DESIGN AND FABRICATION OF PLC-ENHANCE SEWER EXCAVATOR

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Keywords

Excavator, Fabrication, 4-bar mechanism, Object Detection, Open-Source, Motor, Shaft, Actuator.

Introduction / Background

A manhole is an opening through which a man may enter a sewer for inspection, cleaning and other maintenance and is fitted with a removable cover to withstand traffic loads. The manholes are first constructed and then the sewers are laid interconnecting these manholes.

The machine that we are designing uses a pulley mechanism using wire rope. This requires a worker to operate into the manhole in order to open and close the buckets. This machine is driven using battery/electricity to insert the bucket into the manhole, to open, to close and remove the waste collected successfully. By doing so we intend to make the project to be PLC automatic as well.

Our designed machine utilizes a rope motor mechanism, requiring a worker to operate the buckets from inside the manhole for opening and closing. It is powered by either a battery or electricity, enabling the machine to insert the bucket into the manhole, perform the opening and closing actions, and effectively remove the waste that has been collected. The objective of this design is to achieve a plc semi-automatic project implementation.

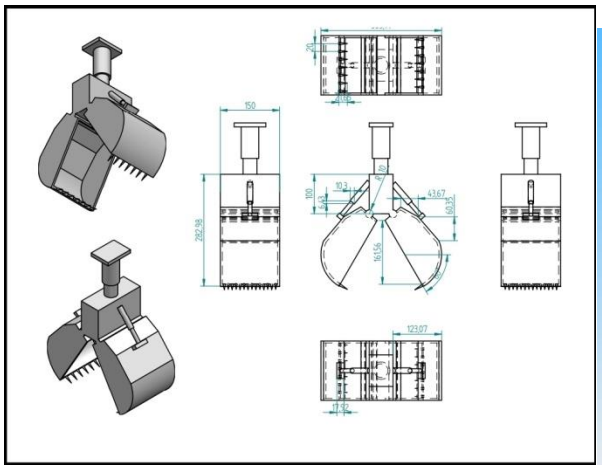
Objectives

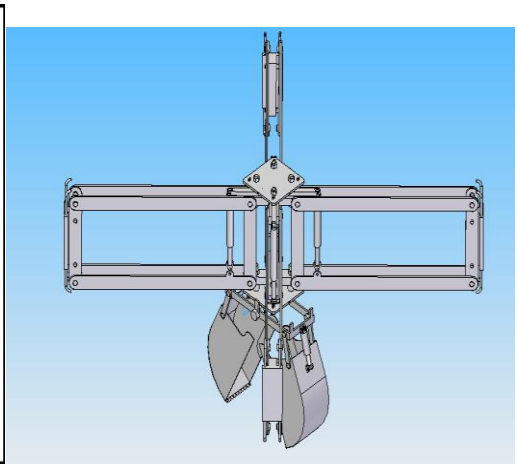
- Through this project we aim to eliminate the practice of human entering the manhole physically to clean and collect the waste.
- We are concentrating on using an electric mechanism to open the close the buckets.

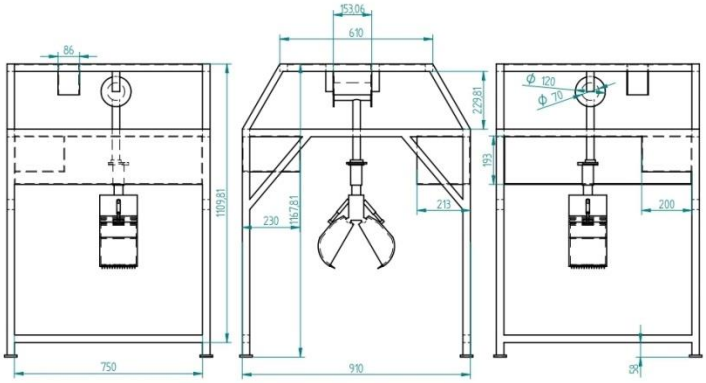
- We are concentrating on using an electric mechanism to open the close the 4-bar mechanism (robotic arm)
- The existing machines occupy a lot of space on the road while we are concentrating on making our machine compact.
- To incorporate operational safety and hygiene in the sewer excavator.
- To replace the manual system by PLC controlled system.
- To make the system portable and compact.
- To make it Cost effective and light weight.
- The system should be able to segregate solid waste from the drainage.
- To make the system user friendly & easy to operate by the workers.

