



AttendancePlus

Team 18
SDP 20

Meet the Team!



**Jonah
Palmer**

CSE
Team Manager



**Colin
LaFountain**

CSE
PCB Lead



**Jacqueline
Thornton**

CSE



**Jonathan
Eisenbies**

CSE



**Professor
David Irwin**

Faculty Advisor

Problem Statement



Teachers waste precious time throughout the day keeping track of where students are, cutting into time they could be spending teaching.

Further, in an emergency situation, it is impossible to know precisely who is in the school or where they are at any given time.



THE SOLUTION

The Solution



RFID sensor system in classroom and students have an RFID tag:

- RFID system reports back to database application
 - Track student's location and time
- Interactive GUI for authorized users
 - Allow students to be found in real time
 - View current occupants of a given classroom
- Passive system (no "swiping" needed for detection)
- Secure to protect sensitive student data

System Specifications



- I.** Automated detection & identification of students entering / exiting a classroom
- II.** Display location of students in school in real-time
- III.** Non-intrusive, low maintenance integration with existing tech in school
- IV.** Interactive GUI for administrators & faculty
- V.** Protect information from unauthorized individuals
- VI.** Keep privacy invasion to a minimum

Quantitative Requirement Specifications

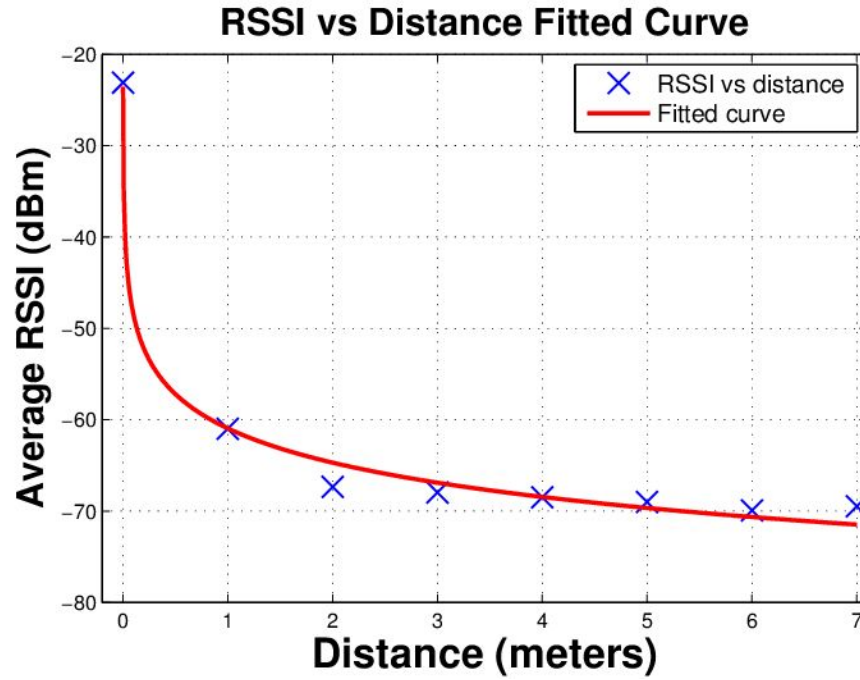


- **High Degree of Reliability: > 95%**
 - Failure to detect tag in room < 5% of all detections
- **Easy Installation**
 - System on ceiling of room
 - Connect to existing power source
- **Privacy Protection**
 - Secure tag registration (e.g. encrypted tag data)
 - Secure data transmission
 - Authentication & confidentiality for GUI

RSSI & Range



RSSI (Received Signal Strength Indicator)

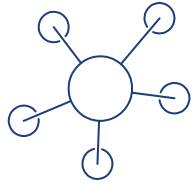


RSSI & Range



RSSI to Determine Distance

- Indicator of signal strength from tag to reader
 - Estimate distance
- Higher the RSSI level, the closer the tag is to reader
- RSSI levels will vary depending on...
 - Reflecting materials bounce signals
 - Liquid absorbs signal
 - Blocking objects
 - Height delta of tag and reader
 - Orientation of tag



