Follow Me Shopping Cart

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Devpost Link:
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Final Project, Fall 2020
ESE519/IPD519: Real-Time and Embedded Systems
University of Pennsylvania

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Abstract

A follow me robot being able to get attached to shopping carts is introduced as a convenient way for everyday shopping. The robot will have the feature of following a specific human based on their Bluetooth mobile device.

Motivation

Our inspiration for this project arose from the daily inconveniences shoppers face while getting items from a shopping facility. The customers typically move around with their shopping carts across the many isles to get their produce. This is cumbersome. To solve this, we have decided to build a follow-me shopping cart to simplify the user's shopping experience. With this device, the shopping cart will follow the customer making it more convenient for our user to purchase their products.

The developed device could be added to various shopping cart sizes and make real-life shopping life much more convenient. One of the challenges to be addressed is how to identify our user from the pool of all other customers within the same area. Supermarkets can get crowded plus any interaction between our user and other people should not interfere with the robot's function. To solve this problem, we will use Bluetooth and configure our robot to link with a Bluetooth enabled device e.g. cellphone, fitbit etc.

An extra feature that could get added if time permits is the addition of a remote controller determining the distance the follow-me cart is going to keep from the user.

Goals (not in chronological order)

1. Order and receive all the necessary parts
2. Build Structure of Robot
3. Develop software for the main follow-me part
4. Communication with Bluetooth and connection to specific cell phone
5. Introduction of Bluetooth function to the main follow-me code
6. Potential extra feature of remote

A. Milestone 1

Points 1,2,3 and introduction to 4th should be completed by the first milestone.

B. Final Demo

Points 4,5 and possibly 6 should be completed by the end of the semester. Also, potential corrections and improvements to the existing structure and program.

Methodology

The core of the project is going to be the robot assembly in addition to the program that instructs it to follow humans. There is a lot of information online for both hardware and software above mentioned parts but the software is written in Arduino code so the understanding and conversion of the program to C/C++ is going to be a priority.
Each of the two IR sensors will be placed on each side of the robot's "head". These IR sensors can detect any obstacle (in our case humans) within a specified distance. When something is detected, the program is going to start functioning:

- The "head" of the robot containing the IR sensors and the ultrasonic will be able to turn, facing our user all the time.
- The ultrasonic detects the exact distance between the robot and the detected obstacle. This information can then be used to calculate the speeds of the four wheels.
- Using the Bluetooth module we will establish a connection between the robot and a specific cell phone. Then, depending on how strong the signal is, we will compare the calculated distance of the Bluetooth with the ultrasonic measurement. If they are matching, then the detected human is our user so the movement towards them may begin. If not, then we can ignore the ultrasonic measurements because it means that another obstacle is being detected.

Note: The reason we need both the ultrasonic and the Bluetooth is because the Bluetooth only gives us information based on a radius around the device, while the ultrasonic will be facing at the correct direction of the path.
In case we have time to complete the extra features, we are going to assemble a simple remote with two or three buttons, one IR LED (we chose IR LED so we can avoid interference caused by the overhead lights) and add another simple IR sensor to the robot. Pressing each button will make the IR LED blink with a different frequency. From the robot side, each frequency detection will translate to a different distance command to the robot. For example, for 70Hz the robot will keep a 5 feet distance from the user while for 40Hz it will keep a 2.5 feet distance.

Note: We have to keep in mind that the distance has to always be relatively small so that the user can easily reach the cart and place the items inside.
For the motion of the robot, we are most likely going to implement differential drive, which means the separation of the four wheels into two groups: the left and the right side wheels. Each pair is going to have different velocity commands which would allow the robot to make any necessary turns.

Components

Components	Quantity	Function
Arduino UNO	1 (or 2)	Robot (and remote)
Motor shield	1	Control of the wheels
Ultrasonic sensor	1	Distance detector
IR transceiver	2	Placed at two sides of “head” for obstacle detection
DC motor	4	Attached to every wheel
Wheel	4	
9V battery	1	Power to circuit
Laser cut parts for main base		
(IR LED)	1	Extra feature
(IR sensor)	1	Extra feature

Evaluation

Our goal for this project is to ensure the robot follows a person without the person having to do specific signals or movements. It should also be able to follow a specific person in a crowd of 3-4 people. The perfection of the Bluetooth feature could be developed at a later version of the project.

The project should also consider the difference in size of the developed robot versus a real-life shopping cart. It should be able to clearly show the necessary modifications to function with various shopping cart sizes.

