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AN ARDUINO BASED SMART FAUCET DESIGN

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Abstract: In this paper, we propose a new design of smart faucet system that measures the body's temperature prior the water falling in pipes by using DS18B20 sensor an act correspondingly. The design was implemented using Arduino Uno Microcontroller that is connected with temperature senor to control two water valves (i.e. Hot & Cold) in order to mix the proper amount of hot and cold water conforming the body temperature. The proposed design can be easily adapted to the water piping system of already constructed buildings by replacing the old faucets with the new automated ones. Such design can be very useful to reduce the amount of wasted water during the setup phase of mixing hot and cold water.

Keywords: Arduino, Microcontroller, Smart Faucet, Temperature Sensors, Solenoid Valves, Relays.

I. INTRODUCTION

From running a shower and rinsing the dishes to washing hands and 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 combination boiler to reach a useable temperature. Research has shown that up to eight liters of water can be wasted every time someone turns on a hot tap and waits for the water to reach the required temperature. With more than 60% of million households now using a combo-boiler, 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, we determined to stop this waste of water, and that is how to decide to build a smart faucet. Basically, our project is smart faucet with microcontroller and temperature sensor. It's aiming to detect the temperature of the user, then analyze it and do certain function based on these readings which is getting the right water temperature for the user, if it detected then a certain procedure will be activated in order to save your time and water bill.

Smart Faucet can prove effective in helping to significantly reduce water wastage. We have all been there, first turn on the hot faucet and wait for the water to heat up, and then turn on the cold faucet to bring the temperature back down to a comfortable level. How much water is wasted from that? And finding the right balance of hot and cold is a frustrating game. An average home has almost 40 m of 20 mm pipe. This holds 12 liters of water. If hot water is used 10 times per day, 117 liters of water is wasted running the faucets/shower to get the convenient water temperature. In a year, this equals 43384.6 liters of water. Over twenty-five million homes waste approximately 1 Trillion liters of water annually [1].

Money is a big concern when it comes to appliances and home improvement, which is one reason why smart home products are so great, they save you energy and money whether we're talking about thermostats, power plugs, or lighting solutions and faucets now join that list. For example, smart faucets that are marked Water Sense use 20% less water than traditional faucets right out of the faucet. Couple that with finer controls for temperature and pressure and you'll conserve more water while wasting less.After all, improved water efficiency means you can get the same amount done with less water, and less water used means a smaller water bill every month. Also, it comes from an Islamic impetus where our prophet Mohammed (peace be upon him) told us by meaning "Don't waste water, even if you on a flowing river". Moreover, here is a survey that we have done to take a closer look on how serious is the problem and how much litter of water have been wasted.

In this paper, we propose a new design for smart faucet using Arduino microcontroller and sensing unit as well as water flaw control unit. The proposed faucet system provides many features such as: detect the user's temperature, knowing what is the right water temperature that the user needs, save water by the auto adjustment of the valves, make life easier, save the time for each and

every time you adjust your ordinary faucet, save children or adult from getting burned accidentally by hot water.

II. DESIGN REQUIREMENTS

The system to be designed, it requires the contribution of both software (such as Arduino IDE and C programming Language) and hardware components. Table.1. shows the complete system requirements while we summarize the three major components as follows:

A. DS18B20 [2]: is a digital thermometer provides temperature readings which indicate the temperature of the device. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line and ground for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line eliminating the need for an external power supply.

B. ARDUINO UNO [3]: is a microcontroller chip based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed by using a free software called Arduino IDE which it is available in every computer system, which is used to write and upload the computer code to the physical board.

C. FCD270A SOLENOID VALVE [4]: is a device that converts electrical energy into mechanical energy. In addition, a solenoid valve can control the flow of media either open or closed. The principles are based around a thin copper wire wound around the solenoid in such a way that when electrical energy is applied a sufficient magnetic field is generated to provide a lifting force to a Ferro magnetic stainless-steel armature within the solenoid valve armature assembly which in turn will directly or indirectly change the position of the valve.

Table 1: The complete system components

Wires		Arduino Uno	
Multimeter		**DC Batteries**	
Resistors		**Solenoid Valve (FCD270A)**	
Tempreture -Sensor (DS18B20)		**4 Channel 5v Relay**	

III. SYSTEM MECHANISM

In general, the system has been built from several components such as sensor, Arduino, relay, and valve. These components work together in a conditional and iterative mechanism as illustrated in the flowchart of the system in Fig.1 which summarizes the mechanism of smart faucet.

