Indoor People Tracking System – IPTS

Group 7:
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Brandon Tuero
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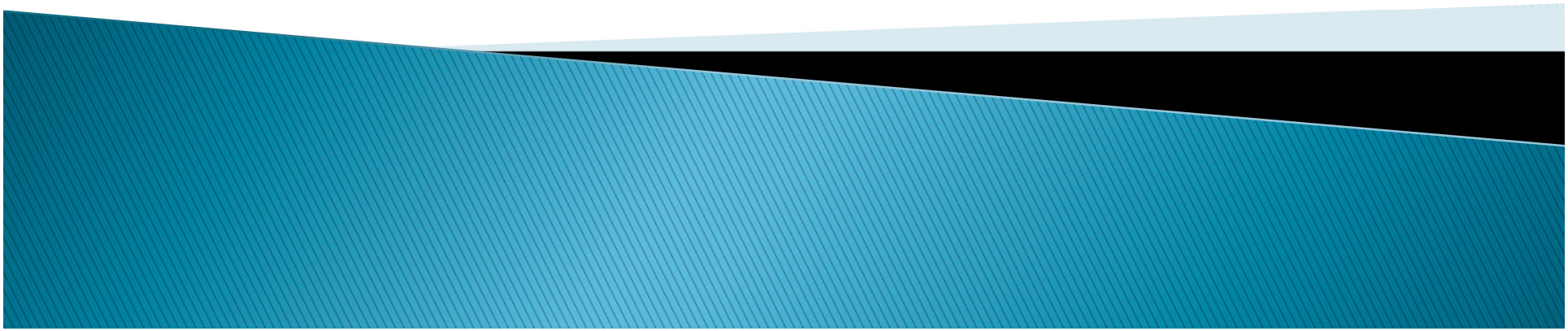
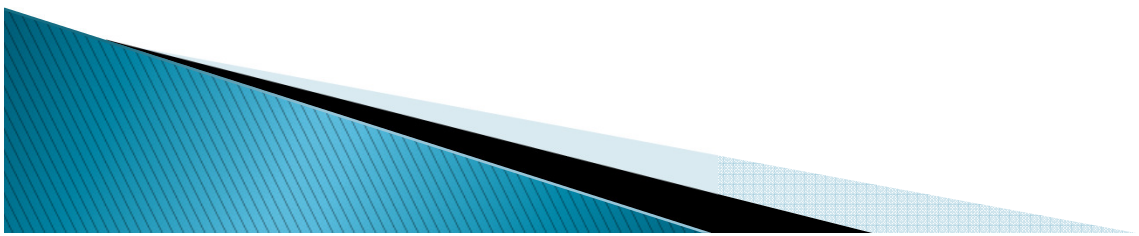


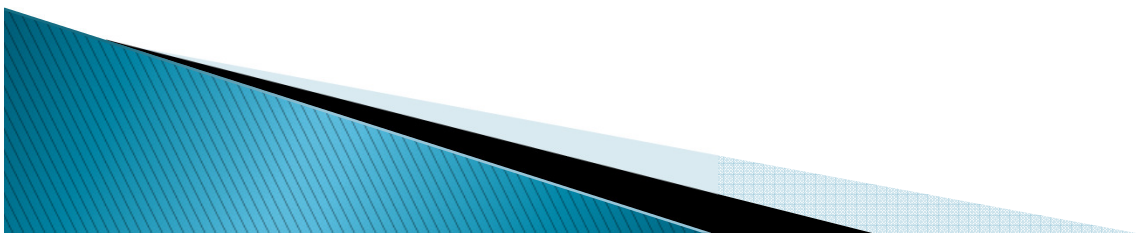
Goals

- Accurately track the location of personal and guests within a secure facility on graphical display
- Identify the current location within a facility with the push of a button
- Send a distress signal in case of emergency
- Receive the location of a person in distress
- Receive the location of a security breach



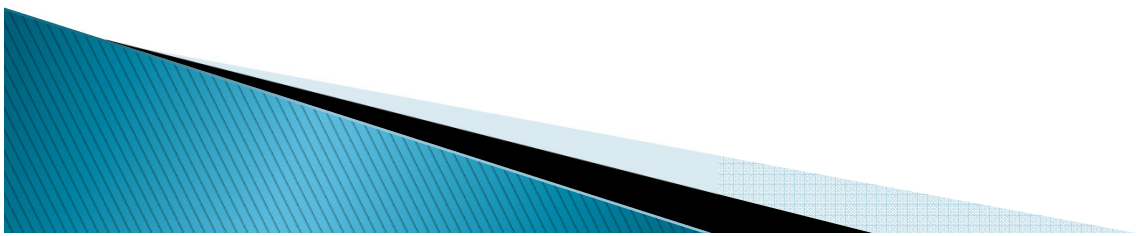
Indoor Positioning Challenges

- High cost
- Complex designs
- Building structures interfere with the signal
- Noise from outside sources
- Accuracy



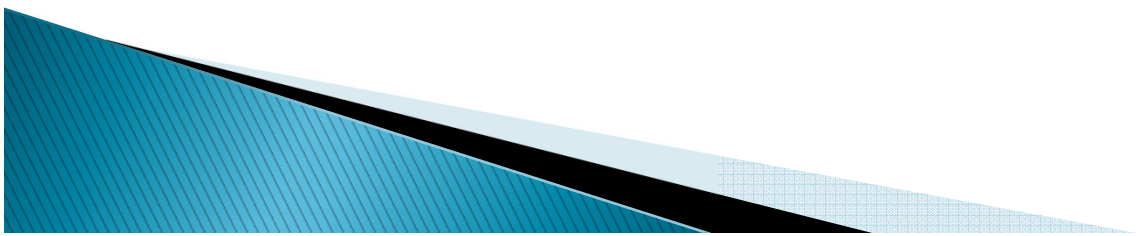
System Specifications

- Minimum location accuracy of 5 ft in any direction
- Maximum tag read range of 500 ft
- Operation frequency 2.4 GHz

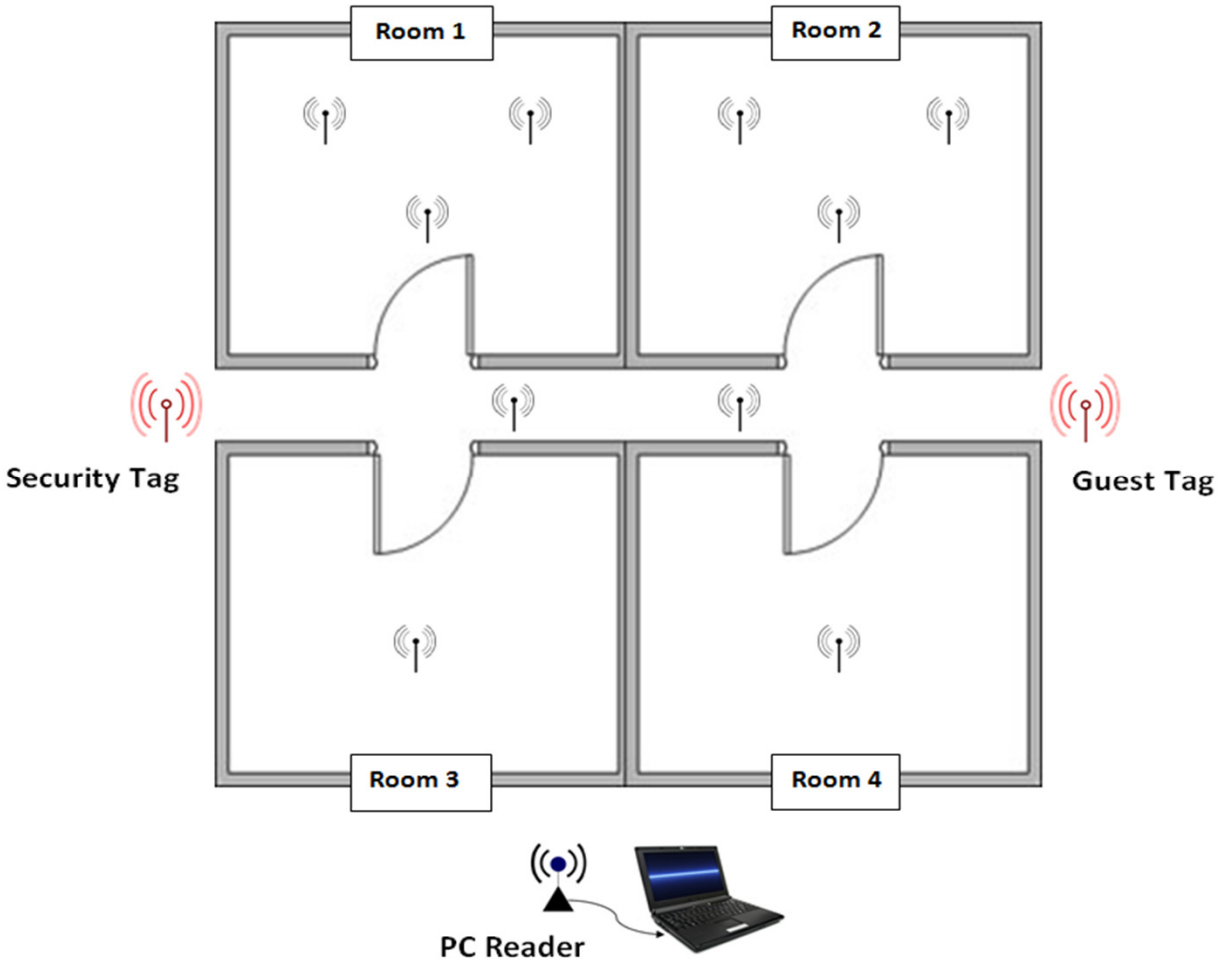


System Components

- **Guest Tag**: Carried around by person to be tracked
- **Security Tag**: Carried around by authorized personal
- **Reader Mesh**: Placed around the area where people need to be tracked
- **Base Reader**: Connected to the pc, receives data from reader nodes and sends it to the pc
- **PC GUI**: Process the tag data and display it on a map

