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Design And Fabrication of Aqua Dredger River Cleaning Machine

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Abstract:

The efficient maintenance of river systems is crucial for ensuring the smooth operation of urban infrastructure. However, clogging due to various residues poses a significant challenge, leading to blockages and potential environmental hazards. In response to this issue, this research presents a novel prototype model of a river cleaner designed to effectively tackle such obstructions. The prototype incorporates innovative features aimed at enhancing cleaning efficacy while minimizing environmental impact. Through a combination of mechanical and chemical methods, the proposed river cleaner offers a versatile solution adaptable to diverse river scenarios. This paper outlines the design, fabrication, and testing of the prototype, highlighting its potential applications and benefits for sustainable urban management.

Keywords: river cleaner, prototype model, urban river cleaner, blockage removal, sustainable management

1. Introduction

Urban river cleaning systems play a vital role in maintaining public health, environmental quality, and overall infrastructure functionality. However, these systems are prone to blockages caused by various contaminants such as grease, oil, food waste, and sediment accumulation. Such blockages not only disrupt the flow of wastewater but also pose risks of flooding and contamination, necessitating effective cleaning solutions.

Traditional river cleaning methods, often reliant on manual labor or rudimentary tools, are labor-intensive, time-consuming, and sometimes ineffective, particularly for stubborn clogs or in hard-to-reach areas.

Moreover, many conventional river cleaners utilize harsh chemicals that can be detrimental to both the environment and public health. In response to these challenges, there is a growing demand for innovative drain cleaning technologies that are not only efficient but also environmentally friendly. This research addresses this need by proposing a prototype model of a river cleaner that combines mechanical and chemical approaches to effectively dislodge and remove obstructions.

The design of the prototype is based on a thorough analysis of common causes of drain blockages and existing cleaning methods. It incorporates features such as adjustable nozzle configurations, high-pressure water jets, and environmentally safe cleaning agents. Furthermore, the prototype is designed to be compact, portable, and easy to operate, making it suitable for use in various urban settings.

This paper provides a detailed overview of the design and fabrication process of the prototype river cleaner, including the selection of materials, components, and manufacturing techniques. Additionally, experimental testing and performance evaluations are conducted to assess the effectiveness and efficiency of the prototype in different drainage scenarios.

Overall, this research aims to contribute to the advancement of sustainable urban management practices by offering a practical solution for maintaining clean and functional river systems. The prototype model presented herein represents a significant step towards achieving this goal, with potential applications in municipal infrastructure maintenance, industrial facilities, and residential settings.

2. Literature Review

Prior research on water hyacinth's, wastes effects on water quality has focused mainly on the consequences of the dense mats formed by the interlocking of individual plants. The most commonly documented effects are lower phytoplankton productivity and dissolved oxygen concentrations beneath mats.[1] Other water quality effects include higher sedimentation rates within the plant's complex root structure and higher evapotranspiration rates from water hyacinth leaves when compared to evaporation rates from open water.[2] Water hyacinth also has been found to stabilize pH levels and temperature in experimental lagoons, thereby preventing stratification and increasing mixing within the water column.[3]

On the other hand over growth of these plants adversely affects aquaculture productivity as they take up the available nutrients from the water body, affect plankton production, interfere with sunlight penetration, create extreme dissolved oxygen variations between day and night, give shelter to harmful insects and fish predators, require large amount of oxygen.[4]

Aquatic plants are among the prolific ones on earth associated with both positive and negative impact on aquaculture. Aquatic plants grow profusely in lakes and waterways all over the worlds and have in recent decades their negative effects magnified by man's intensive use of natural water bodies. Eradication of the weeds has proved almost impossible and even reasonable control is difficult.[5]

Submersed plants in rivers and irrigation canals increase the bed and bank roughness increasing drag and decreasing flow. As plant biomass increases seasonally this effect is magnified. Plant biomass displaces

part of the canals cross sectional area resulting in higher water levels and increased likelihood of flooding. Floating plants increase water loss through evapotranspiration.[6]

