Design and Construction of an Automated Community Bicycle Loan/Return System

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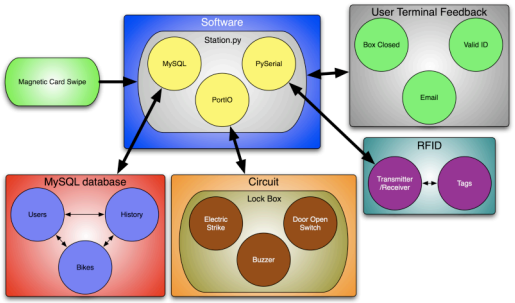
Abstract

Community bicycle programs are being implemented in large cities all over the world. These programs inspire environmentally friendly and healthy modes of transportation. Regions Bank of Shreveport, LA generously donated eight community bicycles to Centenary College of Louisiana. To facilitate use of these bicycles students have designed and constructed a prototype system for automated loan and return. The system consists of hardware including a magnetic card swipe, control circuit, lock-box with electric strike, and radio frequency identification (RFID) transmitter/receiver and key fobs. Keys with RFID fobs are stored in the lock-box in close proximity to the RFID transmitter/receiver. Software written in Python controls access to the ke ys and logs all interactions to a remote MySQL database. Access to keys is obtained via magnetic student ID cards. Details of the system will be described and demonstrated.

Introduction

The goal of the project is to design a system that automates the loan/return of Centenary bicycles through an easily maintained network of hardware and software. To achieve this goal, students have designed a system that allows a user to use his or her student ID to access a bicycle key. An inexpensive prototype system was built using an electric strike, electronic buzzer, and push-button switch, all computer-controlled via the parallel port and a simple circuit, to allow valid users to retrieve a key. Radio Frequency IDentification (RFID) technology was used to indentify the bicycle keys. Python-developed software controls the entire system and records transactions in a remote MySQL database.



Description of Flowchart

1) The Magnetic Card Swipe sends user ID to Station.py.

2) Station.py checks the *User* table in the MySQL database for a valid ID and sends feedback.

3) If the ID is valid, Station.py uses PortIO to instruct the circuit to unlock the Electric Strike, activate the Buzzer, and check the Door Open Switch.

4) The Door Open Switch continuously sends an opened status to Station.py through PortIO until the door is closed.

5) When the door is closed, Station.py instructs the RFID Transmitter/receiver to check for all the RFID tags present.

6) The transmitter sends this information to Station.py which determines which keys/bikes were taken and assigns those keys/bikes to the user ID from step 1 (stored in the *Bikes* table of MySQL).

7) A record of this transaction is stored in the MySQL *History* table.

8) Station.py takes this transaction information and sends it in an email to the user from step 1.

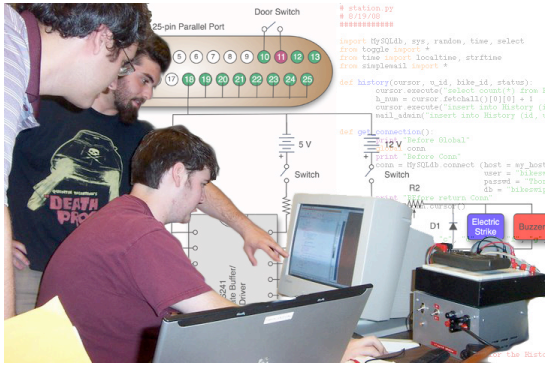
Software

Station.py: Orchestrates the System by Monitoring the status of the Lock Box and RFID, and awaits User input.

PortIO: Allows Python to communicate with hardware via parallel port by adapting input/output using a C library in Linux.

PySerial: Issue commands to and obtains information from the RFID transmitter/receiver about the state of RFID tags through an RS-232 port.

MySQL: Manages a database that records bike transactions using *Users*, *Bikes*, and *History* tables.



Hardware

Lock Box: The lock box houses the circuit, electric strike, buzzer, switch, RFID transmitter/receiver, and the keys.

Circuit: The circuit controls the electric strike, buzzer, and switch. It responds to commands from Station.py (regulated by PortIO).The circuit consists of a 25 Pin Parallel Port, Line Driver, 5 V and 12 V power supply, two switches, transistor, three resistors,electric strike, buzzer, and door open switch.

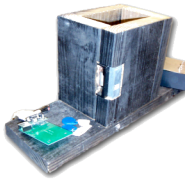
Electric Strike: The electric strike works like a normal door lock except it unlocks when the circuit supplies a current to it.

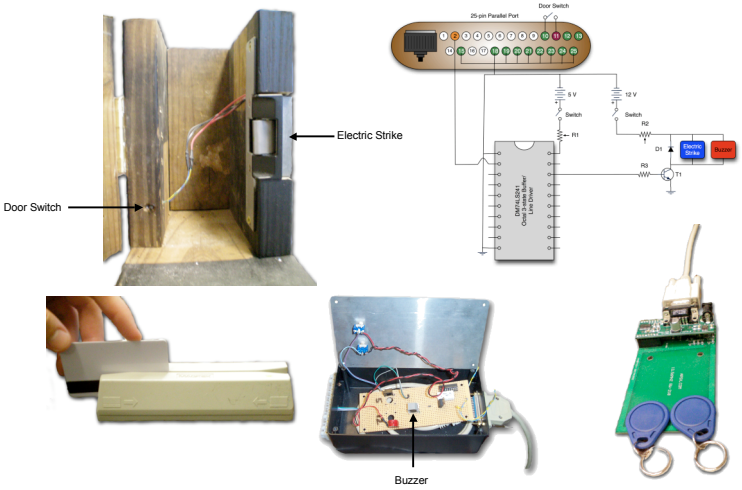
Buzzer: The buzzer buzzes when the circuit applies current to it. This notifies the user that the door is unlocked.

Door Open Switch: The door open switch closes when the door is closed, notifying station.py to continue.

RFID Transmitter/Receiver: The transmitter checks the box for any RFID tags present. It interacts with Station.py through pyserial.

RFID Tags: The RFID tags carry an ID number. Each of these tags are attached to a key which in turn identifies a bike





Summary

We have completed a functioning prototype. All components of the project have been developed and tested. We are currently working to improve our RFID detection scheme. To do this, we are implementing a pseudo anti-collision detection of multiple RFID tags by using a tag-selected read mode. Once implemented, we will scale our prototype to a campus wide system.

References

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