# WATER LEADERS APPLICATION

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## Abstract

We take water for granted. In the United States, it's relatively cheap but there are parts of the world where it's very expensive and even parts where there isn't much water for such essentials as drinking or washing. The idea of our project was to create a prototype mobile awareness application for people to use. The app tracks daily water usage and shows consumers just how much water is used every day in comparison to something most people around Nebraska would recognize, e.g., how long the corresponding water usage would take to fill up the Nebraska Huskers Football stadium or an Olympic pool.

The user inputs the number of gallons of water they believed was used during a specific activity, such as shower, toilet flush, restroom sink, kitchen sink, dishwasher, laundry, sprinklers, outdoor watering, and miscellaneous. The user can check how much water they have used during a specific time period; day, week, month. Since it is compared to something that everyone knows, we hope it would show just how much water an average consumer uses.

## Introduction

Climate change is real whether we accept it or not. According to an article published on NASA's website [5], climate change is defined as "a change in Earth's climate. This could be a change in Earth's usual temperature. Or it could be a change in where rain and snow usually fall on Earth." Millions of people have debated over climate change over past few years. So, the population is divided into people who believe climate change is real and people who believe climate change is a hoax. The article from NASA states that "Earth's climate is always changing. People who study the Earth see that Earth's climate is getting warmer. Earth's temperature has gone up about one-degree Fahrenheit in the last 100 years. This may not seem like much. But small changes in Earth's temperature can have big effects." Most everyone has about global warming at some

point in their lives. Global warming relates to the rise in the temperature of Earth's surface. Global warming is a popular example when it comes to defining what climate change is.

Along with global warming comes an expected impact on precipitation patterns. For example, a research article [3] states that "in the southwest and central plains of Western North America, climate change is expected to increase drought severity in the coming decades. These regions nevertheless experienced extended Medieval-era droughts that were more persistent than any historical event, providing crucial targets in the paleoclimate record for bench-marking the severity of future drought risks."

And drought is not the only problem that we are facing, there is also depletion of aquifers. This depletion is tied to multiple pressures including lower precipitation which not only fails to replenish an aquifer, but also increased irrigation which draws on the aquifer to sustain crops in the face of lower precipitation. The thesaurus dictionary has defined aquifer as "any geological formation containing or conducting groundwater, especially one that supplies the water for wells, springs, etc." According to a research paper [8] published by Dr. Stephen R. Overmann of Southeast Missouri State University, the Ogallala Aquifer is the largest groundwater system in North America. The paper also states that, "The water of the Ogallala Aquifer has become the underpinning of the agriculture-based economy of the High Plains. This economic success has come at the expense of declining water levels in the aquifer. Nearly 200,000 wells are withdrawing water from this aquifer. Estimates are that withdrawal rates are 10 to 50 times greater than recharge rates. In some areas, the water table has dropped 100 to 200 feet as a result of over drafting of the aquifer. Earlier in the century it was assumed that the groundwater-riches of the aquifer were endless, but by the 1980s it became clear that the High Plains Aquifer was being rapidly depleted." So, we need to be aware of our water usage because if we use the water resource at this rate, then soon we will completely deplete the aquifer. Especially, farmers need to be aware of over consumption since, according to an article [2] by Jane Braxton, more than 90% of the water pumped from the aquifer is used to irrigate crops, and withdrawals equal 30% of the total groundwater used for irrigation in the U.S. The majority of the water pumped from the aquifer is used for agricultural purposes and the article also states that "more than $20 billion worth of food and fiber will vanish from the world's markets. And scientists say it will take natural processes 6,000 years to refill the reservoir."

So, we need to acknowledge the risks of drought and this declining natural resource and we need to act immediately. If not acted upon quickly, the chances of saving the water resources given the expected impending drought are slim to none. Today, there are many organizations working to conserve what's left of the natural resource and minimize the impacts of drought. But the number of organizations working to save our resources is still very low and the progress being made on saving the resources so far is still below the amount needed as the rate at which the Ogallala aquifer is depleting is still very high. Educating the public about this critical resource is vital.

