Street Flooding Warning System

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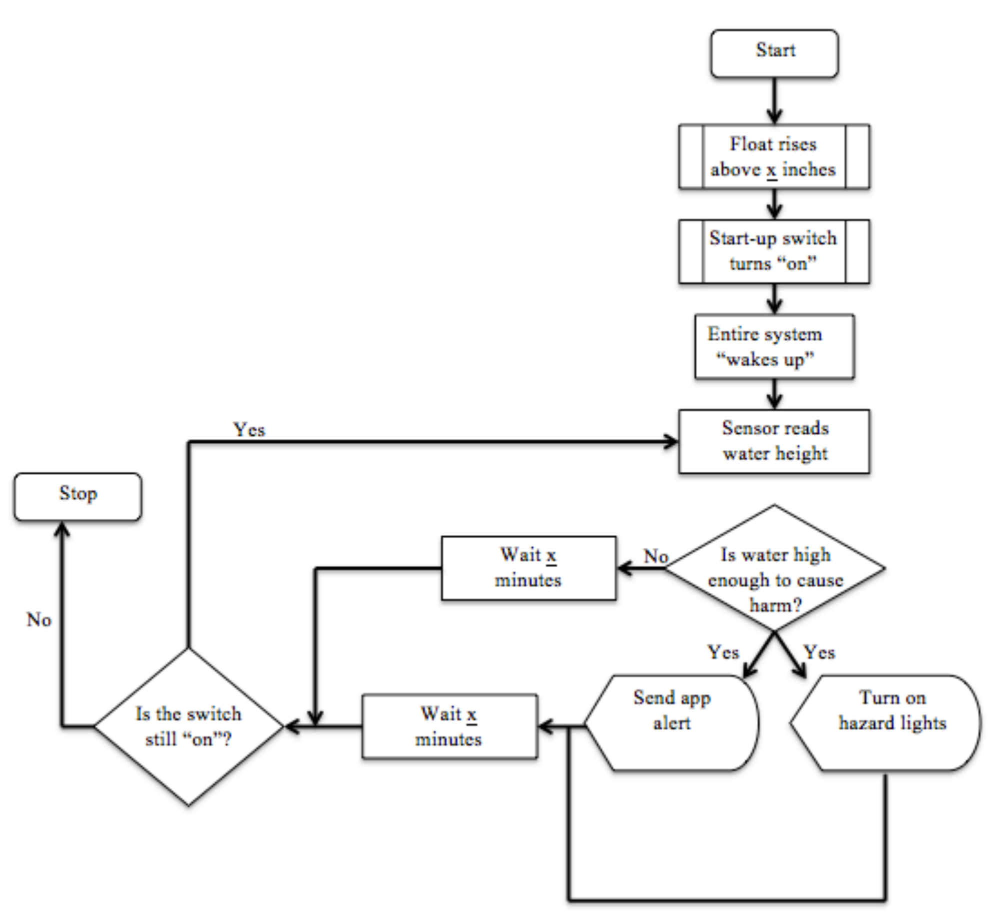
Objective

With approximately 200 deaths per year in the United States alone, flash floods have become the leading cause of weather related deaths topping even tornadoes and hurricanes in the past 30 years. Of these 200 deaths per year, approximately 135 of them are vehicle related. Because of these startling numbers, we have decided to take action and create a curbside flood monitoring/warning system. This system will allow drivers to view roads that are safe to drive through, roads that are cautious to drive through, and roads that should be avoided at all costs. All of this information will be available to the driver before even entering his/her vehicle via a phone application. A light system will also be placed near the monitoring device to warn oncoming traffic of the flood level before they attempt to risk their lives and their vehicles by driving through unknown water depths. This system should have a relatively low cost while providing drivers with possibly lifesaving knowledge.

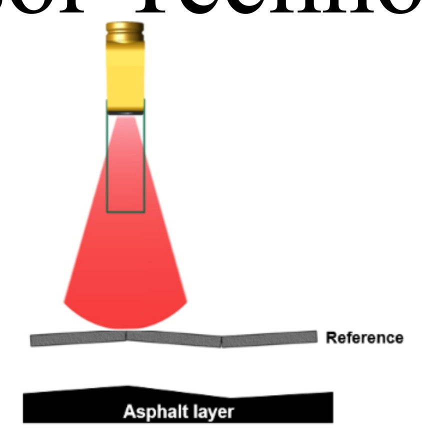
Behavioral Model



Engineering Requirements

- The product should cost less than $500 for an end user
- Device sensor should be able to accurately measure either 1/100 or 1/10-foot intervals
- Device should be able to operate in temperatures ranging from 30° F to 100° F
- The device should be able to withstand lightning strikes
- Device will generate its own power needs
- Device should communicate with a website or application to allow drivers to adjust routes, if necessary
- All essential electronics must be protected from water damage
- Device should be able to continuously run for 12 hours

