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Modelling and Fabrication of Adaptable Tree Climbing Robot

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ABSTRACT

The objective of the project is to model and construct a prototype of the robot which adapts to vary a size of trees. Many living creatures can climb the tree, but human's way of climbing the tree is simple and to varies and varying sizes of a tree with the suitable change in the model of the prototype.

KEY WORDS: adaptable, size, climbing.

1. INTRODUCTION

Researchers in the world work on climbing robots. Climbing robots are capable of climbing regular structures like walls, domes, etc. But some are capable of climbing trees, the main reason it's being different size and variation of diameter with a shape. It also required a greater agility and high maneuverability to use in a project. Also, the clash of some trees it cannot be strong and smoothers the fast of the climbing robot. The different climbing robots are cannot be used in the tree robot. Trees like coconut palm tree are so tall that climbing to them becomes risky. Hence harvesting fruits and nuts and maintaining them becomes difficult. So the development of a unique tree climbing mechanism is necessary which may be it can use for maintaining and harvesting applications.

The robot was to consist of two sets of segments, joined by a spine which could be extended or retracted. Each segment would have four links. To climb, the legs on the top of the gripping would grip together and secure the tree robot. Then the screw would be retracted, pulling up the bottom segment. The links in the down of the gripping link would then grip to the tree, and the top of the gripping link would be release. Finally, the screw would be extended, pushing the top of the gripping links to move forward and the process over again. The climbing tree sequence is similar to the way of inch worm climbs.

In my original design, all four sets of links in each segment were controlled by lead screw mechanism is using in the model. I choose to ditch this idea for a few reasons. Firstly, I could not find the type of idea needed to mesh the links together. Also, with all the links linked together, the robot would have a very hard time gripping in the uneven places. Finally, I choose that the robot would be much easier to build if the motors drive the links straightly. The other similar change I made from my original design was the way the spine worked. In my model, I used a lead screw type to extend and contract. I could not find the necessary parts to build such a system, so I ended up using a threaded rod coupled to with a motor to actuate the spine. This report discusses the necessity of the project and various aspects of planning, design, selection of materials, fabrication, erection and estimation.

2. METHODOLOGY

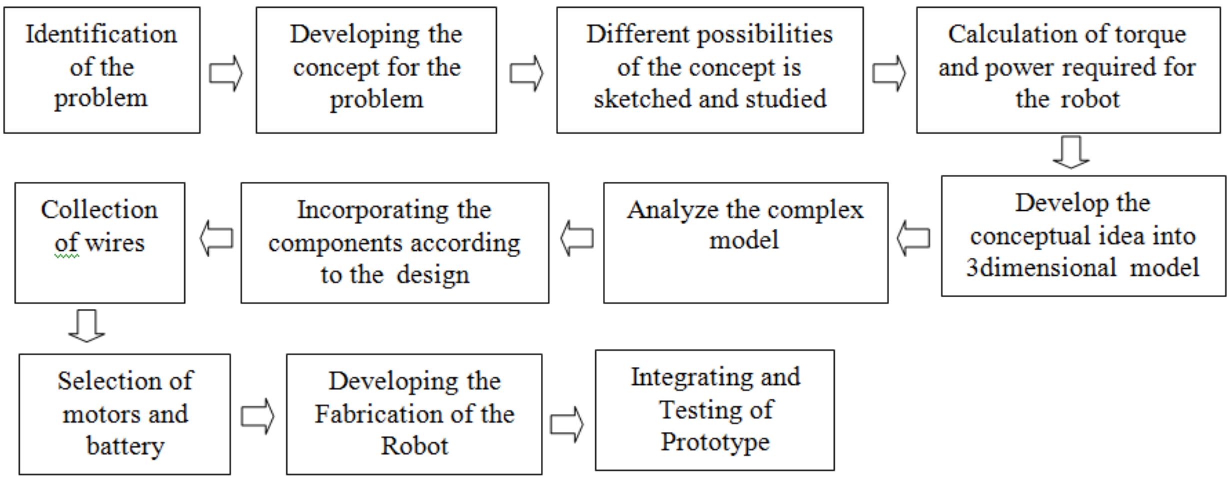

Fig.1 Methodology Block Diagram

Model:

Lead Screw: The design consists of a lead screw M20 of length 300mm in order to make the robot climb up and down the tree. By a motor when it rotates in the clockwise direction the set up moves one direction and in opposite direction when it will be reversed. These motions will result in expand, and contract of the robot frame set up changing the distance between two gripper plate respectively.

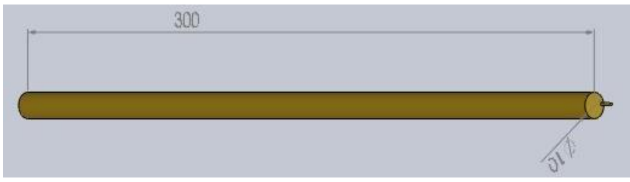

Fig.2. Design of Lead Screw

Motor specifications: a) 100 RPM 12V DC motor, b) 18000 RPM base motor, c) Shaft diameter: 6 mm., d) Gearbox diameter 37 mm., e) Motor diameter 28.5 mm., f) Length 63 mm without shaft, g) Shaft length 15mm., h) Weight: 300gm., i) 10Kgcm torque, j) No load current: 800mA (max).

Frame set: Build frame settings to hold the motors and links together and in place. I started the frame by making a plate out of aluminum to hold the lead screw together. I drilled the plate to fit the lead screw coupled to the shaft. The lead screw makes the robot move up and down by translating the frame set up and down. Gripper links mounted on the frame set with the motors. The guide rod traverse on one frame set through guide hole and fixed on another frame set in guide hole to keep the robot aligned to travel in an axis.

Next, I made a matching plate for the opposite side of the lead screw assembly. This plate holds the spine straight while they turn. I drilled holes through the screw, opposite to the motor hubs. Then I bolted the lead screw through the plate with washers and to hold to the place, and they spin freely on the bolt.

Fig.3. Design of frame

Gripper Links: The links are some of the most valuable parts of in this tree robot, because their design determines to whether it or not the robot can grip onto trees. I decided to have four links, each link controlled by one motor. To make the links, and I cut four 18.30 cm lengths of the aluminum bar. I marked the segments 25cm from each end. At those marks, I bent the aluminum at a right angle, to make a "C" shape.

Two links are to be used in order to adapt to varying size of tree. The two links are differs based on the dimensions, so named as short link and long link. Use of these links to grip firmly to climb the tree. The links are connected to pin with each other so they can be actuated independently. Since they are of different size different torque can be used depending on the surface condition the tree. The short and long links are show in figure 3.

Fig.4. Design of Gripping Link

Figure.5 shows the 3D Model of the tree climbing robot with one of the possible diagonal link arrangement.

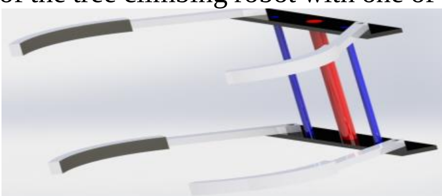

Fig.5. Assembly of tree climbing robot

3. CONCLUSION

This paper present about a tree climbing robot which moves along a tree by its arms using high torque square box geared motor. It moves vertically in a specified constant velocity using screw mechanism. Precise gripping is to achieve by curved arms that connect to two bars each. The robot adjusts its arms according to the varying cross-section and various designs were taken, their limitations and challenges studied, and the suitable design is selected. The robot has been modeled and designed using 3-D design software and fabricated

4. ACKNOWLEDGEMENT

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