

Autonomous Recycling Robot

EnviRobo

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Overview

Introduction to the project

Mechanics

Intercommunication and Navigation System

Image Capturing and Processing

Building the Environment

Problems Encountered

Q&A

Purpose of our Project

What is our project:

- Environmentally friendly robot

- Sorts and collects desired objects

Why we picked it:

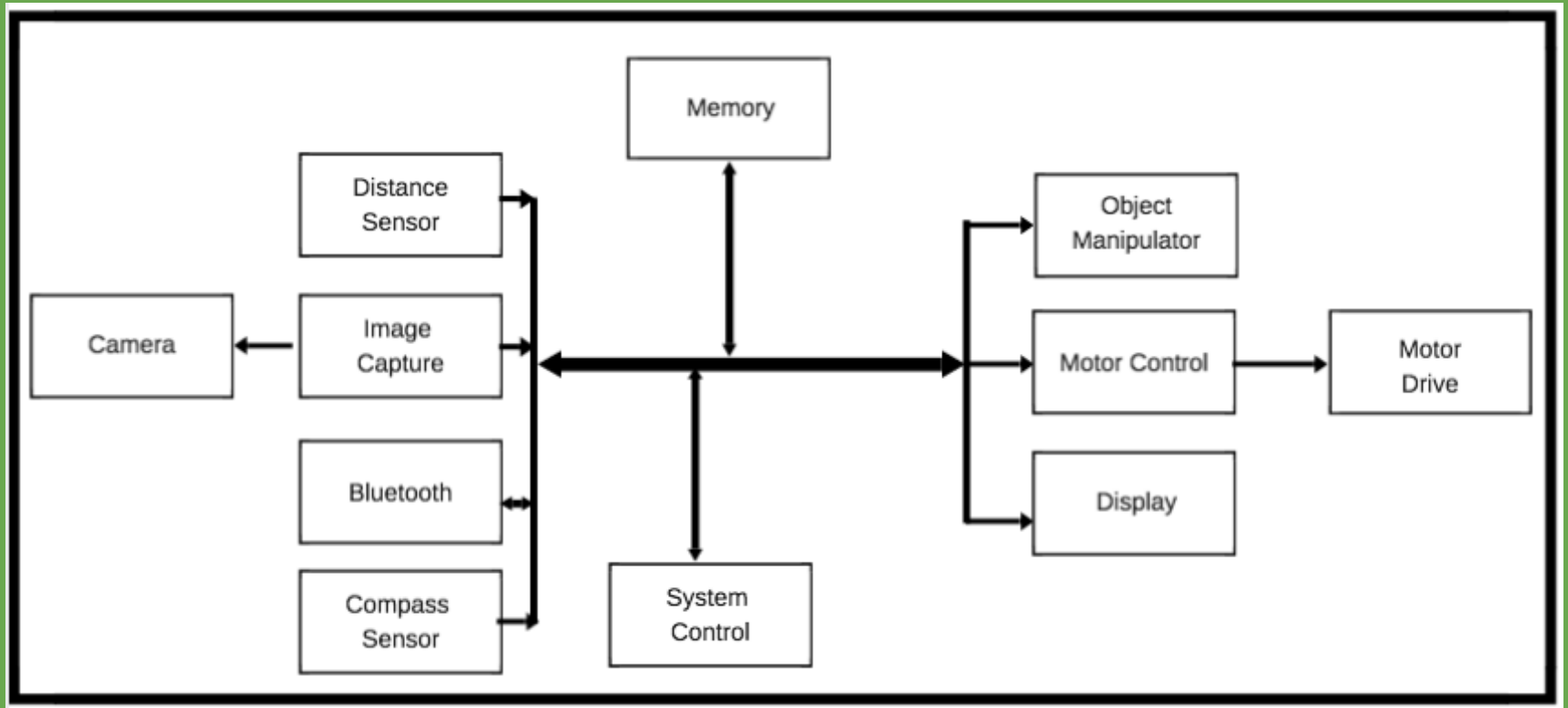
- Fix an everyday problem

- Solution to picking up trash

- Solution to sorting trash correctly



Block Diagram



Motion and Mechanisms

Components:

