GOAT: Autonomous Weed Detection and Removal System

-

Giri Pranay Kona
Jahnavi Talluri
Rama Rao Koka

Abstract

project's aim:

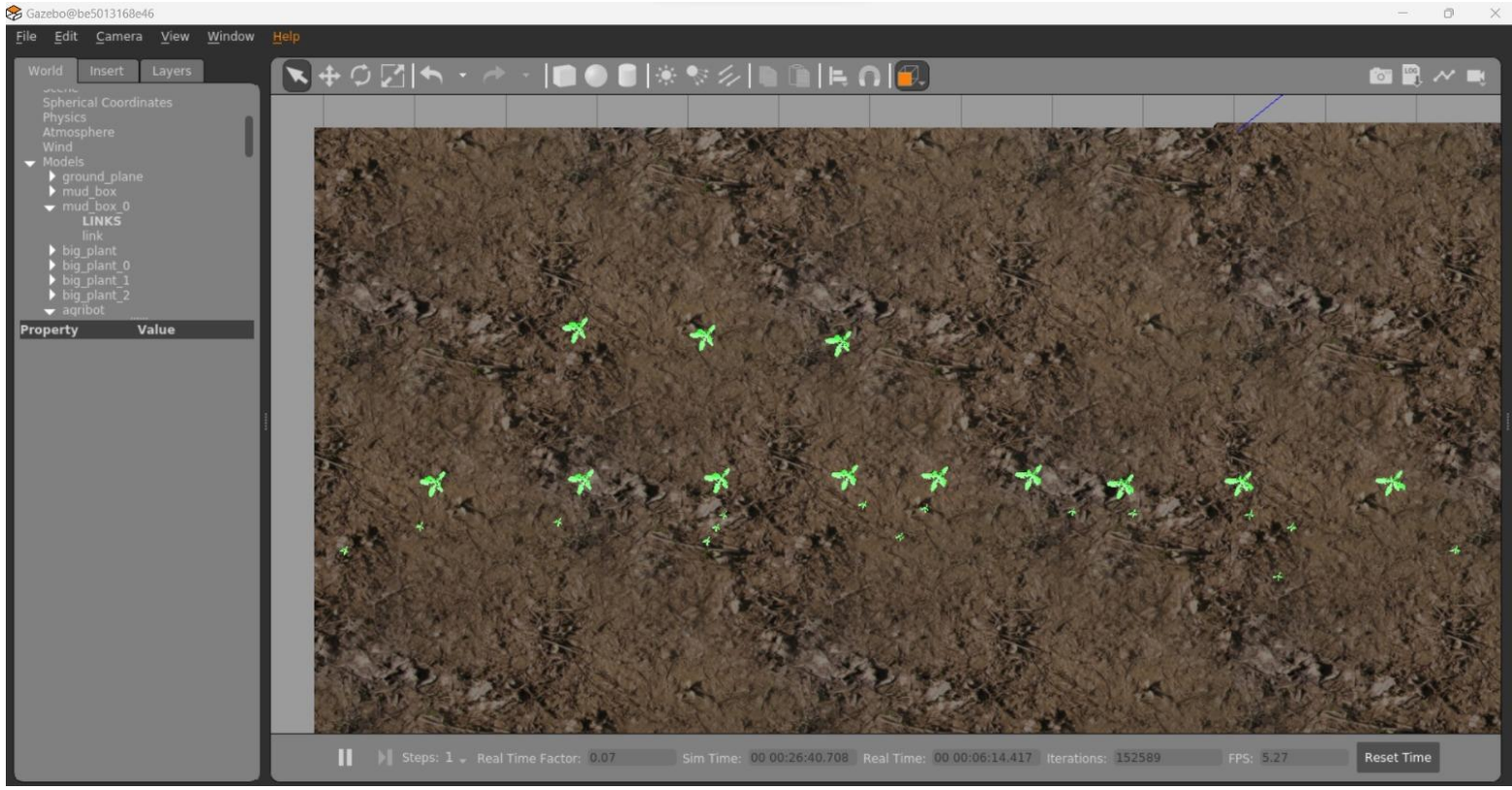
- Combating weed infestations in farming and garden settings using an autonomous system
- employs advanced computer vision and robotic techniques for identifying, extracting, and disposing of weeds.

