

IMPLEMENTATION OF SEWER INSPECTION ROBOT

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Abstract - Manual scavenging was made illegal in 2013, but private contractors hired by the municipal government continue to employ manual scavengers. Hundreds reportedly die from the work each year. To provide a complete solution to this deplorable situation, a robot can be used as a replacement to manpower in sewer maintenance. The sewage inspection and cleaning is done by this robot. The robot inspects sewer lines for cracks, corrosion, obstacles, gas present, etc. A camera installed atop the robot carries out live streaming of the interior of the pipeline. These visuals are viewed by the operator in software to be recorded for future reference. After finding the nature of gas present in the sewer line, robot has a neutralizing agent that will reduce the harmful gases present in the sewer. After the identification of crack, corrosion, etc. and after neutralizing the gases human may enter the sewer to fix the corrosion of the pipe by sand blasting, recoating, etc. By which the lifetime of the pipe will be extended. Thus, this device effectively decreases all the predicaments associated with sewage cleaning and inspection.

Key Words: Robot, Inspect Obstacles, Camera, Neutralizing agent, Reduce harmful gases, etc

1. INTRODUCTION

Sewage Cleaning by Employing Labor is made Illegal by Government "Prohibition Of Manual Scavenging Act" in 2013, but it still prevails in our country.

According to the study of "Tata Institute Of Social Science" 80% of sewage cleaners in India die before the age of 60 because of Work-related Health Problems. A Survey was made from year (2010-2017), the number of people, dead due to sewage cleaning keep on increasing drastically.

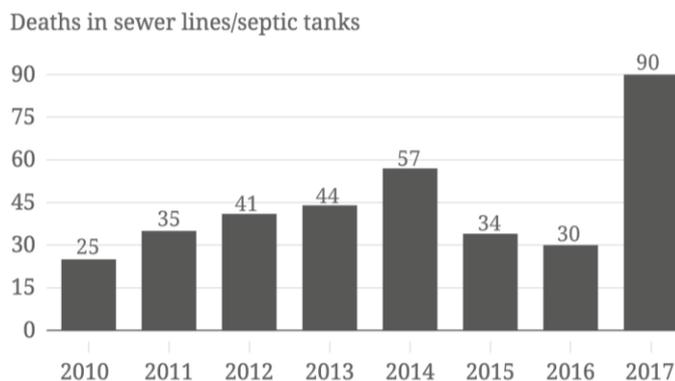


Fig-1: Survey of death in sewer lines

In order to reduce such Human Death due to sewage cleaning, we have implemented a Robot. This system is based on Iot platform. The main objective of the project is to reduce the human loss during sewage cleaning process and to reduce the maintenance cost.

1.1 BLOCK DIAGRAM

An ESP8266 ESP-12E UART WIFI Wireless Shield Development Board for Arduino UNO R3 is the microcontroller used in our system. A L293D Motor Driver circuit is used in controlling the motors of robot. A MQ2 gas sensor is used to sense harmful gases like H₂S (hydrogen sulphide), LPG (liquefied petroleum gas), (Methane) CH₄, CO (carbon monoxide), alcohol, smoke, propane etc. We are implementing a 360° rotating IR camera. The camera is used to inspect the internal environment of the pipe.

The blade is used to clear the obstacles inside the pipe. The pump is used to inject liquefied microbes which act as neutralizing agent. The hardware requirements are Arduino (ESP8266 Enabled), Motor Driver (L293D), MQ-2 Sensor (Gas Sensor), Liquid pump, Motors (1000 rpm), Wheel, Chasse, Battery (12V-7Ah), 360° IR Camera. The software requirements are Arduino IDE (For coding), Camera Monitoring Application (For camera controlling), HTML (For controlling).

