Host Cubbies

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Project Summary

Solve-It! Companies LLC is developing an accessory, the Host Cubby, for Airbnb properties. The design should be interesting and intrigue guests.

The project requires a single item vending machine that can interface with a user's personal phone to sell the item. Connection between the phone and cubby should use NFC, near field communication.

Background

The Airbnb host would like to sell guests items they may have forgotten or needed last minute to improve their stay such as wine or a phone charger.

Customer Requirements

1. Portable
2. Affordable
3. Easy to use
4. Easy to maintain
5. Electromechanical locking mechanism
6. NFC enabled
7. Visually Appealing

Design

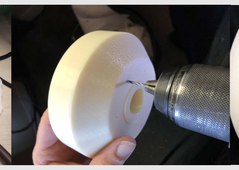
The NFC antenna and the microcontroller are placed in the top cap of the cubby. When the NFC antenna reads a tag, firmware on the microcontroller opens the cubby.

The cubby enclosure is an acrylic cylinder that rotates 180° to reveal a rectangular cutout for the user to remove their item from inside.

The locking mechanism at the bottom consists of two parallel concentric disks that rotate and are held in place with a solenoid driven shear pin.

Mechanical

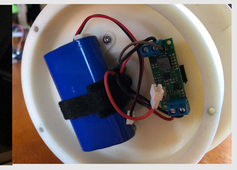
Smoothed facing surfaces on printed parts



Tapped holes and removed supports inside drilled holes

Mounted rotational components

Fit electrical components



Assembled with cylinder and electronics

3-D Printing

STL files were created from Solidworks parts then placed in the build plate envelope.

The printed parts consisted of the rotating disk, item platform, stationary base and the support structures.

The prototype was printed on a Stratasys 3-D printer using ABS filament to print the prototype.

Assembly

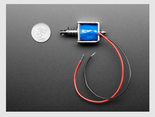
Our off the shelf components consist of a constant force spring, roller bearing, rubber gromet, wiring loom, and various pieces fasteners including tamper proof exterior bolts.

These were assembled with the 3-D printed parts for the final prototype.

Final assembly

Electronics and Software

Components



Adafruit medium push-pull solenoid uses 5.28 V to actuate and release the door.

3.7V Lithium Ion Cylindrical Battery with a capacity of 4400mAh.

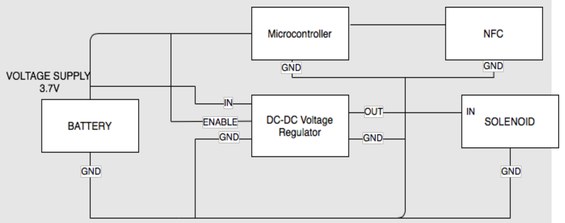
U3V70A Fine Tune Adjustable Step Up Voltage Regulator boots the input voltage in order to provide the required output voltage needed for the solenoid.

Adafruit PN532 Breakout Board reads the RFID tag.

SparkFun RedBoard Turbo micro-controller connects to the battery, voltage regulator, and NFC breakout board.

Firmware

The firmware for this project was developed using in the Arduino IDE and uses libraries for the PN532 provided by Adafruit.
The code verifies that a valid RFID tag was read by the antenna and sets the digital output pin to high. This pin is connected to the enable on the voltage regulator which causes the proper voltage to be supplied to the solenoid, unlocking the cubby.



Requirement Verification

Spec No.	Parameter Description	Max Requirement or Target	Actual	Compliance
1	Weight	10 lbs.	6.92 lbs.	Pass
2	Volume	425 in^3	194.75 in^3	Pass
3	Production Cost	$300	$192.77	Pass
4	NFC enabled	1 NFC antenna	Breakout board	Pass
5	Battery Powered	5V	3.6V	Pass

The weight was calculated from the Solidworks model since the ABS plastic is not the final manufacturing material.
The prototype production cost was calculated by summing the bill of materials.
The firmware is not complete, but the antenna works with RFID card.

Final Prototype

Conclusion

The NFC antenna and microcontroller can successfully read valid RFID tags and actuate the solenoid. The actuated solenoid allows the constant force spring to rotate the acrylic door into the open position.

The prototype as a proof of concept shows the design is viable. It is the first steps in providing the Airbnb host a novel way of selling items to their guests.

Future work would include injection molding or machining the mechanical components and updating the firmware to work with peer-to-peer NFC.