MSP432P401R - control logic

Robot - chassis

Continuous rotation servos - wheels

Towerpro Micro Servo SG90 - plastic trapping mechanism

Battery pack - wheels

Rechargeable battery - MSP

6 digital sensors



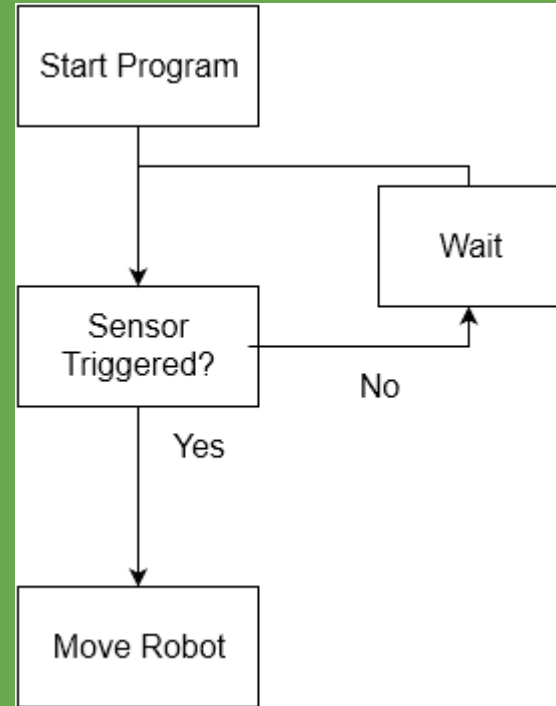
Motion and Mechanisms

Algorithms:

Polling: digital sensor data

Autonomous motion - if else logic

Manual control - bluetooth communication



Motion and Mechanisms

Testing and Results:

- Setting up the platform

- Configuring wheel servos / arm servos

- Powering the system for mobile use

- Distance sensors (power and accuracy)



Intercommunication and Navigation System

Components:

The GY-85 9 Degrees of Freedom Sensors
I²C Protocol with R-Pi

Magnetometer (HMC5883L) for direction

Accelerometer (ADXL345) for tilt sensing

BlueSMIRF RN-42 Bluetooth Module

UART protocol

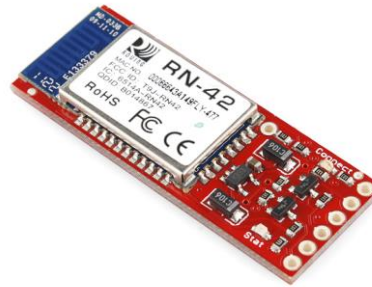
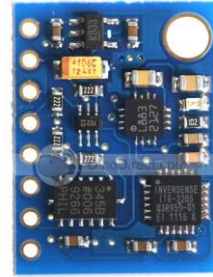
Configured in SPP mode

