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Design a Smart Faucet for Reducing the Water Wastage using IoT

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Abstract- Smart faucet aims to reduce the wastage of water that happened in the bathroom while using a solar water heater for a bath. It also prevents the hot water scalds due to high temperature in showers and hot water taps. It controls the hot water temperature by mixing required cold water to bring down to user-defined temperature. Users can set the temperature value in the control unit and switch it either by the switch or by using the mobile application using IoT. It takes time to reach hot water in tap from solar water heater due to long pipeline connections. So much water is wasted and time too. Users can switch the unit and make it ready for use before entering the bathroom by using the mobile application. Unless Coldwater stored in the hot water pipeline is underground water storage for recycling. Smart faucet uses NodeMCU as a controller, temperature sensor, motorized ball valves, solenoid valves, temperature knob and relays for switching the solenoid valves.

NodeMCU is incorporated with the android application called 'Blynk'. It receives and sends data to NodeMCU so that the user can monitor all the parameters like flow rate, temperature, the quantity of water used and control the unit from the mobile. The motorized ball valve is used to regulate the water flow rate. So that the ratio of hot water to cold water can be achieved. These adjustments are carried out by means of the control unit as per the decision taken according to the temperature sensor value. In the meantime, the temperature required by the user can be taken as input by means of a potentiometer. By considering the user-defined temperature and temperature sensor signal, the angle of hot water and cold-water ball valve will be modified automatically to achieve the required temperature. The solenoid valve will open and close the line for draining purposes and for use. It acts as a direction control valve. All the above processes will carry out simultaneously once the user switch ON the unit. Hence wastage of water will be stopped and valve automation is achieved.

Keywords: Automatic valve, Smart faucet, IoT based faucet.

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I. INTRODUCTION

More than 60% of million households now using a solar water heater, which means hundreds of millions of liters of water unnecessarily, goes down the plughole every day. That is a huge problem that needs a quick solution. Therefore, to overcome the problem waste of water should be stopped for the purpose we decide to build a smart faucet Basically, our project is an automated faucet with Arduino as controller and temperature sensor is used. It aims to detect the temperature of the user from potentiometer input, then certain functions based on these readings which are getting the right water temperature for the user to save time and water bill. It can be also operated by using a mobile application instead of wasting time in front of the tap.

Normally we used to get hot water at the desired temperature by adjusting manually in a wall mixer for taking a bath. Hundreds of millions of liters of water are wasted every day as people turn on their hot tap and wait for the water from a solar water heater to reach a useable temperature. Research has shown that up to fifteen liters of water can be wasted every time someone turns on a hot tap and waits for the water to reach the required temperature. Suresh babu et al. (2014) used a catalytic coating technique for the elimination of exhaust gas after-treatment systems for reducing the emission and improving the performance of the IC engine. Similarly, in this project to minimize the wastage of water and user-defined temperature control system is used with the help of IoT techniques.

II. LITERATURE REVIEW

Xiao zenghong et al. (2012) The field open washrooms utilize the sun-based vitality as the force it will be productive on both nature and the economy. This paper has utilized Polysun programming as the instrument for a re-enactment of wide-open restrooms warming frameworks execution. Playing out a parametric report and to meet a given least sunlight-based portion with the most reduced expense. Finding ideal working conditions for the framework.

Aldrin C. Tasong et al. (2019) Water is fundamental in the standard ordinary nearness of humankind. Nuclear family people use water to proceed with life. Nowadays, nuclear family people superfluously use water without acknowledging how much water do they starting at now eat up continuously and are oblivious on which installation in the family has the most raised water usage. With the use of the snare of things (IoT) organize with the visual examination (VA), a consistent water usage checking system has been made for the nuclear family and promoted assembling applications.

Akazue I. Maureen, AjenaghughrureIghoyota Ben (2017) Existing brilliant restroom computerized spigot frameworks work on conventional control hypothesis, with total control esteem, regardless of its level of precision. For instance, a sans hands hand wash bowl might be customized to discharge water when an article is about 2cm near the infrared sensor.

This outright control esteem has traps, for example, discovering the amount of water required for every activity, without actuating the water stream change to discharge water at a most extreme rate, prompting wastage of water assets.

