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Anti-clogging Sewerage System Using IOT

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Abstract: This project aims to create a low-cost, self-contained sewerage system using IoT and without the need for human intervention. Real-time data forecasting the extent of sludge and water is critical for proper sewer system operation. Higher runoff volume, combined with large areas of impervious ground, has overburdened the drainage system, resulting in inundation and blockage. All of this could be avoided if a smart system is implemented that detects both the water level and redirects water using sensor-controlled gates. A smart system could be created by leveraging existing Artificial Intelligence, IOT principles, and adequate sensor data analysis to provide real-time information monitoring and reporting to the municipality or concerning authority. Will eliminate the need for manual drain inspections and allow for immediate response without the need for human intervention or delay.

Keywords: Sewerage system, Linear regression, MQ135, Rain drop sensor, IoT, CSO, Chocked Flow

1. INTRODUCTION

With climate change, the effect has been evident with longer monsoon seasons burdening the existing sewage system with increased influx which the infrastructure is unable to handle and requires proper planning and management of Sewerage Systems. Sewerage systems are sewage collection networks. Waste water is transported from its point of origin to treatment facilities through pipes, conduits, and ancillary works before being discharged back into the environment. Increased population, infrastructure constraints, and rains have all wreaked havoc on India's sewerage system, posing risks to people, economic assets, infrastructure, and the environment. To deal with the volume of storm water, measures must be taken preventing sewer floods in urban areas Flooding from overflowing manholes (wet weather overflow) or chamber gullies occurs as a result of

excessive discharge following heavy rainfall events due to blockage, storm water infiltration, or engineering failure. Due to overflow or excessive wastewater, the discharge of Combined Sewer Overflow directly into the environment is extremely dangerous. Smart planning can both make it dangerous and discourage it. After heavy rains, CSO pollutes the environment by discharging untreated wastewater directly into the environment. Furthermore, the presence of any blockage or obstruction can have a significant effect on sewerage operation management, as well as an increase in the concentration of toxic gases, which can lead to leakage and death if inhaled in large quantities. Sewerage network is a man-made system that is required to receive water that did not percolate to groundwater in any catchment hydrological cycle. As a result, the intensity of flow in the sewerage network varies greatly depending on rainfall and the permeability of the infrastructure in the region, and hydraulic flow can range from open channel to pressurized conduit. These dynamic changes could be best evaluated across a network of interconnected devices and could be sufficiently exploited to have real-time control (RTC), where the devices will use IOT principles to regulate the flow of wastewater in accordance with rainfalls, blockages, and overall infrastructure to better respond to changes without human intervention, reducing the overhead time as well as the costs of a timely response.

In the field of sewerage management systems, the Internet of Things and Data Science have enormous potential for both collecting and analyzing data related to environmental and physical parameters, as well as their impacts. These advances could be made possible by the use of a wireless sensor network, which would produce critical data on a variety of variables. (environmental and other) could be properly visualized using a Geographic Information System and an appropriate data science model, allowing for proactive implementation of needed changes without the need for human intervention.

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NEED OF AUTONOMOUS SEWERAGE SYSTEM

1. It would automate the process of inspection of manhole and hence reduce life risks due inhalation of dangerous gases and drowning.

2. It would generate real time data which could further be analysed to understand the correlation of various factors including clogging etc. for flooding and manhole overflow.

3. It's a completely interconnected system which would prevent the human delay and error in the process, would proactively route the flow according to the dynamic situation through the gates and pressure booster pumps.

4. Reduce any possibility of floods, also prevent direct discharge of contaminated water through CSOs.

5. Cost effective as it proactively maintains the operation of the whole sewage system reducing the maintenance cost of wear and tear, that would have eventually occurred by ensuring none of the node(manholes) bear influx above a threshold capacity.

6. It would help to better realize the situation of the sewage system using data from various sensors and could provide a more understandable and graphical representation of data.

VISUAL IMPLEMENTATION

The Wireless Sensor Network (WSN) is a monitoring technology that consists of node sensors that are spread across a wireless network system in a coordinated manner. Data processing (microcontroller, CPU, or DSP chip), memory (programme, data, flash memory), RF transceiver, power supply system (battery or solar cell), and one or more sensors (pressure, water level, gas) are all included in each node.

