Design and development of a mechatronic water saving system for conventional faucets

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Abstract. In many places in the globe, such as north Africa and middle Asia, water is very precious and scarce resource and must be must be used rationally. For example, preventing water from running through the taps when it is not being used is one of the actions that should be considered. This article follows on from this idea and describes the prototype for that can be attached to conventional off-the-shelf faucets in order to prevent water waste.
the document later disclose the water wastage problem specific to the households problem namely water taps, highlighting a shade of what predecessors had relevantly done to solve it. In addition, the paper provides the obtained results annexed with some explanatory diagrams. drawings the conclusions. the Water is essential for all living creatures on the planet, hence efforts to conserve it must be made. Making automated water taps is one way to reduce water consumption. so it's important to conceive of a solution that controls both water level and water flow much us reducing related energy like heat and electricity. Basically, the circuit is mounted on a breadboard as the electronic part will be incorporated into the system design conceived to fit the majority of single lever tap. The document end with a study of a 3d devise having design which can be a commercialised devise with more improvement of a potential manufacturer.

Keywords: infrared · Ultrasonic sensor · Single Lever Tap. ·

1 Introduction

Water is vital for all living things on the earth, so there must be an effort to save water. One effort to save on water use is by making automatic water taps. Automatic water taps which are meant here are water taps on the sink and also water taps for ablution. The working principle of the two taps is the same, that is, the water tap will open if there is an object(human) detected in front of the water tap. In this automatic faucet system the arduino mega2560 micro-controller is used as data processor obtained from ultrasonic sensors and Passive Infrared Receiver (PIR) sensors. The two sensors are used interchangeably and the results are compared to determine the difference in response time. Based on the tests that have been done,it is found that the time needed for the ultrasonic sensor to open or close the water tap is faster than the PIR sensor. When opening the tap the time needed by the two sensors is almost the same, which is only 4ms difference.

Whereas when closing the tap the time needed for the PIR sensor is much longer, which is more than 4s. This is because the process of returning the sensor to return to normal is not detecting the presence of humans or in other words the sensor does not detect infrared rays tend to require a longer time. As for the ultrasonic sensor because what is detected is the distance, so the object moves from the front of the tap then the distance detected will change immediately so that the tap will immediately close again.1. Introduction The Earth's surface is covered 71% of water. (PDF) Comparison of Automatic Water Taps Using Ultrasonic Sensors and PIR Sensors.

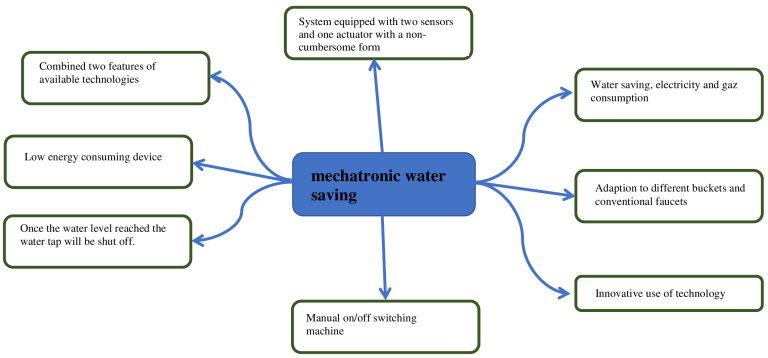


Fig. 1: Operational characteristics that the current solution must provide.

2 Related work

The author in [1] discussed a possible implementation of a camera to visualise, analyse and detects the washer's hand. the solution consist the programming of the micro controller through Python. An approach referring to the segmentation integrating colour and motion. In addition to the hand detection his solution encloses another feature such us the bottle detection that concerns the water level detection. The bottle is detected, and the bounding box is computed. By that way the machine will calculate the amount of the required water for the hand otherwise for filling the bottle/container. As a result the accuracy obtained for the detection of hand is 85.7% and for the bottle is 77.8%. In [2] researchers have had discussed a solution comprising of an infrared spreader and receiver circuit, as well as a unit and a solenoid valve. The infrared sensor is used to detect hands. This investigation came as a response to requirements of irrigate level

manager in irrigation in farming. The working principal is the following: The pourings rate is determined through a Hall effect Sensor. The Hall effect irrigate flood sensor is a used sense unit with a turbine rotor. the device is able to changes its rotational speed in response to the irrigate flow rate. As a result of the project were a low cost solution As well as being simple for Mounting and the accuracy above ground. The investigation paper in [3] is about a system that consist a solenoid valve that will block/liberate the water flows thus the project aims to concrete a smart water meter monitor connected to an application through WIFI in order to send real time data. this feature is insured by the electronic chip ESP8266 equipped with WiFi. the card is related to an Arduino mega as an entry extension, In addition, The ATmega328P micro-controller put out instruction that are synchronised by the hardware, which then executes the desired operation. Users can use two extra functions: Set Timer and Set Plan. Users can use the Set Timer function to set a timer to turn on/off a water supply tap.