Alexander Belov et al. (2012) This paper introduces a novel ongoing water stream control approach for residential water warming frameworks targeting diminishing the recompense impact of DLC activities. The distinguish conceivable control techniques dependent on an examination of the water framework's warm elements. The plan the issue of ideal water stream control as far as the least WH compensation request and greatest client comfort fulfillment. Client comfort is formalized by an indispensable vitality trademark. Reproductions show that water stream control can altogether relieve the DLC recompense impact by arriving at the reasonable trade-off between vitality reserve funds and distress of an end-client.

Daniel Berglund et al. (2018) This similar life-cycle evaluation features three fundamental choices for the redesign of wastewater sewerage: pipe substitution, relieved set up pipe (CIPP) lining (additionally called slip lining) and renovation by coatings. The useful unit of this investigation is a six-story square house that was manufactured in1960 and has 29 lofts. The portrayed consequences of ecological effects show an advantage for CIPP-lining over channel substitution in 14 of the 18 contemplated sway classes. Concerning in which effects were nearly huge when taking a gander at the normal effect from a European resident as indicated by the Recipe strategy forever cycle stock rundown, pipe replacement has more noteworthy effects than CIPP-lining.

Chia-Fen Chi et al. (2019) The present examination represents the symbol configuration process for 20 capacities for a brilliant lounge room and savvy bathroom of a business shrewd structure control framework. For each capacity name, seven symbol groups (picture related, concept-related, semi-unique, subjective, word, shortened form, and joined) were created by 30 alumni students and contrasted and an inclination positioning test by another 13 official MBA understudies. The participatory design and positioning test assessment approach can be applied for the plan and assessment of visual symbols in other application settings.

Thomas Collin et al. (2006) Singes in kids brought about by hot shower water have been for all intents and purposes disposed of in nations where thermostatic blender valve (TMV)devices have been presented. We intended to decide the recurrence and seriousness of these wounds in our district and gauge a decrease in the outstanding task at hand and cost if TMVs were presented later on.

Talita Cruz et al. (2020) Sun oriented vitality is a promising hotspot for water warming in the family area in Brazil. Be that as it may, in spite of its huge potential, its utilization is as yet constrained in the nation. This examination investigates the specialized monetary capability of Solar Water Heating (SWH) frameworks in the family unit division in Brazil, partitioning the nation in various atmosphere zones and utilizing an assortment of parameters and site-explicit conditions. A Geographical Information System (GIS) is utilized for spatial investigation. Results show the best locales to actualize SWH frameworks in Brazil, just as their specialized financial potential until 2050. The investigation shows that SWH frameworks are monetarily doable for 17.9% of thought about cases by 2020, prompting reserve funds of up to 15.54 TWh/yr

Haytham M. Dbouk et al. (2019) The interest for sun-powered water warming frameworks has expanded essentially all through the world thinking that sunlight-based vitality is a sustainable source ready to diminish the dependence on rare assets. In any case, the overabundance of sun radiations (particularly during summer) has brought about an overheating issue which lessens the unit life expectancy, causes untimely segment disappointment, and diminishes the framework's presentation. This paper displays a plan for a temperature control framework that can decrease the overheating of private sunlight-based water warming frameworks, therefore securing the unit. The created model was tried on a full-scale sun-powered water radiator with promising outcomes.

Danilo de Freitas Melo et al. (2017) In lofts, houses, and inns, showers are by a long shot the greatest customers of water, reacting to about 25% of the absolute volume expended each month. At the point when winter hits enormous urban communities, what's more, temperatures fall, the boiling water utilization increments significantly. Since end, clients regularly apportion cold water present in the pipelines until the warmed water from the repositories is seen in showers or different purposes of utilization, inns and private structures are liable for an impressive misuse of treated water. The accomplished advantages are substantial and noteworthy when contrasted with the committed existing frameworks.

Mary Alison Durand et al. (2012) Small kids and more established individuals are especially powerless against tap water scalding. For kids, there are likewise financial disparities in chance. Proof suggests that lessening faucet water temperatures in social (open) lodging through 'detached' signifies is successful in decreasing danger. Be that as it may, little is thought about guardians' or more established individuals' perceptions of burn hazard and counteraction.

Prachi Dutta (2016) Because of developing requests of water in the up and coming a long time and with numerous nations seriously affected by water emergencies today, we would require a more proficient framework than customary methods of residential water the executives. This paper focuses on building up a productive and financially savvy technique for putting a maximum of utmost on the measure of water utilized day by day. This model is a spigot gadget which has two methods of activity: running mode also, filling mode. This novel observing methodology is economical which likewise spares a wealthy amount of water.