Brezner al reported transpiration for water hyacinth was 130 to 150% higher than evaporation from a free water surface under equivalent conditions while Timer and Weldon reported values 370% higher than a free water surface. In irrigation canals and drainage ditches, they slow or prevent water movement increasing the likelihood of flooding. Floating plants clog waterways, plug water pumps, stop or slow boat traffic, close marinas, prevent access for fishing, prevent water access by waterfowl and wildlife, and causes an increase in mosquitoes.[7]

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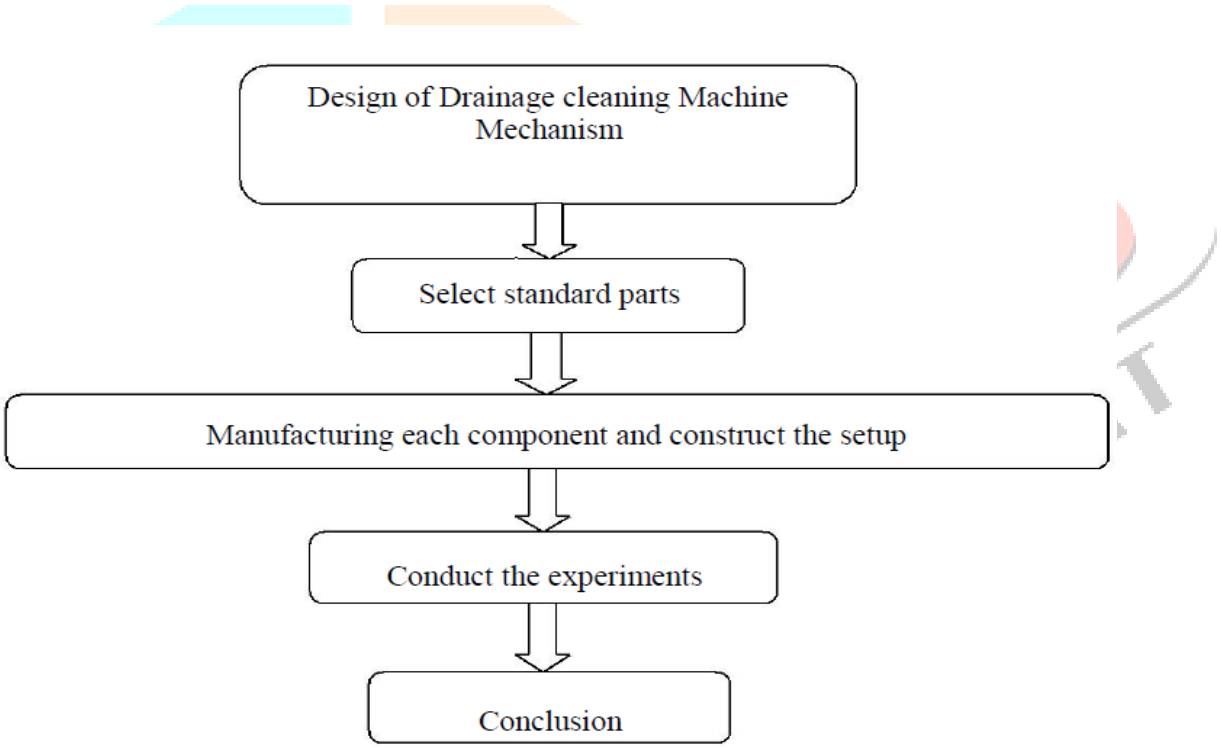
3. Flow Chart



4. Construction Parts Overview

4.1 Motor

DC Motor:

A DC motor converts direct current electrical power into mechanical power. Key types include brushed and brushless motors, which use different methods to manage current flow and create rotary motion. DC motors are favored for their wide speed control range, making them suitable for tools, toys, appliances, and vehicles. Gear motors, combining a motor and a gearbox, are used for high torque, low speed applications.

