FAKULTI TEKNOLOGI MAKLUMAT DAN KOMUNIKASI

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WORKSHOP 2 (BITU 3923)

BITI

PROGRESS REPORT II

PROJECT TITLE:

Automated Crop Harvester

GROUP NUMBER:

Group 7

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CHAPTER IV

DESIGN

4.1 Introduction

Automated Crops Harvester used Lego Mindstorms EV3 components and Tetrix Component Set to complete the design and the architecture.

4.2 Robot Architecture

As mentioned above, the project is built using the EV3 set together with the Tetrix set. The Tetrix components, Flat bar, Channel, Wheels and Gears are used for the base of the robot and the EV3 LEGO set components are used for the claw that will move to pick the ripe tomatoes.

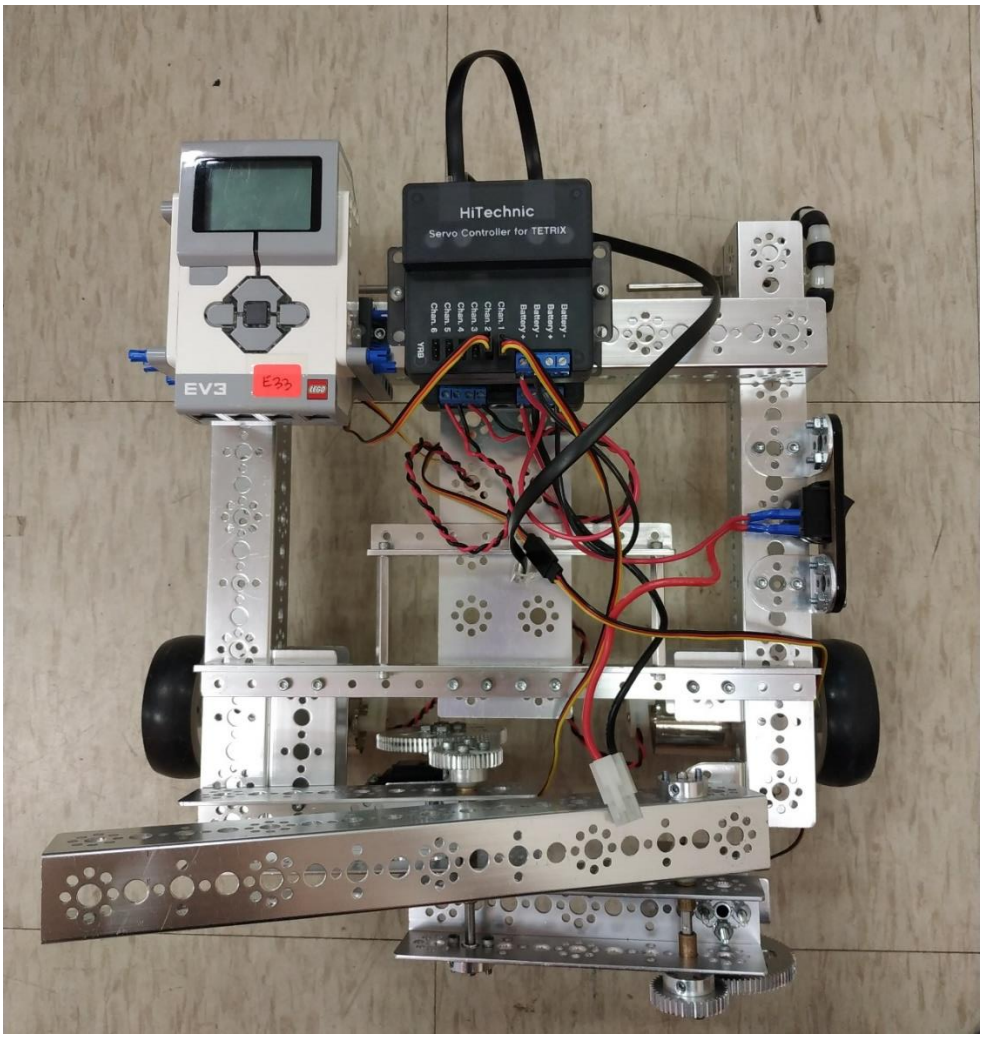

Figure 4.2.1 Latest Design of Automated Crops Harvester

Above is the lastest design of Automated Crops Harvester. The base of the robot is built up by Tetrix Set consists of two MAX CD Motor. EV3 brick is attached on top of the robot. Besides that, two servo motor is attached to the side of the robot using Tetrix Set for the arm part. By using Tetrix Set, the robot's arm is more stable compare to arm build using EV3 Lego Set.

