

# GAMIFYING WATER CONSERVATION

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## ABSTRACT

*This project proposed a social-centred gamification approach to improve household water use efficiency. Raising consumer awareness and stimulating behaviour change in the use of natural resources such as water has become an important research challenge. An Arduino and Node MCU based application is developed for water conservation which monitors and controls the water consumption by the user. The limit of daily usage of water consumption informed to the user through the application. The current water readings will be compared with set point reading to check if water consumed was less or more. If more, the user will be shown ways to better water consumption right on the application. This system will have a game like implementation, thus gamifying experience. Best consumptions will be encouraged through positive reinforcement. According to Psychology, Honor makes a man more encouraging to do any work. This is done by awarding positive reinforcement in our application. This application runs on two modes, Online mode and Offline mode. In Online mode, the application monitors and controls the flow rate, collects rewards and maintains history. In Offline mode, GSM is used to send indication regarding the flow rate value and alerts the user to control the valve. It also includes an additional feature 'Jal Jest', an online shopping experience which can be accessed through the gained reward points for better water usage. Recently, a special interest has been given by the government to the gamification design on systems addressing natural resource consumption issues such as to encourage efficient household water consumption. This application helps to motivate people and encourage them to conserve water efficiently.*

**Keyword :** - gamification , jal jest, K, and smart water conservation etc....

## 1. MOTIVATION OF THE PROJECT

1 As water crises become severe, the desire to explore alternative strategies that focus on the demand-side of water-conservation increase. Changing behaviour through persuasion (message framing) can be an integral part of providing water demand solutions. In this study, we examined the effectiveness of messages related to household water use on water scarcity and intentions to act. We tested whether relationships between communication and water conservation were mediated via increasing capability, opportunity, and motivation behaviour. The awareness and educational aspects of water conservation to our future leads to the intention through 'gamification'. Thus, the motivation of this project is to develop a water conservation system in households via gamifying application.

### 1.1 Jal Shakthi Abhiyan

The Jal Shakthi Abhiyan is a central government scheme introduced for initialization of water conservation.

**Phase I:** 1<sup>st</sup> July to 15<sup>th</sup> September 2019 (all states)

**Phase II:** 1<sup>st</sup> October to 30<sup>th</sup> November 2019 (States with retreating with retreating monsoon)

The Jal Shakti Abhiyan (JSA) is a time-bound, mission-mode water conservation campaign. The JSA will run in two Phases: Phase 1 from 1<sup>st</sup> July to 15<sup>th</sup> September 2019 for all states and Union Territories; and Phase 2 from 1<sup>st</sup> October to 30<sup>th</sup> November 2019 for States and UTs receiving the retreating monsoon (Andhra Pradesh, Karnataka, Puduchery and Tamil Nadu).

The 'Jal Shakti Abhiyan' focuses on five aspects -- water conservation and rainwater harvesting, renovation of traditional and other water bodies, reuse of water and recharging of structures, watershed development, and intensive afforestation. Government launches this scheme to save water. It aims to provide piped water to every household within the next five years.

### 1.2 National Water Mission

The "National Water Mission" identifies the strategies for achieving the goals of

- (a) Comprehensive water data base in public domain and assessment of the impact of climate change on water resource
- (b) Promotion of citizen and state actions for water conservation, augmentation and preservation
- (c) Focused attention to vulnerable areas including over-exploited areas
- (d) Increasing water use efficiency by 20%
- (e) Promotion of basic level integrated water resources management.

## 2. PROPOSED SYSTEM

Our System proposes an idea of innovation in water conservation for the user who is provided with a live data of water usage and yielding rewards. It is a smart method to conserve water effectively by monitoring and controlling the flow of water through mobile application. It can record and store the water flow readings in cloud for further observation. Moreover, offline messages can also be sent to make more compatible for user in poor connection. Also the habit of conserving water can be improved by motivating the user by rewarding them for better water usage.

A real time application does not solely depend on the hardware, it also requires some help from the software. For running of the hardware in the way we want, there should be some software used. The hardware used in this project is Arduino UNO, where here it uses Arduino IDE platform. As we saw above, this chapter also contains the software that is required for this project. Software is an important part in implementing a project in the real time application.

The Arduino board which is connected in the system is used to monitor and control the flow rate of the water. The flow sensor provides necessary information regarding the flow rate to the arduino for further processing. The flow rate is controlled by controlling the speed of the flow by varying the speed of the motor. In addition to this, a relay circuitry is used to vary the speed of the motor in order to control the flow rate. A node MCU board is used to connect the system with cloud server and application.

