An RFID Integrated Solution Using NI myRIO

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Abstract: This paper explains the pedagogical advantages of student projects and describes the project a freshman at Northern Kentucky University carried out. This project uses NI myRIO paired with third party sensors to prototype a lock opener.

Key–Words: RFID, NI myRIO, LabVIEW

1 Introduction

Student-centered education is a priority at Northern Kentucky University. Advanced students are engaged in academically valuable projects beyond the classroom. Because students are better engaged if their work is displayed to professional circles and their names become known, avenues are sought for showcasing their work. Student projects with the following aspects carry academic value

- Students find relevance and meaning in the project. Cutting edge projects and projects with a significant impact on the community are usually perceived as relevant and meaningful.
- Students are driven to determine what they need to do, what knowledge they need to acquire and what questions they need to ask in order to complete the project successfully.
- Students are inspired to learn and broaden their knowledge.
- Students are compelled to develop time management and scheduling skills.
- Students are urged to understand the importance of teamwork and to develop communication skills.

The project described by this paper explores RFID solutions using NI myRIO paired with third party sensors for the design and prototype of a lock opener. A lock opener which does not require that the user takes something out of a packet or luggage may be very handy. Such a lock opener has many applications, from hotel rooms and classrooms to cars and briefcases to kitchen appliances.

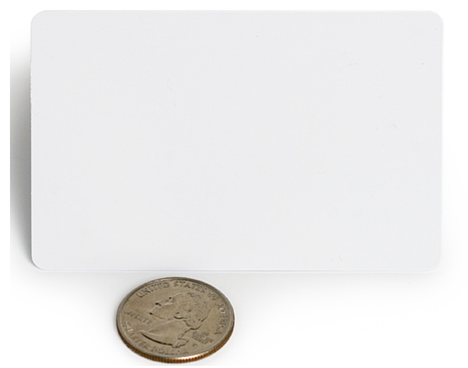

Figure 1: RFID Tag

In addition to controlling the opening of a lock, the prototype of the project at hand logs information about who has attempted to open the lock and when. The following section provides with some background information on RFID.

2 Background on RFID

RFID requires that an electronic signature (unique identifier in electronic form) is transferred from the RFID tag to the RFID reader. For the transmission of data, wireless radio communication is used [1], [2].

The basic components of an RFID system as specified in [3], [4] are

1. RFID tag: An example of which is shown in Fig. 1. The picture of the coin next to the tag puts its size in context. In its simplest form, the RFID tag is a Read Only Memory (ROM) chip. This is the type we have used in our project. In more

Figure 2: NI myRIO

complex forms, an RFID tag contains a power supply along with a read/write memory chip.

2. RFID reader (or scanner): It includes an antenna for sending out signals in search of one or more tags. The antenna also gathers information from the tags.

3. Host: For communicating with the RFID reader and processing raw data into meaningful information. For this role, our experiment utilized the NI myRIO device connected to the USB port of a computer. The NI myRIO device is depicted in Fig. 2

RFID is an emerging technology that has a number of applications. As specified in [4] some of these applications are

- Supply chain
- Access control systems
- Point of sale systems
- Toll collection systems
- Animal tracking systems
- Wrist and ankle bands for infants and security

Traditionally, the protocol for communication between the RFID reader and the RFID tag was proprietary. As a result, readers could not communicate with tags from different vendors. For faster growth, universally accepted standards have been adopted. A common data format for the RFID tag is based on the EM4100 protocol. This protocol has been adopted for our project [3], [6].

EM4100 RFID tags carry 64 bits of ROM. The RFID tags compatible with the ID-Innovations Readers have the following format: One STX byte, ten data bytes, two check sum bytes, one CR byte, one LF byte and one ETX byte. STX stands for start of communication, ETX stands for end of communications, CR stands for carriage returns and LF stands for line feed. The ten data bytes are the unique signature that each compatible RFID tag carries [5], [6].

The next section describes the prototype of the project at hand.

3 Prototype

The prototype of the project described by this paper is composed of a personal computer connected via a USB cable to the NI myRIO device, which is connected via jumper wires to an external circuit. The personal computer runs LabView 2014 and NI myRIO software bundle. The NI myRIO is used for accepting analog inputs, digitizing them, processing them as requested and passing them to the computer.

The external circuitry is depicted in Fig.3 and composed of:

- A breadboard that serves as the canvas of our design.
- Two RFID tags compatible with ID-Innovations readers. These tags have the format specified by the EM4100 protocol and operate at 125 kHz.
- An ID-12LA RFID reader for sensing the RFID tags and passing on digital information for further processing.
- A Breakout board for the ID-12LA RFID reader: The breakout board converts the 2 mm pin spacing to the standard 0.1 in pin spacing for breadboards. The RFID reader pins need to be soldered onto the one side of the breakout board.
- Eleven breakaway headers with male pins spaced at 0.1 in apart. The short ends of these headers connect the breakout board to the breadboard and require soldering. The long ends of the headers are plugged into the breadboard.
- A red led indicating when an EM4100 compatible RFID card is waved over the reader.
- A green light indicating when the door lock is supposed to open.

