IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 7, Issue 1, July 2021
Impact Factor: 4.819

An Innovative Internet of Things (IOT) Based Smart Electric Valve Monitoring and Controlling System

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Abstract: *Internet of Things is the concept of connecting any device (so long as it has an on/off switch) to the Internet and to other connected devices. The IoT is a giant network of connected things and people, all of which collect and share data about the way they are used and about the environment around them. Experts estimate that the IoT will consist of about 30 billion objects by 2020. This paper presents a innovative internet of things (IoT) based technique to Control the flow of any fluid, Prevent the Wastage of Water by timely reporting the unnecessary water flow and Real Time Monitoring of Fluid Flow at anytime from anywhere by providing push notification about whether the fluid is flowing, has stopped, Valve is On or Valve is Off on any handy gadget and Fast Operation and Proper Feedback provided by IoT using Wi-Fi Module.*

Keywords: Internet of things (IoT), Smart Electric valve, Real Time Monitoring.

I. INTRODUCTION

There are various applications of IoT, we're discussing about IoT based Electric Valve. According to recent survey, water has become a big issue because of less rain fall and increase in population many cities are facing this problem. People have to suffer as they don't get sufficient amount of water for their daily needs. Water is important and hence it should be used in effective manner. For effective usages we must minimize wastage of water. In many cases it could be seen that, even if there is no need of water, taps are still open which leads to water wastage. We are concerned about this useless water flow, so with the help of IoT we can control this useless water flow by smart switching. This technology will help to control your water tap from anywhere at any time through internet. The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

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This paper presents a innovative internet of things (IoT) based technique to Control the flow of any fluid, Prevent the Wastage of Water by timely reporting the unnecessary water flow and Real Time Monitoring of Fluid Flow at anytime

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II. INTERNET OF THINGS (IOT) ARCHITECTURE AND ITS KEY FEATURES

Architecture of IoT depends on various applications of IoT. For e.g. consider two scenarios. Scenario-1: Let's consider smart devices for pollution, wherein sensors sense the amount of carbon monoxide, nitrogen dioxide, sound level etc. and sends these data continuously to the central database. These data will be analysed by using analytical tools and gives information about amount of air pollution in that particular city to the traffic police. This information helps to take the precaution when it exceeds the normal level. In this scenario architecture hold good. Here sensor layer indicates sensors will be continuously sensing the air and sends the data through Wired or wireless communication to the database. This data will be processed and analysed and final consolidated result will be send to the user smart phone through the Air pollution control application. Hence four layers architecture is required.

