Read by Joseph Kueny

Final Presentation

sddec20-18

Read by Isaiah Exley-Schuman

Project Layout

- Problem Statement
- Initial Progress
- Standards
- Functional Requirements
- Non-Functional Requirements
- Potential Risks
- Schedule and Milestones
- Current Standing

Read by Isaiah Exley-Schuman

Problem Statement

Changing the batteries in wireless door sensors is an inconvenient and easily forgotten task, but wired door sensors can look ugly and take a long time to install. The purpose of this project is to develop a wireless, maintenance free door sensor (meaning no batteries or wired power) to replace existing home security door sensors.

Read by Collin Kauth-Fisher

Initial Brainstorming

Active sensors (power harvesting)

- RF power
- Power from door motion

Passive sensors (WiFi “echolocation”)

- CSI
- Line of sight laser

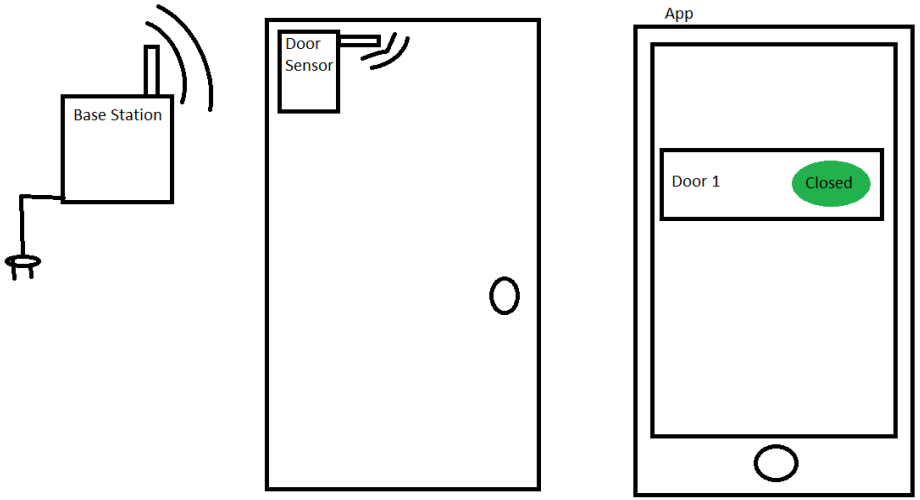
Read by Isaiah Exley-Schuman

Initial Focus Path

Active RF Power harvesting sensor with CSI error checking

Read by Collin Kauth-Fisher

Initial Sketches



Read by Mitchell Bratina

Engineering Standards (Hardware)

- Enclosure must have an IP rating of IP20 (protection against finger intrusion)
- Device must remain operational within acceptable parameters when subject to temperatures between -10C and 40C
- All wireless transmission/reception will comply with FCC laws
- Base station hardware will be primarily PCB based

Read by Mitchell Bratina

Engineering Standards (Software)

- Code shall not contain more than one statement in any given line
- Code shall not implement 1 character variable names except in iterative loops
- Code shall not contain lines of length more than 100 characters
- Code shall follow consistent use of variable naming schemes
    - E.G. MyVariable vs myVariable vs my_variable ... etc.
- Code shall not ignore exceptions
- Each nested block shall be indented more than the previous block

Read by Calvin Christensen

Functional Requirements

- Our base stations will be able to support up to 8 door sensors
- The system will be modular
- Users will be able to “daisy-chain” base stations
- Base station will have light and sound notification
- RF signal broadcasts will not interfere and will be FCC compliant
- The door sensors will be at most two pieces to attach to the door
- The base station and door sensor will require no physical upkeep

Read by Calvin Christensen

Functional Requirements Cont.

- The system must accurately report “door open” status 99% of times, and “door closed” status 95% of times
- One base station module and one door module will be designed and physically implemented
- The base station module will interface with a phone application and the door module
- The base station module will notify the phone user when the door has opened, as determined by the system
- The door module will not be powered by battery or by wire

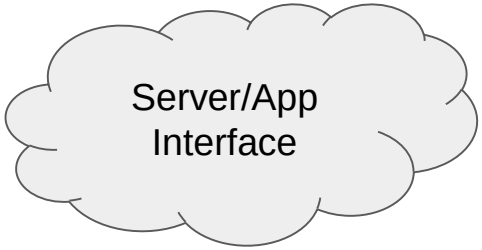
Read by Calvin Christensen

Functional Requirements Cont.

