Secure Mailbox with Mobile Connectivity

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Problem:

Mail is an integral part of how we receive information from other people, our communities, and businesses alike. However, even though it is delivered almost everyday, mail containing your personal information is in many cases not secure and risks being taken by others. While apartment buildings have keys which are only possessed by the tenant and mailman, many single family and townhomes have a conventional mailbox which is able to be opened by anyone. Currently, smart boxes exist for packages that can be placed outside your front door to be notified when you have a package, but this does not solve the issue for normal paper mail. Upon further inspection, there does not seem to be a smart mailbox which is both secure and can be mounted in place of an existing mailbox.

Solution Overview:

Our solution is to create a mailbox that is able to automatically lock as well as schedule when it is unlocked and send status updates to a mobile application.

The mailbox will use a magnetic contact sensor to determine when the mailbox is opened and then send a signal to the PCB that sets a ready state and waits for the close signal. Once the door is closed, the magnetic contact sensor will send another signal to the PCB which in turn instructs the lock to close.

The PCB will also interface with the mobile application which will send unlock and lock signals to the PCB to control the actions of the locking mechanism. This system will also be used for unlocking the mailbox during a scheduled window which can be controlled in the app.

In order to notify the user if mail is present in the mailbox, multiple ultrasonic sensors will be used to detect if mail is covering any one of them. This information will be sent back to the PCB and then be sent to the mobile application to alert the user of mail.

Solution Components:

- Micro Servo Motor: This small, low powered, motor will be used to lock and unlock the mailbox. It will be attached to a metal extension to secure the lock. Something such as: FeeTech S0005 analog servo.

- Ultrasonic Sensor: This will be used to determine with greater accuracy than a weight sensor whether mail is present inside of the mailbox by checking if the sensor is covered or not.

https://www.sparkfun.com/products/15569

- Magnetic Contact Sensor: This will be used to determine when the mailbox is being opened and closed. The magnetic sensor has two components and when they are separated a signal is delivered. It will be separated when the door is opened. Something such as: 7939WG Magnetic Contact
https://buildings.honeywell.com/us/en/products/by-category/sensors/contact-sensors/7939wg-magnetic-contact

https://www.sparkfun.com/products/13247

- Wireless module: This will be used to allow the microcontroller to communicate with our mobile application. Something such as: ESP8266.

- Mailbox: We will use a 3d printer to create the mailbox outer casing

-Battery: Lithium Ion Battery - https://www.sparkfun.com/products/13855

Subsystem 1: Power

We will utilize a battery for power and take the necessary steps to supply the PCB, motor, sensors, and other components with the required voltage demands.

Subsystem 2: Locking Mechanism

The locking mechanism will be utilizing a servo to lock and unlock the mailbox. When the servo is in a horizontal position it will be used as a barrier between the door and the chassis so that the door cannot be opened. It will be moved to a vertical position when the user wants the mailbox to be unlocked in order for the door to open. The locking mechanism will be connected to the PCB which will send the unlock and lock commands.

Subsystem 3: Sensors Subsystem

There will be ultrasonic sensors in the base of the mailbox and it will detect whenever mail or a package is placed in the mailbox. They will be placed at several positions along the base to ensure mail is detected and the user is accurately notified. We will also have a magnetic contact sensor at the top of the door. This will allow us to accurately know when the door is closed so that we can accordingly lock and secure the mail. Furthermore, we will have a wireless module allowing WIFI connectivity and data transfer to and from the mobile app. All sensors will be connected to and controlled from the PCB.

Subsystem 4: Application

There will be a mobile application that will be created in order for the user to manually unlock and lock the mailbox. The user will also be able to set time windows in which the mailbox will be unlocked in case of multiple deliveries.

Criterion for Success:
The mailbox is able to automatically lock and secure the mail after closing

The mailbox is able to detect mail present and send a notification to the user's application

The user is able to lock and unlock the mailbox remotely from the user's application

User is able to specify window of time where mailbox will be unlocked