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Home Water Saving System Using Flowmeter With Application and Water Leak Detector

NAME : Reem Khalifa Al Busaidi

Project name: Home Water Saving System Using Flowmeter with Application and Water Leak Detector.

Project Supervisor: Dr. Sulaiman Al Hasani

Studying in :GLOBAL COLLOGE OF ENGNEERNG AND THECNOLOGE /Oman

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ABTSRUCT:

Arduino collects and receives data that can be connected to an interactive application that shows the values in real-time along with the standard values of a component that a crop requires. This paper proposes and demonstrates that a controlled flow water system centred in Arduino is economical and simple to use.

A kind of smart water meter design scheme was introduced in this project based on the study of the current water meters. The modern reading method for manual meters was not only a waste of human and material resources but also a very uncomfortable method. The automatic reading system for cable meters was very fragile and requires a heavy workload for building wiring. This traditional way of managing water was obviously inefficient, especially in recent years with the advent of several high-rise residential buildings.

Many of the existing methods of acoustic leak detection are based on external measurements of sound produced from the turbulent water flow of the pipes. Acoustic leak detection methods are proven to be effective and have been commonly used in water supply systems for many decades. Clear acoustic checks, a pipe has recently been discussed inside the flow as an important complementary technique for detecting leaks.

After considering situational variables, the findings substantiate the importance of personal involvement and habit formation in explaining water usage, offering further guidance in environmental psychology to adjust and enhance repetitive behaviour models.

KEY-WORD:

S.NO	Abbreviation	Full Name
1	Mag meter	Magnetic flow meter
2	PCB board	Printed Circuit Board
3	MFM	Magnetic flow meter
4	PWM Arduino	Pulse with Modulation
5	GPM	Gallons Per Minute
6	Kg/h	Kilograms per hour
7	UNEP	United Nations Environment Programme

Mag meter : A magnetic field is produced in a magnetic flowmeter and channelled into the fluid that flows through the pipe. According to Faraday's Law, the flow of a conductive liquid through the magnetic field will cause the electrodes located on the walls of the flow tube to sense a voltage signal.

PCB board : is a thin board consisting of fibreglass, carbon epoxy, or other laminate. Conductive pathways are engraved or "printed" onto the plate, connecting various components such as transistors, resistors, and integrated circuits on the PCB.

PWM Arduino: is a method that uses optical means to get analogue results. A square wave, a signal switched between on and off, is generated by digital control. This on-off pattern will approximate voltages between full-on (5 Volts) and off (0 Volts) by adjusting the amount of time the signal spends on relative to the amount of time the signal spends off.

GPM: is the flow rate of any source, water that can be drained through a pump or through pipes from an overhead tank.

Kg/h : Derived from g/0.5 L integrating the Canadian Grain Commission, regression equations were developed to predict the estimated kg / hL as the standard Shopper Chronometer methodology should have defined.

UNEP is an international organization established in 1972 to catalyse and organize activities aimed at increasing scientific awareness of environmental change and improving methods for environmental management.

INTRODUCTION

Home Water Saving System Using Flowmeter with Application and Water Leak Detector is consisting of three sections in one project linked to each other in order to reduce water consumption in a lot. the project starts from the home, which is a small personal world, then the awareness expands to the outside home when people of the house become conscious in the consumption of water.

Findings suggest that households with lower water usage have a greater understanding of water conservation problems, are more interested in water usage decisions, and tend to shape patterns correlated with lower rates of use.

Through the preliminary research of the project, found some similar papers for the project mentioned here.

Baoding Zhang and jialei Liu from China wrote about the traditional water meter, on their paper (A Kind of Design Schema of Wireless Smart Water Meter Reading System Based on Zigbee Technology) and said: The traditional way of manual meter reading was not only existed water meters, but a kind of design schema of wireless smart design schema is also appropriate for modern water management.

Transmitted through the Zigbee modules to the data acquisition equipment collects meter data regularly poll way to. Network there mainly are smart water meters, data acquisition upper computers, and lower data processing concentrators is. Processing the collected data simply, these data can be transmitted to data concentrator equipment by Zigbee modules.

1. Wireless intelligent meters are at the bottom of the lower network equipment, and it is composed of three main components: basic meter, microcontroller, and wireless communication modules.

2. Data acquisition terminal Data collection terminal is actually a bridge between the wireless smart meter and data concentrator, its main function is to transmit the user's wireless smart meter data to the data concentrator and when received instructions from the upper network, data acquisition terminal can send meter-reading instructions and power outage instructions.

3. In the data processing centre, there is a database management system, to store and analyse the received data from data concentrators. Data processing centre The main function of the data processing centre is to receive data, store them, and remote control. (Zhang and Liu, 2010)

Gary D. Gerory and Michael Dr Led wrote an article on factors affecting water consumption, saying:

Based on previous work and development of an environmental behaviour model (Fig.1), it introduces a range of potentially significant variables.

