

AUTOMATIC DRAINAGE CLEANING SYSTEM WITH THE USE OF SOLAR ENERGY

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Abstract – Water is the basic need for the existence of life on earth. In spite of 70% water on earth majority of water is not suitable for drinking purpose. There is a huge demand of clean water as it is used for a variety of purpose such as drinking, bathing, cleaning, cooking etc.. The chief function of the automatic drainage system is to collect as well dispose the solid waste to the waste bucket with the help of forks. Solid waste in drainage water includes empty bottles, polythene bags, papers etc. Impurities in drainage water can lead to blockage of the drainage system. In order to avoid such situation these impurities are needed to be taken out time to time for the continuous flow of drainage water. Drain can be cleaned continuously by the help of model using the drive system to remove the solid waste and threw it into waste bucket. This project is designed with the objective to initiate the efficient working of system. This project automatically cleans the water in the drainage system each time any impurity appears, and forks which are driven by chain sprocket grasp the solid waste and threw it into the waste bucket to avoid blockage. It even reduces the cost of manual labor as well as reduces the threat to human life.

Key Words: Drainage system, Clean water, Sewage,

1. INTRODUCTION

The proper disposal of common wastes is still a challenge faced nowadays, even though automation plays a vital role in the industrial and commercial applications. Usually what we see in a country like India is that common wastes like plastic bottles, covers, sanitary pads, etc and others are left in the streets and in the open drains. These waste particles obviously cause blockage of the drainage system during monsoon season when there is a flow of water through the roads and drainage systems. This blockage of drainage system can cause accumulation of waste water in these drains. Several water borne diseases such as cholera, worm disease, typhoid, malaria etc will occur due to the contamination of these stagnant water. This can cause many health issues and may even lead to deaths, other than the local common issues caused by the blockage of drainage. In India, there is no existing automated mechanism by which this blockage of drainage can be removed. Currently these blocked drains are cleared with the help of manual workers were the workers have to get into the drains and manually remove the wastes. In such

situations the rate of diseases spread among these workers are high and this affects their life's and reduces their immunity.

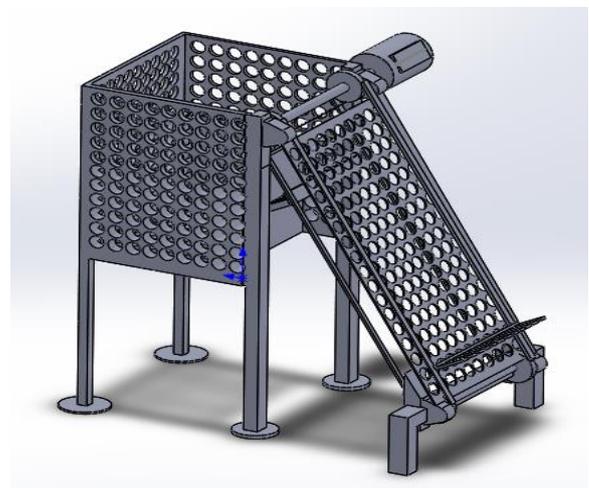
As a solution to theses social relevant problems and as a solution to the health issues caused thereby, we propose an automated mechanism, "Automatic Drainage Cleaning Mechanism with the aid of solar energy".

Our proposed system is used to clean and control the suspended waste in drains eliminating the human labour involved in doing so.