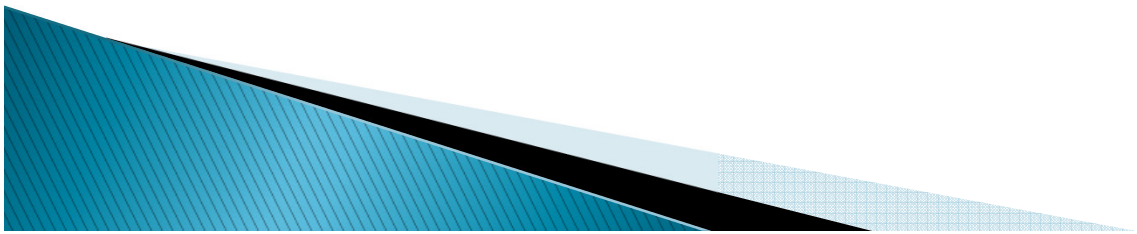


System Layout



Guest Tag Overview

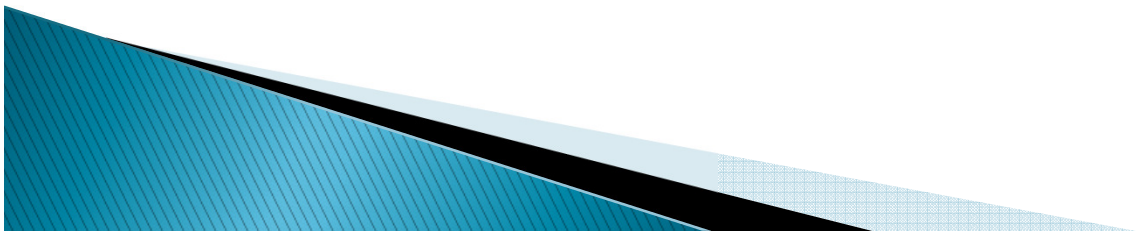
- Push-Button Identification
- Push-Button Distress Call
- Low-Battery Indication



Guest Tag:
Room Identification

- External flash for audio files: SD Card
- Can not use FAT implementation
- Must use SPI

Memory	MSP 430G2	Needed for FAT
RAM	128 Bytes	1024 Bytes
FLASH	2048 Bytes	Several K-Bytes



Guest Tag:
Room Identification

- 8-bit audio sample
- 8KHz.wav saved as raw text file
- Imaged to SD card starting at sector 0

SD Card Layout

Sector	Current Byte ↓						
0	0	1	2	...	509	510	511
1	0	1	2	...	509	510	511
2	0	1	2	...	509	510	511

Guest Tag
Room Identification

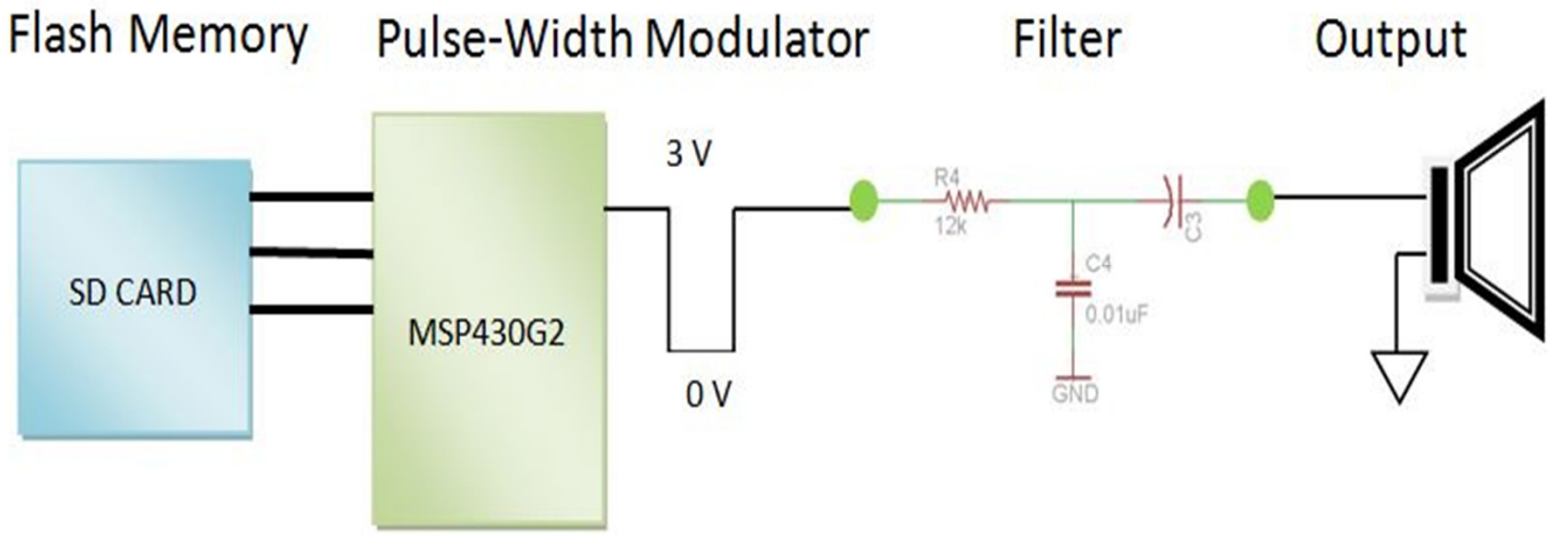
- Access always starts with sector 0
- Only sectors containing desired song go to output
- Each byte placed into the PWM duty cycle register until end of last sector

- Internal CLK --- 8MHz
- Sample Rate --- 8KHz
- PWM Reg Updt--8KHz
- WDT Interrupt --8KHz
- WDT Trigger--8M/512 = 15,625
- Routine updates audio every other interrupt, or 7,812.5 ≈ 8,000

