Iot Based Manhole Monitoring System

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***Abstract*— In India, at least two die each day due to open manholes. If proper action is performed on time, then many lives could be saved. The objective of this paper is to make the system low-cost and effective. This system design consists of three sensors which are used to detect water level, gas level and tilt in the manhole cover. If the sensor values reach the threshold level, then that data is sent to the administrator through IFTTT which is 'If This Then That' platform. In this system IoT data is collected and analyzed on ThingSpeak. Thingspeak provides graphical representation of sensor data which helps to understand the error in sensor readings and analyzing the sensor data. Real time updating on the internet will help to check if there is any problem in the system data and thus avoiding any problems occurred due to it.**

Keywords*— *Sensors , sms , monitoring , iot , thingspeak ,ifttt.

I. INTRODUCTION

Due to absence of manhole covers, accidents take place everywhere in world. Manholes are not maintained especially in the developed and developing countries. The gases in manhole which are inflammable result in explosion. If the drainage maintenance is not proper it will create problem for routine life, traffic may get jammed infectious disease may get spread and there is a chance of occurrence of accidents Hence, the main objective of the paper is to design a IoT Based Manhole Monitoring System to inform the authority by sending notification of the state of the manhole system so that they can fix the manhole as soon as possible.

This system design consists of three sensors which are used to detect water level, gas level and tilt in the manhole cover. If the sensor values reach the threshold level, then that data is sent to the administrator. The IoT data is collected and analyzed on ThingSpeak. Thingspeak provides graphical representation of sensor data which helps to understand the error in sensor readings and analyzing the sensor data.

In this system ESP8266 NodeMCU, SR-04 Ultrasonic sensor, MQ gas sensor and tilt sensor are used. IFTTT server is used to send SMS of the state of manhole obtained from sensor data to the municipal authority. Ultrasonic sensor is used to check water level inside the manhole. Gas sensor detects inflammable gases inside the manhole. Tilt sensor detects if the manhole cover is tilted or not.

II. RELATED WORK

In[2], the system was created using components like Arduino UNO , DHT11 sensor which is temperature and humidity sensor, MQ gas sensor, flow sensor and Wi-Fi module ESP8266. Their sensors sense the all parameters such as gas, water level and also measure the humidity and temperature inside the manhole. They used Arduino UNO to send the sensor data through Wifi module to authorities.

In[3], the authors discussed a research related to an IoT enabled manhole wastewater spillage detection system. As soon as the water started overflowing, the system was able to send a tweet for public to be aware, an email and SMS to the municipal authorities with the exact time and GPS location of the manhole.

In[4], when the water overflows from manhole or the manhole cover is removed or when pressure inside the manhole is increased, the sensed information is transmitted through Blynk to the municipal corporation using Wi-Fi, and the water level and gas value data is uploaded live on the cloud for analyzing the data. And the GPS location of the particular drainage is also sent via Blynk Server.

In [5], the authors discussed the 'Secure Manhole Monitoring System Employing Sensors and GSM Techniques'. When the sewage water is overflowed from manhole or if pressure increases inside the manhole, manhole cover can get cracked. To avoid such incidents, the public should be alerted. Hence, in their system they made an alerting system where the buzzer alerts the surrounding. In the code, each sensor will have a certain reference value, where sensors will monitor the water, temperature levels. If the sensor value is greater than the reference value the data will be sent to concerned authorities.

In[6], the authors published paper named 'Manhole cover monitoring system over IOT'. In this research, manhole on road is recognized via camera which can capture 30 frames per second. Their system also locates the absent manhole cover. In order to locate the absent cover, their system gets the coordinates of the missing manhole cover through the GSM or GPRS. Then the coordinates are given on IOT.

In[7] , their system monitors various parameters like toxic gases, temperature, and water levels in the manhole using sensors like gas sensor, temperatute sensor and ultrasonic sensor. The parameters of sensors are monitored continuously and through Arduino the required alert messages are sent to GSM. GSM sends these messages to government officials and then they can take the necessary actions.

