Initial Project and Group Identification Document

Divide and Conquer, Version 2.0

Signal Operated Lock And Security System

(SOLASS)

University of Central Florida

College of Electrical and Computer Engineering

Senior Design I - Group 16

EEL 4914

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Project Narrative

All common households require a reliable front door lock to protect the inside. Even though the front door handle is very useful and accomplishes its task, in some situations, it can be a hassle.

This project, SOLASS, is concerned with making opening a household door more of a hands-off experience. The motivation for it came from the common struggle of carrying many items, such as groceries, and trying to hold onto the items while pulling out a set of keys and manually unlocking the door. SOLASS will make it so that a physical key does not need to be used to manually unlock the door, but rather make it a more automatic process; it would be most similar to newer car doors that communicate with the car keys and unlock automatically when they are near enough and the user touches the door handle.

SOLASS will be close range, activating first once a user arrives on their porch, and then further interacted with a few inches away from the lock itself. It will also be easy to use, only requiring the user to swipe a simple password with their hand if they so choose to have the feature enabled. The price of the system would be relatively cheap, the only major expenses being an RF transmitter in a worn bracelet, the automatic deadbolt, and a camera. This camera will add additional security to the lock system, taking a picture of the surrounding area whenever motion is detected on the porch area. This picture is then uploaded to a website the user can login into to see what has set off their security system.

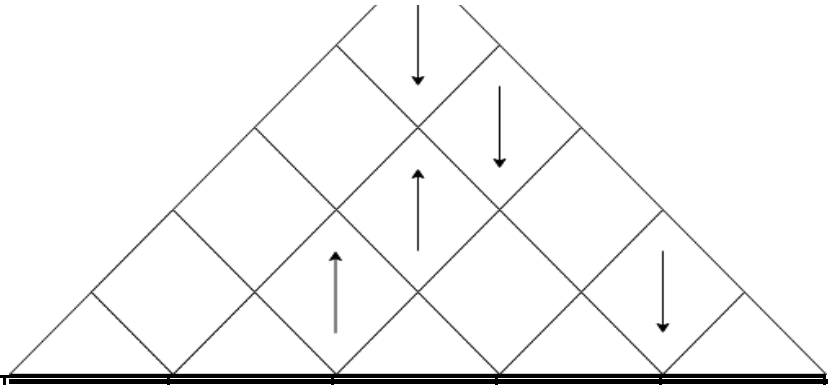
Required Specifications

Table 1 and figure 1 below cover the various aspects and features of SOLASS that will be incorporated and tested during the prototyping stage.

Table 1: Required Specification and Constraints for the Project

	Specifications / Constraints	
Password Signal	Use of RFID Signal Transmitter and Receiver to send the signal	Range for password signal will be ~4 feet
Motion Sensor to accept password	Range of motion sensor will be ~3 inches to start pattern recognition	Accept password signal in a short amount of time (~5 seconds)
Entering the door	Unlocking the door needs to be entirely hands free	Should be able to push door open once unlocked
Standardized	Door lock Should be the same size as standard door handles to easily fit on doors	Physical door lock will use standard deadbolt mechanism
Bracelet	Adjustable for 14-20.3cm (womens small - mens large)	Must be a non-metal material to not interfere with the RFID
Power source	Both door handle and bracelet should be battery powered	Should be small enough to not increase the size of the lock and bracelet extensively
Physical Key	In an event the battery dies, the door can still be opened	
Web access	Door lock should be able to send photos to users' website	Wifi signal to the door lock must be strong enough to access the web
Proximity Sensor	Range of the Proximity sensor will be ~4 feet to restore the system from power saving mode	

House of Quality



		Cost	Dimensions	Installation Time	Power Drawn	Battery Life
		-	-	-	-	+
Accessibility	+	↓				
Security	+	↓	↓	↓	↓	↓
Cost	-	↑ ↑	↓		↑	↓ ↓
Picture quality	+	↓ ↓			↓ ↓	↓ ↓
Installation ease	+		↑	↑		
Targets For Engineering requirements		<$300	1.6 x 2.6 x 4.8 inches, < 1lb	<30 min	10-15 watts	≥ 1 year