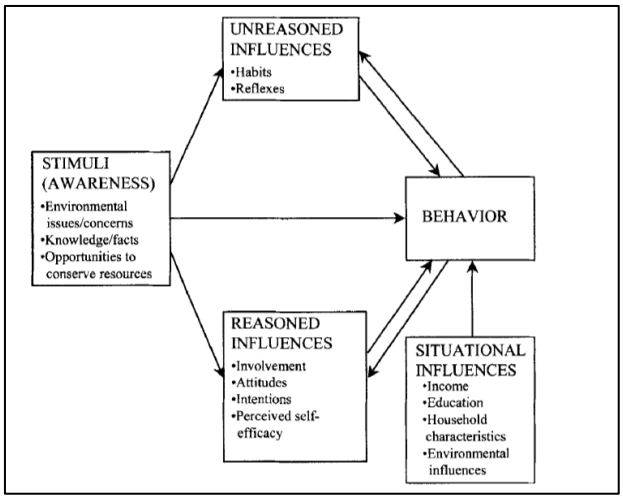

Fig.1 Environmental behaviour model. (GREGORY and LEO, 2003)

Many of the variables within this model have been investigated in previous studies and are consistent with cognitive psychology, applied behaviour analysis, and behavioural decision theory (Ronis, Yates, & Kirscht, 1989). More importantly, the environmental behaviour model is used to measure the overall effects of psychological factors on water consumption behaviour, as well as to provide an initial framework for future research in the environmental behaviour field.

This model considers the impact of stimuli on habits(unreasoned influences), cognitive processes (reasoned influences), and situational influences (e.g., income, family size) in explaining behaviour.

individuals who are highly involved in water usage situations may then consider modifying behaviour, such as watering the garden at night, reducing the number of loads of laundry, or taking shorter showers. As an intervening factor in water consumption behaviour, a consumer's level of involvement can affect his or her day-to-day water usage activities. When involvement levels are high, you would expect individuals to develop pro-conservation behaviour, directly contributing to lower water usage levels. The need for water conservation then becomes personally relevant, heightening the level of involvement in water consumption activities.

Since renters tend to be transient, homeowners were chosen to increase the chance that current occupants have been living in the house during the data collection period. Additionally, renters in New South Wales have a portion of the water bill paid by the homeowners, potentially affecting both interest and involvement in water consumption behaviour. The sample population for this study

consisted of household water users residing in the municipality of Shoalhaven, a region in southern New south wales, Australia.

Even after controlling for situational factors (e.g., household size), the findings substantiate the role of personal involvement and habit formation in explaining water consumption, lending further support to the adaptation and development of theory using repeated behaviour models in environmental psychology.

Profiles of water users suggest that households with lower water usage demonstrate greater awareness of conservation issues, local concerns, and future preservation of water resources.

What is a Smart Water Meter?

A Smart Water Meter is a normal water meter linked to a device that allows continuous electronic reading and display of the water consumption. Mobile phone technology, wireless modems, the internet, and other data distribution technologies make it possible to bring this signal readily to a computer.

Fig.2 Typical Smart Water Meter Set-up. (Hauber-Davidson and Idris, 2006)

Options for Data Collection and Distribution

The more modern systems relay their information directly to the web, or at least to a central server using wireless modems, dial-up links, secure connections via a company's LAN or ripple technology to send the signal via electrical wires. If the meter or logger fails the day after it was installed, it will take until the next visit when it is noticed that four weeks' worth of monitoring time has just been lost.

mounting another meter nearer the electrical or data connection point can overcome that, but it can also be costly, and it leaves the part of the system unmonitored. Depending on the site, application, and ease of installation, the different options for data distribution are summarised in Fig3.

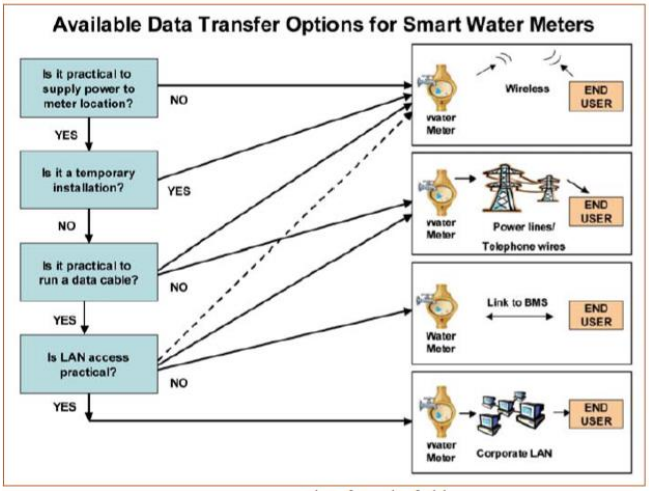

Fig.3 Options to convey smart meter data from the field to a computer near the person.

(Hauber Davidson and Idris, 2006)

However, the rapid fall in costs for wireless modems and communications have quickly absorbed the cost of a service technician to go out to site every time a data download is needed.

(Hauber-Davidson and Idris, 2006)

Through these papers presented in the project, I extracted the idea of the project and how to implement it, but in similar ways.

- Water conservation technology and reduce it consumption expressed through the Drop application.
- A smart flow meter sensor uses to know the amount of water flowing into the home.
- Using a buzzer to detect ware leaks through the open circuit to reach the leaking water and close the circuit as we know that the water is an electricity conductor.

