College Level Entrepreneurship Projects

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Abstract – Some Colleges are beginning to create what they call "Entrepreneur Centers", where students from Business, Technology and Medical programs are teamed up to collaborate on a "killer application" type project. After graduation, participants go on to either market the idea on their own through a startup or within an existing company that they join. The key ingredient to make this endeavor a success idea consists of, not only teaching engineering students timely subjects but also cultivating creativity and innovation to bring the entrepreneurship college experience to another level. This paper gives a comprehensive view showing how developing state of the art mini-projects used in my microcontroller class, helps students innovate new products to solve societal problems. The three projects described are 1) RFID-based Prohibitive Texting and Driving system; 2) RFID-based Voting system and 3) RFID-based Self Check Out system. All these three projects used the HCS12 microcontroller-based Dragon Board from Wytec and the RFID reader from Parallax.

Keywords: RFID, Texting, Driving, Voting, Check Out.

PROHIBITIVE TEXTING AND DRIVING

One of the projects was developed to prevent a driver from texting or browsing while driving.
When a simulated GPS signal, indicating the car is moving, is received by the cell phone, all form of texting and browsing for outgoing and incoming transmissions using the device are disabled. Only the voice function is still enabled. Two RFID readers are installed in the back of the two front vehicle seats and one reader is installed under the glove compartment. Each passenger's phone is equipped with a RFID tag. The RFID reader, at proximity to the passenger only location in the vehicle, will turn on the mobile phone data and texting functions. The driver compartment lacking such a reader will leave these functions disabled only on the driver's mobile phone and thus, preventing the driver from using the phone functions other that voice, while driving. The diagram below depicts the general idea of the system.

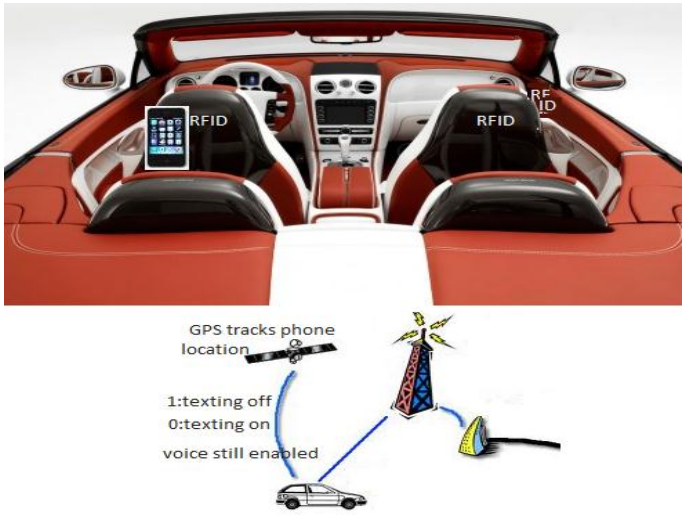

Fig. 1 RFID-based prohibitive phone functions in driving mode

Two RFID readers are strategically embedded in the back of the two front seats facing the passengers in the back. Another RFID module is fitted in the passenger front door. Any mobile phone close enough (about 10 in or less) can be enabled to text or browse. This, of course, will prevent anyone in the driver seat to use their phone for texting or

browsing functions. This prohibitive feature works only one the GPS signal received by the phone indicates that the vehicle is moving. The texting function for the passengers is a private activity and is not suppressed by this system compared to "Voice Texting" popular in other systems where everyone in the car may hear the message being dictated for texting purpose.

The Parallax Radio Frequency Identification (RFID) Read/Write Module provides a low-cost solution to read and write passive RFID transponder tags up to 3 inches away. The RFID transponder 125 kHz tags provide a unique serial number and can store up to 116 bytes of user data, which can be password protected to allow only authorized access. The Freescale HCS12 microcontroller was originally designed for the automotive industry but became popular in the Engineering school laboratories for its ubiquitous and low cost. The fairly easy connection of the RFID module to the Microcontroller board is shown below in Fig. 2.

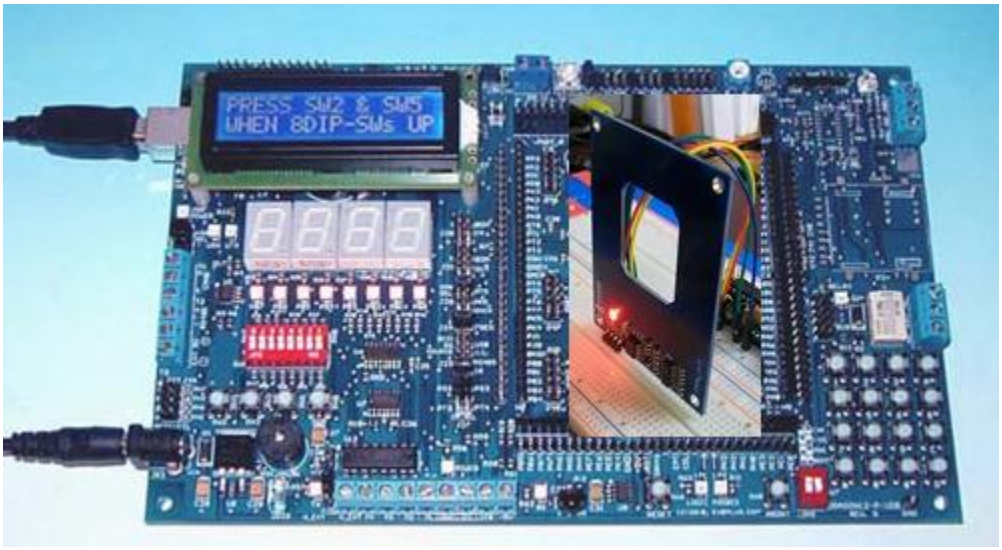

Fig. 2 RFID reader and Dragon Board 12 Plus

The RFID reader interfaces to the microcontroller board using the Serial Communication Interface SCI1 to read stream the tag data to the controller using an interrupt scheme. The enable pin is controlled thru PORT T. The RFID module is powered by +5V directly picked up from the Dragon Board connector strip.

