RFID Lock Proposal

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Introduction

Problem

The problem we aim to solve is the difficulty of use of classic door key locks especially when under adverse conditions such as frozen debris, low light levels, inebriation, or disabilities such as parkinsons or blindness making location and use of these locks a challenge. For example, resources for people who are blind on unlocking doors and managing keys can be found here. While there is not a formal study done on it, a quick google search shows resources for people who are blind or those afflicted with parkinsons on how to renovate their homes or homes of loved ones to make lives simpler. Examples of that can be found here and here.

However, not everyone is able to undertake such drastic measures for home renovations and some likely cannot afford the home itself. For college students or any age range, renting an apartment may be the best and only option available to them. Modern solutions for example found here require replacing the previous door lock entirely. For those of us renting a place, that might not be an option since we could lose our security deposit either screwing in new mounts to the door or since the locks are swapped it could lock landlords out from inspections or apartment showings which is a new problem entirely.

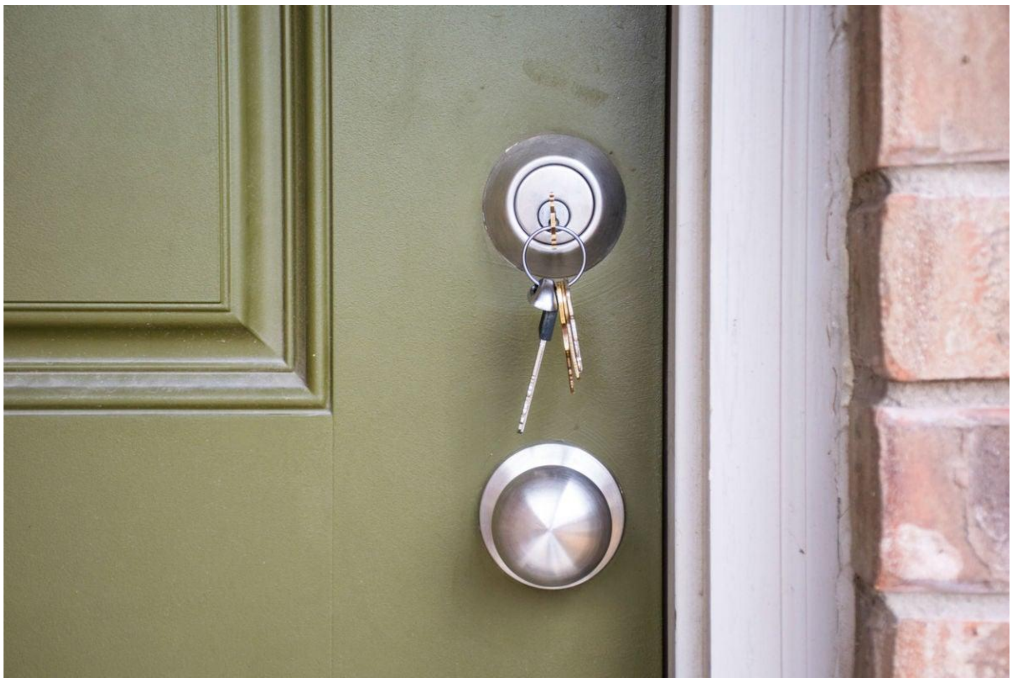
Solution

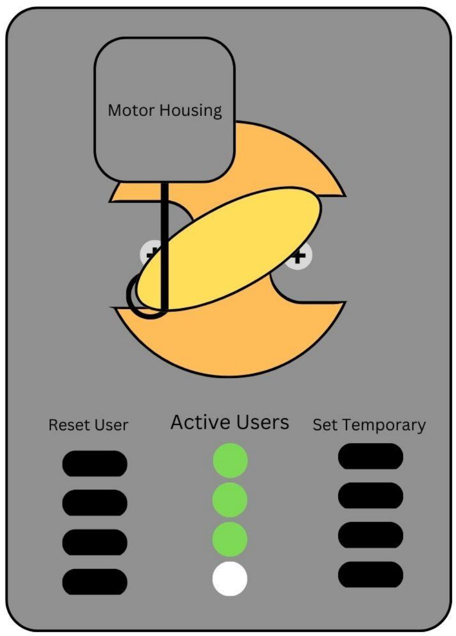
Our solution is to create a renter friendly system that works in tandem with current infrastructure on your door and will mount with the deadbolt lock. Since our solution will be mounting using the same screw and friction system the deadbolt lock uses, our product will slip into the deadbolt position without marking up or requiring new screw holes to be installed on the door and losing security deposit etc after you move out.