Sensor Technology

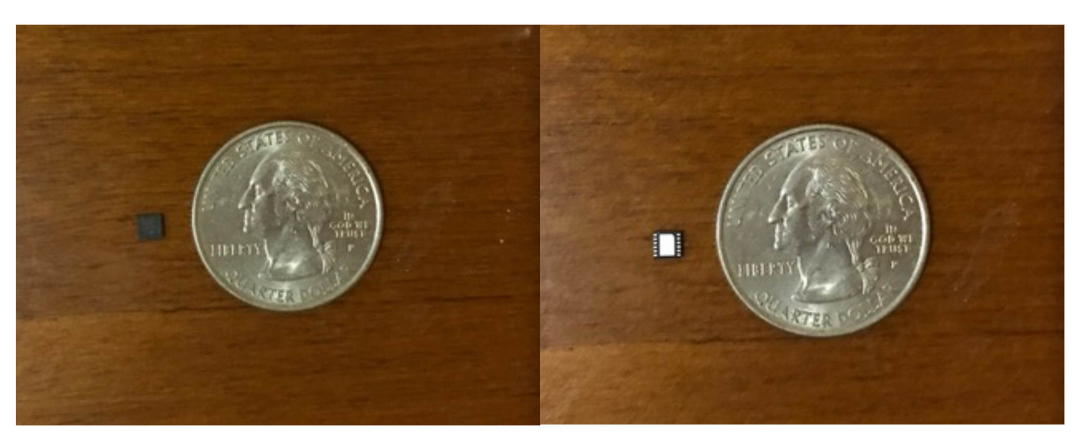


https://mobacommunity.com/blogs/entry/MOBA-Sonic-Ski-10-common-questions-asked-about-the-multi-ultrasonic-sensor-Sonic-Ski

Ultrasonic sensors are mainly used for the detection of an object, or proximity of one object to another. To determine the proximity of one object to another, a signal is transmitted from the transmitter and travels at the speed of sound towards an object. The signal then bounces off the object and returns to the receiver at the same speed. The total amount of time it takes the signal to be transmitted and then received is multiplied by the speed of sound to get the total distance. Then, the total distance can be divided by 2 to determine the proximity of the object from the sensor. In this project, we are using this technology to determine the height of flood water.