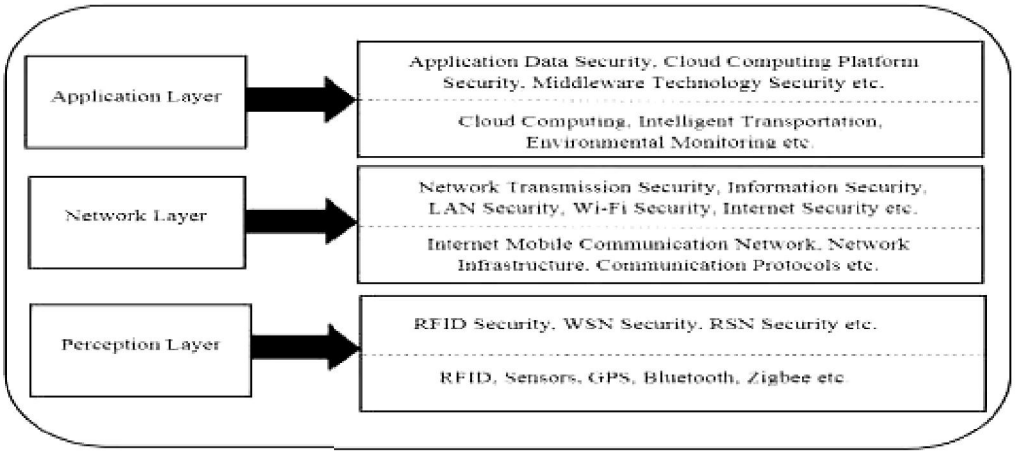

Figure 1: General 3 Layer/ 4 Layer architecture for IoT

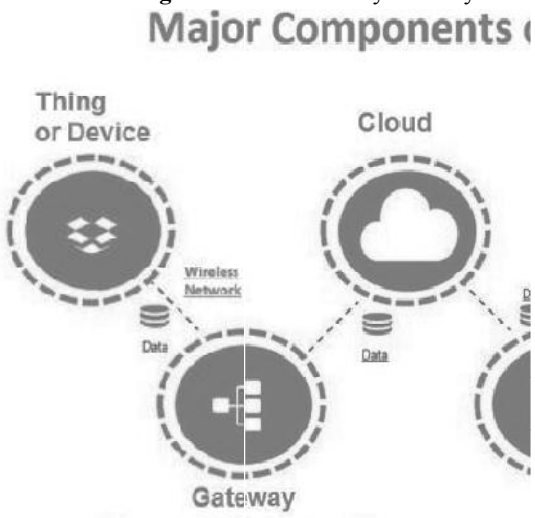

Figure 2: Essential Key elements of IoT

Scenario-2: Let's consider a sensor is attached near the kitchen or gas cylinder with context to find the gas leakage. In this whenever sensor detects gas leakage it has to alert the surrounding immediately and then has to send the message to the owner. In this case analyzing has to be done in the sensor layer itself. Hence architecture shown in Fig.3 hold good.

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2.1 IoT – Key Features

The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use. A brief review of these features is given below:

- **AI** – IoT essentially makes virtually anything "smart", meaning it enhances every aspect of life with the power of data collection, artificial intelligence algorithms, and networks. This can mean something as simple as enhancing your refrigerator and cabinets to detect when milk and your favourite cereal run low, and to then place an order with your preferred grocer.
- **Connectivity** – New enabling technologies for networking, and specifically IoT networking, mean networks are no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its system devices.
- **Sensors** – IoT loses its distinction without sensors. They act as defining instruments which transform IoT from a standard passive network of devices into an active system capable of real-world integration.
- **Active Engagement** – Much of today's interaction with connected technology happens through passive engagement. IoT introduces a new paradigm for active content, product, or service engagement.
- **Small Devices** – Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, and versatility.

III. Conventional Water Taps – An Introduction

A tap is a valve controlling the release of a liquid or gas. Tap is used in the British Isles and most of the Commonwealth for any everyday type of valve, particularly the fittings that control water supply to bathtubs and sinks. Water and gas taps have adjustable flow: gate valves are more progressive; ball valves coarser, typically used in on-off applications. Turning a valve knob or lever adjusts flow by varying the aperture of the control device in the valve assembly. The result when opened in any degree is a choked flow. Its rate is independent of the viscosity or temperature of the fluid or gas in the pipe, and depends only weakly on the supply pressure, so that flow rate is stable at a given setting. At intermediate flow settings the pressure at the valve restriction drops nearly to zero from the Venturi effect; in water taps, this causes the water to boil momentarily at room temperature as it passes through the restriction. Bubbles of cool water vapour form and collapse at the restriction, causing the familiar hissing sound. At very low flow settings, the viscosity of the water becomes important and the pressure drop (and hissing noise) vanish; at full flow settings, parasitic drag in the pipes becomes important and the water again becomes silent.

Figure 3: Conventional Water Tap

IV. Internet of Things (IoT) Based Smart Electric Valve– Its Implementation

In Modern Aspects People Prefer to Live in Flats and Apartments. Due to Heavy busy life sometimes people forget to close the water Tap or they are unaware of opening of water tap which leads to water wastage. This wastage could be stopped by the application of Automatic Switching. For this we have modified Manually Operated Water Tap by introducing Electrical Element, "solenoid valve". In this we are Performing automation through IoT using certain Wi-Fi

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modules and microcontrollers. As this is a Tap so this should be operated both manually as well as through Internet, for this to happen there is an electronic arrangement of logic gates and some power transforming devices.