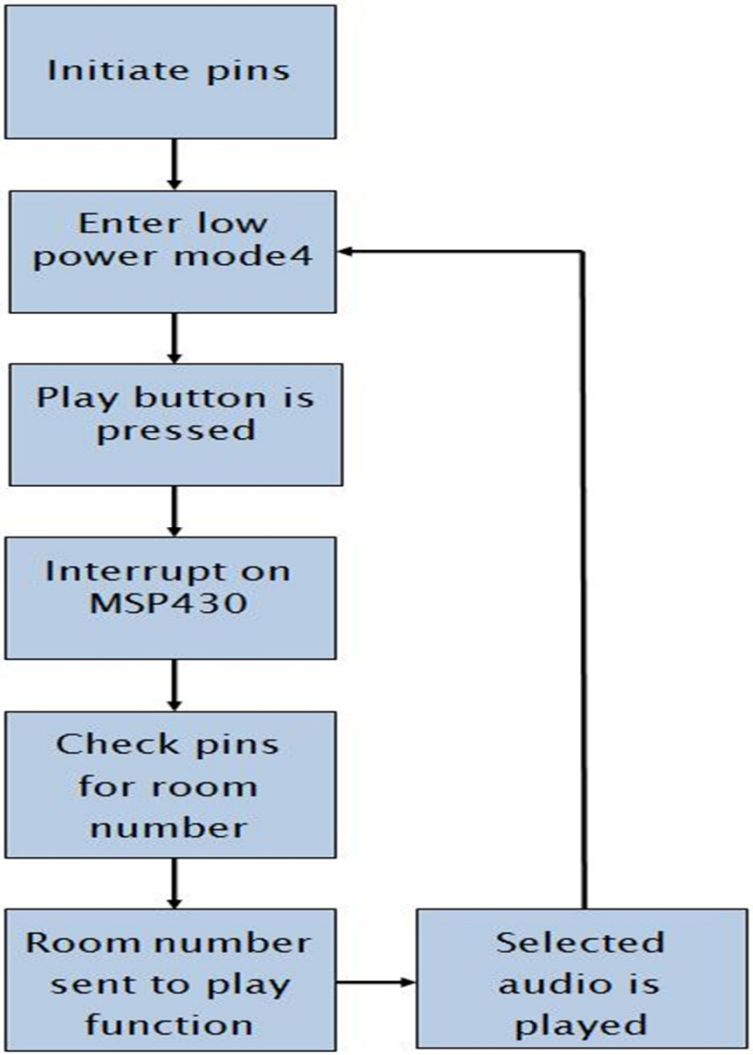
SD Card Access

Playback Rate

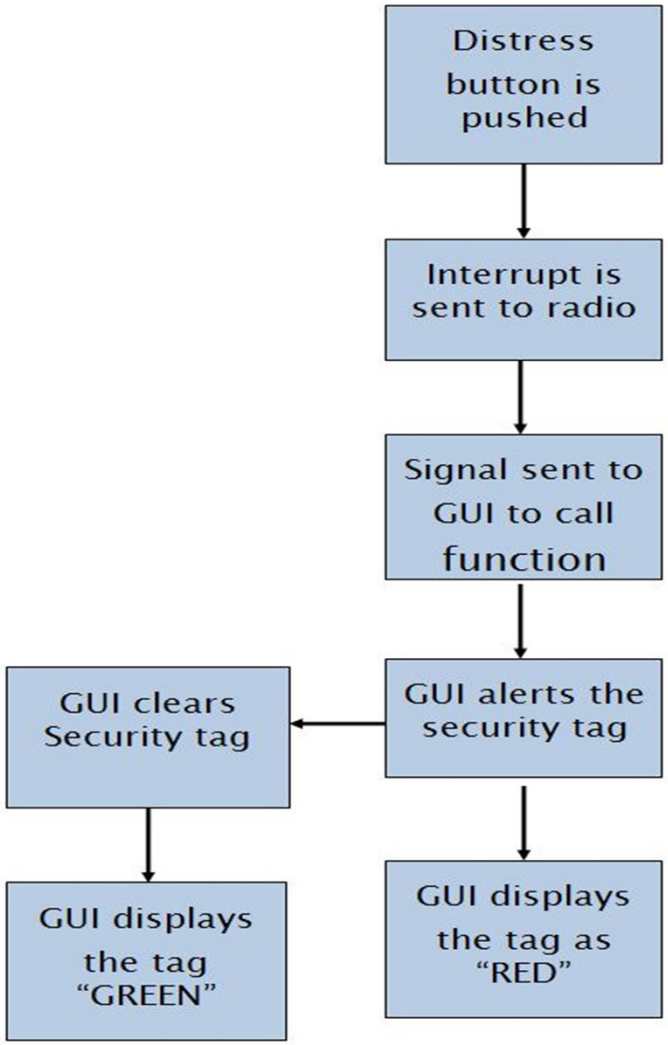
Guest Tag
Playing Raw Audio File



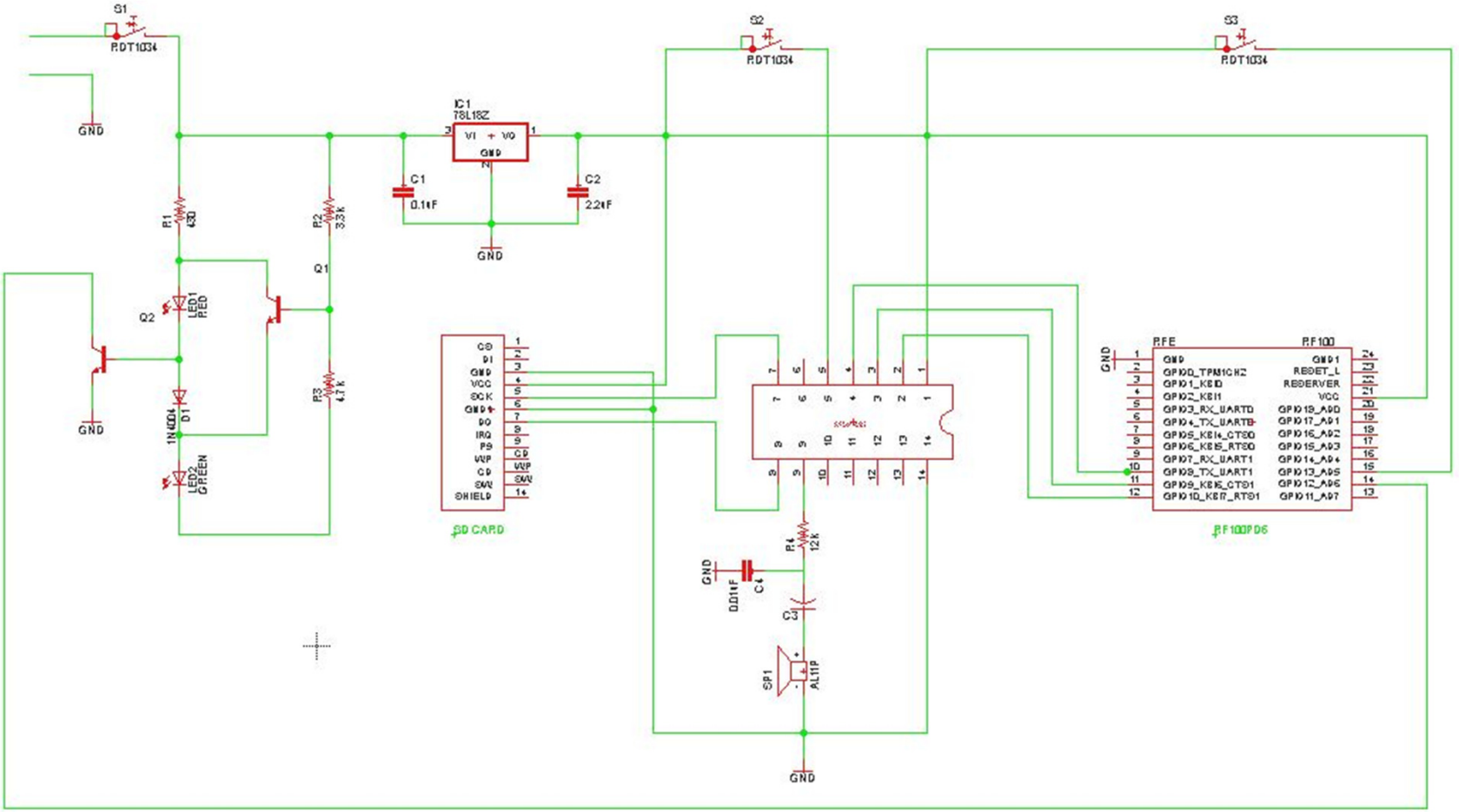
Program Flow



Distress Call

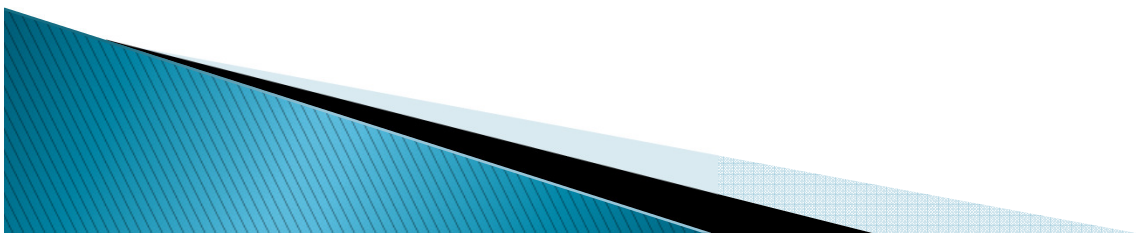


Guest Tag Layout



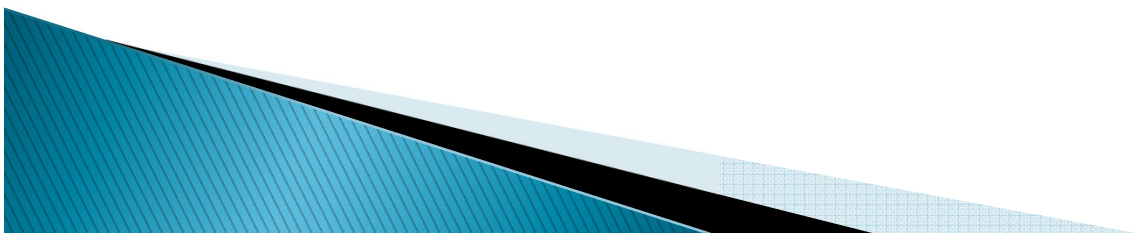
Security Tag Overview

- Carried by security personnel
- Viewable by the tracking software
- Will monitor the system for emergencies or security breaches
- LCD display will show where the situation is occurring
- Small buzzer will sound to notify of change of status



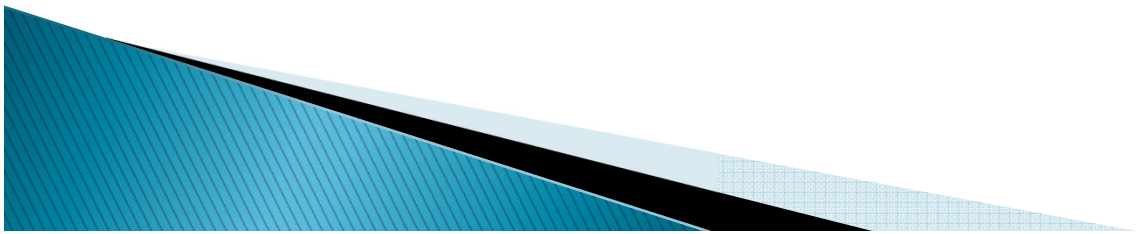
RF

- All tags and readers utilize Synapse RF Modules
- IEEE 802.15.4 Standard at 2.4 GHz
- System will use 2 different RF modules
  - RF100 PC6 with built in F antenna
  - RF100 PD6 with SMA connection for external antenna
- Code on the tag radio will transmit address of radio every 1 seconds



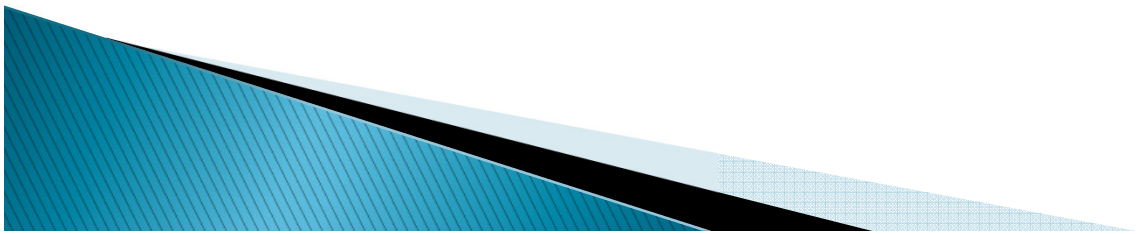
RF Engine Specifications

- RF 100 Modules have an outdoor LOS range of 3 miles and a 1000 foot indoor range
- 19 General Purpose I/O pins
- Small 33x33mm size
- Uses about 60 mA when transmitting, but has a low power sleep state of 1.6 µA