Wireless human interface

SSD1306 OLED Display

I²C protocol with MSP432

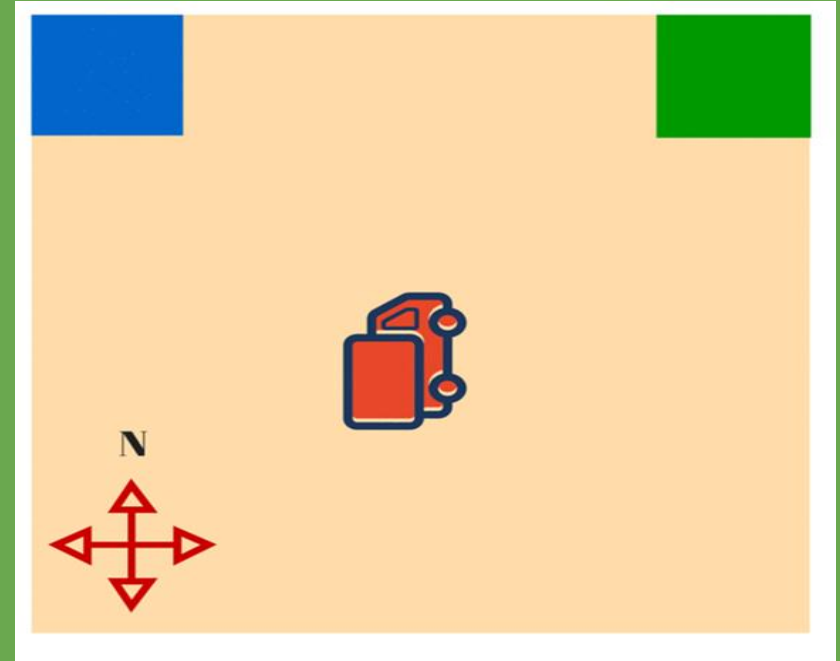
General debugging interface



Intercommunication and Navigation System

Algorithms:

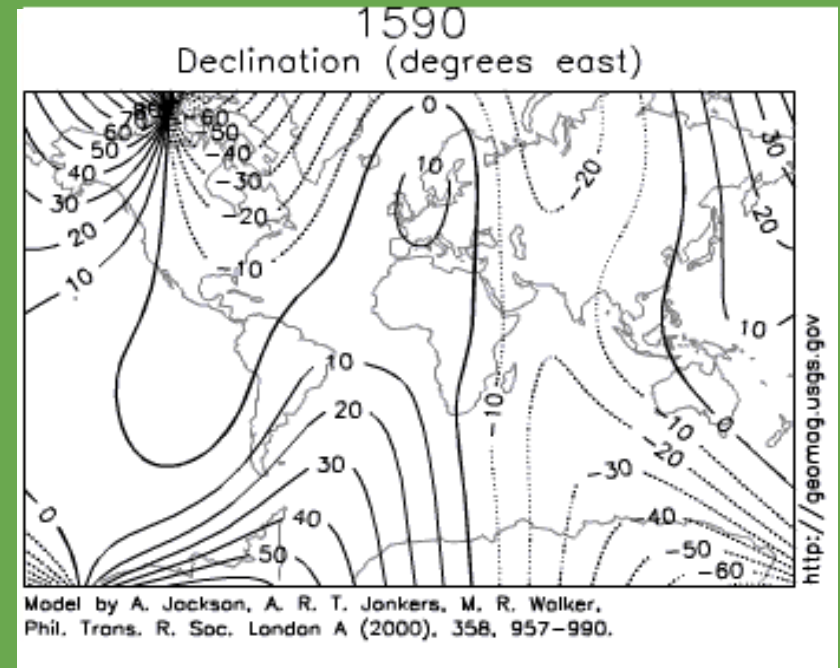
- The Navigation System
 - Magnetometer as an indoor compass
 - Heading to determine direction
 - Default direction after trapping (North)
- Predetermined Locations
 - NW bin for bottles
 - NE bin for bananas
- Problem: Magnetic North, not True North
 - Avoid environments with metals
 - Magnetic declination



Intercommunication and Navigation System

Algorithms:

- The Navigation System
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Intercommunication and Navigation System

Algorithms:

- User interface
 - Matlab GUI utility
 - Serial data over Bluetooth: PC to MSP432
 - Directions, modes, and trapper
- System Display
 - OLED Display
 - Direction status
 - Overall status (trapping? searching?)

