Low-Cost Mobile Hydrology Reporting

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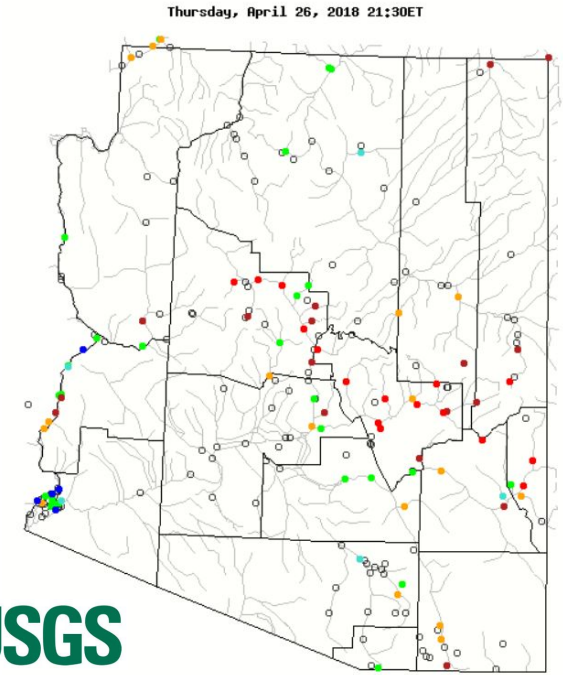
Team: Luis Arroyo, Logan Brewer, Ryan Ladwig, Kelli Ruddy

Why Hydrological Data Collection is Important

- Flood Prevention
  - Better warnings
  - Flood preparation
- Water Management
  - Measure river flow, runoff levels
  - Infrastructure design
- Public Education Knowledge
  - Influence how community votes for public officials based on how important they think water management is
  - When to evacuate

What's Wrong With The Current System?



- USGS - United States Geological Survey
- The USGS installs stream gauge sensors that monitor water level
- Works with the National Weather Service to provide emergency flood data

A Vision: Crowdsourced Hydrology

What is crowdsourcing?

- Collect information from general public
- Examples : Waze, Google Crowdsource, Starbucks Cups

What does this mean for hydrology?

- 1000’s of users adding data
- How would users upload and be motivated to collect data?

First Attempt: Citizens Science

- Dr. Benjamin Ruddell
  - Associate Professor at NAU
  - Complex Systems Informatics Laboratory
- Dr. Robert Pastel
  - Associate Professor at Michigan Tech

- Overall Plan
  - Build a station
  - Passersby take a picture of the gauge
  - Upload the picture to the website
- Drawbacks
  - Only works on the website
  - Only as accurate as the algorithm
  - No instant feedback
  - Slow process

Key Requirements

- Mobile
- Offline Functionality
  - Access graphs
- Geolocation
  - Pull users location
- Image Processing
  - Calculate water depth on phone
- Database Management
  - Store collected data
- User Accounts
  - Option to create account
- Gamification
  - Notifications and data visualization

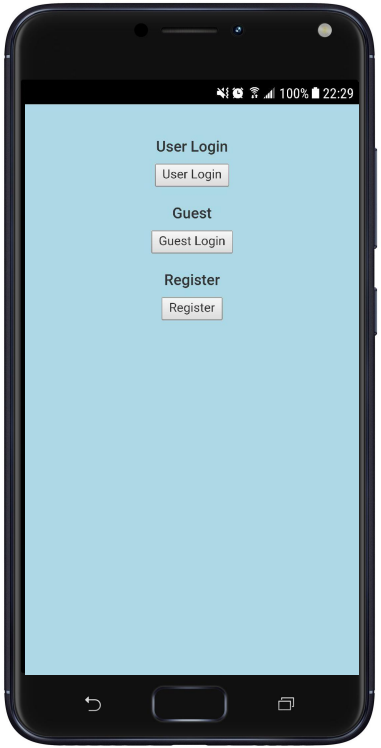
Requirements:	Count
Functional	59
Performance	12
Environmental	6

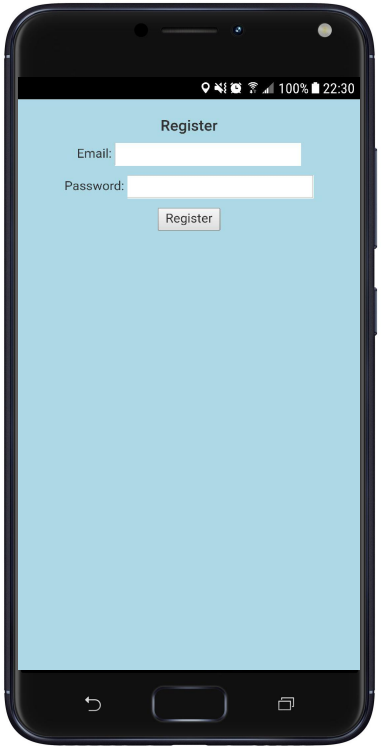
Our Solution: Overview

- Our Plan
  - Build a station
  - Passersby take pictures of the station
  - Submit the data through our application
- Key features
  - Works on mobile
  - More accurate data
  - Instant display of graph on collection
  - Faster process