In an attempt to help conserve water resources, the Nebraska Water Leaders Academy, in cooperation with the University of Nebraska at Kearney, recently joined forces on a project to create a mobile application that could help educate the public about the impacts of their water usage. Nebraska Water Leaders Academy, is an organization with the primary mission to provide

learning opportunities that focus on cooperative approaches to solving Nebraska's Water issues and according to their website, "The Nebraska Water Leaders Academy is supported through the Water Futures Partnership-Nebraska, a 501(c)(3) organization." [7]

## Water Leaders App

The idea behind the Nebraska Water Leaders Application is a mobile application that will raise awareness about the importance of conservation of water, statewide and nationwide. A small change can make a big difference, and this application is designed to be that change. It would be a small drop of water in the big ocean, but like we all know small drops of water make the mighty ocean. The way this application works, is it makes the user aware of how much water they are saving and how much they are wasting on a daily basis. This app also generates a daily, weekly, and monthly reports of how much water has the user spent for different activities and how much water could have been saved, so that the users get the general idea of the importance of saving water.

## Overview of the App

The Water Leaders App has initially targeted the Android platform as most of the customers at the Water Leaders Academy are Android users. The app is composed of a main menu which is also the default home screen of the app, so every time the app is opened, it will direct the user to the main menu layout. The main menu layout consists of 9 sub layouts that will then direct the user to different types water usage which are as follows: Shower, Bathroom flush, Toilet sink, Kitchen sink, Dishwasher, Laundry machine, Sprinklers, miscellaneous and Outdoor hose.

The way this app basically works is the user selects the desired category and then the app directs you to a second screen for that chosen category. After the second page layout has been loaded the user is given options to enter the amount of water used for that category by simply typing the numbers in or through the feature seek bark where the user simply slides the bar to input the desired amount of water used. The app also gives the users option to load predefined amount of water for specific activities such as Toilet flush, Shower, Dishwashing etc., and this is all through touch a button pre-defined in each layout. Some of these predefined values were provided by the Water Leaders Academy as they had already done some research about those activities and the others were found online via the researchers our development team. The app also features a Report page which the user can load by pressing the Report button. This page displays an overall information of how much water was consumed in each activity in table format where activity coincides with the amount of water consumed, it also adds them all together and displays the total amount of water consumption that day. The report layout feature two more buttons, and they are "Clear all data" and "Using this amount every day". So, the first button is practically a reset button that resets the local database stored inside the mobile phone. It clears out all the information of water consumption and sets every value to the starting point, i.e. zero. And, the second button is more of an awareness feature that we installed in the application. So, this button will take user to another page which has a picture of Olympic swimming pool and

Nebraska Cornhuskers football team. So, the idea behind this page was to calculate and display the number of days it would take to fill up these places based on the total amount of water consumed by the users. The essence of this page is to educate the users to save water where possible.

## Life Cycle of the Project

The project was divided into four different phases development phases. We first started with developing the layout or the user interface for the application. And, the second phase was developing the database, which would be the backend for the application for storing all the data input. Then, the third phase was making the connection from frontend to the backend. And, the final phase was the testing phase where we put the application through series of tests before the release of the application.

## First Phase

We started the first phase on a whiteboard as shown in figure one below and then went to develop the actual layouts through Eclipse Android plugin working in JAVA. We went through each different page that we knew was going to be in there and designed a layout to get started. We decided to go with 8 different forms of water usage and a miscellaneous button in case there is some form of water usage that we did not incorporate into the application. In addition to those 9 buttons for entry we added an additional button for a report in which it will show the total water usage for each type of water form and then puts it into a graph format to show you where you use most of your water. Below all that there is a button which will take you to a page which will show you your results compared to how long it would take you to fill up an Olympic swimming pool and the Huskers Football Stadium with the amount of water you use daily. We decided to show that and more, in which you can enter in the number of people within your community and it will show you how long it would take for your community to fill up the swimming pool and the stadium if everyone used the same amount of water as you.

