which serves as both a microcontroller and a wireless module, receives and processes the data from these sensors. Here, a push notice is given to the mobile device in case of Blockage or Overflow in addition to the real-time ultrasonic distance being supplied to the Blynk/Adafruit Application. Using our smartphones, we can control any IoT device using the Blynk/Adafruit application, which can operate on Android, iOS, and Windows platforms. To develop the graphical user interface for our IoT application, we may create our own GUI.***

I. EXISTING SYSTEM

To overcome the blockage and overflow of sewage manyorganizations have prepared a sewage maintenance system to makesure there is no blockage or overflow. Each area is supervised bythe municipality and many people are assigned to check thesewage on a regular basis. And the sewage maintenance system istoo large which is currently being used and it is not easy to install. The existing system has the following disadvantages:

1) They are expensive and require human assistance.
2) Sewage maintenance system is large in size which isdifficult to install.
3) They do not provide a cloud register and log the entries init.
4) You don't receive a response for every entry.
5) The detection and registering processes are neithercombined nor automated all in one system.

Also, the existing system used for wastewater treatments checks the contents of chemicals in the wastewater. And these chemical contents are monitored at each and every stage of the refining process. And then sending samples to the laboratory and getting results is a time-consuming process. So, even if we are able to find the chemical contents, the resource we use and time required is comparatively more.

II. PROPOSED SYSTEM

Development and implementation of a network that regulates sewer conditions and provides a means to maintain and control the underground infrastructure using methodical approaches. The model proposed consists of a wide range of components which require routine maintenance and observation. The current system lacks a specified network for the simultaneous management of multiple types of sensors. In such a scenario the risk of failure is possible. The system design includes two sensors that detects sewage level and blockage, a controller to order,a communication network that records complaints about continuous rise in sewage level, and if any, blockages. To record the data a database must be maintained. The system generates warning signals prior to overflow by means of complaints to the specified departments via mail and SMS.

III. RELEVANCE OF THE PROJECT

Two million tons of sewage, industrial waste, and agricultural waste are currently dumped into the world's rivers, and one child under the age of five dies from a water-related disease every 20 seconds, or about 1.8 million children worldwide. Only 20% of the world's wastewater is properly treated, as treatment capacity often varies with a nation's income level.

Nearly every factory releases its daily wastewater production immediately and without any pre-treatment into neighboring water bodies. In order to conserve money, the majority of industrial units do not frequently operate their effluent treatment facilities (ETP). Our nation has a system in place to protect the quality of the wastewater, but it is time- consuming to process and contains expensive equipment. Additionally, the majority of the industry disregards governmental regulations due to inadequate oversight. A continuous online monitoring system is necessary to implement pollution reduction plans and effectively handle pollution incidents in order to recoup the effects. Therefore, utilizing IoT, the authority may establish a continuous online quality monitoring system in each and every industry, which is a smart solution for wastewater management. Additionally, it is anticipated that IoT will serve as a catalyst for upcoming technical advancements and that its application will increasesignificantly in the years to come. Additionally, through connecting more things to the internet and developingmore effective systems through data analysis.

As a result of the suggested technology's deployment, many approaches and strategies have been employed to keep track of the sewage routes. An effective alarm system is built into the moduleto remedy the problem when the readings critically exceed the ideal range. We can address the issue as soon as possible as we receive this alert.

IV. HARDWARE USED

Different hardware parts are used. They are a ESP8266 NodeMCU, HC-SR04 Ultrasonic Distance Sensor,Float sensor,LED – Light Emitting Diode,Breadboard Power supply,12V,1AMP DC Adapter,pH Sensor.

1) *ESP8266 NodeMCU:* NodeMcu is an open source firmware to use the wifi esp8266 SOC(System on Chip). It is used as an internet gateway for IoT. NodeMcu consists of 16 GPIO pins and supports protocols like SPI,12C,Uart etc.The Nodemcu can be connected to any device to make it a smart device by giving it wifi capabilities. Nodemcu can be programmed using the Lua scripting. Alternatively it can also be programmed using the arduino IDE.

Figure 1:ESP8266 NodeMCU

2) *HC-SR04 Ultrasonic Distance Sensor:* Sonar is employed by the HC-SR04 Ultrasonic Distance Sensor to gauge adistance to an item. The HC-SR04, which consists of two ultrasonic transmitters (essentially speakers), a receiver, and a control circuit, employs non-contact ultrasound sonar to measure the distance to an object. The receiver listens for any return echo after the transmitters' high frequency ultrasonic sound has bounced off any nearby solid objects. The control circuit then processes that echo to determine how much time has passed between the signal's transmission and reception. The distance between the sensor and the reflected item can then be determined using this time and some creative arithmetic.

