Design and fabricate a machine to cut off invasive species to ensure clean water surfaces

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Abstract: *This paper intends to consider a control framework for surface cleaning robot and the concentration of the investigation is the surface cleaning robot controller outline The issue of gliding trash especially water hyacinth (Eichhornia crassipes) & like plastic sacks, bottles, and so forth and also plant excess on surface of water bodies which more often than not goes unchecked and contributes in the lessening of water quality, causes blockages and damages amphibian biological communities. As outlined compact framework is power controlled coasting unit, which will have the capacity to gather gliding Aquatic flotsam and jetsam in water bodies and return it to the shore. The unit will be worked from the surface, with the goal that the administrator require not open himself to the contaminants in the water straightforwardly. A frequently observing sea-going waste or flotsam and jetsam is of more enthusiasm to the conditions, amphibian life, human wellbeing, and water transport.*

Keywords: Surface Cleaning Robot, Control System, water hyacinth, Aquatic debris

1. INTRODUCTION

The water hyacinth (Eichhornia crassipes) is a floating plant. Recognized as one of the top 10 worst weeds in the world, it is characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance. This invasive nuisance often jams rivers and lakes with uncounted thousands of tons of floating plant matter. A healthy acre of water hyacinths can weigh up to 200 tons! [7, 8]

Surface cleaning robots are natural assurance gear predominantly utilized for gathering gliding waste in beach front waters or waterways and lakes. As indicated by the prerequisites of the errand they can likewise be utilized for observing the earth of ports, conduits, waterfront, shorelines and so forth., storing up hydrological data and doing unsafe operations, for example, surface inquiry and protect and so forth., with gear, e.g., a profundity sounder, a stream meter, GPS collectors and camcorders. [1, 2, 3]
The flotsam and jetsam passages are regularly unpredictable in a huge geographic district [4], making them exceedingly hard to the robot to clean and gather that. Robotic vehicle design is one of the important aspects for the performance of a vehicle. When the vehicle across a medium at high speed, the medium will acts on the vehicle in term of resistance [6], To address these difficulties, in this paper we considered the accompanying things-Design and create a machine or unit with the limit of satisfying the essential capacity of checking oceanic surface contamination in both significant structures i.e. intrusive species like water hyacinth and marine litter [5]. It must have the capacity to gather marine litter and slice off obtrusive species to guarantee clean surfaces.

1.1 CONCEPTUALIZATION

Significant favorable circumstances of this outline approach are that it is exceptionally efficient both for creation and in addition use since it disposes of the need to configuration confounded components to get singular coasting bodies as payload, the computations expected to adjust for expanding weight of the unit as payload continues expanding amid operation are dispensed with and the machine turns out to be extremely easy to use for an administrator as he/she has no confused pickup instruments to deal with[9].

2. SHAPE, SIZE & DIMENSIONS OF ROBOT

The characteristic sense fit as a fiddle of any pontoon as a rule is to give it a shape which is as streamlined as conceivable to expand propeller use. In any case, considering the motivation behind our unit, a piece shape is beneficial considering the accompanying viewpoints

- Streamlined shapes basically slice through the water, as it were, and in this manner redirect any drifting bodies far from them to make an easiest course of action. What we need is a correct inverse capacity of the above.

- A streamlined body skims at a higher speed in water. This, thus, produces swells beginning from the body and coordinated outwards. Drifting bodies are spread over bigger ranges as an impact..

- A square shape is naturally steadier if any planar powers are included as it gives higher imperviousness to movement of a pontoon in horizontal and additionally longitudinal bearings.

Streamlining requires confounding forming of the vessel structure which is uncalled for in applications where moderate speed is prerequisite of the framework.

A rectangular shape was picked passing by the cases of a dominant part of water crafts which are essentially rectangular fit as a fiddle. The size expected to sufficiently huge that adequate waste can be gathered in a solitary run yet additionally sufficiently little that a solitary individual can transport the unit with no bothers.