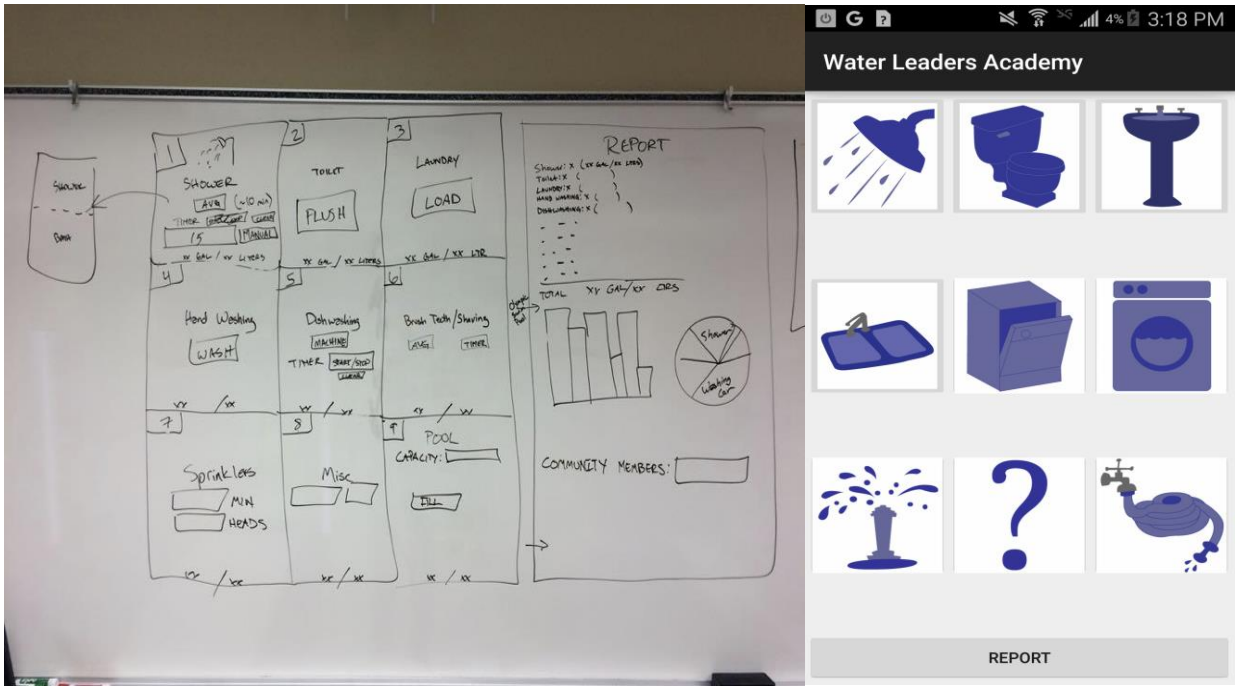



Figure 1: App brainstorming and flow definition (Left)
Figure 2: Display of initial screen (Right)

## Second Phase

Having created the layouts for the pages we started to then start work on the database, for which we used SQLite within Eclipse to save all the information for the application. We first started with importing all the necessary tools like database utilities, SQLite database helper, etc. The database was set up in a form which each water type would save information to a single location. Any database must do the most basic functions which are Create, Read, Update and Delete. So we had to devise a way to first start of by creating the first report with zeros(blank) to start off, then edit where when someone added information from the pages it would just update the report page and the number of gallons at the bottom of each page (e.g. shower). The readability was not too difficult as we would increment the numbers as the application was used. We decided to incorporate a delete button in the report page to delete all the information within the database, essentially restarting the application from scratch. Since the application would save data to the phone itself, when the application was closed and restarted at another time, the data that was previously input would not get deleted so someone could continue to increment the information as needed.

