Biometric Door Lock

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Introduction

We live in a busy and evolving world, where personal security is becoming harder to protect. Many businesses, institutions, and homes are getting broken into day by day. Keys and RFID cards are also constantly getting lost – or even copied, if fallen into the wrong hands. To solve this problem, our group came up with the idea to create a “Biometric Door Lock” – a system that guarantees a person’s security, with the touch of their own unique fingerprint. Our Biometric Door Lock integrates advanced technology, that allows a person to register up to 127 fingerprints. If an unregistered fingerprint is placed on the fingerprint sensor more than 3 times, a buzzer would sound, alerting others of a potential intruder. Our product is an outstanding choice for both safety and security, as opposed to a traditional door lock.

Our group agreed that our main objective was to create a design for our Biometric Door Lock that was simple, cost-effective, and of quality. We approached this project in the same manner we would, if we were creating an actual product for a start-up business. Since start-up businesses are not generating any revenue when they are first formed, we figured that if we made our design as simple as possible, the cost to create and produce our product would be much cheaper. This would be beneficial to our business (since we are saving money), as well as to future consumers (since our product would not break the bank). We also figured that if we were to make our product as simple as possible, failure within our product would be less prevalent, due to less systems being involved. Although there were positives to cutting costs, we were also aware of the negatives - mainly one being that cheaper parts generally lead to cheap quality. To avoid creating a cheap quality product, we made sure that the components we used were from reputable vendors.

Methodology

We had three versions of our Biometric Door Lock: an initial design, a prototype, and a final product. Figure 1 below depicts the block diagram for our initial plan. We had a fingerprint scanner hooked up to the Arduino, as well as an LCD display that would portray the status of the door lock when a fingerprint was read. The TIP122 NPN transistor was also connected to the Arduino: the emitter pin was connected to a ground port of the Arduino, and the collector pin was connected to the ground of our door lock, and the base pin was connected to pin 12 of our Arduino. For one of our 9V batteries, the positive terminal was connected to the door lock, and the negative was connected to another ground port on our Arduino. To power the Arduino, we had another 9V battery connected to its power jack connector. We built our prototype based on Figure 1 - however, we ran into issues that caused us to change our design. These issues will be further discussed in the “Analysis and Results” section.

Figure 1. Block diagram for the first version of our prototype

Figure 2. Circuit layout for our final product

Although our design in Figure 2 worked successfully, our group was still not satisfied. We felt like our design could be simplified even further, so we decided to research and reconstruct a more efficient system. Figure 3 below depicts the final version of our Biometric Door Lock. The biggest change was creating a PCB. A PCB served to simplify our design, thus eliminating most hardwiring in our product. It contained most of the components from our previous designs, such as a 5V relay and NPN transistor. We also made sure that the PCB had a place to connect and solder our other components, such as the fingerprint sensor, door lock, and OLED display (which we decided to bring back). Since we were not using an Arduino, we still needed a microprocessor to handle all of the logic within our system. We decided to use an ESP32 - a perfect choice since it had similar functions of an Arduino and could be integrated onto our PCB. We also wanted our design to be powered by only one source, so we incorporated a power jack on our PCB, to connect our 12V wall adapter to. Figure 4 below depicts the schematic for our final design, and Figures 5 and 6 depict a sketch and 3D model of our PCB, respectively.

Key References


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We would like to thank NextPCB for manufacturing our PCB, at a cheap and fast price. We want to note how they verified that our Gerber files had no errors before manufacturing, and how they shipped our order to us in a timely manner.