The idea of the project was making the water meter more accurate by having a smart water meter to conserve water and calculate it accurately and reduce the individual's water consumption by application. To save water more, I put a detector to reduce water leakage at home.

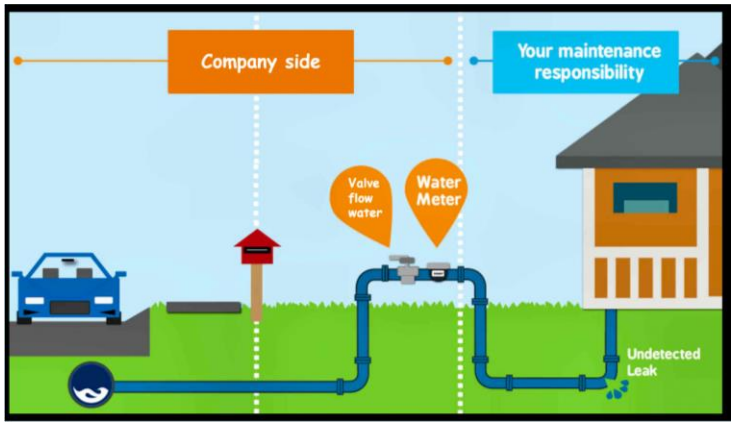

Fig.4system concept of the project (Report Water Leaks Online - Newcastle on Hunter, 2019)

Methodology:

This chapter will describe the research design and methodology used to understand the principle of project work. The first of this chapter will provide a justified explanation for the use of research methods demonstrated in addition to the discussion, including a description of samples and experiments for the tools used in the initiation. Chapter two discusses the data collection and analysis of steps.

Connecting the water flow sensor to Arduino requires minimal interconnection. Connect the water flow sensor's VCC (Red) and GND (Black) wires to Arduino's 5v and GND and connect the water flow sensor's Pulse Output (Yellow) wire to Arduino's digital pin 2. With resistor 10KΩ to reduce current flow in. I2C here is a screen to see how much water flowed from the tank to home.

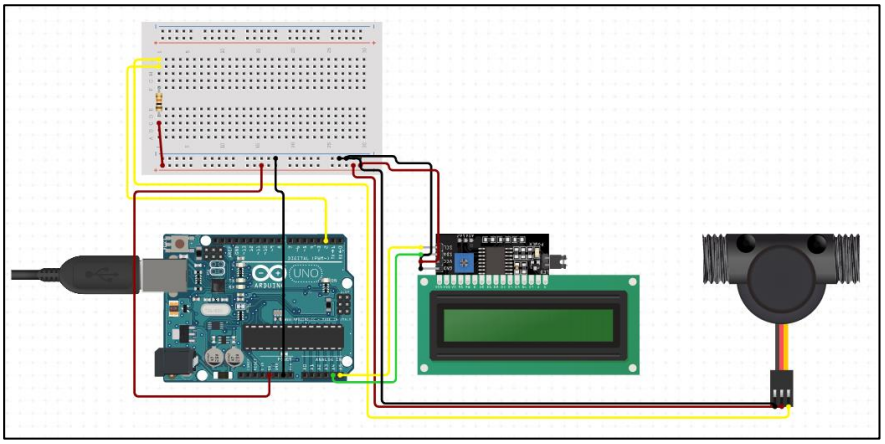

Fig.6 Circuit diagram of the flowmeter sensor

The working of the YFS201 water flow sensor

A magnetic hall effect sensor is integrated into the water flow sensor which generates an electrical pulse with every revolution. Hall effect is creating the potential difference across an electric conductor by applying a magnetic field in the direction perpendicular to that of the current flow. Its architecture allows the hall effect sensor to be sealed off from the water, enabling the sensor to remain secure and dry. (Kumar, 2020)

Table 1: connection of the flow meter sensor with Arduino board

S.NO	Water Flow sensor pins	Arduino Pins
1	Red Wire	5V
2	Black wire	GND
3	Yellow wire	7

Look at the mathematics behind the Arduino software. One YF-S201 water flow sensor was used in our laboratory experiment. To calculate the amount of water that was passed through the water flow sensor in a specific period, it was first passed through the water flow sensor which was taken as the input interface in the flow. Formulas are applied in order to measure the number of rotations/pulses in a minute of rotation.

Different techniques like velocity shift or kinetic energy will inferentially determine the flow rate.

The average velocity is an indicator of the flow rate since the cross-sectional region of the pipe is known and remains constant.

The basis relationship for calculating the flow rate of the liquid is Q = VA, where Q is the flow rate / total water flow through the pipe, V is the average flow rate, and A is the cross-sectional area of the pipe (NOTE: can viscosity, density, and friction of the liquid in contact with the pipe also affect the flow rate of water).

Where :

- Pulse frequency (Hz) = 7.5Q, Q is flow rate in Litres/minute
- Flow Rate (Litres/hour) = (Pulse frequency x 60 min) / 7.5Q

The equation will be: Litres = Q * time elapsed (seconds) / 60 (seconds/minute).