Our solution will be an RFID scanner mounted on the deadbolt that will be connected to an inner pcb system to ensure the RFID tag is allowed to open this door and will then power a linear actuator to rotate the deadbolt into the unlocked position. The whole system will also be powered by induction where the RFID tag will be housed with a powerbank with remote power transmitter. The doors RFID scanner will also have a remote power receiver coil that when the RFID tag is scanned on the door the bank and transmitter will also be in contact to wirelessly power the system. This will ensure the RFID door system will never require a battery change out and also only be useful when a proper RFID tag is touching it which is an indirect security measure.

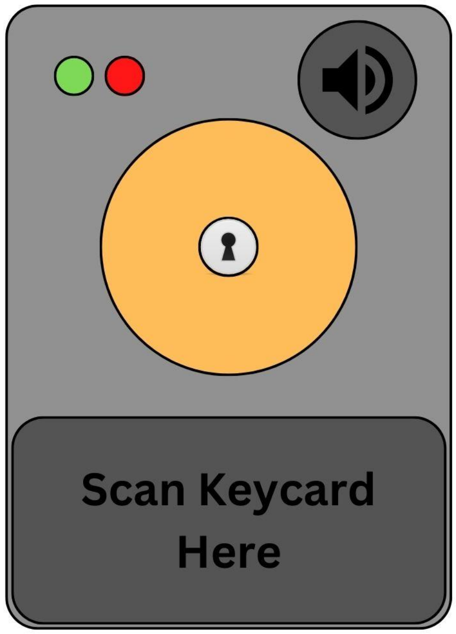
Visual Aid

Mounted on a door deadbolt similar to this one





Indoor Lock Housing



Outdoor Lock Housing

Underneath the RFID pad will be where the power receiver lies so that when the tag is scanned the powerbank and transmitter are also in contact with the receiver inside the door unit.

High Level Requirements

1. Does not require the battery to be replaced, main power method is through the wireless transmitter/transceiver bank

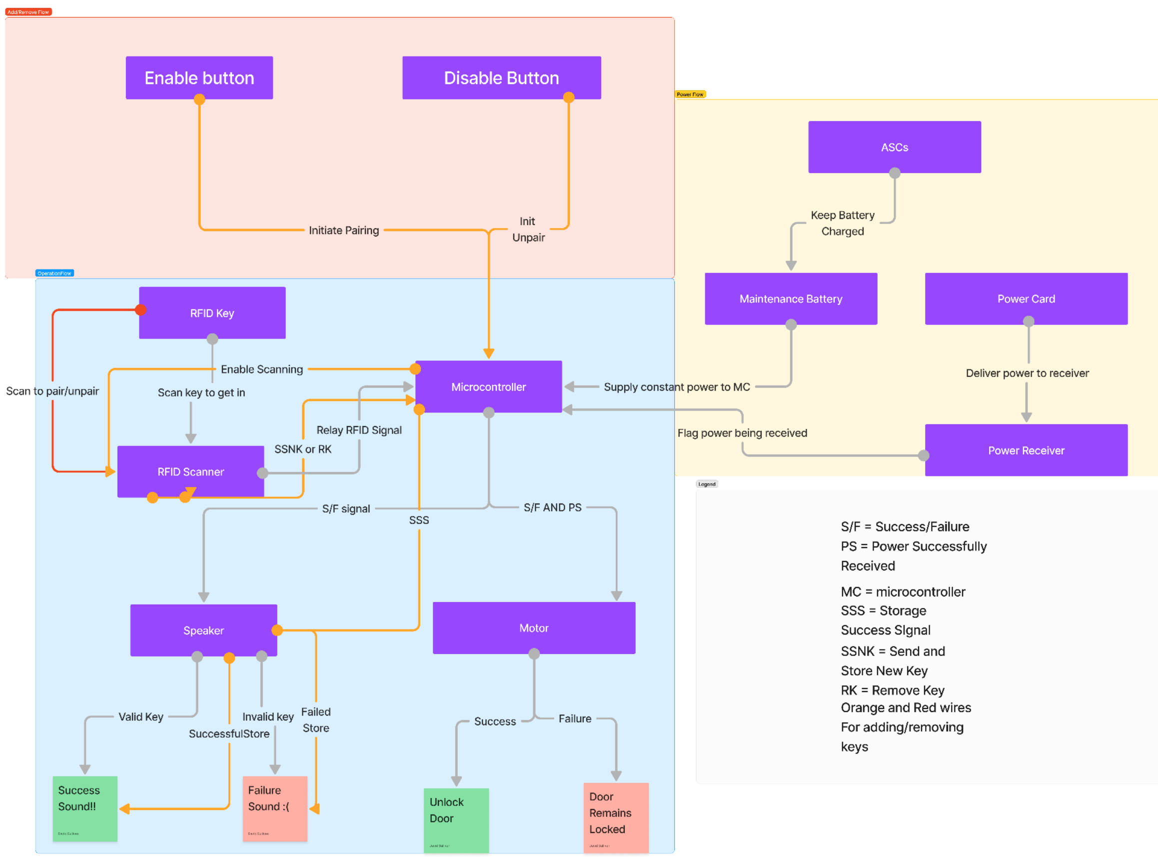
2. The CPU is fast enough to process RFID and turn door lock since the bank has to be held to the scanner for the system to have power (aim for under 30 seconds)