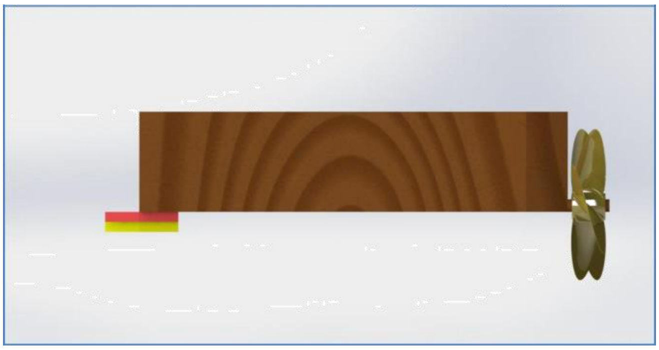

Fig. 1- Initial design side view

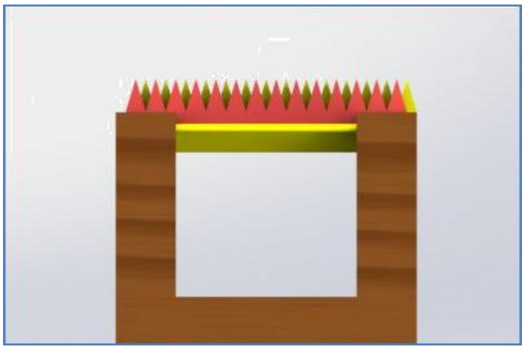

Fig. 2- Cutting and collection area top view

3. MATERIAL SELECTION FOR ROBOT

Material for the unit was to be selected as the primary step after initial conceptualization. The factors we had to keep in mind while choosing frame material were:

- Weight density
- Behaviour /Suitability in water
- Cost and availability in local markets
- Is the material eco-friendly
- Workability/Ease of machining

Keeping up a wooden pontoon in an ecologically inviting way is conceivable in the event that it is sufficiently little to routinely expel it from the water. Evident cases are wood kayaks and rowboats that experience their years upside down on blocks or in a boathouse. Late headways in non-dangerous epoxy coatings indicate guarantee in saving wooden water crafts proficiently.

As can be seen from the graphs, wood has higher strength and Young's modulus relative to density as compared to aluminium, steel. However it lacks stiffness and tensile strength and is not suitable for applications where high loads are at work. As we do not require high strengths in our unit, we choose wood as our frame material owing to its low cost, local availability and ease of working.

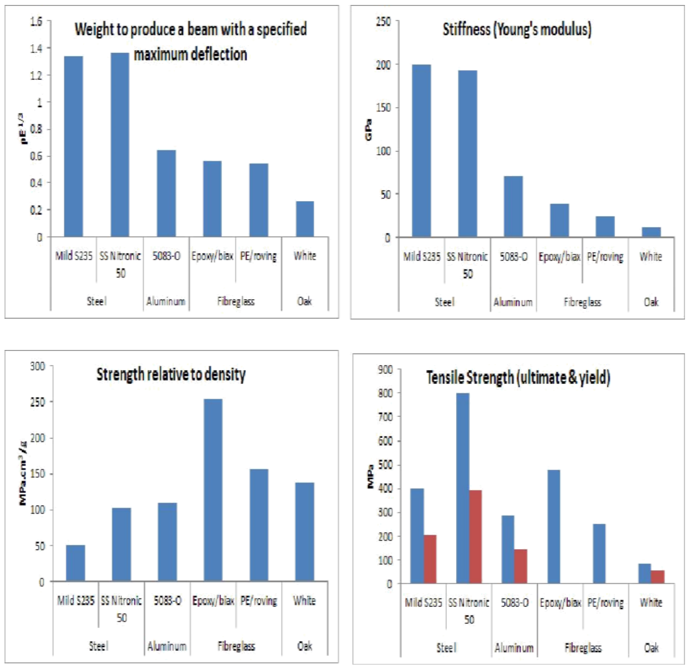

Fig. 3- Comparison graphs of various mechanical properties of boat materials

4. SELECTION OF PROPELLERS

The guideline of propeller working is that a weight contrast is created between the forward and raise surfaces of the airfoil-formed sharp edge, and a liquid, (for example, air or water) is quickened behind the edge. Clear decisions for propeller materials; plastic propellers were picked due their lightweight nature and furthermore the inaccessibility of business aluminium propellers beneath a width of 450mm.

Fig .4- Propeller

5. CUTTER MECHANISM DESIGN

Aquatic plants, primarily like water hyacinth, are up to 1 meter high although 40 cm is the more usual height The design finalized was to attaching one blade free to reciprocate as the slider of the quick return mechanism and attaching a second blade rigidly to the frame above the moving blade oriented parallel to the moving blade with a slight gap in between.