(K. HAREENDRAN, 2019)

In general, the present disclosure relates to home automation but not by restricting the identification and prevention of water leakage with home automation systems, processes, tools, and processor-readable media. A water leak in a home is usually only discovered if a person observes the water leak visually, sometimes too late after substantial water damage occurs. (Kummer, 2018)

How does a water leak detector work?

It operates off the same concept as a basic transistor touch switch circuit except that it uses a piece of paper that -if wet- helps to close the path and provide continuity between the "touch" contacts, turning on the transistor, and buzzer in effect. It uses a piece of paper, the functionality associated with an NPN transistor, and the extremely annoying sound created by a buzzer to deliver one with an early water leak detection/warning system. (philo mech, 2014)

Parts List:

- NPN transistor (2N2222).
- Buzzer.
- 1K resistor (X 2).
- 1N4148 diode .
- alligator clips wires.
- power supply .
- jumper wires.

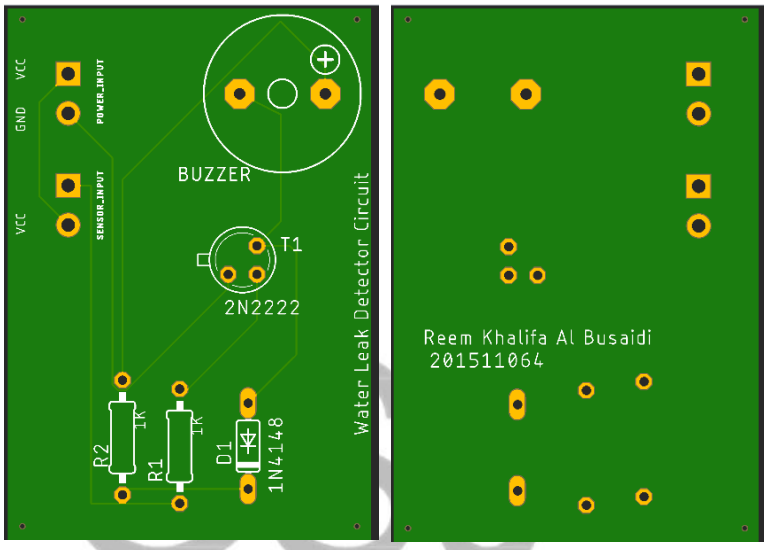

Fig.8 Water leak detector circuit diagram in PCB

The transmitter tests the time difference between the echo signal being transmitted and received, and using the formula, the onboard microprocessor calculates the distance to the liquid surface.

Distance = (Speed of sound in air x time delay) / 2.

If the transmitter is equipped with the application's bottom reference the microprocessor measures the liquid amount. The basic equation for calculating the level of a tank is:

Level = Tank Height – Distance. (Automatic Water Level Indicator using Arduino, 2019)

In this circuit use this component :

- Parts:

  Arduino board.

  ultrasonic sensor HC SR04.
- Materials:

wires for connecting sensor to Arduino.

The water level on a LED light stage, which is connected to the receiver circuit, is shown percentagewise. The transmitter circuit utilizes an ultrasonic sensor to determine the distance of the water level. Two circuits are used in this project: a transmitter circuit, and a receiver circuit. Using RF communication, the data is sent to the receiver circuit. (Hari Hara Prasad, 2017)

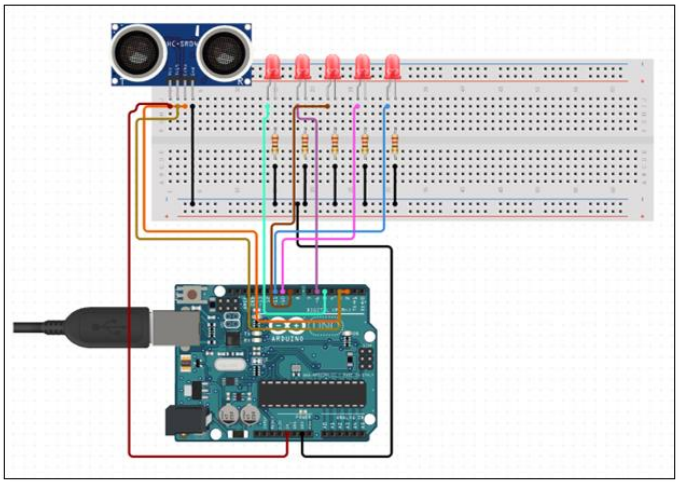

Fig.9 Circuit diagram of the Ultrasonic sensor and LED level with Arduino board

The LEDs are used to show the percentage of water available in the water tank this is a beginner's level project explaining the basics file in the next version of the water level monitoring system. Fig 9 shows how to make a water level monitoring system using ultrasonic sensor and some LEDs.

In order to know the percentage of water inside the tank, put 5 LEDs to indicate the level of water level, which expresses the percentage of filling the tank with water. The ultrasonic sensor works here as an observatory of the water level inside the tank. In the circuit diagram connect the ultrasonic sensor with Arduino board in the pins that mentioned on table 3 below.