Figure 1: House of quality

Block Diagrams

Group members Matthew Guevara and Lody Morillo will be in charge of the hardware and electrical connections, shown in figure 2 below. The system starts with the Proximity Sensor which scans the surrounding area for movement to turn on the system. Once the system is turned on, the control board will access the webcam and the wireless network adapter to take a picture of the area and send it to the user's website for the door lock. Once the system is turned on, the motion sensor will check if there is movement around the lock in order to know whether or not to turn on the RFID transmitter. Then, the transmitter connects to the receiver to allow the receiver to send the passcode to the door lock. From there, depending on if the passcode is accepted, the door lock will unlock or flag the photo that was taken and then turn off the system.

As shown in the figure, there are also three LEDs and a power source that are used in the system. The Blue LED is used to show when the system is turned off by keeping the light solid, and when the system is processing information by flashing the LED. The Red LED will show that the passcode sent to the door lock was not accepted and the green LED will show that the passcode was accepted. Finally, the power source will power the entire system.

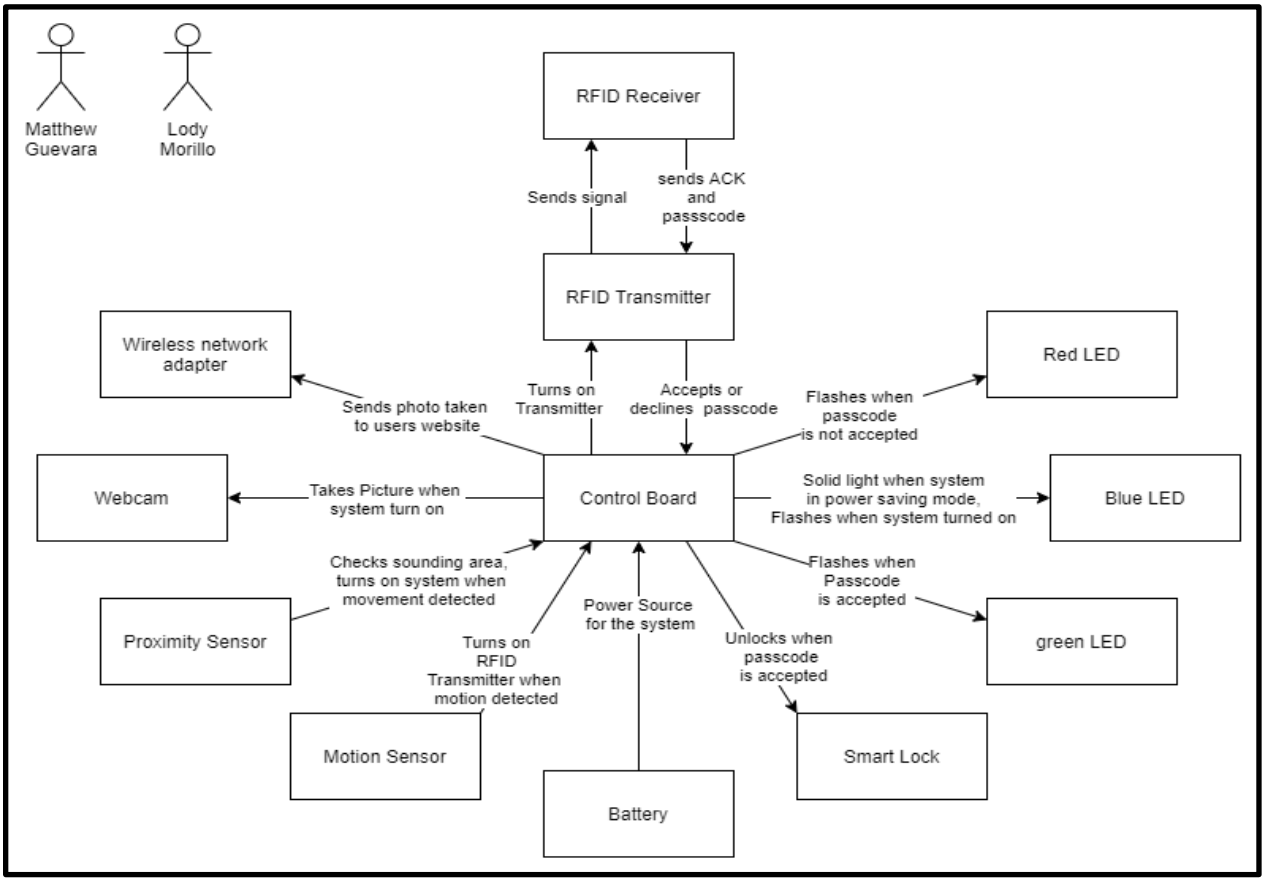


Figure 2: Hardware Connections

Group members Devon Anselmo and Keanu Zeng will be responsible for the programming and software components of the project. As seen in the figure 3 below, the lock system will have 2 main states, power saving and processing, with an LED to indicate the current state. Once a user approaches within around four feet of the lock, a proximity sensor will detect them and interrupt the system to the processing state. At this point, a webcam above the lock will also take a picture of the surrounding area and post it to a website where the user can view it at their convenience.

Now, the RF receiver in the door lock will look for the signal sent from the bracelet; if it does not sense the bracelet within 10 seconds, it returns to power saving state. If it senses that the bracelet is nearby, the software will enter the next tier in the processing state. At this point, the user can swipe their hand, arm, elbow, held pencil, book, or bag of groceries in front of the short range motion sensor in a given pattern to unlock the door. This pattern can be set by the user to be complex if they choose extra security, or can be disabled entirely if the user knows they will be holding many groceries when they return.

Once unlocked, the user may enter, and can re-lock the door by pressing a button on the bracelet.