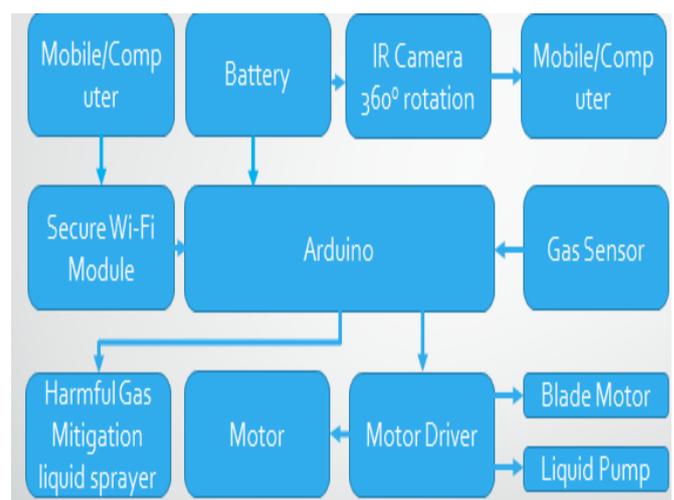


FIG-2: BLOCK DIAGRAM

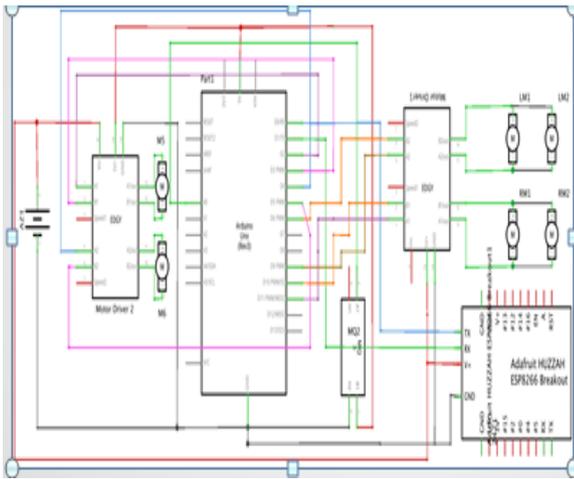


FIG-3:CIRCUIT DIAGRAM

2.METHODOLOGY

Employing a labor to clean sewage is made illegal by government by, Prohibition of Manual Scavenging Act. This still prevails in our country. In order to avoid these we are implementing a wireless sewer inspection robot. This robot is used to clear the obstacle present inside the pipe .A camera is used to inspect the internal environment of the pipe.

The major reason in the sewer pipe is due to inhalation of toxic gases by workers inside the pipe. The main objective of the paper is to reduce these toxic gases ,thereby reducing human losses. So in this paper we are implementing a pump ,through which we are injecting a liquefied microbes which act as neutralizing agent .Microbes are used to increase the oxygen content inside the pipe .We have designed a webpage in a very simple manner. This webpage is used controlling the overall robot motion ,its blades and controls the pump .Thereby human loss due to sewage cleaning process is reduced .

2.1 OPERATION DESCRIPTION

An input supply of 12v is given to the wifi inbuilt Arduino. An input supply of 6v is given to camera. The robot is let inside the pipe. Since our project objective is to reduce the human loss, we implemented a gas sensor that can sense H₂S, LPG, Methane, CH₄, CO, alcohol, smoke, propane, etc., The above mentioned are some of the harmful and odor producing gases. To mitigate that we introduced a liquid sprayer, in that we will have the microbes that will help to reduce the production of above mentioned gases.

Then our next objective is to reduce the maintenance cost. So that we here implemented the 360° rotating IR camera. With the help of it we can find which section of the pipe is damaged and the intensity of the damage. By which we can save the pipe from full corroding and other physical damages.The repair can be made by human itself, since we

reduced the harmful gases introducing the microbes into the sewage water.

The communication with the robot is through the Wi-Fi. Range of the Wi-Fi can be extended through repeaters. A single Wi-Fi device itself enough for our country, because for each kilometer they installed two to three man holes. So the on-board Wi-Fi itself enough. Since we are using Wi-Fi we can get into a more protective communication, We implemented a Wi-Fi Security for logging in with the robot. The only way to tap the communication is by editing the code of the robot. So it is more secure than other communication methods.

MQ2 Gas Sensor Range

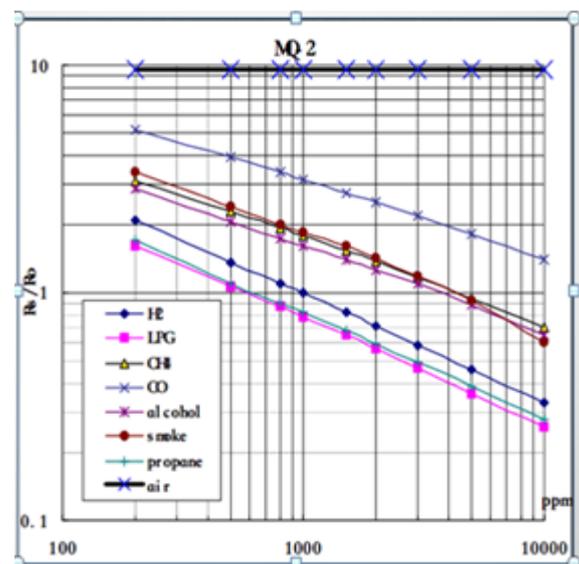


FIG-4 :MQ2 GAS SENSOR RANGE

3.HARDWARE DESCRIPTION

3.1 L293D(MOTOR DRIVER)

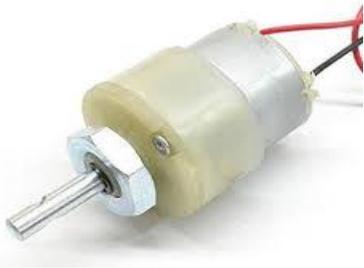


L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-

pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. An *H bridge* is an electronic circuit that enables a voltage to be applied across a load in opposite direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards.

3.2 DC MOTORS (1000 rpm)

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors.



3.3 ARDUINO ESP8266



The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems. The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application

processor. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated allowing it to - work under all operating conditions, and requires no external RF parts.