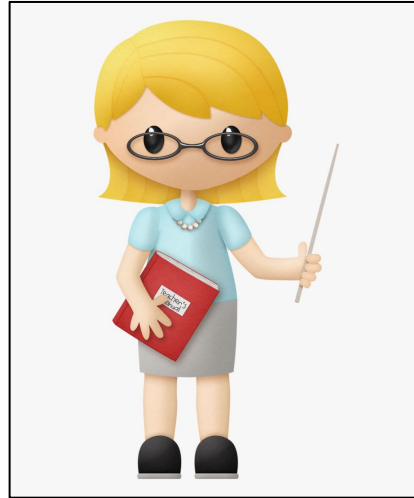
DESIGN ALTERNATIVES

Market Alternative #1



Manual Attendance:

- Not automatic - uses large amount of time (I)
- No interactive method to find student location (II, IV)

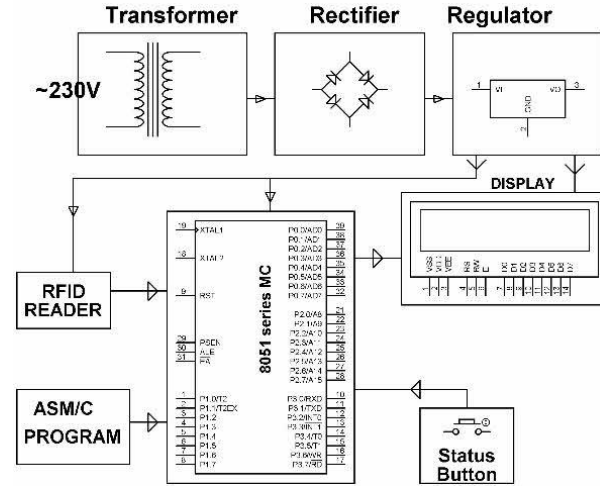


Market Alternative #2



RFID System:

- Less extensive than our goal
 - No GUI (IV)
- Uses swiping (I)
 - Active
 - Not automatic

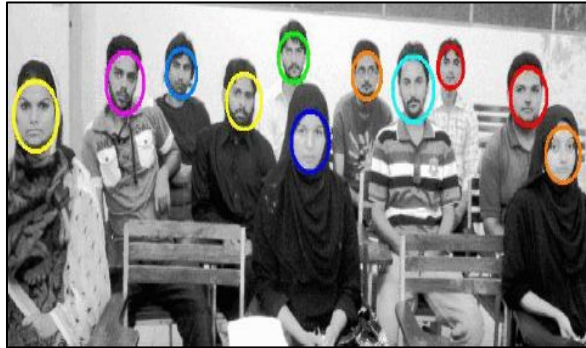


Market Alternative #3



Facial Recognition System:

- Not easy to install into school buildings (III)
- Less reliable than our goal
 - Low facial recognition rates
- Privacy issues with videoing children (VI)



Algorithm	Percentage Results		
	Veil	Unveil	Beard
Face Detection	45%	93%	79%
Face Recognition	10%	87%	65%

Market Alternative #4



TimeClockPlus:

- Fingerprint reading for attendance
- Not an automatic system (I)
 - Interrupts daily activities
- Invasive (VI)



Our Design Alternatives



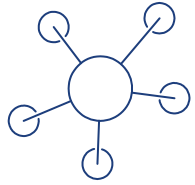
- Reader positioning
 - In doorway vs. ceiling
 - i. Many possible false positives / negatives
 - ii. Doesn't account for multiple entry points
- Reader on ceiling
 - Decreases false positives / negatives
 - Accounts for multiple entry points
 - Focuses on reading tags in the room

Our Design Alternatives



- Wireless vs. Wired
 - Reader & WiFi module require significant power
 - Reader must have continuous power to perform optimally
 - Route power via ceiling instead of drilling through walls
- WiFi vs. Bluetooth
 - Limited range with Bluetooth
 - WiFi allows further communication





