

# Northern Arizona University

## School of Informatics, Computing, and Cyber Systems

# Low-Cost Mobile Hydrology Reporting

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Client: Dr. Benjamin Ruddell

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College of Engineering,  
Forestry, and  
Natural Sciences

### Motivation

**Problem:** Collection of hydrological data is important because it helps us to more fully predict how increased amounts of rainfall is going to act in a specific area. United States Geological Survey (USGS) is the main contributor of this data.

Issues with the current collection of this data include:

- USGS stream gauges cost \$14,000-\$16,000 a year to maintain.
- Very few data points are being collected.
- Lack of understanding of the big picture.

**Current Solution:** Our client, Dr. Benjamin Ruddell, with the help of his colleague Dr. Robert Pastel at Michigan Tech University, has developed a citizen's science web application to crowdsource hydrological data. Red and white-striped PVC pipes are installed outside and users submit images of these pipes to the web application.

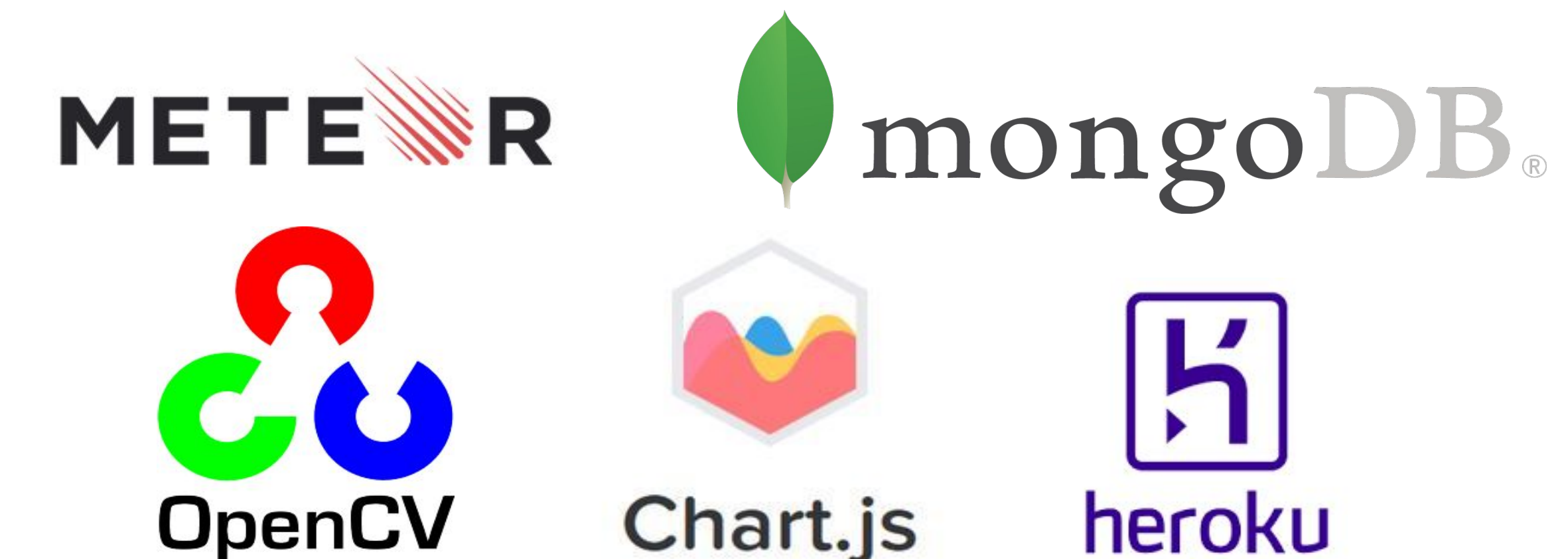


**Drawbacks of Current Solution:**

- Only works on the website.
- Requires an internet connection.
- No instant feedback.
- Generally slow process.