4.1 Functional Block Diagram

The block diagram of the implemented work is as shown below:

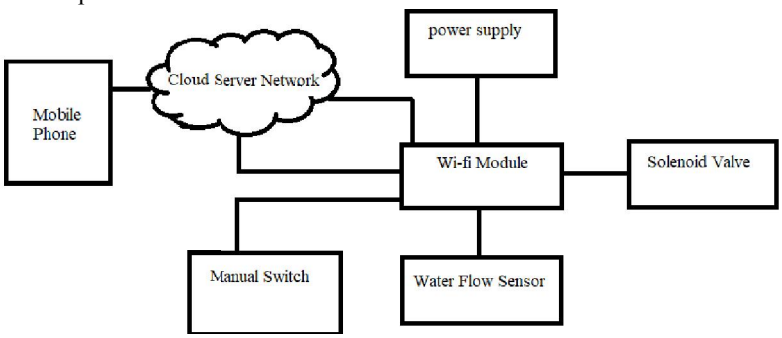

Figure 4: Functional Block Diagram

Above figure shows the block diagram of the system. The Water flow sensor provides the input signal to the Wi-Fi module. Here a Solenoid valve is connected to control the water flow. Power supply can be given either through a 12V dc battery or through an adapter. A Voltage regulator LM317 is used to provide 3.3V dc supply to the Wi-Fi module. Another voltage regulator IC7805 is used to convert 12V dc to 5V dc. A push button is also used to enable manual switching. Push button is just altering the state of the valve, either from ON to OFF or from OFF to ON. The device also has a water flow sensor, which is here detecting the water flow and just notify us about the same.

4.2 Working of IoT based smart Electric Valve

The power is obtained through an adapter. The adapter takes ac power supplied at 220-230Vand convert it into 9V DC. This 9V is sent to the 7805 Voltage Regulator which covert it to lower voltage level. Another voltage regulator LM1117 is used which convert the voltage to 3.3V which is needed for proper operation of the ESP8266 Wi-Fi Module. This Wi-Fi Module is already programmed by Arduino IDE. It acts as a bridge between the hardware and the network cloud centre.

The ESP8266 connects to the Wi-Fi as soon as it reaches within its range. The username and password of the module are unique and are previously fed in the programming chip. The module catches the signal of that particular network whose username and password matches with the Wi-Fi Module.

After getting connected to the network, the ESP8266 continuously send the information received from sensor and valve to the android application used. Whenever the device which is connected to the model is connected to internet, the android application sends notification on the device about the status of valve and the sensor.

The android application has a specific screen on which a digital switch is provided. When the user operates the switch, the corresponding command is sent to the module by the application. The module then according to the in-built program commands the Valve and Sensor to operate. Different resistors and capacitors are used in the circuit in order to have smooth operation.

V. Internet of Things (IoT) Based Smart Electric Valve– Result & Discussion

The Internet of Things Electric Valve is a device used in place of conventional water valve to provide smart control over water flow. This valve is connected to a sensor which can sense flow of water or any liquid through it and can notify about the same.

The Model consists of an ESP8266 Wi-Fi module which operates at 3.3V. It can be programmed through a serial port. LM317 is used here to supply module favourable voltage which is 3.3V dc. MOSFET is used to trigger solenoid valve ON and OFF. Whenever there is a flow of water through the valve and then through water flow sensor then

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sensor comes into picture and it will give notification namely “Water is flowing” as an indication of water flow. And when water flow stopped then sensor gives the notification like “Water flow stopped” to indicate that flow of water has been stopped. An LED is connected to solenoid valve just to indicate whether it is ON or OFF. As solenoid is an inductor in terms of electrical element so to avoid high arcing voltage across its terminal while sudden break of circuit, a resistor is connected across the terminals of solenoid to keep it in circuit even after turn of the supply.

Figure 5: Working Model of IoT based Electric Valve

The Working of the model is shown below in four different modes.