LEDs meaning of percentage

- The first LED show 20% of water.
- The second LED show 40% of water.
- The thread LED show 50% of water.
- The fourth LED show 80% of water.
- The fifth LED show 100% of water.

the resistors 220Ω connect with series to limit current for the LEDs.

LEDs circuit will design it in PCB board.

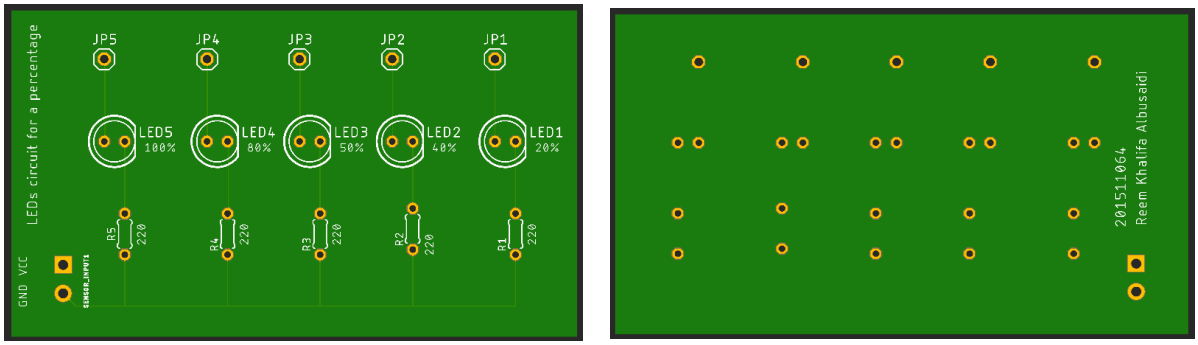

Fig.10 Circuit diagram of the LEDs level in PCB board

The LEDs circuit is made up of fives LEDs, resistor 220, battery 5v, and jumper wires to connect it with the Arduino board. the LEDs relate to the resistors in series. Table 3 below show the LED's connections with the Arduino board.

Table3: connection of the Ultrasonic sensor and LEDs with Arduino board

S.NO	Ultrasonic pin	Arduino Pins	LEDs red connections with Arduino Pins
1	VCC	5V	6
2	TRIG	3	9
3	ECHO	2	10
4	GND	GND	11
5	-	-	5

First, need to activate the ultrasonic sensor module to relay signals using Arduino, and then wait for ECHO to be received.
Can estimate the distance by using the given formula: Distance= (travel time/2) * speed, of sound
Where the speed of sound is approximately 340m per second.

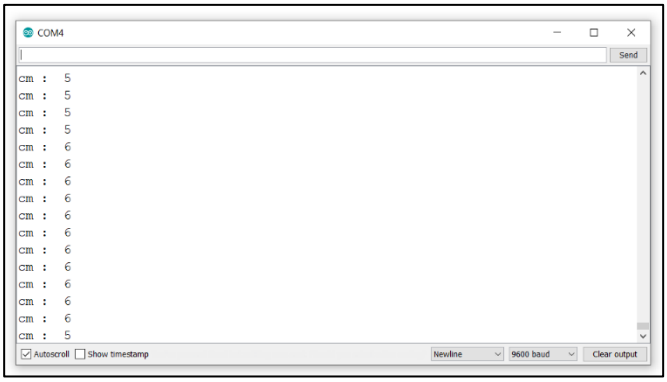

Fig.11 Serial reader for the Ultrasonic level sensor.

To activate a Drop application Bluetooth must be enabled in order to obtain water usage data at home. This makes it easier for the application user to know his water consumption. This is shown through the Android Studio program, which is a program designed for applications.

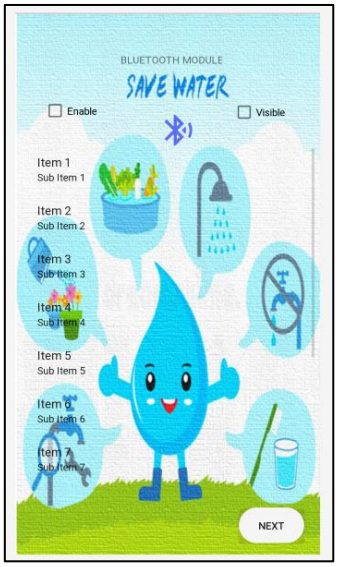

Fig.12 Bluetooth page in Drop application

In the fig12, the Bluetooth link page design appears when the user does the application with a button that enables the Bluetooth link to be displayed as items.

Here the android app is programmed to send serial data to the Bluetooth module when a certain button is pressed.

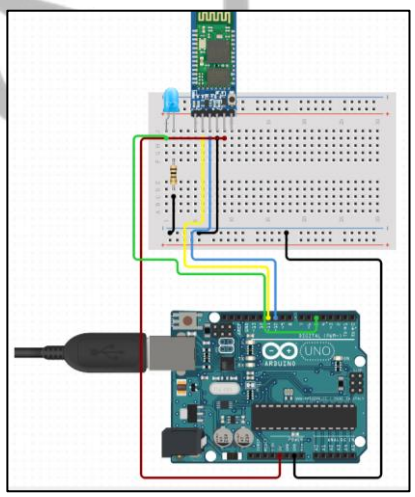

Fig.13 Bluetooth circuit diagram with Arduino board

How to Use the HC-05 Bluetooth module:

The HC-05 has two operating modes, one is the Data mode in which it can send and receive data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed.