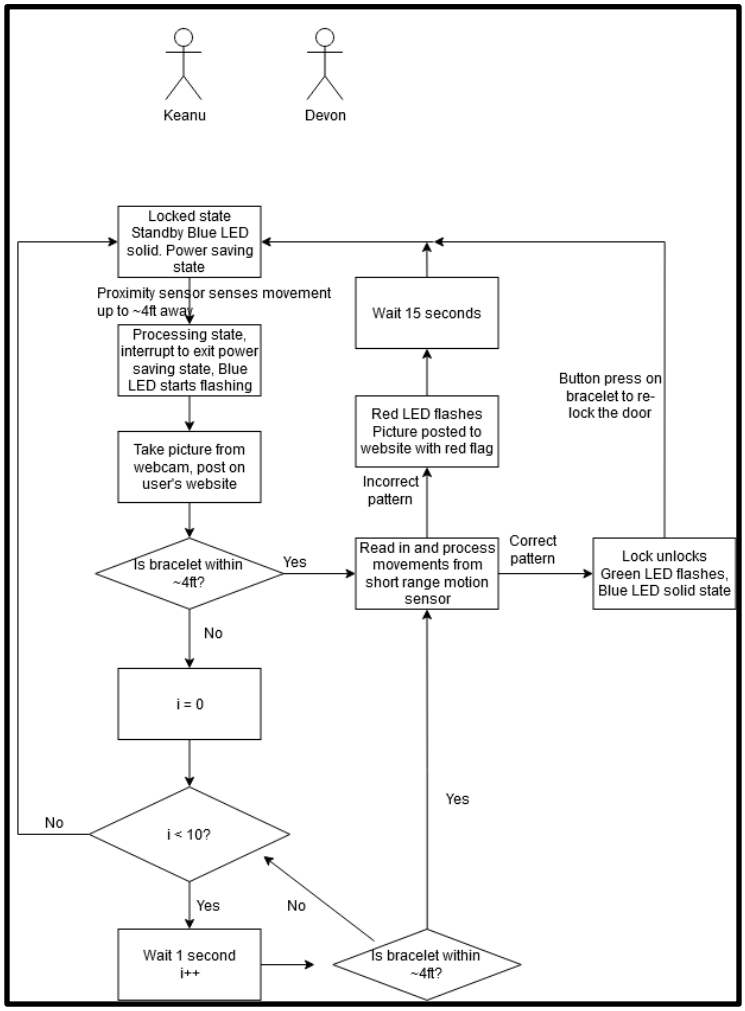


Figure 3: Software actions/System state

Estimated Project budget and financing

To incorporate all of the features of SOLASS, many parts will have to be bought, which the team believes it can do within $280.13, as seen in the budget table below.

Table 2: Senior Design I Project Budget Table

Quantity	Name	Website	Price
1	Kwikset Halifax Door Handle with Modern Contemporary Slim Square Design	www.Amazon.com	$26.95
1	High Torque Standard Size Servo Motor	www.Adafruit.com	$19.95
1	RF Transmitter and receiver	www.DigiKey.com	$5-$10
1	FIBO STEEL Braided Adjustable Bracelets	www.Amazon.com	$14.99
1	PCB Manufacturing Cost	www.PCBway.com	$50
1	Samsung Motion Sensor in White	www.BestBuy.com	$24.99
1	Logitech - HD Webcam C270 - Black	www.BestBuy.com	$39.99
1	2-in x 12-in x 8-ft Southern Yellow Pine Lumber	www.Lowes.com	$13.26
1	Glue, Mounting Tape, Jumper Wires, LED light	www.Google.com	$50 - $80

Project Milestones

To ensure deadlines are met, the project's milestones have been broken up by task for each semester in the schedules below.

Table 3: Senior Design I Project milestones schedule

Senior Design I		
Task	**Dates**	**Duration**
Discuss Project Ideas	8/27/2020 - 9/10/2020	14 days
Divide and Conquer Document v1	9/11/2020 - 9/22/2020	11 days
Research Smart lock base	9/22/2020 - 10/2/2020	10 days
Research different sensor technologies	9/22/2020 - 10/2/2020	10 days
Research additional features	9/22/2020 - 10/2/2020	10 days
Look into past Senior Design Projects	9/22/2020 - 10/2/2020	10 days
Divide and Conquer Document v2	9/27/2020 - 10/2/2020	6 days
Draft of Documentation	10/26/2020 - 11/13/2020	19 days
Final Documentation	11/23/2020 - 12/8/2020	16 days