Mode – 1 - Turning the Electric Valve ON through IoT

After initializing and connecting Module to Wi-Fi connection, the information is sent to the device through ESP8266 chip. The android app used is Blink app. It is already installed on the device. The current status is shown as a notification on the device through Blink app and the IoT mode is established.

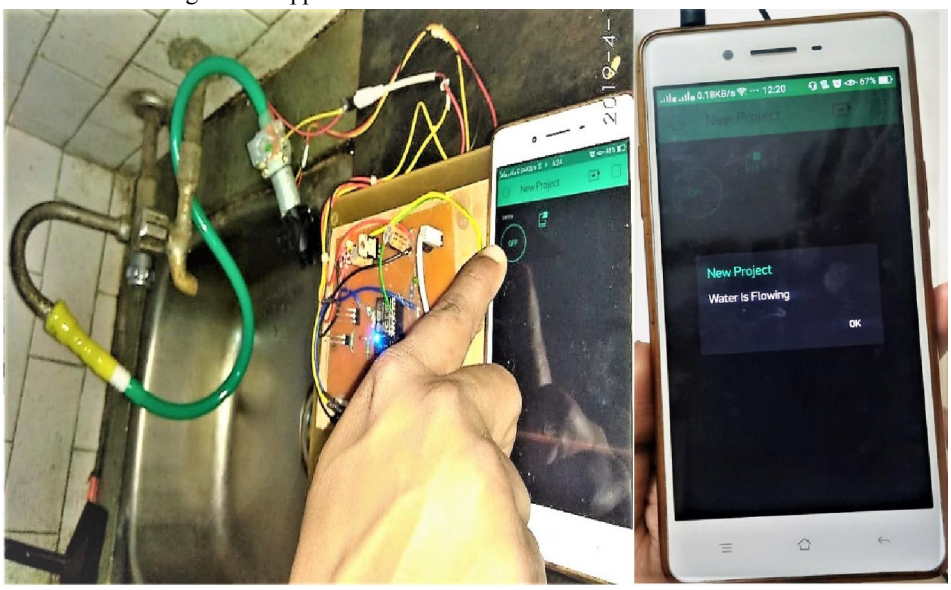

Figure 6: Water flow status on phone

Here the LED is glowing which indicates that the solenoid valve is ON and immediately we get the notification regarding water flow.

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Mode – 2 - Turning the Electric Valve OFF through IoT

Turn OFF the valve through the device connected to IoT through the Blink app when you are outside the home or could not operate the manual valve due to any reason to stop unnecessary water flow. The electric valve can be turned on and off through the device connected to IoT.

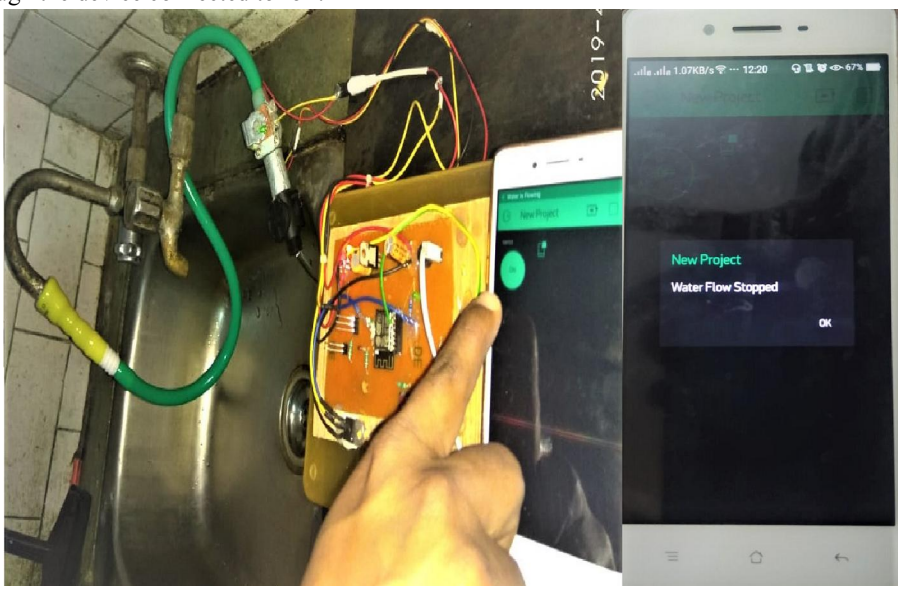

Figure 7: Water flow stopped status on phone

Here the LED is not glowing, it indicates that the solenoid valve is OFF and hence the water flow has stopped. The notification regarding the status of the valve can be received on device. Also the notification about the flow of water is received on the device connected through IoT.