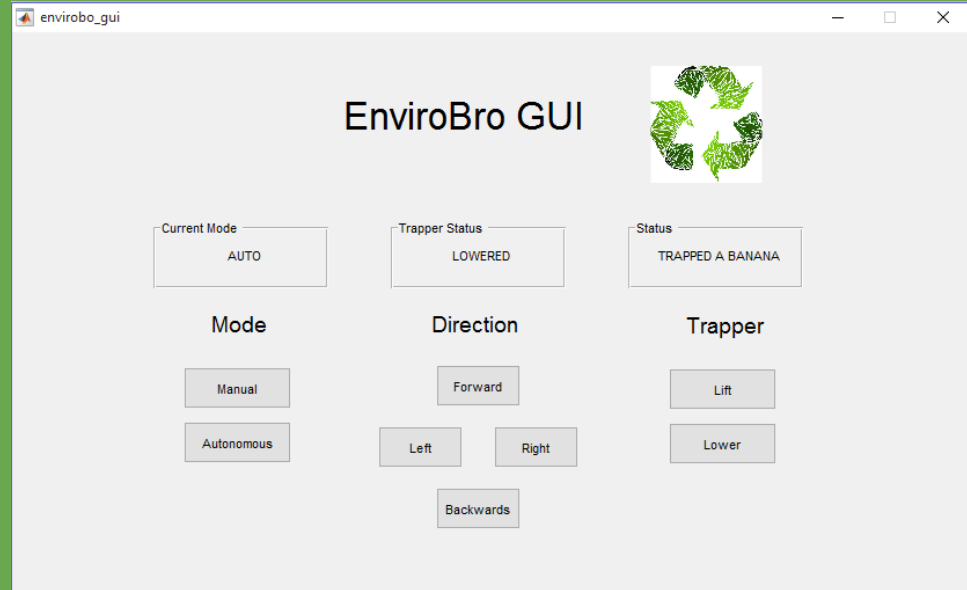


Image Capturing and Processing

Components:

Raspberry Pi

Raspberry Pi camera module

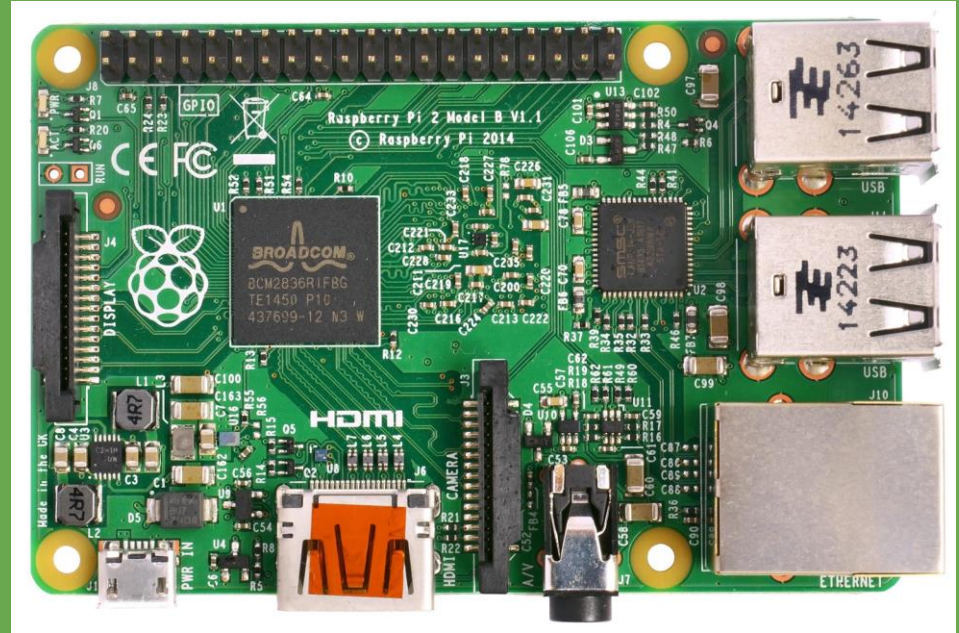
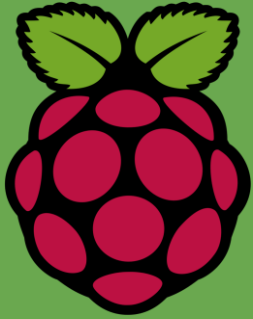


Image Capturing and Processing

Algorithms:

Sequence of images v.s. Video:

Video recording is preferred

Problem with the bandwidth

Solution is multithreading

Slower and smaller frame rate

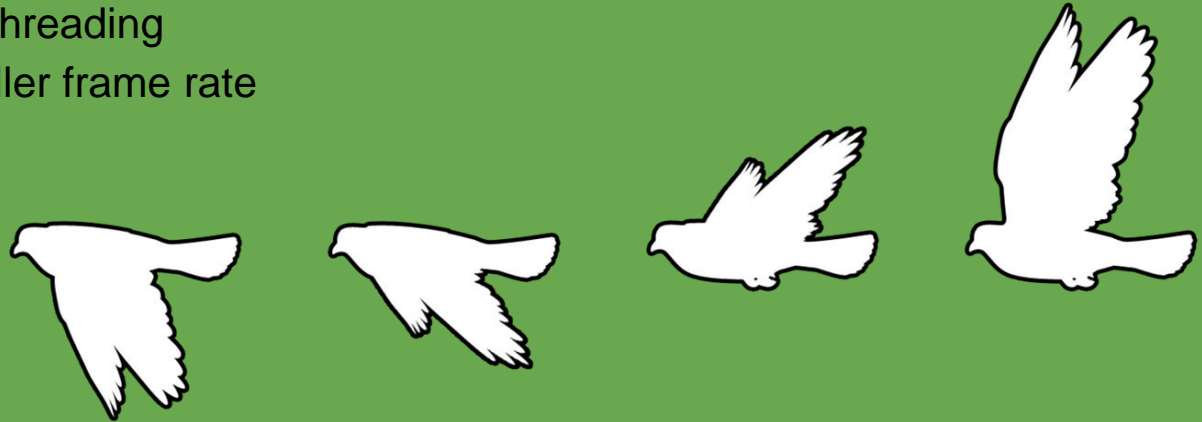


Image Capturing and Processing

Algorithms:

Object recognition:

OpenCV + Python

Haar feature-based cascade classifier

Collecting Image Database

Arranging Negative Images

Crop & Mark Positive Images

Haar-Training

Creating the XML file

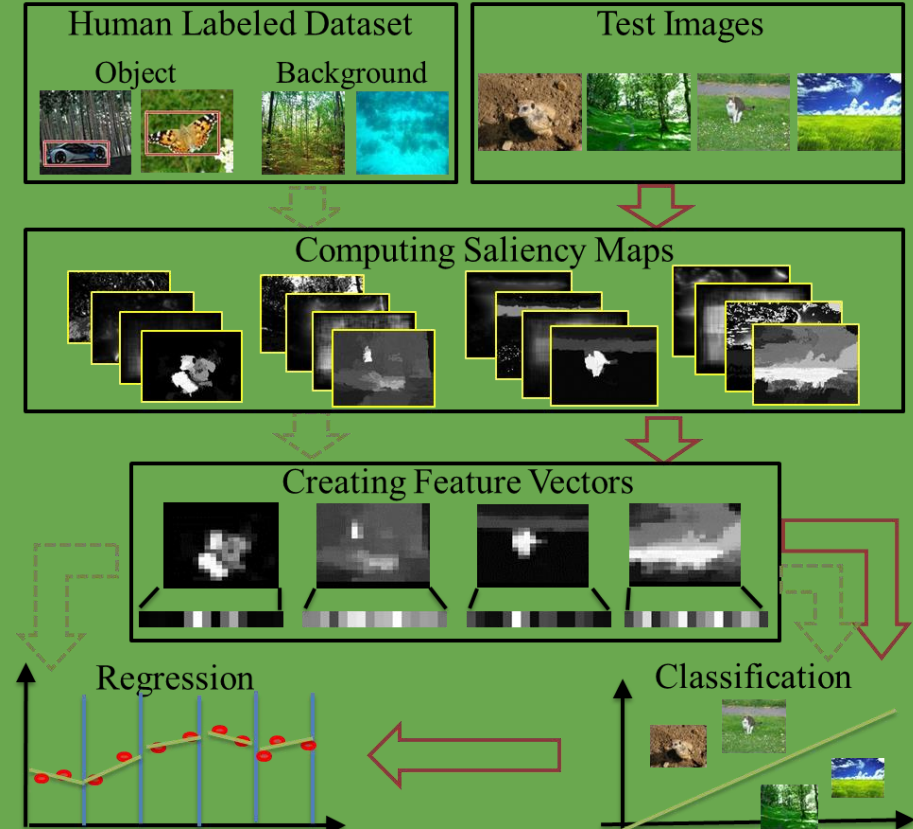


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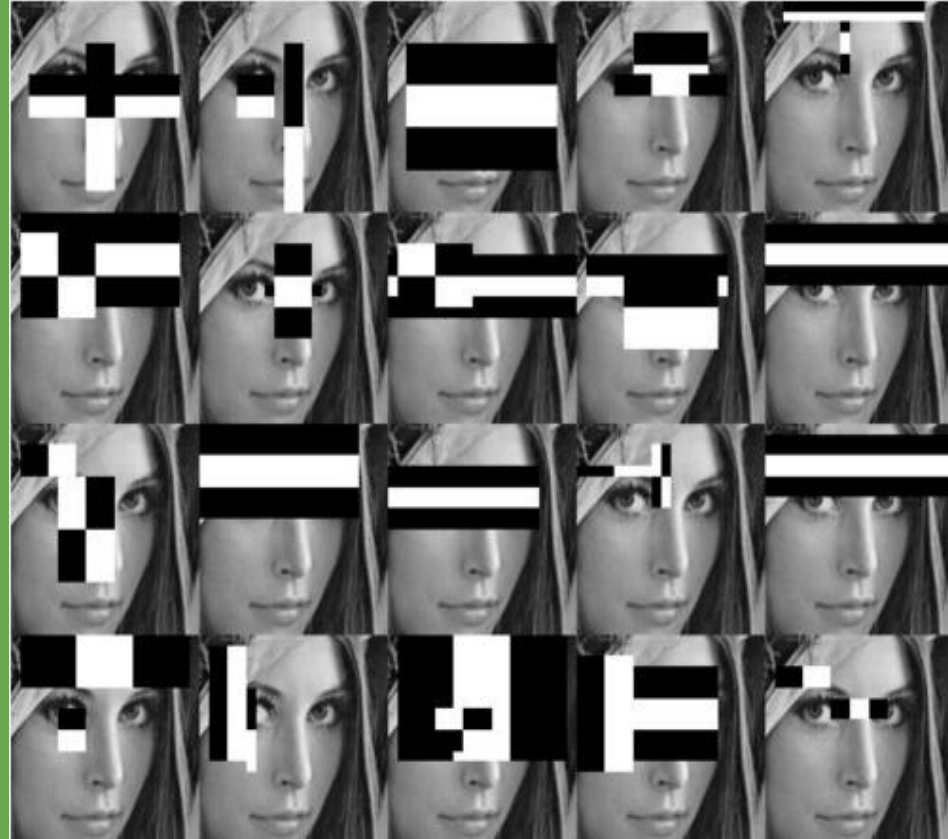
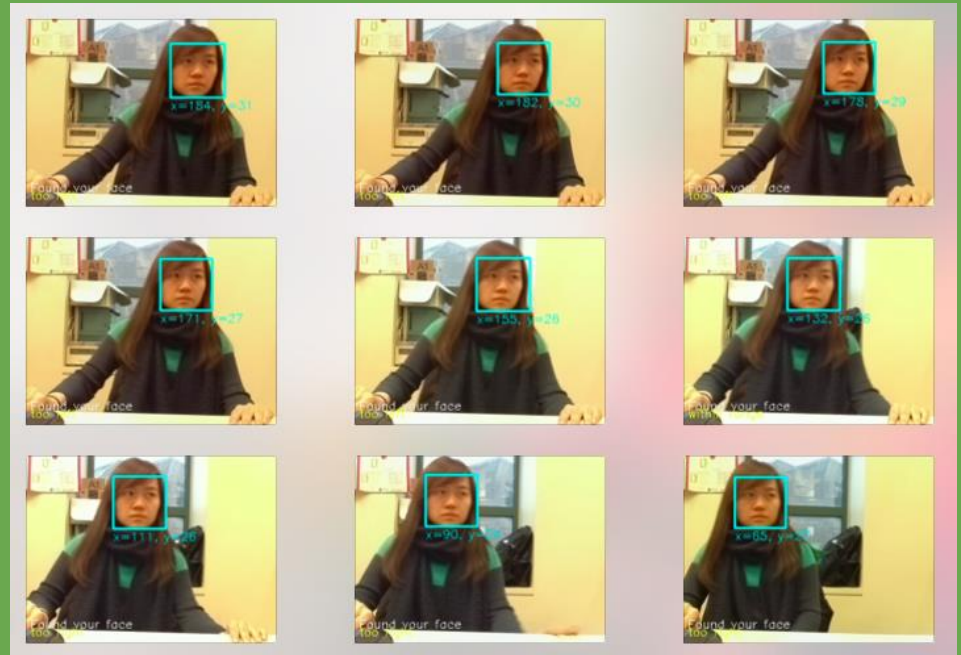
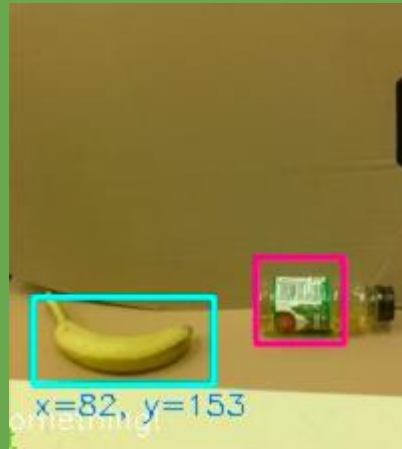
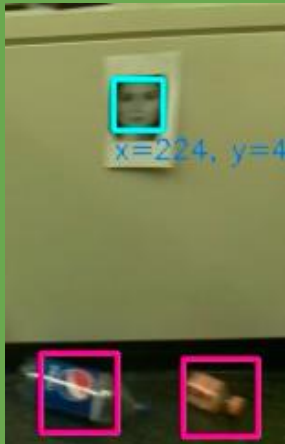