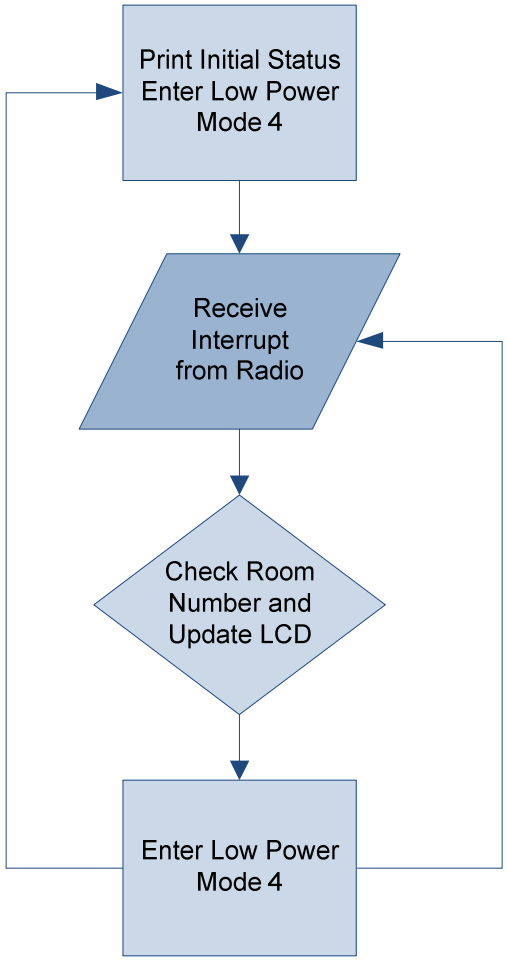


Microcontroller

	MSP430G2231
Package	14 Pin PDIP
I/O	10 GPIO
Voltage	1.8-3.6 V
Active Mode Current	300μA
Low Power Mode 4	0.8μA
Cost	FREE

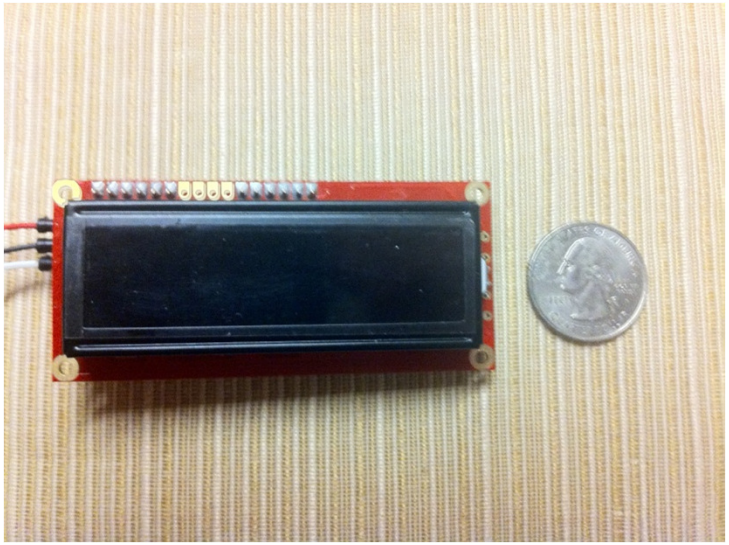


MCU Program Flow



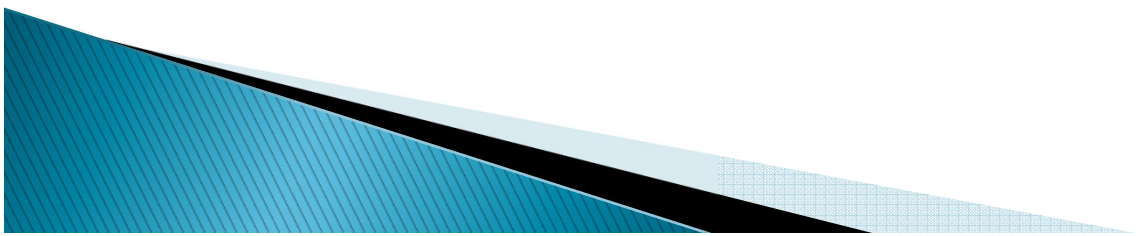
LCD Display

- Sparkfun 3.3V serial enabled LCD
- 16x2 character display
- Buzzer will sound for about 1 second to notify user
- 20mA current draw



Power

- L4931 3.3 V voltage regulator made by STMicroelectronics
- Output current of 250 mA
- Max current of security tag during testing of 110 mA
- Very low dropout voltage of 0.4 V

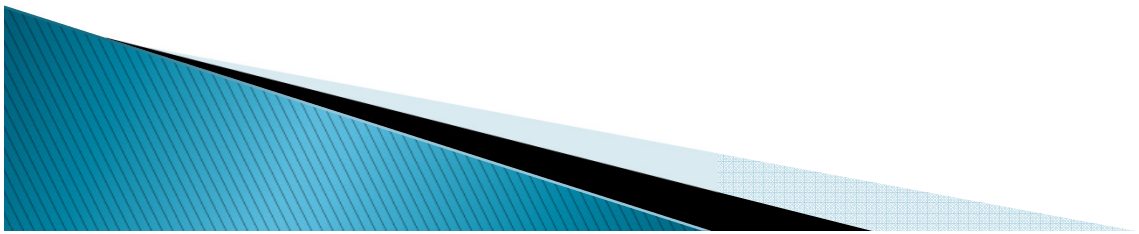


Battery

- Guest and security tag have Sparkfun 3.7 volt polymer lithium-ion battery
- 2000 mAh capacity
- Lightweight at 36g
- Small size 0.25”x2.1”x2.1”

Battery Life = Capacity of Battery (mAh)/Consumption of Device(mA) * 0.7

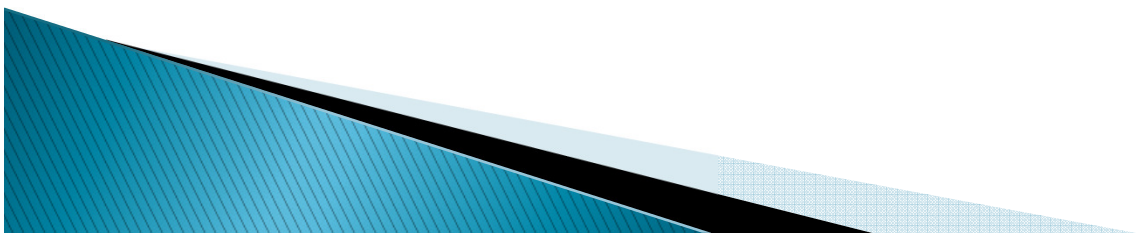
- Battery Life = Approximately 12 Hours



Battery

Battery	4 x AAA	7.2 V Li-ion
Capacity	~1000 mAh	2200 mAh
Cost	$2.00	$21.95
Life in hours	6	14