Amar Banmare et al. (2019) In the present everyday life computerization can assume a significant job. Mechanization makes things basic. Right now, we are taking a shot at an android application where a client will give voice directions to controlling gadgets,
for example, "COLD and HOT" which will be associated with the raspberry pi and as per it the necessary procedure will work by means of Bluetooth availability. This computerization can be utilized significantly in the home as well as in mature age home. This framework requires a small-scale SD card with an OS (LINUX) for Raspberry Pi. Utilizing this we can say a normal home is changed over to savvy home.
Fidar. A.M et al. (2016) The quick pace of urbanization accompanies extensive natural ramifications including pressures on already focused on constrained water assets. In urban territories, a large portion of water use is related to water consumption in structures. The second biggest utilization of water is by means of taps. It is frequently expected that water taps with low stream rates can add to decreased per capita water utilization. Be that as it may, this is based on very little proof. This paper shows the combination of 13,000 high goal perceptions made to investigate the genuine water utilization of creative (water sparing) electronic taps and conventional mixer taps.
Fuentes. E et al. (2017) Local heated water utilization (DHW) represents a noteworthy portion of vitality utilization in various sorts of structures. Accomplishing a point by point portrayal of residential high temp water use profiles is of extraordinary pertinence, as this data will take into consideration a progressively dependable appraisal of the vitality productivity of frameworks and structures. Cutting edge demonstrating instruments for creating DHW use profiles are outlined and new research lines are then proposed, considering the admonitions in the ebb and flow portrayal and displaying of DHW utilization in structures.
Kendrick D et al. (2010) To evaluate the viability of thermostatic blending valves (TMVs) in decreasing shower hot faucet water temperature, survey agreeableness of TMVs to families and effect on shower time security rehearses.
Naik-Nimbalkar. V.S et al. (2010) Temperature vacillations happen because of the warm blending of hot and cold streams in the T-intersections of the funneling framework in atomic force plants. Temperature variances cause a warm weakness of the funneling framework. In the present work, warm blending investigations are completed on a T-intersection with water. Speed and temperature fields are estimated utilizing hot film anemometer (HFA). Three-dimensional consistent state computational liquid elements (CFD) reproductions have been completed to foresee the speed and temperature fields.
Salgado-Conrado. L et al. (2019) Right now, recognize and depict the hindrances that point to confinement to the establishment of sunlight-based water warming (SWH)systems in Mexico and the way in which the Mexican government has been progressing in the direction of overcoming these difficulties. Information in regards to compositional, specialized, monetary, advertising, social, and political obstructions was gathered from legitimate administrative distributions, Mexican diaries, and articles, and contrasted and results from comparable research articles. Our outcomes uncovered that the legislative projects have decidedly propelled the reception of SWH frameworks.
Punnaiah Veeraboina et al. (2012) A sun-oriented water warming framework (SWHS) is a gadget that makes accessible the warm vitality of the occurrence sun-oriented radiation for use in different water warming applications. SWHS to a great extent relies upon the exhibition of the authority's productivity at catching the occurrence of sun-oriented radiation and moving it to the water. With the present SWHS, water can be warmed up to temperatures of 60–80 ◦C. Warmed water is gathered in a tank protected to forestall heat misfortune. Dissemination of water from the tank through the gatherers and back to the tank proceeds consequently due to the thermosiphon standard. India has the most elevated vitality forces in Asia. Almost no speculation and need are being given to increment of productivity.

III. COMPONENTS DETAILS

Based on the literature reviews there is no evidence, for wastewater recovery and valve automation for the solar water heater. This will lead to a water crisis and cause hot water scalds. So, we decided to make a product that will overcome the wastewater from a solar water heater and make automation for hot and cold-water regulation. This will become a smart home appliance for user-friendly performance. The various components involved in the smart faucet listed below in table.1

Table: 1 Component of the smart faucet

Si.no	Description	specifications	Qty
1	Motorised ball valve	0-90 (servo control)	2
2	Solenoid valve	½” 12 v	3
3	Relay module	4 channel 5 volt	1
4	Control unit	Node MCU	1
5	SMPS	5Volt&12Volt	1
6	Temperature sensor	DS18B20	1
7	Potentiometer	10K	1

