Smart Rack (EzRack)

Group 13

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Narrative Description

Finding parking at the University of Central Florida can be difficult. Making the campus friendlier to bicycling will encourage more students to give up their cars in favor of biking to school and thus help alleviate University of Central Florida's parking problem.

University of Central Florida has bicycle lanes going around the university and low speed limits which improve the safety of bicyclists. In addition to the speed limits, the school has four bike-share locations providing students with bicycles at no charge for a 24-hour period and a bike shop that provides no cost repairs to students provided they supply the parts. What University of Central Florida lacks however are convenient bike racks. Our project aims to solve that issue.

Our goal is to develop a bike rack that improves the safety and convenience of students who use bikes as transportation on campus. Our bike rack will offer students the ability to see the availability of the slot on the bike rack beforehand and reserve the slot. The bike rack will offer a smart lock for students using a mobile application or a keypad for entering a physical pin. Students will also have the ability to see the nearest bike rack and check if the current rack is fully occupied.

The initial inspiration for EzRack came from Smack, a smart bike rack developed by UT electrical and computer engineering seniors. Smack allows users to reserve space for their bike and set a pin to unlock a specific slot in the rack. Inspiration for the use of solar panels and finding rack locations came from bikeep.

Product Features

EzRack has two main parts; the bike rack and the mobile application accompanying it.

The bike rack will contain:
- Two slots to hold bicycles
- A lock to secure bicycles
- A physical keypad for entering pins manually in the event access to the mobile application is not possible.
- A solar panel to provide power

The mobile application will be used for:
- Checking the rack for slot availability
- Finding rack locations
- Reserving a slot
- Auto generating passcodes
- Locking and unlocking slots on the bike rack

The mobile application will make use of a database for storing:
- Bike rack locations
- Slot availability
- Reservations
- Passcodes
- User information

Additionally, the EzRack will be ARMY proof (i.e., easy to use).

Project Constraints

During the next two semesters, the three major constraints that will be faced are physical, economical and time related.

Due to the physical aspects of the bike rack, and the fact that the team is comprised solely of electrical and computer engineering students, the design and construction of the rack will be limited to easy to assemble and premade components.

EzRack will be entirely self-funded and the budget is determined by the amount that can be contributed by team members. When selecting components, how well they fit into the budget will be one of the primary considerations, especially since a large portion of the budget will have to be reserved for the solar panel(s). The already limited budget must also factor in lost or damaged parts.

The largest constraint however, may be time. All team-mates either have a full time job and/or a full course load potentially taking time away from the project. Additionally, the second half of the class will occur during the summer which is a shorter semester. Summer semester is cut short by four weeks which will leave us with less time to complete the project. It may also hinder our ability to add more advanced functionality to the smart bike rack.