4.3 Movement Module

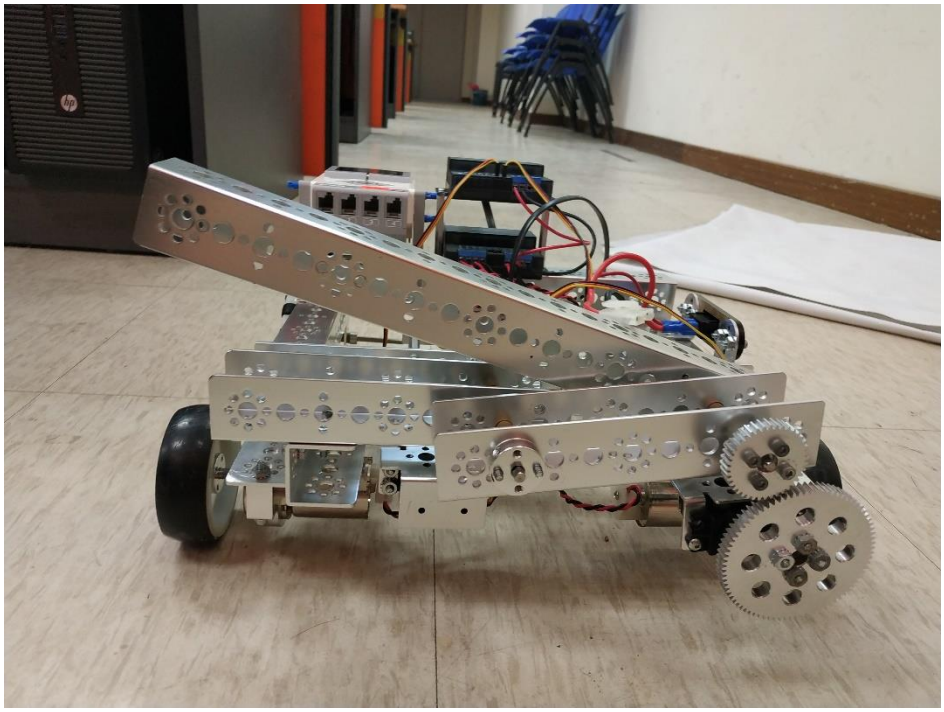

Figure 4.3.1 Side View of the robot

Figure 4.3.1 shows the arm part of the Automated Crops Havester. Two gears attached to the lower servo motor for stronger force apply to the whole arm part of the robot. Two MAX DC Motor is used to move the Automated Crops Harvester.

4.4 Sensors (Detection and Response) Module

a. Webcam

The webcam is used to detect tomato. The position of the webcam is fixed so that the system can calculate the position of the tomato accuratetly. The captured image is then sent to the image recognition module for recognition purpose.

b. Gyro Sensor

A Gyro Sensor from EV3 Lego Set is use to move the robot arm's angle accuratly.

4.5 Intelligent Module

Image processing is used in the Automated Crops Harvester.

a. Image Recognition

In implementing the tomato identifier, we utilize an object detection technique called Single-Shot Multibox Detector (SSD) through Tensorflow. However, we do not build the model from scratch, instead applying a technique called transfer learning to adapt an existing SSD model to our situation. Towards this end, we sampled 100 images of ripe red tomatoes and 100 images of unripe green tomatoes and retrain the model.

In the implementation, the source of the images will be capture and collect from a camera. Using the OpenCV library, the Python script will take pictures at regular intervals and then the numpy library will convert the images into arrays. The arrays will then be fed through the model by the tensorflow library. The results will be then be passed to the actuator system.

In summary, the OpenCV library will capture images of the tomatoes, while the numpy library converts the images into arrays that will then be fed through an SSD model by the tensorflow library to produce the results needed by the system. To retrain the model to fit our purposes, we will perform transfer learning to adapt an existing SSD model to differentiate between ripe and unripe tomatoes.

4.6 Summary

In conclusion, the Automated Crop Harvester is designed by using the components of EV3 Lego Mindstorms set which contains bricks, motors and sensors. Also, Tetrix set components is chosen to be base of the robot so that the robot movement is more stable and accurate for performing the task.

CHAPTER V

IMPLEMENTATION

5.1 Introduction

Automated Crops Harvester is an intelligent system that are developed to harvest ripe tomato by using image processing. The intelligent module that embedded in the application enables the harvester to identify ripe tomato and harvest it at its optimal period end eventually reduce the wastage of crops.

Besides that, image processing and decision-making is done by using Python programming language on the computer. Commands are then issued to the EV3 brick that is running LeJos software to perform the actions.

5.2 Movement

a. Medium Motor Movement

The medium motor is used to control the claw movement of the Automated Crops Harvester according to the results of image processing. Medium motor and other compenents from the EV3 LEGO Set are used to build the claw part of the system. The motor is programmed for claw opening and closing to grab and drop the selected tomato.

b. Large Motor Movement

The motor will move control the position of the claw of the Automated Crops Harvester. The large motor is attached to the claw using components of EV3 LEGO set. Large motor is programmed to control upwards and downwards movement of the claw for easier tomato grabbing.

c. MAX DC Motor

Two MAX DC Motor is attached by the side of the robot. The motor is used with other components of Tetrix Set to control the movement of the whole Automated Crops Harvester. It is programmed to move the robot left and right along the path.

d. Servo Motor

Two servo motor is used to control the arm movement of the Automated Crops Harvester. The servo motor and other components from Tetrix Set is used to build and control the arm part. One of the servo motor is programmed to move the lower arm, and another is programmed to control movement of upper arm.

5.3 Detection and Response to Environment

a. Image Detection and Recognition

A webcam is used to detect and capture tomato. The system will recognize the tomato and classfy it as ripe or unripe tomato. The image processing is implkemented by using Tensorflow Library.

b. Large Motor

Two large motors is programmed to move along the path.

c. Medium Motor

The medium motor moves in response to the results obtained from the system embedded with the image processing. When the system recognize a ripe tomato, it will response by control the claw to collect the respective tomato.

d. Servo Motor

Servo Motors move in response to the height of the tomato calculated by the system. Both of the servo motor response concurrently to reach the optimum height for claw to collect the tomato.

5.4 Completing Task via Intelligence

Image Processing

To implement the image processing technique, a image recognition training model is used to train the data. The training model helps to recognize the ripe and unripe tomatoes according to the color of the tomato. 50 dataset of ripe tomato and 50 dataset of unripe tomato are collected.

The webcam will capture the tomato, and then analyse the image using the trained model that used TensorFlow Library.

5.5 Summary

In conclusion, the intelligent application was successfully implemented and developed. The system will perform different task when ripe tomato is detected or unripe tomato is detected. Lastly, the intelligent model which is image processing embedded in the application will allow the program to run smart and efficiently.