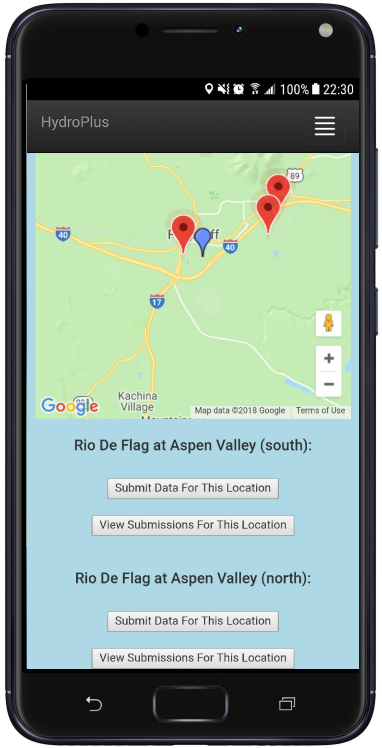
Scenario

Setting Up The App



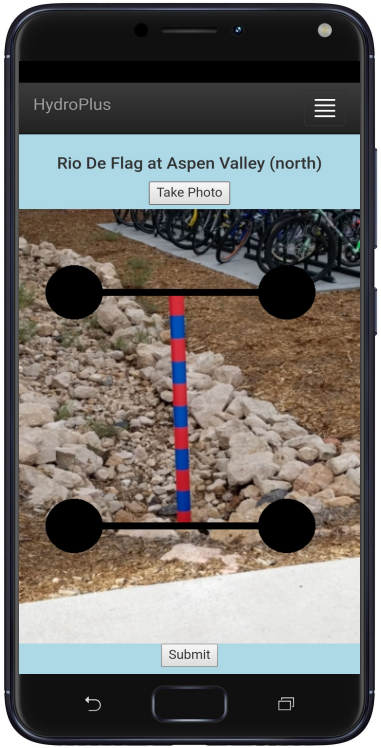


First Use

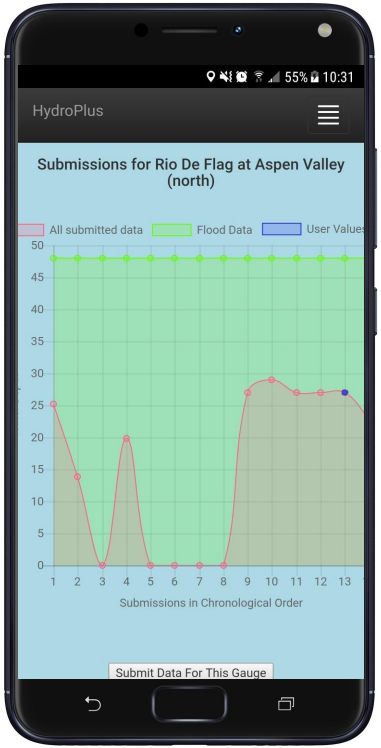

100% 22:30
HydroPlus
Kachina Village
Map data ©2018 Google
Terms of Use
Rio De Flag at Aspen Valley (south):
Submit Data For This Location
View Submissions For This Location
Rio De Flag at Aspen Valley (north):
Submit Data For This Location
View Submissions For This Location

