Smart Water flow Oriented Recording Device [S.W.O.R.D]

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ABSTRACT
In modern era, the basic elements of life such as water should be given much more importance than the past, as the population is severely increasing and each individual must be provided with these basic elements in order to lead a life. In such a scenario, the conservation of water should be given greater importance. But even the most educated individuals also do not prefer to save the water in their busy scheduled day to day life. Thus it becomes necessary to force them to conserve water by providing limited amount of water. This Smart Water flow Oriented Recording Device (S.W.O.R.D) uses one such approach of forcing the consumer to limit their water wastage which provides clear path for conservation of water.

Keywords
Water-flow oriented recording, Microcontroller, Conservation of water, Smart Water-flow oriented recording device (S.W.O.R.D)

1. INTRODUCTION
Water conservation is a big thing, but every little bit helps, a whole lot of people doing a little bit add up to a whole lot. Everyone must make changes in their lifestyle, so that will bring changes in the conservation of water and its quality. Water conservation needs to be a way of life, not just something that is thought about once in a while. If everyone do their part in conserving water, that makes a huge difference for the environment. Water conservation is not a job that is just for the technician, soil scientist, hydrologist, forester, wildlife manager, plant scientist, city planner, park manager, farmer, rancher, or mine owner alone. It is a duty of every person who likes to have an access to the life sustaining resource of water. But how can water conservation be incorporated to everyone's life. The most popular way of incorporating the concept of conservation of water is through creating awareness about the importance of water in the minds of the people. But it is very well known that even the most educated ones also do not prefer to conserve it in their busy day of life. When all the indirect ways are failed, then it becomes necessary to follow with direct way, which emphasizes on forcing the people to conserve.With advancement in the field of technology, the life style of people has changed such that it results in scarcity of resources available for the further use. But this paper attempts to prove that the same advancement in technology can be used for better utilization of available resources.

2. METHODOLOGY
In this paper, the smart way of conservation of water by using advancement of technology is being discussed. In the Internet of Things (IoT) age, connecting web data to our daily lives is the name of the game. By utilizing web data, smarter systems can be created, especially when it comes to water conservation [1]. Here this device has to be employed at the premises of consumer which receives data such as, an amount of water available in main water reservoir (tank) thus analyzing the condition of water level and then decides the maximum amount of water to be let-out into the consumer premises.

The main objective of this method is to enforce the individuals of cities to conserve water by proper water management. In this scheme, those who waste water are liable for penalties whereas those who avoid wastage liable for rewards. In order to determine the wastage of water, the consumer is been provided with three lines of water supply instead of one line for different purposes such as drinking line, general line, miscellaneous line. The three different lines are programmed with different characteristics like drinking line provides small amount of water daily with no price whereas general line with medium amount of water with small price, but miscellaneous line will provide unlimited amount of water with higher price. Thus a person who wastes water in above two categories is liable for higher price. The price and limit of each category is directly dependent on the data obtained from the web (via GSM module). Thus the scheme is named as "Smart Water flow Oriented Recording Device (S.W.O.R.D)"