### Technologies

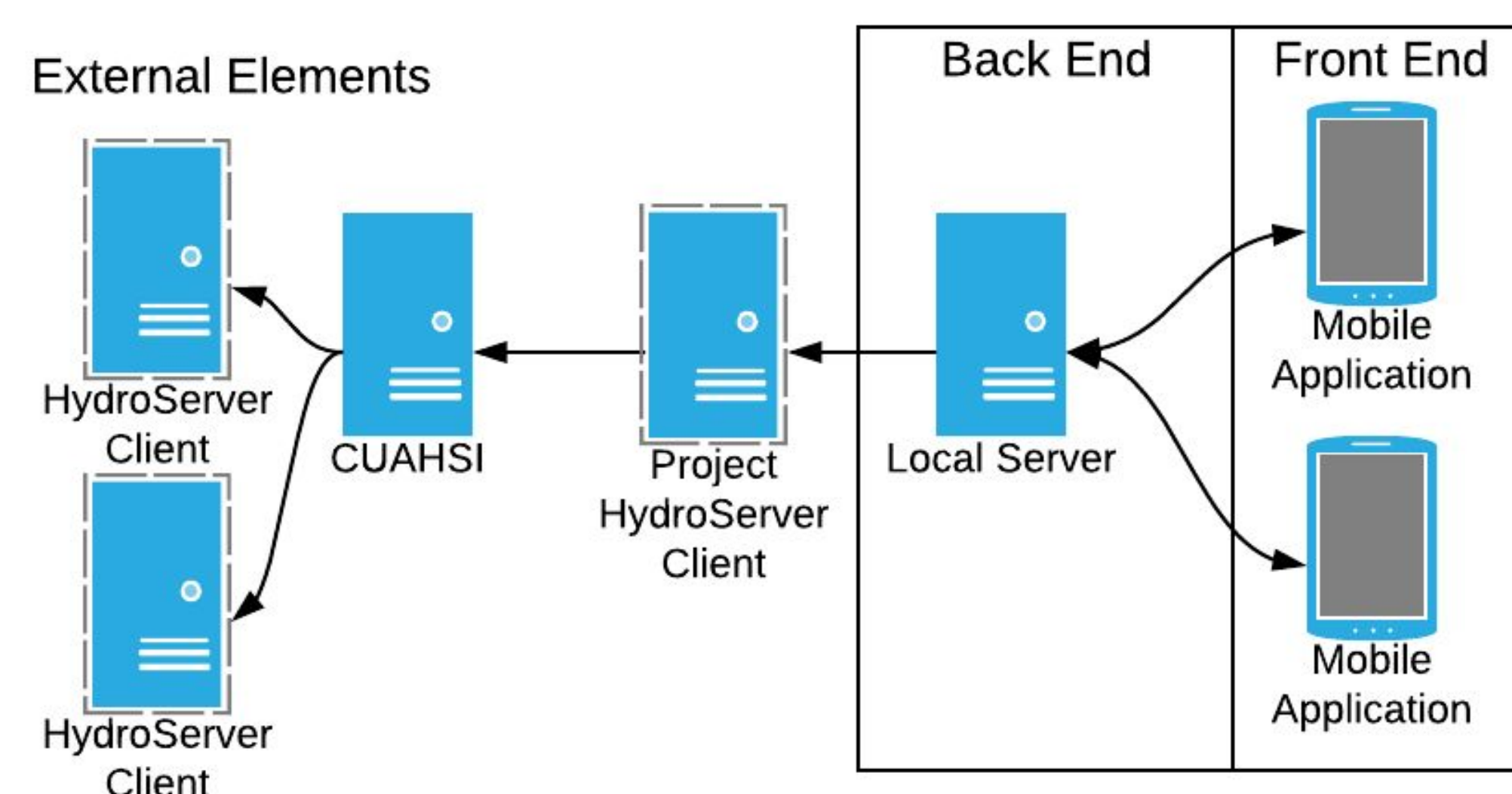


### Challenges Addressed

- OpenCV package running in Meteor JS
  - **Solution :** Modify application build settings.
- Meteor documentation being outdated
  - **Solution :** Looked at online forums and consulted experienced Meteor developers
- Sending offline and online notifications to a user
  - **Solution :** Send text message to users as a form of a notification

### Our Solution

1. Users install a gauge station as seen above.
2. Users open our application, HydroPlus, and take a picture of this gauging station to measure the pole.
3. Users submit this data to our local database where it is federated to the CUAHSI database.



