

Problem

Bike Theft

- Two million reported thefts in 2019 (Every 16 seconds)
- #1 crime reported on college campuses
- 20% of registered bikes at Calvin were stolen in the 2020-2021 academic year

Poor Current Locking Solutions

- Easily breakable cable locks
- Sufficient locks are expensive
- Only locks the frame (wheels are often stolen)
- Finicky (can be time consuming and difficult to use)

Solution

To solve this problem, we created a bike stall that removes the burden of carrying your own lock while alleviating the stress of leaving your bike vulnerable to theft.

Our station will provide better security for all major components of the bike: the frame and the front and rear wheel assemblies.

A user can drop off their bike at our station and after entering a PIN or scanning your badge, we will handle the rest.

Product is:

- For college campuses, metropolitan areas, workplaces
- Grid powered
- Stalls of 5-10



Final Design Prototype

Prototype

- A wooden prototype was built to quickly validate our locking strategy, and to provide a visual aid for our stall.
- The prototype was tested to troubleshoot issues that could arise when locking bikes of different shapes and sizes.
- From this, we determined the location of the three main locking points.



Wooden Prototype of Initial Design

Final Design

Housing

The housing was built to withstand applied forces and be large enough to hold internal components. Other features are:

- Reduced stall length to allow space for handlebars and shock forks
- Increased pedal gap for easier bicycle orientation
- Asymmetry gives user a sense of bicycle direction and spacing
- Material selection: 80/20 T-Slotted Aluminum

Locking Arm

The locking arm was designed and welded together to wrap around the bike easily. The three locking points on the arm lock the frame and both wheels of the bike. Other features are:

- Front arm length longer than the rear to lock more bike shapes
- One central security lock through the bike frame
- Two locking pegs to secure the wheels of the bike
- Material selection: 1"x1" steel tubing, 1/2" steel rods, 2 bearings

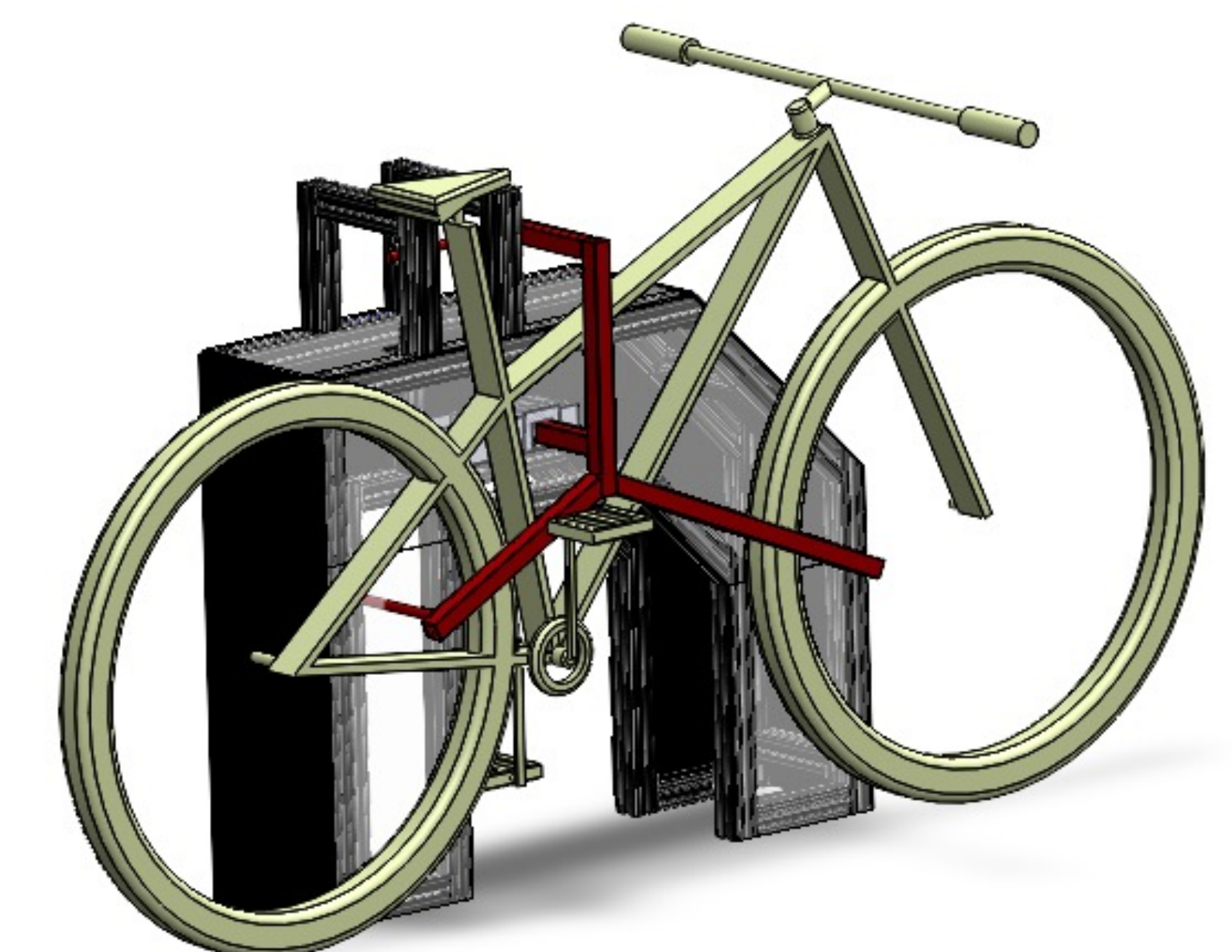
Electronics

The user interface was designed with two simple ways to lock and unlock the bicycle: a keypad for a personalized code and an RFID scanner for a university ID or work badge. An Arduino microcontroller controls a stepper motor to power a gear and rack system. This engages the locking arm directly to secure the bicycle. Limit switches were installed within the electronic housing to easily determine if the arm is fully inserted and if the station is locked or unlocked in the case of a power failure.

The Team



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CAD Model of Final Design

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