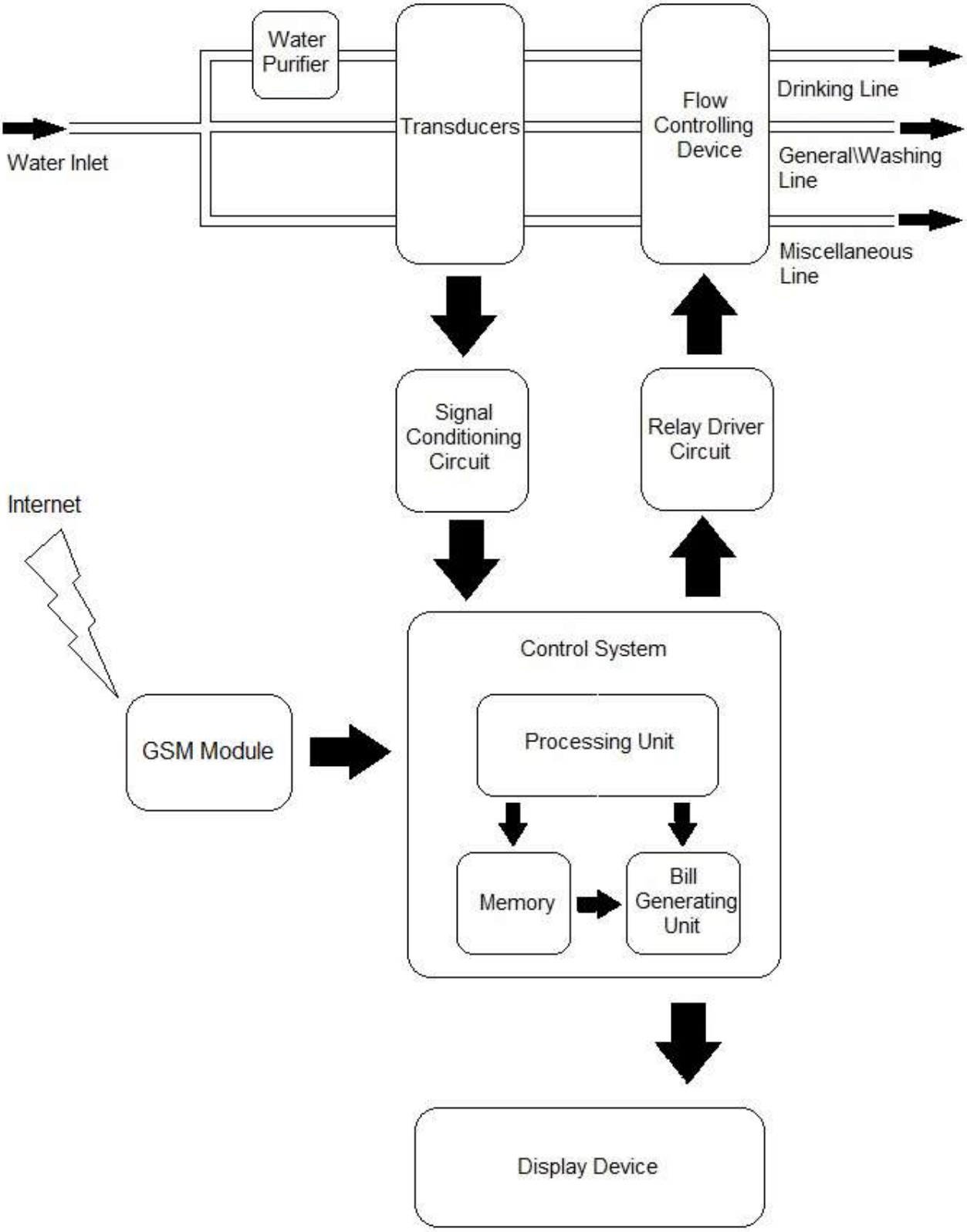

Figure 1 Shows the Block diagram of this Scheme

3. FUNCTIONAL BLOCK OF 'S.W.O.R.D'

The block diagram of this scheme is as shown in figure 1. The description of functional blocks of this scheme is given below:

3.1.Transducer

The transducer used in this project is flow sensor which gives signal to microcontroller whenever there is a flow of water in the pipes [2].

3.2.Signal conditioning circuit

Since the signal from transducer is incompatible to microcontroller directly thus there is a need for a signal conditioning circuit which conditions the input signal.

3.3.Control system

The control system is the main heart of this scheme which controls water flow to a house by recording amount of water consumed. The control unit has 3 main functional units such as

3.3.1. *Processing unit*: Controls the output by taking input.

3.3.2. *Memory unit* Records all the readings of water consumed.

3.3.3. *Bill generation unit* Generates bill in specified format.

The microcontroller to be used is AT89S52 [3] which is 40-Pin 24MHz 8kb 8-bit Microcontroller. It is programmed for the following algorithm:

1. Initialize the maximum time duration for water flow for 2 pipe line i.e. drinking line and general line.
2. The condition for each solenoid operation is determined by signal from flow sensor and time limit in above step.
3. The memory of microcontroller is reset for every 24 hrs.
4. For billing purpose, the data is to be transferred to a computer by serial communication whenever a particular pin in microcontroller is high.

3.4.Display Unit

The two display units used in this scheme are

a. LCD screen: for displaying real time data.
b. Computer: for printing generated bill.

