Indoor People Tracking System – IPTS

Group 7:
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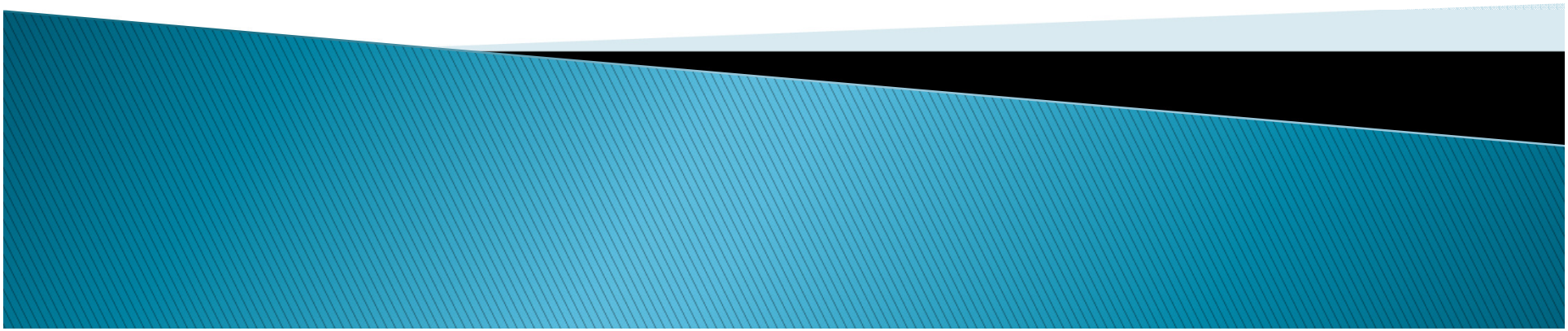
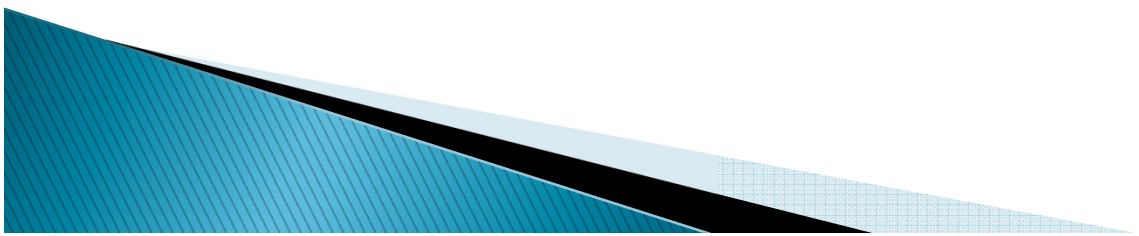


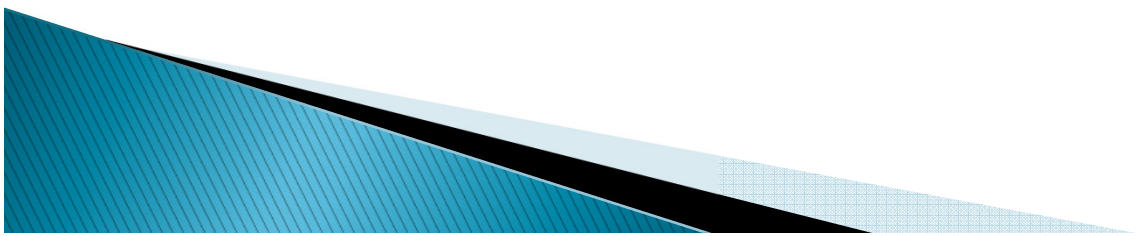
Goals

- 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



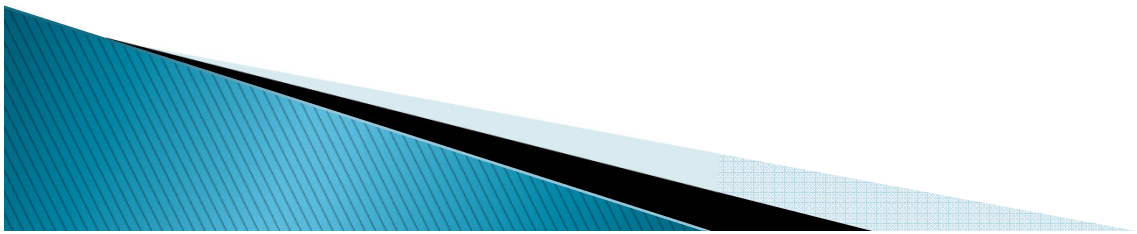
Indoor Positioning Challenges

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



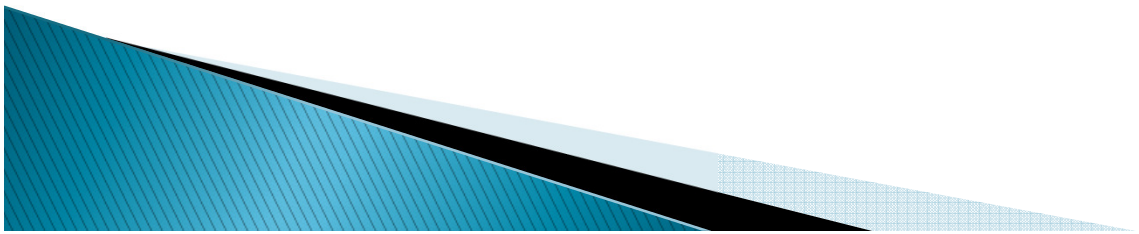
System Specifications

- Minimum room location accuracy of 3 ft from either side of entry threshold
- Maximum tag read range of 500 ft
- Operation frequency 2.4 GHz

