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CLEAN 'N' SHINE PIPE-ROBO

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ABSTRACT

Manual scavenging is the act that has been made illegal in 2013 but are still on the hike leading to the death of many. Private contractors are even now hiring to employ manual scavengers. To provide a solution to this situation, our robotic system could be used as an alternative to manpower. Pipe - Bot being an automated sewer robot can perform inspection of the sewage pipeline and clear any blockage. The robot inspects sewer lines for cracks, corrosion obstacles, etc. A camera has been installed atop, performs visual inspection of the interior of the pipeline. These visuals are recorded for future reference and research. The robot has proximity sensors to detect the presence of obstacles in front of it. As the robot nears the obstacle, there is a turbine that cuts through the obstacle with a suction mechanism to effectively clear the obstacles. The system has size adjustment mechanism to fit into pipes of varying diameters. This device, thus, effectively and efficiently reduces all the impediments related to pipe cleaning and inspection.

KEYWORDS: manual scavenging; electronic cleaning; in-line inspection

I. INTRODUCTION :

The sewage is a harsh environment needing regular inspection and clearance due to obstacles like plants with long roots, corrosion materials in pipes, etc. The damages cause the groundwater to get contaminated form time to time and heavy rainfall events leads to inroad of the systems causing overflow. Sewage leaking out can pollute the soil and ground water washing away the soil, and thus crowding the pavements.

Sewage contains non biodegradable chemicals that can lead to the emission of harmful fumes proving to be toxic to humans and animals. Earlier internal inspection and maintenance was possible only in cases where pipe diameters are large enough to accommodate workers to clean them. Small sewers offer no space for human beings, and whenever they are damaged the only possible solution is to expose the affected pipe sections.

The currently existing historical techniques like Bucket machine, Rodding etc, use tons and gallons of water to clear off the sewage wastes. But the main disadvantage of these techniques is that they are not very effective in removing heavy debris. Since large amounts of water are used, the water can get collected and remains stagnant. This stagnant water can cause pollution as well as spread of epidemic among the people. Many sewer cleaners risk their lives yearly in the Indian business hub of Mumbai because of a lack of basic safety gear.

According to the census taken in 2011, almost 1.3 lakh households are meeting their livelihood only because they employ themselves as manual scavengers. The list is topped by Maharashtra followed by Madhya Pradesh and Tripura. The workers who hail mainly from low castes and backward classes, die before the age of 60 because of work-related health problems. Many workers working in such unemployable conditions die each month due to accidents, suffocation or exposure to toxic gases. Workers use metal scrapers, brooms or just their bare hands to clear drainage and sanitation lines.

They are often engulfed and surrounded by swarms of cockroaches with no protection mask to protect them poisonous fumes. Sometimes, they are supposed to go much deeper underground with just a rope to prevent them from getting drowned in the sludge thus proving the job to be dangerous and risky as well. Nowadays, sewer robots with electronic automations reduce the cost of inspection and maintenance.

II. PROPOSED METHODOLOGY :

TRAVERSING MECHANISM

The traversing mechanism is selected to ensure good motion, traction and stability. The mechanism is carefully chosen to enable the robot to make its motion possible on any kind of terrain, may it be rough, rugged, smooth terrains etc. The robot moves with wheels attached on each side of its triangular shaped body, therefore moves with 6 wheels in total.

The robot moves by pressing its wheels against the walls of pipe to be cleaned. The wheels are connected to each other through motors and pulleys to the body in such a way that this itself works as a size adjustment mechanism for the system using which the robot could easily move through pipes with both small and large diameters.

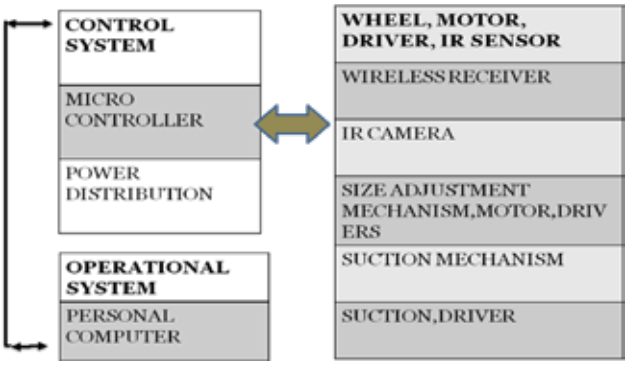


Fig 1 : Block diagram

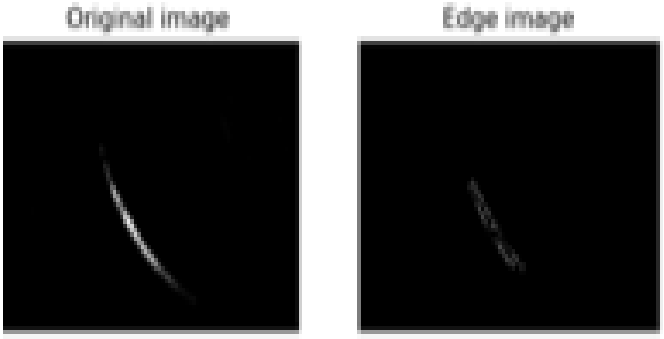
INSPECTION MECHANISM

The inspection mechanism is selected to provide in-line inspection of the inner walls of the pipes and sewers.

To perform this function, the system uses cameras and IR sensors. IR cameras are very useful in this project since the pipe-bot is made to work at fully

enclosed or underground sewage pipes filled with darkness and IR cameras can be used to provide the best visuals in the absence of light. IR cameras thus help in inspection of interior of the pipes for any cracks also.