3.5.Flow Controlling unit

As the main purpose of this scheme is to control the water flow which is achieved by using a solenoid valve which forms the flow controlling unit. This unit is controlled by control system.

3.6.Relay driver circuit

The control system cannot control the solenoid valve directly; hence there is a need for relay driver circuit.

3.7.GSM Module

The data from the web is received to the control system through a GSM module which works similar to that of mobile technology.

4. HARDWARE AND SOFTWARE REQUIREMENT

The hardware components used in the construction of this device decides the proper operation of the Scheme. Thus selection and design of each components of the device has to consider the cost of each component also, as it directly influences the overall cost of the scheme. From the selection of flow sensor to major parts such as solenoid valve and the microcontroller are very important in the design procedure. Since the scheme is based on programming the microcontroller, several software tools are being used throughout the design of this scheme starting from programming and simulation of the program to generation of bill. The table 2 shows the software used along with its purpose. The coordination of both hardware and software is very much necessary in actual operation of the device and in order to meet the objectives of the Scheme.

The table 1 shows the hardware components required for the device along with its purpose.

Sl.no	Hardware Parts	Purpose
1	Power source	The power supply of 12Vdc and 5Vdc is required to power up the components
2	Microcontroller	programmed as a main control system
3	Water Solenoid valve	Controls the water flow to consumer premises
4	Flow Sensor	Records the amount of water flowed
5	LCD	Display Real time data recorded
6	GSM Module	To receive data from web to microcontroller

The table 2 shows the software used along with its purpose.

Sl.no	Software tool	Description
1	Keil µVision 4	Programming the microcontroller and simulating the program.
2	Willar programming software	Burning the program to microcontroller
3	HyperTerminal private Edition or PuTTY software	Displaying the bill generated by microcontroller that is sent through serial communication

5. BILLING SYSTEM

As per the recent survey in 2011, it is reported that the average urban water usage (liter/capita/day) is 126 liters [4], in that around 20 liters of water is mainly required for water consumption purpose which include drinking and cooking. The linear pricing system is been currently in use. According to the same ADB study the average tariff for all customers – including industrial, commercial and public customers – is ₹38 (58¢ US) per cubic meter [5].

In this work we have adopted purpose based pricing system, where each purpose is charged differently depending upon the necessity of that purpose. The details of price and amount of water allowed for each purpose is shown below in table 3.
Table 3 shows the details of price and amount of water allowed for each purpose

Purpose	Average amount of water[maximum limit] per person daily	Price per liter of water used
Drinking	26 liters	free
General	100 liters	3.8 Paisa
Miscellaneous	unlimited	7.5 Paisa

6. EXPERIMENTAL RESULTS

The results obtained from experiment on the proposed model is tabulated in the form of graph as shown in figure 2, which shows the variation of maximum limit for each purpose of usage depending on the total amount of water left in the tank (via data received through GSM module) represented in percentage. The total cost of water per day per person depending on the amount of water used is shown in figure 3. The results obtained are as per the value obtained from table 3. From figure 3, it is seen that price of water does not follow linear variation. Thus the person who wastes water has to pay higher charges.