Table4 : Pin Configuration of the Bluetooth HC-05.

S.NO	Pin Name	Description
1	Enable / Key	This pin is used to switch between Data Mode (set low) and command AT (set high) mode.
2	Vcc	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX – Transmitter	Provides Serial Info. This pin will hand out everything obtained via Bluetooth as serial data.
5	RX – Receiver	Every serial data given to this pin will be broadcasted via Bluetooth. Receive Serial Data.
6	State	The state pin is connected to the LED on board, it can be used as input to test if Bluetooth is functioning properly.

(HC-05 Bluetooth Module Pinout, Specifications, Default Settings, Replacements & Datasheet, 2018)

Table5: The circuit connection of the Bluetooth HC-05 with Arduino

S.NO	Bluetooth pin	Arduino pins	LED connection with Arduino pin
1	Vcc	5V	5
2	RX	11	-
3	TX	10	-
4	GND	GND	-

Through the long search for how to start the project, this plan became clear through three sections connected to each other. The first section is the smart water meter. The second section is the water leakage detector. The third section is the application of water conservation (drop). The idea is inspired by the amount of massive research on the depletion of freshwater, Therefore, every member of the family must consume water in an economy that reduces the amount of water consumed per day and fluctuation allows each person to know the use of it per day, which makes the individual less consuming water.

Result:

Through studies conducted on water consumption, I decided to do a questionnaire for a different group of people over the extent of their conservation of water and reduce its consumption per day as the data appeared as follows:

85.71% of people answer that know the person can use water form 173 litters in a day.

while 14.29% of people don't know that.

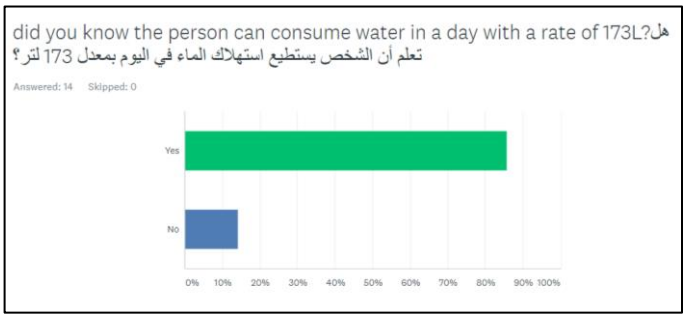

Fig.11 Results of the question 1 from the questionnaire

78.57% of people economize to use water.

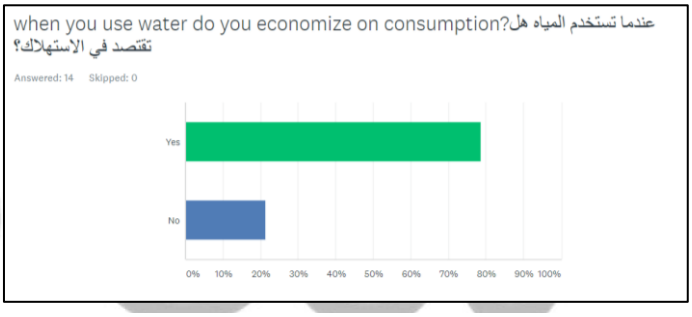

Fig.12 Results of the question 2 from the questionnaire

When putting this question in the questionnaire. what is the right Behavior that contributes to the economy of water consumption?

Most of the answer were :

Moderate use of water.

Close the water when nobody at home.

Check up the pipes.

Close the water tap tightly.

85.71% answer yes if they have an application on their phone to show the amount of water used, they will reduce their water consumption per day.

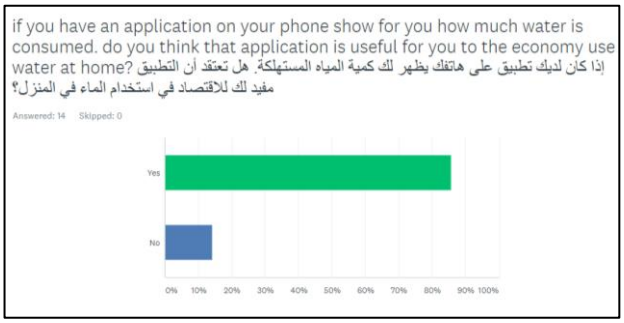

Fig.13 Results of the question 4 from the questionnaire

The rate is designed to assess how people conserve water and reduce it when using.
The answers are mixed between -always use a little water at home-, answer it 42.86% of people. answer 57.14% of people that - sometimes use a little water at home-.