Introduction

The GOAT project aims to combat the challenges of weed infestations in farming and garden settings. By employing advanced computer vision and robotic techniques.

Farm World

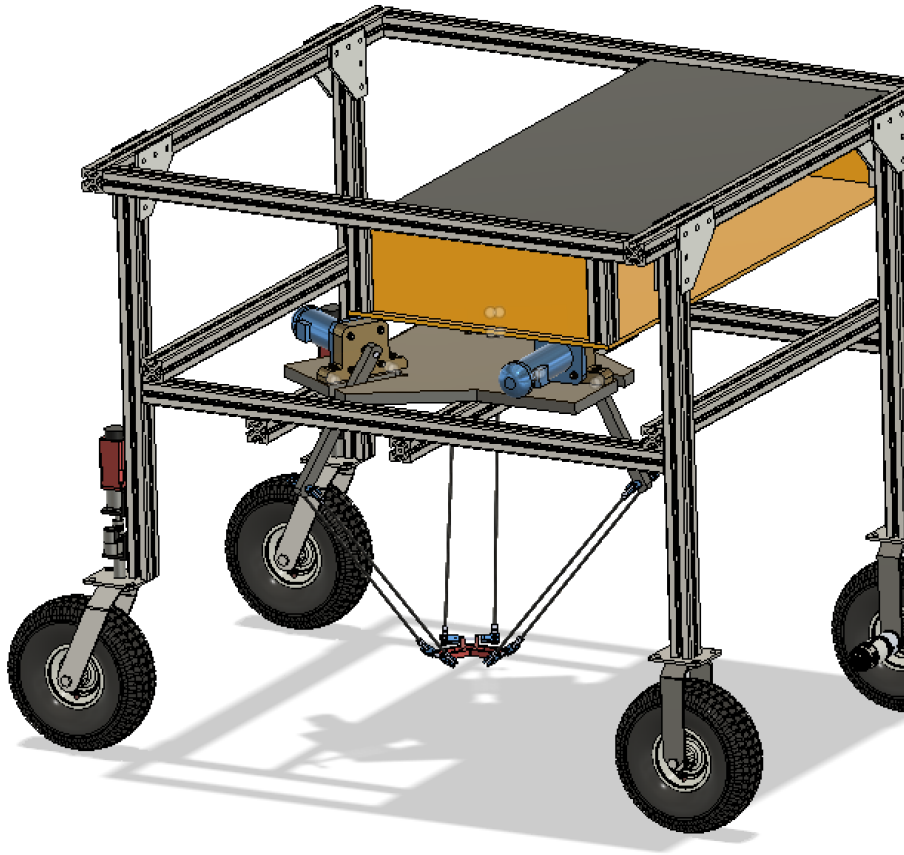
- The designed farm contains weeds and plants in rows
- We aim to navigate the robot through all crop rows in the field