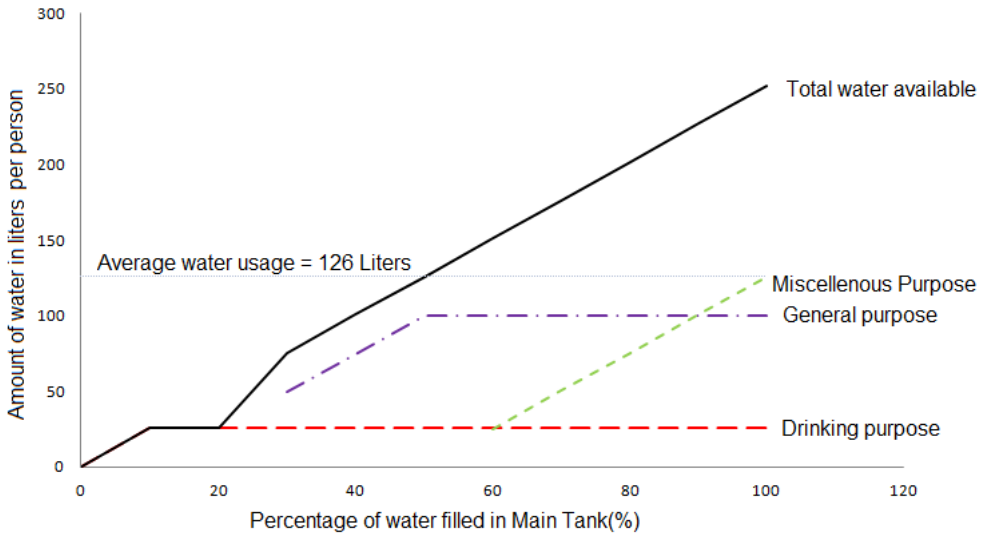

Figure 2 Amount of water Available per person v/s Percentage of water in Tank

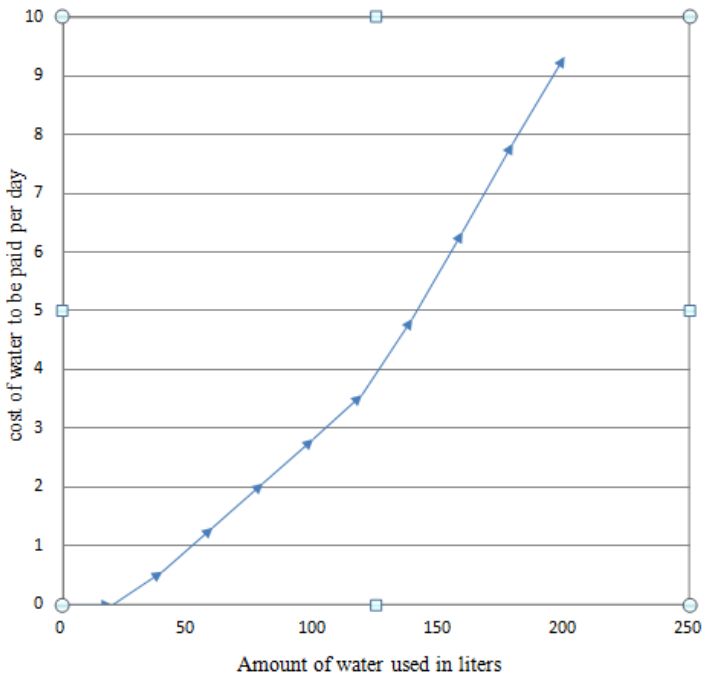

Figure 3 shows cost of water used v/s amount of water used

7. BENEFITS OF 'S.W.O.R.D'

7.1. The conservation of water is directly forced into each individual's day to day life.

7.2. The users need to pay for what they use where pricing system takes into consideration the purpose for which the water is used.

7.3. Since control system comprises of microcontroller, the cost of the system is pretty low.

7.4. The price system used in this project provides both rewards as well as penalties for consumers depending on their water management.

7.5. This system is compatible with the existing one, as this device can be directly installed into the existing pipelines.

7.6. Since bill generated contains data of all 30 days of a month, thus the variation of data can be used in optimizing water usage. By examining all the data available at the end of month, the load forecasting can be done based on the data obtained from the Microcontroller, thus helps in the proper management of the water resource.

8. CONCLUSION

We can conclude from the testing process that device can effectively set a maximum limit for the usage of water for various purposes, which depends on the data obtained from the web, thus enforcing conservation of water in every individual's life. As the price per unit of water also depends on availability of water, a fair pricing system is implemented which eliminates the problem of "paying same at all situations".This work proves that the same advancement in technology can be used for better utilization of available resources. The control system developed not only helps in conservation of water source but also for the smooth and smart operation of billing process.

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10. REFERENCE:

[1] Smart Sprinkler: Water Saving Irrigation Controller for Residential Use by Andrew Palmer (ajp294@cornell.edu)

[2] "Use of Water Consumption Metering as a Tariff Policy Tool: Moldova's Experience by S. Drozdov

[3] Datasheet of Microcontroller AT89S52 available in Alldatasheets.com

[4] https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_India#Tariffs.2C_cost_recovery_and_subsidies

[5] Asian Development Bank:2007 Benchmarking and Data Book of Water Utilities in India, 2007, p. 3