CNT Capstone Project

**Interfacing Robot Car**

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Computer Engineering Technology

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As a requirement of CMPE2960, CNT Capstone course, we are submitting this project proposal for consideration. We intend to create a prototype for a car safely controlled by the MC9S12E128 micro board provided by CNT program. Ideally, the car will communicate with a mobile application provided with a user-friendly interface and smart features, such as warning the user about the obstacles in advance. After contemplation and discussion with our Capstone mentors and instructors, Mr. Marc Anderson and Mr. P Ross Taylor, we decided to divide our project into four goals.

***Goal* 1:** MC9S12E128 micro board interfacing between the RF receiver chip and the signal output chip on the RC car circuit board.

Pressing switches on the provided RF remote control will send signals to the CNT micro board through the RF receiver chip. Then, the CNT micro board will forward those signals to the signal output chip to drive the motors. As a result, communication with the RC car and software implementation for smart features in the following goals will be achievable using the CNT micro board.

***Goal*** **2**: Communication between the CNT micro board and a Bluetooth module installed on the CNT micro board.

A mobile application developed on the Android phone will act as a virtual remote control to send directional signals to the CNT micro board, in order to drive the car.

***Goal* 3**: Obstacle detection using an Infrared Proximity Sensor installed on the CNT micro board.

The CNT micro board will receive the distance to obstacle data from the Infrared Proximity Sensor, and forward this data to the mobile application through Bluetooth. The micro board will be programmed to make obstacle avoidance decisions at a close distance.

***Goal 4***: Calculating the speed with an accelerometer sensor installed on the CNT micro board.

The accelerometer sensor will transfer the acceleration data to the CNT micro board and to the mobile application through Bluetooth. The mobile application will calculate the speed and estimate the amount of time left before hitting an obstacle.

We have performed some preliminary research and have decided to utilize the MC9S12E128 micro board to control the RC car. The CNT micro board will receive instructions from the mobile app through a Bluetooth connection, and if time permits, to install and enable the distance and accelerometer sensors for enhanced performance. The Bluetooth RS232 module can transmit data within a range of 10 meters. The Sharp Infrared Proximity Sensor we may use can detect obstacles within a range of 20 to 150cm. The MPU-6050 Accelerometer + Gyro Sensor we may use can provide 3-axis (x-axis, y-axis, z-axis) acceleration outputs, which will be sufficient for calculating the speed and distance travelled by the car.

We intend to write the Android mobile app in Java; we also intend to write the code in C to the CNT micro board.

Elements of the project that will require research include:

* Interface requirements for the RF receiver chip and the signal output chip on the RC car circuit board to transfer signals with the CNT micro board.
* Understanding the datasheet, C language and libraries for the CNT MC9S12E128 micro board, which is different from the MC9S12XDP512 micro board, the one used in the previous CNT course.
* Connecting the Bluetooth module to the CNT micro board; transmitting data between the micro board and the mobile application.
* Learning the Android mobile application development in Java language.
* If time permits, researching and coding in C on the CNT micro board with the Infrared Proximity Sensor for sending distance data and avoiding obstacle by usage of that data.
* If time permits, interface requirements for the accelerometer sensor as well as reading the acceleration data using C; learning the algorithm of converting acceleration outputs to actual velocity and distance using Java.

Materials that are currently available:

* CNT MC9S12E128 micro board.
* C libraries for IIC communications and PWM for programming the CNT micro board to communicate with other devices.
* Code Warrior for programming the CNT micro board.
* Android Studio IDE for programing Android mobile application in Java.
* Samsung Galaxy SIII.

Components/Materials required for the Project:

* An RC car, a Bluetooth RS232 module, and battery power supply for the MC9S12E128 micro board.
* If time permits, an Infrared Proximity Sensor and a MPU-6050 Accelerometer + Gyro Sensor.
* Researching to determine how the RF receiver chip and the signal output chip on the RC car circuit board, the Bluetooth module and the optional sensors work.
* Creating libraries to operate the Bluetooth module, and possibly, to receive data from the sensors on the CNT micro board.

We would like to propose the following timeline to ensure that we complete the project on time.

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| Week | Activity |
| 1 – Jan 6, 2016 | Project selection and research, discussion with Capstone course coordinator and instructor Ross Taylor, Marc Anderson.  Creation of the proposal which describes the goals of the project.  Placing orders for all the necessary missing elements for the project. |
| 2 – Jan 12, 2016 |
| 3 – Jan 19, 2016 | Dismantling the RC car.  Analyzing the directional pins on the RC car circuit board for interfacing with the CNT micro board via Oscilloscope.  Researching the Java language for the mobile application development using Android Studio IDE. |
| 4 – Jan 26, 2016 | Starting the code in C using Code Warrior to produce PWM signals in order to control the RC Car on the CNT micro board.  Connecting the RC car to the CNT micro board. |
| 5 – Feb 2, 2016 | Status Report #1 – progress to date.  Completing the code in C for controlling the RC Car on the CNT micro board.  Testing the code with provided RF remote control in order to accomplish Goal 1.  Starting to build the basic user interface on Android mobile application in Java using Android Studio IDE. |
| 6 – Feb 9, 2016 | Expecting delivery of the ordered parts.  Connecting the Bluetooth module to the CNT micro board.  Transmitting data between the mobile application and the CNT micro board, using C on the CNT micro board, and Java on the mobile app. |
| X – Feb 16, 2016 | Reading Week, no classes.  Completing the code in C on the CNT micro board, and Java on the mobile app.  Debugging the code for data transfer via Bluetooth in order to accomplish Goal 2. |
| 7 – Feb 23, 2016 | Researching and coding in C on the CNT micro board with the Infrared Proximity Sensor for sending distance data and avoiding obstacle. |
| 8 – Mar 1, 2016 | Status Report #2 – progress to date. Debugging the code for obstacle avoidance via Infrared Proximity Sensor in order to accomplish Goal 3. |
| 9 – Mar 8, 2016 | Researching and coding in Java on the mobile app with the accelerometer sensor to calculate the velocity and distance travelled by the car. |
| 10 – Mar 15, 2016 | Calculating estimated amount of time left before hitting the obstacles. Completing the code in Java on the mobile application with display of calculated data. |
| 11 – Mar 22, 2016 | Finalizing the code, the UI design of the mobile application, and design of the car with sensors in order to accomplish Goal 4. |
| 12 – Mar 29, 2016 | Status Report #3 – progress to date. |
| 13 – Apr 5, 2016 | Completing report and presentation. |
| 14 – Apr 12, 2016 | Project Presentation to CNT and the English department. |
| 15 – Apr 19, 2016 | Completing the project and handing-in for grading at the start of the week. |

During the development of this project, we will expand our knowledge about the MC9S12E128 micro board, hardware interfacing, and programming language we have learned in class. In addition, we will learn about the robot car mechanism, C and Java language, the Bluetooth technology, and the interface requirements for connecting sensors. All in all, we will demonstrate the knowledge and information achieved from our project beyond that provided by the CNT program.