Recording Data

Finding the Water Height on Your Image



Seeing Your Data



Architecture Overview

Platform
Android, iOS

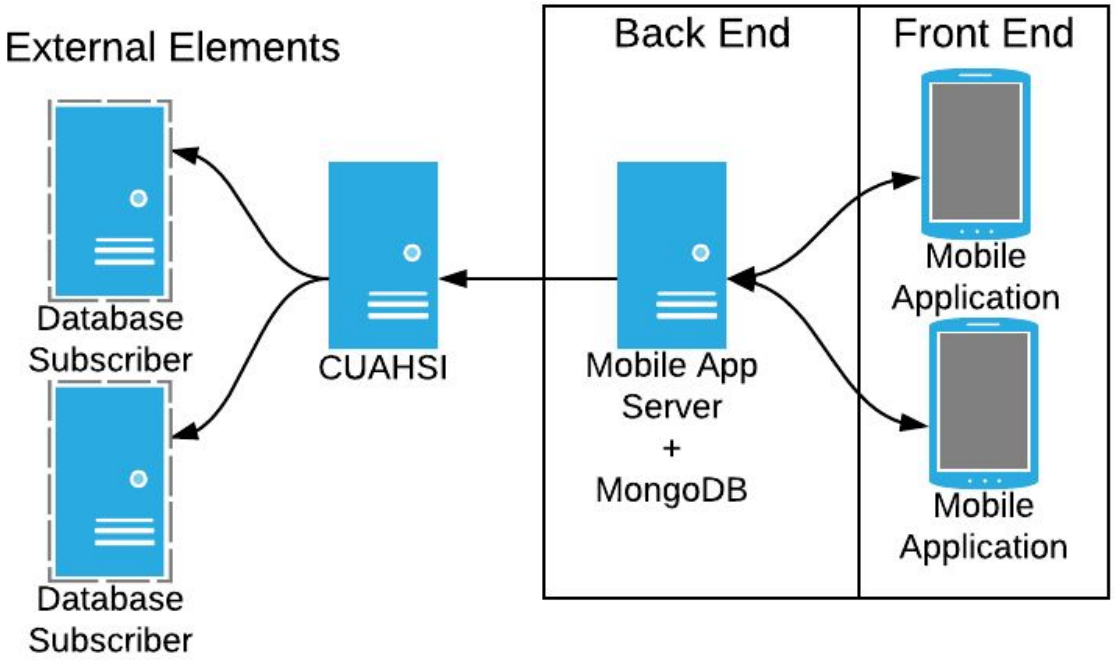
Application Framework
Meteor JS, PhoneGap, Android Studio

Notifications
Twilio, Firebase

Data Visualization
Chart.js, D3.js

Database
MongoDB, MySQL, Apache Cassandra

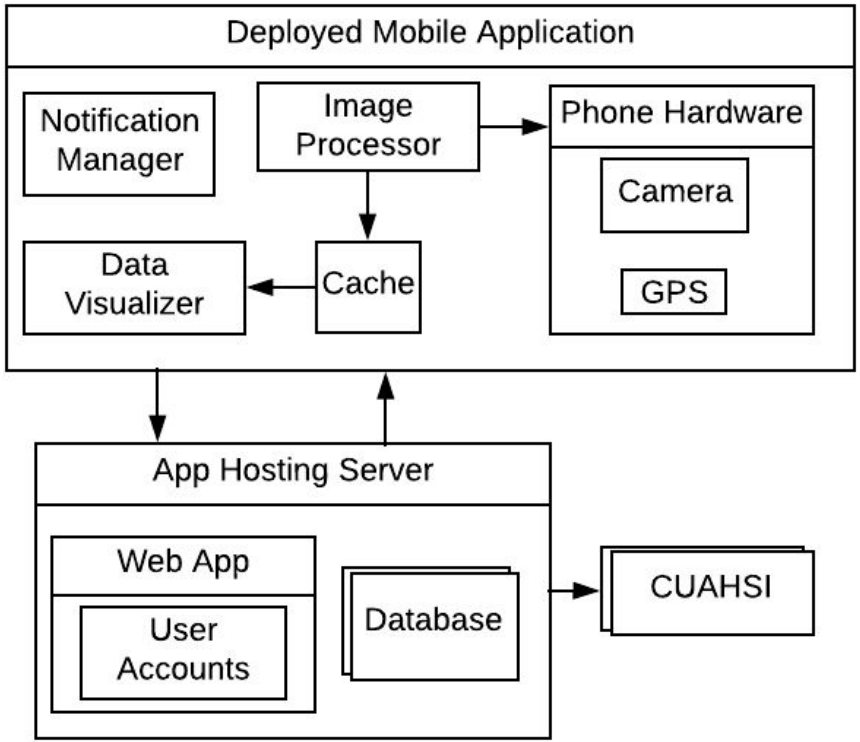
Computer Vision
OpenCV, Tracking JS, JS Feat



Implementation: How It Works

Key Modules:

- Image Processor
- Notification Manager
- Data Visualizer
- User Accounts
- Database