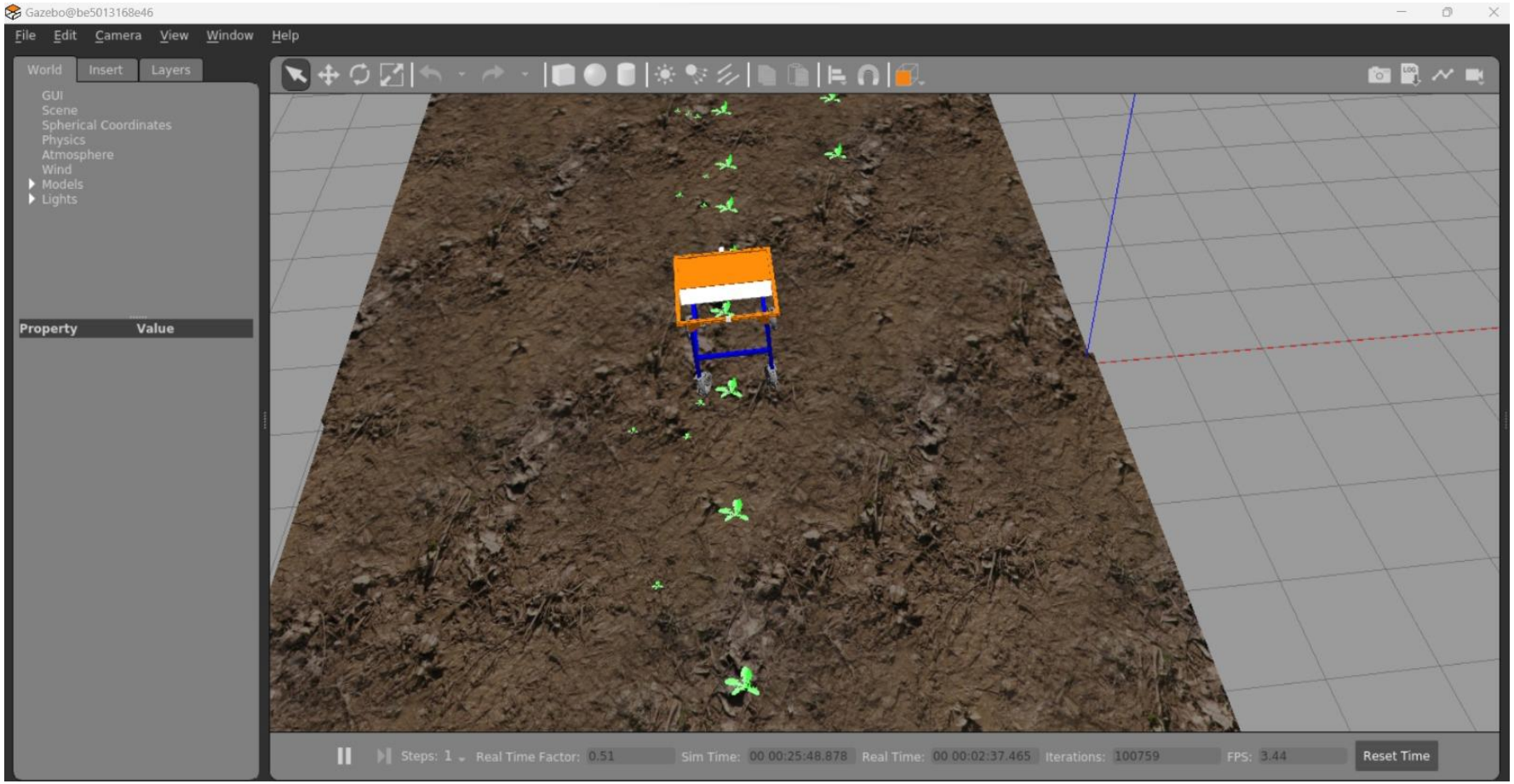
Robot-Model

- We also used various links to design the body and movement of the robot

Type: Mobile Robot : This robot designed to navigate through agricultural environments for the purpose of identifying and removing weeds. Its mobile platform allows it to move between crop rows or across open land.



Robot


Gazebo@be5013168e46
File Edit Camera View Window Help
World Insert Layers
GUI
Scene
Spherical Coordinates
Physics
Atmosphere
Wind
Models
Lights
Property Value
Steps: 1 Real Time Factor: 0.51 Sim Time: 00 00:25:48.878 Real Time: 00 00:02:37.465 Iterations: 100759 FPS: 3.44
Reset Time

Robot Navigation implementation

- **Type: Mobile Robot :** This robot is a specialized autonomous vehicle, designed to navigate through agricultural environments for the purpose of identifying and removing weeds. Its mobile platform allows it to move between crop rows or across open land.

