Smart Home Water Monitoring System

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Abstract— The amount of water we have on Earth is limited and freshwater even more so. In this day and age, we use water very freely and forget about how scarce it really is. My smart water monitoring system aims to solve this and reduce water consumption in households. When users are informed about their water usage and can track their daily consumption in a convenient place, they do become aware and judicious about their usage. This is basic human behavior and my aim is to put this information into their palms - the smartphone.

Index Terms— Smart Home, Water Monitoring, Internet of Things, Remote Sensing, Mobile Application, Water Flow Sensor, Cloud Storage

1 Introduction

As the youth of this country we must give innovative and creative ideas to help people conserve water. My project enables consumers to not only monitor their consumption but also limit it. This brings about awareness to use water judicially. It is a cheap yet effective way to bring about a change in our habits. My project consists of a flow sensor and a NodeMCU with ESP8266 Wi-Fi module.

My technology solution is called Drop-Top consisting of a hardware sensor that will be installed on spot and a mobile app available for Android OS. The device can measure the amount of water being used on a daily basis and the current flow rate in a household. Its point of installation is at the main pipe that outlets from the overhead tanker. All the details about the usage can be viewed on the app that we will be providing. The users can also set a limit to their water usage on the mobile app, and on crossing that limit – the app will show an alert to the user.

I believe that the project can be taken forward and be made into a mainstream consumer product. First of all, the product can be made self-sustaining by adding a generator component that uses the flowing water to charge the batteries inside the device. We can also include a mobile data shield that will allow the device to work independent of Wi-Fi, and instead over mobile internet. We firmly believe that through my endeavour of putting data into the palms of the users, a lot of water can be saved in households all over India

2 Background

In 2009–2010 Sydney Water, the primary water utility in Sydney, conducted a comprehensive Smart Metering trial in residentiaxl homes in the suburb of Westleigh, in Sydney's north. The trial involved 1923 participants residing in 630 households. A entire of community strategy for engagement was applied to capture the perspectives on occupants from 12 to 70+ years of age. The trial examined the effects of the development on the water use of an intervention bundle compared with that of a matched control gathering. After clearing properties that had been sold since the beginning of the trial, properties in the examination bundle were matched with a control pack property on the basis of the family size, property size and the proximity (or something different) of a pool. The impacts of the innovation on utilization were measured and analysed for the period July 2009 to June 2010, combined with qualitative information that was gathered all through the duration of the examination. A key finding was that households with the in-home display (IHD) installed, reduced their consumption by an average of over 6.8% over the study period when compared to the control group.

This study clearly indicates to the underlying fact that we are trying to exploit. When users are informed about their water usage and can track their daily consumption in a convenient place, they do become aware and judicious about their usage. This is basic human behaviour and my aim is to put this information into the most commonly used device of this decade – the smartphone. When the users are able to see their water usage right in their palms throughout the day, they will realise how much water they actually consume and understand its true value. My project involves a small battery powered system to be connected between their tanks and main pipes; this device sends data to the cloud and travels through fully secure channels. The system is low cost and easy to install making it ideal for Indian households who consider IoT and automation as a luxury. Due to its exploitative nature and huge potential, many research papers somewhat related have been written.

In the Energy-Efficient, Noninvasive Water Flow Sensor paper (doi: 10.1109/ SMARTCOMP.2018.00084), they are interested in hot and cold water flow detection in domestic kitchen and bathroom taps for smart home environments. After reading the paper in depth, we have concluded that it is not a viable solution because the volume of water used cannot be accurately measured. It gives an estimated result which is useful for day to day savings. However, a proper analysis of this data cannot be done to restrict water usage. It is also not cost effective as the technology to accurately detect vibrations is more

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expensive than alternate options such as a mechanical rotor.

3 Approach

I have created the system in two parts – the hardware and the software. The hardware includes the hardware box containing the Node MCU chip and the water flow sensor which. Connects to the internet. The software part is the mobile application that pulls data from the cloud and displays the information in your palm.

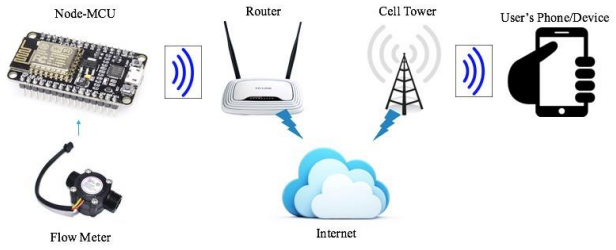

Figure 1: Schematic diagram of data flow in water. monitoring system

The app was developed using Swift 3 and Xcode (trademarks of Apple Inc.). The app runs on all iOS devices. For cloud storage we have used EmonCMS, a great choice for any data driver IoT based application. To collect data from the sever we have used the Alamofire framework to make the HTTP calls (Alamofire Software Foundation) and SwiftyJSON for managing the incoming data. The Node MCU was programmed using Arduino IDE.

