CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36702

Project Title

Smart Flood Sensor: Detect, Analyze, and Predict Water Accumulation in City's Drainage System

Abstract

Objectives/Goals

Build a Smart Flood Sensor device that can be used in a network of flow sensors in a city's drainage system to collect, analyze, and predict rain and storm water flow data. Specifically, the device should be able to calculate water flow with 90% accuracy, upload the data periodically to the IoT cloud, and send text alerts to nearby utilities crew if flood levels reach a certain threshold. The analysis software should be able to predict flood at a drain, given the historic and real time flood level buildup at adjacent drains. It should also recommend optimal drain pipe sizes needed to fix the choking points. The software component should be serviceable wirelessly within 25 feet radius.

Methods/Materials

My device uses a Hall Effect based water flow meter, Arduino microcontroller, GSM/GPRS shield, a Bluetooth link for UART connection, and a rechargeable battery (10K mAh), all enclosed in a UL rated waterproof enclosure. It has low power requirements (~20mA idle, 40-60mA operating), small form factor (4.5"x4.5"x2"), and is non-obstructive to water flow. My software running in this device calculates flow rate, connects to thingspeak.com servers, and uploads data in 15 sec intervals. Analysis phase uses my MatLab software and my graph theory algorithm to predict flood levels in the drain network.

Results

I tested my project by installing devices at five different drain openings in my neighborhood streets. During the recent rainy days, these devices successfully recorded water flow data and uploaded them to the IoT servers in 15 sec intervals. In parallel, the analysis software analyzed data every 15 minutes. One of the devices sent a text alert that it has detected an excessive water flow (>350ml/sec) at a drain. HOA was notified to increase pipe capacity at that opening. It also identified a drain where flow was gradually decreasing while other drains showed higher flow rate. HOA was alerted in real time and it was found that debris was the cause. This device saved a flood occurrence in that street. In another case, HOA was alerted of a leaking sprinkler.

Conclusions/Discussion

Regular flooding in city streets proves that the city planners are not connected to what is happening under the ground. My Smart Flood sensor, a low cost (~$220) device, can not only help identify drain openings in city streets that are getting clogged in real time, but can also determine areas where more drain pipes are needed.

Summary Statement

In order to reduce flooding in city streets, I made a Smart Flood Sensor device to collect, analyze, and predict water flow data in city's drainage system.

Help Received

My Home Owners Association for allowing me to test my devices in 5 streets. My Java teacher, Mrs.Debbie Frazier for providing guidance and reviewing the results throughout the project.