3.4 MQ2 GAS SENSOR



Sensitive material of MQ-2 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.

3.5 INFRARED CAMERA



A rotating line Infrared camera is a digital camera that uses a linear CCD array to assemble a digital image as the camera rotates. The CCD array may consist of three sensor lines, one for each RGB color channel. Advanced rotating line cameras may have multiple linear CCD arrays on the focal plate and may capture multiple panoramic images during their rotation. A infrared 360° camera is used mainly as night vision which is rotating.

3.6 POWER SUPPLY

The power supply for camera is through 6v battery. The main power is supplied through 12v battery.

4. WEBPAGE DESIGN

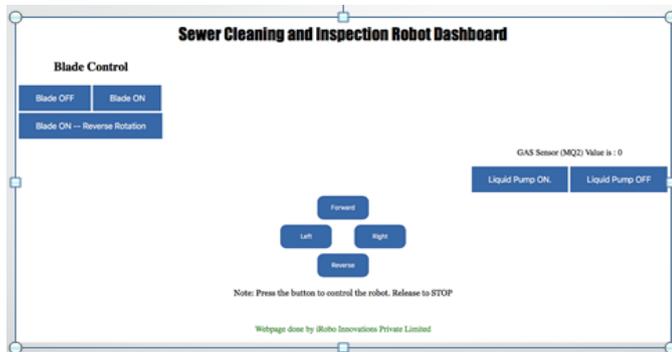


FIG-5: WEBPAGE DESIGN

The webpage is designed using coding. The coding is mainly based on HTML and Java. This webpage is designed in a very simple manner. The manual scavengers can employed in controlling this robot. So that there is no loss of job through this robot.

4.1 OPERATION OF SYSTEM

The overall control of this robot should be done by two systems. This webpage is accessed through a particular IP address. The IP address is given to the person who control this robot. This same address along with wifi password is given to the person who inspects the internal environment of the pipe through camera.

This system is very secure. The communication with the robot is through Wi-Fi. Range of the Wi-Fi can be extended through repeaters. A single Wi-Fi device itself enough for our country, because for each kilometer they installed two to three man holes. So the on-board Wi-Fi itself enough.

4.2 CIRCUIT CONNECTION

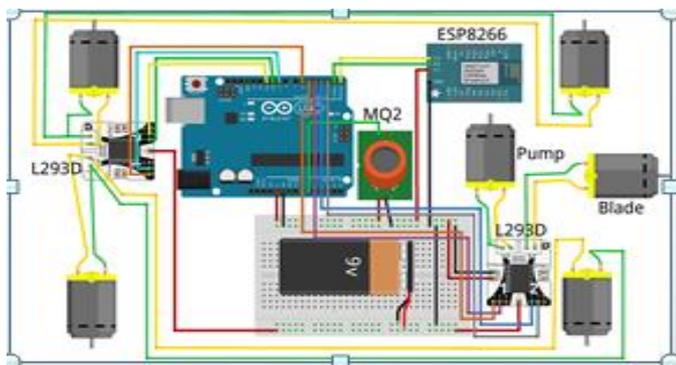


FIG-6: CIRCUIT CONNECTION

5. PROPOSED MODEL

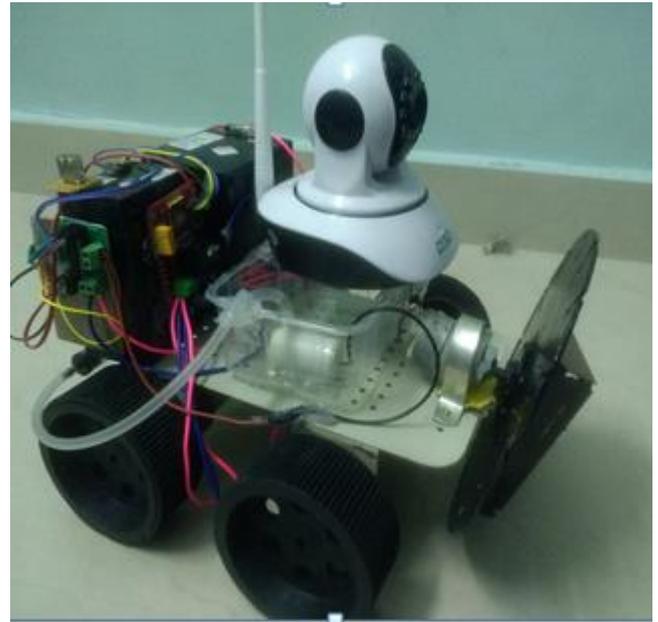


FIG-7: PROPOSED MODEL

6. CONCLUSION

The problem that faced during cleaning, inspection and maintenance of the sewer pipe line can be reduced with the help of the above proposed solution. There are further more development in this project, to develop a more secured and prolonged range of communication method. To design a more effective and jet stream enabled blade for cutting and to make the blockage to run down the stream, and enabling for all sized pipeline.

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