

MANUALLY CONTROLLED MANHOLE CLEANING ROBOTIC SYSTEM

Gopal Joshi, Animesh Rana, Venkateshwar.R,
SCHOOL OF ENGINEERING,

VELS UNIVERSITY, CHENNAI, INDIA.

Abstract- Aimed at tackling the disadvantages of conventional manhole a new manually controlled manhole cleaning robot system is proposed for performing cleaning work instead of human cleaning manholes that is characteristic of low safety, low efficiency, long time and environmental pollution problems. The robotic system consists of manually controlled suction pump, hydraulic pump station, probe controller, LCD screen for monitoring; windlass, biodegradable bags, disinfectant sprayer. The modular structures have been adopted in the robotic system, which makes it possible to assemble all subsystems in a single unit. This robotic system can reduce the complex mechanism for cleaning the manholes and even provide environmental friendly way of disposing the sludge.

Keywords: Manually controlled, Eco-friendly, Easy disposal, Safer, Easy use.

I. INTRODUCTION

The basic need of this robotic system is to clean the sludge from manholes. In most of the countries these manholes are being cleaned by humans who put themselves into greater degree of risks. The need of a robotic system which replaces human from cleaning job is quite high in many in most of the countries. This manually controlled robotic system will not only reduce the degree of risk for the people who are associated with this cleaning work but will also provide an eco-friendly way of managing and decomposing these biodegradable wastes. This will minimize the human interference in cleaning work and will make it more safer and easier way of cleaning manholes. It is similar to the systems that are used in cleaning oil tank [1]. The cleaning mechanism used here differs from the conventional oil tank cleaners. The technology proposed here is eco-friendly way of treating the sludge from the manholes which makes this robotic system more reliable and practically feasible.



Fig.1: The above figure shows the basic way cleaning manholes i.e. man entering the manhole risking his life and subjecting him to many bacteria and viruses present in these sludge.

II. SYSTEM REQUIREMENT

In this section, we will review the requirement of manhole cleaning robotic system. Major problem associated with cleaning this manhole is the size of this manhole. The radius of these manholes is extremely small which makes it very difficult for human to go in and clean thus causing injuries. The other problem is people cleaning this manhole come in direct contact with the harmful viruses present in the sludge. All these leads to the requirement of the manually controlled robotic system that helps in solving these mentioned problem and many other problems associated with it.

This manually controlled robotic system works on basic principle suction technique using suction pumps [2], this suction pump induces high pressure inside the manholes breaking the larger particles that are sucked using this induced pressure mechanism. The entire component used in this manually controlled robotic system works on advanced lithium-ion solid polymer electrolyte batteries [3], these high power batteries can be used for portable electronics applications [3]. It consists of touch screen LCD display device which performs dual function of controlling each and every component involved in the working of this system and for keeping track on all the function undergoing in the system. When the power supply is applied to the system, the system gets switched ON and all the controlling features appears on the LCD display. With the help of these controlling features manhole cleaning process is initiated.

There is another problem associated with this manhole cleaning process is proper and eco-friendly method of decomposing this sludge. This sludge from manholes are either dumped in rivers polluting the water body or burning these sludge in open ground causing air pollution and other environmental problem. In order to overcome

this problem this robotic system is provided mechanism in which bio-degradable bags are used to fill all the sludge and later these bio-degradable bags are disposed [4] using various disposing methods. These biodegradable-bags are kept in the form rolls, when the controller starts suction process all the sludge from the manhole is sucked and starts filling in these bio-degradable bags. The sludge filled bags are then sealed. As soon as one bag is filled and led out the probe present in the robot pulls out another bag. When cleaning process is completed all sludge filled bags are disposed accordingly.

III. SYSTEM OVERVIEW

A. Power Source

The power source which can be used is advanced lithium-ion solid polymer electrolyte batteries [3][6]. These new batteries will utilize new high-energy density anode and cathode active materials developed by SNL and RTI. UBI will incorporate these new materials into an optimized Li-Ion SPE electrode laminate [3].

