Maker Challenge 2016 Submission Project

Project name: Pi Cam Car

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From Hochschule Rhein-Waal

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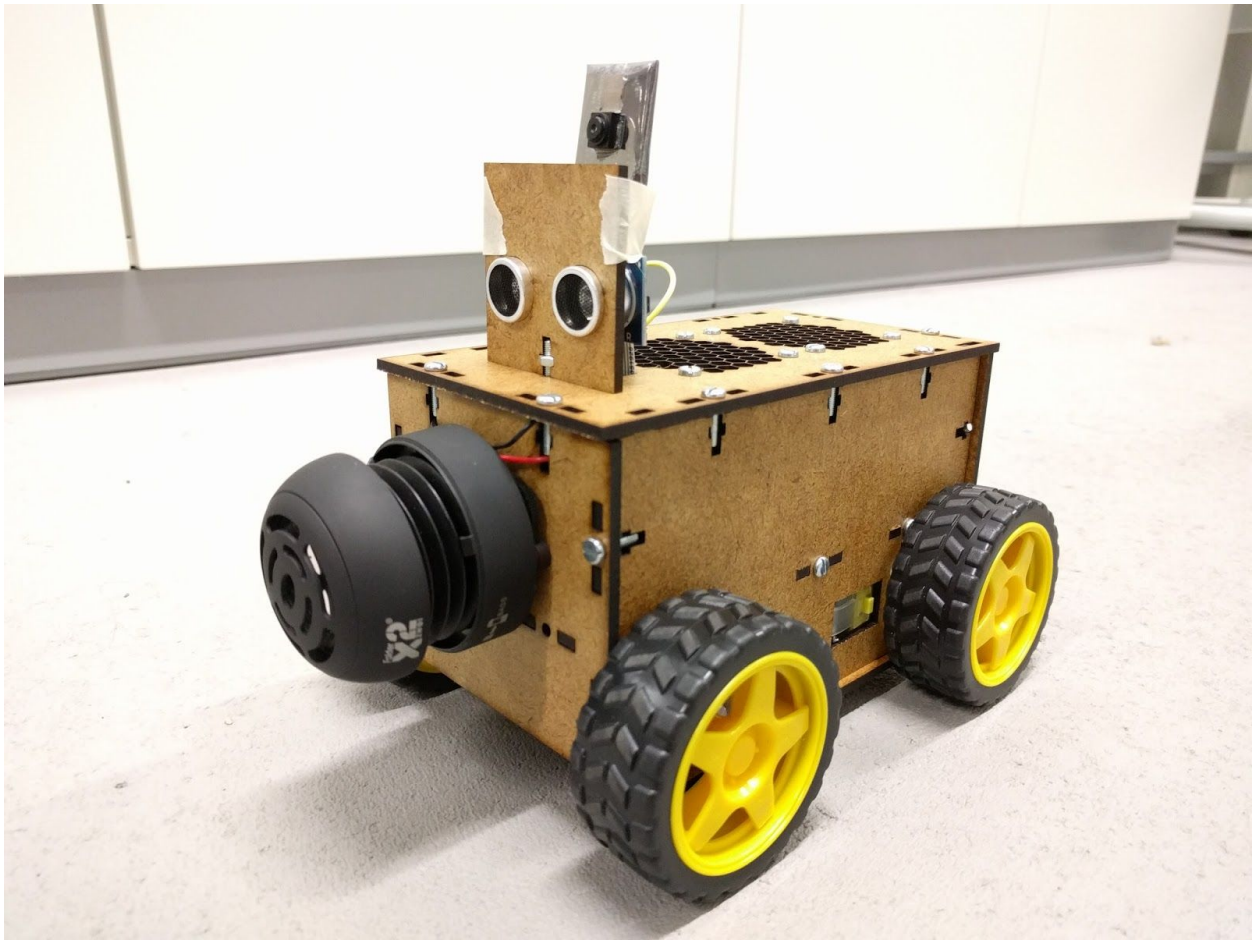

Introduction

Through this project, we would like to contribute to the open source maker community with a robotic car that is able to perform smart tasks such as: **automated driving, avoiding obstructions, face recognising, and providing audio feedback**. We believe that automated robots are not only a trend but can actually add value to various aspects of our life and our future. We hope this will become a useful educational tool and inspiration for young makers who not only love building things but also have strong interest in electronics and programming.

Despite the popularity of Arduino boards and Arduino programming among the maker community, our project uses a Raspberry Pi and the Python programming language instead. This is because of the aims of the project, which include computer vision and audio feedback, thus audio input, a camera and video streaming is needed. We believe using a Raspberry Pi and the Pi camera module is more budget-friendly than an Arduino and an Arduino shield, and the Raspberry Pi is certainly more powerful and can meet the requirements of the project.

Along the course of the project, we have come across many troubles, some of which we managed to tackle, some we had to find alternatives, and some we still could not solve. Also because of the packed timeline, we could not include more features and functions that we intended to, but we will make sure to work on them later on when we have sufficient time and resources.

Description of functionalities

1. Automated driving and obstruction avoiding

When wired correctly and powered using the recommended battery pack, the Pi Cam Car should be able to drive by itself. While driving, it can detect obstructions in front of it. This is done using the ultrasonic sensor placed at the top front of the car. When the obstruction is close enough, the car will avoid the obstruction by turning left or right, until there is no more obstruction in its way.

2. Face recognition and interaction

Our Pi Cam Car is able to detect faces within its viewing perspective, which is the perspective of the attached Pi Camera. This perspective can be observed on another computer or laptop through the Remote Desktop function installed on the Raspberry Pi. As such, we can have kind of a live stream of what the car actually “sees” and check whether it has correctly recognised faces.

Once the car has detected a face at a sufficiently close distance, it will drive by itself towards the person and interact with the person through audio output.

3. Provide audio feedback

Pi Cam Car is able to play supported audio file through its attached loudspeaker in response to certain triggers. For example, after approaching the person whose face has been recognised, it will say hello or introduce itself. It can also play warning sound when facing with obstruction, and notification sound when obstruction is successfully avoided.

Potential extensions of functionalities

1. Flexible camera angle

One important add on could be a separate camera mounting unit that can help to rotate the camera and move it up and down so that it can have a wider view and detect more faces. It is possible to modify the code such that the camera can detect an object of choice instead of only faces, however, this would require much more complicated programming and thus was excluded in the project.

2. Motion tracking and additional face features recognitions

It would be ideal if we could track the motion of the identified object or person and interact with the person based on their motion or changes in facial expressions. For example, play a certain sound when a person smiles, another sound when a person waves their hand, etc.

3. Voice recognition

In addition to interaction based on motion and features of objects, the car can also be improved to respond to certain sound through voice recognition. For example, move forward, backward, left, right based on the corresponding audio input.

4. Sensor fusion

Multiple sensors can be embedded to obtain higher precision in avoiding obstructions. For example, ultrasonic and infrared distance sensors can be combined to output more precise measurements. Or alternatively, we can use 2 camera for stereo vision, which will allow the car to detect obstructions and steer itself based on the camera pictures.

Attached documents

Below is the list of all documents and files needed to build the project:

- car_frame_design.pdf
- code_package.zip
- material_list.xls
- project_desciption.pdf
- set_up_instructions.pdf

Licenses and information

We agree to publish and share this project as an open source project with all the included files.
A copy of the project is available on GitHub under the link: https://goo.gl/MNSrCQ
For further information, please contact us via email: andreas.markwart@hsrw.org or thi.yen-thu.nguyen@hsrw.org