In addition, (Wayne 1999). WSNs are used to track physical and environmental variables such as precipitation, humidity, temperature, sound, pressure, and harmful gases, among others. WSNs are low-power, low-cost multihopping systems that are self-healing data paths and are independent of external service providers. They can form an extendable network without line of sight coverage. The purpose of this paper is to discuss the design of an Autonomous Anti-Clogging Sewerage System that would use IoT, WSN, and server concepts to generate data, use linear regression to predict the need for action, and automatically initiate the action.

2. BLOCK DIAGRAM

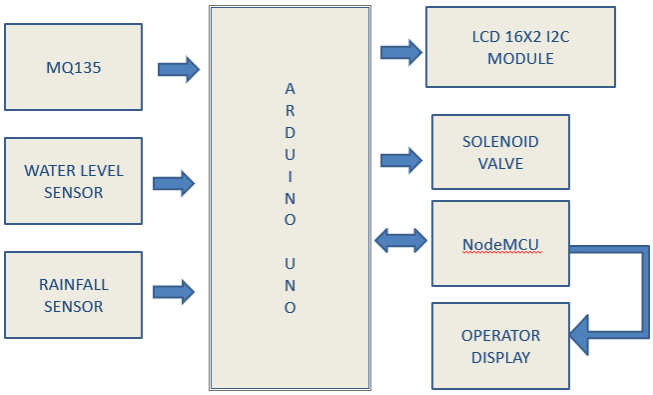

Fig -2: Overall Block Diagram

3. COMPONENTS DESCRIPTION

3.1 GAS SENSOR

The MQ135 Gas Sensor is a gas detector that can detect NH3, NOx, alcohol, benzene, smoke, and CO2. In the office or in the factory, this item is ideal. The MQ135 gas sensor is highly sensitive to ammonia, sulphide, and benzene steam, as well as smoke and other dangerous gases.

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Fig - 3.1: MQ135 Gas Sensor

3.2 WATER LEVEL SENSOR

A water level indicator is a device that sends data to a control panel, to show whether the water level in a body of water is high or low. To detect water levels, some water level indicators combine probe sensors and float switches. “A simple mechanism is used by the Water Level Indicator to detect and indicate the water level in an overhead tank or any other water container.” Electronic hub reports.

A water level indicator is used to monitor and control the level of water in a water tank. When the water level drops too low, the control panel can be programmed to automatically turn on a water pump to refill the tank.

Fig-3.2: Water Level Sensor

3.3 RAIN DROP SENSOR

The Raindrop Sensor is a device that detects raindrops. It is made up of two modules: a rain board that detects rain and a control module that compares and converts analogue values to digital values. Raindrop sensors are used in the automotive industry to automatically control windshield wipers, in agriculture to detect rain, and in home automation systems. Raindrop sensor is basically a board on which nickel is coated in the form of lines.

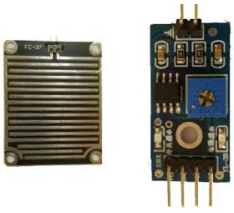

Fig-3.3: Raindrop Sensor

3.4 ARDUINO UNO

Arduino is an open-source electronics platform with simple hardware and software that is low-cost and easy to use. The Arduino Uno is an open-source microcontroller board created by Arduino.cc and based on the Microchip ATmega328P microcontroller. The board has a number of digital and analogue input/output (I/O) pins that can be used to connect to different expansion boards (shields) and other circuits . The board has 14 digital I/O pins (six of which can be used to generate PWM output) and 6 analogue I/O pins, and it can be programmed using the Arduino IDE (Integrated Development Environment) and a type B USB cable. It can be powered by a USB cable or an external 9-volt battery, with voltages ranging from 7 to 20 volts.

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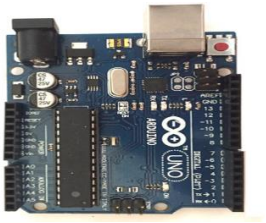

Fig-3.4: Arduino Uno

3.5 NodeMCU ESP8266

NodeMCU is an open-source Lua-based firmware and development board that is specifically designed for Internet of Things (IoT) applications. It provides firmware for Espressif Systems' ESP8266 Wi-Fi SoC and hardware for the ESP-12 module. This is a low cost open source IoT platform. It has a memory of 128kbytes and storage of 4Mbytes.

