**Keyless Home Entry**

**Project Proposal**

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I. Introduction

With the advent of cheaper embedded systems and the rise in popularity of smartphones over the last decade there is an increased interest in leveraging cell phones as a central control unit for various intelligent devices inside the home. Typically, any discussion of smart devices quickly moves towards topics such as phones, appliances, cars, tools, watches, etc. Home security systems have also become commonplace. However, there seems to still be room for expansion to automate even more. This project aims to design and develop a system that integrates an Android smartphone with an embedded system (Raspberry Pi) to drive a deadbolt between locked and unlocked positions. Equipped with sensors, motors, and wireless communications controlled via an Android application on the phone, the Raspberry Pi will sense that the smartphone is within an appropriate range and unlock the door or lock the door once out of range.

II. Motivation

The premise of this project is similar to that of a keyless entry car. The point of which is to retain the integrity of car security with the addition of increased convenience to the car owner by not requiring the need to remove keys from a pocket and inserting it into the door. This is particularly helpful in situations where a person has their hands full and does not want to set down what they are holding, (i.e. grocery bags, box, or small child). Perhaps the keys are buried deep in handbag or backpack. As long as the bag with the key is in the passenger seat it is still possible to open or start the car as well. From the perspective of the owner it is as if keys are not required since there is no direct interaction between user and the car. However, to others the car is still unable to be accessed. This same situation often occurs with doors in the home. Therefore, it is advantageous to apply the same operational principles by utilizing a device that is often on someone’s person, such as a smart phone. An Android phone can act as the key fob which can be used to communicate with a Raspberry Pi based on attached sensors that detect the state of the door as well as operate the physical locking mechanism of the door.

III. Background

Keyless entry cars operate through encrypted radio signals between the car and a key fob. Since smartphones typically do not operate via radio signals different wireless communications are necessary. Various communication methods are available such as Bluetooth, NFC, WiFi, etc. One of these will be chosen as the primary mode of communication between the phone and the Raspberry Pi.

IV. Things to Consider

During the design process it is important to consider some of the challenges. **Range**: It is important in the design because there needs to be a reasonable range of operation. If the Raspberry Pi registers the phone too far away then it is not secure. However, it should be able to detect it with some distance so the phone does not need to leave the user’s pocket or bag. **Sensors/Motors**: Careful consideration needs to be done to determine the proper sensors and motors needed. The motor needs to be able to turn in two different directions. The sensors need to be able to detect the phone and possibly vibration of the door. **Communication protocols**: Communication type needs to be considered carefully. NFC may require too close of a range and would need to work through a door. WiFi could complicate things if the internet goes down in the house. Ultrasonic is another option using inaudible sound to send a signal between the two devices. Bluetooth may be the best option for direct short range connection, but more research is required before a choice is made. **Power supply**: The choice between battery powered or wall outlet needs to be determined. It needs to be determined as to how long a battery might last if driving sensors and motors as well as continuously search for the phone signal.

V. Primary Goals

There are essential aspects that must be functional for the entire system to work. **1)** The Android phone must communicate with the Raspberry Pi controlled via an application on the phone and sensors on the Raspberry Pi. **2)** The Raspberry Pi turns the deadbolt to unlocked if phone is within a given range. It should also automatically lock once the phone is out of the range. The range will be determined via sensors attached to the Raspberry Pi. **3)** On the application, the user should be able to know the status of the door to tell them if it is locked or unlocked.

VI. Secondary Goals

Once the primary functionality has been achieved there are possible expansions to the system that could enhance the experience. **1)** Guest access is very appealing. It would be ideal to be able to have a guest at the door send a request for access via the Android application. The homeowner receives a notification and can choose to approve or deny access. If approved the guest will be able to use their phone to access the door for a given period of time. Once the time has elapsed the door will not respond to their phone. **2)** The homeowner could receive notification if sensor picks up shaking in the door to alert them that someone may be trying to enter. **3)** A camera attachment could forward a picture via the application the sensors determine someone is trying to enter. **4)** If higher security is required a pin pad could be used in addition to the smartphone for two-factor authentication. **5)** A 3D printed casing may be design as a more aesthetically pleasing enclosure for door mounting.