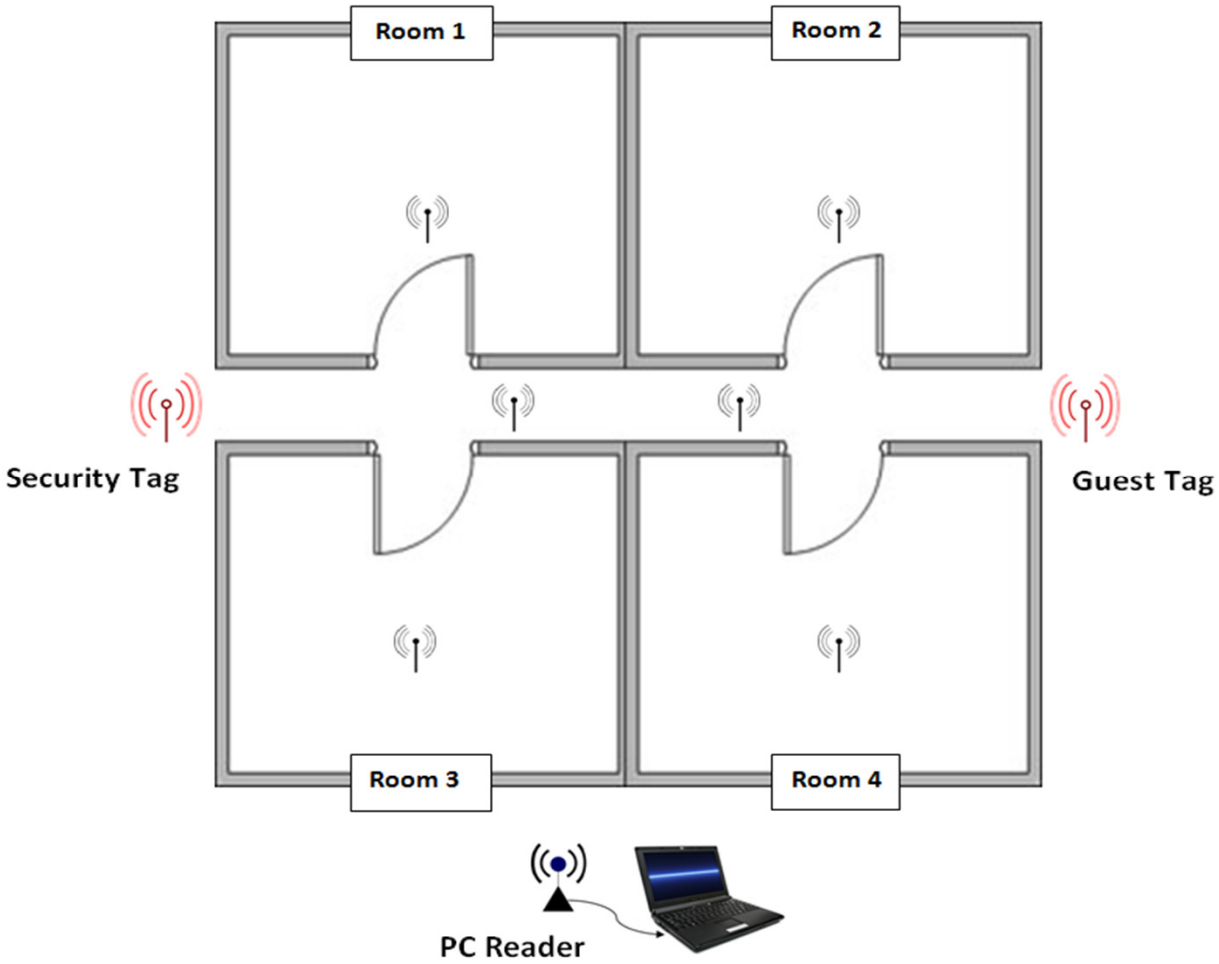


System Components

- **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

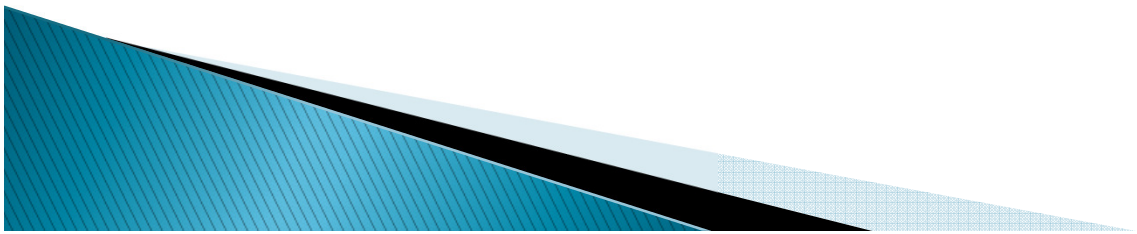


System Layout

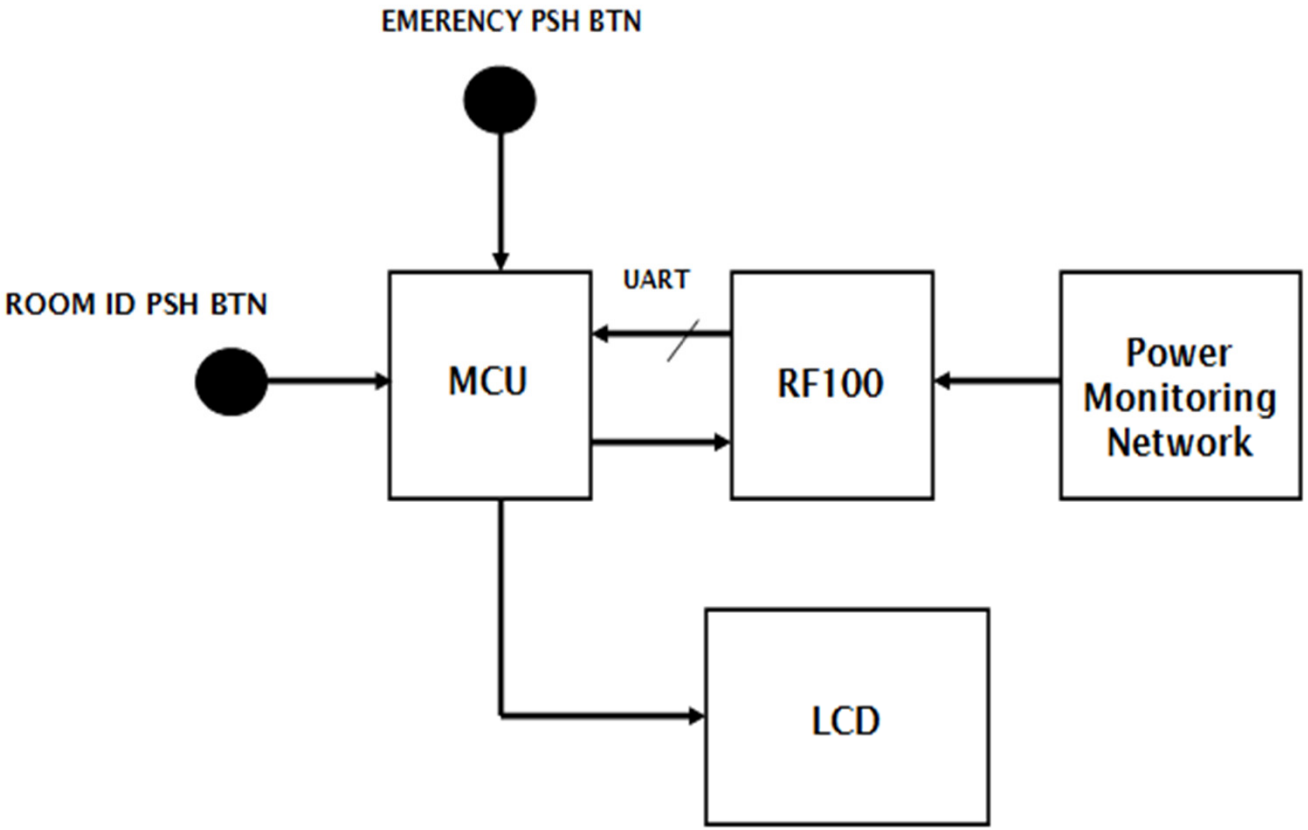


Guest Tag Overview

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

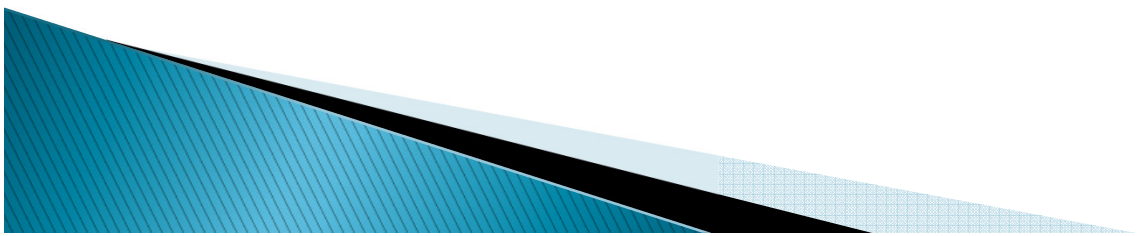


Guest Tag Overview



Guest Tag:
Room Identification

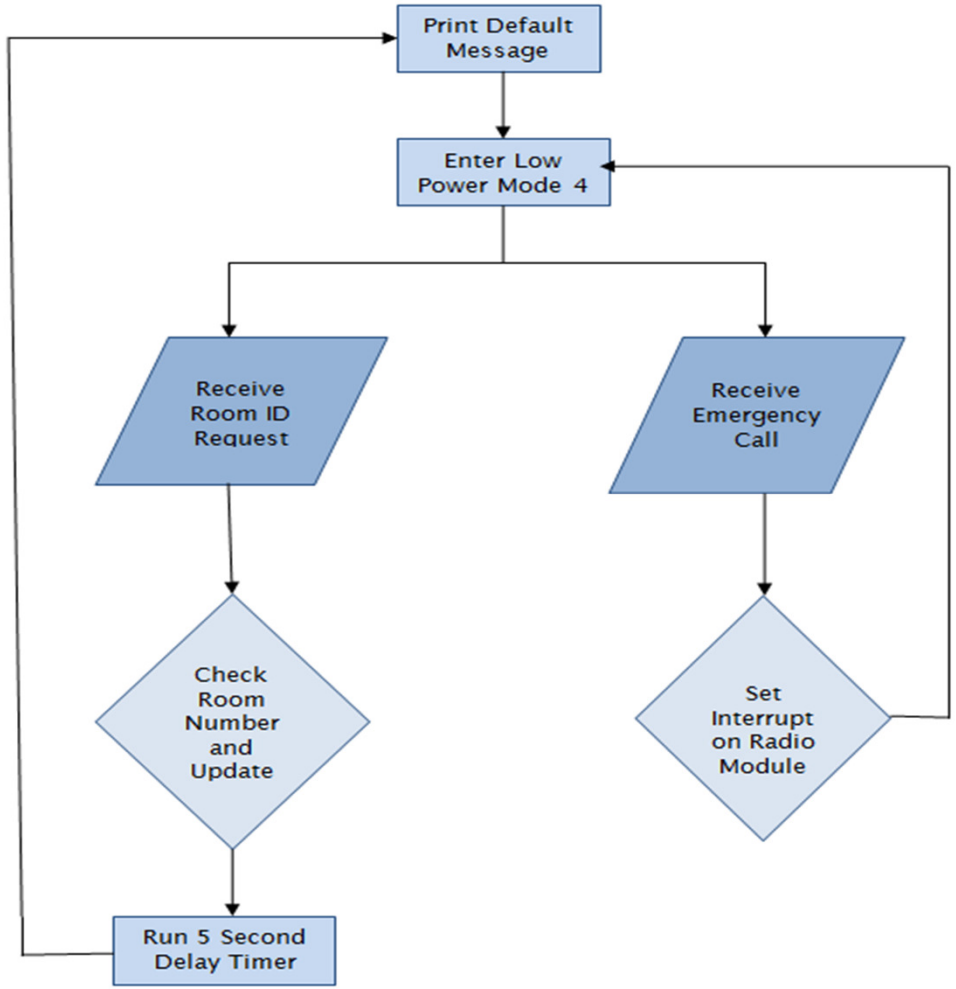
- Display current room location at any time with push button
- Receive room data from radio module only when new information is available
- Display room location for 5 sec and return to default message