Image Capturing and Processing

Testings and Results:

Used face recognition for testing
Testing UART with computer



Building the Environment

Components:

Cardboards + Duct tape

Requirements:

Eliminate background noise

Flatter surface

Predefined corners as recycle bins



Problems Encountered

Power Management

Environmental

Object recognition

Wheels on floor

Compatibility of the software systems

Python 2 and Python 3

Libraries



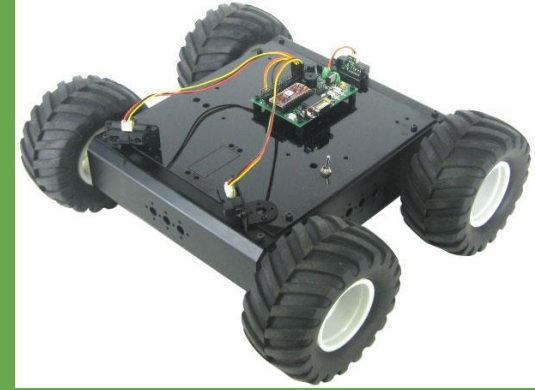
Conclusion

Things that can be done differently:

Hardware

- Different robot body

- Add or use different sensors

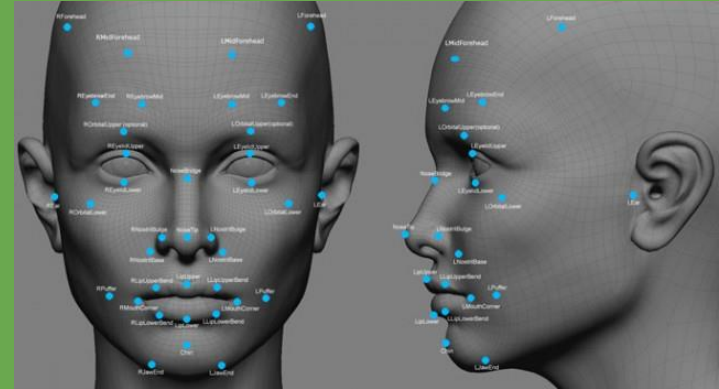


Software

- Better object recognition

- Smarter motion logic

- Develop an app/server for objects



The End

Thank you for listening :)