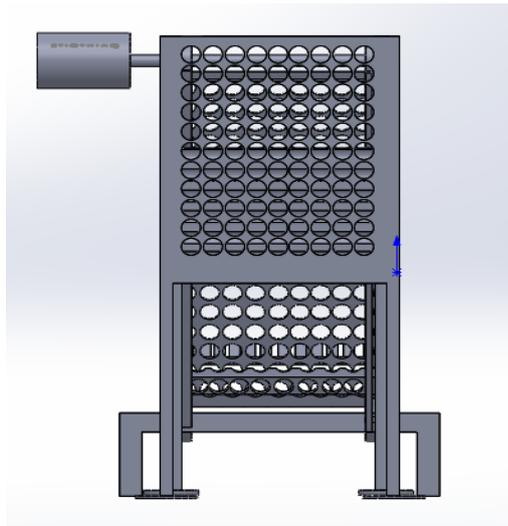
1.1 DESIGN, MATERIALS AND WORKING METHODOLOGY

A. DESIGN OF THE PROTOTYPE

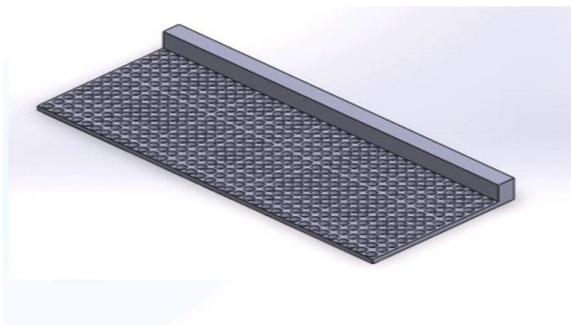
With the help of solid works software we were able to do a sketch of our prototype and finally developed a 3D model of the primary design considering all the aspects of the mechanism. The Fig.1.1.(a) & (b) shows the isometric view and the rear view of the developed design of the prototype. Further changes were made in the dimensions and designs during the time of fabrication, to make the equipment more stable and effective. The forks , which are connected to the conveyor mechanism were also designed according to the size and the property's of the floating waste materials in the drains.



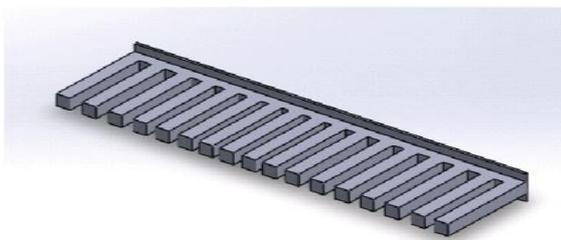
a)



b)



c)



d)

Fig.1.1. Prototype design developed in solidworks (a) isometric view (b) rear view (c) fork for acquiring finite particles (d) fork for acquiring larger floating body's

B. COMPONENTS DESCRIPTION

The major components involved in the design and the fabrication are.

1) SOLAR PANEL & BATTERY

India is a country with vast quantity's of non-conventional sources of energy, and to make use of these energy's is our responsibility. We have decided to make use of the solar energy to power up our prototype, so we adopted a solar panel. A 12V 100W solar panel is used to charge a 40Ah

battery. This will give us sufficient charge to run the motor for the required time and at the required load conditions.

2) DC MOTOR

A 12V DC wiper motor is adopted to meet the required torque and the varying loads. The motor is attached to a driving shaft, which gives motion to a conveyor system.

3) ARDUINO

During the literature survey it was found that suspended waste particles do not flow continuously through the drains, so the continuous operation of the motor is found to be ineffective. To make the system more effective and to conserve the charge of the battery we adopt a microcontroller, such as an arduino board to regulate the rotation of the motor. With the help of the arduino board we can regulate the rotation speed and the interval time between two adjacent rotation of the motor. The charge of the battery will be conserved during the stagnant condition of the motor and the life of the motor will increased accordingly.

4 CONVEYOR MECHANISM

The motor is coupled to a shaft, which will be the driving shaft. The driving shaft is connected to a driven shaft via 2 sets of chains and 4 sets of sprockets, which acts as a conveyor mechanism. The forks are then linked to each set of chain drives on the either side, thus we obtain a conveyor motion for the forks.

5. FORK

The forks acts as rake in collecting the floating and sub-floating particles in the drain and carry them to the collecting basket. If in case of any continuous flow of waste occurs, 3 sets of forks are attached to the conveyor chain drive to clean up the drainage water effectively. For picking up larger floating particles like plastic bags, algae's, sanitary pads, bottles, etc. we make use of a fork (Fig.1.1.(d) with large finger like teeth which is capable of lifting larger particles. For the collection and disposal of small particles such as paper or plastic bits, small leaves, silts, etc we use a fork with small holes (Fig.1.1.(c)) which are capable of collecting tiny floating bodies.

