# Wi-Fi Connected Locker Access System
## Cylocker  May 15-25

## Problem

The existing lockers for the senior design teams at Iowa State are being secured by padlocks, where the same locks are reused semester after semester. The previous students may remember their locker combination and tamper with current student's projects, as well as having the maintenance overhead of manually assigning lockers to students. This is unaceptable, as students spend hundreds of hours and hundreds of dollars on their projects, and the senior design lockers must be as secure as possible.

## Solution

Our solution, which is extensible, reliable, and affordable, is to re-prise the current system to utilize electronic lockers, complete with remote management. These lockers are battery powered, and access is provided using current student's ISU ID cards. Groups can also be assigned a username and password to access their lockers under the case that individual students forget their ID card.
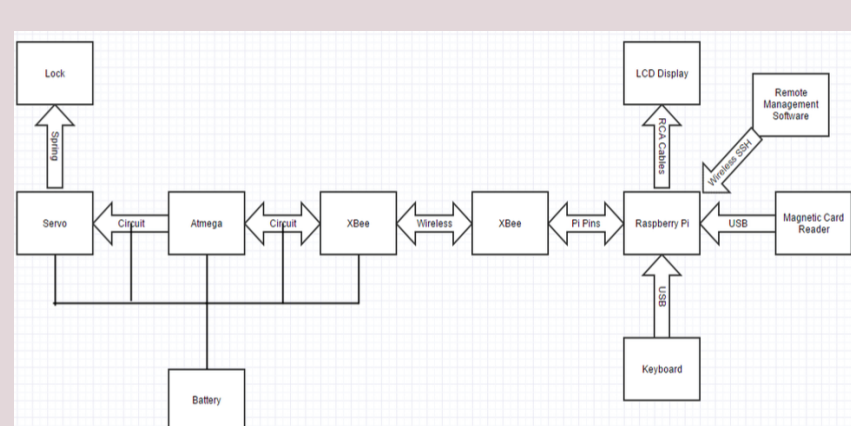
## Design

**Initial Design Issues**
- Battery Usage
- Expensive

**Current Design**
- Databases Defined
- Power saving circuitry
- Admin Software

**Initial Concept      LCU       MCU**



## Locker Control Unit (LCU)



- Battery Powered
- Easy to configure
- Replacable
- Easily integrated into existing systems
- Sleeps to conserve power
    - ☐ Watchdog timer
- Powerful transmitter
    - ☐ Easily covers length of room

## Main Control Unit (MCU)
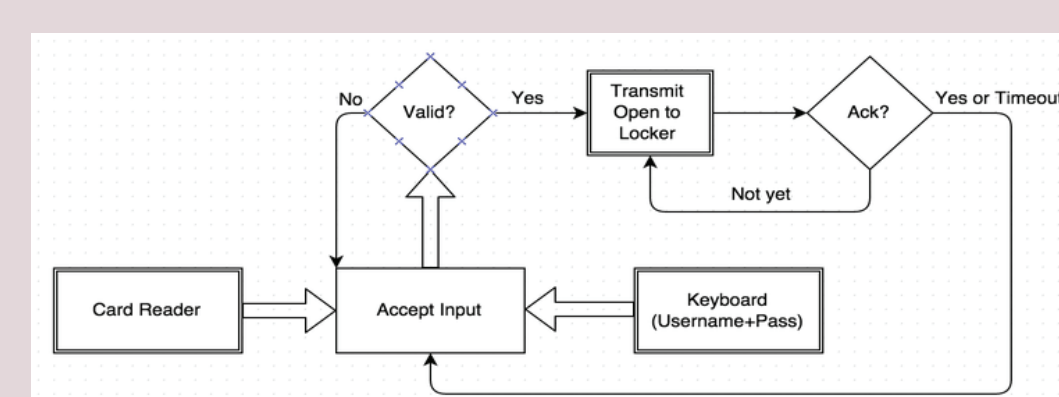


- Allows admins to manage system
- Extendable and Reliable
- Easy to configure
- "Brains" of the system
    - ☐ Receives battery data from lockers
    - ☐ Tells locker to open

## Requirements

System must readsenior design student's ISU ID Card, providing access on a valid swipe and opening their locker

System must have a keyboard failback, such that students without ID Cards may still access the system and open their locker

System must allow administrative functionality, both local and remote, including altering access lists and overriding funtionality

Wireless transmitters should securely transmit data, ensuring only secure access to lockers

LCU ("Locker Control Unit") must be secure, in that only a valid signal from the MCU ("Main Control Unit") will open the locker

The MCU must store usernames/passwords/groups of users, and be easy to remotely manage to alter information

The MCU must be "locked-down", such that non-administrative users cannot alter or access any information

## Environments & Users

**Location**
- Classroooms
- Workplace

**Detailed Environment**
- Temperature: 65° to 75°
- Locker Dimensions 4' x 5.5' x 17"
- Room Dimensions 44' x 28'
- Room Obstacles
    - ☐ Hindrances and Obstructions

**Intended Users**
- Students
- Administrator(s)

**Secure Uses**
- "Bolt-cutter safe"
- Digital cracking

## Testing

A series of system and unit level tests were performed in the lab to verfiy the functionality of our hardware and software. The tests performed are seen below:

- Servo Torque
- System Range
- Current Draw
- Low Battery Status
- System Timing
- LED Lighting
- Encryption
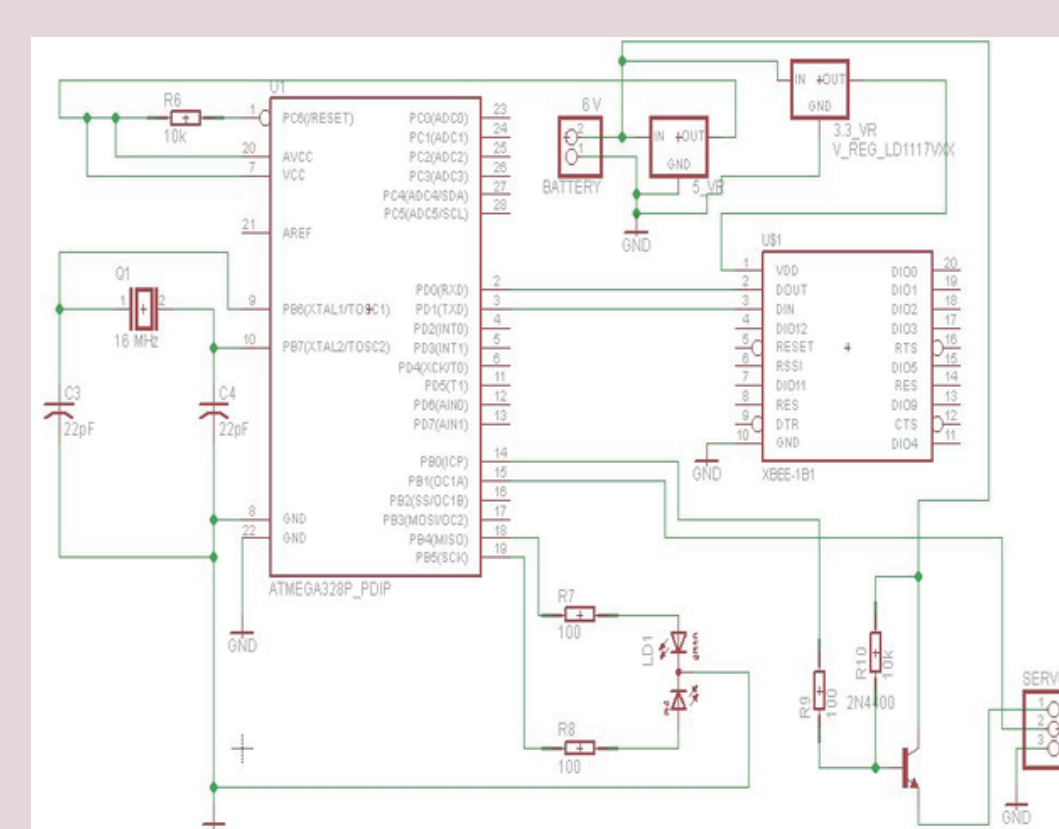- Security Attacks

## Power Management

- Power management is critical
- System designed to stay powered for two semesters (9 months) of use
- Powered using generic AA batteries
- Several methods to save power
    - ☐ Disconnect unused circuit elements
    - ☐ Use agressive sleep functions
    - ☐ Use passive locking mechanisms

| Scenario Definitions | | | |
|---|---|---|---|
| | LCU looks for signal from MCU every 'x' | LCU Checks Battery Status Every 'x' | Locker Opens Every 'x' |
| Scenario 1 | 5 seconds | 1/week | 0/week |
| Scenario 2 | 5 seconds | 1/week | 2/week |
| Scenario 3 | 5 seconds | 1/week | 6/week |
| Scenario 4 | 5 seconds | 1/week | 8/week |
| Scenario 5 | 5 seconds | 1/week | 14/week |
| Scenario 6 | 5 seconds | 1/week | 28/week |

| Scenario Calculations | | | |
|---|---|---|---|
| | Current Draw (mA) | Time (hours) | Electric Power Over Time (mAH) | How many academic semesters with AAA batteries? |
| Scenario 1 | 0.155904514 | 2688 | 419.0713347 | 25.77126877 |
| Scenario 2 | 1.006373505 | 2688 | 2705.131981 | 3.992411489 |
| Scenario 1 | 1.027328477 | 2688 | 2761.458947 | 3.91097612 |
| Scenario 4 | 1.037805964 | 2688 | 2789.622431 | 3.871491609 |
| Scenario 5 | 1.069238426 | 2688 | 2874.11289 | 3.75768109 |
| Scenario 6 | 1.142580035 | 2688 | 3071.257284 | 3.516475176 |

| Battery Types | Type | Voltage | Capacity(mAh) | Cost/8 pk | Capacity/cost |
|---|---|---|---|---|---|
| Energizer Ultimate lithium | Lithium/Iron Disulfide (Li/FeS2) | 1.5 V | 3000 | $18.99 | 157.9778831 |
| Energizer max | Alkline | 1.5 V | 2779 | $6.39 | 434.8982786 |
| Energizer power plus(rechargable) | NiMH (nickel-metal hydride) | 1.2 V | 2300 | $33.94 | 67.76664702 |

**Iowa State University**
Department of Electrical and Computer Engineering

**Faculty Adviser and Client**
Lee Harker

**Team Members**
Nathan Castek, Nathan Lafferty, Corey Cozzato, Mohammad Mohd-Asri, Priyank Patel