B. Suction pump

The pressure of the suction pump can be manually adjusted according to the requirement. This suction pump works on the mechanism of producing air pressures and absorbing the target [2][6].

C. Bio-degradable Bags and decomposition

The purpose of using bio-degradable bag is to reduce pollution, ease the disposal work, prevention of unwanted manual labor. The main material starch and plant fiber for produce the dishware is analyzed in these bags. Biodegradable material is a kind of Green material, which is easily reclaimed and reused, it does not pollute the environment, and it can decompose quickly, there is not insurant to produce after trash [4][6].



Fig.2: Bio-degradable bag roll.

D. LCD Controller And Display

The LCD display unit and controller is fixed on the handle bar of the robotic system. This touch screen LCD device has pre-installed application which is used to control all the functional unit of this robotic system.

IV. ENVIRONMENT BENEFITS OF BIO-DEGRADABLE BAGS

Biodegradable bags from natural materials, such as vegetable crop derivatives or animal products, sequester CO₂ during the phase when they're growing, only to release CO₂ when they're decomposing, so there is no net gain in carbon dioxide emissions. Under proper conditions biodegradable plastics can degrade where microorganisms can metabolize them.

V. MANUALLY CONTROLLED MANHOLE CLEANING ROBOTIC SYSTEM

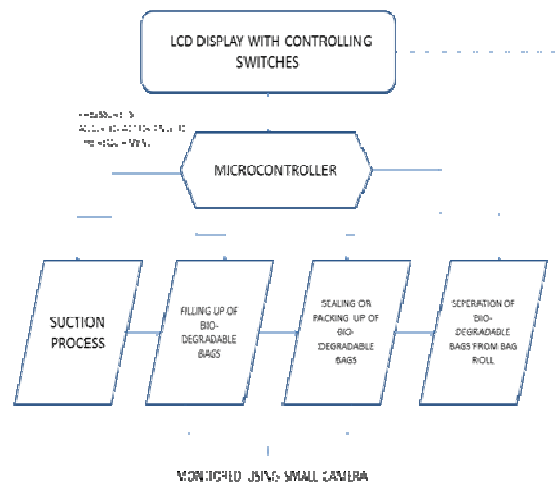


Fig.3 Schematic diagram of working process

VI. WORKING

The working process of this manually controlled robotics system is done by operator. All the components are controlled by application that can be accessed using touch screen LCD device which is connected to each component. Small camera is fixed inside the circuitry through which entire process can be seen on LCD display. This will help the operator to keep the check on all the process taking place inside the system.

Following process takes place in this system:

A. Suction process

When the operator applies the power sources, the suction pump with adjustable pressure gets switched ON and the suction pipe is inserted into the manhole [6]. This inserted suction pipe creates pressure inside the manhole to be cleaned. The smaller sludge particles are easily sucked but it is really difficult to suck relatively larger sludge particle. As this suction pump is provided with adjustable pressure range mechanism, high pressure is induced inside the manhole. Due to this high pressure the larger sludge particles blocking the manholes are disintegrated into smaller particles. These disintegrated particles are then easily sucked by this mounted

pressure. The operator continues this process until all the sludge from the manhole is sucked.

B. Filling process

The operator then starts the filling process, using two probes bag is pulled from the provide roll of bio-degradable bags. The sludge that is sucked using suction pump is then filled into these bio-degradable bags. These bio-debags are used because it is easy to decompose and environment friendly method of disposal of the sludge. The usage of these bio-degradable bags prevents the disposal of sludge [6] into water bodies or burning them in open ground effecting environment.

C. Sealing process

After the sludge is being filled in the bio-degradable bags, the operator switches on the sealing process. In this process, when the bag is completely filled with the sludge it[6] is sealed and lead out.

D. Disinfecting process

The robotic system is provided with another section known as disinfecting section. In this section when cleaning process is performed completely some amount of disinfecting chemical is sprayed into the manhole. This sprayed chemical disinfects the manhole.