3. System would have short term power ~1 minute so that the system could run even when the power brick is pulled away

Design

Block Diagram

System this report is based off of uses only wireless power transmitting and scrapped solar and battery (We might need to change this depending on efficiency of power transmission)



Subsystems:

Power Receiver: Located next to the RFID scanner under the pad on the outside, this power receiver will be the main power component to the door locking system. When the RFID tag and power bank combo are pressed onto the door, this receiver will draw power from the bank and power the door system.

RFID Scanner: Will be mounted on the outside of the door, will receive RFID tag signal and send that data to the pcb/microcontroller located on the inside of the door. It is powered by the power receiver.

LED's and Speaker: Are located on the outside of the door unit on the external portion of the casing. These LED's and speakers will provide feedback if the door was unlocked or not. LED's will flash green or red and the speaker will play a distinct success or failure noise.

Linear Actuator/Motor: This is the main mechanical component of the lock as it will turn the deadbolt lock into the unlocked position. It is located inside the door and will be powered on on a successful RFID tag scan. It will then push the rotating portion of the deadbolt until the door is unlocked.

Microcontroller: The main component on the indoor unit, this microcontroller will be powered on when the power receiver is powered and will receive the RFID tag at the same time it is powered on. It will determine if the tag is a valid tag to unlock the door and will instruct the linear actuator to turn the deadbolt as well as instruct the outdoor LED and speaker to display proper colors and noises. Our current microcontroller will draw 2.2-3.6V (minimum voltage is -0.3V and maximum voltage is 5.5V) at an operating current of 27 mA in run-mode. If operating in standby, current consumption will can drop as low as 2 microA

Indoor Programming Buttons: Since this unit is meant for people renting, roommates are a likely scenario or even caregivers who may want ease of access when this unit is installed. Therefore the indoor portion of the unit will have buttons to add new RFID tags as users to the door as well as removing and setting users as temporary access.

Tolerance analysis:

Since our system is not connected to a wall socket it will have to be battery powered in some fashion. The current design shows a battery pack sending power from the portable power supply to the door mounted unit. We can measure both how much power the induction wireless power transmitter sends, and how much power the induction wireless power receiver gets/power needed to run the circuit. To do this we can measure the current out of the battery and voltage difference across battery output using **equation 1.1**.

$P=IV$ Equation 1.1

Knowing the power consumption per-use of our system, we can divide the power capacity of the battery by per use power for total uses before battery recharge/device failure occurs shown by **equation 1.2**.

$TotalUses = P_{pc} / P_{pu}$ Equation 1.2

Ethical Guidelines:

The team is committed to following the IEEE code of Ethics as well as the ACM code of ethics during the entirety of the development of the project. This project aims at providing a safe way for users to secure their apartments and homes. The IEEE Code of Ethics states that the "safety, health, and welfare of the public" must be a priority. Because our project centers around security, we will make sure to perform accurate and extensive testing to ensure that the project does not fail the user. Ways this could happen include unexpected dead battery, not recognizing the RFID tag, and failing to register other RFID tags. During development we will test and ensure that the system can detect low battery levels, and alert the user when an RFID tag has not been successfully added to prevent tags from not being properly added to the system. Other ways we will sustain proper ethical protocol is by recording everything in the engineering notebook, cleaning our lab station after use in the 445 lab, and accepting all errors and criticism during and after development of the project.

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