CprE491 Senior Design
Project Plan 10/2/14
Group: May1525

Advisor: Lee Harkin
Client: Lee Harkin / Department of Electrical and Computer Engineering
Project Title: CyLocker Access System

Group Roles

Team Leader ->	Nathan Castek
Team WebMaster ->	Corey Coazzato
Team Communicator ->	Nathan Lafferty
Team Key Concept ->	Priyank Patel
Team Technical Leader ->	Mohammad Syazwan

Revision History

Date	Revision	Description
10/2/2014	1.0	Initial Plan

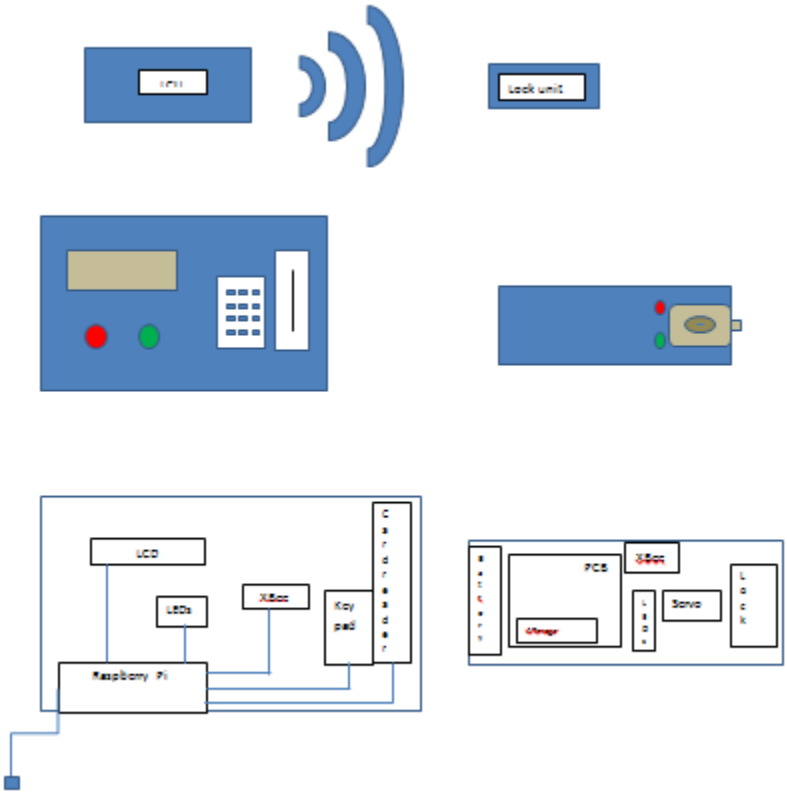
Problem Statement

The issue with the current, manual, locker system is security and maintenance overhead. In particular, locks are re-used semester after semester, design team by design team. This means that any previous design team can go to their old locker, open it up, and take the current team's possessions. In terms of maintenance, someone would have to physically go

up to each locker at the end of the semester, and shuffle the locks to avoid this (but it does not alleviate the problem). A more secure and dynamic solution is required.

Our goal is to design an electronic locking suite, capable of remote management and reliable use. Our design must be simple, low-cost, maintainable, and extensible.

Concept Sketch/Mockup



Deliverables

First Semester

1. Project Plan Draft
2. Design Document Draft
3. Project Website Draft
4. User Control Panel Prototype
5. Locker Module Prototype

Second Semester

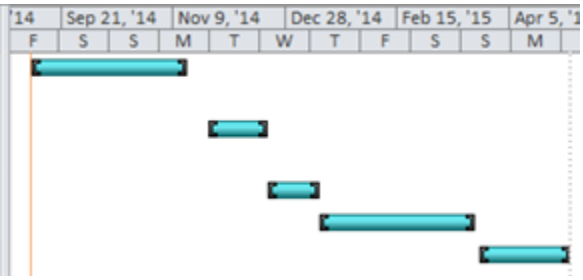
1. Final Project Plan
2. Final Design Document
3. Project Website
4. Completed User Control Panel
    a. Numeric Keypad
    b. Magnetic Card Reader
    c. I/O Display
    d. Wireless Transmit Ability
    e. Extensible Design

5. Three Completed Locker Modules

a. Locking Mechanism
b. Monitoring Status of Locker
c. Wireless Receive Ability
d. Battery-Powered for a single student-year

Project Schedule

Task Name	Duration	Start	Finish
Research and Design System	50 days	Mon 9/8/14	Fri 11/14/14
Prove System will Function	20 days	Mon 11/24/14	Fri 12/19/14
Order Parts	17 days	Sat 12/20/14	Sun 1/11/15
Verification Testing	50 days	Mon 1/12/15	Fri 3/20/15
System Documentation	30 days	Mon 3/23/15	Fri 5/1/15



Work Breakdown Structure

The work shall be broken down into the following areas and assigned accordingly:

1. PCB Fabrication / Design - Mohammad

a. Includes Mockups, Sketches, and actual Fabrication

2. Power Systems - Priyank

. Includes battery selection and maintenance

a. Includes delivering of power to the rest of the circuit

3. General Electrical Design - Electrical Engineers (Castek + Mohammad + Priyank)

. Resistors, Capacitors, etc.

a. Heavy Math

4. Communication System - Computer Engineers (Corey + Lafferty)

. Communication between PCU and LCU

5. PCU - Pi Control Unit - Lafferty

. Includes card reader, numpad entry, display, and the Pi board itself

a. Includes all software running on the Pi

6. LCU - Locker Control Unit - Corey

. Houses PCB, mechanical lock, batteries

a. Includes Arduino Microcontroller

7. Mechanical Design - Castek
. Design of the locking mechanism

Specifications

Power System

The power system plays an important role in this project. The LCU needs some power to run properly, and without power the system won't run and administrators would have to manually open the locker. The power system will be powered using AA batteries to supply the required power to each of the individual components of the LCU. The power system must stay above the operating threshold for at least a single student-year, and must also be affordable.

Communication

The locker system requires wireless communication in order to send the data from the controller unit, where the input is inserted through ISU student card or student ID number, to the locking system of the locker. The wireless communication device used is XBee 1mW Trace Antenna – Series 1 (802.15.4). The XBee is manufactured by Digi. The range of the communication system must be able to reasonably reach all of the lockers in the room. The XBee can be programmed easily by using the X-CTU software. It also has a sleep mode which can help to save the battery usage of the locker system.

LCU

The LCU is the "Locker Control Unit". Formally, it is the Arduino microcontroller that is responsible for communicating with the PCU and the hardware on the locker itself. It is running on the "Atmega328".

PCU

The PCU is an acronym for "Pi Controlling Unit", and it is the primary interface with the user and the various LCU's. It is in control over all LCU's, and is capable of telling them to lock/unlock their doors, as well as requesting status updates. It interfaces with the user through the use of a card-reader, as well as a numpad (should a student forget their ISU card). A display may or may not be implemented with the board, depending on utility and usefulness.

Operating Environment

The operating environment of the LCU and the locker units would be a type of classroom or workplace. Users would be able to safely store personal items in a designated locker with an automated lock. This lock would be controlled by the swipe of an id card. The user would be able to either swipe their personal card or type their id number in a corresponding keypad. This control of access to the lockers is determined by the credentials stored on the LCU located in the room. Additionally, we are assuming a stable operating environment in a temperature-controller room, and we are already assuming physical

security. As such, no physical security shall be implemented to the controlling units beyond a standard casing unit. Additionally, we are assuming the environment will be weather-controlled and will not be exposed to the elements.

User Interface Description

The user interface will be in four key parts:

1. The PCU numpad
2. The PCU keypad
3. The PCU display (optional)
4. Interaction with the locker itself

The numpad is a standard 10 digit numpad (0-9), and students will be able to enter their passcode for the locker into the device. Alternatively, students may use their ISU ID Card and swipe it to gain access into their locker. On proper authentication, the locker will be opened. On authentication failure, feedback will be displayed to the user.

The locker itself will require an HCI component, with timings and sensors to determine how long the lock should be displaced for, as well as determining if there is an error with the LCU itself (a/e, battery low).

The display will primarily be used to display the input of the user (and standard astrick format) and to render feedback (AUTH_SUCCESSFUL, AUTH_FAILURE). Additionally, an administrator mode will be enabled, such that administrators can see the status of all of the lockers currently in the system. Remote-access will be enabled through the use of SSH, such that admins may replace locker permissions at-will from editing configuration files on the controller itself.

Resource Requirements

- Students are able to access their locker by using their ISU card or by entering their student ID number on the numpad
- The system must have a battery life for at least two semester
- The display must indicate when the battery is at 20% or lower
- The SD card must be able to read and store database of names and locker numbers so administrators can update all the names and numbers each year
- Transmitter should be able to send the code safely to receiver
- The wireless data transmission need to be transmit data at the longest distance from the LCU

Risks

- There are possibility of security breach such as the locker being hacked
- Determining a low-cost battery option
- The cost of the project will be more than the budget provided if the components of the project is not selected carefully

- Physical damage to the components can compromise security

Market Survey

The Smart Locker System manufactured by Genesys can be the best example for our project. It has a similar functionality as our project which is an automated keyless locker system. The only required item to access the locker is an ID card. The Smart Locker controller unit consists of a LCD screen and a scanner. The ID card need to be scanned through the scanner in order to use or open the locker. The information from the ID card such as name and locker number will be presented on the LCD screen. Also, the locker has two colored LED which will turn red light on when the locker is closed and green light on when the locker is opened. Inside the locker, there are two AC power sockets which enables the user to charge electrical devices when being stored in the locker. The major differences between the Genesys Smart Locker and our project are Genesys Smart Locker has no keypad and no battery powered unit. Figure 1 shows the Smart Locker System designed and created by Genesys.

Figure 1: Genesys Smart Locker System