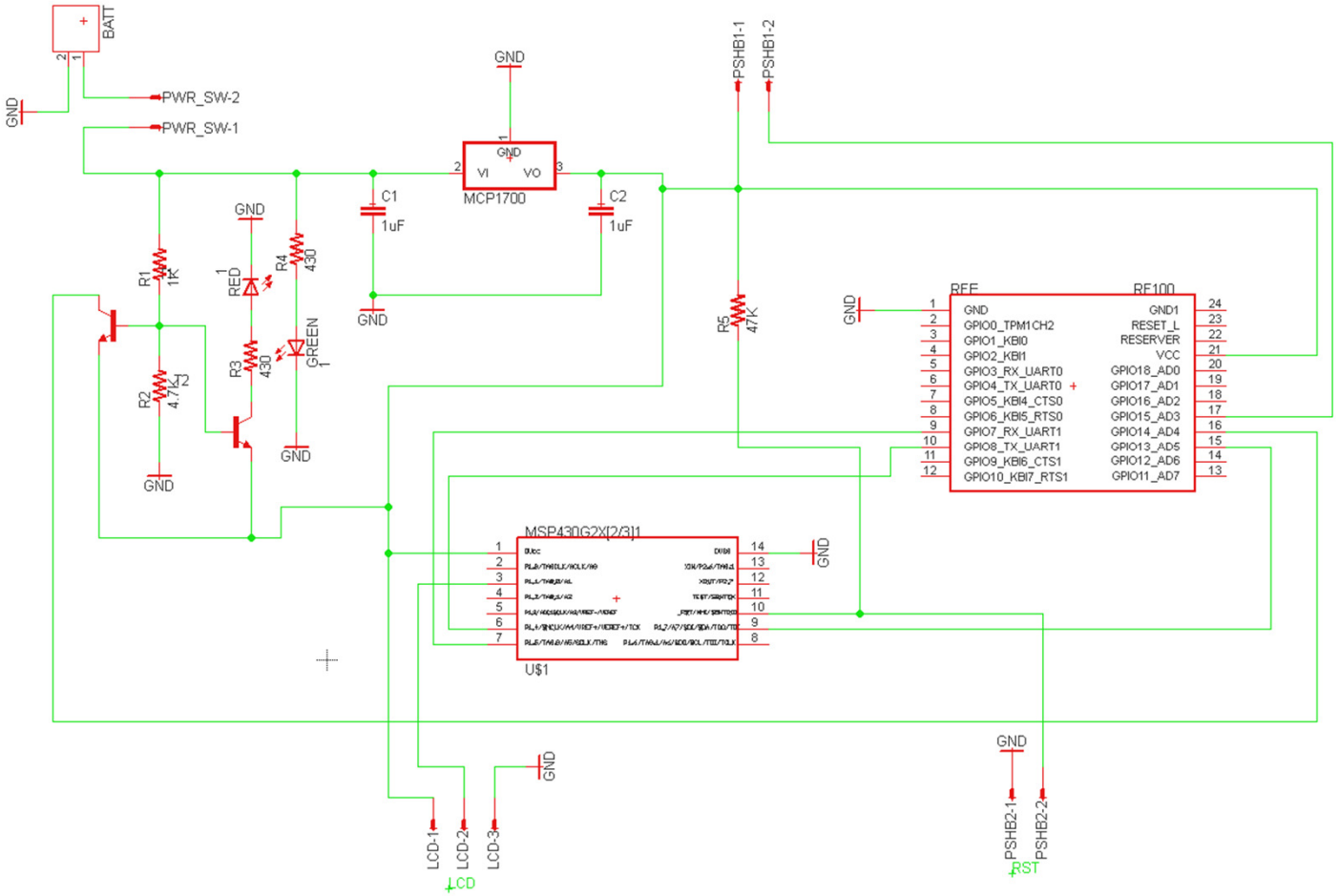
Guest Tag
Emergency Distress Call

- As a safety feature, the guest will be able to request assistance incase of emergency
- Push button will interrupt the MCU
- The MCU will send request to local radio module
- The radio will relay the request to GUI for dispatch to the nearest authorized personal