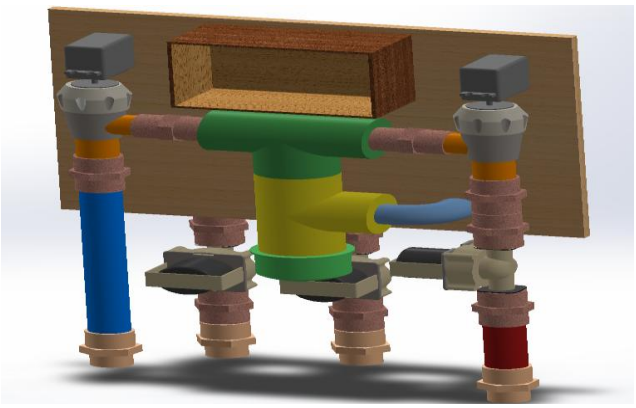


Figure: 1 Design of the smart faucet

The proposed smart faucet is designed by using solid works v2018 software. It is shown in fig.1. the function of each component is decided below.

IV. FUNCTION OF COMPONENTS

A. Node MCU

Node MCU is an open-source IoT platform. It initially included firmware that runs on the ESP8266 WiFi SoC from Espressif Systems and hardware which was based on the ESP-12 module.

B. Relays

Transfers are exchanging that open and close circuits electromechanically. Transfers control one electrical circuit by opening and closing contacts in another circuit. At the point when a hand-off contact is Normally Closed (NC), there is a shut contact when the hand-off isn't invigorated.

C. Solenoid valve

They are regularly used to supplant manual valves or remote control. Solenoid valve work includes either opening or shutting a hole in a valve body, which either permits or forestalls move through the valve. An unclogged open or shuts the hole by raising or bringing down inside a sleeve tube by stimulating the loop.

D. DC motor

A 12-volt DC engine is a rotational engine that can change over the immediate current into mechanical vitality or convert mechanical vitality into DC power. It implies that the 12-volt DC engine can interconvert electric vitality and mechanical vitality. At the point when it is worked as a DC engine, electric vitality is changed over into mechanical vitality.

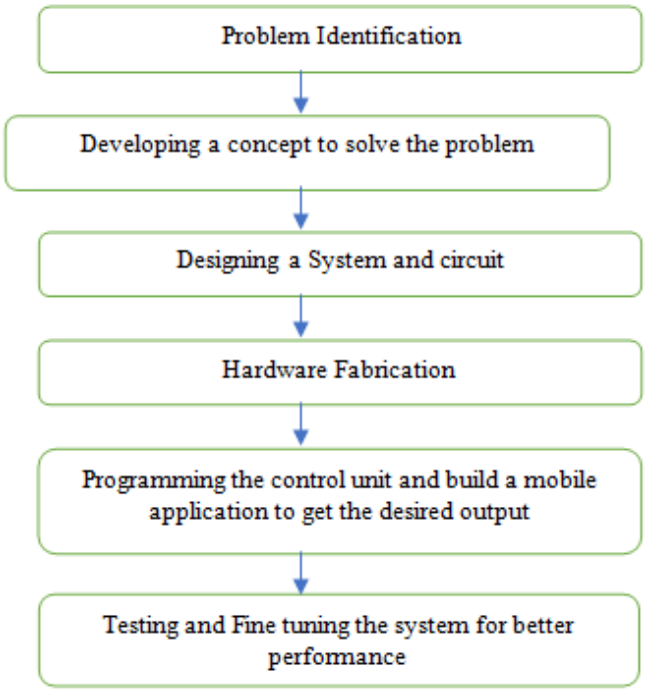
E. Temperature sensor

The DS18B20 is an alleged 1-wire advanced temperature sensor. Suresh babu et al (2020) used three different types of sensors for emission measurement of IC engine. Similarly, in this project for temperature measurement of water RTD type thermocouple sensor is used. The words "advanced" and "1-wire" make this sensor truly cool and permit you, with a too straightforward arrangement, to peruse the temperature of at least one sensor. You can even associate the various gadgets together, using just one pin on your Arduino.

F. Servo motor

The capacity of the servo engine is to get a control signal that speaks to an ideal yield position of the servo shaft and apply capacity to its DC engine until its pole goes to that position.

V. METHODOLOGY



VI. RESULT AND DISCUSSION

The experimental result for different water temperatures for user-defined value is tabulated below.

User-Defined Temperature: 40 ℃

Both the hot and cold water is set to the same flow rate.