VIII. PROCESS OVERVIEW

In this section the diagrammatical working mechanism of the manhole cleaning process is shown.

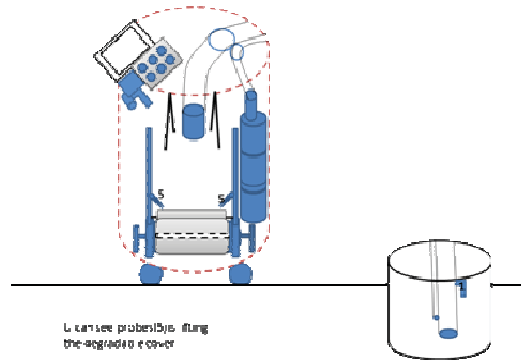


Fig.5.1 Basic Model

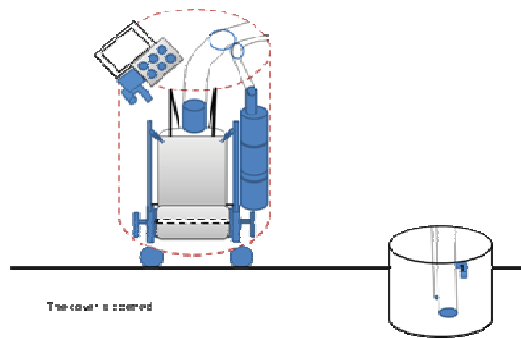


Fig.5.2 Opening of biodegradable bags using probes

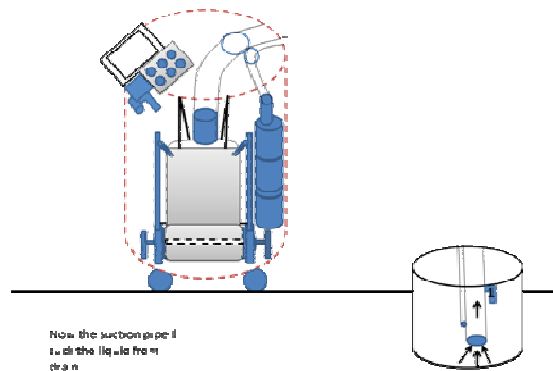


Fig.5.3 Sludge suction operation

VIII. PROPOSED MANUALLY CONTROLLED ROBOTIC SYSTEM

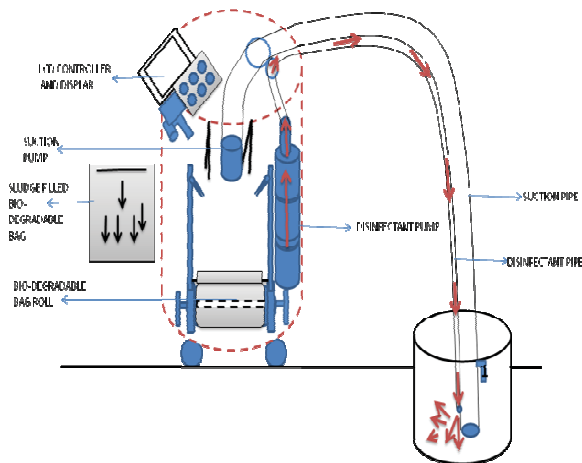


Fig.4 Proposed manually controlled robotic system.