Program Flow

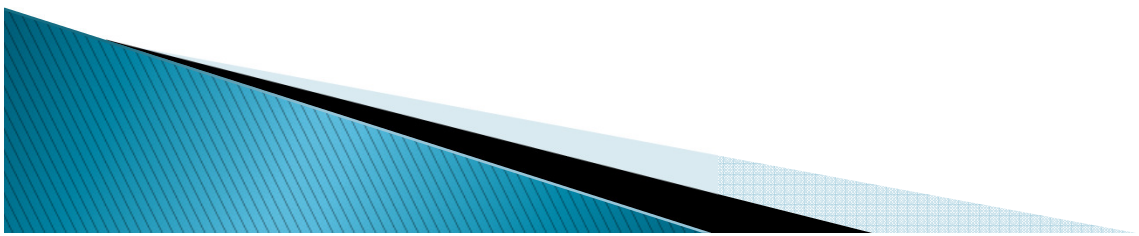


Guest Tag Layout



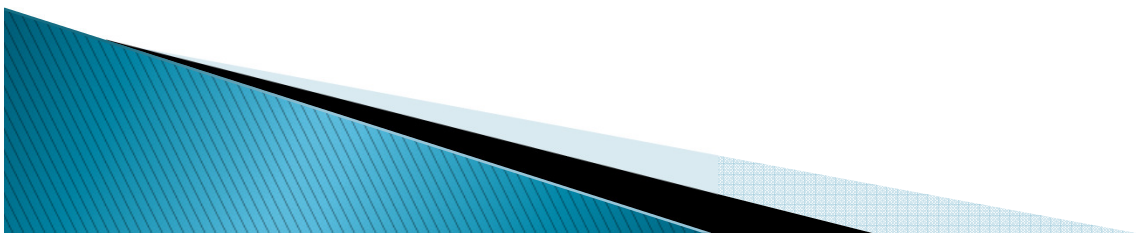
Security Tag Overview

- 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



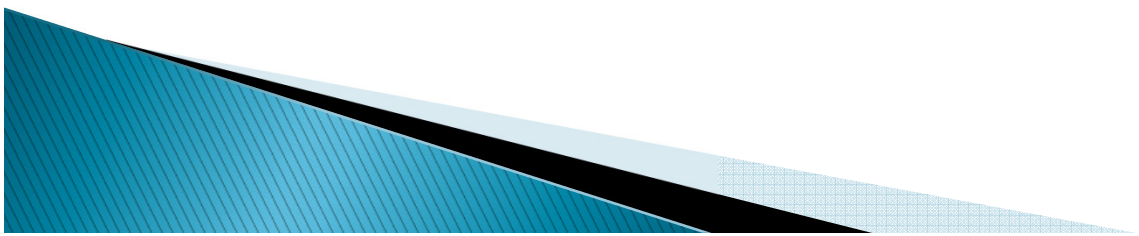
RF

- 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 twice a second



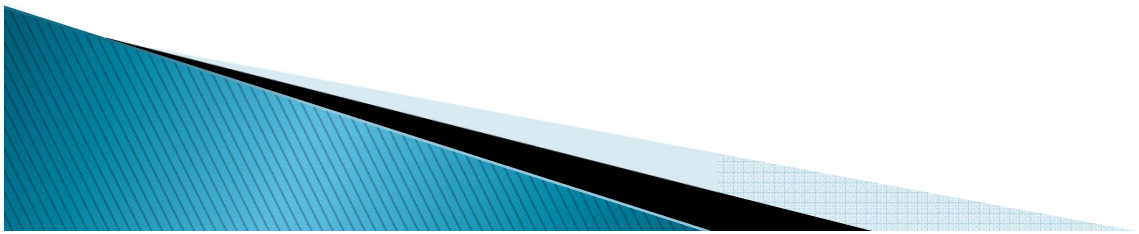
RF Engine Specifications

- 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

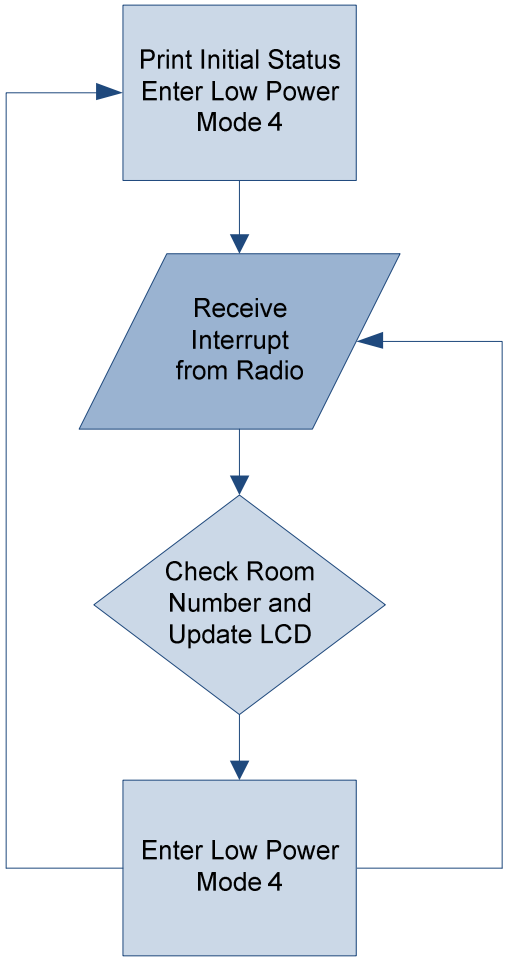


Microcontroller

	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

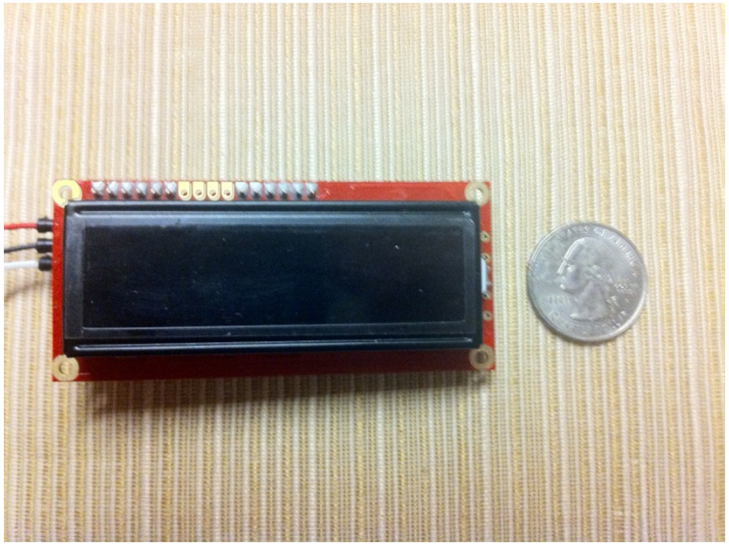


MCU Program Flow



LCD Display

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



Power

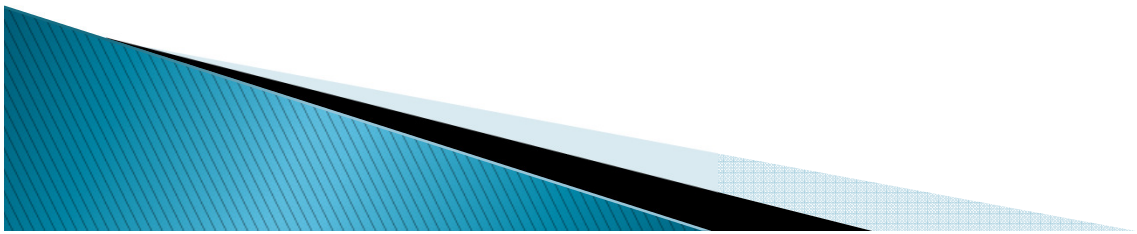
- MCP1700 3.3 V voltage regulator made by Microchip
- Very low dropout voltage of 178 mV
- Output current of 250 mA
- Max current of security tag during testing of 110 mA

