CLOACINA

Practical Issue:

A sewer drain clog is a very serious problem that can be considered a plumbing emergency and a potential health concern. The wastewater overflows and leads to water clogging on the arterial roads.The foul smell from the drainage water and exposure to the disease causing germs from the wastewater pose a major threat to the health and hygiene sector. This problem is further aggravated at the times of monsoon.One of the main causes of urban floods is poorly maintained sewers.

This is a very common problem faced by the Indian cities. We find the cases of water clogging in most of the overpopulated and slum areas. The solution currently in practice for removing the blocks in the drainage pipes is manual removal of the sludge. The waste management workers, termed as “Manhole Scavengers”, without any protective measures, risk their lives everyday trying to unclog drains and sewers. As per the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013, manually cleaning, carrying, disposing of, or otherwise handling in any manner, human excreta from the insanitary latrines is prohibited and illegal. Yet, a large number of people practice manual scavenging.

The newspaper articles of deaths caused due to manhole scavenging can be found often in some or the other parts of the country. Some statistics to throw a light on the life threat posed by manual scavenging:

- At least one Indian worker has died while cleaning sewers or septic tanks every 5 days since the beginning of 2017 according to numbers collated by the National Commission for Safai Karamcharis (NCSK), the statutory body that was set up by an Act of Parliament for the welfare of sanitation workers.
- The Ministry of Social Justice and Empowerment itself told the Lok Sabha in 2017 that the country saw 300 manual scavengers die that year. Of these, 12 deaths occurred in Delhi and 140 in Tamil Nadu, which was the highest.
- In January 2018 alone, seven such workers died in Mumbai and Bengaluru.
- Kerala witnessed a tragedy in 2015 when an autorickshaw driver, along with the two municipal workers he was trying to save, choked to death inside a drain in Kozhikode town.

The need for an alternative to manhole scavengers to unclog drains is something that requires immediate action. Fellow humans die in magnitudes comparable to that of a major calamity. This is what drove us to develop a bot that enters manhole and unclogs them in place of the manhole scavengers.

The Sewer Unclogging Bot: **Cloacina**

The proposed robot, Cloacina, lifts heavy manhole covers, goes into the manhole, unclogs the sewer and collects the waste which can then be disposed of, after the bot comes out of the manhole.

- To increase the durability of the bot, we have used a “minimal electronics” design so as to make it resist the hostile conditions inside the sewers. The only electrical part used is a planetary gear motor. The feedback system takes care of the complex analysis required.

- The robot is designed to be compatible with various sizes as well as depths of the manhole. It stabilizes itself by taking support from side walls of the manhole.

- There are two major parts that make up the bot - ‘screw’ and ‘casing’. The screw is a vertical ‘auger’ and the casing is a hollow cylinder surrounding the screw. A planetary gear mechanism is used to rotate the screw and casing in opposite directions to lift up the dense, heterogenic sludge which is then collected.

- Depending on the density of sludge in a particular manhole, speed to torque ratio is maintained. The blades at the bottom of the casing cut the harder sludge into finer pieces which can be lifted up and collected.

- The bot is compact and portable. Major parts of the bot which will be in direct contact with sludge are made of plastic and synthetics to make it resistant to corrosion and also reduce its weight.
- After its use, the bot can “clean itself” by rotating the screw in opposite direction thereby, getting rid of most of the sludge on it. The remaining can be hosed off with water.

Impact:

We started the ideation and design of Cloacina to do our part supporting the ‘Swachh Bharat’ campaign.This bot is sustainable,considering the fact that it affects the environment in no negative ways and has a huge positive impact on many sectors of the society, taking a huge step towards the progress of our country by addressing the issues of cleanliness, health care , social awareness regarding this issue, sustainable development, cost efficient methods. Technologically, it is designed to use a single motor which makes it simple as well as cheap. This ensures that we do not pollute the environment. It was always kept in mind that “Development does not just address the problems of today’s society but also takes the

responsibility of protecting the nature for the future generations. It can also be scaled to meet the sewage cleaning requirements across the country. The greatest advantage is that it can also be deployed for periodic maintenance purposes rather than just when there is a problem.

The system, being almost completely autonomous, will reduce the time taken to clean when compared to manual inspection. The projected time for cleaning a clogged manhole is about 15 minutes (including the time taken to open the manhole, insert the robot and start operation) as compared to human laborers taking well over an hour to do the same job. So, the robot's efficiency compared to a human's is 4:1 in speed. Even cost wise, Cloacina is much cheaper using mini cranes. A 3500 mAh 12V battery is sufficient to run it for about an hour which makes it ridiculously inexpensive to use, giving a 1:10 ratio compared to manual labor cost. This system can be considered as a step toward modernization in general in India.

Feasibility and Practicability:

The robot is easy to manufacture and use. The fact that it doesn't require much human talent can be exploited for the re-employment of the manhole scavengers in operating this. The uniqueness in this bot lies in the fact that many practical issues that maybe encountered are already kept in mind while designing it. The material and machine parts used are quite affordable and easily available. The positive results on testing the prototype explain the practicability of it.
Three contractors were asked their opinion on Cloacina and they were unanimous in their support.

Future goals:

Through large scale manufacturing and employment of the bot and supply to municipal corporations, we aim to:

- Eradicate the practice of manhole scavenging.
- Make Cloacina reach each and every manhole in the country
- Solve the problem of sewage on-ground water clogging due to blockage

For the technicalities of the Bot, we plan on improvising the bot in the following aspects:

1) Feedback system:

Gives feedback to motor on how it should function (speed, torque, the direction of operation) depending on sludge properties like density, plastic content.

2) Extra Module:

A module attached to the bot which helps in unclogging the pipes of the manhole which bring in the waste.

3)Detection of harmful Gas:

Identifies if the gas is harmful to humans and indicates accordingly, thereby preventing any possibility of loss of life that might occur due to proximity to the manhole.

Conclusion:

Since independence, India has been emerging rapidly in all sectors and adapting new technologies. Yet, in western world India is always represented as one of the most dirtiest, unhygienic, unclean, underprovided, with lack of infrastructure and sanitation. The potentially deadly hard work of humans going into the manholes to unclog them can be easily replaced by the smartwork of making the robots do the job for us. Cloacina is an efficient, cost effective, sustainable solution to the overlooked problem of manhole scavenging, which is easy to use and minimalistic in design.

References and further reading:

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