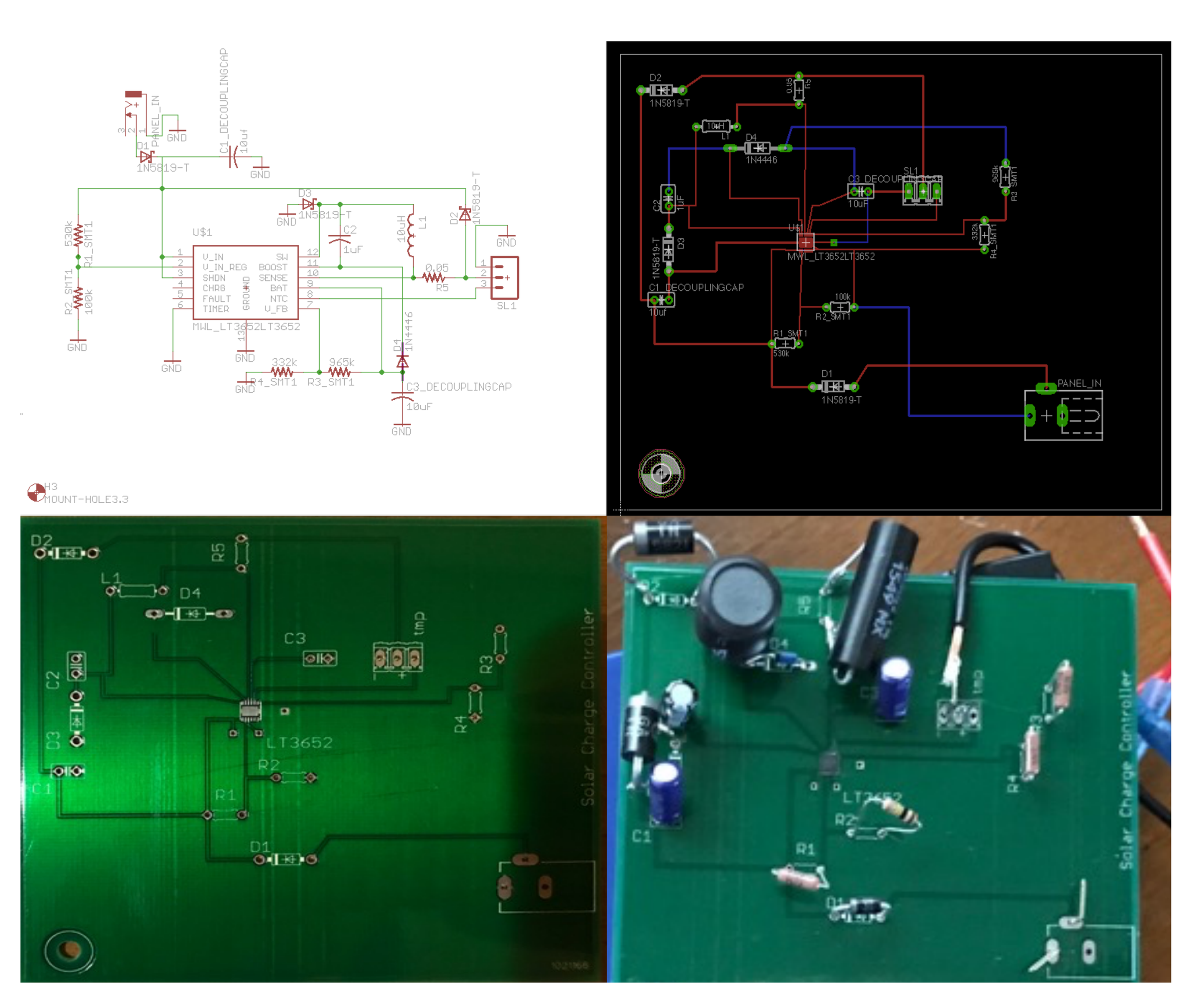
Charge Controller

A solar panel is being used to charge the battery. In this configuration, a charge controller is needed to prevent overcharging and over-discharging of the battery. We are using a 6V lithium iron phosphate (LiFePO4) battery, and the charge controller needed to be designed accordingly. The charge controller is designed around the utilization of the LT3652 chip. This chip is a 2A, power tracking charger for solar panels. This chip features constant-current and constant-voltage charge characteristics with a maximum charging current of 2A, which we are using.



PCB Design

The charge controller circuit that was designed in PSPICE is laid out in Eagle PCB design software. Lastly, it is soldered together.



Microprocessor and GPS

The microprocessor is the brains behind our device's operation. We are using the Particle Electron. One main feature of this microprocessor is the cellular capabilities it offers. The microprocessor system theory centers around the microprocessor being able to operate the device, take readings, and publish them to the web.

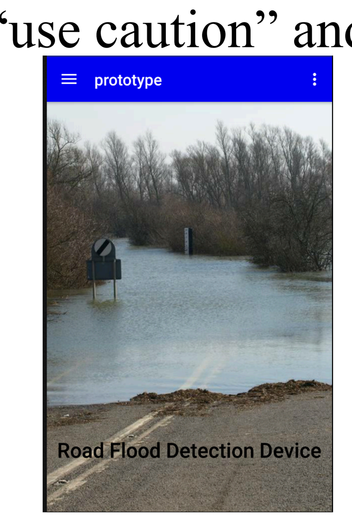
We are using the Global Navigation Satellite System (GNSS) module to acquire the geographic location of where our device is so that we can display the information on Google Maps from the Android phone app.

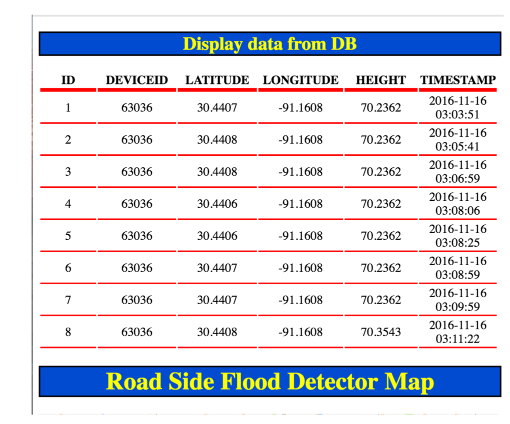
http://makezine.com/wp-content/uploads/2016/01/Compare-ParticleElectron.jpg

http://www.hobbytronics.co.uk/image/cache/data/sparkfun/sensors/gp735-gps-56-channel-500x500.jpg

User Interface

The user interface includes an app, a website, and flashing LED warning lights. The makeup of the app was designed to make the road flood information accessible and informative for people to use. The website was used in place of an LCD screen. We originally planned to use an LCD screen to warn drivers; however, we were unsuccessful in implementing it. Instead we decided to send this warning information to a website. Lastly, our device features two LEDs: yellow and red. Where yellow means "use caution" and red means "dangerous".





Display data from DB

ID	DEVICEID	LATITUDE	LONGITUDE	HEIGHT	TIMESTAMP
1	63036	30.4407	-91.1608	70.2362	2016-11-16 03:03:51
2	63036	30.4408	-91.1608	70.2362	2016-11-16 03:05:41
3	63036	30.4408	-91.1608	70.2362	2016-11-16 03:06:59
4	63036	30.4406	-91.1608	70.2362	2016-11-16 03:08:06
5	63036	30.4406	-91.1608	70.2362	2016-11-16 03:08:25
6	63036	30.4407	-91.1608	70.2362	2016-11-16 03:08:59
7	63036	30.4407	-91.1608	70.2362	2016-11-16 03:09:59
8	63036	30.4408	-91.1608	70.3543	2016-11-16 03:11:22

Road Side Flood Detector Map

Results

All aspects of our project did not end up working as we had hoped. First, we were unable to construct an ultrasonic sensor of our own. We originally intended to design out own sensor, but we were unsuccessful and had to purchase one. Second, we were unable to get the LCD screen working properly. Instead of utilizing an LCD screen, we designed a website to show we are able to send flooding data to an external location. One aspect of our project that did work is the charge controller circuit. This circuit was designed and printed on a PCB. Overall, we created a structure that can generate its own power, read flood water levels, transmit that data to both a website and an app, and output warning lights to alert drivers.