III. METHODOLOGY

- Sensors are used to detect and respond to changes in manhole.
- The sensor data is taken in by NodeMCU and send the message accordingly to IFTTT.
- The sensor values will be shown in Arduino IDE software.
- IFTTT software is used to send SMS notifications to administrator if the sensor values reach their threshold level.
- Iot data that is data received from sensors is collected and analyzed on ThingSpeak.

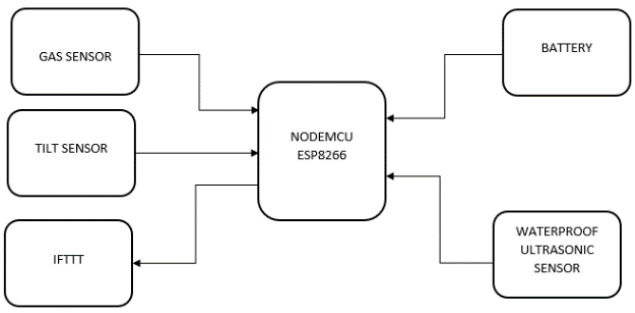

Fig. 1. Block diagram of the system

Ultrasonic Sensor is used to detect the water level in manhole. In this system the reference value is 20 cm. If the distance between water and manhole cover is less than 20 cm, SMS will be sent named "WaterLevelReached" to the respective authorities through IFTTT server.

Tilt sensor is used to detect if there is any tilt in the manhole cover. The value is kept 0 if no tilt is detected and 1 if tilt is detected. If the value of tilt is 1 then SMS will be sent named "TiltDetected" to the respective authority.

Gas sensor is used to detect if there is presence of gas in the manhole. The reference value of gas sensor is kept as 80 ppm. If the ppm value is greater than 80 ppm, SMS will be sent named "GasDetected" to the administrator.

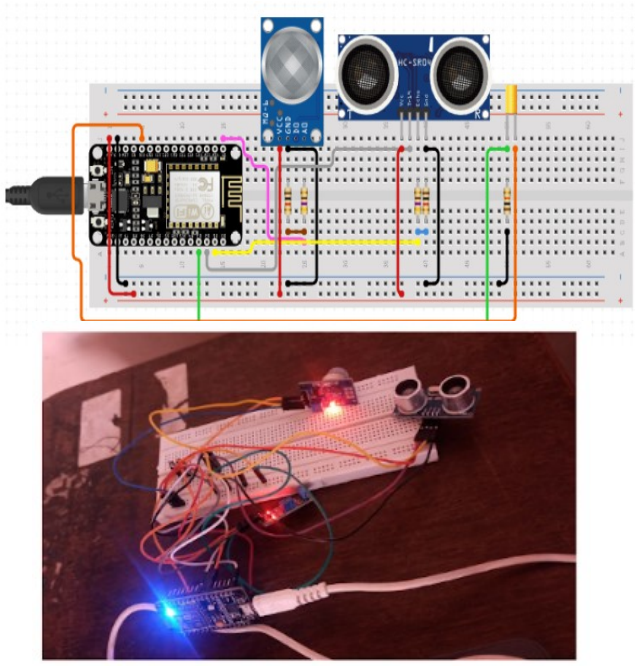

Fig. 2. Circuit Diagram of the system

The following are the steps used for creating and burning the code in NodeMCU:

- First, the sensors are connected to the NodeMCU.
- Then this hardware is connected to the laptop or PC through USB cord.
- The code is burned in NodeMCU.
- The channel is created on ThingSpeak.
- The ThingSpeak 'channel number' and 'channel id' is inserted in the code.
- An 'applet' is created on IFTTT platform.

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- The website link obtained from IFTTT platform is inserted in the code.
- Insert Wifi name and password in the code.
- Run the final code in Arduino IDE.

Fig. 3. Hardware Demonstration

In Fig. 3, the book is the manhole cover. On the book, there is the hardware of the system which contains NodeMCU ESP8266, ultrasonic sensor, gas sensor and tilt sensor. The hardware is given a power of 5V through power bank. The below bucket is the manhole.