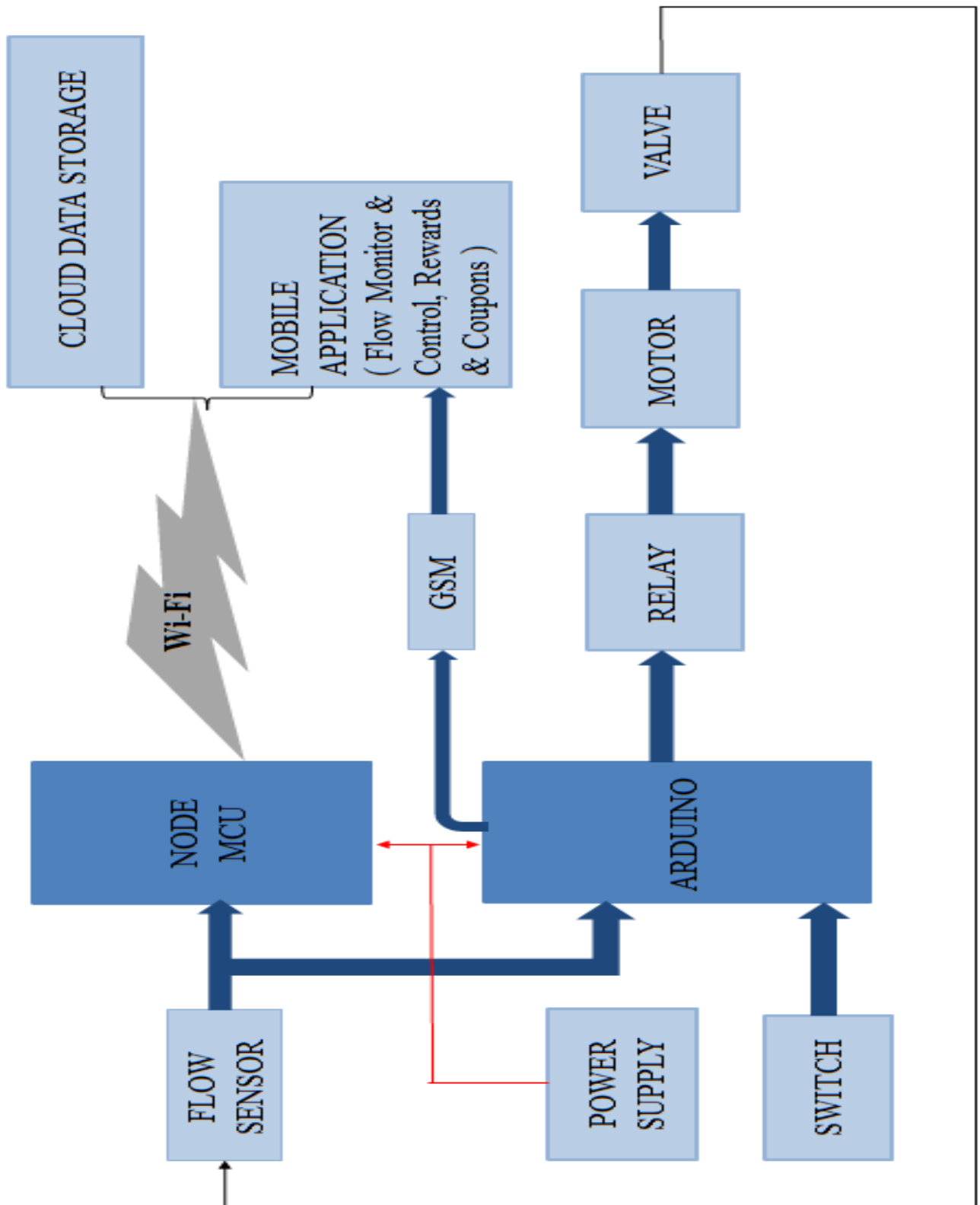


Fig-1 Block diagram –proposed system

It is an Arduino and a Node-MCU based Wi-Fi application which notes down the water flow (water that came out of the tank) and sends it to the application. The readings are recorded and saved in a cloud for knowing better user consumption. This setup works in two modes:

1. Online Mode

2. Offline Mode



**Fig -2**Gamification water conservation via mobile application

### 2.1 Merits of installing the proposed system

The proposed system deals with the cloud computing and mobile application. It also includes an additional feature of online shopping experience called a 'Jal Jest Bazaar' which can be accessed through the gained rewards by conserving daily water usage. Thus providing a gaming and fun experience to the user in a constructive way. The following are the merits gained by installing the proposed system.