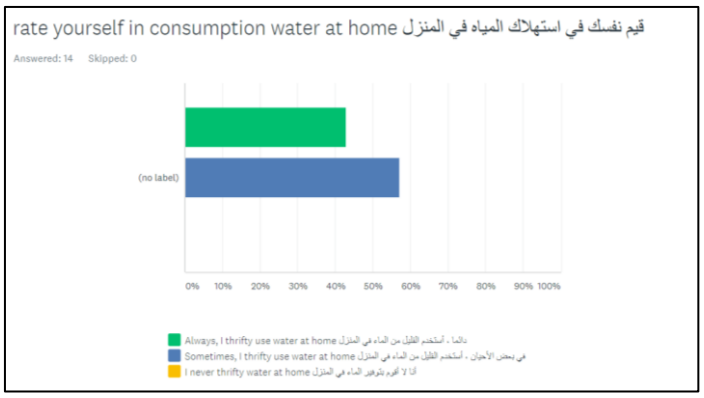

Fig.14 Results of the question 5 from the questionnaire

Through the questionnaire, it appears that this sample of people is aware of the dangers of frequent consumption of water. the percentage of preserving water higher than the rate of not conserving

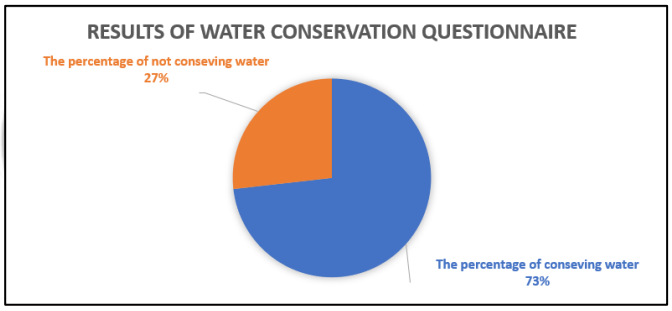

Fig.15 Results of water conservation questionnaire

Unfortunately, there's a lot of uncertainty in an industry lathered by plumber jargon about what the water flow rate is, and if installing a water filter will make your pressure drop. Yet there is also a mathematical definition of water flow — the water flow rate and how it affects your capacity in your own home to use it comfortably. As we speak of water, we also speak of its flow; how it flows through rivers, streams, large bodies of water.

HOW TO CALCULATE YOUR WATER FLOW RATE

Start by turning your faucet on full blast and fill a container or measuring cup for 10 seconds. Convert the amount from cups to gallons if measured in cups (U.S.) Instead, according to The Spruce, all you must do is "multiply the estimated water quantity by 6 to determine the flow rate in gallons per minute".

Fig.16 U.S. measured cup (Hotel Restaurant Supply Inc, 2020)

Compare this to the normal flow rates across the United States. One average GPM looks like this for the regular home:

- Kitchen faucet: 2-3 GPM.
- Shower: 1.5-3 GPM.
- Dishwasher: 2-4 GPM.
- Washing machine: 3-5 GPM.

If those average flow levels are right, all the faucets running at the same time will result in a drop in the water.

How many Litters per second are in 1-gallon US per minute? The answer is: for every 1 gal/min equals 0.063 L/sec.

Table 6: gal/min To L/sec flow water rate conversion result

From	Unit	Equals	Result	Unit
1	gal/min	=	0.063	L/sec
2	gal/min	=	0.13	L/sec
3	gal/min	=	0.19	L/sec

(Convert gal/min to L/sec | gallon US per minute to Litters per second, 2019)

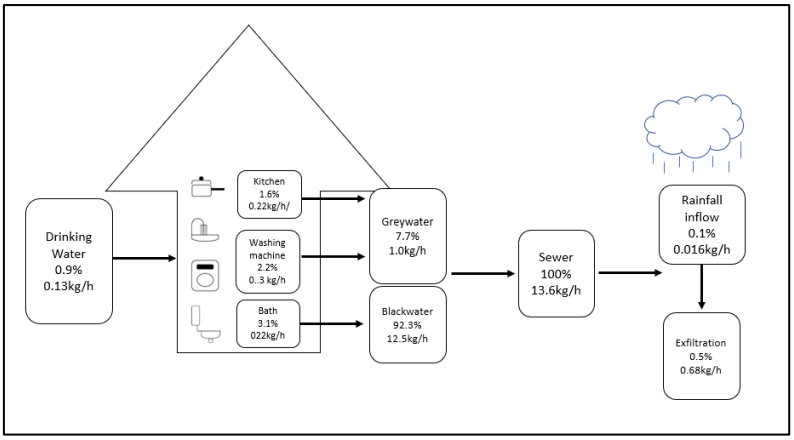

Fig.17 A scheme to show the water consumed at home (R.Gray and S.C. Becker, 2002)

The diagram considers flows derived from the urban residential development (i.e. Rainfall as well as water and wastewater) and the percentage load from each source is based on the total load derived from the urban site.

Where the amount of water used from the house and from nature, the individual can use greywater for recycling, this reduces all the water going from grey and black to sewage, where some of the water used in the kitchen, such as washing vegetables and some foods can be collected and watered by crops, but not collected more From 24 hours in order not to allow the multiplication of germs and microbes. If heavy rain occurs in the area, it can be satisfied with irrigation.