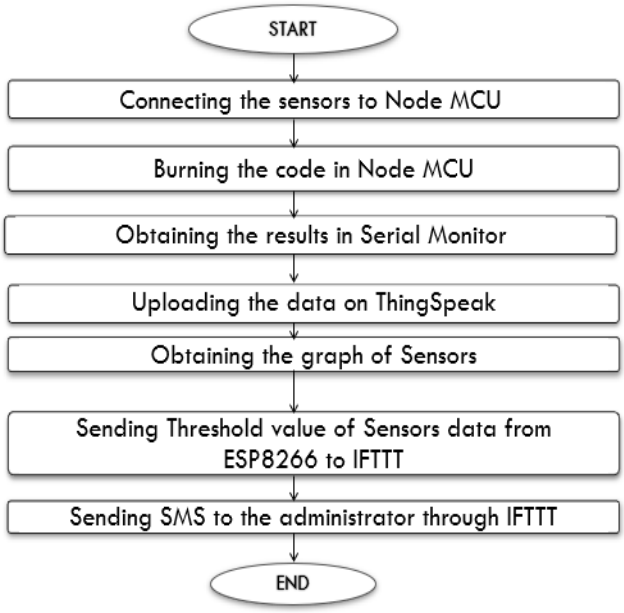
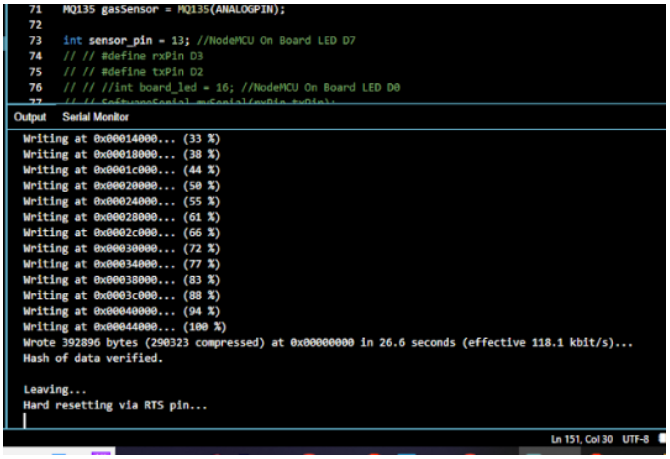


Fig. 4. Flowchart of the system

For burning the code in NodeMCU, Arduino IDE software is used.



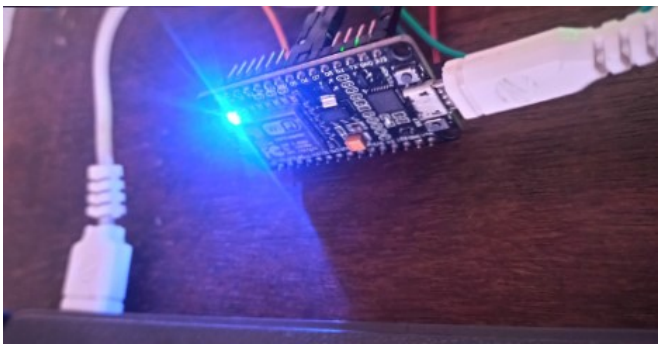


Fig. 5. Code Burned in NodeMCU

The code is divided in two parts. The first part is sending sensor data to ThingSpeak. The second part is to link IFTTT to NodeMCU.

The channel is named as “manholedetection” on ThingSpeak for plotting graph. ThingSpeak provides graphical representation of sensor data which helps to understand the error in sensor readings and analyzing the sensor data. The channel id and apikey are used for connection with nodemcu.

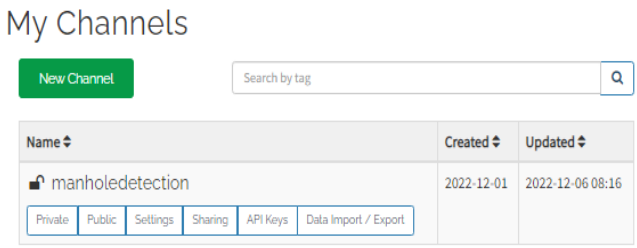


Fig. 6. ThingSpeak Channel

Applet is created on IFTTT platform.

Fig. 7. Applet creation on IFTTT

After connection is established, http site is to be created. The website consists of key and event name. This system's event name is "esp_manhole" and key is "mhPbDCf_MW2cfCa9haSmWaKS690cK6Y8 RGVqidGOOw6".