Fig 2 : Crack and edge detection (output of python code)



CLEANING MECHANISM

The robot consists of a suction mechanism that rotates via a motor and cleans the pipe along its diameter while it is in motion through the pipe. It has a turbine blade connected at the front end to enable it to cut through the obstacles, once the camera or sensors detect the presence of any obstacle, turbine starts working.

Thus it helps in smooth movement of the robot inside the pipe and effective cleaning also. Once the camera or sensors detect the presence of any obstacle turbine starts working. Debris or dirt which is difficult to suck using the suction mechanism could be swept or pushed to the end also.

But mostly the suction mechanism shouldn't be facing much difficulty since cutting using turbine blades is useful prior to suction.

III. WORKING :

All the above discussed sections work synchronously to enable the efficient working of the entire system.

The robot moves with 6 wheels in total, with 3 wheels in front and 3 wheels at the back, touching the ground to provide increased traction and stability.

Pipe inspection is carried out using a camera that is enforced to obtain visuals of the interior of the pipe which is under inspection. A propeller can be used to perform obstacle clearance.

The pipe bot in general, has a triangular shaped body as shown in figure 3 with wheels attached for movement on its three sides. All the driving components of the system are placed in a platform inside this triangular structure. And the suction cup is also connected with a rotating motor in this for fine cleaning the inside of pipe.

The tube from suction cup, which will be carrying the dirt, is directed outside of the manhole. It will have enough length to carry dirt from one manhole to another without any breakage. There are turbine blades in the front end in order to cut through obstacles & there will be a heavy sweeping mechanism to push this dirt to the end of manhole.

Camera placed at the top of the robot obtains images inside the pipe. There are proximity sensors also, placed at the front end, to detect the obstacles which might have been missed by the camera. And there will be a wireless receiver (HC12) connected to the laptop, which will be receiving the information from pipe bot. Power for the system is given via wired connection.

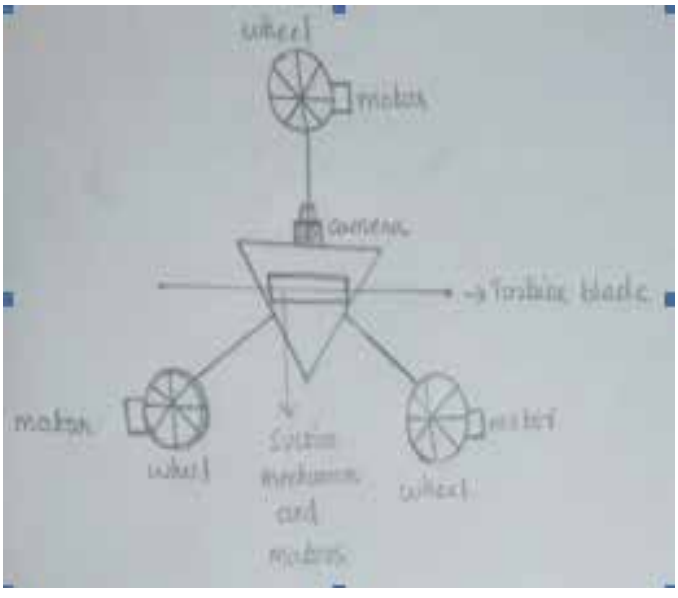


Fig 3 : Front view of mechanical structure

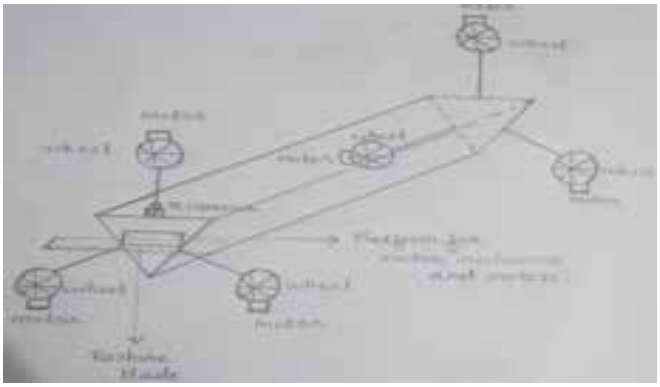


Fig 4 : Side view of mechanical structure

IV. SOCIAL RELEVANCE :

Manual scavenging refers to manually cleaning, carrying, disposing or handling any form of human excreta and other wastes from dry latrines and sewers using tools such as buckets and brooms with India's lower castes performing this job. They force themselves into choked sewers and septic tanks, hang on for hours, scooping out filth with bare hands and bearing the stench of sewage.

Despite pertaining laws, manual scavenging persists in India. While it has ended as a form of employment, the stigma and discrimination associated with it lingers on. The system is designed to overcome all the disadvantages associated with manual scavenging.

The system helps to reduce the time and cost needed to clean the pipes and sewers manually. It helps to prevent the spread of epidemic and thus protect mankind and causes no harm to human health. As the system uses very less amount of water, the ill effects associated with water pollution can be effectively reduced. This paves ways to make the environment a sustainable one thus making it safe and easy to implement. The system proves to be the most productive methodology to overcome all the problems existing at present.

V. CONCLUSION :

The project proposes an innovative, fully autonomous and un-tethered sewer inspection and clearance robot which fits into pipes having an varying diameter having live streaming of the interior of the pipeline. Since the visual obtained can be recorded in the software, the data can be utilized for study of sewer pipelines.

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