**Senior Design**

ENG EC 463

**Autonomous Legged Guide Robot**

**Team 2**

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**Required Materials:**

Hardware:

1. OAK-D Camera (with cables)
2. Raspberry Pi
3. Puppypi robot dog

Software:

1. Nvidia Omniverse
2. VNC Viewer

**Setup:**

OAK-D test:

The OAK-D should be connected to the processor. We use a Mac OS for this time. The OAK-D will return the information of the detection to the computer with the class name, distance, and confidence level.

Simulation test:

Open the Issac Sim simulation software and set up a virtual environment for the dog to walk. Plan the route that the dog should take. Put the dog model to its initial position.

Robot Dog test:

The robot dog must be fully charged before testing. The robot dog’s internet setting should be switched to hotspot mode. The SD card with the modified program should be installed. A laptop with VNC software should be prepared to connect to the robot dog.

**Pre-testing Setup Procedure:**

Robot Dog test:

The robot dog should be turned on. A WLAN hotspot with SSID starting with “HW-1a” should be detectable. The computer needs to connect to the hot spot. Then, use the VNC software to connect to the onboard Raspberry Pi. The IP address should be 192.168.149.1 and username should be “pi”, and the password should be “raspberry”. After connection, a graphical desktop should be visible. For file transfer, WinSCP is needed. It can log in using the exact same credentials. Once these are done, the setup is complete.

**Testing Procedure:**

OAK-D test:

1. Set the detection parameters
2. Use the camera to “see” an environment with the target for a very short time
3. Use the camera to approach the target
4. The computer will respond with the detection correspondingly with the speaking module.

Simulation test:

1. Add obstacles in the simulation scene.
2. Add a quadruped-legged robot into the scene.
3. Move the dog and check the interaction with the obstacle.

Robot Dog test:

1. Put the robot dog in a test environment with no obstacle
2. Observe the test environment, and find the best route the robot can go
3. Program the robot based on route
4. Check if the robot can walk along the planned route

**Measurable Criteria:**

OAK-D test:

1. The processor should be able to speak the target object with distance
2. The processor should not speak when only have a glance of the target

Simulation test:

1. In the test environment, the robot should be able to walk as planned.
2. In the simulation, the robot dog should walk normally and stop in front of the wall in the simulation software.

**Score Sheet:**

| Objective | Correct? |
| --- | --- |
| In the simulation, the robot dog stops in front of the obstacle | Yes |
| In the test environment, the robot dog can be reprogrammed as desired | Yes |
| In the test environment, the robot dog can be programmed to walk along the desired route | Yes |

**Conclusion:**

Overall, our first prototype test went reasonably well as most measurable criteria were met.

For the OAK-D camera test, the camera was able to successfully detect not only the face of the person, but also the hand. The speaking module was connected to the recognition module properly as the detection and the voice output were successfully demonstrated. And since the duration of detection was set to be 2 seconds, there was no output when the hand or the face of the person was only within the detectable range for “a glance”, or anytime shorter than 2 seconds.

For the simulation test, due to hardware limitations, we were unable to perform a real-time demonstration of simulation on any laptops. Therefore, a video of simulation of a certain situation was recorded and presented instead. In the video, the robot dog was able to detect the obstacles in front and perform a proper detour to avoid that obstacle.

For the robot dog test, we were able to connect the robot dog with our monitor via hotspot connect. And by modifying the code and adding command to the robot dog, the dog was able to perform all types of basic actions including moving forward, moving backward, and making turns.

Even though the first prototype test went smoothly as most criteria were met, we have a set of potential issues to face in the foreseeable future. First of all, the connection between the robot dog’s cpu, which is Raspberry Pi, and the OAK-D camera could be problematic. If Pi is utilized as the power source of the OAK-D camera, the CPU might not be powerful enough to process all the data passed from OAK-D and it might be extremely power consuming.