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# AUTOMATIC WATER FLOW REGULATOR

**[1]JyotirmayeeBehera, [2]Sarosh Q. Baig, [3]Dillip Kumar Mishra , [4]Gayatri Devi**

[1,2,3,4]Ajay Binay Institute of Technology, Cuttack

**ABSTRACT**

***Water scarcity is one of the biggestproblem in major citifies of India today, which if unaddressed, may further get deteriorated.In this backdrop, there is a compelling need to judiciously use the water particularly in the urban setting, where a significant wastage of water is happening through either over use or leakages of water.***

***Theabove problem can be effectively addressed by bringing inappropriate technological innovation.Accordingly, in this paper, we have discussed about a technological solution namely"Automatic Water Flow Regulator" which can control the water flow including its leakage and over use by using flow sensor implemented on the basis of IOT. The IOT based circuit has been designed to enable the flow detector to function as a threshold detector so that it works as an on/Off switch for solenoid valve based on time and volumetric measurement. The device conceptualized is simpler to use and is of low cost which can be easily affordedby thecommon people.***

**Key Words:** Flow Sensor, Solenoid Valve, Relay Switch, Arduino Microcontroller, Raspberry Pi.

## 1.INTRODUCTION:

The people now-a-days, in cities live in multi-storeyapartments or societies having common overhead tanks and water distribution systems. Further, they also live in nuclear families with both husband and wife working. The changing life style in Indian towns and cities has a lot of bearing on the way the water is utilized. The major reasons behindwastage of water are elaborated below: -

### 1.1 Overuse of water:

The residents or dwellers tend to over use the water on account of following reasons: -

a. Lack of measurement:
   Dwellers are not aware of the volume of water being used by them on day to day basis.
b. MoralHazards(Psychological Hurdle):
   Dwellers are afraid that if they will not use it, others in the society would take a larger share of water.

### 1.2 Leakage of water:

Leakage of water is happening due to the following reasons: -

a. Leaking Tap :Water may be leaking from tap due to faulty washer or faucet. The amount of water getting leaked from the fault system may seem to beless butcumulatively it would be contributing significantly to the wastage of water.
b. Carelessness of the residents:
   Residents may not be diligentabout usingthe waterefficiently. (Example – Tap is open when somebody is brushing the teeth)
c. Unintentional:
   Sometimes the residents may have opened the tap when a tank is empty and has gone out of the house without closing it.
d. Overflow in the common overhead tank:
   Although there are systems available for controlling the overflow of water from tank, those are not full proof.

Keeping the above in view, the "Automatic water flow regulator" has been designed.The aim of this paper is to develop a prototype of an Automatic Water Flow Regulator, which is an electronic based sensor device that will automatically open or close the flow of water based on two measurement parameters i.e. (i) Volume of water flown and (ii) Duration of water flow in the tap.The device can be customized to be installed at society level orat family level or even at individual tap level.

## 2.PREVIOUS WORK:

Lot of research work has been carried out for evolving different water flow measurement techniques. C.N. Ananwu et.al (2012) described design and implementation of water level controller [1]. S.M. Khalied Reza et.al (2010) given the idea of low cost automatic water level control for domestic applications [2]. Santhosh KV and BK Roy (2012) proposed an intelligent flow measurement technique using Ultrasonic Flow Meter with optimized neural network [3]. JavadRezanejadGatabi et. al. (2010) developed an auxiliary fluid flow meter in which the flow of an auxiliary fluid is measured, instead of direct measurement of the main fluid flow. The auxiliary fluids injected into the main fluid and with measuring its travel time between two different positions, its velocity could be calculated [4]. Zhang Wenzhao et. al (2010) developed a liquid differential pressure flow sensor for straight pipe [5]. Luis Castalier et.al (1997) described design and fabrication of a low-cost water flow meter which can measure up to 9liter / minute, avoiding direct contact of flow with silicon sensors [6]. Thwe Mu Han, Ohn Mar Myaing (2011) developed Microcontroller – Based Water Flow Control System. [6]. ShiqianCai and HalukToral (1993) proposed a technique of measuring flow rate in Air-Water Horizontal Pipeline with the help of Neural Networks. In this paper, the Kohonen self-organsing feature map (KSOFM) and the multi-layer back propagation network (MBPN) were applied in a hybrid network model to measure the flow rate of individual phase in horizontal air-water flow [7]. Young-Woo-Lee et. al (2008) developed a wireless Digital Water Meter with Low Power Consumption for Automatic Meter Reading in which they used magnetic hole sensors to calculate the amount of water consumption and ZigBee wireless protocol is used to transfer amount of water consumption to the gateway [8].