Fig. 8. Website creation

IV. RESULTS AND DISCUSSION

ThingSpeak provides graphical representation of sensor data which helps to understand the error in sensor readings and analyzing the sensor data. The sensor data results are shown on serial monitor of ARDUINO IDE.

That data is sent to ThingSpeak channel if there is proper WiFi connection. The results obtained are shown in Fig. 9 and 10.

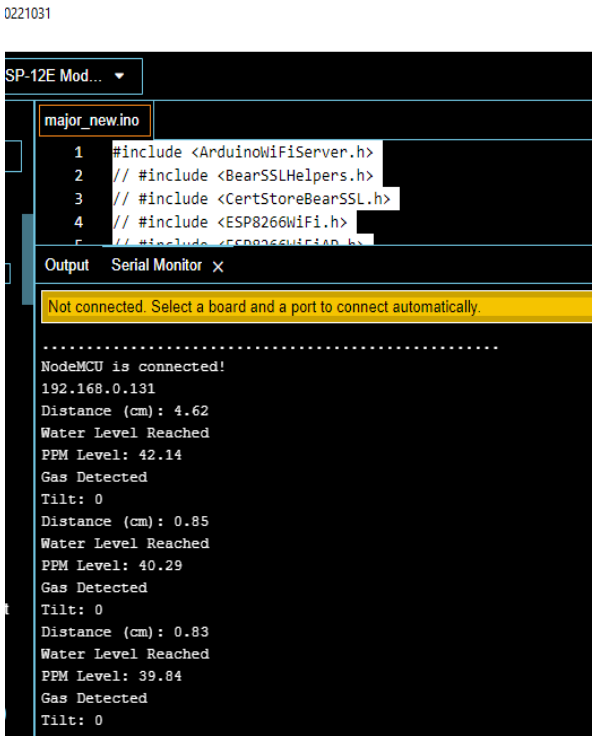


Fig. 9. Sensor Data

Fig. 10. ThingSpeak Graph

From Fig. 8, after creation of website on IFTTT platform that site along with key and event name will be used for the coding in ARDUINO IDE for sending SMS to the administrator.

Fig. 11. Serial Monitor Results

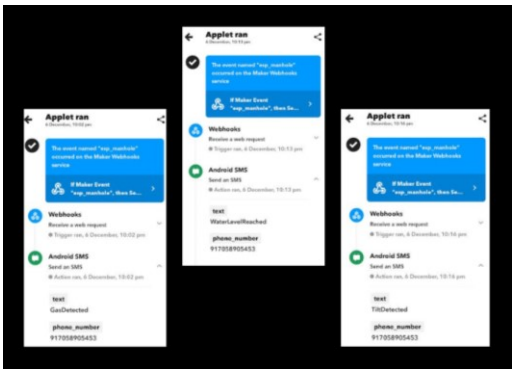


Fig. 12. SMS Sent Through IFTTT

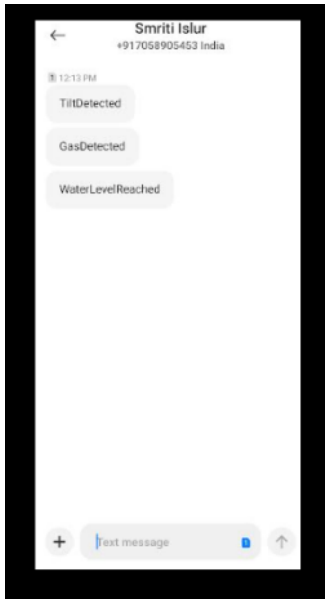


Fig. 13. TEXT SMS received

V. CONCLUSION

There are many accidents due to cracked and missing manhole covers. Hence manhole monitoring is very essential. Urban floods are very common in populated urban areas due to poor management and monitoring of the manholes. Such incidents can be avoided by using Manhole Monitoring System using IoT.

In this paper, IoT based Manhole Monitoring System was designed successfully to solve all the problems of the manhole system by informing the authority by sending notification of the state of the manhole system.

Change in sensor readings were also monitored graphically through ThingSpeak. All the sensors were in working condition. Then SMS through IFTTT was successfully sent and SMS was received on the desired mobile number.

VI. REFERENCES

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