Fig. 3 shows how the external circuitry is connected to the MXP Connector B of the NI myRIO device and Table 1 tabulates the connections in our design. For example, the first row of Table 1 implies that Analog Output 1 of the MXP Connector B of the NI myRIO device is not connected to the RFID reader

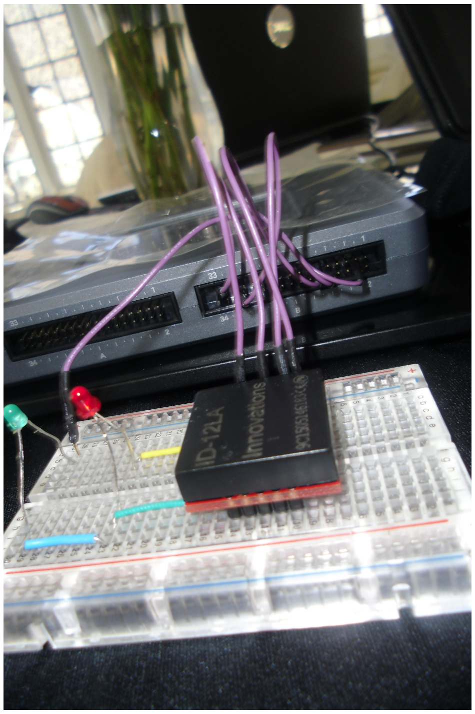

Figure 3: External circuitry of prototype at hand

and is not connected to the Red LED but it is connected to the Anode of the Green LED. More details about the NI myRIO and ID-12LA RFID reader can be found at [8] and [9].

Before the execution of the program, the database file is created. The entries of the database are the signatures of the RFID tags which allow the green light to go on. The location and the name of the file are hard coded. When a compatible RFID tag is waved in front of the RFID reader, the red LED lights as indication that an RFID tag has been detected. The data string of the tag signature is logged and tested against the database file. If the tag signature belongs to the database, the green LED lights. The name and location of the log file is hard-coded. Along with the tag signature, the log file includes timing information.

The following section describes the steps in the implementation algorithm.

4 Programming Approach

The NI myRIO processor has been programmed in LabVIEW, a proprietary language created by National Instruments. LabVIEW is a graphical programming language whose programs are called Virtual Instruments (VIs). Hence, the sub-programs are called sub-VIs. Our project is composed of two VIs and three sub-VIs. One VI runs on the NI myRIO and the other runs on the computer.

On the NI myRIO:

- **Step 1:** Initialize the serial port through which the external circuitry is connected to myRIO.
- **Step 2:** Create a Network Stream in order to communicate to the computer.

When a compatible RFID card is detected,

- **Step 3:** Cause the red LED to light
- **Step 4:** Extract the signature from the RFID code.
- **Step 5:** Communicate the signature to the computer over the network stream.

When the computer communicates a STOP signal,

- **Step 6:** Quit the VI.

On the computer:

- **Step 1:** Open the network stream created by myRIO for reading.
- **Step 2:** Open the text file against which the RFID signatures are checked. This file will serve as the database file.
- **Step 3:** Create a text file in which RFID signatures are logged. This file will serve as the log file.

When an input is detected at the network stream,

- **Step 4:** Record the input to the log file along with a timestamp.
- **Step 5:** Check the input against the database file.
- **Step 6:** If the new input is included in the file, cause the green LED to light.

When the STOP button is pressed,

- **Step 7:** Update the appropriate shared variable so the information will be communicated to myRIO.
- **Step 8:** Quit the VI.

Table 1: The connections of the prototype at hand

NI myRIO	**R**FID reader	**R**ed LED	**G**reen LED
B/AO1 (Pin 4)	n/a	n/a	Anode
B/UART.RX (Pin 10)	UART Data Output D0 (Pin 9)	n/a	n/a
B/DIO0 (Pin 11)	Tag-In-Tange (Pin 6)	n/a	n/a
B/DGND (Pin 30)	Format Selector (Pin 7)	Cathode	Cathode
	GND (Pin 1)		
B/+3.3 V (Pin 33)	VCC (Pin 11)	n/a	n/a
	Reset Bar (Pin 2)		
n/a	Read (Pin 10)	Anode	n/a

5 Conclusions and Considerations

At Northern Kentucky University advanced students are engaged in academically valuable research projects. One such a project has led to the design and implementation of a lock opener. The implementation is in the prototype phase and has a variety of applications in areas where non-contact operation is essential. Implementation details may vary depending on the application.

The prototype described by this paper uses the electronic signatures of RFID cards so that only selected users can lock a door or turn on an appliance. In addition to providing access control, the proposed design records those who attempted access and the time that the incident has occurred.

The proposed lock opener has many applications, from hotel rooms and classrooms to cars and briefcases to kitchen appliances. For better visualization, a green LED is used to indicate that a specific RFID signature belongs to a user who has permission to open the lock. When a real-world locker is implemented, one needs to keep in mind that the myRIO cannot output more than 5 Volts. In addition, considering the loading effect, the voltage that is finally delivered to the relay may be sufficiently less.

The NI myRIO is programmed using LabVIEW, which a proprietary programming language developed by National Instruments. Because LabVIEW is inherently parallel, LabVIEW users take advantage of parallel programming without additional effort and students are introduced to challenged of parallel programming. it is of concern that while the engineering community is driven towards the open standards, the NI myRIO is programmed in LabVIEW whose maintenance depends entirely on a single company.

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