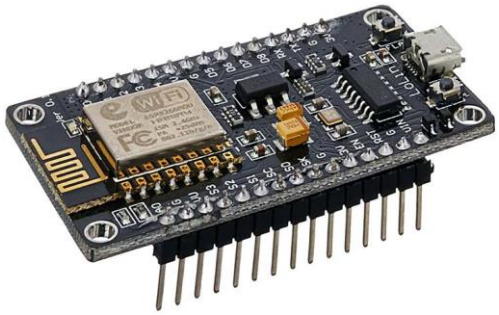

Fig-3.5: NodeMCU ESP8266

3.6 LCD 16*2 DISPLAY

Liquid crystal displays are used in similar applications where LED displays are used with minimal application. These applications are a display of numeric and alphanumeric characters in dot matrix and segmental displays.

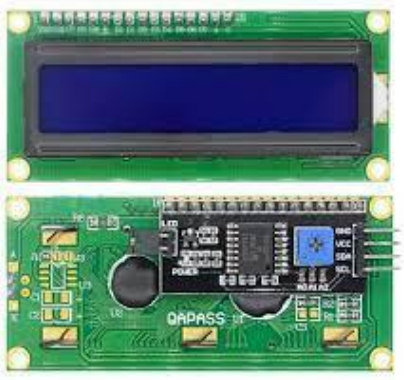

Fig-3.6: LCD 16*2 I2C Display

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4. CIRCUIT DIAGRAM

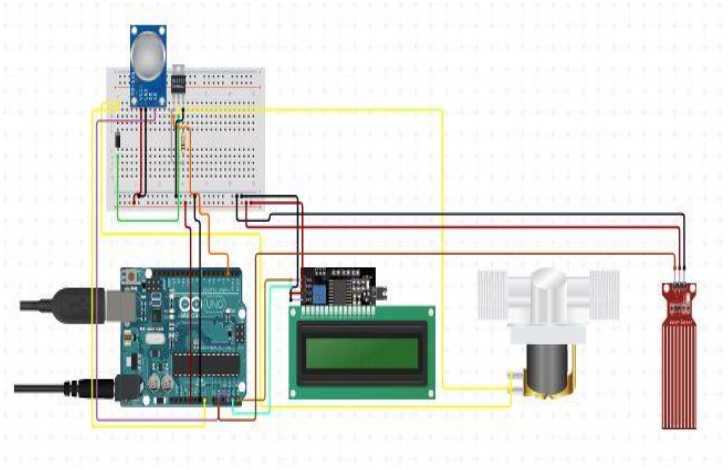

Fig-4: circuit diagram

5. ARDUINO IDE

The **Arduino Integrated Development Environment (IDE)** is a cross-platform (Windows, macOS, Linux) framework written in C and C++ functions. It's used to write and upload programmes to Arduino-compatible boards, as well as other vendor development boards with the support of third-party cores. In Italian, "uno" means "one," and it was chosen to commemorate the release of Arduino Software (IDE) 1.0 . The Uno board and Arduino Software (IDE) version 1.0 were the reference versions of Arduino, which have since been superseded by newer updates. The Arduino Uno board is the first in a series of USB Arduino boards and the platform's reference model; see the Arduino index of boards for a comprehensive list of new, past, and obsolete boards.

TYPES:

- Arduino Uno Rev3 SMD
- Arduino Uno Wi-Fi Rev2

```
#include "MQ135.h"
#include <Wire.h> // Library for I2C communication
#include <LiquidCrystal_I2C.h> // Library for LCD
MQ135 gasSensor = MQ135(A0);
LiquidCrystal_I2C lcd = LiquidCrystal_I2C(0x3f, 16, 2);
int val;
int sensorPin = A0;
int sensorValue = 0;
const int capteur_D = 7;
const int capteur_A = A0;
int val_analogique;
const int read = A0; //Sensor AO pin to Arduino pin A0
int value;          //Variable to store the incomming data
int solenoidPin = 4;
void setup() {
  Serial.begin(9600);
  pinMode(sensorPin, INPUT);
  pinMode(capteur_D, INPUT);
  pinMode(capteur_A, INPUT);
  pinMode(solenoidPin, OUTPUT);
  lcd.init();
  lcd.backlight();
```

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6. WORKING

The smart sensor sewage system is made to work with the principle of Arduino UNO and IoT module. The Arduino UNO is connected with four components and they are programmed. The four components connected are rain fall sensor, water level sensor, gas sensor (MQ135) and the solenoid valve. The rain fall sensor is used to detect the presence and absence of the rain fall and to show the level of water in the system. The water level sensor is used to detect the amount of water level contained in the sewage system. The Gas sensor (MQ135) is used to detect the presence of ammonia gas in the sewage system and the sensor acts to rectify the gas. The solenoid valve contains a tank that consists of the hydrochloric acid (HCL). When the water reaches a level, the solenoid valve gets triggered and opens for 5 seconds and the concentrated HCL flows into it. The node MCQ module shares the output to the system and the date is calculated and analysed. Then the data is shared to the authority to make the needs to rectify the problem.