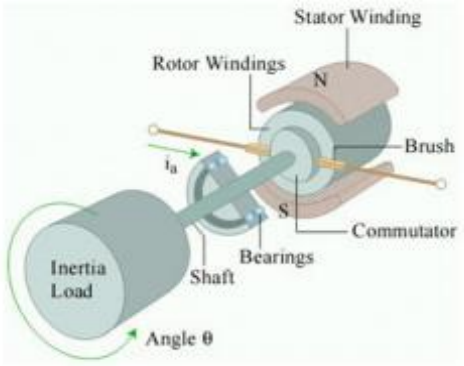


Fig 1 – Construction of DC Motor

60 RPM Center Shaft Metal Gear DC Motor:

Material: Metal gears and ferrite magnets.

Brush type: Brush.

Drive type: Homopolar.

Voltage: Operates smoothly from 4V to 12V, giving a range of RPM and torque.

Construction: Gearbox sealed and lubricated, requiring no maintenance. Designed for durability and efficiency.

Single-phase Induction Motors:

Split-phase: Used in washing machines, dryers.

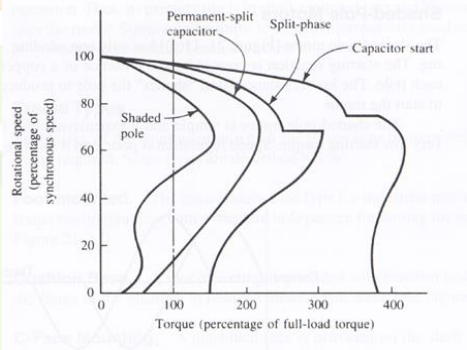


Fig 2 – Split Phase

Capacitor start: High starting torque, also used in washing machines.

Permanent split capacitor: Quiet, efficient, used in fans and air-conditioners.

Shaded pole: Low power, used in small fans.

4.2 Linear Blades

Linear blades made of mild steel (M.S.) are fixed on the machine for specific cutting or processing functions.

4.3 Conveyor Belt

A conveyor belt, made of rubber, is driven by motors via driver and driven pulleys. It's an endless loop rotating around these pulleys to move materials.

General material handling: Moves boxes in factories.

Bulk material handling: Transports large volumes of materials like grain, coal, and ore.

4.4 Bearing

Ball Bearing:

Inner ring, outer ring, balls, and cage.

Single-row radial bearings: For various loads.

Angular contact bearings: For radial and axial loads.

Self-aligning bearings: Handle misalignment.

Mounting and Maintenance: Bearings must be carefully mounted and lubricated to minimize friction and power loss.

4.5 Drive and Driven Pulley

Drive pulley: Gets power from the motor.

Driven pulley: Gets power from the drive pulley via a belt.

Cost-effective, easy to install, and versatile.

High efficiency and reliability in power transmission.

4.6 Frame

The frame, made of mild steel (M.S.), supports the entire assembly, including blades, guiders, bearings, conveyor, and motors.

4.7 Sprocket

Sprockets are crucial in power transmission, connecting the front and rear sprockets of a motorcycle via a chain. They come in various sizes and materials to match different applications.

Fig 3 – Sprocket Wheel

4.8 Chain

Transmission chains: Transmit rotary power.

Conveyor chains: Support weight and transport materials.

Inverted tooth (silent) chains: Reduce noise.

Leaf (lifting) chains: Designed for lifting rather than power transmission.

This construction utilizes a combination of DC motors, linear blades, conveyor belts, bearings, pulleys, sprockets, and chains to create a functional mechanical system. Each component is chosen for its specific properties to ensure efficient power transmission, durability, and ease of maintenance. The design balances cost, performance, and versatility, making it suitable for a wide range of industrial applications.

