

TREE CLIMBING ROBOT (TREEBOT)

Introduction:

A creature like robot which is designed to climb trees. It climbs in the same way a caterpillar climbs or in a way people climb coconut trees. The robot is consist of two pairs of hand and a pair of spine. Hand help the robot to hold the tree while the spine is supposed make the robot climb.



Final robot

MOTIVATION:

Trees are gifts to us from mother nature. They are indispensable natural resource. And we often need to climb trees to utilise its resources like plucking fruits, collecting twigs etc. A tree climbing robot can let you make use of a tree. Reason for our motivation is these videos.

https://www.youtube.com/watch?v=h5M_YJdrRyw

<https://www.youtube.com/watch?v=zkpH1BjD6Wc>

<https://www.youtube.com/watch?v=EUZzhRXEfm4>

Team members:

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Technical aspects of our project:

It can be summarized as follows..

Mechanical:

- 1) 4X 6 rpm DC Motors : Used for gripping mechanism.
- 2) 2X 500 rpm dc motor : for climbing.
- 3) 2X threaded rods: used for making spine.
- 4) Aluminium bars: used for making gripper and other parts of the robot
- 5) M-Seal: for making strong joints. .
- 6) Other hardware (Bolt, Nuts, clamps..etc)

Electrical:

- 1) Arduino uno: microprocessor to operate the bot.
- 2) L298N motor driver to drive 500 rpm motors.
- 3) 2X 10 Amp motor driver to drive 6 rpm DC motors
- 4) 2X ACS712 (20 Amp) current sensors to control grippers.
- 5) 12V LiPo battery to power the entire bot.
- 6) Toggle switch to switch on/off the bot.
- 7) Circuit Board
- 8) 9V Voltage regulator: to power arduino from high volt battery.

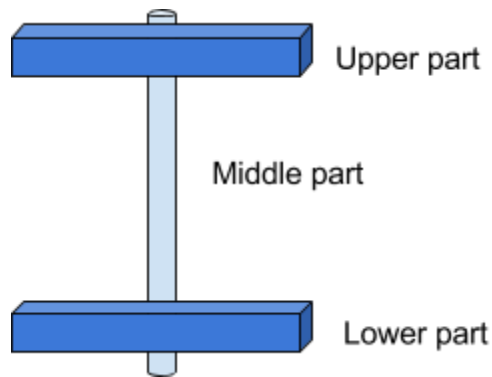
Theory:

As mentioned above, the robot will climb in similar fashion in which a caterpillar or a coconut climber does. The robot can be divided into three parts viz upper, middle and lower. The upper and lower parts are the hand/grippers of the robot while the middle one is the spine. A schematic diagram is illustrated here.

We referred to following links to make our projects

[Idea for our project](#)

[Arduino tutorials](#)



Algorithm for climbing

Functions:

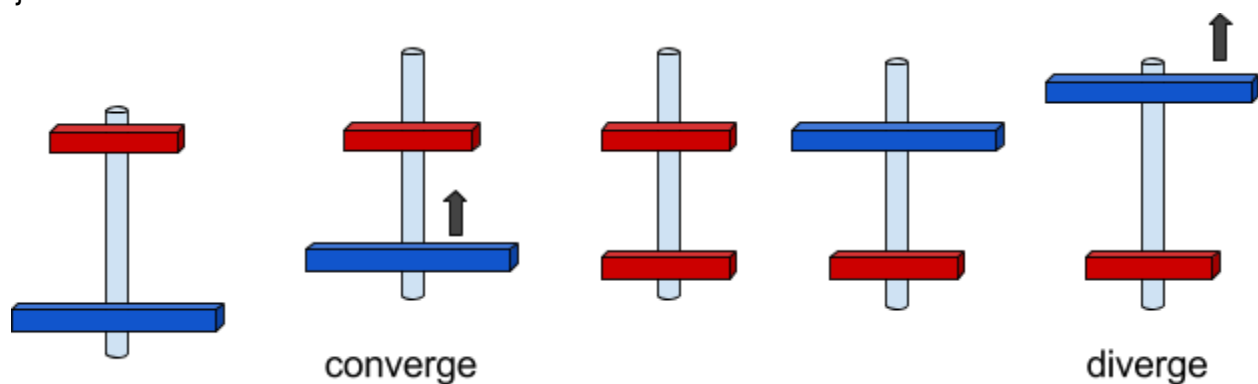
Upper part and lower part: hold(grip)/release(ungrip)

Middle part: converge/diverge

```

Hold upper part;
repeat
{
  Converge ;
  Hold lower part ;
  Release upper part ;
  Diverge ;
  Hold upper part ;
  Release lower part ;
}

```



A pair of threaded rods attached with 500 rpm motors and nuts was used for climbing purpose. By reversing direction of rotation of motor (using L298N motor driver), we can perform converge/diverge functions.

