



Eradication of hydraulic anomalies using smart sewer inspection robot

P.Kavitha

kaviakshya@gmail.com

MAM School of Engineering, Siruganur, Tamil Nadu

ABSTRACT

This paper presents a robotic mechanism for detecting and eliminating blockages in sewage pipes. It is a robot that will be used to clean the interior of the pipes using a brushing mechanism. One of the critical areas of the oil and gas industry is the transport of oil and other fluids through a network of pipes. Over time these pipes have accumulated the amount of slug and other deposits; this leads to a decrease in a pipeline carrying capacity, reduced reliability, loss of power due to higher pumping pressure required and irregular flow. This will not only clean the interior of the pipe but also be able to send live video feedback to the personnel on the ground depicting the kind of residues found in the pipes. The robot can also be added with additional sensors to relay any other critical information.

Keywords— Sewage, Cleaning, Blockages, Robot, Detection, Rotating. Pipelines

1. INTRODUCTION

Drainage is the natural or artificial removal of surface and sub-surface water from an area. As long as the draining system is considered the function of the main drainage system is to collect, transport and dispose of the water through an outfall or outlet. There is a need for the development of cleaning the drainage wastes by using robots. Since drainage cleaning involves manual scavenging which leads to several health hazards to the person entering the manholes of the drainage.

Many deaths occur due to drowning, trench collapses, falls, and exposure to chlorine or Hydrogen- sulphide gas. Peoples are also affected by cardiovascular degeneration, musculoskeletal disorders like osteoarthritic changes and intervertebral disc herniation, infections like hepatitis, leptospirosis and helicobacter, skin problems, respiratory system problems. Those who die during the duty are replaced by others, waiting to put their lives in danger just to earn a living for themselves and their families. The impurities present in drainage water can cause blockage in the drainage system. Hence, there is a need to replace manual work with high tech robots. Robots can be used safely at these dangerous conditions. The human safety is

guaranteed by these robots and enormous human workforce are replaced.

2. BLOCK DIAGRAM

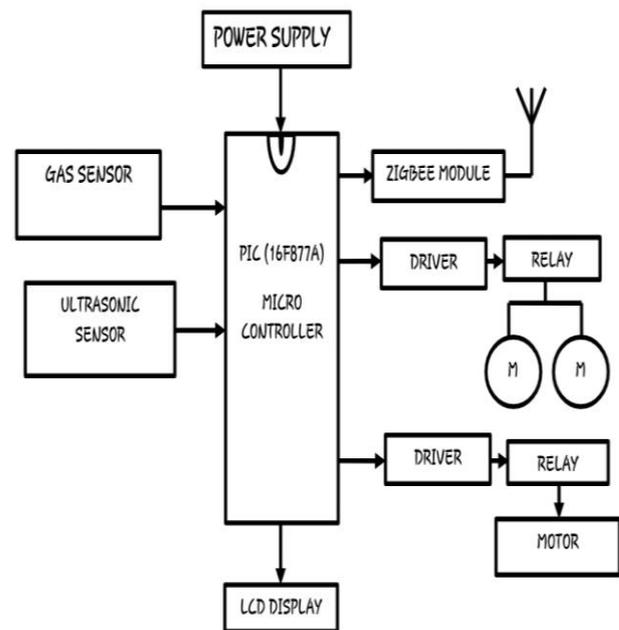


Fig. 1: Block diagram of unit I

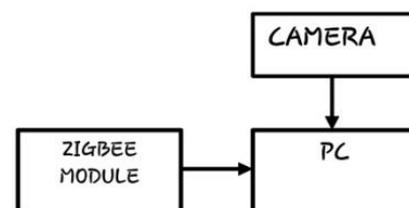


Fig. 2: Block diagram of unit II

Our proposed system attempts to detect and completely eliminate the blockages using a sewer robot. The block diagram comprises a PIC microcontroller. This controller is interfaced with the wheel motors, camera, ultrasonic sensor, gas sensor, a driver circuit, and Zigbee modules.

3. OPERATION

PIC microcontroller PIC16F877A is used to control the operation of mechanical parts. PIC microcontroller can perform different tasks and it can be controlled by software.

All the activities of the robot are controlled by this centralized microcontroller attached to this robot. The driver circuit is enabled by the Microcontroller when the Robot is turned the driver circuit enables the motion of robot inside the pipeline by turning on the motors.

This project is designed to keep clean the drainage system and helps for the smooth working of the system. It is an easy way of cleaning the drainage system and preventing blockage.

In our system following functions are performed:

- Activities are controlled by PIC microcontroller
- Enabling the motion of robot using a driver circuit.
- The camera transmits information to the controller.
- An ultrasonic sensor detects the blockages inside the drain.
- “Turn on rotating mechanism” to clear blocks.
- The gas sensor is used to detect the presence of poisonous gases
- The Motor can be operated on a battery.