5. Working

4.1 Experimental Design

This method is very simple to construction. First when this mechanism goes in water their blade through hyacinth is removed directly. Then this cutter is directly connected to the one conveyor belt, conveyor belt through hyacinth is goes through crusher tank. Then this hyacinth is directly crushed in crusher. There chain drive through this conveyor belt will rotate. There two motors are connected. One is connected to chain drive to rotate conveyor. And another is connected to crusher because this crusher crushes the hyacinth automatically.

Light from the sun is incident on the solar panel in order to generate power in terms of solar energy which is then transmitted into chemical energy of the battery by the help of battery charger which is connected to the solar panel as well as the battery. Battery is connected to the DC motor and once it is fully charged chemical energy is converted into electrical energy and is passed to DC motor which rotates the armature of coil which in turn initiates the chain & sprocket drive mechanism. Chain is properly lubricated. Finger shaped clasp is attached to the chain which is used to pick up the solid waste from drain and carries it and throws it away in waste bucket attached at backside of drainage system model.

This process continues automatically till the energy is imparted to the motor by the help of battery in order to avoid blockage of drains and enhance sewage treatment system.

6. Software Design

This project involved the use of Computer-Aided Design (CAD) tools and various manufacturing processes to design and create a mechanical component. The goal was to leverage CAD for precise design and documentation, followed by implementing manufacturing techniques to produce the final product.

6.1 CAD Design

We used SOLIDWORKS, a leading CAD software, for the design phase. SOLIDWORKS allowed us to create detailed 2D drawings and 3D models of the component.

Design Steps

1. Conceptualization: Initial sketches and ideas were drawn on paper to outline the basic design.

2. 2D Drafting: Basic 2D shapes and dimensions were created in SOLIDWORKS.

3. 3D Modeling: The 2D sketches were extruded and revolved to create 3D models.

4. Simulation: The design was tested for stress and load-bearing capacity using SOLIDWORKS Simulation.

Outputs

Detailed Drawings: Comprehensive blueprints with dimensions, tolerances, and material specifications.

3D Models: Realistic renderings and animations to visualize the final product.

6.2 Manufacturing Processes

The designed component was manufactured using various processes such as metal cutting, welding, and grinding.

Metal Cutting

1. Sawing: A cold saw with a high-speed steel blade was used to cut raw metal into manageable sizes.

2. Drilling: Holes were created using a drill press with twist drill bits for precise hole placement.

3. Milling: A milling machine was used to shape and refine the component surfaces.

Welding

The parts were joined using Shielded Metal Arc Welding (SMAW). This process involved:

Electrode Selection: Choosing appropriate electrodes based on material compatibility.

Arc Welding: Fusing metal parts together with controlled heat input to form strong joints.

Grinding

Precision grinding was performed to achieve the desired surface finish and tight tolerances. The grinding wheel parameters were carefully selected for optimal results:

Abrasive Material: Chosen based on the metal's hardness.

Wheel Structure: Ensured to provide the required surface quality.

Quality Assurance

Throughout the manufacturing process, various quality checks were conducted:

Dimensional Inspection: Ensured all dimensions met the design specifications.

Surface Finish Check: Verified the smoothness and finish of the machined surfaces.

Strength Testing: Confirmed the welded joints could withstand the required loads.

The project successfully demonstrated the integration of CAD design and manufacturing processes. Using SOLIDWORKS for design provided precision and clarity, while the various manufacturing techniques ensured the component was produced to exact specifications. This approach not only improved productivity but also enhanced the overall quality of the final product.