Figure 2:HC-SR04 Ultrasonic Distance Sensor

3) *Float Sensor:* A float sensor is a tool used to measure the liquid level inside a tank. The switch could be applied to a pump, an alarm, an indicator, or another gadget. An electromagnetic ON/OFF switch is a magnetic float sensor. It is useful to feel the amount of water in the above tank or sump. The float of these sensors has a permanent magnet. The white stem of the sensor contains the Switch. The signal collected from the sensors is used along with the water level controllers for controlling the motor pump as the float rises or falls with the level of water in the tank and the switch gets activated by the magnet in the float.

Figure 3: Float Sensor

4) *LED – Light Emitting Diode:* A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it.
5) *Breadboard Power Supply:* A breadboard power supply is a companion module, which provides 5 V, 3 V, and 12 V rails on a solderless breadboard. It is an extremely useful facility, which provides regulated voltage rails for project circuits. The module design is usually in the form of a plug-in, which connects onto the breadboard, and the power to the module usually comes from an adapter or USB port of a PC.

Figure 4: Breadboard Power supply

6) *12V, 1 AMP DC Adapter:* The 12 Volt Power Adapter, also known as a "Brick", "Desk Wart" and "Floor" supply, provides a regulated 12 Volts DC output. A 12 Volt Adapter Power Supply is enclosed in a plastic protective case that comes with either an attached AC cord, or a mating socket for one of the 3 common IEC cordsets.

Figure 5: 12V, 1 AMP DC Adapter

pH Sensor: A pH sensor is one of the most essential tools that's typically used for water measurements. This type of sensor is able to measure the amount of alkalinity and acidity in water and other solutions. When used correctly, pH sensors are able to ensurethe safety and quality of a product and the processes that occur within a wastewater or sewage management plant. Raw wastewater generally has a pH near neutral (7.0), although it may vary between6 and 8.

Figure 6: pH Sensor

7) *Gas Sensor(MQ136/137):* With a sensing range of 1 - 200 ppm for hydrogen sulphide and 5 - 500 for ammonia gas, the MQ-136/137 is a hydrogen sulphide and ammonia detection sensor. SnO2, the sensing component, has a reduced conductivity in pure air. The conductivity of the sensor increases along with the gas concentration when H2S and ammonia gas are present, enabling it to detect the gases and activate an alert.

Figure 7: Gas Sensor

V. SOFTWARE USED

Different software and applications are used to establish IoT. They are Arduino IDE, IFTTT,Adafruit IO.

1) *Arduino IDE:* Arduino is an open-source Integrated Development Environment. It is made easy by using predefined functions which are available in libraries. The Arduino program contains two parts:

a) setup()

b) loop()

They are essential parts of the structure of Arduino.

2) *IFTTT:* A user can set up a response to happenings in the world using the services offered by the private corporation If This Then That. With the use of relationships with various serviceproviders, IFTTT is able to receive event notifications and carry out commands that implement responses.

3) *Adafruit IO:* Adafruit is an Online UI that is used to do projects in the field of IoT. It is a customizable UI where the user can store data from a client. The client to store data in the UI has to follow the MQTT protocol. The client that uploads data into the UI is the publish client and the client that uses the data from the UI is the subscribe client.

4) *MATLAB:* Engineers and scientists can use the programming environment MATLAB to analyze, create, and test systems and technologies that will change the world. The MATLAB language, a matrix-based language that enables the most natural expression of computer mathematics, is the core of MATLAB.

VI. DESIGN METHODOLOGY

1) In the project, four sensors will be used as input devices, i.e. Ultrasonic sensor which is used to detect the blockage, the Water level sensor which is used to detect the overflow of water,pH sensor which is used to measure the acidic range of the sewage water as accurately as possible so that the water can be treated in a wastewater treatment plant and can be reused and a gas sensor is used to measure the to detect all the toxic gases released from the sewage. Finally, using Image Processing we can detect the cracks in the pipes by feeding the image samples taken while sewage monitoring.
2) The information from these sensors is received and processed in the ESP8266 which acts as both Microcontroller and Wi-Fi module.
3) The ESP8266 performs all the logical and mathematical operations inside and sends the appropriate signals to the Adafruit cloud for the necessary actions.
4) Here, the real-time ultrasonic distance is sent to the Adafruit application, and also a push notification is sent to the mobile in case of Blockage or Overflow.
5) Blynk/Adafruit is an application that can run over Android and iOS devices to control any IoT devices using our smartphones. We can create our own Graphical User Interface to design our IoT application GUI