Once a block is identified and its distance is measured using the ultrasonic sensor, the next step is to clear the block using a rotating mechanism which comprises of fan-like structured sharp blades. It has been developed with the aim of removing stubborn dirt under tough working conditions. Water gets things so clean because its molecules have a slight electrical polarity (one end is positively charged and the other is negatively charged). Detergents (soap chemicals) help water to do its job even better by breaking down gunges and grease and making it easier for water to flush away. If the block is cleared using the blades, it is indicated to the robot by using the ultrasonic sensor distance measurement and the robot proceeds to clear the next blockage along the length of the pipe

4. ULTRASONIC SENSOR

The ultrasonic sensor is used to detect an object. It is generally used to measure the distance of an object using sound waves.



Fig. 3: Ultrasonic sensor

The robot moves through the pipe by balancing on its wheels. Ultrasonic sensor HCSR04 is assembled in the robot.

5. GAS SENSOR

It is a type of chemical sensor which detects and measures the concentration of gas in its vicinity. They are used in various industries ranging from medicine to aerospace.



Fig. 4: Gas sensor

The gas sensor is turned on only in a rare case if both the pumping mechanism and rotating mechanism are unable to remove the block. In such a case, the output of the gas sensor is used to determine whether poisonous gases such as chlorine or carbon monoxide are present inside the pipeline. This provides precautionary measures for the sewage workers before getting into the drain.

6. ZIGBEE MODULE

This technology formed on IEEE 802.15.4 which describes the operation of low rate Wireless Personal Area Networks.



Fig. 4: ZigBee module

This system provides continuous visual monitoring through the small camera attached to the mobile robot, continuously sending data to the control unit when necessary.

7. CAMERA

The wireless camera continuously transmits the information to the controller which shows it in the user's display device.

8. DC MOTOR

DC motors transform electrical energy into mechanical energy. The basic principle of DC motors is the same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin.

9. MECHANISM FOR BLOCKAGE CLEARANCE

Once a block is identified and its distance is measured using the ultrasonic sensor, the next step is to clear the block using a pumping mechanism which comprises of a high-pressure washer. High-pressure washers remove stubborn dirt under tough working conditions.

Efficient flow rates are achieved using a high flow rate and high pressure. Water gets things so clean because its molecules have a slight electrical polarity (one end is positively charged and the other is negatively charged).

Detergents (soap chemicals) help water to do its job even better by breaking down gunges and grease and making it easier for water to flush away. But some kinds of ground-on dirt just won't budge, no matter how hard we try. That's when a pressure washer is used. It uses a narrow, high-pressure jet of hot or cold water to blast dirt free. Because the water is travelling fast, it hits the dirty surface with high kinetic energy, knocking dirt and dust away like a constant rain of tiny hammer blows. It's only water, though, so it doesn't damage most hard surfaces.

If the block is cleared using the high-pressure pump, it is indicated to the robot by using the ultrasonic sensor distance measurement and the robot proceeds to clear the next blockage along the length of the pipe.

Microcontroller does the following function.

When the operator turns on the robot, the microcontroller enables the driver circuit. The movements of the robot can be controlled by the preprogrammed instructions. The motion of the robot inside the pipeline is enabled by the driver circuit. The wireless camera continuously transmits the information to the controller which shows it in the user's display device.

The output values of the ultrasonic sensor are sent to the controller periodically. The abrupt deviation in these values are sensed by the controller and the presence of a blockage is confirmed. The driver circuit is interrupted by the controller and the pumping mechanism is turned ON. The pumping mechanism is operated till the output values of the ultrasonic sensor return to normal.

The control is now returned back by the controller to the driver circuit and the robot is moved in the forward direction.

Stubborn blockages such as wood pieces, thick sheets etc which cannot be removed by pumping mechanism are removed by a rotating mechanism.

It consists of a rotating fan-like structure with very sharp blades. This is capable of cutting the wood pieces, covers, boxes etc. The hard pieces are cut by the robot with the help of these blades. Later, the pumping mechanism can be used to clear the remains of the block.

The display device is interfaced with the controller and continuous monitoring can be done by the user.

The gas sensor is turned on only in a rare case if both the pumping mechanism and rotating mechanism are unable to remove the block.

In such a case, the output of the gas sensor is used to determine whether poisonous gases such as chlorine or carbon monoxide are present inside the pipeline. This provides precautionary measures for the sewage workers before getting into the drain.

10. DISADVANTAGES

This robot is not fully automated. It needs humans to control the operation.

11. CONCLUSIONS

In this paper, the proposed robot is designed with the motive of helping the sewage cleaners to prevent them from getting affected by serious diseases because of entering the drainage. The death rate of sewage cleaners is alarming. It is high time that this robot should be implemented to clean the sewage pipes all over the world. Moreover, this robot will help to find the poisonous gases inside the drain which will help the authorities to curb the dumping of untreated raw waste from the industries into the drains. This will not lead to unemployment of sewage workers but will just make the job easier and healthier for them. When this robot would be implemented in real time, it will save thousands of poor people's lives who come forward to clean the drainage just to earn a few bucks a day. In this modern society, a human cleaning the sewage waste shows that very less

attention has been given to those people's lives due to their poverty. Hence, this robot helps to have clean and hygienic drain systems everywhere.

12. PHOTOGRAPHY



Fig. 5: Final Outcome

13. REFERENCES

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