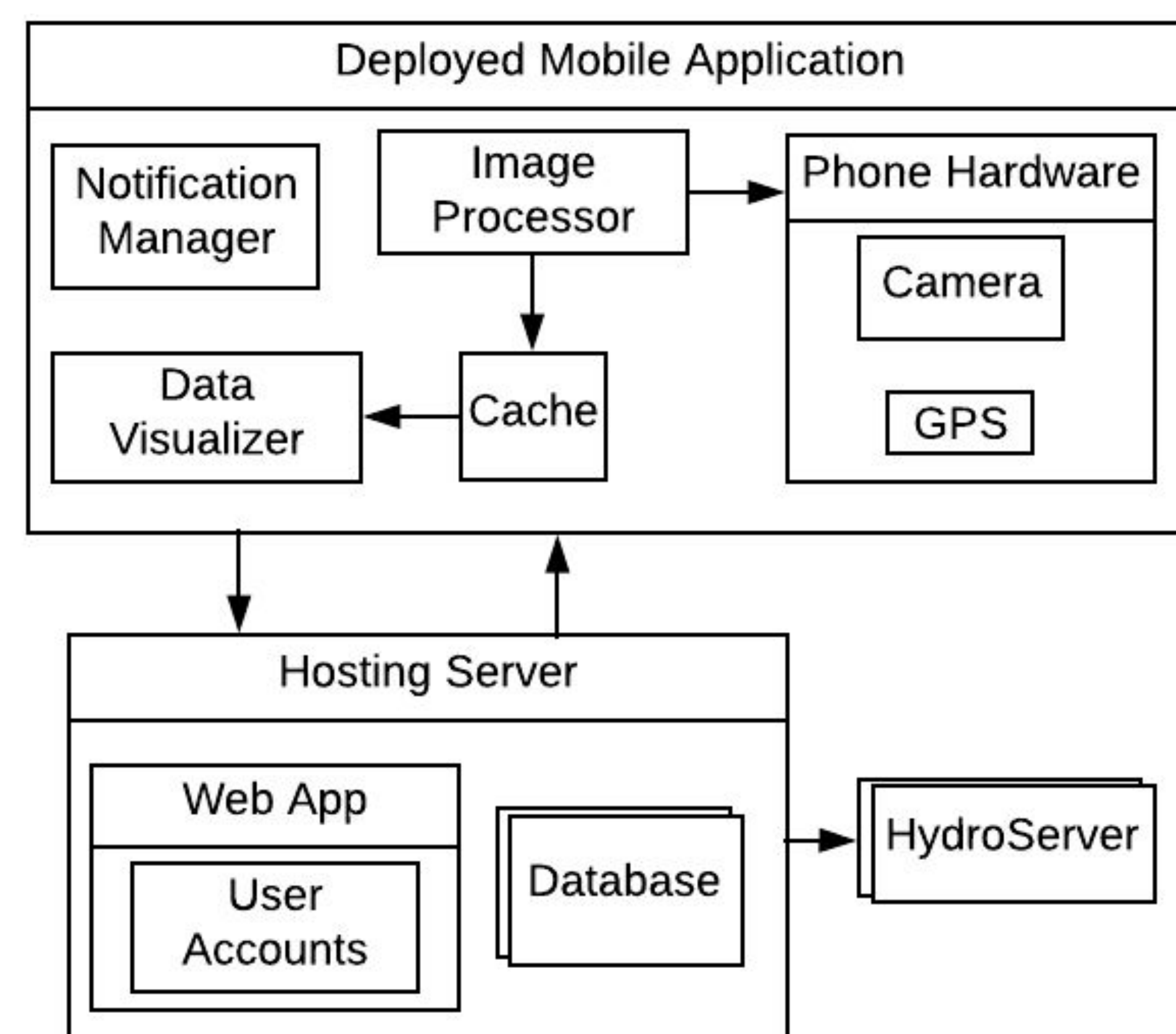
**Key Features:**

- Mobile
- Offline Visualizations
- Geolocation
- Image Processing on device
- Database Management
- User Accounts
- Notifications
- Visualizations