Battery Life = Capacity of Battery (mAh)/Consumption of Device(mA) * 0.7

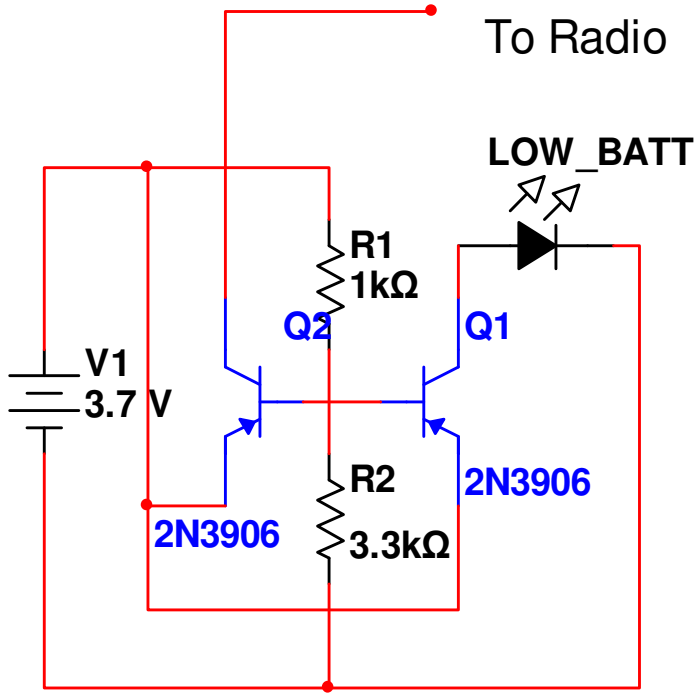


Power/Low Battery Circuit

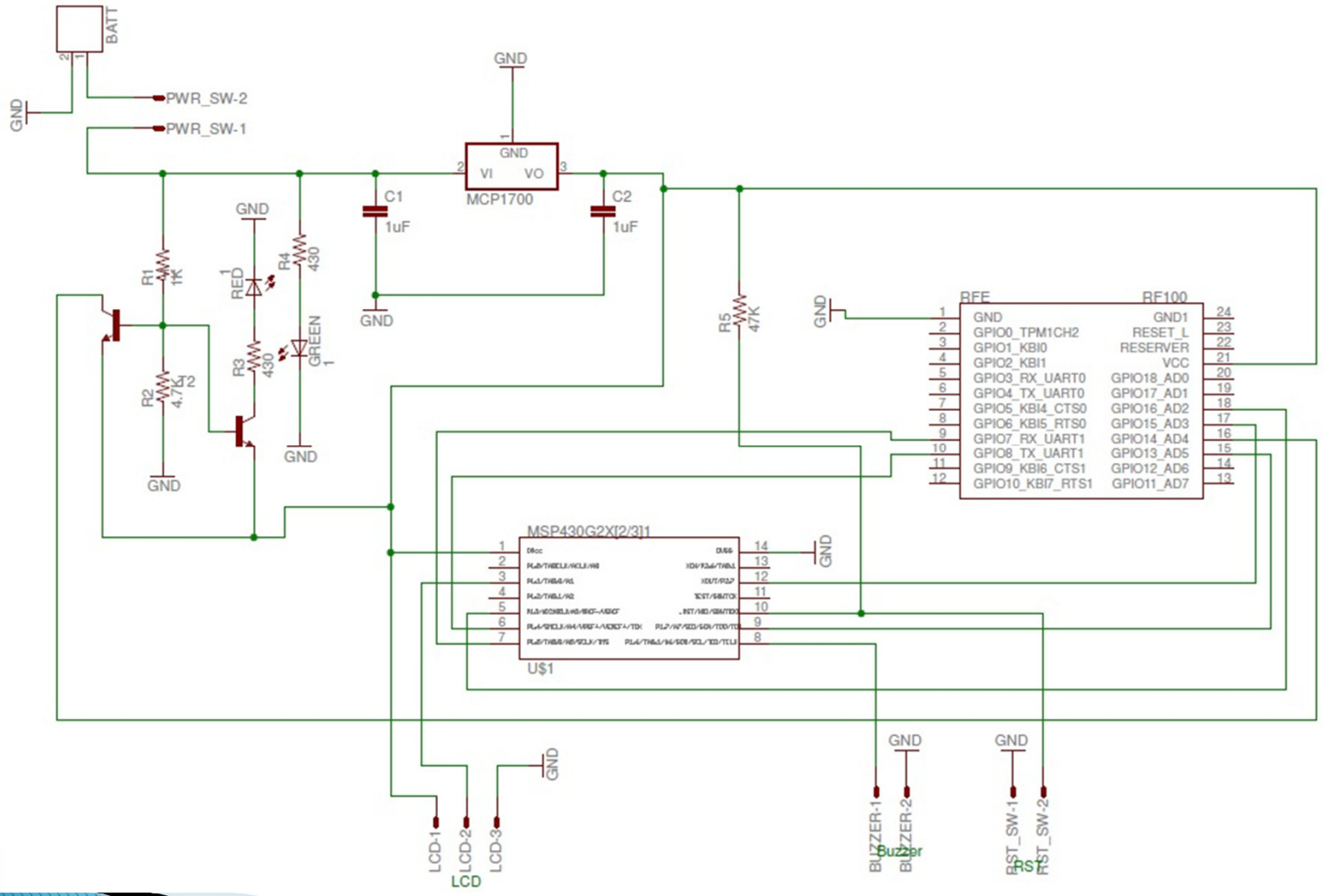
- 2 LEDs, green when unit is turned on, red when battery is low

$$3.3\ V * \left(\frac{R2}{R1 + R2}\right) = 0.7\ V$$

Low Battery Resistor Formula



Security Tag Schematic

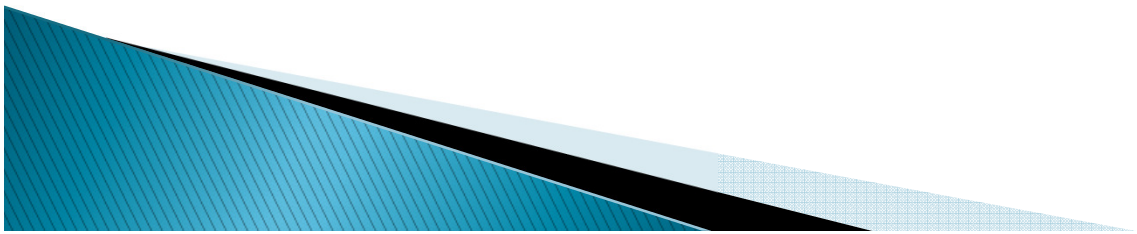


Reader Nodes

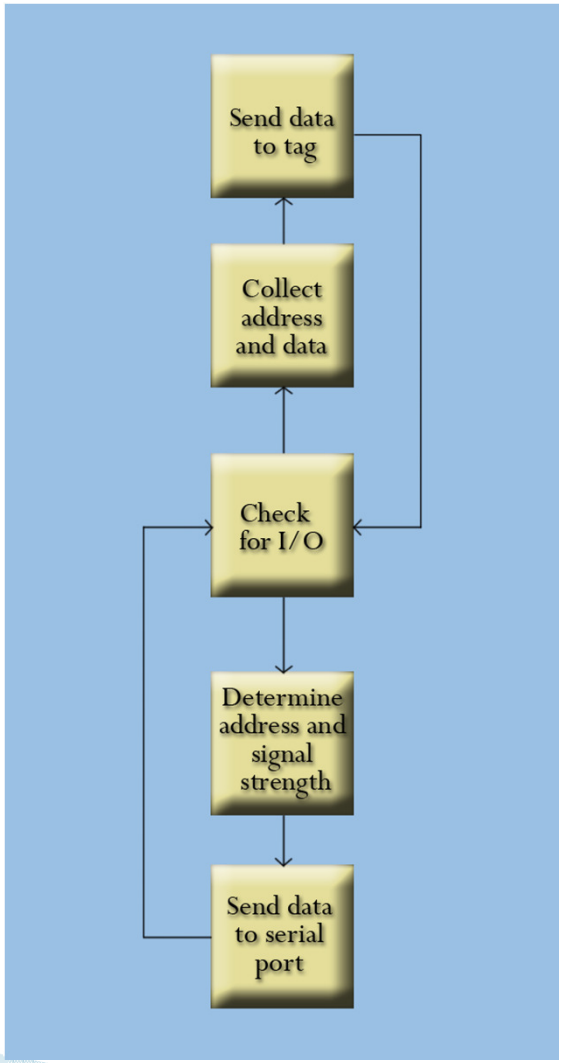
- Each room will have a reader node
- Will simply consist of an RF module in a small case, 2 inches squared, powered by a DC wall adapter
- Nodes also contain a voltage regulator due to low quality wall adapter
- Constantly on, communicating information back to base unit

Base Unit

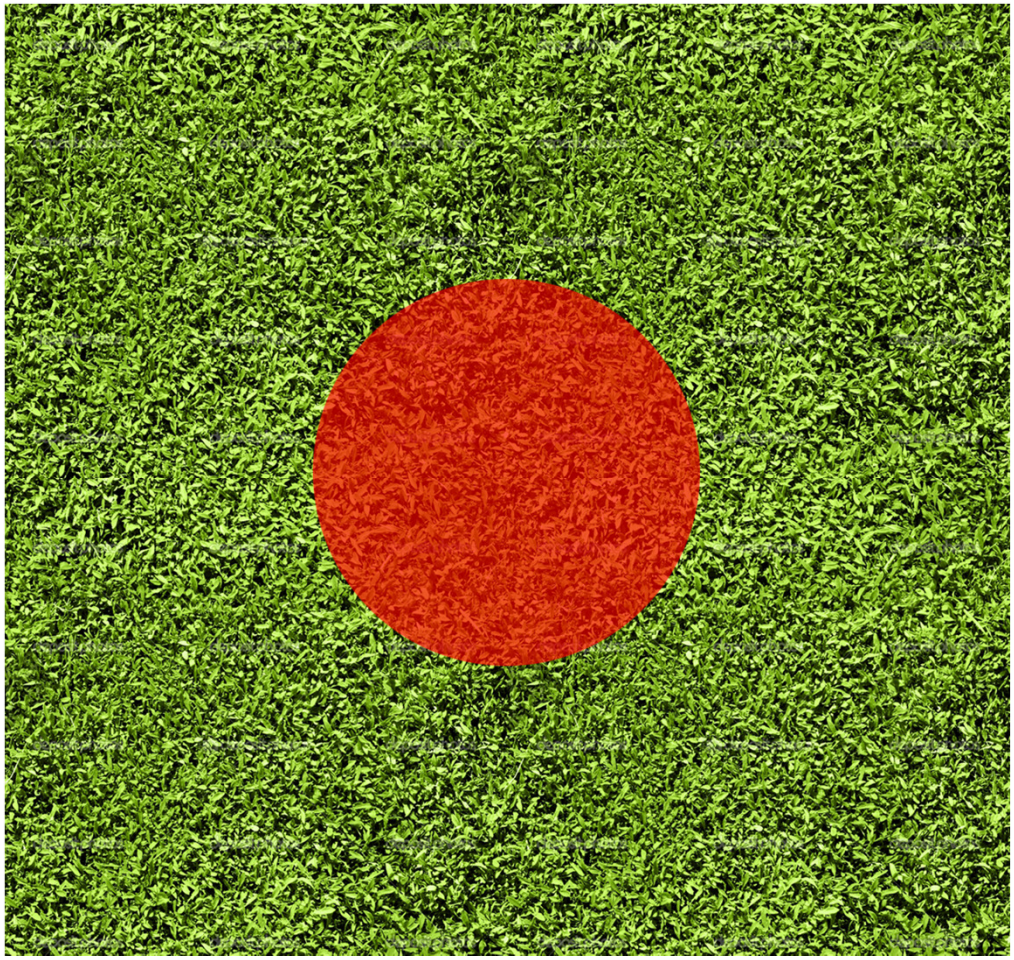
- Handles serial data to and from the GUI
- Serial to USB chip used for convenience
- Powered through the USB