Sensors Used:

1. **IMU Sensor:** An Inertial Measurement Unit (IMU), which is essential for understanding the robot's orientation, acceleration, and, by extension, its movement.
2. **GPS Sensor:** A GPS sensor is likely used for outdoor navigation, providing location data to help the robot navigate large and complex farm environments.
3. **Camera for Vision-based Navigation:** The "camera_link" associated with the "camera_joint" suggests the use of a camera, which could be vital for both navigation and the primary function of weed detection.

Navigation

- **Components of ROS Navigation**

1.Localization

1. Determining the robot's position in the environment.

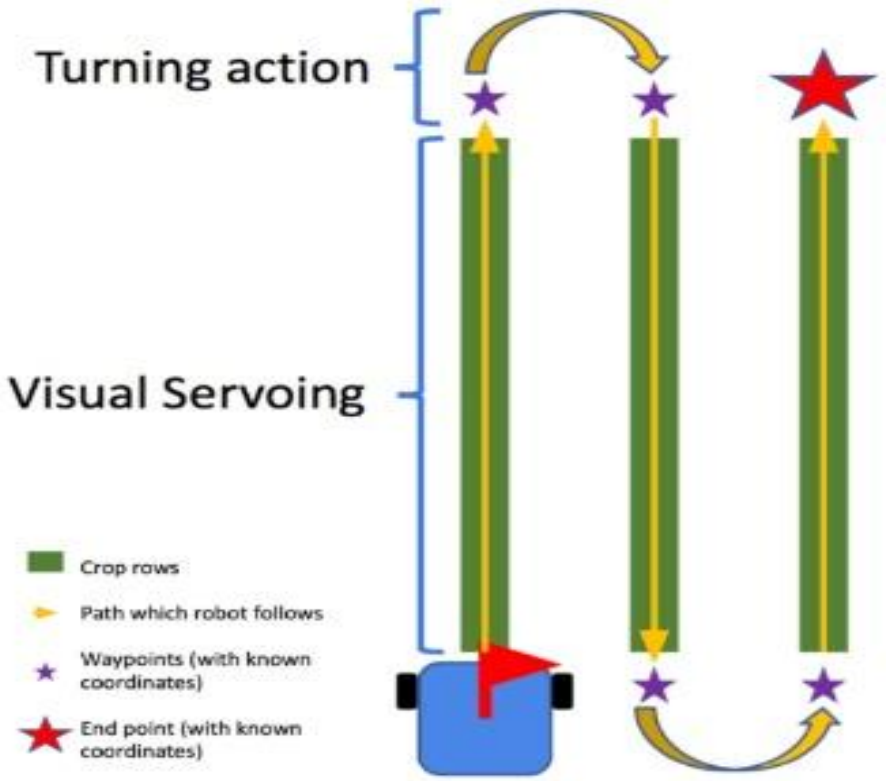
2.Mapping

1. Creating a representation of the environment

3.Navigation