7. OUTPUT

7.1. CLOG REMOVAL

```
06:32:23.946 -> MQ135 Digital Output= 170
06:32:23.946 -> ppm: 2.90
06:32:28.932 -> Digital value : RAINING!!!
06:32:44.420 -> MQ135 Digital Output= 175
06:32:44.420 -> ppm: 3.15
06:32:49.397 -> Digital value : RAINING!!!
06:32:54.387 -> Rain Fall Analog Output: 176
06:32:59.403 -> Water Level: 432
06:33:04.377 -> Clog Threat Detected
06:33:04.424 -> Opening Solenoid Valve
06:33:04.424 ->
06:33:04.424 -> Water Level Down, CLOG REMOVED SUCCESSFULLY
```

7.2. RAINING BUT NO CLOG

```
06:32:03.911 -> MQ135 Digital Output= 168
06:32:03.958 -> ppm: 2.80
06:32:08.913 -> Digital value : RAINING!!!
06:32:13.881 -> Rain Fall Analog Output: 175
06:32:18.911 -> Water Level: 415
06:32:23.899 -> No Clog Detected
06:32:23.899 -> Safe Operation
```

7.3. NORMAL OPERATION

```
06:27:03.629 -> MQ135 Digital Output= 146
06:27:03.629 -> ppm: 1.84
06:27:08.611 -> Digital value : Not Raining
06:27:13.600 -> Rain Fall Analog Output: 144
06:27:18.605 -> Water Level: 13
06:27:23.559 -> No Clog Detected
06:27:23.606 -> Safe Operation
```

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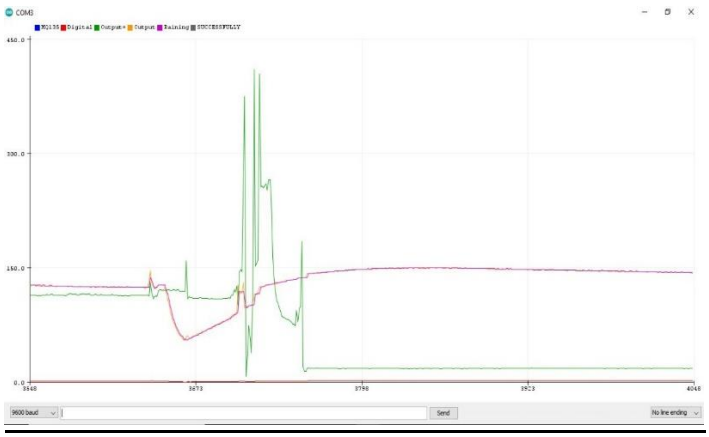
8. FINAL OUTPUT



Here, the green line represents the spike where the clogging occurs. Once the clog gets removed the operation becomes to normal.

9. LCD OUTPUT

9.1 WITH RAINFALL

9.2 WITHOUT RAINFALL

10. RESULT

The anticlogging sewage system comes with the new innovation of clog removal and block in the sewage system. This system uses the Arduino UNO and IoT module to present the real time data to the authority and municipality to detect and rectify the blockage in the sewage system. The main aim of this project is to avoid the human work for the clog removal in the sewage system. The LCD display shows the reading level of the water level detected in the system.

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11. ADVANTAGE

- There is no human interference.
- Easy to detect the presence of clog.
- The cost is low.
- Quick in analyzing the data and transferring to the mobile or laptop.

12. CONCLUSION

- By use of IoT module and ARDUINO UNO the data is collected easily and the output is obtained as graph so that the presence of clog is detected easily.
- This project is mainly focused to avoid the Manual Scavenging.
- This project is made up of low cost so that the work time will be minimized.
- Here the maintenance cost is absolutely low on comparing with the advanced prototypes.
- Here, the defect and the clog can be identified through the mobile were the model is added with the IoT module.
- By the above statement the clogging can be identified easily and the process of work time will be minimized.
- It also helps to avoid the unnecessary digging or damaging of pavements.

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