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

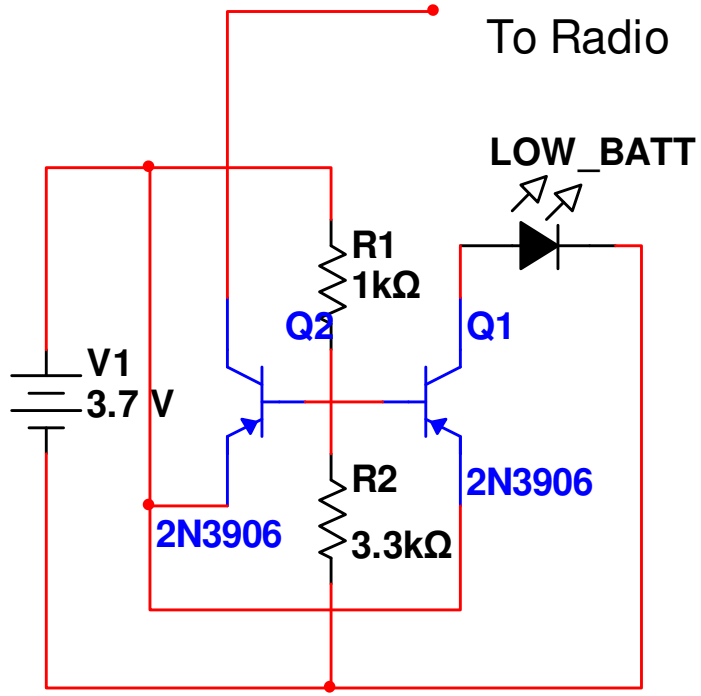


Power/Low Battery Circuit

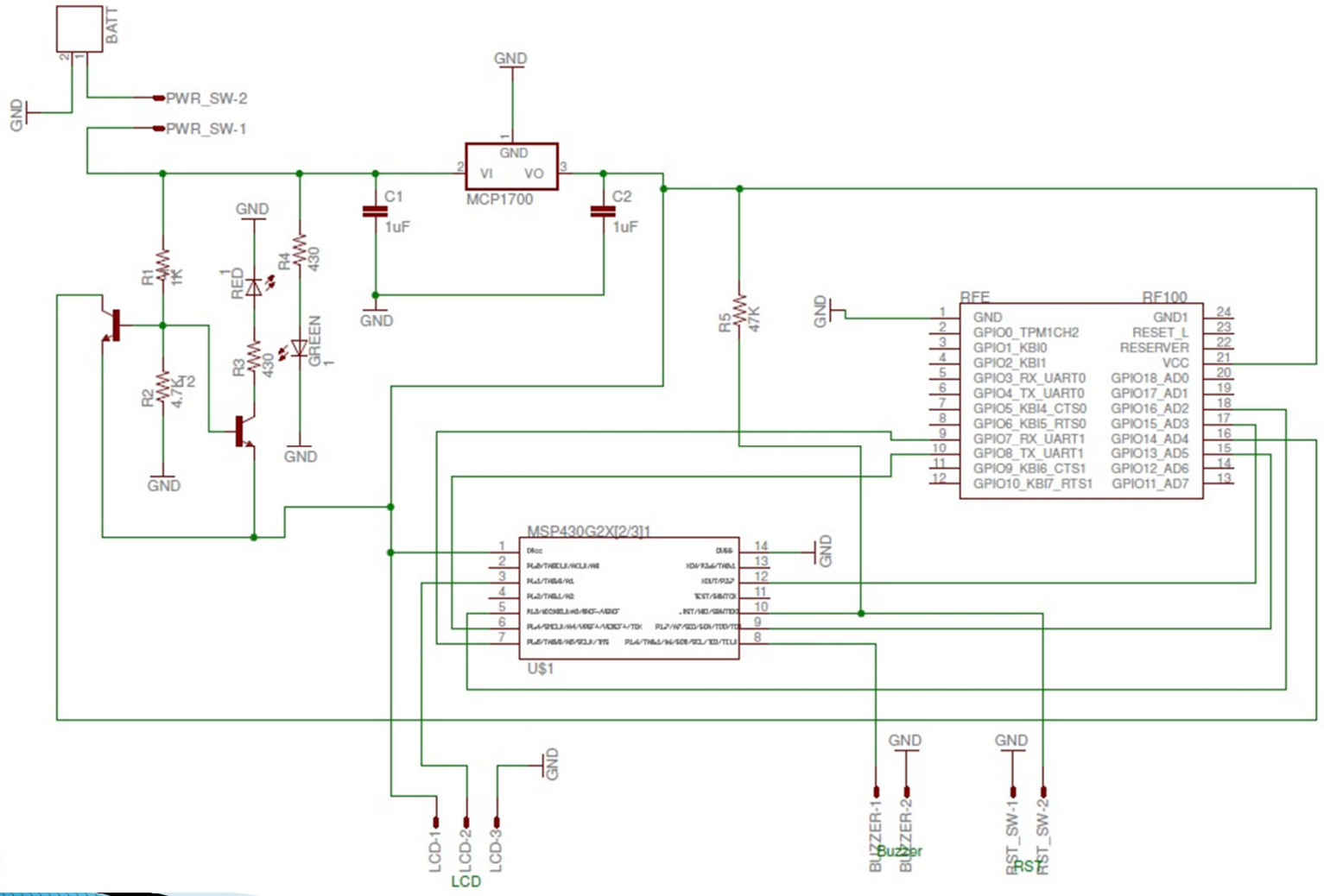
- 2 LEDs, green when unit is turned on, red when battery is low

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

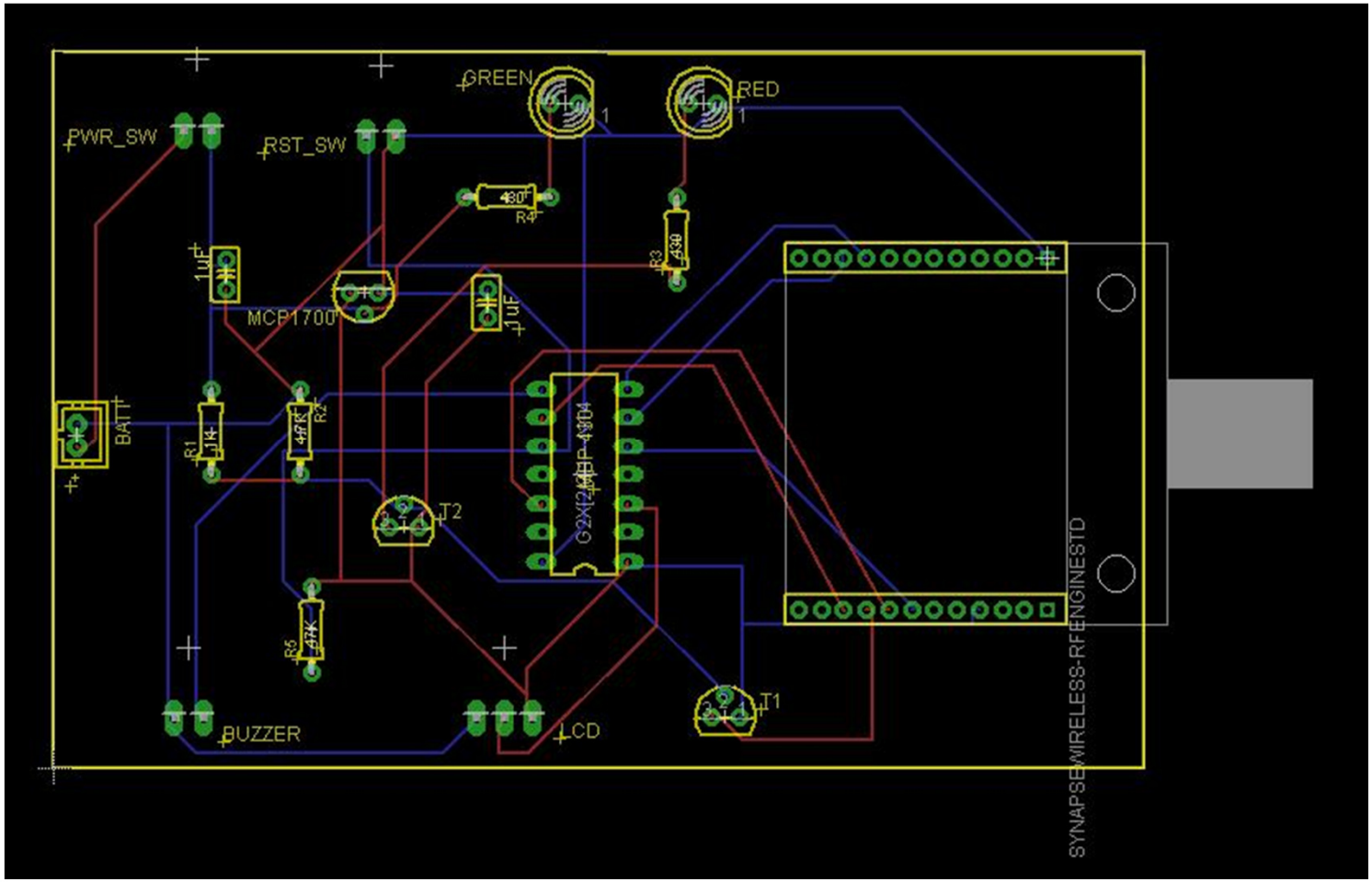
Low Battery Resistor Formula



Security Tag Schematic



PCB Layout

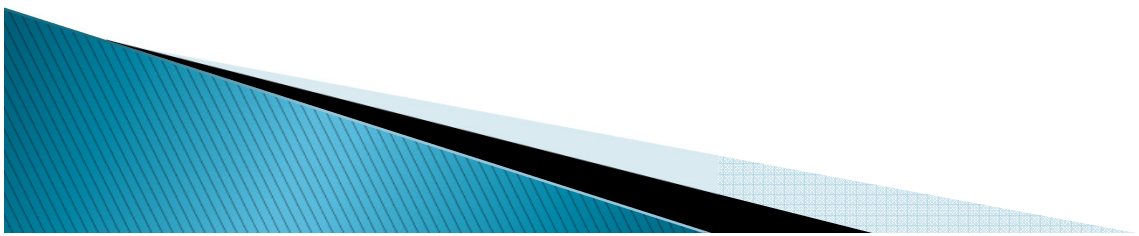

GREEN
RED
PWR_SW
RST_SW
430
R4
R3
1uF
MCP1700
BATT
R1
R2
T2
T1
BUZZER
LCD
SYNAPSEWIRELESS-RFENGINESTD

Reader Nodes

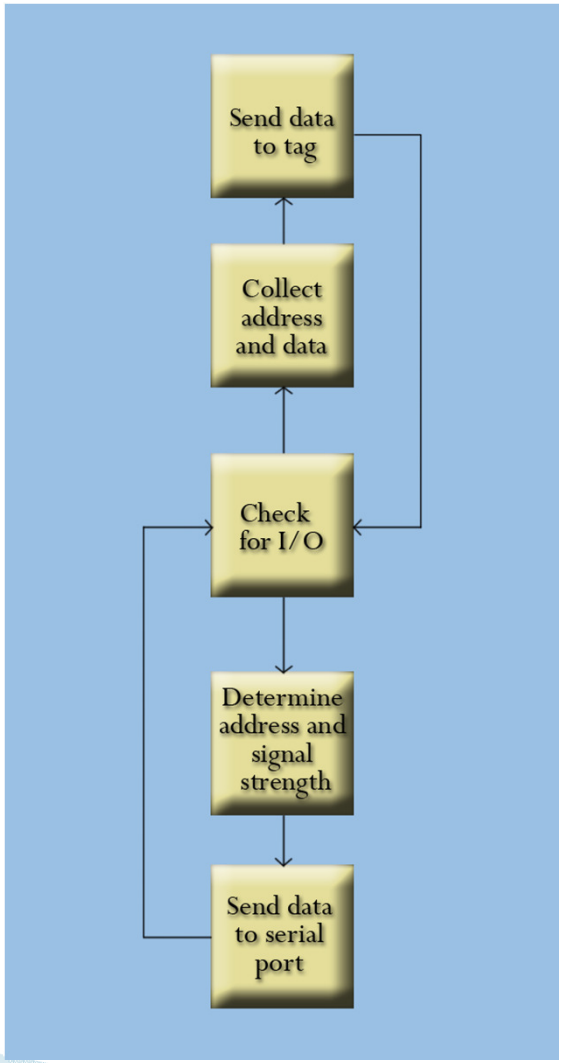
- Each room will have a reader node
- Will simply consist of an RF module in a small case, 2 inches squared, powered by a DC wall adapter
- Nodes also contain a voltage regulator due to low quality wall adapter
- Constantly on, communicating information back to base unit

Base Unit

- Handles serial data to and from the GUI
- Serial to USB converter used for convenience
- Uses 5V, since powering through USB is not possible due to the converter.