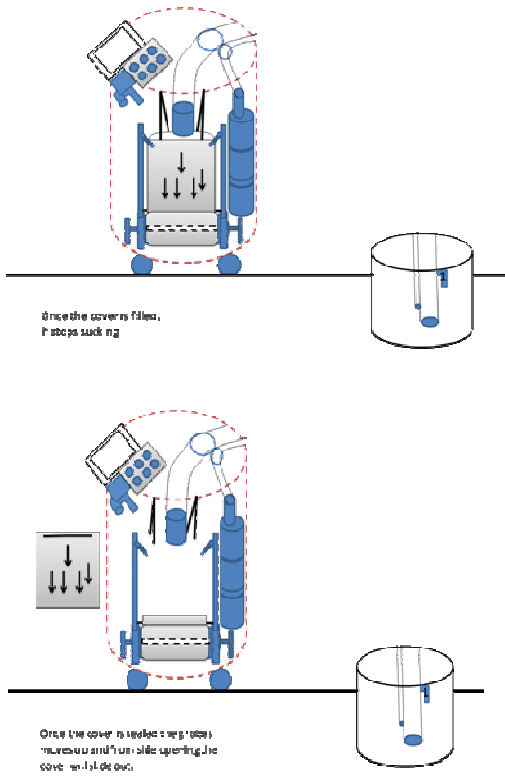


Fig.5.4 Removal of bag for decomposition

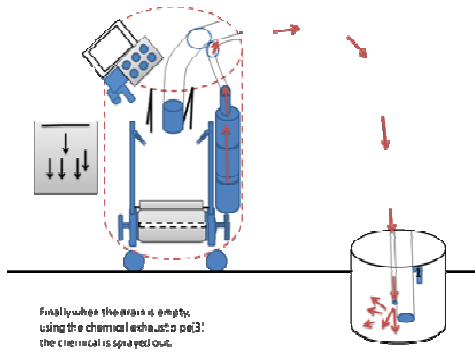


Fig.5.5. Disinfecting process

VIII. ARCHITECTURE OF MANHOLE CLEANING PROCESS

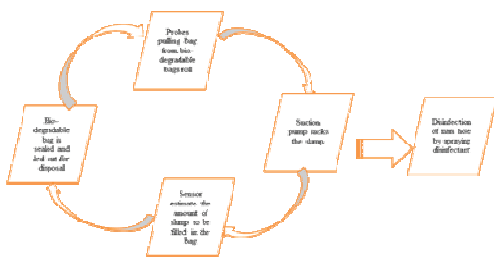


Fig.6 Architecture of manhole cleaning process

IX. CONCLUSION

In this paper we discuss about the use of robotic system to clean manhole. The use of this system will not only make this work simple but it will eco-friendly and safer for the people associated in this cleaning process. Future technologies can make it even more simple and easy to use.

X. FUTURE WORKS

In this paper we have proposed the idea of manually controlled robotic system. We are preparing the prototype of this manually controlled robotic system. Automated version of this robotic system will be done our future work.

REFERENCES

[1] Deng Sanpeng; Xu Xiaoli; LiChongning; Zhang Xinghui; *Research on the oil tank sludge cleaning robot system, Mechanic Automation and Control Engineering (MACE), 2010 International Conference on 26-28 June 2010* ISBN: 978-1-4244-7737-1, Wuhan

[2] Hablanian, M. H.; *Performance characteristics of displacement-type vacuum pumps, Massachusetts 02173, Journal of Vacuum Science & Technology A: Vacuum, surfaces, and Films, May 1986.*

[3] Teofilo, V.L.; Isaacson, M.J.; Higgins, R.L.; Cuellar, E.A.; *Advanced lithium ion solid polymer electrolyte battery development, Aerospace and Electronic Systems Magazine, IEEE, Nov 1999 Volume: 14 Issue: 11, ISSN: 0885-8985, 06 August 2002*

[4] Xiujie Jia, Jianfeng Li, Fangyi Li, Baokun Wei, "Analysis of different biodegradable materials and its technique to produce dishware," *isee, pp.1-5, 2008 IEEE International Symposium on Electronics and the Environment, 2008*

[5] *IEEE Transactions on Computers, : 0018-9340, IEEE Computer Society, Publication Details: IEEE Transactions on Computers*

[6] Rana, A.; Venkateshwar; Joshi, G.S. *Emerging Trends in Robotics and Communication Technologies (INTERACT), 2010, Manhole cleaning robotic system (MCRS), International conference on 3-5 Dec. 2010, ISBN: 978-1-4244-9004-2 INSPEC Accession Number: 11822608 ,Chennai*