## 3.SYSTEM DESIGN AND DEVELOPMENT:

### 3.1 Overview of the Device:

The overview of the device is provided in the figure below:

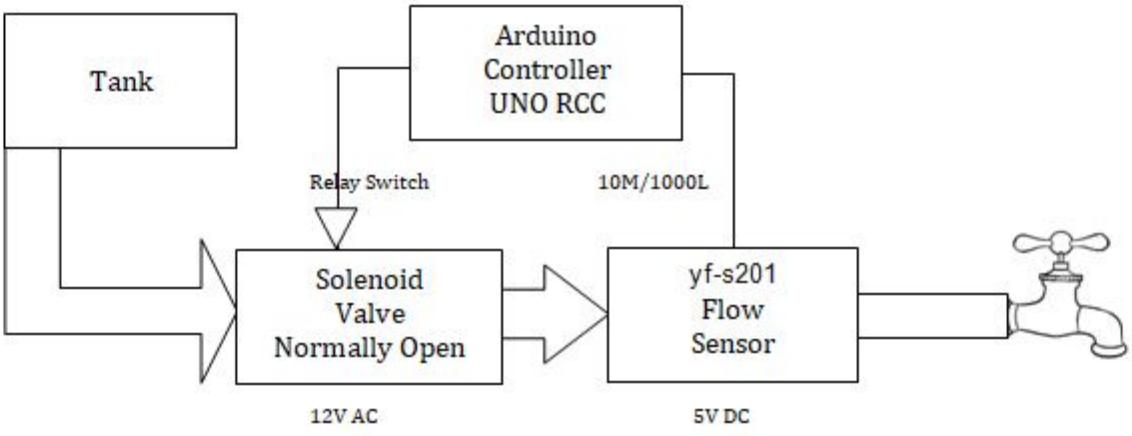


**Figure 1:** Overview of the Device

### 3.2 Components:

The different components of the device are provided below:

a. Flow sensor and measuring meter
b. Solenoid valve/valve system

c. Arduino microcontroller
d. Relay switch&Raspberry Pi

**3.3 Design and Circuit:**

All the above four components have to be integrated as one device, with appropriate interfacing between measuring instrument, sensor, valve and IOT system, for the functioning as an automatic flow regulator. Beside the four components as discussed above, the regulator would also require a battery system, as the device has to be charged through a battery. Battery system should be provided for its operation which can be detachable.