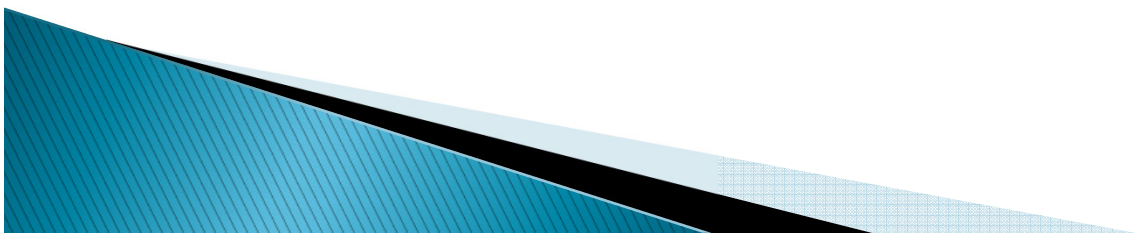
Base Unit Program



Trilateration

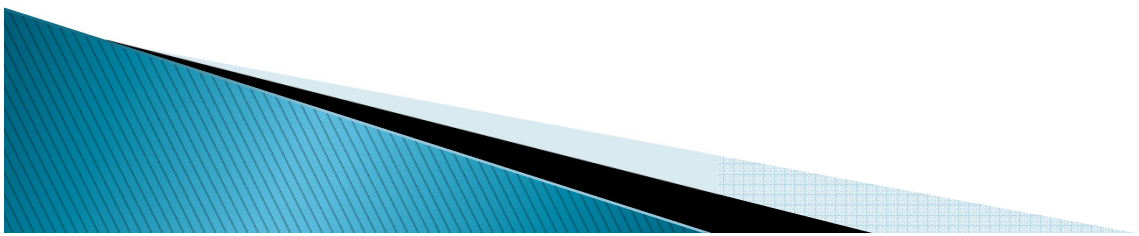
Our Approach

- Each room will have at least one node
- Closest room is determined by the largest signal strength
- Information is sent back to the tags based on the location

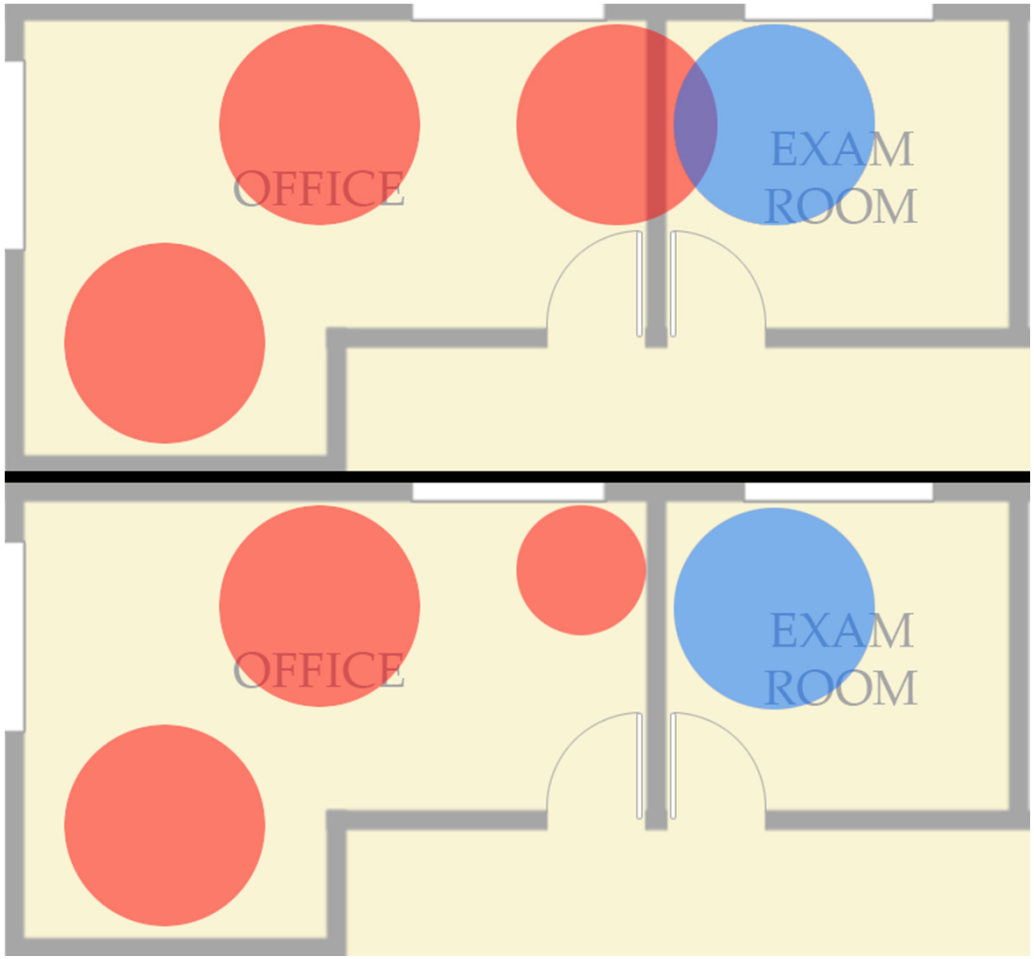


Variation In Signal Strength While Stationary

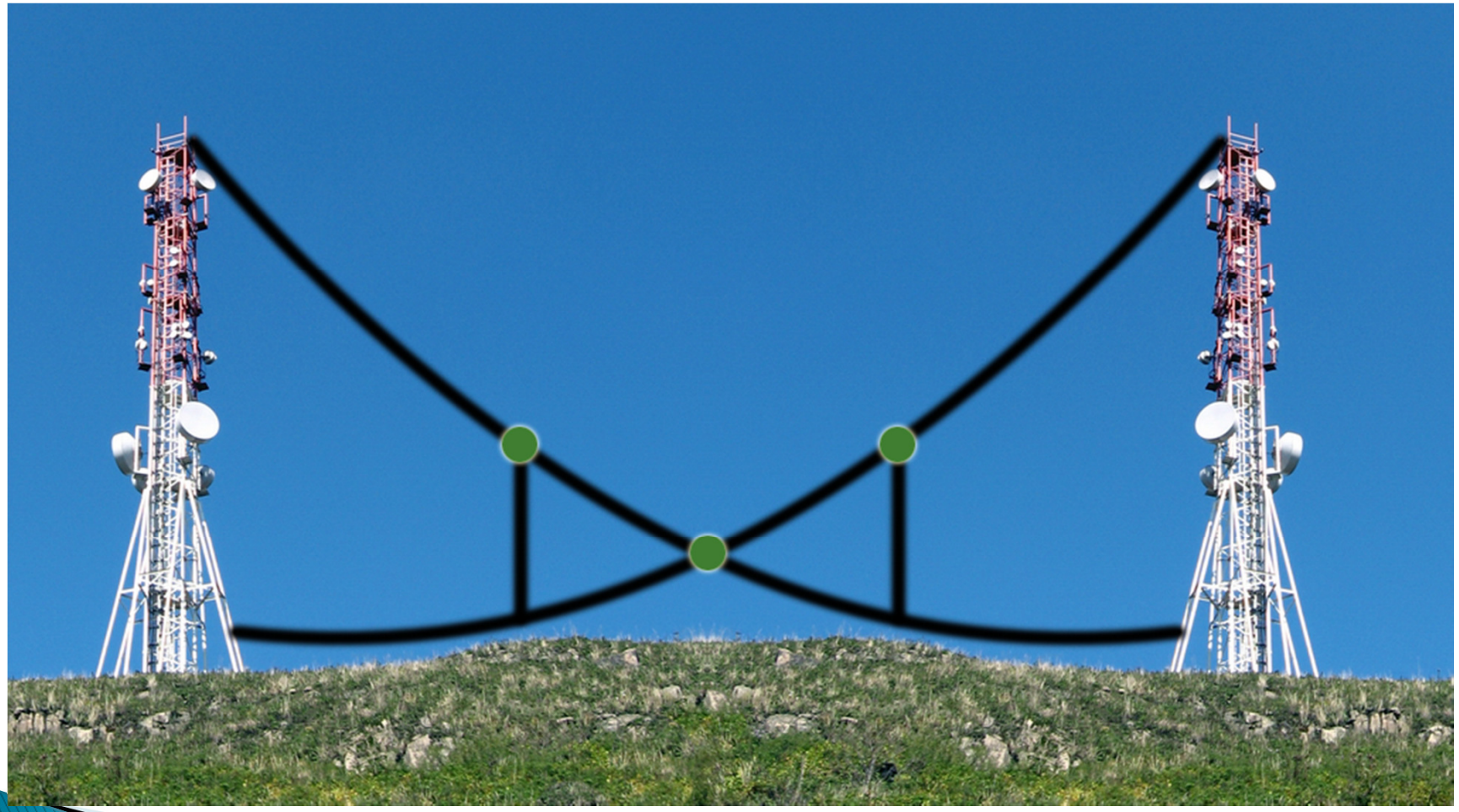
- Signal strength varies even when all components are stationary
- If this variance isn't dealt with, the movement would continue to jump around.
- Our solution is to establish a threshold that determines if the variation in signal strength is due to actual movement or not.



