Raspberry Pi 3 Robot

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**Electronic Projects**

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**Abstract**

This is a report containing information about a project that I attemptted to do for my "Electronic Projects" class. In this project, I decided to create an autonomous robot that is able to follow a set of given instructions using a camera. With a budget of approximatly $241.15, I designed and built the robot from scratch. I decided to use a Raspberry Pi 3. Currently, the robot is able to track faces and follow a line. At the time that this report is completed, the Raspberrry Pi 3 Robot will only be able to do those two tasks. But hopefully in the future I will be able to update this entire report and finish programming the robot.

**Methods**

To start, I planned the most of the project using Microsoft Word, Excel, and PowerPoint. All of the details will be displayed in the Results section. Most of the parts came from online websites. After the parts arrived, I had to setup the Raspberry Pi 3 using the official guides and documentations released by: <https://www.raspberrypi.org/>. To access the Raspberry Pi 3, I used a monitor with HDMI IN. After gaining access, I turned on the options VNC and the Raspberry Pi Camera module. VNC also had to be installed on a PC or Laptop. VNC allows easy remote access from a PC to a Raspberry Pi. After setting up the Raspberry Pi 3. I had to teach myself a new programming language called Python3. The site I mainly used is: <https://www.learnpython.org/en/>. After I learned the basics, I programmed on the Raspberry Pi using a software called Ninja-IDE. Any problems or bugs I came across was researched and fixed quickly. I mainly used the PiGPIO module for Python3 to gain control of the Raspberry Pi 3: <http://abyz.co.uk/rpi/pigpio/index.html>.

**Results**

**Project Details/Description**

**Project Subject:** Building an Autonomous Robot

**Author(s):** Jimmy Vang

**Main Objective:** Build an autonomous robot that is able to follow a set of given instructions using a camera.

**(Optional) Other Objectives:** Program machine learning to the robot.

Program the robot to be able to explore and wander.

Program the bot to do voice recognition.

**Estimated Cost (Budget):** $241.15

**Responsibilities:**

Jimmy Vang – All objectives.

**Plan/Timeline:**

Key:

* - Finished
* - Not Finished

Objective 1: Research and Buy.

* - Research
* - Buy Robot Parts.

Objective 2: Design/Build Robot.

* - Design robot.
* - Build robot.

Objective 3: Learn and Study Python Coding + Program Autonomous Robot.

* - Learn the Python language.
* - Setup computer vision system for camera.
* - Setup servos for camera.
* - Program simple line follower.
* - Program face recognition.
* - Program robot to track objects.
* - Program simple obstacle avoidance. **(ON HIATUS)**
* - Program robot to follow a person. **(ON HIATUS)**
* - Program robot to see surroundings and avoid them. **(ON HIATUS)**

Objective 5: Test and Calibrate Robot.

* - Test and calibrate robot for maximum performance and errors.
* - Fix bugs and code if needed.

(Optional) Finish Other Objectives if possible.

* - Program machine learning to the robot. **(ON HIATUS)**
* - Program the robot to be able to explore and wander. **(ON HIATUS)**
* - Program the bot to do voice recognition. **(ON HIATUS)**
* - If time allows, add more objectives. **(ON HIATUS)**
* - Create User Documentation. **(ON HIATUS)**

**Budget**

|  |  |  |
| --- | --- | --- |
| **Current Budget** |  |  |
| **Part** | **Cost** | **Quantity** |
| 120cm A to Micro B USB Cable | $3.05 | 1 |
| 2WD Beginner Robot Chassis | $11.89 | 1 |
| 300mm Flex Cable for Raspberry Pi Camera | $1.95 | 1 |
| 400 Tie Point Interlocking Solderless Breadboard | $3.79 | 1 |
| 65 x 22 Gauge Assorted Jumper Wires | $3.95 | 1 |
| Adjustable Camera Mount Holder Stand Bracket For Raspberry Pi Camera | $3.68 | 1 |
| DFRobot Assorted Jumper Wires Premium M / F Pack of 65 | $5.90 | 1 |
| Lynxmotion Pan and Tilt Kit / Aluminium | $29.93 | 1 |
| Pololu Dual DC Motor Driver 1A, 4.5V-13.5V- TB6612FNG | $4.95 | 1 |
| Raspberry Pi 3 Model B V2.1 Computer Board | $39.95 | 1 |
| RPi Camera for Raspberry Pi | $15.99 | 1 |
| Self-Adhesive Pure Copper Heat Sink For Raspberry Pi | $0.99 | 1 |
| Wall Adapter Power Supply - 5VDC 2A | $5.95 | 1 |
| 7.1 Channel USB External Sound Card Audio Adapter | $6.99 | 1 |
| Movo GM100 Lavalier Lapel Clip-on Omnidirectional Condenser Microphone | $14.95 | 1 |
| Raspberry Pi Transcend Micro SD Card 16GB Class 10 NOOBS Preloaded (Pi 3 2 B) | $9.99 | 1 |
| Adafruit PiTFT 2.4" HAT Mini Kit - 320x240 TFT Touchscreen | $34.95 | 1 |
| Brass M2.5 Standoffs for Pi HATs - Black Plated - Pack of 2 | $1.50 | 2 |
| Fast Vibration Sensor Switch (Easy to trigger) | $0.95 | 1 |
| ADXL326 - 5V ready triple-axis accelerometer (+-16g analog out) | $17.95 | 1 |
| Black Nylon Screw and Stand-off Set – M2.5 Thread | $16.95 | 1 |
| Tactile Switch Buttons (6mm slim) x 20 pack | $4.95 | 1 |
| **TOTAL** | **$241.15** |  |

**Demo**

The Demo was written in Python3 code and is still being modified and optimized. It features a simple text GUI and allows the user to run 2 main programs, 2 of which are test programs. They are as follows: Object Tracker, Line Follower, Motor Tester, and the Servo Tester. I plan to add more programs soon.

**Program #1: Object Tracker**

I was able to get the object tracker to work using OpenCV2. Currently the Raspberry Pi Camera is only able to track faces. The code is still being worked on and needs to be optimized.

**Program #2: Line Follower**

Using OpenCV2 I was able to get the robot to follow a straight and curved line. The Raspberry Pi Camera uses hough lines in OpenCV2 <http://docs.opencv.org/3.0-beta/doc/py_tutorials/py_imgproc/py_houghlines/py_houghlines.html>. The code still needs to be optimized.

**Datasheet Links For Parts**

Raspberry Pi 3 Datasheet

- <https://www.raspberrypi.org/documentation/hardware/computemodule/RPI-CM-DATASHEET-V1_0.pdf>

Hitec HS-422 Servo Motor Datasheets

- <http://www.robotshop.com/media/files/pdf/hs422-31422s.pdf>

- <http://www.robotshop.com/media/files/pdf/servomanual-31422s.pdf>

Pololu Dual DC Motor TB6712FNG

- <https://www.pololu.com/file/0J648/TB6612FNG-dual-motor-driver-carrier-schematic-diagram.pdf>

- <https://www.pololu.com/file/0J86/TB6612FNG.pdf>

Hex Inverter with Open-Collector (N7405A)

- <http://www.ti.com/lit/ds/symlink/sn7405.pdf>

**Conclusion**

The results of this project in its current form are not finished, but they have come pretty far. In this project I completed my first simple Object Tracker, and Line Follower. I also created a Demo to run the programs. The current budget is not official but will be after the project is finished. Being my 2nd time writing a report, this has been a learning experience. Hopefully in the future, I will be able to complete the project and finish coding the entire robot to create my first Autonomous Robot.

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