The steps used to program the system in C are shown below:

1) Read the keypad (representing the cell phone dial).
2) Display the pressed keys on the LCD (texting).
3) Read the switches, looking for a 10101100 key representing the GPS signal. A match indicates the car is moving and causes the program to disable the keypad, then displays the message:" Texting Function Off". At this point, pressing any key on the keypad is disabled.
4) Read the RFID located on the back of the front car seats or in the front passenger door or glove compartment (see picture).
5) Display: "Texting Function On", if a tagged cell phone is close enough to the RFID reader.
6) Disable the texting function and display a message accordingly when one of the passenger's cell phone is moved away.
7) If the switches representing the code for the GPS signal tracking the car moving are modified, this indicates the vehicle has stopped moving and everyone can text or browse again, including the driver.

During testing, the reader module was sensitive to about a 2.5" distance to the transponder tag with a data rate of 2400 serial baud.

The second developed project consisted of using the RFID readers for a voting system. A registered voter would cast a tagged ballot by dropping it in a slot box equipped with a RFID reader. The system tabulates the votes and sent them to a secured database. In case of a contested election outcome, similar to the year 2000 in the Florida presidential election debacle, all the casted ballots in a particular ballot box can be re-read and re-tabulated instantly without having to be moved out of the box.
This system supports the tabulating of two candidates running for office. It can be expanded to multiple candidates such as in a general election event. There are several methods of identification, but the most common is to store a unique serial number that identifies a person or object on a microchip that is attached to an antenna. Each tag contains a unique, read-only serial number (one of 232, or 4,294,967,296 possible combinations) and 116 bytes of user data area stored in a non-volatile EEPROM (Electrically Erasable Read Only Memory). The user data area can be optionally secured with a 32-bit password to allow only authorized read and write operations. To alleviate possibility for fraud, the tag is initially "blank". Using a RFID writer/programmer, the tag is programmed with a unique number assigned to the intended candidate only when a person casts a vote. Simultaneously, the cast vote is tabulated and sent wirelessly through a Zigbee network to be stored in a separate secure medium such as a laptop. This approach of having the votes cast stored in two different and distinct medium, the RFID tags and a hard drive, exerts robustness in the system. In case of contested results by any party, the tags can be re-read and the extracted results are contrasted against the ones read from the laptop for any discrepancies. On tests conducted for this experiment, the tags were read one by one alleviating any possibility for any anomaly. However, by using a more powerful reader such as the Texas Instrument one, the tags can be read without having to be removed from the ballot box and the relative difference in the result collected from the two medium can be insignificantly small. This disagreement can be attributed to the RF signal collision effect from reading the tags.

The broad algorithm steps used to program the system in C are shown below:

1) Display prompt welcoming message (system ready).
2) Read the keypad to accept Voter ID and verify information against data base.
3) Read casted vote and program the blank tag.
4) Drop it in ballot box. .
5) Send vote info to zigbee network to be stored on laptop.
6) Display: "Vote accepted, Thank you for voting".
7) Go back to step 1).

A third challenging experiment used the RFID readers to automatically scan tagged grocery items at the checkout line of a grocery store. While in the shopping cart, packages and boxes with RFID tags are read directly, without a line-of-sight, by the readers installed at the checkout counters. The system is very similar to that of the voting system. Each item or product is tagged with a transponder preprogrammed with a unique secure code to reflect the price of the item it represents. This is the striking difference with the voting system where the tags are not initialized until ballot casting time. Here again, during the testing phase, the items had to be read one by one and like the voting system, a more robust RFID reader would "suck in" the tag information without one having to remove the item from the shopping basket. So, in a real world scenario, all the shopper has to do is scan her or his credit card, get a receipt and head to an open vehicle trunk in the parking lot.

The broad algorithm steps used to program the system in C are shown below:

1) Display prompt welcoming message (system ready).
2) Scan shopper ID.
3) Display Message: "Ready for items scanning"
4) Read tags in basket (one by one) then tabulate.
5) Ask if end of items. If yes, ask for credit card swipe.
6) Dispense receipt. Display: "Thank you for shopping".
7) Go back to step 1)

In spite of the limitations and simplicity described in the projects above, the approach is clearly in demand at the college level where students learn and dream of creating exciting products from novel ideas. A clever combination of skills and availability of low cost new technologies will definitely help turn dreams into reality for some future entrepreneurs.

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Earned a BSEE in 1977 and a MSEE from Missouri University of Science & Technology (formerly UMR) in 1980. He is currently a senior professor at DeVry University where he teaches in the college of Engineering and Information Science. His general interests span Digital Signal Processing (DSP), Embedded Systems and Control Systems.