Auto Vehicle

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Declaration of Sole Authorship

Approved Proposal

Proposal for the development of AutoVehicle

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Executive Summary

As students in the Computer Engineering Technology program, we will be integrating the knowledge and skills we have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build the hardware portion that will connect to a database as well as to a mobile device application. The internet connected hardware will include distance sensors and actuators for controlling the movement of the vehicle. The database will store the mapped area. The mobile device functionality will include remote controlling the vehicle and displaying the mapped area and will be further detailed in the mobile application proposal. I will continue to work together this Winter semester with Jan Yalda and Bilal Al-Fanous, who also built similar hardware last term and worked on the mobile application with me. The hardware will be completed in CENG 317 Hardware Production Techniques independently and the application will be completed in CENG 319 Software Project. These will be integrated together in the subsequent term in CENG 355 Computer Systems Project as a member of a 3-student group.

Background

The problem solved by this project is how to have a robotic vehicle that will be controlled as an RC car with a mobile application, and which can work independently as an autonomous car.

The Hardware which consists of the vehicle's chassis where all the parts are either connected or mounted on which includes the actuators, the H-bridge driver, the ultrasonic sensors and the brain of it all the Raspberry Pi 3. The vehicle's sensors are used to avoid obstacles that are detected and at the same time send data to be used to map an area that will be displayed in the mobile application. Through Wi-Fi the ability to remote control the vehicle is possible using the mobile application.

I have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content" [1] and have found and read the following three articles which provides insight into similar efforts.

- Algorithm Fusion for Feature Extraction and Map Construction from SONAR DataIsmail & Balachandran (2015)
- SLAM for robot navigation Temeltas & Kayak (2008)
- An Open-Source Scaled Automobile Platform for Fault-Tolerant Electronic Stability Control Katzourakis, Papaefstathiou, & Lagoudakis (2010)

In the Computer Engineering Technology program, we have learned about the following topics from the respective relevant courses:

- Java Docs from CENG 212 Programming Techniques In Java,
- Construction of circuits from CENG 215 Digital And Interfacing Systems,
- Rapid application development and Gantt charts from CENG 216 Intro to Software Engineering,
- Micro computing from CENG 252 Embedded Systems,
- SQL from CENG 254 Database With Java,
- Web access of databases from CENG 256 Internet Scripting; and,
- Wireless protocols such as 802.11 from TECH152 Telecom Networks.

This knowledge and skill set will enable me to build the subsystems and integrate them together as my capstone project.

Methodology

This proposal is assigned in the first week of class and is due at the beginning of class in the second week of the fall semester. My coursework will focus on the first two of the 3 phases of this project:
Phase 1 Hardware build.
Phase 2 System integration.
Phase 3 Demonstration to future employers.

Phase 1 Hardware build

The hardware build will be completed in the fall term. It will fit within the CENG Project maximum dimensions of 12 13/16" x 6" x 2 7/8" (32.5cm x 15.25cm x 7.25cm) which represents the space below the tray in the parts kit. The highest AC voltage that will be used is 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will be 20 Watts.

Phase 2 System integration

The system integration will be completed in the fall term.

Phase 3 Demonstration to future employers

This project will showcase the knowledge and skills that I have learned to potential employers.

The tables below provide rough effort and non-labour estimates respectively for each phase. A Gantt chart will be added by week 3 to provide more project schedule details and a more complete budget will be added by week 4. It is important to start tasks as soon as possible to be able to meet deadlines.

Labour Estimates	**Hrs**	**Notes**
Phase 1		
Writing proposal.	9	Tech identification quiz.
Creating project schedule. Initial project team meeting.	9	Proposal due.
Creating budget. Status Meeting.	9	Project Schedule due.
Acquiring components and writing progress report.	9	Budget due.