**3.4 Programming of experiment:**

The programming made for the flow sensor is provided below (Arduino program):

```
intsensorInterrupt = 0;
intsensorPin       = 2;
intsolenoidValve = 5;

intcountMilli=0;
intflowMillicount=0;
intswIn=8;
intswOut=12;
intswVal=0;
intflowstopcounter=0;
intwaterwastage=0;

floatcalibrationFactor = 4.5;

volatile byte pulseCount =0;

floatflowRate = 0.0;
unsignedintflowMilliLitres =0;
unsigned long totalMilliLitres = 0;

unsigned long oldTime = 0;

void setup ()
{

  // Initialize a serial connection for reporting values to the host
Serial.begin(9600);
```

```
pinMode(solenoidValve , OUTPUT);
pinMode(sensorPin, INPUT);

pinMode(swIn , OUTPUT);
pinMode(swOut, INPUT);

digitalWrite(sensorPin, HIGH);
digitalWrite(swOut, HIGH);

  /*The Hall-effect sensor is connected to pin 2 which uses interrupt 0. Configured to trigger on a FALLING state
change (transition from HIGH
  (state to LOW state)*/
attachInterrupt(sensorInterrupt, pulseCounter, FALLING); //you can use Rising or Falling
}

void loop()
{


if((millis() - oldTime) > 1000)    // Only process counters once per second
  {
Serial.println(countMilli);
Serial.print("\t");
countMilli++;
if(countMilli>=100)
    {
resetTotal();
    }
    // Disable the interrupt while calculating flow rate and sending the value to the host
detachInterrupt(sensorInterrupt);

    // Because this loop may not complete in exactly 1 second intervals we calculate the number of milliseconds that
have passed since the last execution and use that to scale the output. We also apply the calibrationFactor to scale the
output based on the number of pulses per second per units of measure (litres/minute in this case) coming from the
sensor.
flowRate = ((1000.0 / (millis() - oldTime)) * pulseCount) / calibrationFactor;

    // Note the time this processing pass was executed. Note that because we've
    // disabled interrupts the millis() function won't actually be incrementing right
    // at this point, but it will still return the value it was set to just before
    // interrupts went away.
oldTime = millis();

    // Divide the flow rate in litres/minute by 60 to determine how many litres have
    // passed through the sensor in this 1 second interval, then multiply by 1000 to
    // convert to millilitres.
flowMilliLitres = (flowRate / 60) * 1000;

    // Add the millilitres passed in this second to the cumulative total
totalMilliLitres += flowMilliLitres;

unsignedintfrac;

    // Print the flow rate for this second in litres / minute
Serial.print("Flow rate: ");
```

```
Serial.print(flowMilliLitres, DEC);  // Print the integer part of the variable
Serial.print("mL/Second");
Serial.print("\t");

   // Print the cumulative total of litres flowed since starting
Serial.print("Output Liquid Quantity: ");
Serial.print(totalMilliLitres,DEC);
Serial.println("mL");
Serial.print("\t");

if (totalMilliLitres> 10000)
   {
setRelay();
   }

if(flowRate> 5)
  {
Serial.print("WATER FLOWING ");
flowMillicount++;
Serial.print("flowMillicount: ");
Serial.println(flowMillicount);
Serial.print("\t");
  }
if(flowRate< 5)
  {
Serial.println("FLOW STOPPED ");
flowstopcounter++;
if(flowstopcounter>2)
    {
flowMillicount=0;
  }
  }

if(flowMillicount>10)
  {
waterwastage=1;
Serial.print("flowMillicount>10");

 }
if(waterwastage==1)
 {
Serial.println("WATER WASTAGE");

swVal=digitalRead(swOut);
if (swVal==LOW)
    {
Serial.println("Button pressed");
resetFlowMillicount();
waterwastage=0;
    }
else
{
Serial.println("Button not pressed");
setRelay();
```

```
  }
 }


pulseCount = 0;

    // Enable the interrupt again now that we've finished sending output
attachInterrupt(sensorInterrupt, pulseCounter, FALLING);
  }
}

//Insterrupt Service Routine

voidpulseCounter()
{
  // Increment the pulse counter
pulseCount++;
}

voidsetRelay()
{
digitalWrite(solenoidValve, HIGH);
}
voidresetRelay()
{
digitalWrite(solenoidValve, LOW);
}
voidresetTotal()
{
totalMilliLitres=0;
countMilli=0;
resetRelay();
}
voidresetFlowMillicount()
{
flowMillicount=0;
resetRelay();
Serial.println("inside resetFlowMillicount()");
}
```

## 4.SIMULATION AND OUTPUT:

The simulation was carried out in the real-lifesituation. The device prototype was tested for accurate measurements of both time and volume and based on the same effect open orclose action. After successive simulations, we are able to calibrate the device including the IOT program to give the desired result. A snapshot of the sample output is given below:

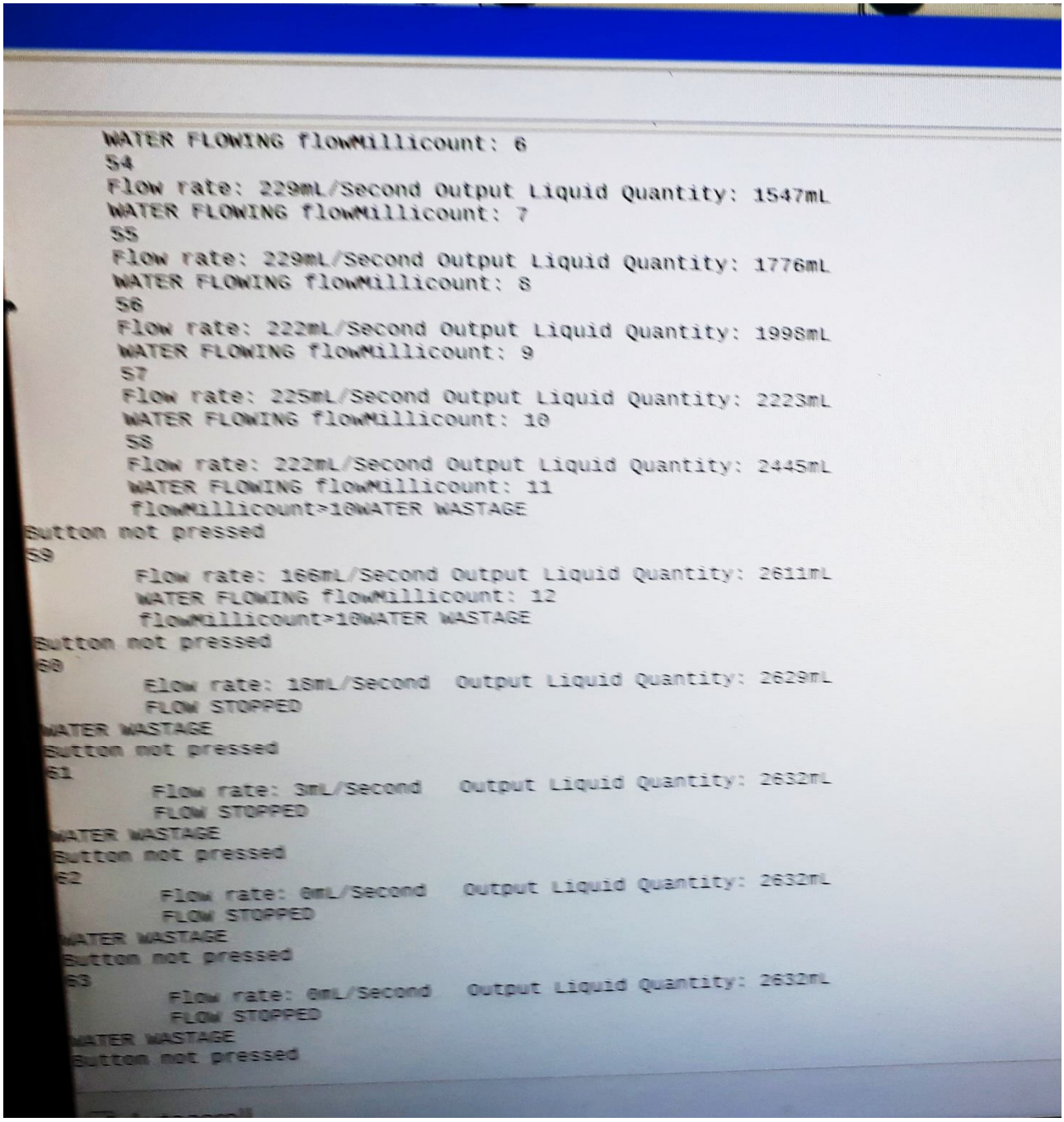


**Figure 3:** Output result of the experiment

## 5.CONCLUSION:

The Automatic Water Flow Regulator Device has been successfully designed and a prototype developed to address the water wastages taking place as discussed in thisPaper. The prototype has been tested for getting automatically turn On/Off on the basis of time and volume parameters provided as input to the system. The system will automatically turn off/on the solenoid valve of supply water control so that for a certain amount of time consumer can use the water. For the given time, if any consumer uses motor pumps to draw in excess of the volumeprovided as input in the system, the system will automatically identify and take appropriate action such as turning off the solenoid valve.

The user can use the device to control the water flow into the system taking into consideration their own usage pattern. User can be anorganisation such as resident societies, Government offices, schools and colleges, commercial complexes etc. The users can also be an individual family.

The users can expect the following additional financial benefits from the usage of Automatic Water Flow Regulator: -

a. Reduction in Water Bill:
With the reduction water usage, the water bill may also reduce.
b. Reduction in electricity use consumption:
The usage of electric motor for pumping water may come down with efficient use of water.
The reduction in the water & electricity bill would effectively reduce the cost of the device. Needless to add, that thebenefitswould also accrue to the society at large in terms of conservation of water.

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**AUTHOR:**

JyotirmayeeBehera: M-tech in Mechanical Engineering from BPUT Odisha . Nowshe is working on IoT based Machine to Machine -communication and working on sensory activity with control system.

SaroshBaig: Continuing M-tech in CSE from BPUT. Now working on IoT implementation and solution based on different micro-controllers.

Dillip Kumar Mishra :Received the B-tech from RTMNU, Nagpur university And M-tech from BPUT , Raurkela , with Computer science and engineering . Now doing his patent work on smart communication with ion saturation . His specialization on WSN, ANN, NuroFuzzy , Deep Learning , Quantum computation.

DrGayatriDevi:PhD in 1998 from Utkal University . Her specialization OR, NN, Software Engg, PCB design , communication . Recently working for patent " newtechology for communication with ion saturation"