MONITORING AND CONTROLLING TOXIC GAS IN SEPTIC TANK SYSTEM USING IoT

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ABSTRACT

Internet of things (IoT) is everywhere now from homes to industries and factories. Use of IoT in homes and industries are increasing in day to day life. Using IoT, it is possible to control any electrical and electronic equipment through internet. Moreover, it can able to monitor the information from any sensors and it can analyze graphically or in any user defined format from anywhere in the world. In this paper a unique solution is given for common septic tank problems which are occurring in India by monitoring the toxic gases in septic tank and process it in FRED (Cloud based Node Red to build and deploy IoT applications). In septic tank system, density of toxic gases such as hydrogen sulphide and etc are continuously monitored by the gas sensors and analyzed in graphical format in FRED. If the toxic gases are going beyond permissible exposure limit (PEL) then, the controller will send notification to the user/concerned officials of public work department to clean the septic tank system. Moreover, our system will automatically add salt and bleaching powder to the septic tank system once the values of toxic gases are nearer to the permissible exposure limit and thereby it will try to decrease the density of toxic gases. So by IoT based Septic tank system, it is possible to avoid abnormality in septic tank and more importantly the death of manual scavengers due to toxic gas exposure (asphyxiation).

Keywords— IoT, FRED, PEL, hydrogen sulphide, toxic gases.

I. INTRODUCTION

In India, only 48.45% of city people using toilets, among that only 35% of people alone using underground sewage system. Others, they rely on the septic tank system. Unofficial septic tank cleaners (without any vehicles, safety equipments) were 5 lakhs, 88 thousand in the year 1992 whereas in 2002, it increases to 7 lakhs, 87 thousand (credit: puthiyathalaimurai TV channel). 27 septic tank cleaners died in between October 2015 and December 2016 due to main reason of toxic gas exposure. Septic tank can be divided into three layers. The solid materials will settle down at the bottom layer called *sludge*, the liquid will settle at the middle layer called *effluent* and, the grease/fat substance will settle at the top layer called *scum* (Figure 1). Only the effluent in the middle layer will leaves to the drain field where it flows to the parallel pipes with the openings that allows the liquid to pass into the soil. There the natural process takes place to remove pathogens (cause of disease organism) from the effluent. If the tank is
not pumped out at a regular interval, there is a possibility of solid layer (sludge) to goes to the drain field. If solid layer (sludge) goes to the drain field, the drain field will saturate which leads to stop the natural process of removing the pathogen by microbes in the sand. The drain field saturates (clogged drain field) results in the system back-ups. Back-ups may contain over 20 disease causing organism. Even worse, contaminated waste water can enter into the ground water, streams, and lakes and affect our wild life environment. The unwanted disposal such as meat waste into the septic tank will increase the density of toxic gases such as hydrogen sulphide. So it is necessary to avoid these problems occurring in septic tank systems by using technologies.

II. PROPOSED METHOD

A. Hardware section

Gas sensor with arduino microcontroller as shown in Figure 2 is fixed in the septic tank collects data at regular intervals and compares its value to the PEL (value to say as toxic). 10 ppm is the PEL (8 hour time-weighted average). 10–20 ppm is the borderline concentration for eye irritation (credit: Wikipedia). Adding salt and bleaching powder is automated in the arduino microcontroller by opening and closing the pipe by using servo motor as shown in Figure 3 once the values of toxic gas are nearer to the PEL. So the system will always try to reduce the density of toxic gases below the PEL. In worse condition, if the collected sensor value is greater than 8 to 9 PPM value then, the arduino microcontroller will send notification to the user/public work department to clean the septic tank system or to take necessary activities.