## Third Phase

The third phase was to finally connect the front-end layouts to the database which was tricky at first as this was the first time we were working with application development and SQLite within it. Having said that we figured it out be simply adding function within the database class, “open” and “close.” So, we would use “databaseConnector.open() to connect the pages to the database and then add the information when the button for adding on the pages would be clicked. For example, within the Dishwasher page, when the button for an average dishwasher was pushed it would update the database for 10 gallons or approximate 37.8 liters [7] and finally it closes the database. After the information is inputted into the database successfully an alert shows up which indicates to the user that the information was added to the database. Not all the types of water uses had an average button but for those that we wanted to have one, we found information about the averages online and used those gallon/liter amounts and tied them to the buttons. As shown below in figure 3, the average button shows a shower of 10 mins and at the bottom it shows the statistic stating how much water is actually used for a shower per minute also a slider bar if someone wanted to add a specific amount of time into there and the app will make the calculations necessary and input them into the database. Then in figure 4, since dishwashers usually have a set amount of time they run, we decided to have a single button to add an average amount of water usage to the database.

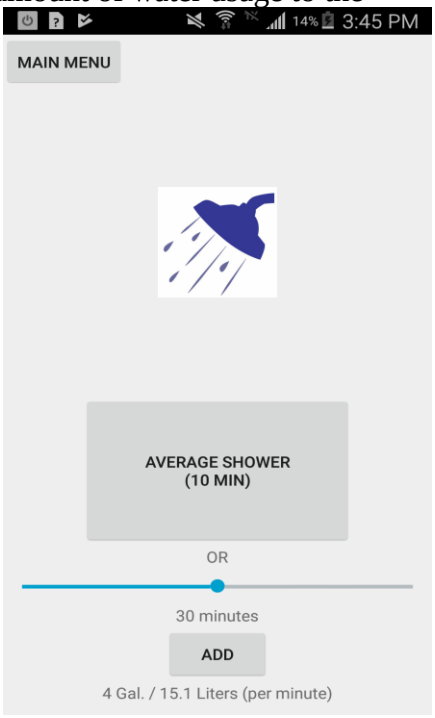



Figure 3: Shower Input Screen

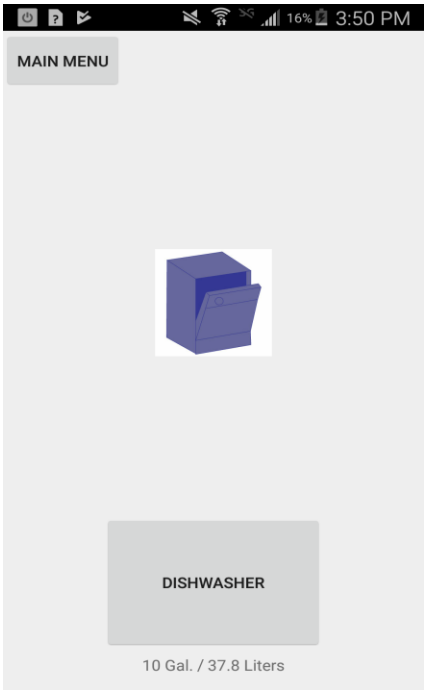
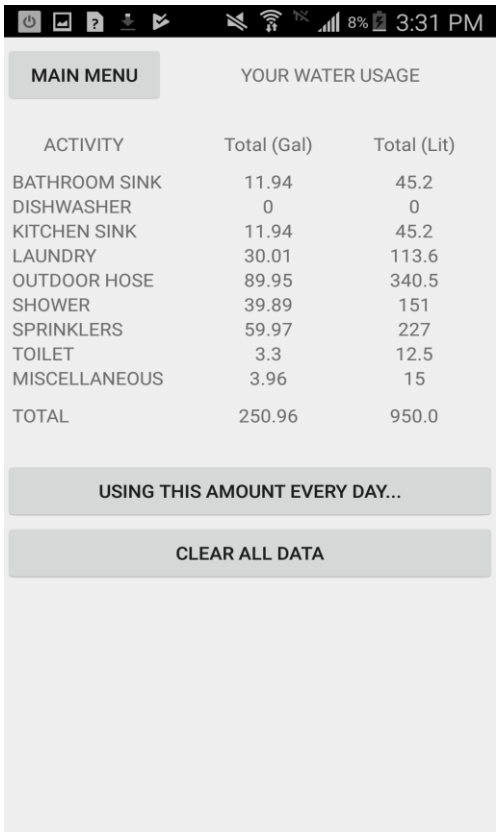