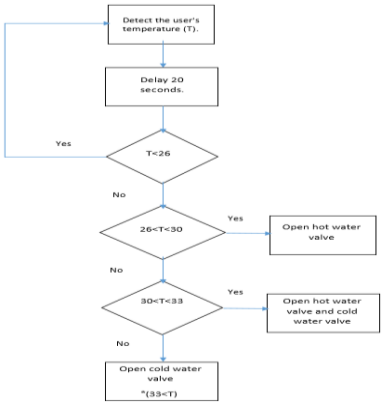

Fig.1: flow chart of the mechanism

First of all, the sensor will start measuring the temperature of the body once the user touch it, and then we will get the result as number. Second, the data will be transferred to Arduino Uno to analyze the data and convert them in form of temperature scales weather in Celsius or Fahrenheit as shown in Fig.2.

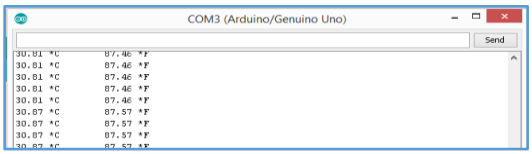

Fig.2: temperature detection through Arduino IDE program

Third, Arduino Uno will send a signal to one of the two relays based on the temperature of the user. After that, when the signal comes to the right relay it will connect the valves with an external 27v battery to open the valve. Finally, the right temperature water will come out from the valve for a specified time, 20 seconds to be more specific.

IV. FINAL PROTOTYPE AND TESTING

The aforementioned components have been all connected and then configured by programming and libraries to perform as a requested: at the beginning the temperature of the body is sensed by the temperature sensor; IF the temperature is less than 33 and greater than 30 Celsius then send a signal to pin 3 and 5 which cold and hot. Finally, if the temperature is less than 30 Celsius then send a signal to pin 3 which hot. The complete prototype can be depicted in Fig.3.

Fig.3: The Final Prototype Design

To verify the system functionality, we have performed several tests that can be summarized as follows:

- The redLED is on which means that your temperature is less than 30Celsius. It means that your temperature is below normal, andyou need hot water.
- The blue LED is on, which means that your temperature is greater than 33 Celsius. It means that yourtemperature is above the normal, and you need hot water.

Both LEDs are on the red and the blue which means that your temperature is greater than 30 Celsius and less than 33 Celsius. It means that your temperature is normal your need normal temperature water.

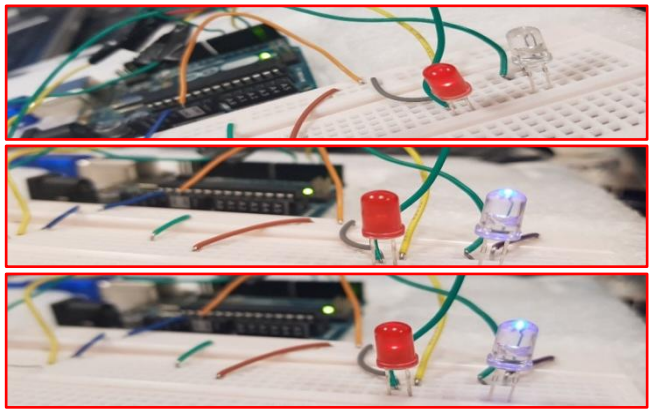

Fig.4: System response if (a) T<30 (b) T>33 (c) 30<T<33

V. CONCLUSION AND FUTURE WORK

Ultimately, Water is the most valuable resource on the earth, and saving it is necessary for solving the problems of water scarcity in the future. In his work, we have developed a faucet that can detect the temperature of the user and based on that reading, it will determine whether the user feels hot or cold. After that, it will decide the right water temperature that the user's need. This work was proposed to enhance water conservation and take our daily life to another stage of convenient, saving time and safety. Since, everything around us becoming automated, we also emphasize the perspective of automating the faucet system. In the future, we think to enhance our project via: (1) using high quality temperature sensor with more accurate measuring the human temperature such as: TMP100 [5]. (2) using Series Zc Control Ball Valve [6] instead of the ordinary solenoid valve because it will only use one battery with value of 10vdc 24 vdc battery for each solenoid valve in order to work. Also, V-ball is simply a solenoid that can open with a 15°, 30°, 45°, 60°, and 90° degree by the value of the voltage coming through it from the battery. TMP100 chip and Series Zc Control Ball Valve are illustrated in Fig.5. below.

Fig.5: (a) TMP100 chip (b) Series Zc Control Ball Valve

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