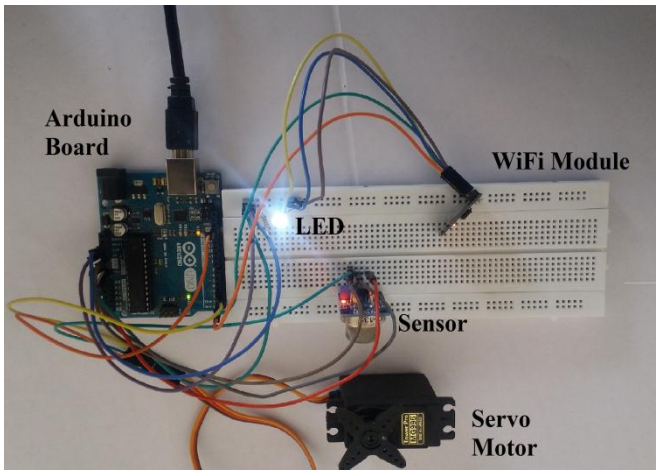

Fig. 1Arduino microcontroller with servo motor and wifi module(proto type)

B. Server section

HTTP and MQTT are the popularly used communication protocols in IoT. Here, HTTP protocol is used to send gas sensor values to FRED for analyzing those values in graphical format. HTTP protocol works as a request and response protocol between a client and server. Usually in IoT, data from sensors will be sent as a HTTP request by client to the server and server will response based on the request. In FRED, it gives the freedom to process the data by receiving the HTTP request and can take action by setting some condition (Check Threshold) on those data. The whole process of septic tank system in FRED is shown in Figure 4. Through the FRED process it is possible to monitor the gas sensor values in dashboards such as chart/gauge/text/audio as shown in Figure 3. The URL to monitor the data is *https://{username}.fred.sensetecnic.com/api/ui/*. At the same time it is also possible to tweet/email to the user/public work department if the gas sensor values are going above the PEL as shown in Figure 4.

