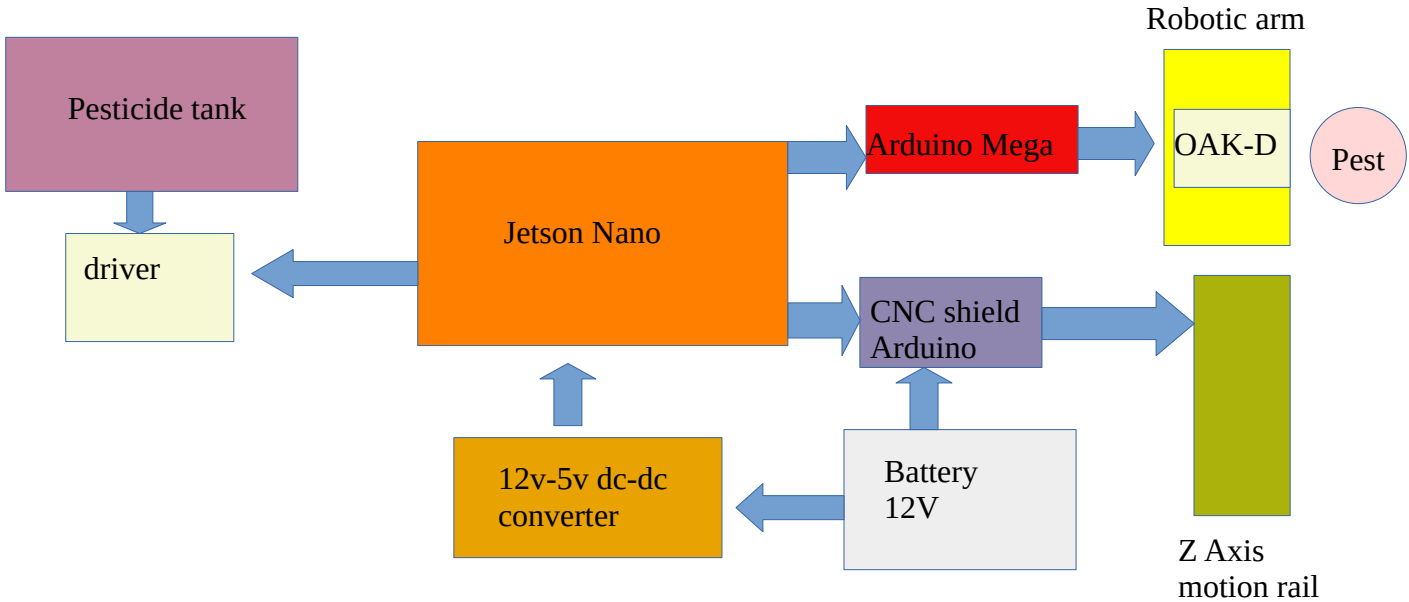
AGRI ROBOT USING OAK-D AND DEEP LEARNING

Problem description:

- Agriculture plays an important role in economic growth.
- Insect pests can affect the metabolic processes of crops to degrade crop yield and quality, which may further hinder the development of agriculture.
- In order to ensure high crop yields, agricultural workers tend to use pesticides according to a schedule rather than the likelihood of pests' presence in the wild.
- The over-use of pesticides is partly because information about pest species and densities cannot be provided in a timely and accurate way.
- If the information is provided in a timely fashion, it could be possible to take proper prevention steps and adopt suitable pest management strategies including the rational use of pesticides.
- Traditionally, the information about pest species and densities is acquired mainly through the visual judgment of humans by comparing pest's shape, colour, texture and other characteristics with the information recorded by many experts.

Implemented solution:

- A robotic rover with robotic arms and OAK-D to effectively target pests and spray pesticide reducing the total amount of pesticide needed and helps the soil and environment.
- Using deep learning based trained to model the OAK-D can detect and get the location of the pests. The host for the module is Nvidia Jetson Nano, which will receive the location data, and using inverse kinematic for two joint robotic arms we can calculate the angle at which each of the arms should rotate.
- We modified the depth API for this purpose that is taking the x,y,z location from mobilenet_ssd_handler.py and depthai.py, calculating the servo rotation angle using inverse kinematics. sending the angle data to the Arduino MEGA using serial communication.
- We also made a stepper motor based CNC motion system using Arduino, A4988 driver, and CNC shield. Which will do 1500 steps clockwise and counter-clockwise direction. And it works asynchronously using Arduino Uno.
- The spraying system will be attached to the arm. Due to the rover motion restriction, we didn't add this to the final deliverable.



Results

Demo link: https://www.youtube.com/watch?v=lSZ1eWDyfjs

Limitations:

- The rover may not work in a harsh environment
- Structural stability has limitations
- Sometimes the size of the pest is too small and leads to not detections.

Future work:

- Developing industrial-grade robotic arm using OAK-D and integrating with the rover
- Removing unwanted connections(wires) from the system.
- Train deep learning model with pests images that have very small size.
- Integrate intelligent rover motion.

Reference:

1. https://github.com/luxonis/depthai
2. https://robotacademy.net.au/lesson/inverse-kinematics-for-a-2-joint-robot-arm-using-geometry/
3. https://github.com/tensorflow/models
4. https://www.arduino.cc/en/Tutorial/LibraryExamples/StepperOneRevolution/
5. https://stackoverflow.com/questions/35840669/arduino-interrupts-with-servo-motor