Project Block Diagram
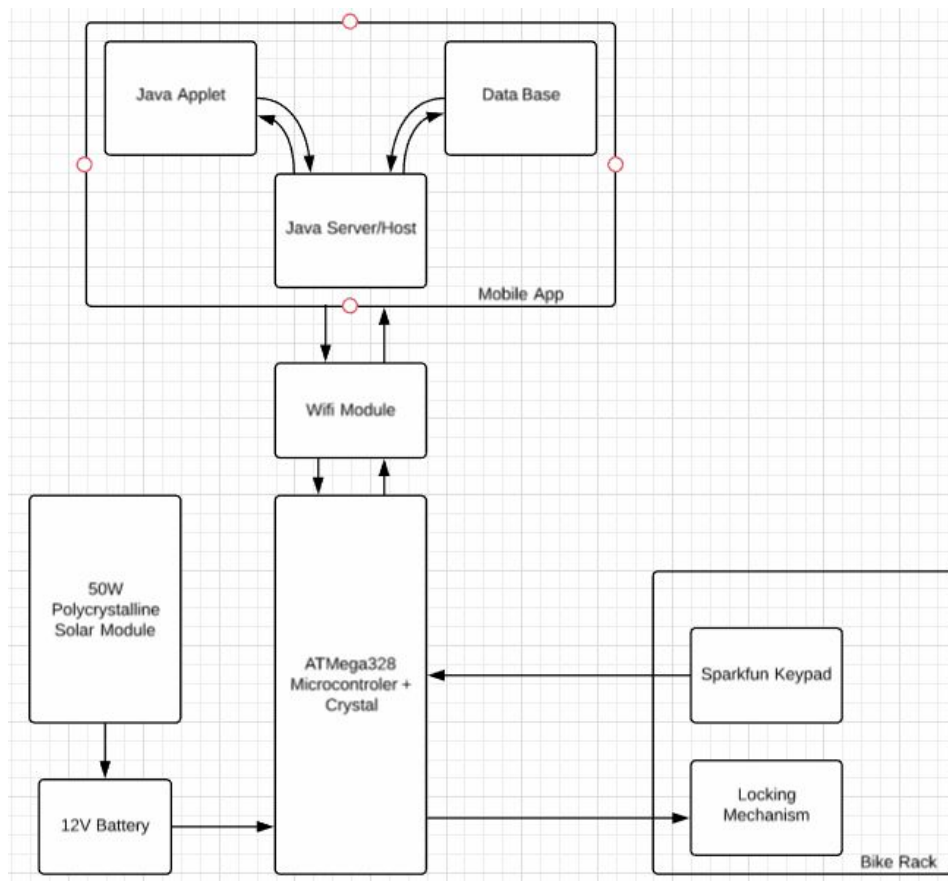
Mobile app is to be designed and developed using Java to communicate with microcontroller through wifi.
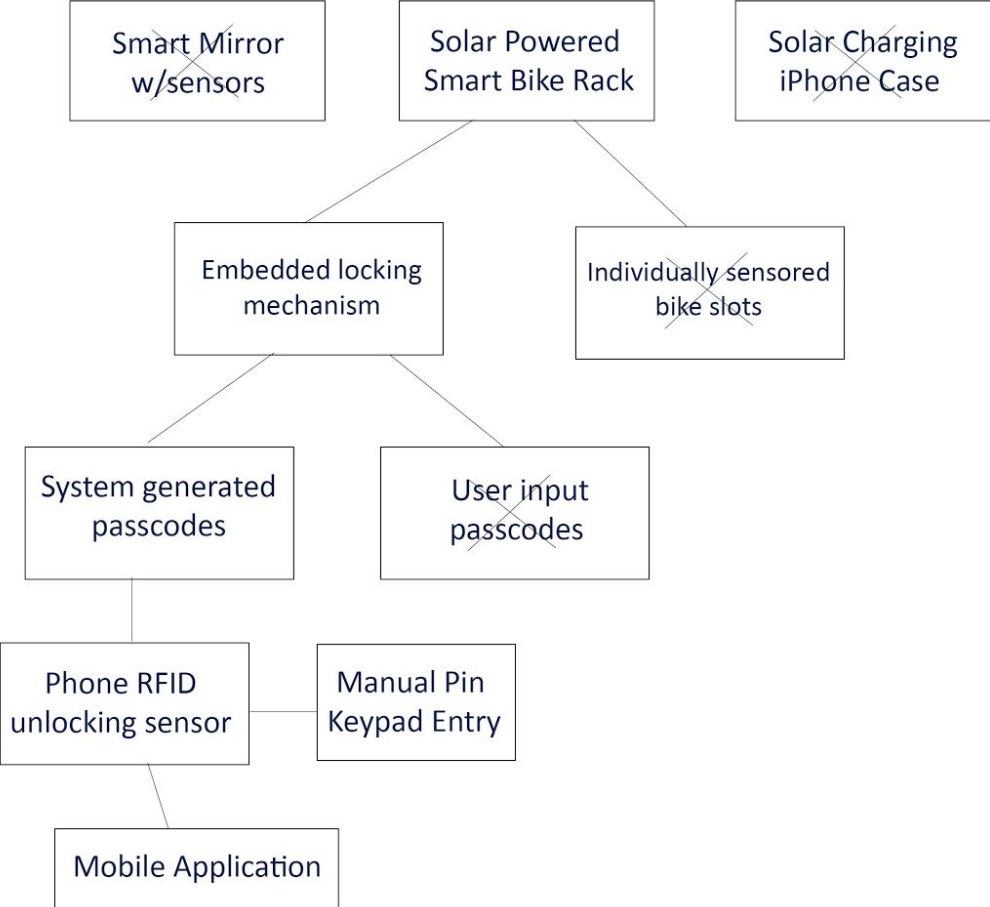
Wifi Module is to be acquired.