[Guide to use L298N](#)

Gripping mechanism:

For gripping mechanism, we used(12V, 6 rpm) high torque dc motor, each for a hand. Rotation of motor caused gripping/ungripping. To make grip strong, we attached nails at the palmar region of the gripper. Piercing would make gripping stronger.



Grippers without spine.

The basic principle behind gripping was: Gripping motors would rotate at max for 5 seconds at a time. The motors will take high current as the trunk hinders their rotation and thus making grip strong.

A Current sensor (ACS712) was connected in the circuit of each pair of gripping motors.

Here is guide how to use acs712

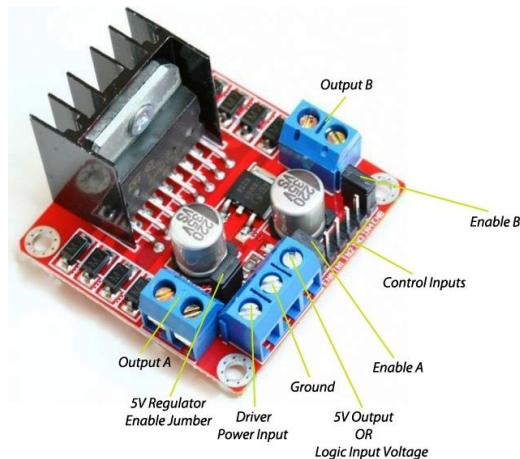
<https://www.youtube.com/watch?v=UF5jrnXvTIM>

http://www.microcontroller-project.com/uploads/2/2/1/5/22159166/6220710_orig.jpg

The moment current goes higher than assigned value(say 1 Amp) the circuit will break (without waiting for 5 seconds to complete) and there will be no activity in the gripping motors. Since we used high torque(low rpm) motor, there was no need to continuously supply current for holding grip.

In this way the gripper will hold the robot with the tree.

The major problem occurred in gripping was,... if excess pressure was applied in grip, the joint between gripper and the motor would break. Nothing could be worse than that. So Instead of passing continuous current to motors, we supplied current 200 millisecond with break of 50 millisecond. This would ensure that no excess pressure is applied on the grippers for long period.



L298N motor driver board



ACS712

Timeline:

Week 1 : Solidwork design of robot, working on its theoretical aspects, learning arduino and purchasing all mechanical equipments.

Week 2 : Made grippers and tested it on a tree. Successful in first attempt. Started making climbing parts.

Week 3 and 4: We made a climbing part and combined gippers in it. Our initial design consisted of one motor along with gear system which will drive the two rods. However it did not work as gear system was not well made. It caused lot of friction while climbing. Also just one motor was not sufficient enough to efficiently drive the entire bot. So we instead used two motors, each connected to a threaded rod. And this one worked. Mechanical part finally over

Week 5 : In the last week we worked only on electronic part. Brought all motor drivers, wires, circuit board, batteries and of course Arduino. We wrote Arduino code and tested our bot several times on trees(it was though difficult for us due to the rainy season) until the robot worked satisfactorily.

[Link for the images of bills of purchased items](#)

Problem faced and drawbacks:

- While testing, there was always a risk that the robot may fall if it fails to make sufficiently strong grip.
- Extra strong grip was no less dangerous than loose grip because it would break the gripping hands.
- High current required for gripping and climbing. Ordinary motor drivers like L293D couldn't be used.
- Rainy season made it really hard for us to test our robot on trees
- Climbing speed of the robot is slow.

Though presently, the function of our robot is just to climb up, running code in reverse order it will make it climb down. Due to lack of time, we couldn't make other features but whatever we have made works fine.

[Here is the video how our robot has worked.](#)

We heartily invite any team who would like to continue this project and make all improvisations in it, thus making it more awesome :). To contact us, mail to saraswatisdaniel@gmail.com

THANK YOU

[Gallery of all of our photos:](#)