1.2 CALCULATIONS

$$\begin{aligned}
 \text{Motor power} &= 17 \text{ w} \\
 \text{Speed N} &= 30 \text{ rpm} \\
 \text{Outer diameter of shaft} &= 20\text{mm} \\
 \text{Inner diameter of shaft} &= 18\text{mm} \\
 \text{Power, P} &= \frac{2\pi NT}{60}
 \end{aligned}$$

$$\begin{aligned} \text{Torque, } T &= \frac{60 \times 17}{2\pi \times 30} \\ &= 5.41 \text{ Nm} \end{aligned}$$

To calculate Maximum load, m

$$\begin{aligned} T &= F \times r \\ 5.45 &= F \times .065 \end{aligned}$$

$$F = 83.84 \text{ N}$$

We Know,

$$\begin{aligned} F &= m \times g \\ 83.64 &= m \times 9.81 \\ m &= 8.54 \text{ Kg} \end{aligned}$$

$$\begin{aligned} \text{The time motor can continuously run} &= \frac{40 \text{ Ah}}{1.41667} \\ &= 28.235 \text{ hours} \end{aligned}$$

Time required to charge battery by solar panel at full intensity of sun (90°)

$$\begin{aligned} &= \frac{V \times 40 \text{ Ah}}{100} \\ &= 2 \text{ hours} \end{aligned}$$

2. DETAILED OPERATION OF THE MECHANISM

The drainage cleaning mechanism is used to take out any floating or sub-floating particles by simply immersing the equipment into the drainage system. Here the mechanism is placed into the drain in such a way that the conveyor portion is placed against the flow of the stream. The bottom of the conveyor is placed into the drain whereas the collecting tank legs sits on a slab just above the drain. This set-up is possible with the help of a hinge which is placed between the collecting tank and the conveyor. From our literature surveys, it was found that the drainage system's actually does not have any standard dimensions; that is the width and the depth of the drains are varied according to the parallel road networks, eg: the size of a drain in the urban areas will be much more larger than the drains in the rural areas. To meet these requirements we decided to make our prototype expandable and contractible. This is achieved by changing the width and the height of the mechanism with the help of a screw nut apparatus. The solar panel and the battery is mounted on a pole or a post which will be erected near to the mechanism.

Initially the mechanism is kept in the drainage system such that it faces against the flow of stream. As the waste particles floats toward the mechanism, it initially gets obstructed by the mesh provided on the conveyor setup. During this instant the revolving forks picks up the waste particle and dumps it into the collecting tank provided behind the mechanism. The fork is attached to the two sets of chain drives which is driven by a 12V DC motor. The motor is controlled by the arduino board such that it regulates the period of rotation of the motor. To attain maximum efficiency and to conserve the energy stored in the battery the arduino is programmed in such a way that the motor will have a 5 minutes rotation followed by a 15 minutes idle time. With the help of this controller circuit

board we can regulate the unnecessary working of the motor and hence increase the life of the motor. If any waste particles flow by during the idle time of the motor, the particles will get accumulated in front of the mesh and during the next working cycle the forks will pick up these waste particles and transfer them into the collecting tank. By placing any type of plastic bags inside the collecting tank, we can collect the accumulated waste particles by simply pulling the lower frame of the collecting tank.

The width and the depth of the drains will vary from one drain to the other, so to make the equipment more effective and usable in any drain we can adjust the width and depth of the equipment with the help of telescopic mechanism. The width is adjusted by simply loosening and tightening of screw nut, which are provided along the central axis of the conveyor mechanism.

Thus by combining a mechanical and a electrically integrated system we obtain a mechanism that is very much efficient and effective in cleaning the waste particles from the drainage system.

3. CONCLUSIONS

Water is a basic necessity of humans and all living beings. There is plenty of water on earth but all of it is not suitable for human use. The impurities present in water are proven hazardous and may even cause death.

Automation is a technology concerned with the application of mechanical, electronic and computer based systems to operate and control production. This technology is applied on our sewage cleaning system. Also we have followed thoroughly the study of time, motion and made our project economical and efficient with the available resources. The system is made more efficient by the use of solar energy and a micro controller. This system was designed, fabricated successfully and also tested. It works satisfactorily. Thus we obtain automatic drainage cleaning.

ACKNOWLEDGEMENT

First and foremost, we thankfully acknowledge our principal Dr. M.D. Mathew for giving us with an opportunity to carry out this project.

The constant encouragement and timely support rendered by our head of department, Dr. Jacob T Varghese is deeply remembered.

We express our heartfelt gratitude to our seminar guide, Er. Sreejith.R, assistant professor, department of mechanical engineering, for his valuable guidance, support and encouragement during the course of the project and in the preparation of the report. We have greatly benefited from his experience and knowledge.

The help extended by our project co-ordinator Er. Vineeth V K, Assistant Professor, Department of Mechanical Engineering, and all other staff members of the department are remembered with gratitude.

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