ECE411 Team 10 Product Design Specification

Project Name: Puzzle Lock

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Executive Summary

In modern society, people are placing more and more importance on security, especially for each of our homes, which need to be safe and protected. However, ordinary keys will be easily duplicated and once the key is lost, the door will be easily opened by anyone who gets it. So for some people who are insecure or live alone, they will want some more secure and sturdy locks that can keep them safe. In this term, our team is going to make a Puzzle lock. This is not an ordinary lock and key, for many people, even if they get the key, they can't put the key in the right place. The lock will only be opened when the owner of the house corresponds the infrared emitter on the key to the correct position with the sensor in the lock cylinder. This ensures the uniqueness and confidentiality of the key and lock.

Brief Market Analysis

Puzzle lock is mainly for those who want a more secure lock to keep them safe, for example, the elderly, or people who live alone or lack security. Puzzle locks' main competitors are probably traditional locks and smart locks. But we have their irreplaceable advantages, both for traditional locks and smart locks. Puzzle lock has a great advantage in terms of privacy because only you will know the correct way to solve Puzzle lock. On the other hand, the Key and Puzzle Lock are made by specific shapes and they are irreproducible, uniquely matched. This cannot be replaced by either the easy-to-replicate key of a traditional lock or the code of a smart door lock. The reason is that only the designer and the customer know the positions of the sensor in the mount. In addition, a Puzzle lock has the same low battery alarm function as smart locks but is much cheaper than smart locks, it is only $79.99, so a Puzzle lock is the best choice for those who need a sense of security.

Requirements

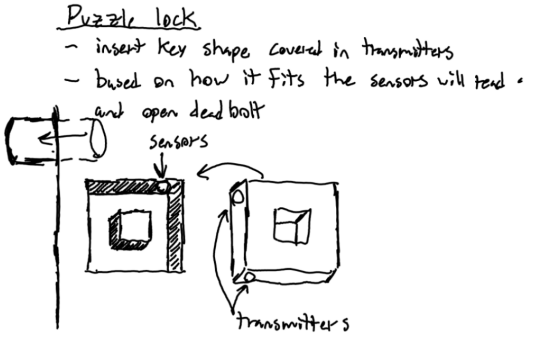

Figure 1. The Rough Schematic of the Puzzle Lock

Must

- Lock/unlock by the exact key with a special position
- Have a key and a mount which are rough as shown in the figure and the shape of them must be highly matched
- Be made of metal
- Powered by the battery (lithium 2032 battery or large capacity battery)
- Have a PCB board
- Programmed by C/ C++

Should

- Keep standby time for at least 6 months
- Have a low or damaged power alert
- Have a traditional lock that can be unlocked in the traditional way

May

- Sized within 15cm x 15cm x 4cm (Mount)
- Sized within 5cm x 3cm x 2cm (Key)

The door lock is the house's defense, and it is of great importance. Replacing traditional door locks with puzzle locks improves security. At the same time, various unlock functions also bring users interesting experiences and security protection.

System Architecture

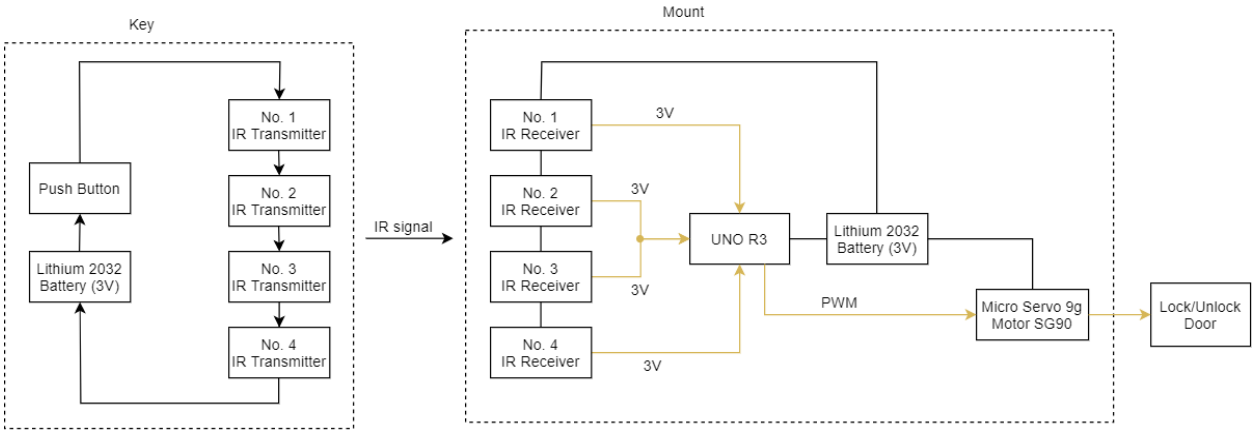

Figure 2. The Level 1 Block Diagram of the Puzzle Lock

Project Design Specifications

The hardware design is fairly simple. There is an interaction between the key and the mount on the door. The key will hold a set number of IR transmitters that will be attached to a battery and a push button. When the key is activated (using the push button) it will send IR signals out from its respective places on the key. When in the mount and aligned correctly the mount will notice inputs from the IR sensors and send 1's or 0's to a controller's I/O ports. When the controller sees the correct inputs being read it will send an output signal to a stepper motor which will cause an actuator to move in or out (based on the previous position) and control the deadbolt of a door.

- *Sensors*: Infrared transmitters/sensors. The finalized part will be included in the bomb, and based on the size and shape of the key we plan to make
- *Actuator:* Micro Servo 9g Motor SG90
- *Controller:* Arduino uno R3
- *Power:* lithium 2032 batteries. They have a good voltage level and are very small.
- *Firmware:* We will be using the "C" programming language. It seems to be the most comfortable language that each team member knows.
- *Integrated Development Environment (IDE):* Arduino