SYSTEM COMPONENTS

Hardware, Software & Block Diagram

Hardware Project Solution

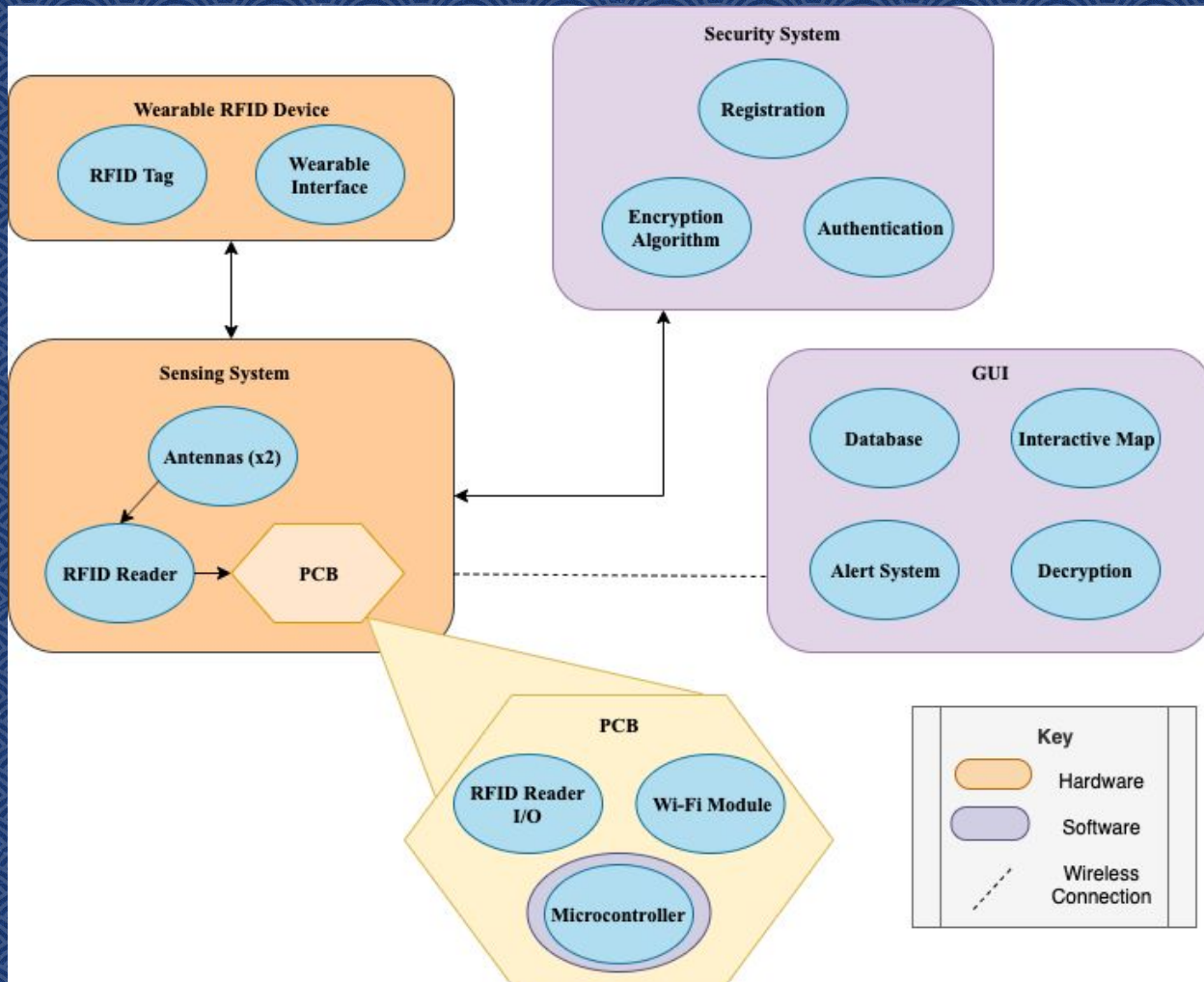


Custom PCB Components:

- ThingMagic Micro Carrier Board (*attached*)
 - RFID Reader
- EEPROM
- Microcontroller
- WiFi module

Other Key Hardware:

- Laird Antenna - Circularly Polarized (x2)
- UHF Active RFID Tags



Budget



1. ThingMagic Micro Carrier Board \$380
2. Antenna: LAIRD S9025PL (x2) \$276
3. WiFi Module: ESP8266 \$7
4. 32 bit Microcontroller \$8
5. 5ft Antenna Cables \$78
6. 50 Ω Terminators \$6
7. MMCX to SMA Antenna Connectors \$8

Total for Classroom: \$763

8. Tag	\$30
---------------	-------------

Total: \$793

AttendancePlus UI



Want UI to be easy for teachers and administrators to...

- Instant role call
- Display last known location for students

Implement protocols for student behavior (for example):

- Not in school by start of first class
- In school but not in correct class
- In bathroom for > 10 mins

Implementation

- Qt Creator / Developer



AttendancePlus Registration



Register new students for each school year

- Tag securely written to w/ student's info
- Digital signature applied to encrypted data
- Store hash of encrypted data to memory for future validation

Transferring Students

- Leaving students turn in their tag
- Students who join school added by administrator

Security Concerns & Solutions



Tag Duplication

- Digital Signature written to tag
- Authenticate unique hash on server side

Eavesdropping (i.e. Package Sniffing)

- Prevent unauthorized data access
- Encryption algorithm used when transmitting tag data

GUI Authorization

- Levels of access for UI
- Authenticate users based on access type



Looking Ahead

MDR and More...

MDR Prototype: Team Plan



Jonah - Team Manager

- Create barebones GUI
- Configure server WiFi communication (*shared task*)
- Implement server security (*shared task*)

Colin - PCB Lead

- Configure RFID reader to read and write tag data
- PCB Prototype

Jonathan

- Configure hardware system's WiFi module
- Configure server WiFi communication (*shared task*)

Jackie

- Implement server security (*shared task*)
- Implement hardware system security



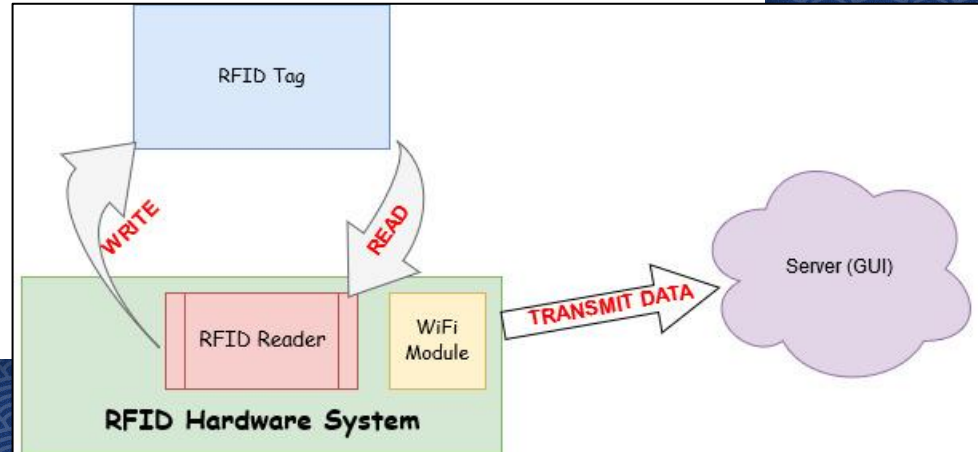
MDR Prototype: Specs



1. System will pick up RFID tag and *securely* transmit tag data via WiFi
2. Server will not continuously process the same tag
3. Challenge: secure tag data
 - a. Writing to tag...
 - i. Reader encrypts data and digitally signs tag
 - ii. Save hash of encrypted data
 - b. Reading tag...
 - i. Hash encrypted data, search memory for hash
 - c. Tag data decrypted by server