Reading Water Flow rate with Water Flow Sensor

The Water Flow Sensor is quick to wiring up. There are three cables: Black, Red, and Yellow. Black to ground pin Red to 5v pin The yellow wire must be attached to a 1kΩ resistor pull up. And then at Arduino pin 7.

It uses a simple spinning circle, which pulses a sensor for the hall effect. By reading these pulses and applying a little mathematics, we can accurately read the liquid flow rate within 3%. The threads are easy, 3⁄4 so it won't be that hard to find barbed ends.

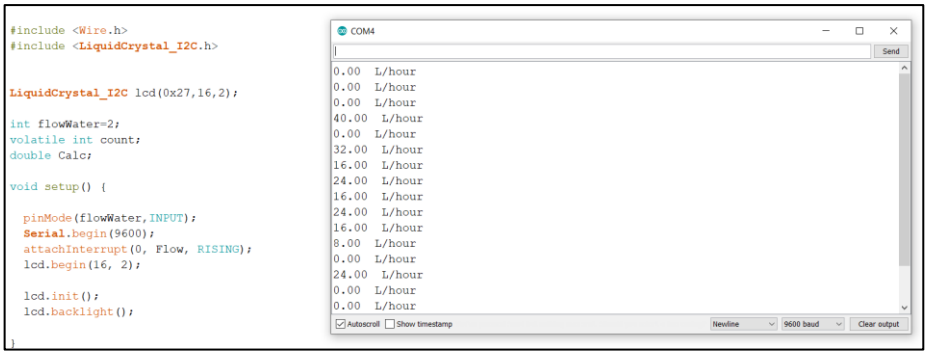

Fig 18. Serial reader for the flow water sensor.

In another embodiment of the present invention, the Voltage Source and the relay coil are in a Separate housing and are coupled to the water Sensor by an electrical conductor. The water detection system includes a Voltage Source, and a water Sensor, connected in series. Shown in Fig 36 of bcp leak

In the application, current governmental and non-governmental water quality and water consumption guidelines are compiled into the Android Studio program with separate worksheets for four purposes of water use: irrigation, kitchen, bath, and washing machine. A user interface has been created to compare interactive data between user input data and quality and water conservation guidelines at the end of the application. The results of the data comparison show whether the use of water is excessive, or the use is low.

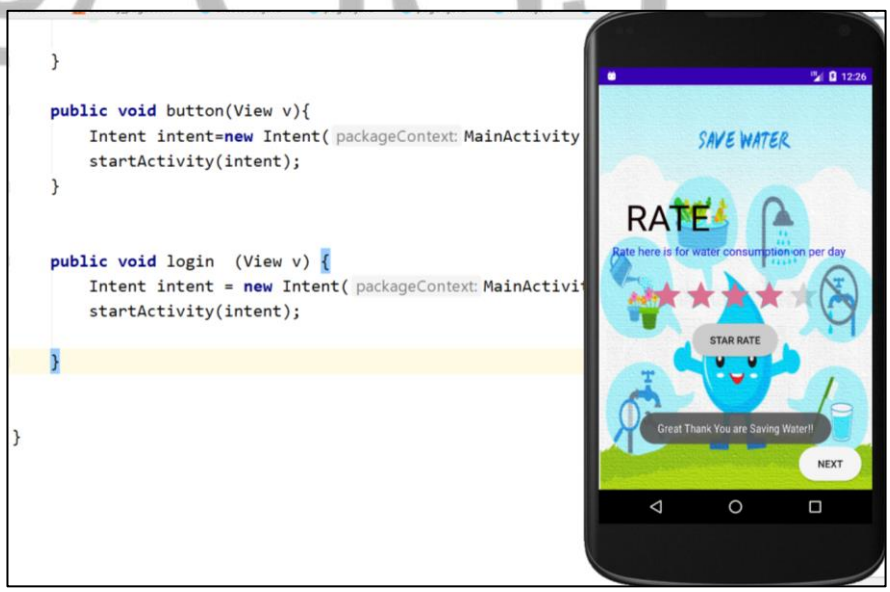

Fig.19 The results of the rate page in Drop application

Conclusion:

A water management scheme would only be feasible if it promotes efficiencies on both the supply and demand sides. Initiatives to satisfy the demand for water supply would be effective if water wastage reduction steps are prioritised. Eviting wastage would help reduce water use and, therefore, delay the need for new supplies. At present, the wireless meter reading device has been studied by several businesses, but, there are not many items. Water is one cause of power consumption. And power consumption is a major problem when using the wireless meter reading device to limit the storage. Using a buzzer, the leak can be acoustically detected by in-pipe. Where the acoustic spectrum recorded in this paper is intrinsic to experimental pipe configuration due to slight turbulence at various surface irregularities within the pipe and is expected to vary for other pipeline systems. A reservoir water level monitor was developed based on image recognition, and a new water level gage was created for two-dimensional code detection. The machine performs remotely, via the ultrasonic sensor module, real-time monitoring of reservoir water level. Hardware design considers the reliability and usability of the actual application, and consideration is given to the consistency and stability of the software design. Improve the issue of broad digital acknowledgement error and relatively low accuracy of traditional water level gauge.

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