50W Polycrystalline Solar Module and 12V battery is to be acquired to create power source for microcontroller.

ATMega328 Microcontroller + Crystal is to be acquired.

Sparkfun Keypad and Lock Mechanism is to be acquired

Decision Matrix

Pricing Information, Estimated Budget, and Financing

Part	Reference	Price
50W Polycrystalline Solar Module	http://www.savegreenmoney.com/product-p/SP50P.htm?gclid=EAIaIQobChMIypv4vYH02AIVUCSBCh18bQejEAQYBCABEgL3TfD_BwE	$60 - $80
Sparkfun Keypad	https://www.mouser.com/ProductDetail/SparkFun-Electronics/COM-08653/?qs=WyAARYrbSnaziea%2FoFmXDA%3D%3D&gclid=EAIaIQobChMI7d3Q8ID02AIVUVYNCh2dIAiCEAQYAyABEgJwj_D_BwE	$4 - $10
12V Battery	https://www.batteriesplus.com/productdetails/SLAA12=1.3F?locationofinterest=&locationphysical=9060005&gclid=EAIaIQobChMIvunol4L02AIVnkoNCh1TRwQmEAQYCSABEgLSkfD_BwE	$22 - $30
Prototype PCB	https://www.amazon.com/Double-side-Prototype-Universal-Printed-Circuit/dp/B0147YM3DG/ref=pd_sim_23_3?_encoding=UTF8&pd_rd_i=B0147YM3DG&pd_rd_r=SHEXYKCK41FNXJ1YSGJT&pd_rd_w=3RWG4&pd_rd_wg=VmB0e&psc=1&refRID=SHEXYKCK41FNXJ1YSGJT	$7 - $20
Wooden Pallets + transportation	http://www.thecarycompany.com/recycled-wood-pallet-48x36?utm_source=google_shopping&m=simple&gclid=EAIaIQobChMIs9y8iIf02AIVA1cNCh1hpgg4EAQYAyABEgK6EfD_BwE	$0 - $30
ATMega328 + Crystal	http://www.studica.com/us/en/arduino/atmega328-microcontroller/a000048.html?ex_ref=google_feed&gclid=EAIaIQobChMI8fXszYj02AIViIvICh2t8QjnEAkYByABEgIhmvD_BwE	$5- $15
Web Hosting Services	https://www.whoishostingthis.com/blog/2014/07/29/website-cost/	$8 -$20
Serial Wifi Module	https://www.sparkfun.com/products/13678	$7 - $10
Wires, Electrical, and Electronic Components	Various	$20 - $40

Using the pricing table shown above we are estimating the project for the project to be $280. This budget is based on the upper bound costs of each component. At this time, funding with be provided directly from our group members.

Initial Project Milestones

At this time we have two important dates that mark significant milestones in our development. The first date, which is April 23rd, will mark the end of the semester and the end of EEL 4914, Senior Design I. By this day, we will have a clear picture of every step necessary for constructing and testing our project.

By the end of the spring semester, all the components and materials needed for designing and testing will be obtained. Each group member will also be familiar with all of the tools and components that they will use to complete the parts they are responsible for. Each group member will also be familiar with the lab that will be utilized for the second part of this course, Senior Design II. Although we will have possession of all of the physical components that are needed to build our project by the end of the semester, we will not connect any of the parts. Despite this, much of the software needed to complete our project will be developed as part of this milestone.

The Java application's user interface and database connectivity will be complete by the end of the first semester. Although the application will not be completely developed and finalized, a sizeable portion of it will be complete and fully functional. In addition to the mobile application, there will be software development done in the embedded portion as well. This will allow a more streamlined transition from this semester to the next. In addition to the benefits of streamlining, completing the preliminary software requirements at the end of this milestone will allow our team to focus more on putting together all of the physical components and hardware testing during the second part of senior design.

By the end of EEL 4915L, a fully functional prototype of our project will be completed. At the conclusion of the summer semester, the project will have gone through extensive hardware and software integration testing. The prototype will be presentable and each group member will have complete knowledge of the design.

Sources

1. http://www.orlandosentinel.com/features/education/os-ucf-bicycle-culture-20170718-story.html
2. http://www.dailytexanonline.com/2017/05/04/ut-seniors%E2%80%99-new-startup-creates-smart-bike-racks
3. https://bikeep.com/smart-commercial-bike-rack