Table: 2 Output result of the smart faucet

Exp.No	Hot water Temp. (℃)	Coldwater Temp. (℃)	Hot water valve (degree)	Coldwater valve (degree)	Output Temp.
1	65	28	20	70	38.7
2	63	28	25	65	39.5
3	61	28	30	60	38.1
4	59	28	35	55	41.6
5	57	28	40	50	39.9
6	55	28	45	45	39.6
7	53	28	50	40	40.8
8	51	28	55	35	38.2
9	49	28	60	30	39
10	47	28	65	25	40.5

11	45	28	70	20	39.3
12	43	28	75	15	41.4
13	41	28	80	10	38.9
14	39	28	85	5	40.2
15	37	28	90	0	39.8

From the experiment, the system performance is studied. And the error in the output value is **±2℃.** Similarly, the behavior of the system is any user-defined temperature.

Wastewater recovery through this smart faucet:

Conventional Faucets	Smart faucet
7.5 Liters* of water is drained in a hot water pipeline for every use. If four-person uses the faucet by two times a day, approximately 60 liters * of water will be wasted every day.	There will be no wastage of water as all the cold water in hot water pipeline will be automatically sent to the storage tank for re pumping to overhead tank

*****The amount of water stored in the pipeline is calculated for two buildings to have two floors. Wastage will increase if the number of floor increase as more length of the pipeline is required to connect hot water from a solar water heater.

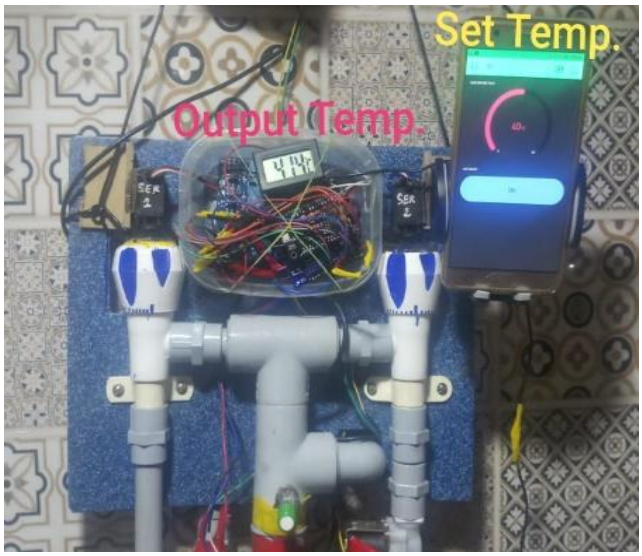


Figure: 2 Experiment on output temperature for different hot water temperature for a user-defined value

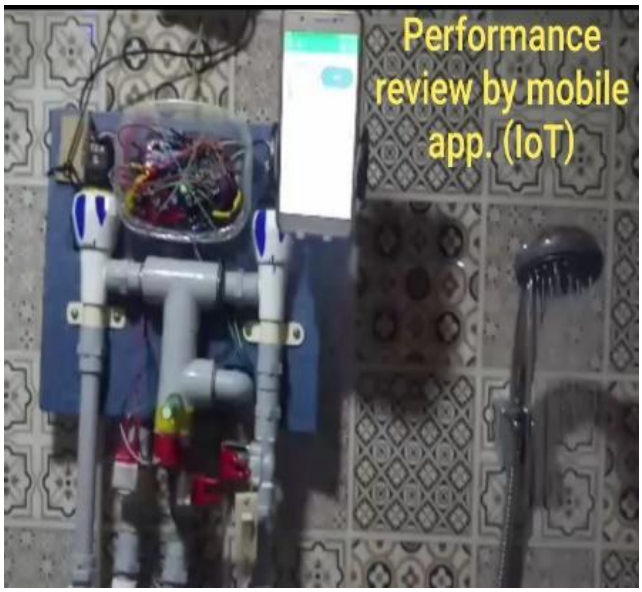


Figure: 3 IoT in a smart faucet

VII. CONCLUSION

Based on the reviews, it is noticed that automation in valves using IR sensors, water usage monitoring, heater efficiency, flow control and improvisation in solar heaters and water dispensers were exist up to date. There is no system still now for wastewater recovery for solar water heater users and IoT based hot water mixer valve. Our proposed design will enable the user to operate the faucet anywhere by using the internet. Users can prepare the hot water and get it ready to dispense from shower or tap for a bath. It reduces the waiting time, meanwhile, there is no wastage of water while drawing hot water from the solar water heater as the useless cold water in the hot water pipeline is automatically send to the storage tank for reuse. It will become a smart device in all homes and commercial buildings to save water and monitor water usage.

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