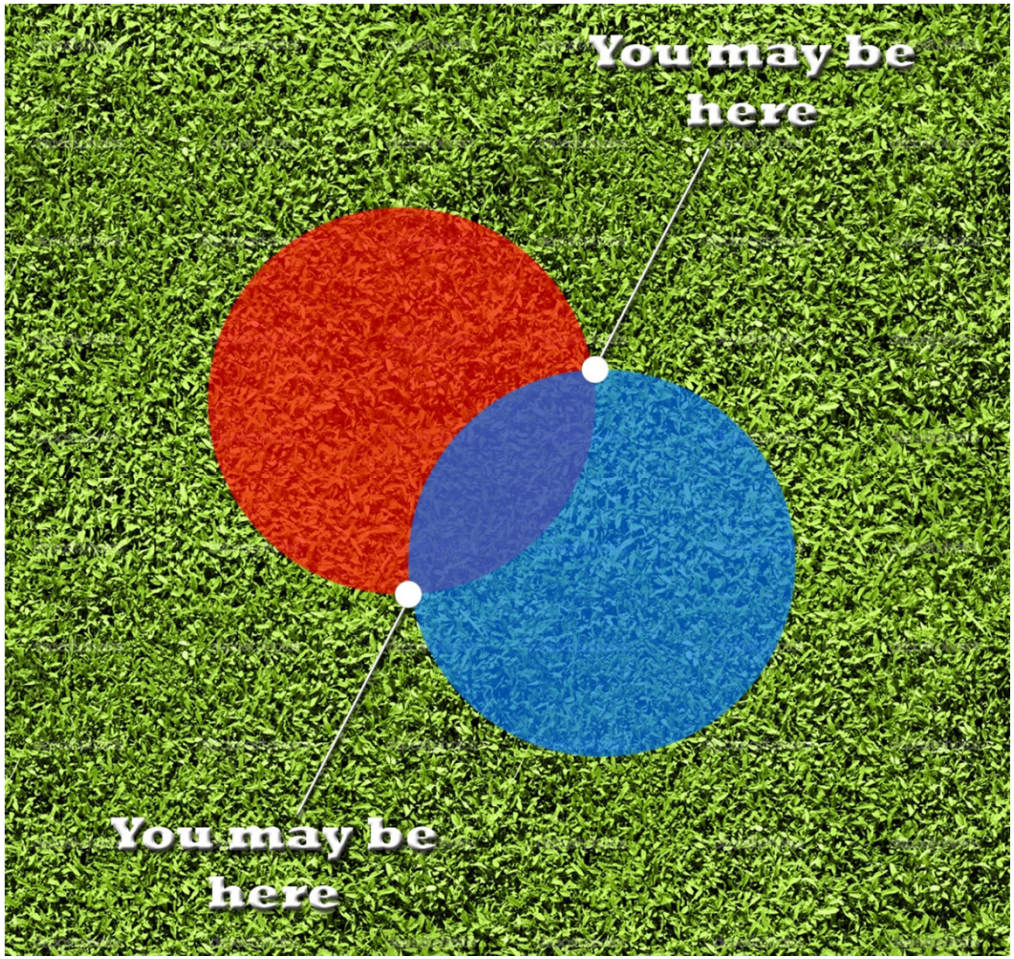


Base Unit Program



Trilateration

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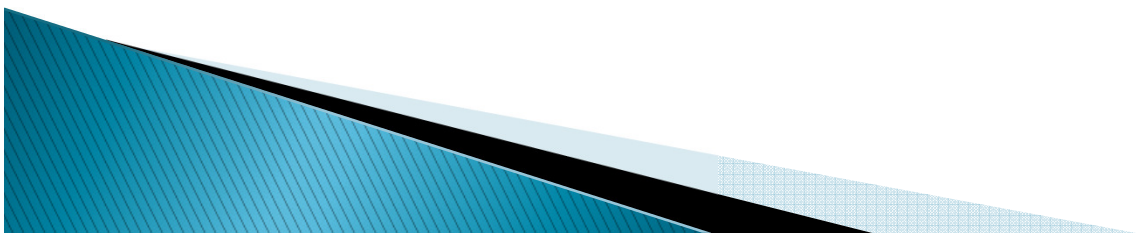
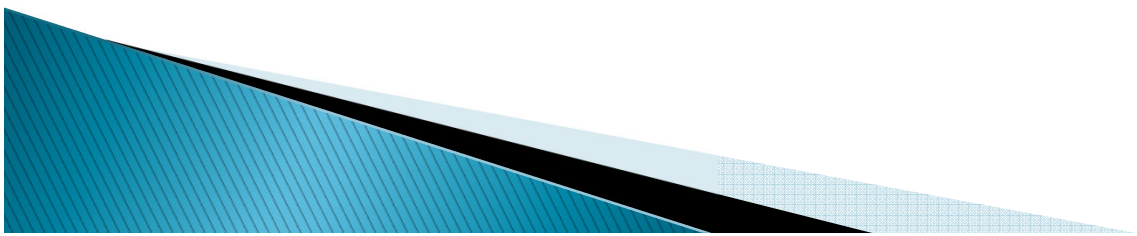
Our Approach

- Each room will have at least one node
- Closest room with be determined by the largest signal strength
- After the room is determined, location within the room is found based on one of three methods
- Information is sent back to the tags based on the location

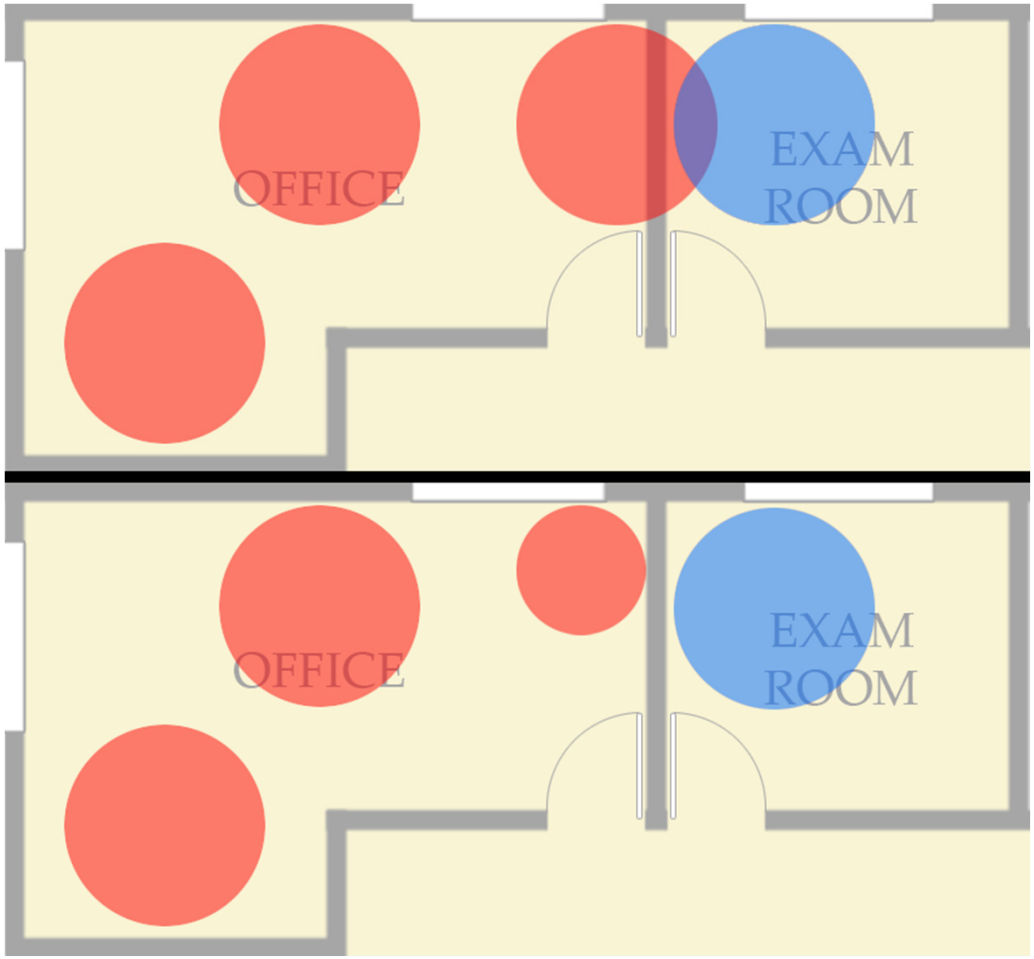


Variation In Signal Strength While Stationary

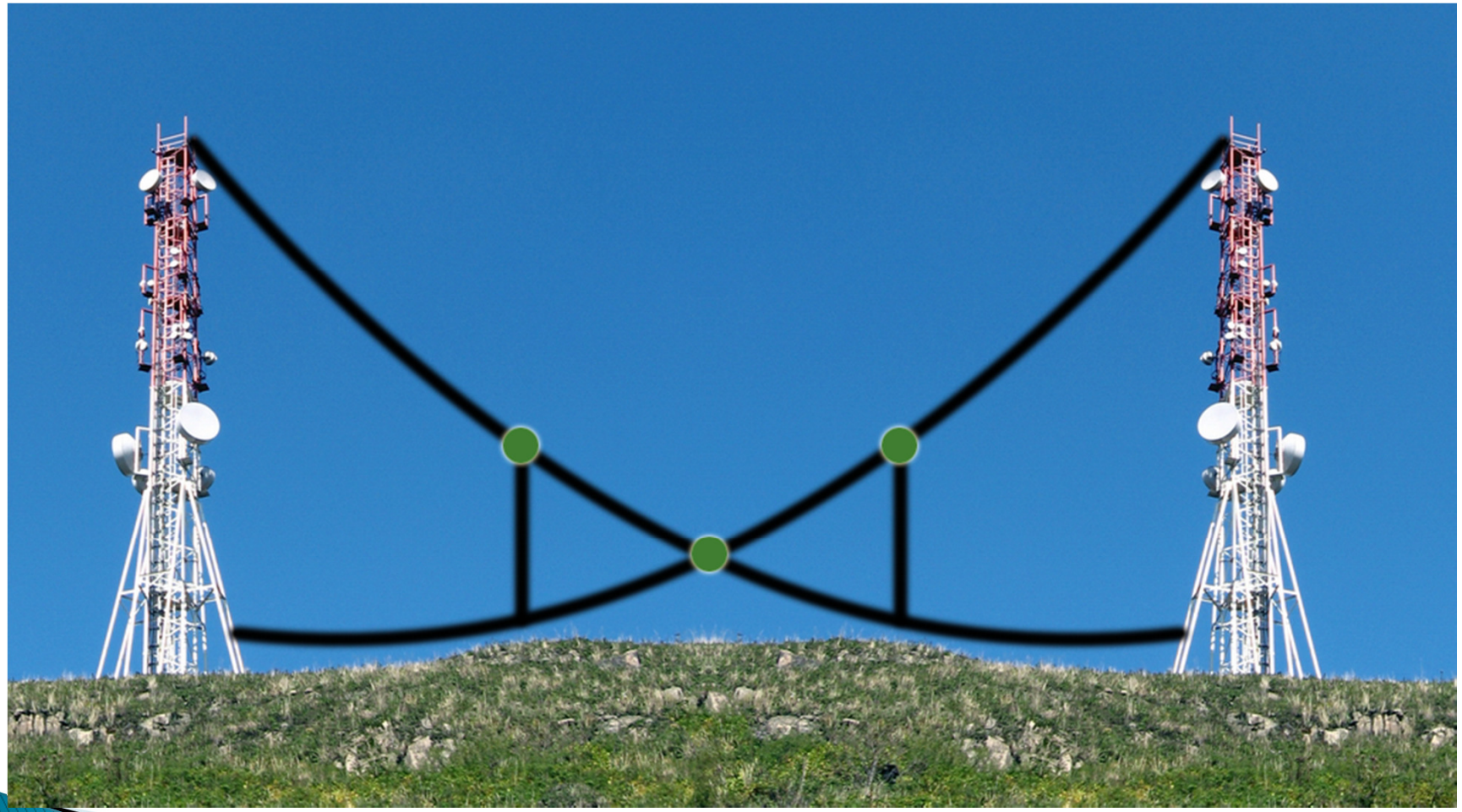
- Signal strength varies even when all components are stationary
- If this variance isn't dealt with, the movement would continue to jump around.
- Our solution is to establish a threshold that determines if the variation in signal strength is due to actual movement or not.



