AGRI ROBOT

TEAM: DEEPFLOW TESSERACT

AI Quadruped Robot

For the farmers cultivating crops, an OAK-D enabled quadruped robot with robotic arm to effectively **spray water/pesticides/insecticides** on the crops by identifying the **crop or the pests**, thus saving farmers investment on agrochemicals and water, utilizing the depth capability to detect the pest and analyze the pest infection in the process.

Traditional pesticide spraying

3D printing and initial prototyping

- Printed on Creality Ender 3 Pro, time taken 10 days, including robotic arm(12 hour printing).

Design phase - 1

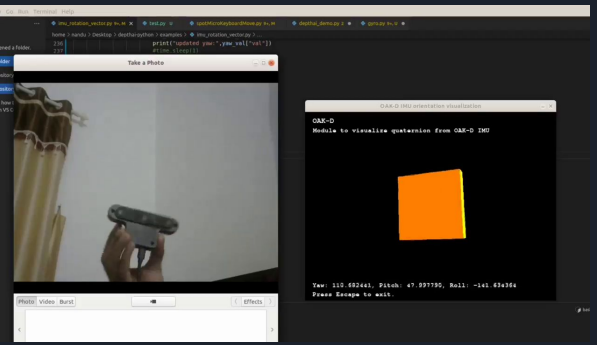
1. Developed the Bot with hobby servos(MG996R)and controlled it through ROS
2. Attached AI depth camera and an arm for spraying and analysis, controlling through VNC viewer through the PC.
3. All the power are supplied externally, batteries not included due to the small load capacity of the servos and the PLA filaments, broken couple of legs.

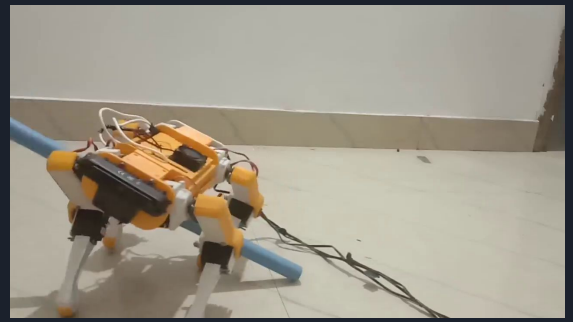
Design phase - 2

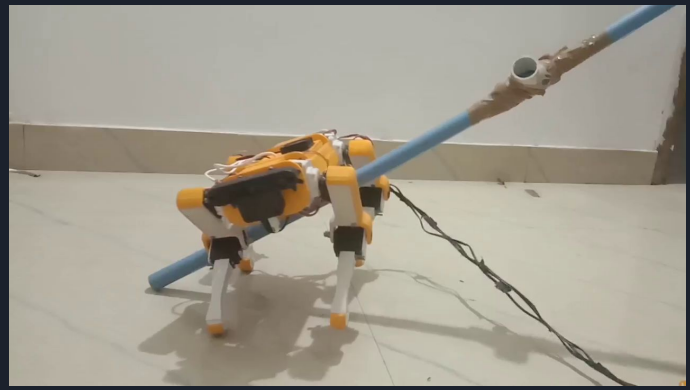
- Walking gaits on a grassy terrain using ROS melodic on Nvidia Jetson Nano, with a keyboard and real-time camera feed using OAK-D.
- In walk command mode, the keys w and s are used to control forward speed, a and d to control side speed, and q and e to control yaw rate. u is used to exiting back to stand mode.

Design phase - 3

- Integrated the inbuilt IMU of OAK-D with ROS to automatically adapt to sudden orientation changes, using an optimization algorithm.







Design phase - 4

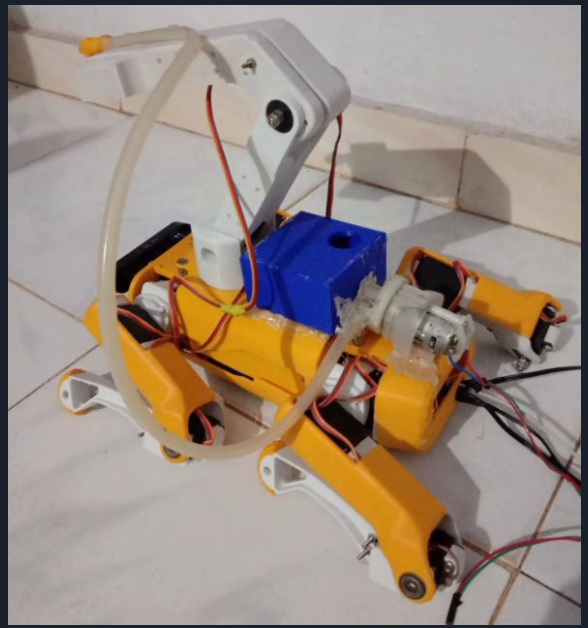
- Pest detection using TensorFlow custom object detection with SSD Mobilenet
- Google Colab link: https://colab.research.google.com/drive/1_K5FxxWU_yEn9JHKa6AOHjoY5Z5Prclv?usp=sharing

Robot without sprayer system

- OAK-D on the head of the bot.
- 2, 10,000 mAH power bank on the robot.