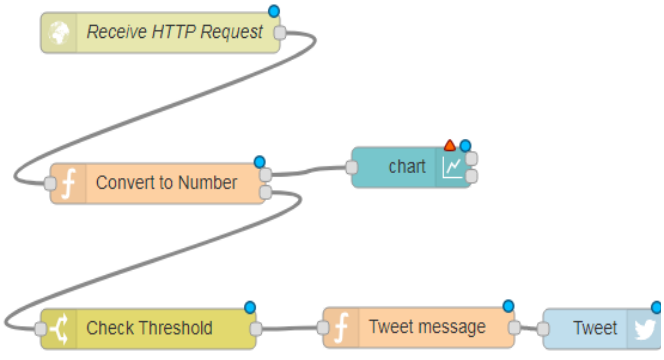

Fig. 2 The FRED process

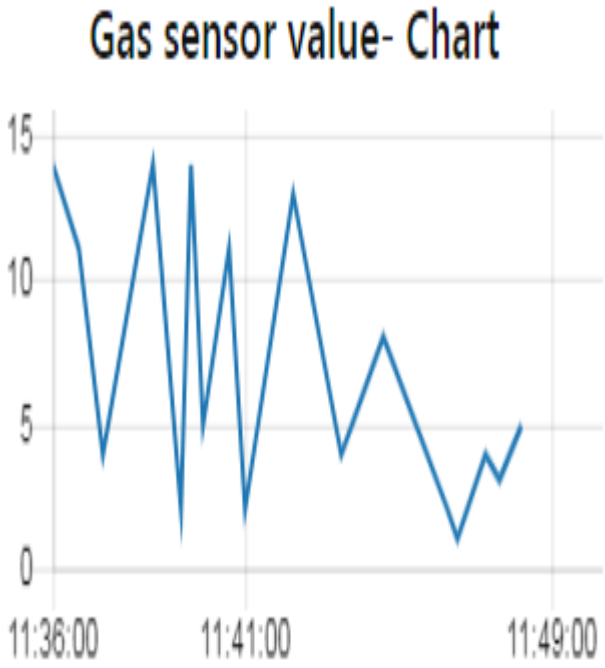

Fig. 3 Monitoring the gas sensor value in FRED

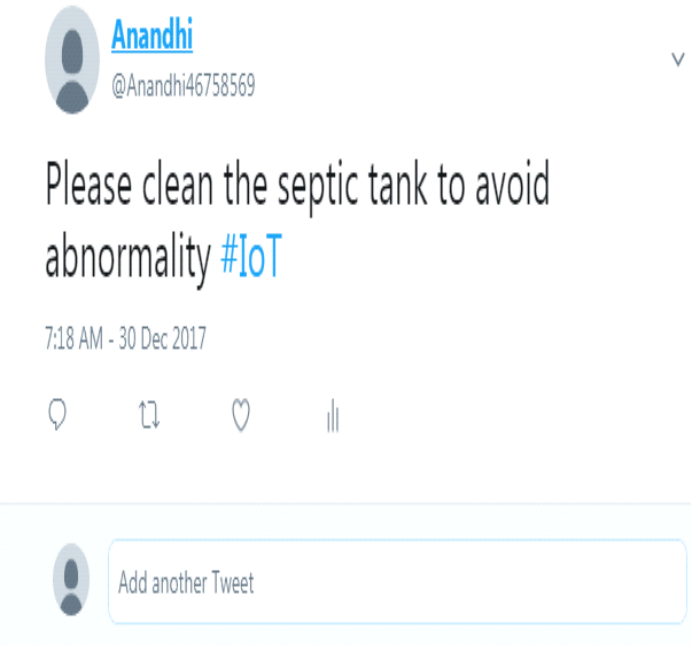

Fig. 4 Tweet notification to the user from FRED

III. WORKING

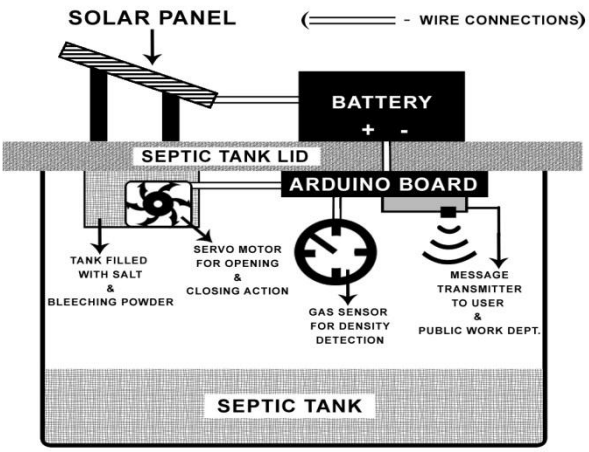

Fig. 5 Layout of the system

This system consists of Solar Panel, Battery, Arduino Board, Tank filled with Salt and Bleeching Powder, Servo Motor for opening and closing action, Gas Sensor for density detection, Message Transmitter to the User and Public Work Department as shown in Figure 5.

Solar Panel is used to generate electrical energy which can be stored in the battery. Battery is used to supply energy to the Arduino Board. The Servo Motor, Gas Sensor and Message Transmitter is connected to the Arduino Board. The Gas Sensor monitors the density rate inside the Septic Tank. When the toxic gases goes beyond PEL. The Arduino Board sends signal to the Servo Motor which acts as Gate Valve to open the Tank containing salt &bleeching powder to reduce density. Immediatey after sending signal to the Servo Motor, the Message Transmitter sends warning information to the User and Public Work Department. Thereby abnormality can be avoided. The Message Transmitter not only works during danger, it also sends the density status twice a day to the user. Thereby the situation inside the Septic Tank can be monitored effectively.

IV. CONCLUSION

IoT plays a vital role in various fields. In this paper, Toxic Gases monitoring in Septic Tank system using IoT is introduced to prevent abnormality. This helps the User and Public Work Department to monitor the situation inside the Septic Tank and get warning information automatically. This system helps to maintain good environment and save the human life.

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