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Semi Automated Drainage Cleaning Machine

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Abstract: *Our Semi-automatic Drainage Cleaning Machine project is primarily focused on the replacement or elimination of manual scavenging. In today's scenario, automation is very vital in all businesses, yet no automation work is available in this field. While cleaning sewage pipes, sadly, human lives are lost and they are exposed to dangerous illnesses. Apart from that, clogged drainage systems might result in flooding and other issues. To address this issue, we are implementing a "Semi-Automated Drainage Cleaning Machine" to address the issues mentioned above.*

Keywords: Include at least 4 keywords or phrases

I. INTRODUCTION

Our project's major purpose is to create a sanitary environment by cleaning drains with minimal effort while taking adequate safety precautions. Water contamination can cause serious ailments. In drainage water, you'll find empty bottles, polythene bags, papers, and other contaminants. When there is garbage in the system, this project helps scour water throughout the system, which is an efficient and simple way of cleaning the system and preventing clogs. It also conserves human energy while improving the quality of the purified water. A gutter/drain cleaning mechanism in our system allows liquids to pass through while trapping and collecting large solid debris like bottles and plastic.

Figure 1: Manual Cleaning Of Drainage

II. LITERATURE REVIEW

The use of a mechanical drainage cleaner to eliminate the need for human drainage cleaning. The drain pipes are filthy. When a drainage system needs to be cleaned, it might be hazardous to human life. To address this issue, they implemented a mechanical semi-automated drainage water cleaner, which ensures that the water flow is efficient due to regular waste filtration. Drainage system machines help to eliminate a variety of environmental dangers.[1]

Reviewing drainage cleaning to replace manual work with an automated system because manual cleaning is hazardous to human life and wastes time, they created a design "Automated drainage water pump monitoring and control system utilising PLC and SCADA" to solve this problem. PLC and SCADA systems were created. In this project, the goal is to employ an effective method to control waste disposal on a regular basis, as well as to handle waste disposal in various ways for harmful and harmless gases. To achieve automated control of sewage waste water treatment, Siemens PLC controllers

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were employed in the treatment system of drainage wastewater control by the stepper motor, compressor, gas exhauster, pressure valve, and liquid level, flow, and other analogue variables.[4]

Explained how manual labour was replaced by an automated system Drainage pipelines are being used for disposal, and it is possible that human life will be lost while clearing the clog. They devised a "Automated Sewage Cleaning System" to solve the problem. They developed their project in such a way that the clearing of gaseous substances is dealt independently, allowing for effective water flow. This job could be completed with the full use of workers, machinery, materials, and funds. With the resources they had, they were able to make their project cost-effective and efficient. They used automation technologies to operate and control production, which included mechanical, electronic, and computer-based systems.[5]

III. METHODOLOGY

First and foremost, we must choose an uncomplicated mechanism capable of lifting the burden, which is why we have chosen the chain mechanism. Our main goal was for it to be able to lift at least 3kg of weight with ease. Then we must select a motor that operates at a low RPM and produces the highest amount of torque to assist in lifting the load. Then we did some calculations for motor selection, and after that, we had to determine on the shaft diameter to which the shaft would be attached. We compute the appropriate diameter of shaft that can resist maximum load using the ASME code for shaft design. There was a collection issue. We used a garbage collection container right behind the chain mechanism, which is supported by a hinge, so we didn't have to remove the machine from the drainage canal. Then we went through the design process, and after that, we built it and tested it on various loads to find the relationship between voltage, current, power, and load.

IV. CAD DESIGN IMAGES

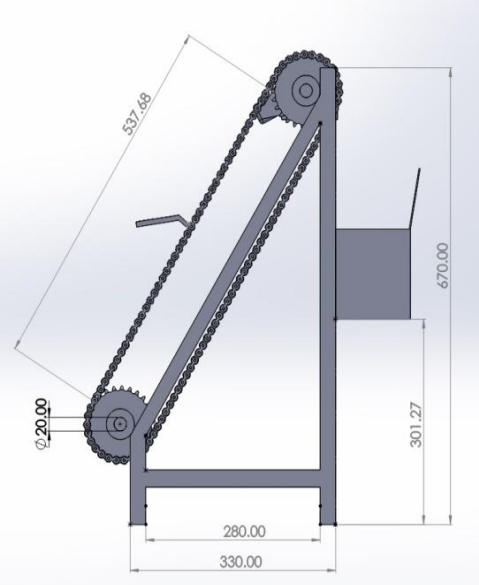

Fig 2 side view of CAD model

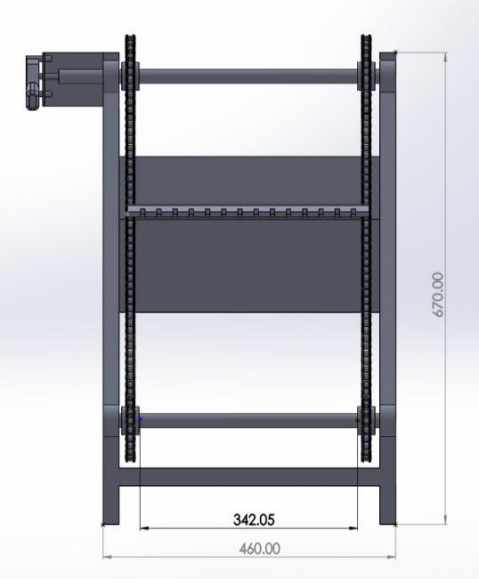

Fig 3 front view of CAD model

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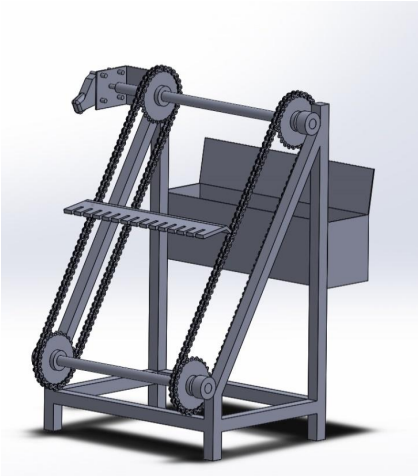