Mechanical assembly and writing progress report. Status Meeting.	9	Progress Report due (components acquired milestone).
PCB fabrication.	9	Progress Report due (Mechanical Assembly milestone).
Interface wiring, Placard design, Status Meeting.	9	PCB Due (power up milestone).
Preparing for demonstration.	9	Placard due.
Writing progress report and demonstrating project.	9	Progress Report due (Demonstrations at Open House Saturday, November 12th, 2016 from 10 a.m. - 2 p.m.).
Editing build video.	9	Peer grading of demonstrations due.
Incorporation of feedback from demonstration and writing progress report. Status Meeting.	9	30 second build video due.
Practice presentations	9	Progress Report due.
1st round of Presentations, Collaborators present.	9	Presentation PowerPoint file due.
2nd round of Presentations	9	Build instructions up due.
Project videos, Status Meeting.	9	30 second script due.
Phase 1 Total	**135**	
Phase 2		
Meet with collaborators	9	Status Meeting
Initial integration.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Meet with collaborators	9	Status Meeting
Incorporation of feedback.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Prepare for demonstration.	9	Progress Report
Complete presentation.	9	Demonstration at Open House Saturday, April 8th, 2017 10 a.m. to 2 p.m.
Complete final report. 1st round of Presentations.	9	Presentation PowerPoint file due.
Write video script. 2nd round of Presentations, delivery of project.	9	Final written report including final budget and record of expenditures, covering both this semester and the previous semester.
Project videos.	9	Video script due
Phase 2 Total	**135**	
Phase 3		
Interviews	TBD	
Phase 3 Total	**TBD**	

Material Estimates	**Cost**	**Notes**
Phase 1		
Raspberry Pi 3 Kit	$99.00	CanaKit
4WD Robot Platform	$42.94	Creatron Inc
L298N H-Bridge	$15.82	Creatron Inc
Mini Bread Board	$3.67	Creatron Inc
Jumper Wires(3-sets)	$6.86	Creatron Inc
HC-SR04 Ultrasonic Sensors (4)	$22.56	Creatron Inc
Standoffs F/F	$3.38	Sayal Elec
Portable Battery	$45.19	Scosche
Philips Head Screws	$5.64	Sayal Elec
Phase 1 Total	**<$200.00**	
Phase 2		

Materials to improve functionality, fit, and finish of project.		
Phase 2 Total	**TBD**	
Phase 3		
Off campus colocation	<$100.00	An example: [4].
Shipping	*TBD*	
Tax	*TBD*	
Duty	*TBD*	
Phase 3 Total	**TBD**	

Concluding remarks

This proposal presents a plan for providing an IoT solution for AutoVehicle This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project. I request approval of this project.

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1. List of Illustrations

2. Introduction

3. System Requirements Document

3.1 Introduction

This section will give an overall description of the requirements document.

3.2 Overall Description

The following section will have an overview of the whole system. The basic functionalities and how it interacts with the mobile application will be explained. Lastly the constraints and assumptions of the system will be discussed.

3.2.1 Work Breakdown

Hardware

The Auto Vehicle's chassis has all the hardware connected or mounted on it that operates together to achieve the functionalities that are required from it. The most important piece of hardware is the Raspberry PI 3, the microcomputer which has all the other hardware connected to in where it receives data from and send data to, it makes it possible to connect to the mobile application as well to send and receive data. The hardware that sends the data to the microcomputer are the Ultrasonic Sensors which are distance sensors, they are used to detect objects that may appear in front of the vehicle then send a signal to the microcomputer where it process it then manipulates the actuators according to the data that it received, the actuators are DC Motors used to move the vehicle, but before that the microcomputer actually sends data to the H-Bridge the driver which based on the data controls the DC Motors direction.

(Developed by Jan Yalda)

Database

The system requires two databases, one will be used to store the users that have signed up to use the mobile application and another to store data of the mapped area. The mobile application user's database is a MySQL database on a free hosting remote server, its main purpose is to store the information of users that sign up for the application. This information consists a username and an encrypted password which will allow the user enter the mobile application. The second database, which is still in development, will be used to receive data from the hardware while it is mapping an area. This data will be stored in the database which can be retrieved by the mobile application to display the mapped area to the user.