Mode – 3 - Manually turning the Electric Valve ON

In case you are able to operate the manual valve or there is no need of IoT connected device. The Valve can be turned on and off through the manual switch provided. To turn the valve on the ma-nual switch need to be pressed.

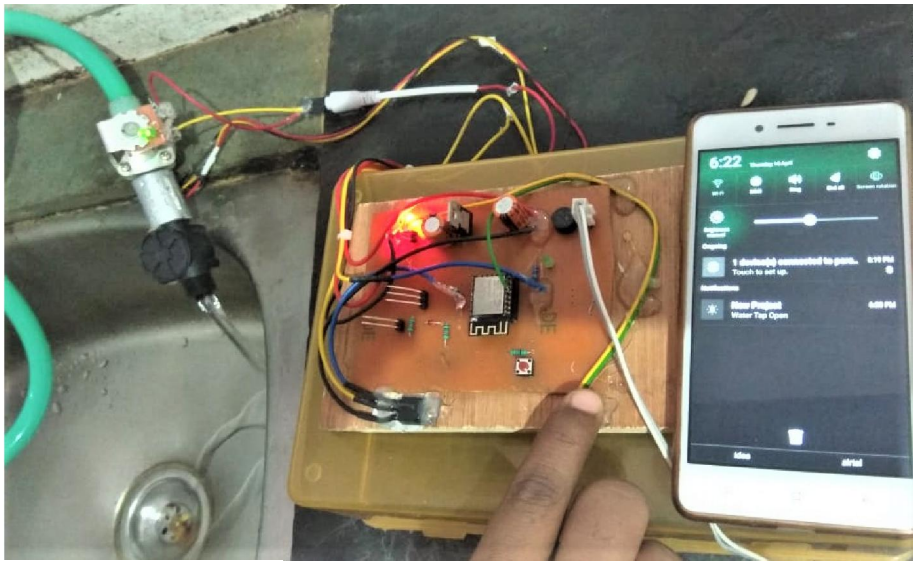

Figure 8: Turning the valve ON manually

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There is a push button near PCB on the ply board, it is used to turn ON or OFF the valve manually. If you press the press button once then it will alter the state of solenoid valve that is if the valve is previously in ON state then on pressing once the valve will goes into OFF state and vice versa. We get a notification as "Water Tap Open" on the device connected to IoT indicating the ON state of the solenoid valve.

Mode – 4 - Manually turning the Electric Valve OFF

Figure 9: Turning off the valve manually

Similar as turning the valve ON manually, we can turn the valve OFF. By pressing the press button we can close the valve as well as the flow of water through the sensor and hence sensor notifies as "Water Flow Stopped" in the device. And Status of the solenoid valve is also mentioned in the notification like "Water Tap close". LED also goes off as the Valve is closed. Therefore by installing this device we can get the proper control of Valve from anywhere and anytime.

VI. CONCLUSION

There are various applications of IoT, we're discussing about IoT based Electric Valve. According to recent survey, water has become a big issue because of less rain fall and increase in population many cities are facing this problem. People have to suffer as they don't get sufficient amount of water for their daily needs. Water is important and hence it should be used in effective manner. For effective usages we must minimize wastage of water. The paper presents a innovative internet of things (IoT) based implementation and controlling of Smart Electric valve to prevent wastage of water flow if water tap is left open by mistake. The Internet of Things Electric Valve is a device used in place of conventional water valve to provide smart control over water flow. This valve is connected to a sensor which can sense flow of water or any liquid through it and can notify about the same.

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