Figure : Flow chart of the proposed model

VII. HARDWARE & SOFTWAREIMPLEMENTATION

The NodeMCU is used as a WIFI module to connect to a server. And then the sensors are connected to the NodeMCU.
Each sensors collect data respectively and share them to the server via the WIFI module using Arduino. Then , the data in the server is represented in a graphical manner .
And then a pH sensor and gas sensor are also used which tests the wastewater and displays the pH value and toxic content of the water which makes it easy to treat the wastewater. Also, we createan application using IFTTT which helps the system to display the pH values and also to alert the users if there is a blockage of pipe or overflow of sewage water. And finally using MATLAB we implement the following:

1) The first step in this process is to collect images while monitoring the sewage which is done at regular intervals.
2) Next is to process these images i.e., the collected images may have a lot of noises (blurred or grainy image) so we use a MATLAB code to remove these noises.
3) And then when we get a clear picture of the pipe but cannot check if there are small cracks, we use the MATLAB software again to binarize the images collected to make the cracks easily recognizable.
4) And then finally, the detected cracks are displayed and then stored in a database which we can access when needed.

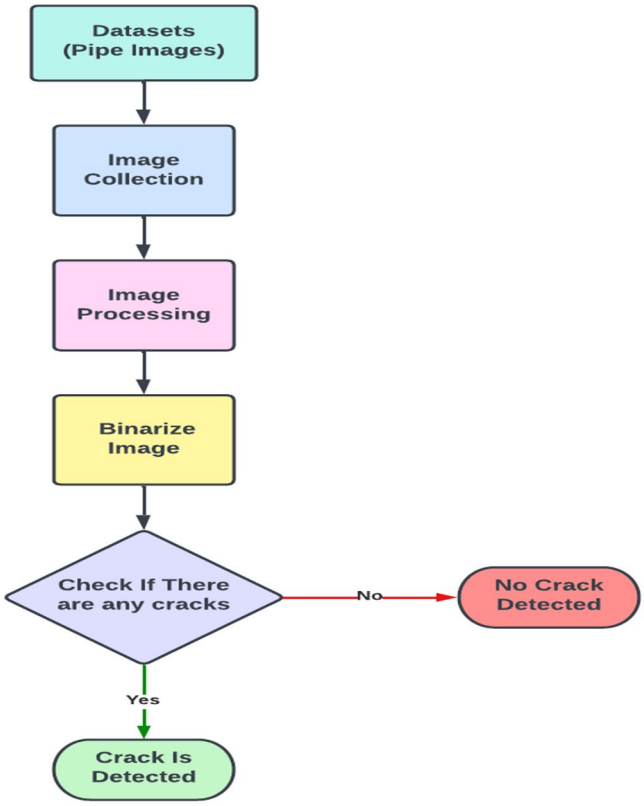
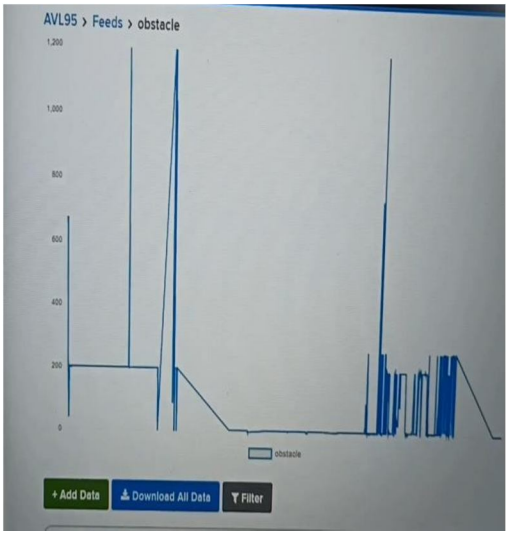


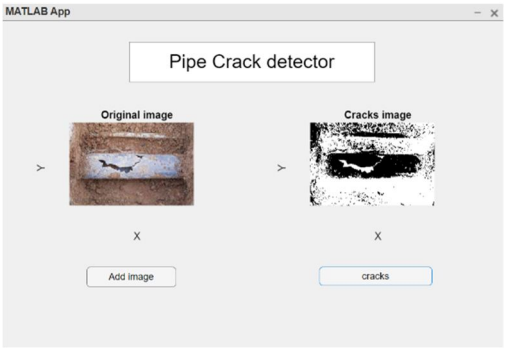
Figure : Flow chart of MATLAB implementation

VIII. EXPERIMENTAL RESULTS

The proposed model works flawlessly. The system checks whether there is an overflow or blockage of sewage water, so that it doesn't affect the surrounding environment in any way. So, there is a great use of this system where there are less complicated drainage systems and even if a problem is detected it will be easy to clear. So, the system provides good real-time monitoring.
BENEFITS

1) This system is easy to set up.
2) It is cost efficient.
3) This system has a less complicated circuit and only requires twobasic sensors.And finally, it is beneficial to maintain a clean environment.