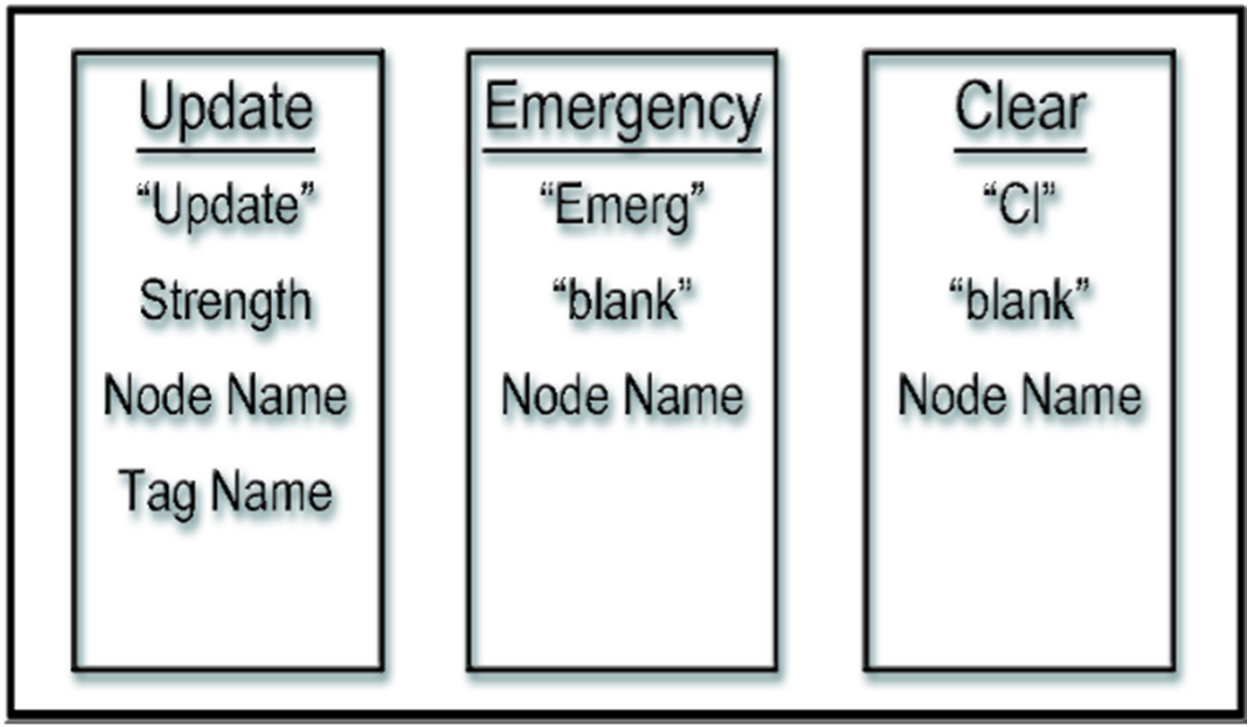
Signal Overwhelming an Adjacent Room



Room Change

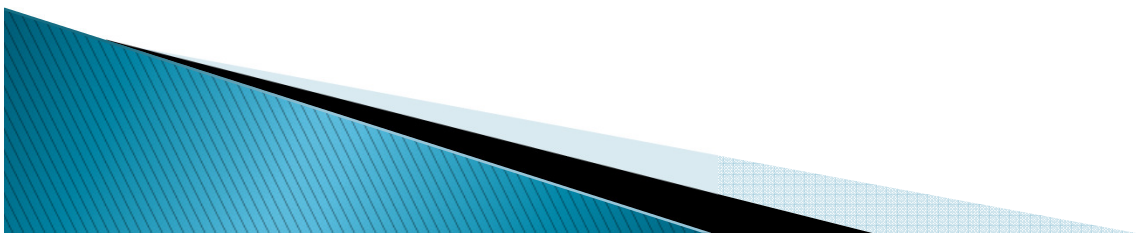


Communication Protocol



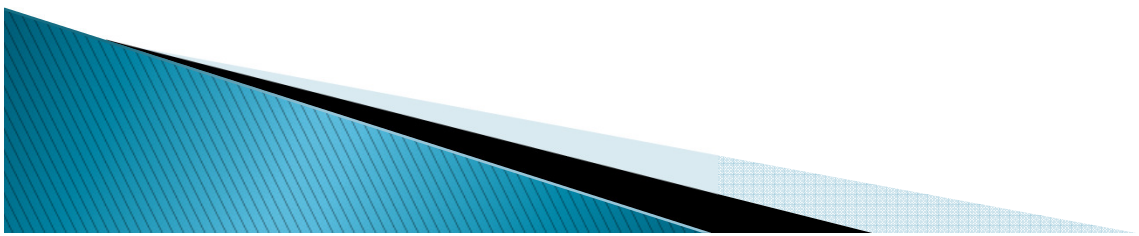
Error Detection

- Wireless communication can (will) become garbled
- The protocol set up throws out improper commands
- Update speed is fast enough to replace the data quickly
- If the buffer becomes clogged, the data was likely old anyway



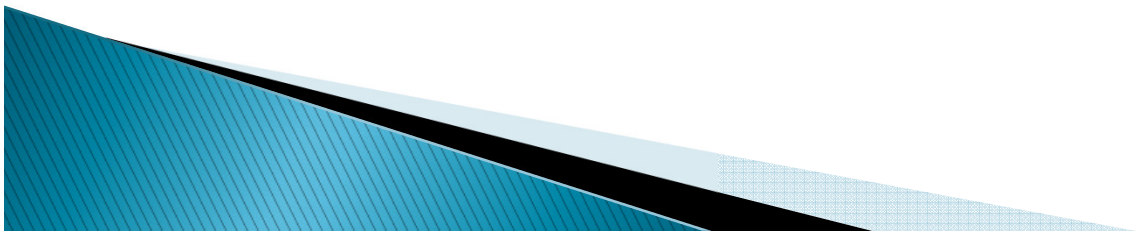
Input/Output

- I/O takes a huge amount of system resources.
- The amount of data being sent quickly overwhelms the PC.
- To solve this problem we divided the GUI into two threads.
- One thread handles calculations and graphics.
- The second thread only handles the I/O.
- Thread communication is kept to a minimum.