Figure 4: Dishwasher Screen

# Final Phase

The final phase was the testing phase in which we had each member of the team test the application. We all used it and decided to include newer functionalities into the app, of which include: slider bars for **(**shower, Sink, Sprinkler, etc.**)** and include blank input pane for the community size input. Tested all the edge cases for each type, like when we had the sliders to input the numbers from 0 mins to the max which is 60 mins. Then we had the app tested through some other students that we thought would include some constructive feedback for us to work on. Having said that, the app that we finished by the end of the semester is still a prototype and will be working on in the future. The figures 5 and 6 below show screenshots from the application Reports Screen and the Community Comparison Screen.



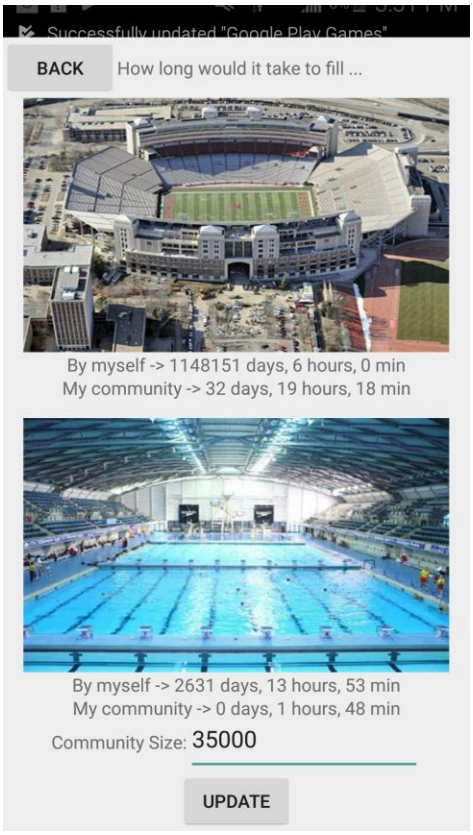




Figure 5: Report Screen (Left)
Figure 6: Community Comparison Screen (Right)

## Future work

Currently, the app runs on Android. In the near future, we will strive to publish our application to both Android and iOS. Xamarin or Ionic are potential options. With these different technologies, the application will be able to run not only on Android but in all the different mobile operating systems (Android, iOS and Windows Phone). There is also the possibility of integrating this solution to social networks APIs, to favor the login options and allow the user to share their water usage online. For instance, we would have options in the app for user to share their usage on Facebook, snapchat, and other popular social media platforms. Use of global database, upgrade from SQLite to something like, MONGODB, MYSQL in order to make things efficient.

## Conclusion

There are a number of apps in the market today, readily downloadable from app stores, created to track water usage throughout the day. Where these apps fail, we feel, is in the potential contribution they could make to a broader understanding of the impacts of community water use. Our app stands out in the approach it takes in attempting to impact the community by educating users on how individual water waste or savings scales to the level of an entire community. This is one example of how we as computer science students can use our skills to positively impact the world around us.

## Acknowledgments

We would like to thank Jacob Fritton from the Nebraska Water Leaders Academy for approaching us with this project opportunity, along with his cooperation and time in seeing the project to completion. We would also like to thank Ben Bomberger for his work throughout all stages of this project from brainstorming on the board, through design and development, to the final testing of the prototype.

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