Road Safe Phone Case

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Problem Statement

Phones have become an integral part of everyone's lives. However, a cell phone can also serve as a fatal distraction. Talking on the phone, sending a text message, and using navigation systems when driving can easily endanger the driver and others on the road.

Solution

Develop an interlocking device that allows the user to access only one object, either their cell phone or car key, at any given time. In case of emergency, access to both the phone and key will be made available.
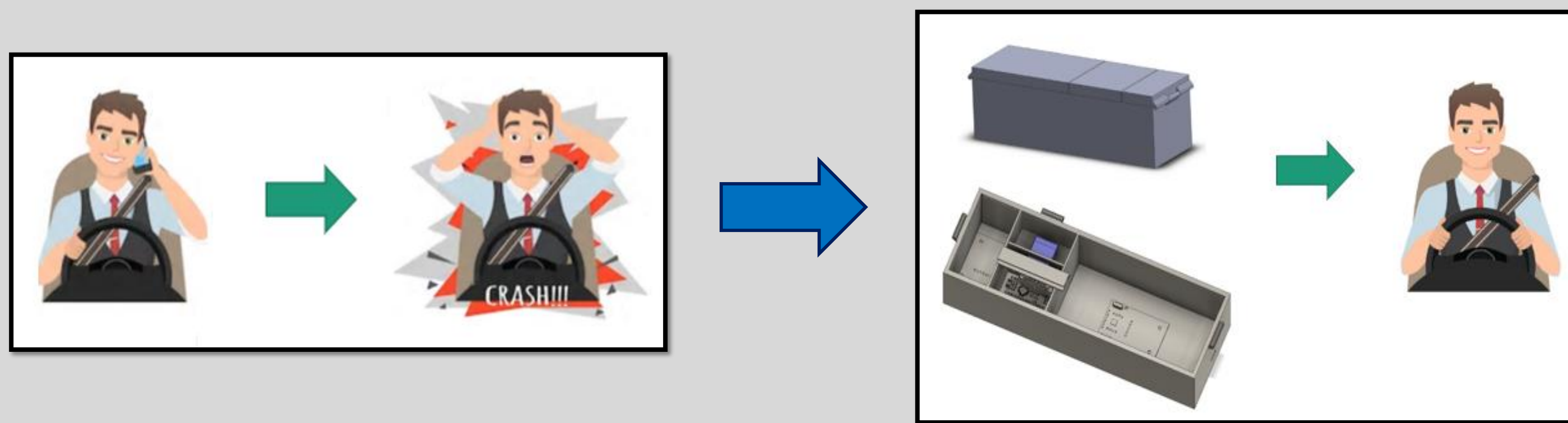
Intended Users

This product is intended for parents and teenagers to ensure that the teenager is not driving distracted or for any driver that wants to be more responsible on the road.

Design Requirements

Functional Requirements:
- Sensors should identify the driver's phone and car key only
- Locking mechanism should only lock one side of the case at all times
- Bluetooth connection between phone and case should enable sending messages

Non-Functional Requirements:
- Components will rely on a 9V battery supply
- Notification system will use wireless communication between components
- Case should lock within seconds of correctly triggering sensors
- Case should be able to withstand a drop from five feet

Operational Environment:
- Driver should only have one phone
- Driver should have a designated individual who will receive notifications
- Case should remain indoors and should endure various temperatures
- Case should fit in a spot within the car where it will remain stationary

System Diagram

Technical Details

Software:
- Google Firebase
- Arduino IDE
- Autodesk Fusion 360

Hardware:
- Arduino Nano
- Bluetooth Module
- Servo Motor
- Reed Sensors
- RFID Tags and Readers

Engineering Constraints:
- Case must be large enough to fit smaller Android phones
- Case must be small enough to comply with campus 3D printing restrictions and to be carried in one hand
- System should operate for five hours from the battery supply

Testing

Component Testing:
- Servo motor passed test to move the gear, shifting the gear rack into the locking positions based on sensor activation and emergency button
- RFID reader passed test to continuously check for phone and key tags
- Bluetooth module passed test to communicate with phone