1. Planning and executing paths for the robot.

Navigation Path



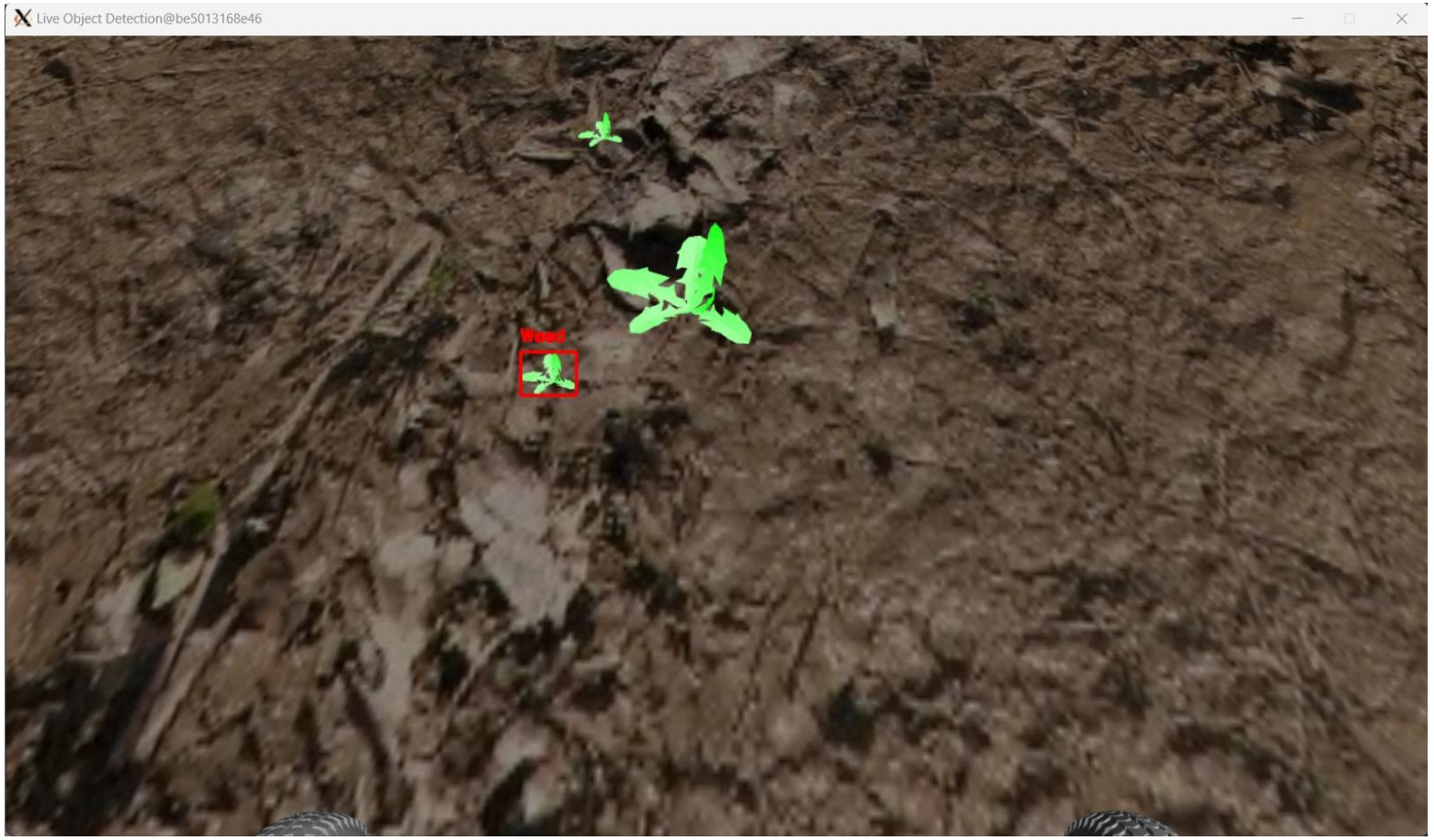
Object Recognition using Computer Vision

Next step is to add object recognition which tells if the object is weed or plant

We can use several machine learning Techniques like YOLO V5

- YOLOv3, a real-time or a custom CV model and train with our specific weed and plant images for different types of fields
- object detection system that divides images into a grid and
- predicts bounding boxes and class probabilities for each box.

Using CV model



YOLO V5 – object recognition

Top-Down grasp of Weed Plant / Pick the weed plant

- Next steps can be building a suitable plucking 3D robot hand and linking it to the current mobile robot

. Use Top-down grasping techniques to pluck out the weed with that hand