(Developed by Jan Yalda)

Web Interface

A website will be developed to allow the user can login to his account. Each specific user will be able to see their previous data been collected using the AutoVehicle. One section of the web site will have a small bio for the developers of the project and their contributions. Another page will contain a step by step explanation for those who may wish to recreate the project on their own. In addition to those, a section will be added to allow visitors give us feedback and suggestions on how we may improve the project.

(Developed by Bilal Alfanous)

Mobile Application

The AutoVehicle Application is used to communicate with the autonomous vehicle remotely. It has in total 12 java classes which includes 6 activities. The functions of the activities are as follows: Login Activity is the first page the user will see when they open the application, it is where the user enters their information to get their user specific information which is stored in the database; MenuActivity is the page the user sees after they successfully login, they can now choose whether they want to control the car or retrieve a map; The register activity is where new users sign up with their information to be stored

in the database. After registering users will be taken back to the login page; The remote control activity has a joystick which the user can use to control the car; the settings activity is where the user can enter the ip address of their car so that they can connect to it; the mapping activity is where the user can see the map that their car has made, it will be blank for new user. The app will work in unison with both the database and hardware to be fully functional. In addition to these various features, the application also has support for both English and French.

(Developed by Khemar Bryan)

3.2.2 Product perspective

The system mainly consists of a mobile application which will be used to control the hardware as an RC car, the other use will be to start and stop the mapping functionality of the hardware and to view the mapped area.

The mobile application has a login functionality which requires a user to be existing in the users database. The mobile application sends a request to the database to check if the user credentials provided matches one of the users that exists in the database then sends a response back to the mobile application which indicates if the user exists or not and therefore gives or denies access to the main functionalities of the application.

After a successful login to the application has been made the two main functionalities are presented. First the functionality to use the Auto Vehicle as a remote controlled car, with this functionality the mobile application communicates with the hardware using the internet and sends commands to be received by the hardware and acted upon which are just basic remote control functionalities. The second functionality the mapping of an area communicates with the hardware the same way, it just orders the hardware to do the mapping functionality instead.

3.2.3 Product functions

Using the mobile application, users logged in will have two main choices on a menu first the remote control functionality and second the mapping functionality. When the users choose one of them they will be taken to the activity that is made for the functionality, where if its the users first time logging in gets an alert saying that an IP address is required which is the IP address of the Auto Vehicle, the user can just to add it right then or can ignore the alert and provide it another time.

When an IP address is provided users going back to the two activities will have the ability to actually connect to the Auto Vehicle and start any functionality that they wish to perform.

The remote control activity provides the users with the option to connect to the hardware using the connect button and start controlling it using the virtual joy stick provided in the remote control activity and finally when they no longer want to continue with this functionality they have the choice to disconnect from the hardware using the button provided.

The mapping activity has the connect and disconnect buttons that have the same functionality as in the remote control activity, but it also has two other buttons one to start the mapping process and the other to stop it, when the stop button is click the mapped will be send from the hardware to the mobile application and displayed in this activity.

3.2.4 User characteristics

The system is mainly meant for the users of the mobile application to interact with. The only requirements are for the users that will use the application.

The users can sign up or login to use the remote control and mapping functionalities. Where through the mobile application they can interact with the hardware send and receive data from it.

3.2.5 Constraints, assumptions and dependencies

The main constraint on the system is that its dependent on the internet for connection to be made to the database when the users want sign up or login, connection to the hardware to be able to access the functionalities is also dependent on the internet.

Another constraint is that the mobile application is only available in two languages that are English and French, therefore users that don't understand any of those two languages will not be able to use the application.

An assumption about the system is that it will require the users to have a certain android API (API level 19 and above) as a minimum requirement to be able to get the mobile application on their smart phones, so users that have phones that don't meet that requirement wont be able to get and use the mobile application.

3.3 Specific Requirements

3.4 Testing

4. Conclusion

5. Recommendation

6. References

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