Fig 4 3D view of Cad Model

V. DESIGN CALCULATIONS

Calculation of selection of motor

Voltage = 12V

Assume weight to be lifted = 3.5Kg

Force = 3.5*9.81

=34.335N

Same amount of torque is required to lift the weight

Torque = 34.335N-m

Power = $\frac{2*3.14*N*T}{60}$

Power = $\frac{2*3.14*30*34.335}{60}$=

=107.8119W

Therefore we are selecting motor of 12V, ranging current between 6-12 Amp, having RPM of 30RPM and torque of 38Nm

Calculation of shaft

From ASME code of design of shaft

Ultimate tensile strength σut=350-650Mpa

Yeild tensile strength σy=250Mpa

From ultimate tensile strength

σ= 0.18*sut

=0.18*650

=117Mpa

From yeild strength

σ= 0.3*sy

= 0.3*250

=75Mpa

Considering minimum strength from both of them we are selectin 75mpa for calculation purpose

To calculate torque produced by motor

Power = 120W

T= $\frac{60*p}{2*3.14*N}$

= $\frac{60*120}{2*3.14*30}$

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T=38.216*$10^3 Mpa$

Considering 100% load means T= T*38.216*10^3*2

=38.216*10^3*2

= 76.432*10^3Mpa

From torsion equation

$$\frac{T}{J} = \frac{\tau}{R}$$

Where,

T= Torque

J=Moment of inertia

τ= Shear stress

R= Radius of shaft

After reducing above equation becomes

$T = \frac{\pi D^3 * \tau}{16}$

$73.762*10^3 = \frac{3.14*20^3*\tau}{16}$

τ=46.98Mpa

Since the allowable shear stress is greater than the calculated shear stress for 20mm diameter

Therefore we can take the diameter of shaft as 20mm

Calculation of input power At various load

At 500gm load

We observed voltage = 11V, Current=6Amp,

By using power formula

Power = VIcosθ where θ = 0 and therefore cosθ=1

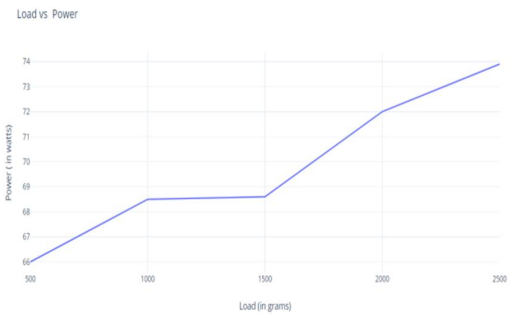
Power =VI

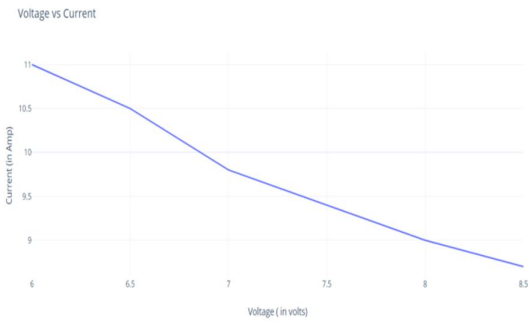
Power=11*6

Power=66watts

VI. RESULT

Load(in grams)	Voltage (in volts)	Current (in Ampere)	Power (in Watts)
500	11	6	66
1000	10.5	6.5	68.5
1500	9.8	7	68.6
2000	9	8	72
2500	8.7	8.5	73.9





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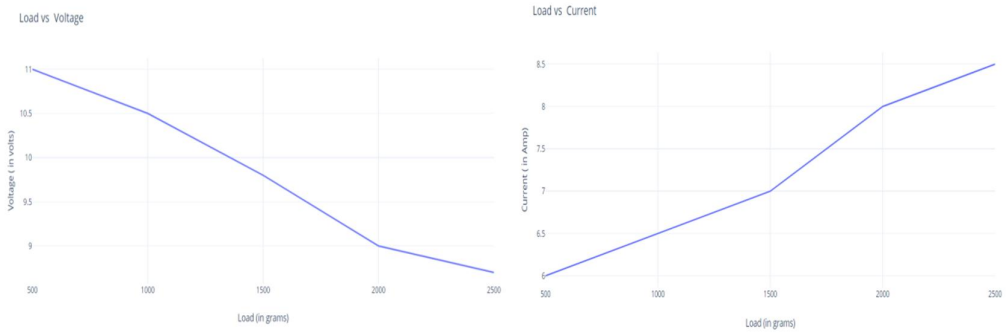

The above graphs shows the relation between the voltage, current and power with the various amount of load that we tested during the testing.

VII. CONCLUSION

- Elimination of manual scavenging to a certain extent.
- By using this machine the cost of drainage cleaning is reduced to a great extent.
- The hard work of drainage cleaning is made easy by using this semi automated machine.
- Semi automatic drainage cleaning machine is fabricated.

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