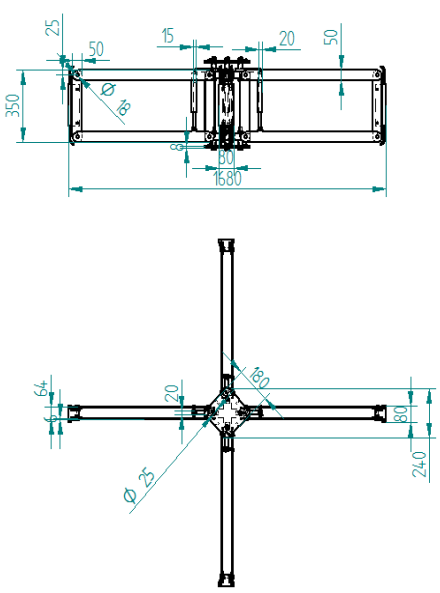
Methodology

- The first step being the selection of the mechanism. In order to open and close the buckets we are implementing a grabbing mechanism and supporting 4-bar mechanism
- After selecting the mechanism, the material that is suitable for this purpose is selected. For our project the material being used is Galvanized Mild Steel and Aluminium.
- After the selection of the material the bucket and 4-bar mechanism is designed, where the calculations are carried out regarding the volume, weight that can be carried etc.
- The next step is the fabrication of the bucket and frame. The frame is fabricated according to the Calculations made.
- In the semi – automatic part of our project, we are using DC motors, gear box and other electrical components to perform the vertical motion and an actuator to perform the opening and closing action.









Components

MS Sheets

Mild steel contains around 0.05–0.30% carbon making it malleable and ductile. Mild steel has moderately low elasticity, however, it is modest and simple to shape; surface hardness can be expanded through carburizing.

ROPE MOTOR

A rope motor is a type of linear motor that utilizes a flexible rope or cable as its primary moving element. Unlike traditional linear motors that use rigid structures, such as magnets or coils, a rope motor achieves linear motion by pulling or pushing on the rope. This design allows for greater flexibility in application, especially in situations where space constraints or complex pathways are present

Power Supply

The 12-volt version has screw terminals and a rectangular base. Since it is 12-volt, this type can be used to power car accessories outside of an automobile, using extra wiring or an adapter.

Electric Actuator

An electric actuator is a device that can create movement of a load, or an action requiring a force such as clamping, using an electric motor to create the necessary force.

Result and Conclusion

- The project aims to make the sewer excavator safer to operate and ensure a cleaner work environment.
- Making the system portable and compact will allow easier transportation and access to confined spaces.
- Workers will find the system easy to operate and navigate, leading to increased productivity and job satisfaction.
- The system will be designed to separate solid waste from drainage, contributing to better environmental practices.
- By replacing manual controls with a semi-automated system, the project seeks to improve efficiency and reduce human error.

Note: We have participated in PROTATVA-2024 in RV Institute of Technology & Management And AVISHKAR-2024 IN VEMANA Institute of Technology Projrct Exhibitions.

1. TOTAL BUCKET VOLUME

VOLUME 1 -

$$\frac{[a+b]}{2} * l * w$$

$$V_1 = \frac{[50+47]}{2} * 52*250$$

$$V_1 = 3.0312x10^5$$

VOLUME 2 -

$$\frac{[a+b]}{2} * l * w$$

$$V_2 = \frac{[80+52]}{2} * 78*250$$

$$V_2 = 12.87x10^5$$

VOLUME 3 -

$$\frac{\pi*d^2}{16} * w$$

$$V_3 = \frac{\pi*120^2}{16} *250$$

$$V_3 = 7.0605x10^5$$

Total volume of the bucket

$V = V1 + V2 + V3$

$V = 3.0312x10^5 + 12.87x10^5 + 7.0605x10^5$

$V = 0.046m^3$

LOAD CALCULATION

A. load submerged weight

$W = p*(W1)$ Kg

$W = 0.1\ (55.2)$ Kg

$W = 5.52$ Kg

TORQUE REQUIRED

$T = \frac{1}{2} * D * W$

$T = \frac{1}{2} * 0.08 * 196.2$

$T = 7.84Nm$

TOTAL BUCKET VOLUME V= 0.096m3
2. Load weight
Submerged weight W = 5.52kg ≈ 6 kg
3. torque calculation T = 7.8Nm ≈ 8 Nm
4. gear ratios GR = 1: 1
5. INPUT rpm N1 = 360 RPM
6. OUTPUT RPM N2 = 600 RPM

Innovation

- These arms are equipped with tools for cleaning and can be controlled remotely by operators, eliminating the need for workers to enter hazardous environments.
- sensors and cameras that provide real-time feedback to operators, allowing for precise navigation and cleaning.
- The machine may include safety mechanisms to protect both operators and infrastructure, such as emergency stop buttons and collision detection systems.

Scope for Future Work

We gathered information and equipment required for the Design and Fabrication of Semi-Automated Sewer Excavator. Studied the construction and principle of it. To Fabricate and test its working. We hope that this will be among the most versatile and

interchangeable in cleaning system. As the project has been based on the concept, to integrate the benefits for human health, societal concerns and national cleanliness policy. Therefore, it covers many sections of proportionate benefits to the whole sphere of our present life.

For Industry

Our Project, as being new in the market network will provide the entrepreneurs the much-needed ideas to blend the technology with societal benefits and harness the market. As a nation we are focusing on the public benefits in the policy making and providing the young generation the employment and environment safety. While being a high- market potential project conserves the profit for the industry section with the advance of providing the corporate social benefits.

For Society-

Sanitations is one of the very basic amenities required for the basic living of a man and providing with such a technological and economical instrument which can change the pathetic sewerage condition of the town and cities of mediocre India. With such a potential instrument of employment generation in the society through industry co-operation, these products land you in the win-situation for the people.