Robot with Sprayer System

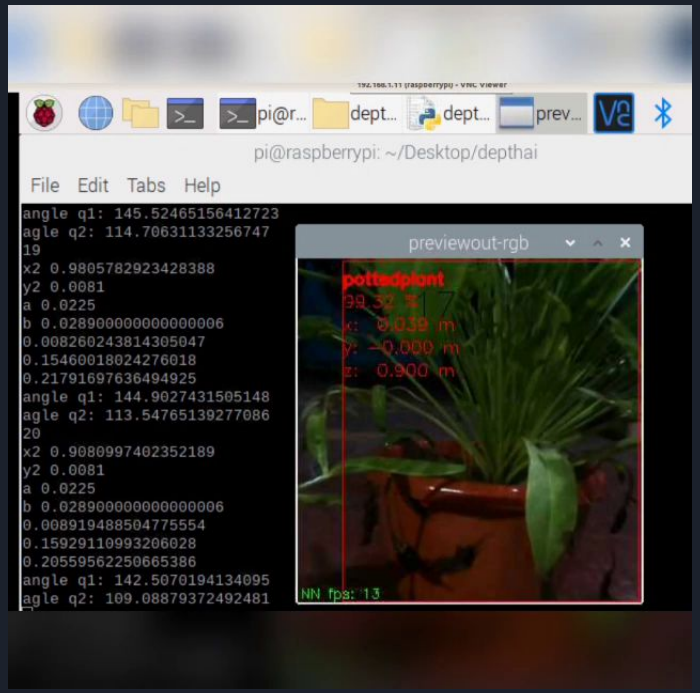
- Added custom 3D printed nozzle, PVC tube water level hose pipe, a 12V DC motor and 3D printed tank to store the water.
- The power bank is taken outside the system due to structural and stability issues.



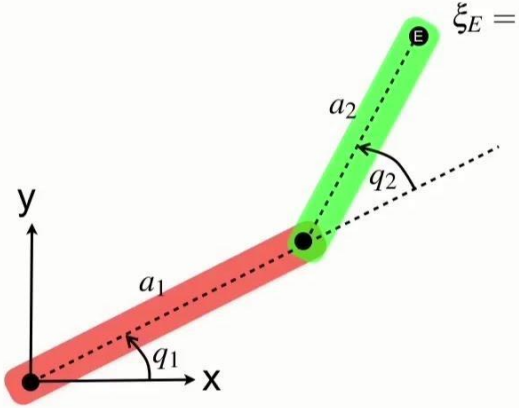
The Robotic Arm

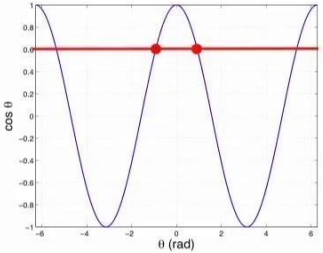
Adding Vision With Robotics

- A simple example of two point inverse kinematics , similar to that used in the robotic arm .
- Here x= z(OAK-D) and y=x(OAK-D)



Tool tip pose





$$\cos q_2 = \frac{x^2 + y^2 - a_1^2 - a_2^2}{2a_1 a_2}$$

$$q_2 = \cos^{-1} \frac{x^2 + y^2 - a_1^2 - a_2^2}{2a_1 a_2}$$

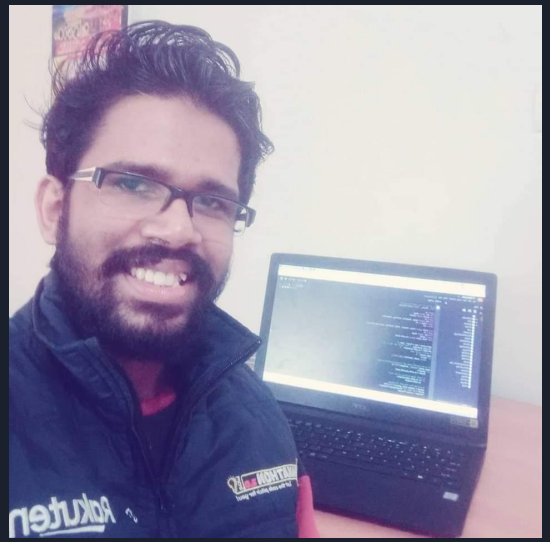
$$q_1 = \tan^{-1} \frac{y}{x} - \tan^{-1} \frac{a_2 \sin q_2}{a_1 + a_2 \cos q_2}$$

GitHub Link

https://github.com/kishorkuttan/AI-Quadruped-Robot-For-Agriculture

Team

The Covid-19 lockdown imposed in Kerala, India pushed us to change the team structure to two and the team mates are,



Nandakishor M (Team leader)
Udemy AI teacher.

Thamban K V
Mentor, Farmer