6.3 Drafting

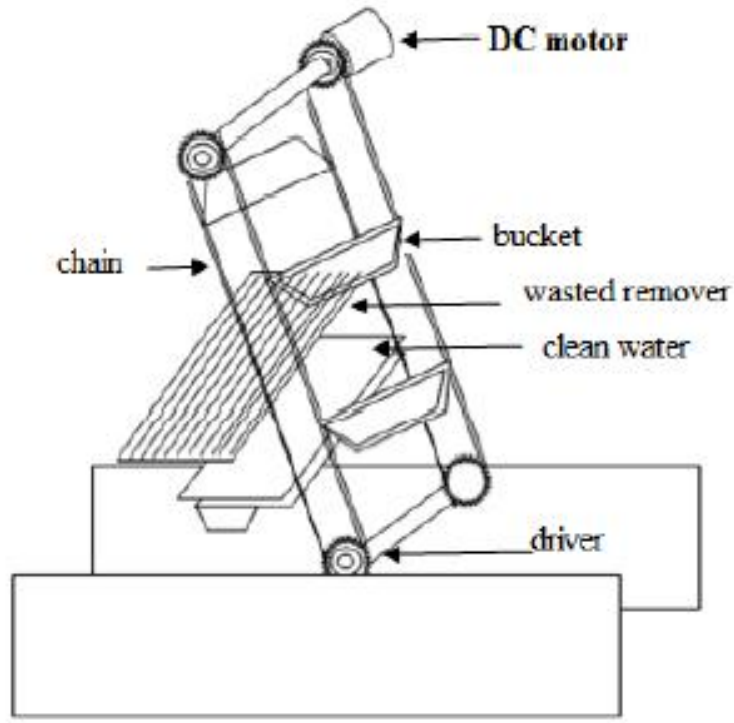


Fig 4 – Automatic Drain Cleaning System (Drafting)

6.4 3D Model

Fig 5 - Automatic Drain Cleaning System (3D)

6.5 Inspection

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. Inspection is generally divided into three categories: (1) Receiving inspection, (2) In-process inspection, and (3) Final inspection. In quality_control (which is

guided by the principle that "Quality cannot be inspected into a product") the role of inspection is to verify and validate the variance data; it does not involve separating the good from the bad.

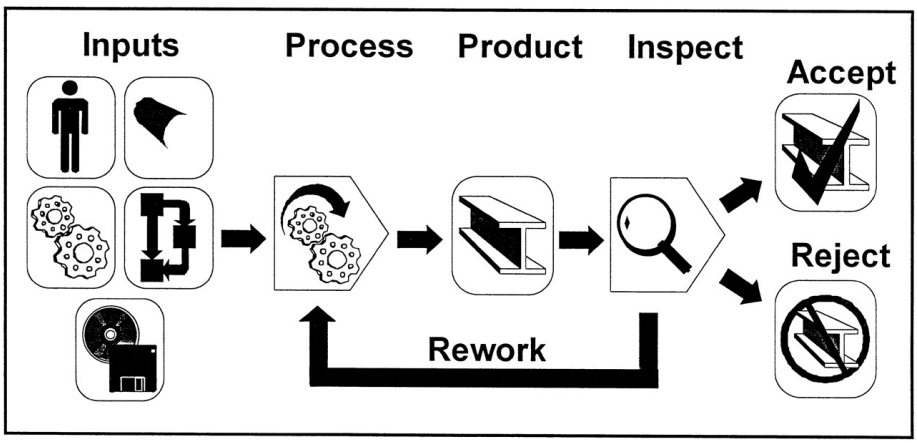


Fig 6 - Inspection

6.6 Assembly

An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labour than by having workers carry parts to a stationary piece for assembly.

6.7 Economics

Table 1 – Cost Estimation

Sr. no.	Component	Cost in Rs.
1.	Base frame	1800
2.	Shaft	1400
3.	12 volt DC motors*2	800
4.	Conveyor belt	1200
5.	Chain	500
6.	Bearing	800
7.	12 volt battery	850
8.	Fabrication	2500
9.	Assembly and labour charges	1800
10.	Others	1500
Total		13,150/-

7. Conclusion

This project may be developed with the full utilization of men, machines, and materials and money. Also, we have followed thoroughly the study of time motion and made our project economical and efficient with the available resources. This system is Designed, fabricated successfully and also tested. It works satisfactorily. We hope that this will be done among the most versatile and interchangeable one even in future. Thus, we can able to obtain following through Automated Drainage Cleaning system.

Acknowledgements

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