- Base station must identify door status up to 30’ away line of sight, or 10’ away through a wall
- System must notify phone user of door opening within 1 second of the event
  - Must implement a disarming system
- Reporting of door events must be wireless

Read by Collin Kauth-Fisher

Elaborated Functional Sketch



Client facing
server
communication

Basestation

CSI Data
Broadcast

RF Power
Broadcast

CSI Data
Reflection

Power Collection
and intermittent
state reporting

Sensor

Read by Mitchell Bratina

Non-Functional Requirements

- The door module must cost less than $70 to produce
- Total system cost must be less than $300
- Door module must weigh less than 1lbs and be less than 6”x6” when installed

Read by Calvin Christensen

Timeline for RF Harvesting

1. Test 1F, 100uF, 470mF, and 1.5F capacitors to verify they can power our microcontroller
2. Test different methods of RF harvesting
3. Test to see how long it takes for RF harvesting to charge our Capacitors enough to send a signal periodically

Read by Joseph Kueny

Timeline for CSI

1. Read through ESP-IDF for ESP32
    a. Look for the ability to read the CSI information
2. Collect all the components for CSI
    a. ESP32, Raspberry Pi
3. Test CSI collection with Raspi transmitter and ESP32
4. Research antenna design for proper CSI reflection off of the door

Read by Joseph Kueny

Project Timeline (Post-COVID-19)

Week Zero	Week One	Week Two	Week Three	Week Four
Everyone gets ESP32				
Signal Gathering and Sending				
	Antenna Design and Research			
	Machine Learning Development & Processed Data Handling			

Read by Collin Kauth-Fisher

Current Standing - Server

We have created a server with a web component to access and display all the information provided by the base stations in an account-based platform.

The server is able to perform a registration/login process using secured passwords.

The user, once logged in, is able to register their base station with their account, so the received information is directed to their display.

The base stations are able to connect to the main server and perform a small handshake process that prevents basic connections from outside sources.

The base stations will monitor the sensors and, based on the configured criteria, perform alert procedures and other broadcast events with the data. They will also be doing routine updates to the main server based on the user's configuration.

Read by Mitchell Bratina

Current Standing - RF Circuit

To date, we have not been able to do much work on the RF circuit portion of our project. We were able to order our parts for this, but were able to do very minimal testing. This part is much more hardware dependent and this made it difficult to work on while quarantined. From the minimal testing we have done, we believe that the capacitors we have purchased will be what we need for the circuit we are planning.

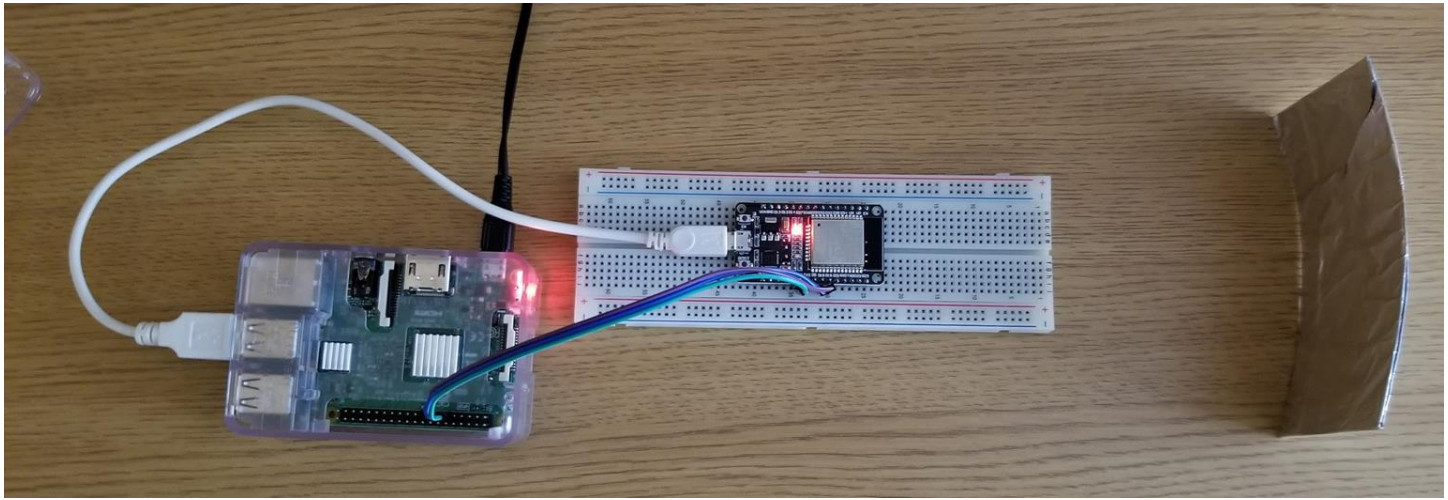
Pending a return to campus in the fall, we will be able to complete this portion of our project next semester. For now, we are more focused on CSI.

Read by Joseph Kueny

Current Standing - CSI

Connection between the ESP32 and the Raspberry Pi is being worked on so that development and data processing can be done from the Pi.

Antenna design has been researched and the best design that we have found that we can make at the moment is a parabolic surface covered in tin foil.



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Questions?

Please direct all questions to sddec20-18@iastate.edu.