Challenges and Resolutions

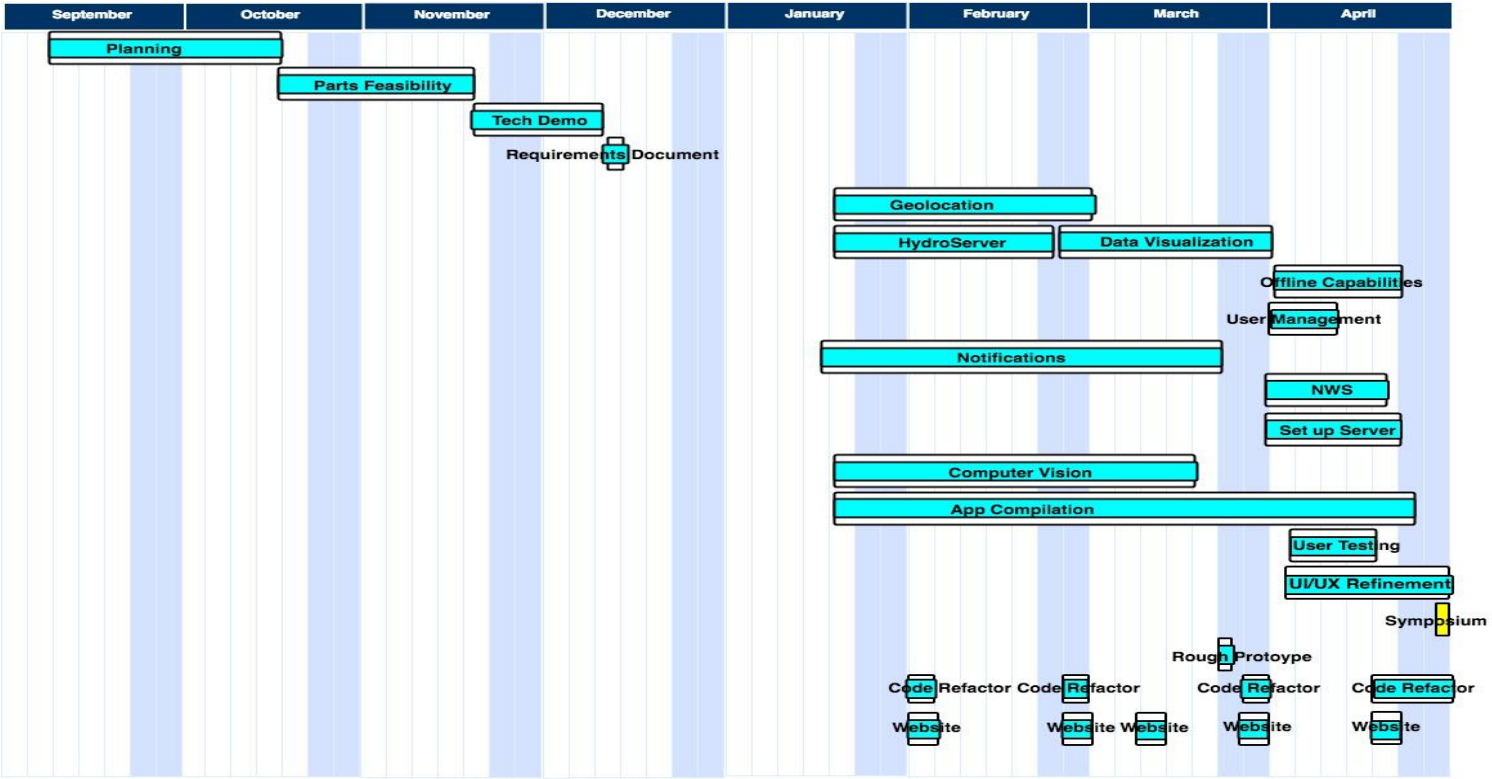
Past Challenges:

Challenge	Solution
Meteor documentation being outdated	Read online forums and consulted experienced Meteor developers
OpenCV Package running in Meteor JS	Modify the build settings
Send offline and online notifications	Send SMS text messages

Current Challenge:

Challenge	Solution
Automatic Upload to CUAHSI	Communicating with CUAHSI

Schedule


September
October
November
December
January
February
March
April
Planning
Parts Feasibility
Tech Demo
Requirements Document
Geolocation
HydroServer
Data Visualization
Offline Capabilities
User Management
Notifications
NWS
Set up Server
Computer Vision
App Compilation
User Testing
UI/UX Refinement
Symposium
Rough Protoype
Code Refactor
Website
Code Refactor
Website
Website
Code Refactor
Website
Code Refactor
Website

Future Work

Improvements:

- OpenCV algorithm
- Not sending text messages as a notification
- New types of notifications

New Features:

- Providing the user history of the area where the gauge is located
- Social media integration
- Create a leaderboard
  - Encourage friendly competition
  - Promote sense of community
- Reward points when user submits data
  - Additional points if the user submits data during the rain

Conclusion

Major Improvements

1. Accuracy
2. Cost

Value To Client

1. 1000’s of Cities Involved
2. Better National Models
3. Citizen Education

Hydro Citizens

NAU Undergraduate Symposium

For more information:

Come See Us At Our Poster Session:

Location: J Lawrence Walkup Skydome

Time: 2-4pm

Section: 17D

Visit our website:

https://www.cefns.nau.edu/capstone/projects/CS/2018/HydroCitizens/