**OBJECTIVE**

With the advancement in our population and urbanization, deforestation has now become one of the trending global problems. An approach to innovation is required to solve this problem. The objective of this project is to design and prototype a TREE PLANTING ROBOT that can traverse around an area of forest, dig soil, plant a tree, cover it with soil again and repeat the procedure by the auto-load mechanism. Deforestation is emerging as a threat to this planet. Performing tree plantation on macro-scale manually is a quite tedious and difficult job, so using a remotely operated robot to plant trees can help us. This project is such an attempt for a change from ‘Deforestation to Reforestation’.

**AIM**

The aim is to design, manufacture, and simulate a tree plantation robot. The robot will be capable of performing the entire tree plantation procedure, which was done manually before.

**Electronics System**

**Raspberry-Pi:** It runs on Ubuntu 18.04LTS instead of Inbuilt RaspbianOS.And also has ROS installed in it to handles communication between the user and the bot.

**ROS**: It is a package available for Linux-OS and is mainly made to control robots. It has been used to take data from the user(generally using a controller), send data to Raspberry-Pi and to control Arduino-mega.

**Arduino-Mega**

Arduino-Mega is used to control all the motor by giving commands to their respective Motor drivers like Cytron, TB6600 (for Stepper Motor) and Hercules (for Linear Actuators).

**Actuation**

* The pneumatic actuators are controlled with the help of solenoid valves.
* The plant-storage unit is rotated by using a stepper motor and TB6600 motor driver.
* All the motors are controlled by Arduino-Mega receiving commands from Raspberry-pi and Cytron motor drivers are used.
* All the Linear Actuators are controlled by Arduino-Mega using Hercules motor drivers.

**Location detection**

Ublox GPS module has been used to detect the exact location of the bot. GPS data is obtained using this module and used in the package of ROS named MapViz which visualizes the data in the form of a red dot on the map.

**Mechanical System**

**Suspension**

* It has been so designed that it can traverse a farm area and rough terrain smoothly.
* It is connected to the chassis with the help of 3 springs, which decreases the bounce while traversing terrain and keeps the whole chassis stable.
* Its angle with the chassis in a stationary position is such that it provides ground clearance required for digging.

**Plant Storage Mechanism**

* It consists of a rotating circular grid having a capacity of 16 plants above a fixed circular frame.
* A slider creates space for the sapling above, to fall through it into a pipe via a funnel and reaches to the dug ground.
* Rack and pinion mechanism is used for the slider, which changes its position according to the availability of the plant. Moreover, for smooth motion of rack and slider, the rack is mounted on a keyboard slider.

**Digging mechanism**

* It digs the soil up to a depth of 9 cm.
* The operation is performed by two spades connected to two pneumatic actuators.
* The spades are cut at calculated angles to collect an adequate amount of soil.
* The actuators are at an angle such that the spades form a closed pyramid in the maximum position and achieve the required penetration in soil.
* Two linear actuators are used to lift this mechanism when digging is done.

**Enforcing mechanism**

* The mechanism is used for tapping the area for proper setting of plants and nearby soil.
* A linear actuator connected with a base plate to which grippers, having reduced orifice, is attached for enforcing the sapling into the ground.
* The synchronous motion of grippers is controlled with a vega motor and spur gears meshed together.

**Chassis**

* The chassis frame is symmetric and a double layer made of aluminium box-section profiles, brazed together to form a lightweight and robust frame.
* The two layers are connected by small vertical box sections to distribute the stress evenly.
* The plant storage mechanism is bolted to a truss-like structure, which is brazed with the chassis.

**Wheels**

* Customized wheels are manufactured to provide traction and support the four-wheeled differential drive.
* The wheel is mounted on the aluminium cylinder (which is further fixed to the suspension )with the help of bearings, which provides effective rotation of wheels.