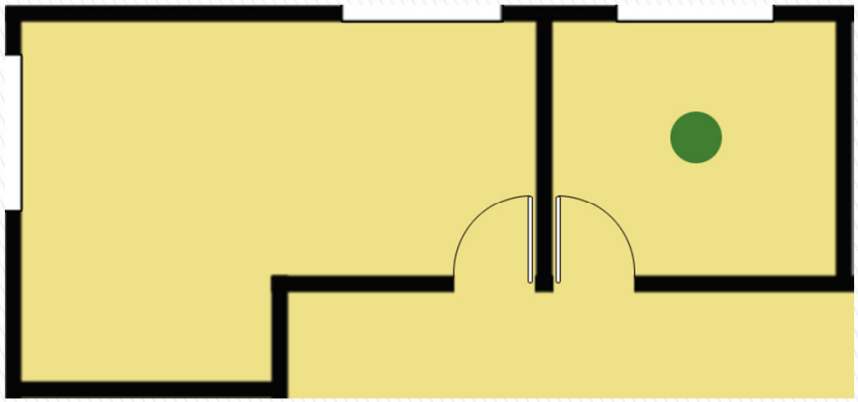
Signal Overwhelming an Adjacent Room

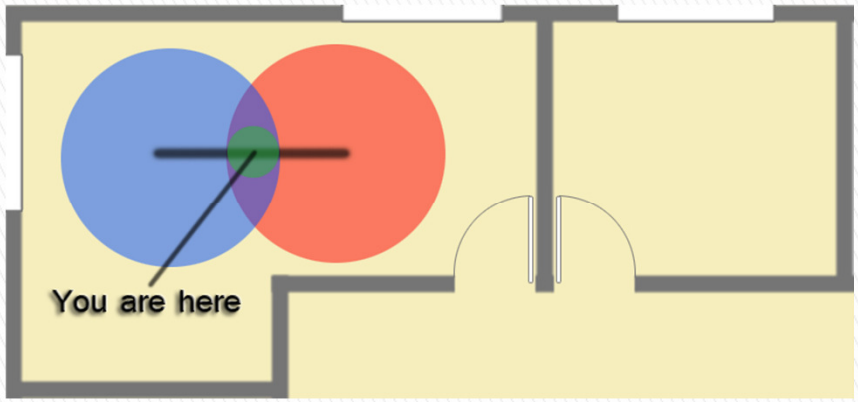


Room Change

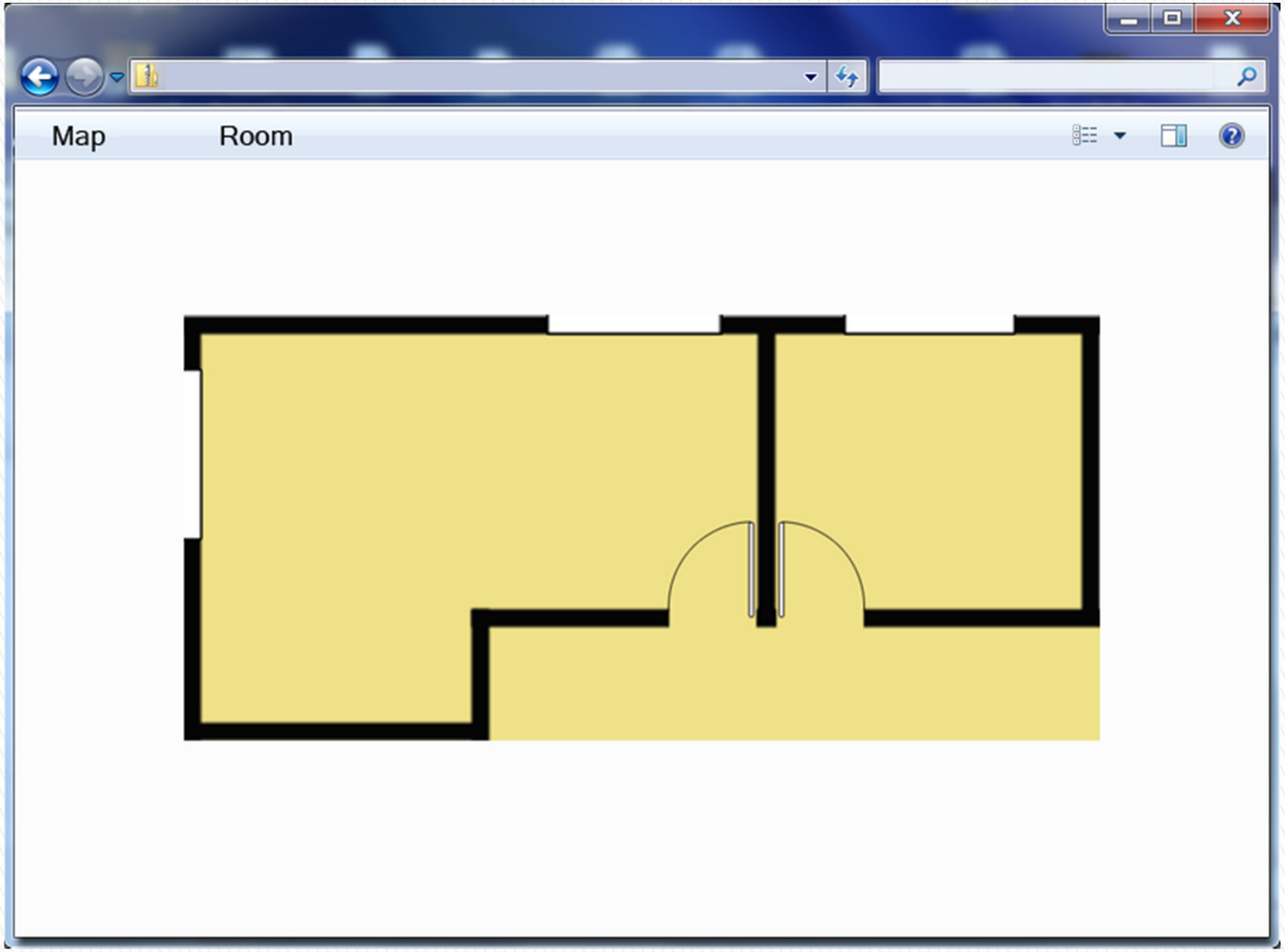


Location Detection Methods

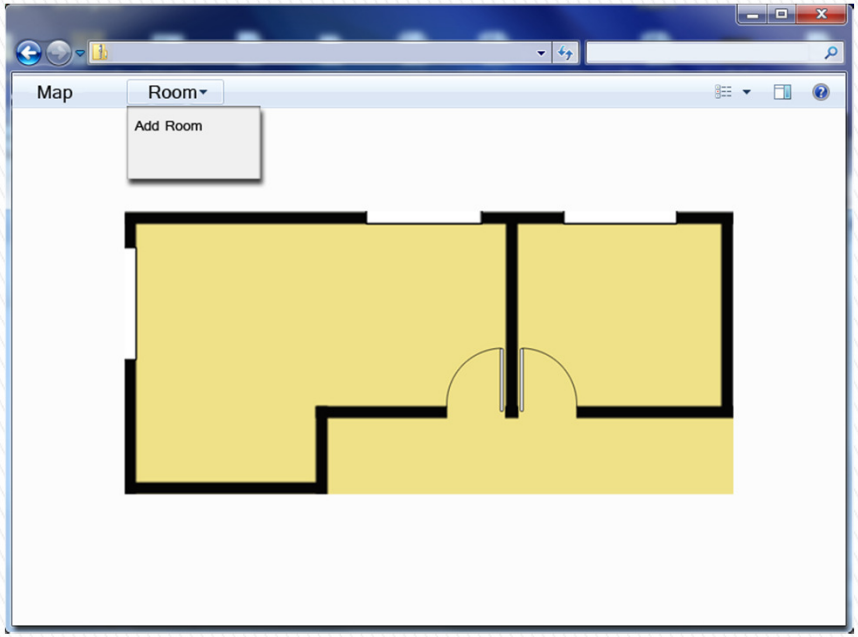


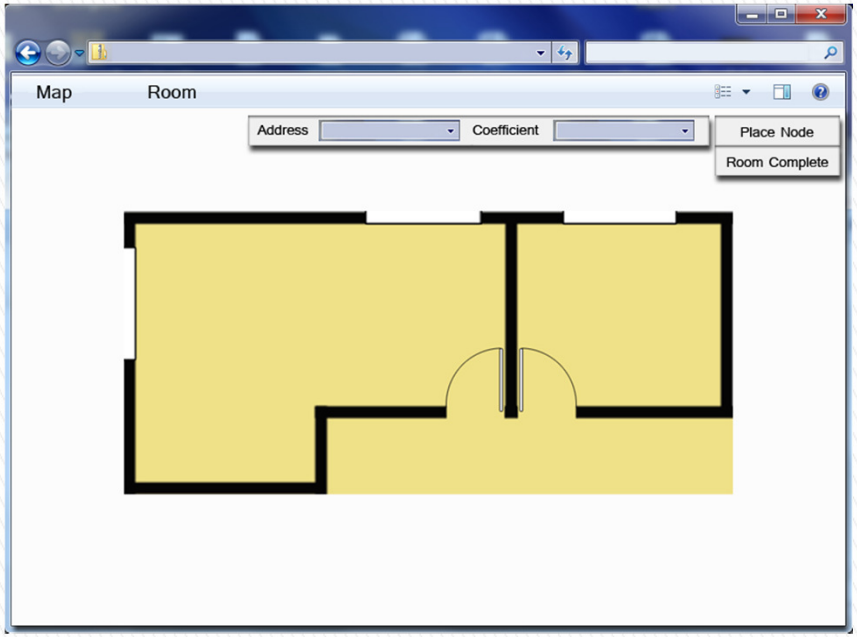


GUI Setup

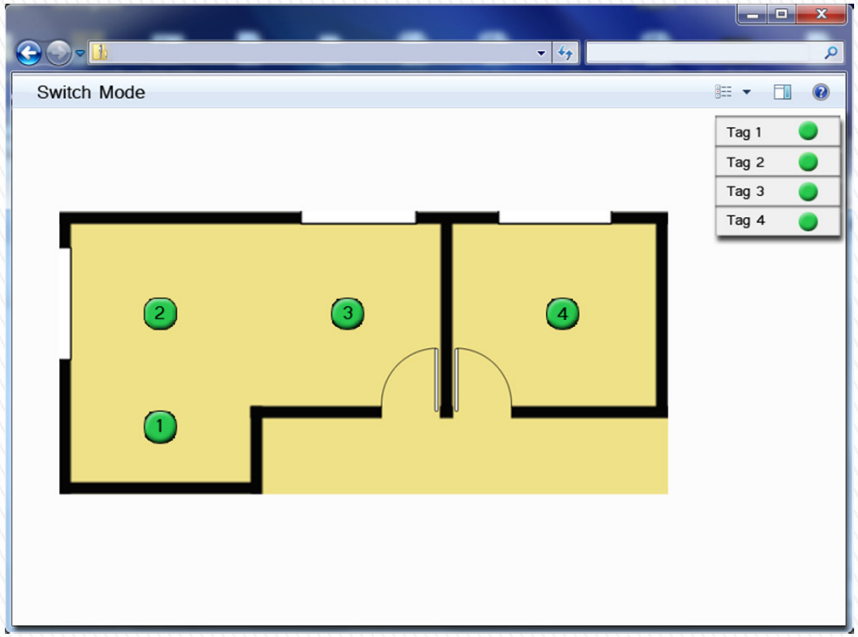


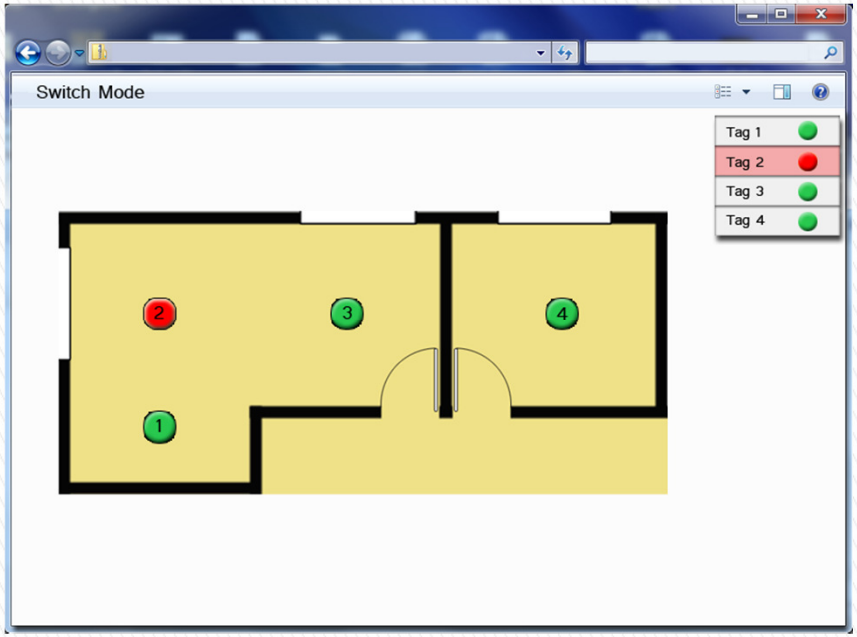
Adding a Room





Running Mode





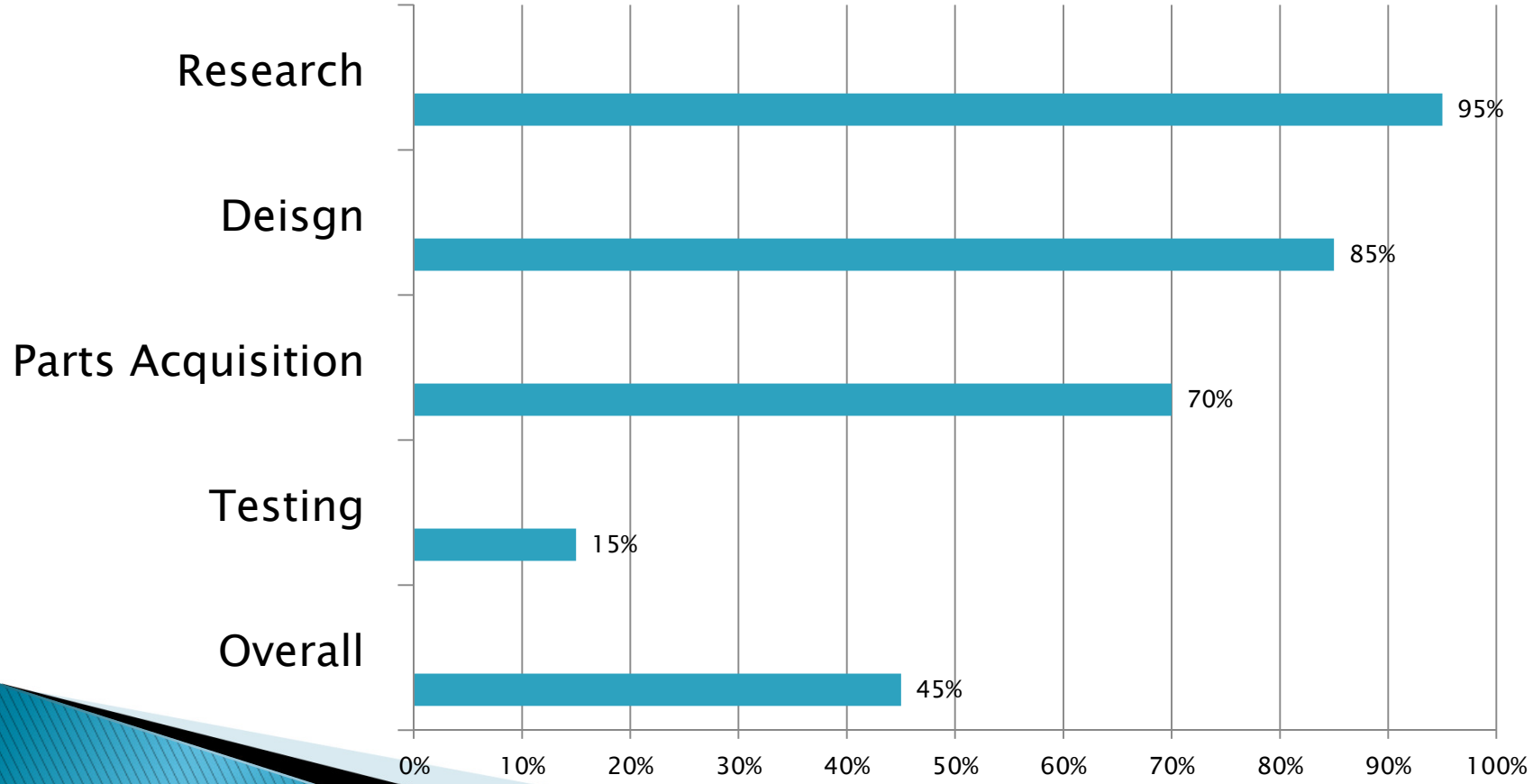
Division of Work

Name	Guest Tag	Security Tag	GUI	MCU Code	Radio Code
Daniel	X			X	
Brandon		X		X	
Matt			X		X

Budget

Part	Quantity	Cost	Extended Cost
Radio Module	10	$30.00	$300.00
Radio DEV Board	1	$40.00	$40.00
MCU	2	FREE	FREE
LCD Display	2	$24.99	$49.98
Discrete Comp.	Misc	Stock	Stock
Battery	2	$16.95	$33.90
PCB	2	$45.00	$90.00
DC Wall Adapter	7	$5.00	$35.00
SD Card/Socket	1	$7.90	$7.90
Speaker	1	$3.00	$3.00
Buzzer	1	$3.00	$3.00
		TOTAL	**$562.78**

Progress


Research
Deisgn
Parts Acquisition
Testing
Overall
95%
85%
70%
15%
45%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

Questions?