IX. CONCLUSION

This system avoids the problem of overflow of sewage on the roads in many cities. It leads to the timely reminder to fix the problems and avoid difficulties and diseases due to sewage overflow. It also leads to a smart system that can maintain and monitor the sewage of the whole city. It additionally guarantees necessary cleaning of blockage due to which sewage level increases by repeatedly sending messages to concerning authorities.

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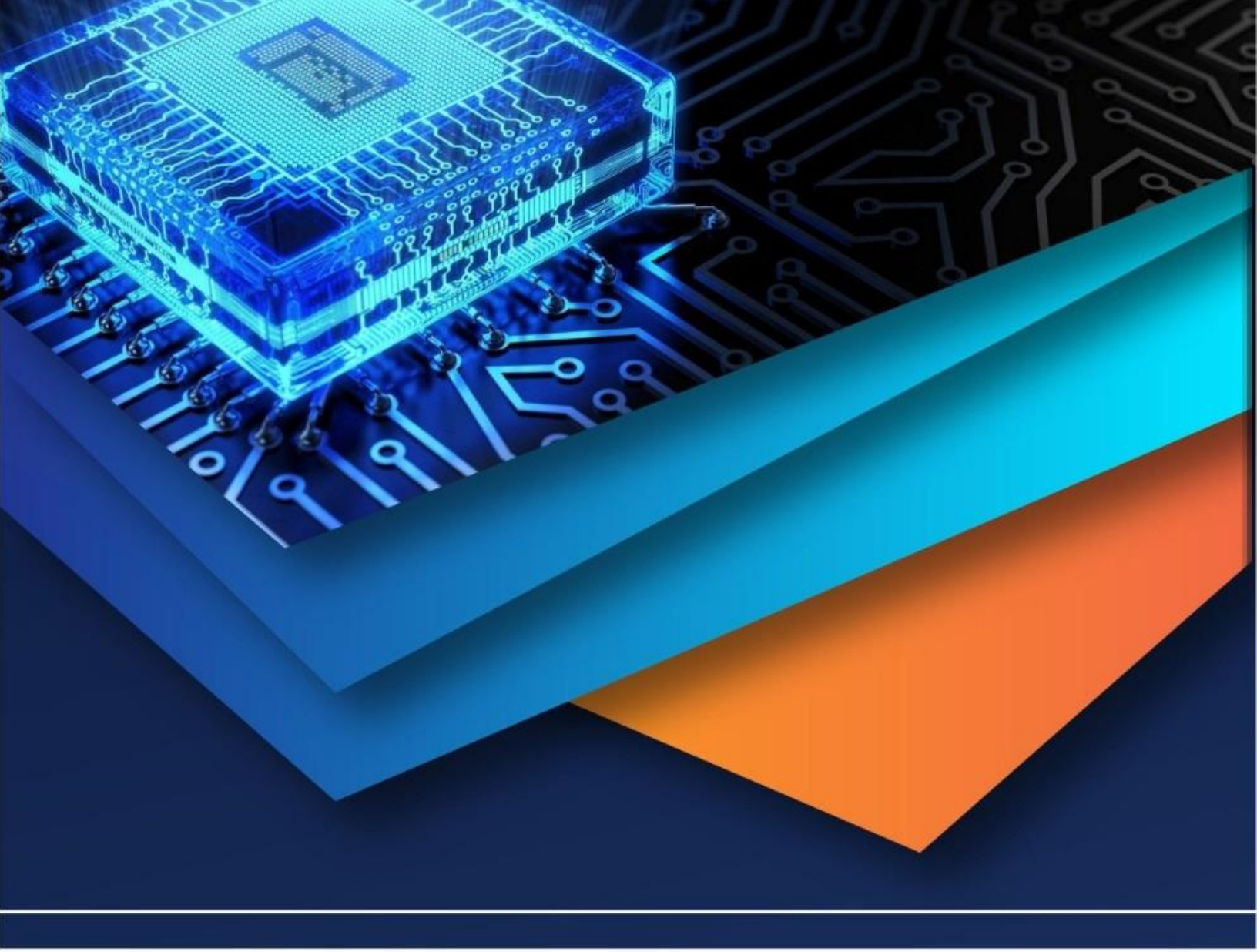

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