Table 4: Senior Design II Project milestones schedule

Senior Design II		
Task	**Dates**	**Duration**
Purchase Parts	1/11/2021 - 1/22/2021	12 days
Build Prototype	1/23/2021 - 2/21/2021	30 days
Test Prototype	2/22/2021 - 3/28/2021	30 days
Finalize Project	3/29/2021 - 4/17/2021	20 days
Final Presentation	4/18/2021 - 4/30/2021	13 days

Project Parameters and Considerations

For the SOLASS project, all the parts necessary to build it totals ~$280, which is around the same price range as other competitor automatic door locks. August Locks are around $250 while Level locks are $229.

The project will include a webcam in the door lock system which takes pictures of anyone who approaches the door. This is similar to the Ring doorbell, but not integrated in most automatic door lock systems on the market.

When the battery gets low in the door lock, it will post a message to the website to alert the user, rather than on the door lock itself. Once the battery dies (or the user forgets their password), the user can still open the door with their key. The battery life is targeted for at least one year, making it longer than other marketed lock systems.

What makes the project unique from some other door lock systems is that it is completely hands free. The system senses the bracelet key worn by the user nearby, and the password is motion-based, rather than numeric.

The system will not connect directly to the user's phone via Bluetooth or app, but it will connect to a website which the user can login to. The proximity sensor in the system will only start working at four feet rather than Wi-Fi unlocking capability in some other systems, although that is not seen to be a problem for a user in this project.