### Architecture

Our architecture is composed of three main components:

- Mobile Application
- Hosting Server
- HydroServer node



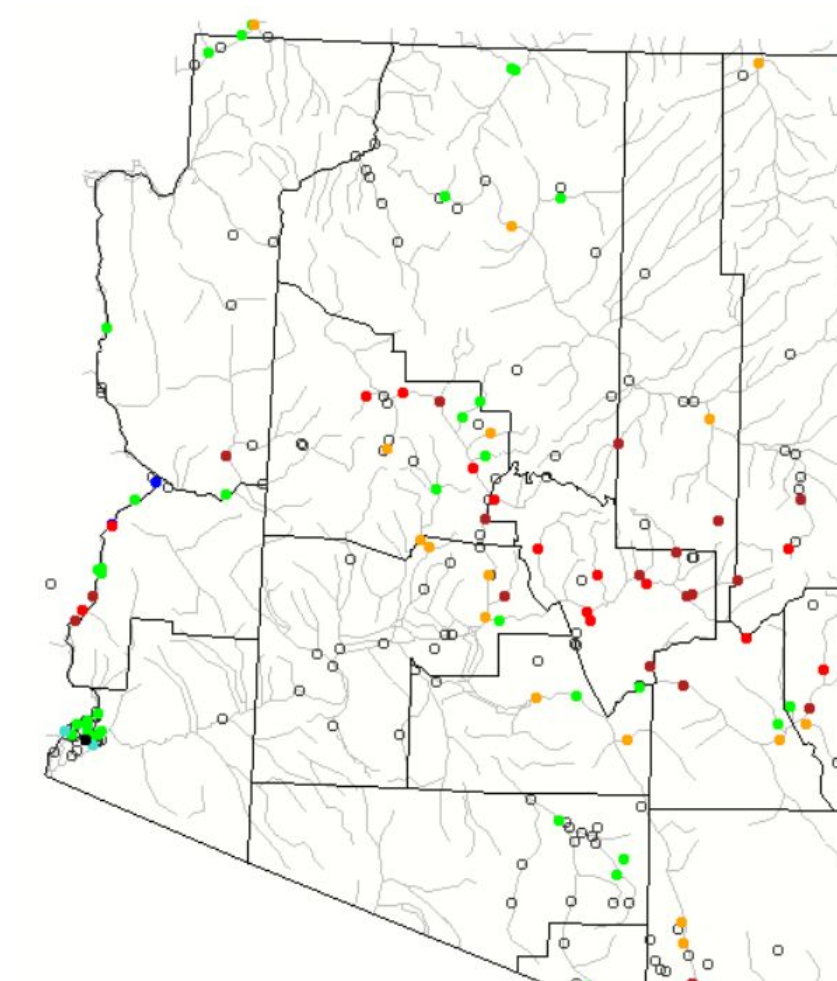
### Impact

**Collection with USGS**

- ~200 gauges covering 113,998 sq. miles in Arizona
- 1 gauge per 570 sq. miles

**Collection with HydroPlus**

- Add ~400 of our gauges, which will increase the total to ~600 gauges in Arizona
- 3 gauges per 570 sq. miles
- 300% increase in data collected



### Future Work

Our client intends to improve this project based on the groundwork done by the team. Some of the improvements the client will make include:

- Improved gamification to retain interest of users and bring in new users
- Provide more educational tools and resources on the application to increase interest
- Create an interactive way for users of the application to communicate with others who may contribute to the same gauges as them
- Use the images taken from users to explore other aspects besides water levels