- **Water Conservation**

Smart water meters enable us to conserve water. Smart water meters monitor water usage. Standard water meters only record your water consumption throughout before the meter reader from your utility company arrives at the end of the month to check the amount consumed and issue you with the bill. Smart water meters enable the water utility company to monitor water usage in your home throughout remotely. The utility company can notice spikes in your water consumption and issue you with a warning. This helps curb water wastage. The spike can be caused by a water leak. This means that you will be able to call a professional Cincinnati plumber in time and have the leak fixed immediately. This will help conserve water in your household.

- **Save Money**

Cincinnati leak detection by helping conserve water at home, a smart water meter will save you a lot of money. If you install a smart water meter, you will not incur heavy monthly water bills. The smart water meter will help you curb water wastage at home. The utility company will alert you in case there is heavy water usage at home. For instance if you are away from home and there is a heavy pipe leak, the utility company will notice this anomaly remotely and call you. You will instantly head back home and call a plumber to fix the leak. This will help you save lots of money in your monthly water bill.

- **Prevent Water Meter Reading Scams**

Many people have had their homes burglarized by fake water and electric meter readers. This is hard to believe if it has never happened to you, but it's true. There have been many reports of people pretending to be agents of utility companies knocking on doors and stealing cash and jewelry when the homeowner is not looking. You can avoid all these problems by installing a smart water meter. The utility company will not need to send people to your house to read the meter if it's the smart type. They will just bill you electronically.

- **Accurate Readings**

Smart water meters offer more accurate readings than the standard water meters. This means that if you install a smart water meter, you will only be billed for the exact amount of water that you use every month. This is both economical and reliable.

- **Creative rate design**

Traditional volumetric water rates are being replaced by creative water tariffs in response to policy directives and water conservation efforts. Water budgets specify water consumption volumes based upon individual customer characteristics like lot size, number of bathrooms or bedrooms, and landscaping. Smart meter water data is critical to the success of water budget implementation. It provides customers with detailed information on how much water they are using and when they are using it, and alerts them when they are in danger of exceeding a specific water tier limit and going into a higher-priced bracket.

- **Identification of customer inefficiencies**

Water technologies have identifiable water use patterns. For example, toilets are a quick couple gallons of water usage, whereas dishwashers and clothes washers spread water usage over a much longer timeframe. By knowing the timing and volume of customer water usage, a utility can analyse the various water end uses and, theoretically, identify customer-specific inefficiencies like high-water-use toilets. This application has obvious customer privacy issues but can provide a very useful tool for assisting customers in identifying where they are using water and ways to reduce that water usage.

- **Timely notification of water conservation efforts**

It is very difficult to get timely customer response to conservation programs using traditional monthly or bimonthly water billing. What these traditional bills tell customers is how much water they used more than a month

ago. They do not allow a customer to track water usage and adjust water consumption to meet pre-specified conservation efforts, as smart meter data does.

### Smart electricity meter installations (2011-2016) percent of sector total

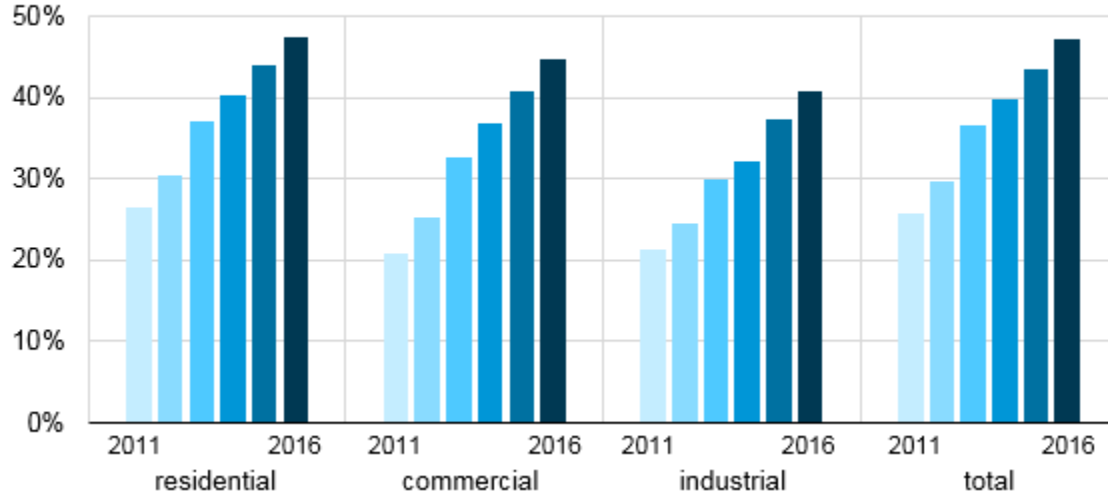


Table -1 Barchart for watermeter reading

## 2.2 Online Mode

When the application can access a sufficient Wi-Fi connection the online mode of operation begins. Also, the user can switch over the modes manually. The following are the tasks performed when the water flows through the pipe.