Integration Testing:
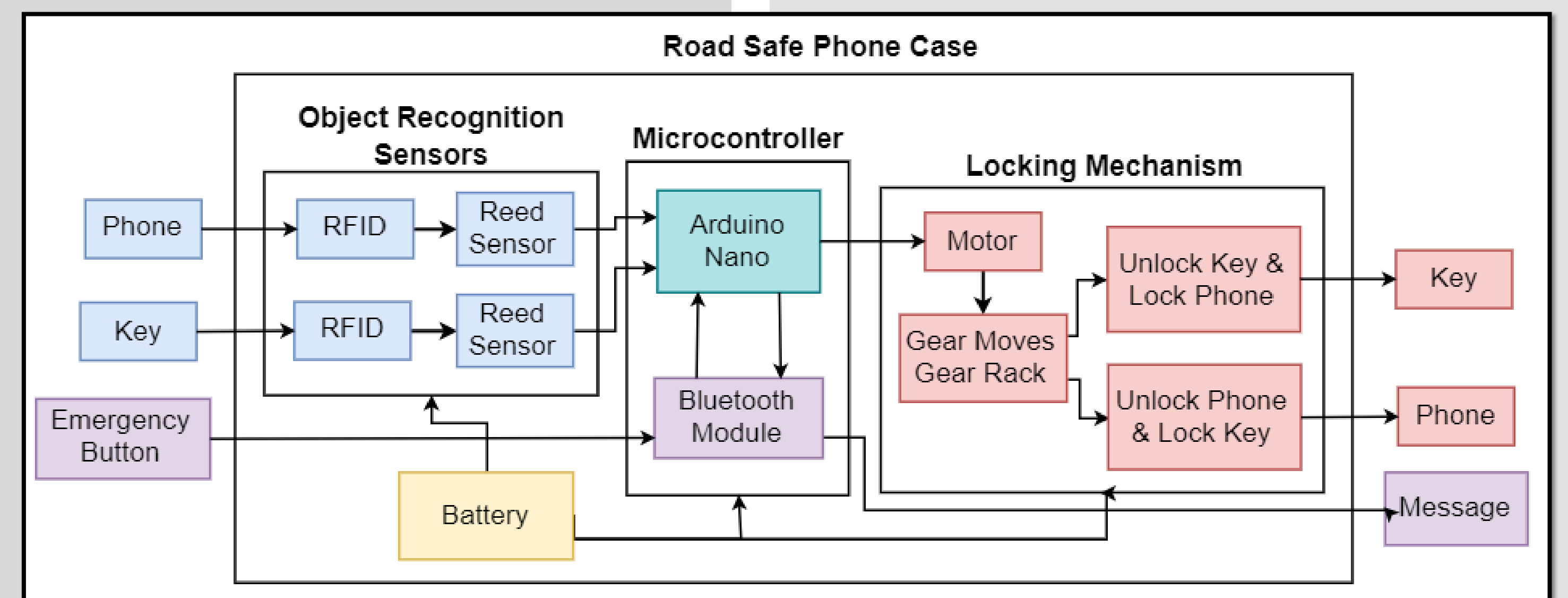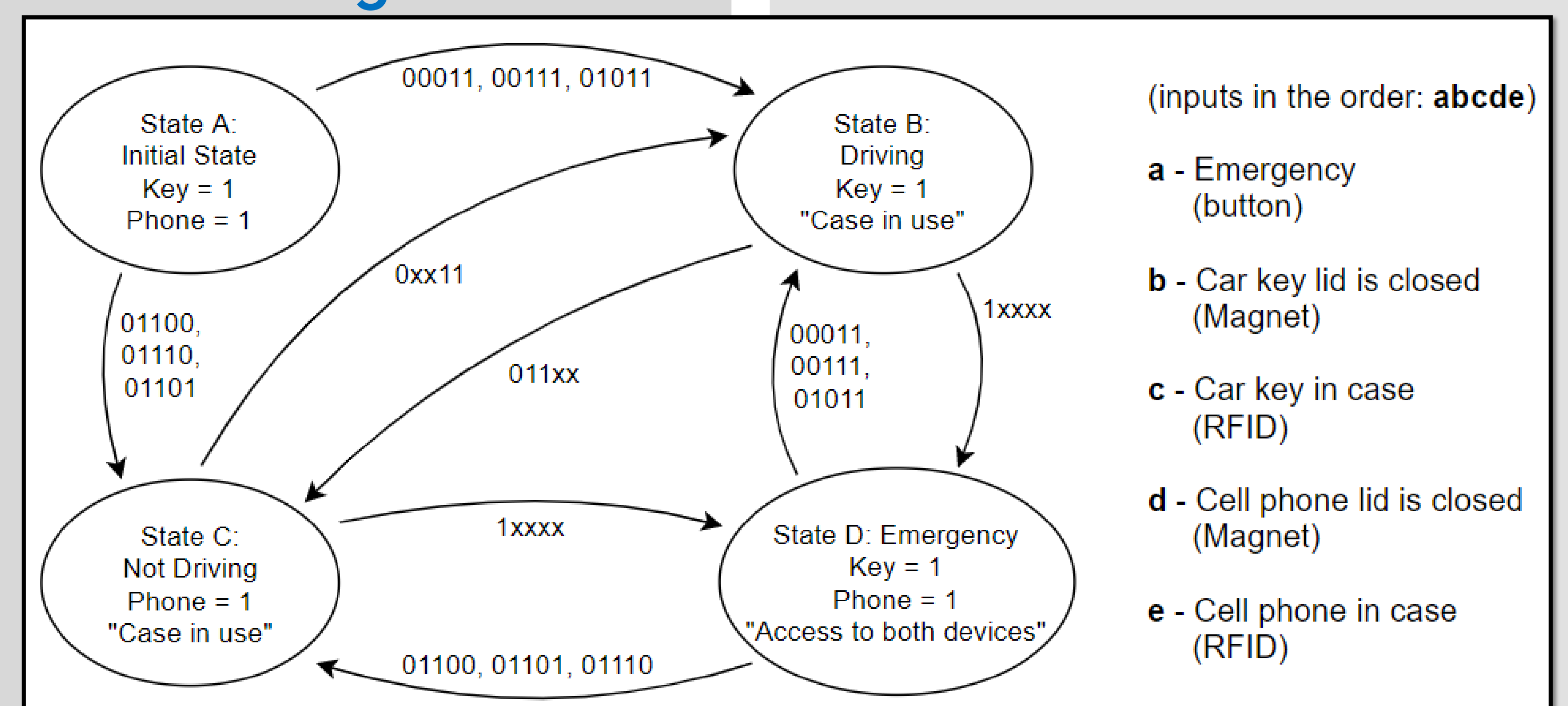- Subsystems were brought together one by one to develop full system

Engineering Prototype:
- Wires and circuit components from integration phase's proof of concept prototype were minimized and organized to fit inside the life-sized 3D printed case

State Diagram

Relevant Standards

- IEEE 1332-2012 Reliability Program for the Development and Production of Electronic Products
- IEEE 1451.7-2010 Transducers to Radio Frequency Identification Systems Communication Protocols
- IEEE 26514-2010 Requirements for Designers and Developers of User Documentation

Final Product