MDR Focus:

Secure tag data write, read, transmission

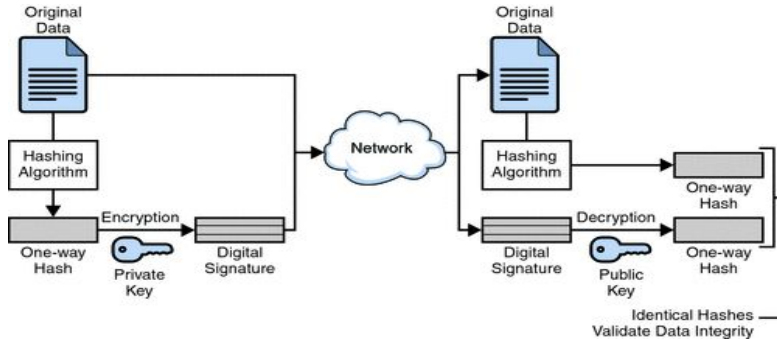


MDR Prototype: Deliverables



What we will show at MDR:

- 1. When writing to tag...**
 - a. Tag data before & after encryption when writing
 - b. Hash of encrypted data
- 2. When reading from tag...**
 - a. What is read
 - b. Hash of encrypted data
 - c. Confirmation of hash found in memory
- 3. When data is transmitted...**
 - a. Data being transmitted
 - b. Decryption of data on server

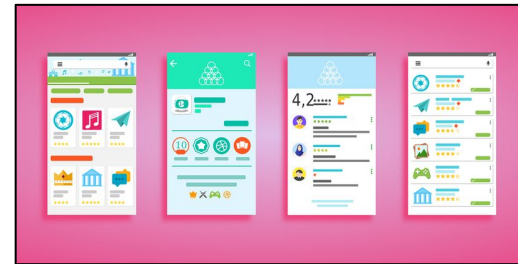
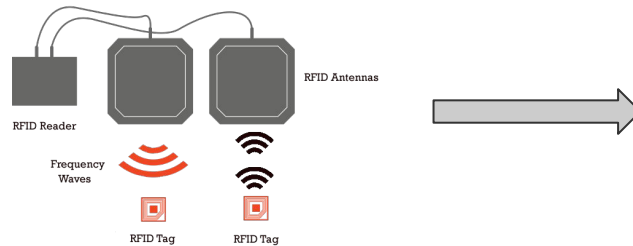


FPR

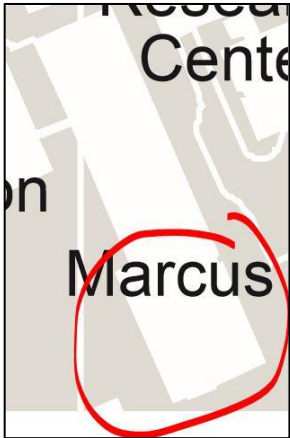


By FPR, we hope to achieve the following...

1. Maximization of reliability of system
 - a. Accurately determine students entering / exiting a room
2. Well-rounded, elegant, easy to use GUI
 - a. List absent and present students
 - b. List student location and time entered
 - c. List number of occupants & their information in a room
 - d. Fully functional student behavior protocols
3. Secure login to GUI



Demo Day



On Demo Day, we hope to at least show...

Complete system functionality:

- Show RFID system correctly marking tag holder present when entering room
 - Show accuracy of reader
- When exiting room, indicator display on GUI to return tag
 - Show student protocols in use
- Show cafe's occupancy of authorized guests
 - Show how many tag holders are present in the room



Thank You!

Any Questions?

Links



- ◎ Alternative Design 1:
 - ◎ <https://www.elprocus.com/rfid-based-attendance-management-system/>
- ◎ Alternative Design 2:
 - ◎ <https://ieeexplore.ieee.org/document/7916753>
- ◎ Alternative Design 3:
 - ◎ <https://www.timeclockplus.com/devices>

- ◎ Presentation template by [SlidesCarnival](#)
- ◎ Photographs by [Unsplash](#)