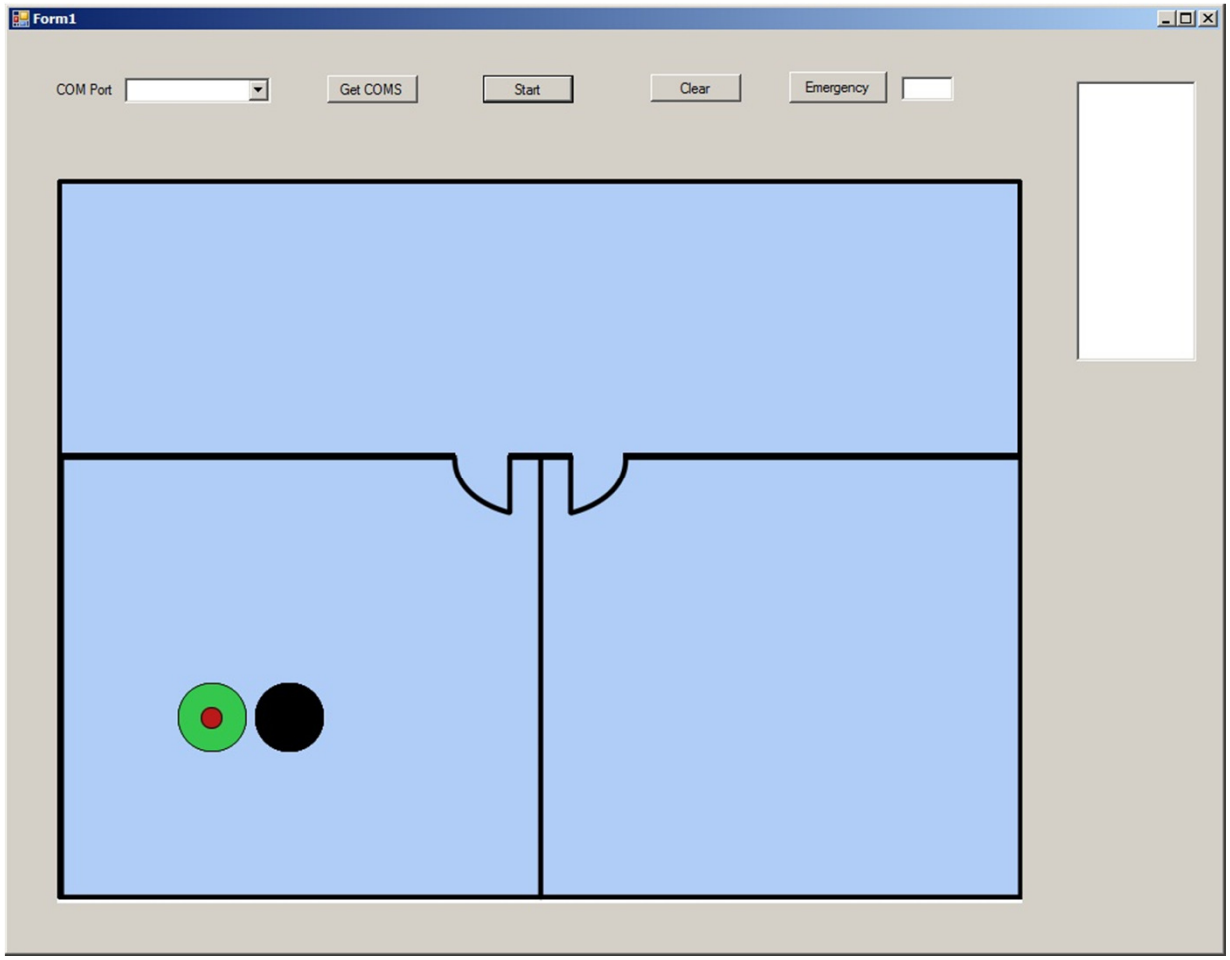


Node Handler Class

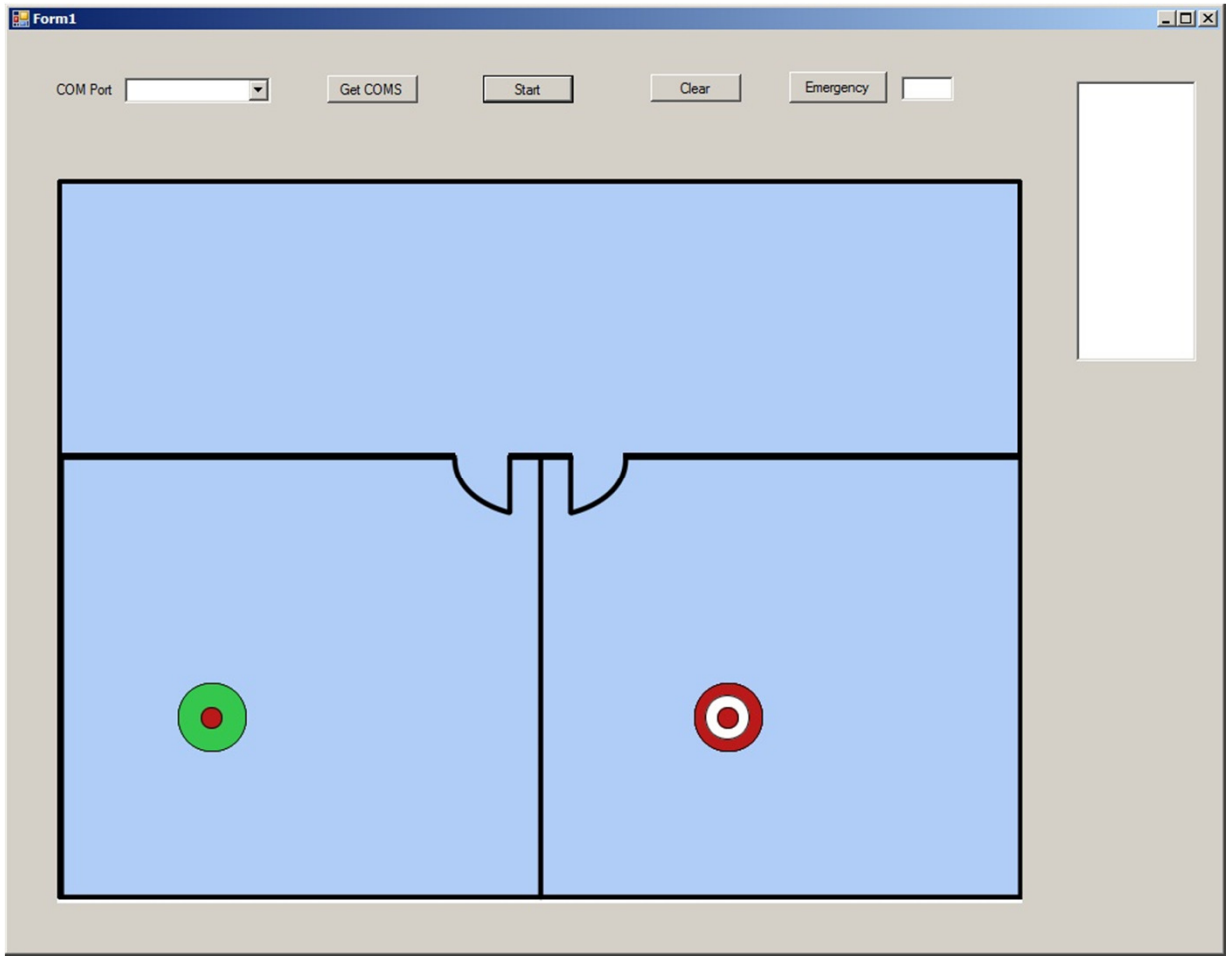
- The Node Handler Class tracks node values for each tag.
- Each tag uses its own object.
- Only alerts the GUI when a change is made.



GUI Setup



Security Breach

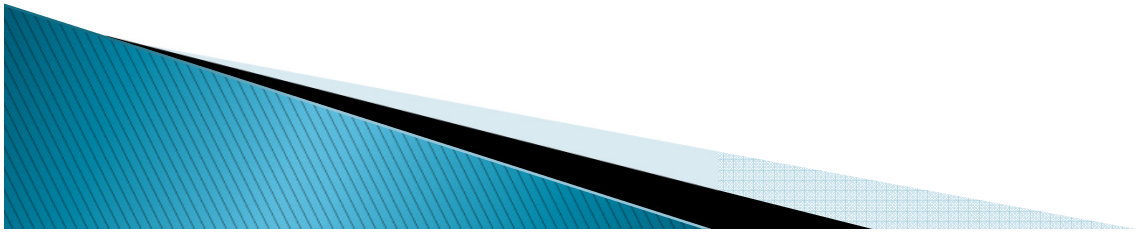


Division of Work

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	6	$30.00	$180.00
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
Buzzer	1	$3.00	$3.00
		TOTAL	$431.88



Questions?