3.1 About the components:

Node-MCU WiFi Development Board – It is a wifi SOC (system on a chip) produced by Espressif Systems. It is based ESP8266 -12E WiFi module. NodeMCU is the WiFi equivalent of ethernet module. It combines the features of
WiFi access point and station + microcontroller. These features make the NodeMCU extremely powerful tool for WiFi networking. It can be used as access point and/or station, host a web server or connect to internet to fetch or upload data.

Water flow sensor - The device used to measure the instant flow rate or quantity of a gas or liquid passing through a pipeline. We ae using a turbine flow sensor which is a flow meter which uses the mechanical energy to rotate the rotor in the direction of the flow and it measures the velocity of the liquid. Rotor shaft moves fast proportionally with the increasing water speed. The sensing system is available to measure the flow in both forward and backward direction.

3.2 Working of device

After the power is turned on, the system will detect the availability of a WiFi connection with the configuration previously entered into the program. While the process of connecting to WiFi, the LED Indicator light will turn on, if WiFi is successful then the LED Indicator light will turn off. The LED Indicator light will turn on if there is water passing through the sensor, followed by sending data to the cloud. Water passing through the sensor will move the rotor causing rotation. This sensor, every litre of water that is flowed per minute produces approximately 4.5 pulses, this number will be used as a calibration.

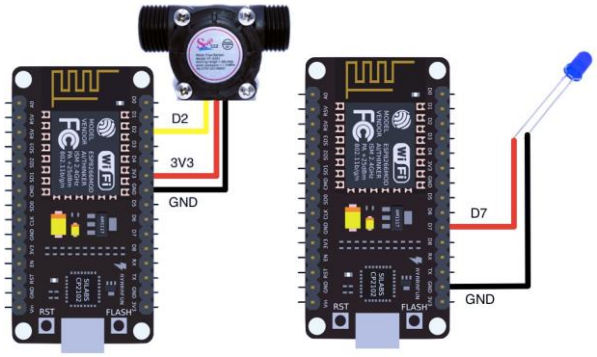

Figure 2: Connection of the LED and flow sensor to Node MCU

4 Results

The data is uploaded onto the cloud and displayed in real time on the mobile app. Through this system, the water consumption of any user would drastically go down as they have real time updates about their water usage along with notifications that are user-defined.

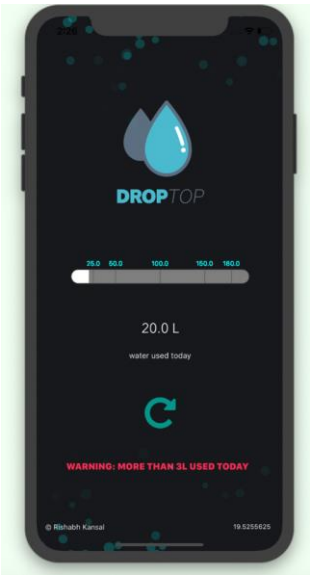

Figure 3: Screenshot of mobile application displaying water usage in real time

5 CONCLUSION

After the completion of this project we have successfully created an all in one solution to provide smart home water monitoring.

The system can be briefly explained as the following: My system uses a flow meter connected to a NodeMcu WiFi Development Board which send data to the internet through a router. The mobile then receives the data from the cloud and displays all the various information on the user's mobile device. The user can also visualize data with the help of graphs through the mobile app. The app will also allow the user to set a limit and notify once the limit has been crossed.

My project is highly cost effective, easy to manufacture and extremely easy to install. Using the Node MCU ESP8266 SoC we are able to push all data to the cloud which provides utmost security and speed. The app does not need to be on the same network as the sensor to disla the data which means the user can view the statistics even when he/she is not at home.

Some key advantages are as follows:

- Using very cheap IoT technologies (NodeMCU instead of Arduino), the final product is cost effective.
- Since there is no IHD (Integrated home display) installed, the cost can be drastically brought done all thanks to the mobile app.
- The product is an all-in-one solution with the device only needing basic plumbing to install.

My vision is to provide an all in one solution. Currently the power is retrieved from a longterm user rechargeable battery. But my goal is to make the system self-sustainable. We aim to do this by attaching a rechargeable battery to the product that charges through electricity generated by the flow of water. We can add a rotary generator along with the sensor that would spin with the flow of waste and charge the integrated rechargeable battery.

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