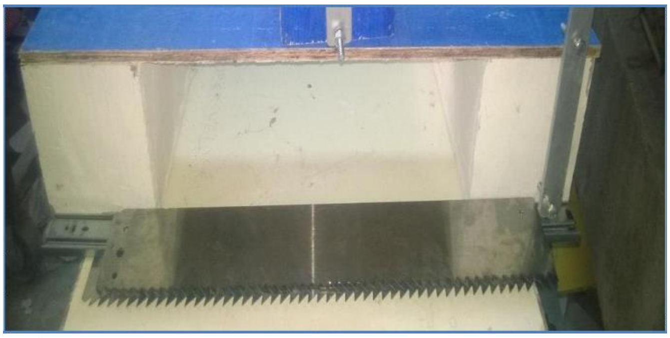

Fig.5- Cutters along with sliders in their planned positions

5.1. CUTTER BLADE

The minimum radius of a curve that can be cut on a particular saw is determined by the width of the band and its kerfs. The blades range in size from about 4 inches wide x 19 inches long to 16 inches wide x 62 inches long.

Fig.6- Saw blades which were used

Fig.7- Grinding of saw blades

For our application, we acquired one blade of 60 inches length which was available economically in the domestic market. We cut the blade into two individual blades to get identical blades to be used in the reciprocating mechanism using shearing machine available in the college. The next step was to further grind the blade edges to sharpen the edges using a grinding wheel so that the edges become sharper and more suitable to our application.

6. DESIGN & CALCULATIONS

6.1 The dimensions of robotic unit are

Length (l) = 40 inch, Breadth (b) = 30 inch, Height (h) = 6 inch, Width of both front arms = 6 inch, Width of horizontal arm = 7 inch.

6.1.1 Dimensions of propeller

Motor housings = 6in length × 6in breadth × 3in height
Thickness of plywood used = 12mm
Density of plywood = 600kg/m3

Major weights considered to satisfy buoyancy conditions are weight of frame and battery.

6.1.2 To find weight of frame

Surface area of plywood frame = (base area of the three arms) ×2+ (surface area of walls)
∴SA=(7×30+33×6×2)×2+(40×6×2+33×6×2+29×6+19×6+5 ×6×2)
∴SA = 2346in2 = 1.5135m2
∴ Weight of plywood = SA × thickness of plywood × density ∴ Wply = 1.5135 × 12×10-3×600
∴ Wply = 10.8975kg Weight of battery (measured) = Wbattery = 5kg
∴Total weight to be supported = Wply + Wbattery = 15.8975kg

To account for weights of aluminium linkages and also possible unaccounted weights, we use a factor of safety of 2.
∴Weight to be buoyed = 15.8975kg×2= 31.792 ≈ 32kg

Now, let us calculate buoyant force exerted by water for a submerged height h of the frame. Volume of water displaced = volume submerged

∴ Volume displaced = volume of 2 propeller housings + volume of partially submerged frame∴ Volume = 2×6×6×3+ (40×30 - 18×34) ×h [here h = submerged height]
∴ Volume = 216+588h in3 = 3.5396×10-3+ 9.6355×10-3h m3
∴ Buoyant force = (Displaced Volume) × (density of water)
∴ Buoyant force = (3.5396×10-3+ 0.39735h) × 1000 kg

Equating equations (i) and (ii) to find h: 32 = (3.5396×10-3+ 0.39735h) × 1000 h = 0.071625 m = 2.8199 in ≈ 3 in robot's decided height h = 6 in > 3 in. Hence suggested design is safe against sinking from overweight and can also accommodate unforeseen overloading.

6.1.3 Force calculation

Our crank being 1.5cm in radius, the required torque output of the motor should be 30X1.5 i.e. 45kgcm. the force required by the system for satisfactory cutting is 30 kg. This has to be supplied by our cutter motor. High speed was also a requirement as we observed that at low speeds, the stems simply slipped out when the moving blade was in motion, hence not getting cut at all. Hence we needed a motor which runs at a moderately high speed and provides a minimum torque of 45 kgcm.

7. CONCLUSIONS

In this paper we finished up the machine to cut off invasive species remover or reaper is best, proficient, practical contrast with other strategy. It has 85% powerful weed pulling. Because of mechanical control compelling tainted water assets administration are finished. In this way now it's the ideal time to making such machine and spares our, lake, cannels and streams.

Our model can be driven just by a single operator as it is remote controlled, thus reducing the need for large number of human labour for the same operations. The dimensions of our model - 40*30 inches makes it extremely portable and its low weight makes it very easy to carry to different places for the cleaning operation as was clear in the testing procedure when we carried the model in a 4-wheeler comfortably. Using vertical cutters coupled with horizontal cutters which ensure that all types of aquatic plants can be cut.

Solar panel can be incorporated for future autonomous robotic structure. Using 3M Reinforced Polyurethane Foam as a substitute as it is a high strength material that is much lighter than wood. GPS coordinated functioning for automated missions in case of long distance application

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