- **Flow monitoring**

Once the water starts to flow in a pipe, the flow sensor YF201 readily monitors the flow of water and its flow rate in L/hr. The recorded analog data is transmitted by pulse width modulation to the mobile application and to the cloud.

- **Control Action**

The user can observe and control the flow rate and also the valve control can be done. They can switch the valve ON / OFF when the water overflows. The water utilization is monitored and controlled by comparing the readings with the fixed threshold. Thus the valve status is identified through the mobile application.

- **Recognition & Rewards**

The flow from different sensors is noted which gives the water activity of the user. The consumed flow reading is compared with the threshold. If the consumed value exceeds the threshold value, better ways to consume less and ways to conserve water is insisted to the user. Else if the consumed value is lesser then the threshold, the user is rewarded with points from which the user can buy products online in bazaar which is an inbuilt feature in the application.

- **Threshold configuration**

When the user consumes very much less amount of water than the threshold, the threshold fixed by the authority is automatically configured to his minimum water reading for that activity. But if he fails to maintain the new threshold, it is replaced with the older one.



### 3. PROJECT DESCRIPTION

The hardware and software units employed in the system. The Arduino board which is connected in the system is used to monitor and control the flow rate of the water. The flow sensor provides necessary information regarding the flow rate to the Arduino for further processing. The flow rate is controlled by controlling the speed of the flow by varying the speed of the motor.

In addition to this, a relay circuitry is used to vary the speed of the motor in order to control the flow rate. A node MCU board is used to connect the system with cloud server and mobile application.

A set point is fixed for the flow of water. Depending upon the set point the reward points are given to the user. If the current reading exceeds the set point, corrective measures or better ways for water conservation is displayed on the application. If it is less, reward points are given to the user. It is fixed in such a way that inefficient water usage reduces the coin collection and vice versa.



#### 3.1 Software description

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen. Using the widgets, you can turn pins on and off or display data from sensors.

Whatever your project is, there are likely hundreds of tutorials that make the hardware part pretty easy, but building the software interface is still difficult. With Blynk, though, the software side is even easier than the hardware. Blynk is perfect for interfacing with simple projects like monitoring the temperature of your fishtank or turning lights on and off remotely. Personally, I'm using it to control RGB LED strips in my living room.

Currently, Blynk supports most Arduino boards, Raspberry Pi models, the ESP8266, Particle Core, and a handful of other common microcontrollers and single-board computers, and more are being added over time. Arduino Wi-Fi and Ethernet shields are supported, though you can also control devices plugged into a computer's USB port as well.



**Fig -2** Pictorial representation of the usage

#### 4. CONCLUSIONS

In a world affected by constant growth and population in the urban areas, the problem of preserving our natural resources such as water has become an important priority. A promising approach to resource conservation is demand management i.e., the ability of positively influence the behavior of the population towards the sustainable consumption. Information and communication technology(ICT) tools have shown a great potential in influencing consumers' behavior, which would be exploited for the common good. However, the design so called persuasive



systems for environmental purpose is a challenging task, because It cannot be based solely on the utilitarian of motivation of the users, but must be able to trigger a broader range of engaging factors deeply rooted in human psychology. In this paper, we review on design principles and models at the base of a class of persuasive systems exploits gamification and game with a purpose (GWAPs) to engage towards sustainability; we identify the most commonly used incentive mechanism towards sustainability; and present a selection gamified systems for water conservation. From such a survey, we distill design guidelines to be applied in the design of demand management socio-technical systems.

Individual consumption of natural resources, such as gas, electricity, and water, has a significant environmental impact. Following progress in information and communication technology (ICT) and large scale smart metering roll out programmes, several initiatives in research and industry have recently pioneered demand-side management through ICT –based behavioural change approaches, to help people awareness on their consumption patterns and motivate them to reduce their level of consumption and/or shift it to off-peak periods. For instance, a recent review on ICT-based water saving initiatives in households showed they have a potential to reduce household final water consumption by 0-5%. usually these initiatives provide an eco feedback through the initiative visualization of consumption data, collected by smart metering infrastructures, and deploy behavioural change stimuli, aimed at inducing resources saving by consumers. For this purpose, gamification principle, mechanics and elements are frequently exploited in attractive interfaces that favour the consumers' engagement, provide them with guidance for improving their resource-saving behavior and reward their progress towards change.

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