Timeline

Week	**Task**	**Assigned To**
Week 1: 11/09 - 11/15	Outline of the project and finalization of needed parts and program	Both
Week 2: 11/16 - 11/22	Order Parts and Start program	Both
Week 3: 11/23 - 11/29	Assembly and main program completion	Both
Week 4: 11/30 - 12/06	Bluetooth connection and connection to program	Both
Week 5: 12/07 - 12/10	improvements/extra features	Both

Proposal Presentation

ESE-519 Final Project
Fall 2021

Follow me Shopping Cart

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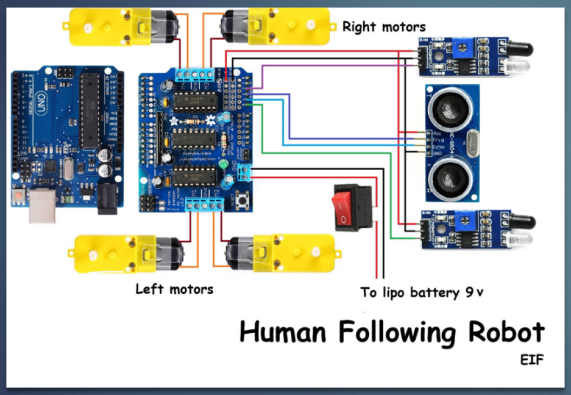
Description

- Help user with everyday shopping
- Follow me robot able to be modified for various sizes
- Bluetooth connection to follow specific person
- Potential extra features: keeping different distance

Technical Details: Main Structure

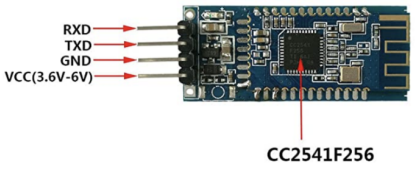


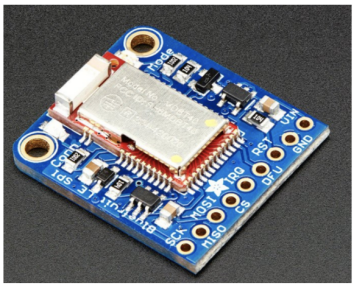
- Small car structure (4 wheels, base, DC motors, motor driver)
- Differential drive
- Two IR sensors for human body detection and DC servo
- Ultrasonic to measure distance

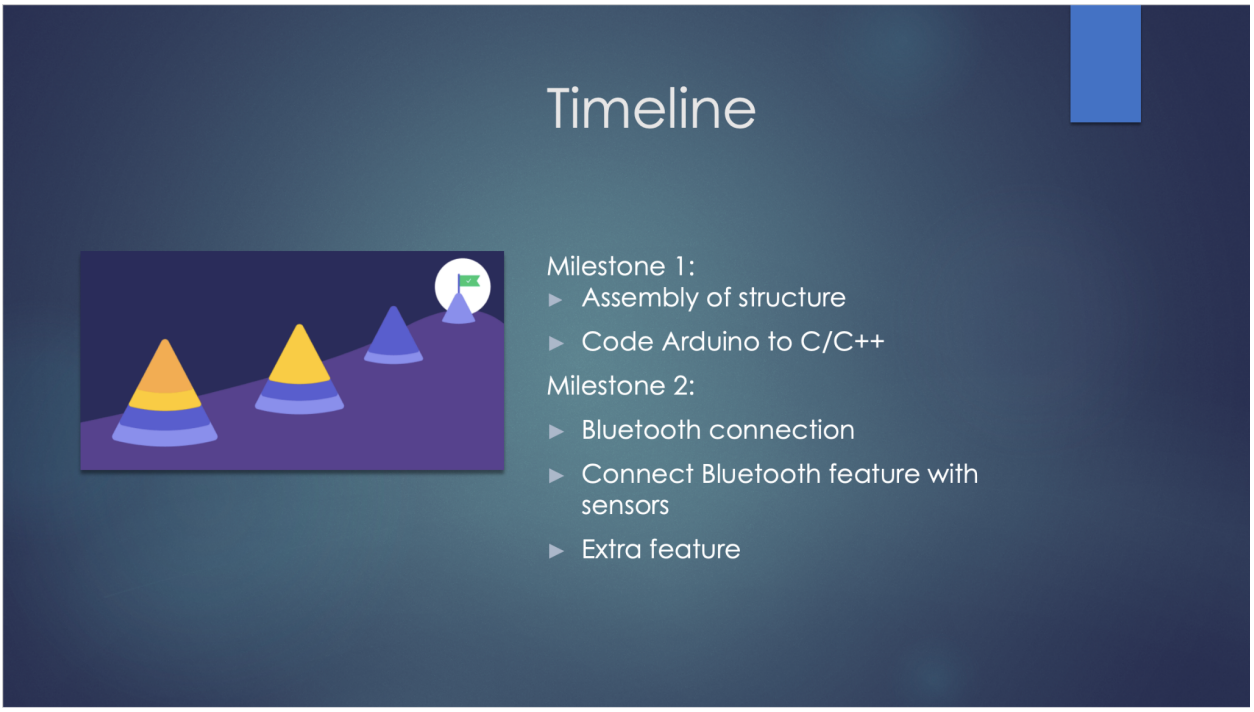
Technical Details: Bluetooth

- Bluetooth chip to connect with specific cellphone
- Coordination of bluetooth with ultrasonic and IR sensors
- Extra feature: remote with IR LED-sensor to change distance

Bluetooth 4.0 BLE Module







References

Main structure:
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https://www.youtube.com/watch?v=yAV5aZ0unag

Human sensing options:
https://en.wikipedia.org/wiki/Human_sensing

Bluetooth and distance:
https://electronics.howstuffworks.com/bluetooth-surveillance.htm
https://smartsensordevices.com/distance-measuring-solution-for-covid-19-using-bluetooth-low-energy/
https://www.instructables.com/Arduino-Bluetooth-and-Ultrasonic-sensor-TUTORIAL/