3 Materials and methods

Here is the steps which allowed to define a possible approach of the prototype's creation. The mechanic conception was made through SolidWorks and 3 design were proposed as steps leading to the final one like shown in the fig.8 then fig. 9 then fig.10 and finally the fig.4 .

The linear actuator get changed to the miniature one. In order to find out the limitations of the actuator through the strength and intensity as discreet in the table 1

As a result the circuit combining sensors with Arduino uno and the actuator using breadboard was established in the fig.10 the Arduino uno will be replaced in the following circuit in fig.4 by the Arduino Uno.

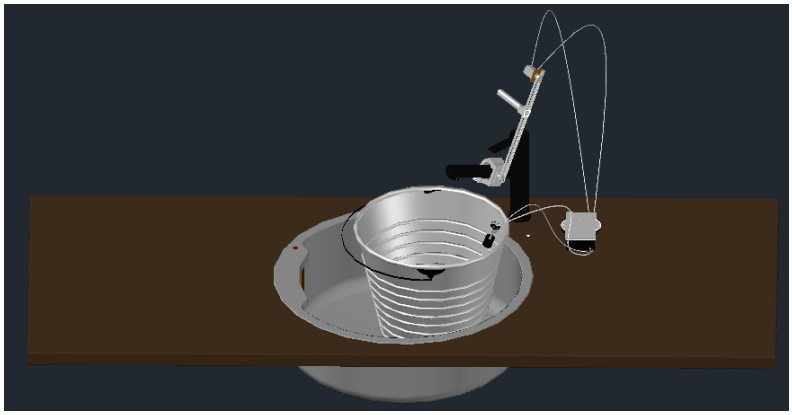


Fig. 2: First prototype

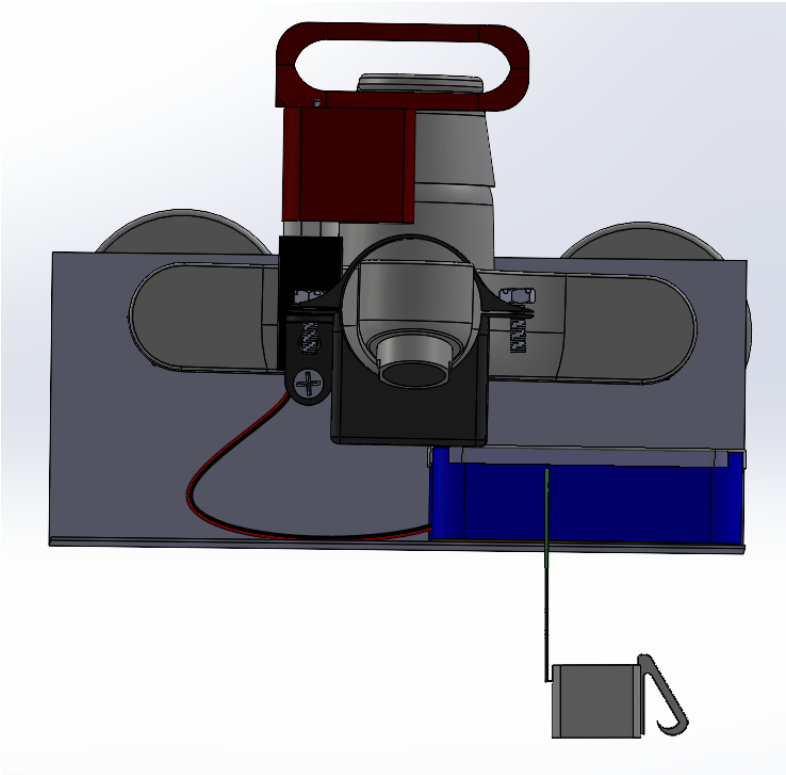


Fig. 3: Final prototype

KG	0	0.771	0.94	1.402	2.180	2.342
I(A)	0.05	0.093	0.135	0.250	0.281	0.256

Table 1: variation of the intensity by the load

4 Material used

The Arduino Uno is a microcontroller board that may be programmed with the Arduino IDE (Fig 4). This board can take in data, process it, and then output it the data. It includes 14 digital input/output pins, 6 analog inputs, and 16 digital input/output pins. A reset button with an ICSP header It has everything you'll need. Simply attach it to a power source to sustain the microcontroller. Use a USB cable to connect to your computer, or use an AC-to-DC converter to power it. To use it, you'll need an adapter or a battery. It runs on a 5V DC power supply [4]. This board will be used in this project to control the water tap lever as well as receive data from the water proximity and water level sensor. The Arduino board then processes the data and sends it on.

This electronic device shown in the Fig. 5 emits infra-red waves from one diode (emiter) to the other (receiver) as in order to sense objects of the surroundings as well

Fig. 4: Arduino Uno

as other abilities such us detecting the motions and measuring the temperature. Based on alimentation (VCC), ground (GND) and output (OUT) for feedback Pins, the assets of this sensor for the project is that it's used to detect the human presence. As it is adjustable, this sensor operates in the following range: 2.8V at 15cm to 0.4V at 150cm with a supply voltage between 4.5 and 5.5 VDC. Power by the Arduino card, the sensor will detect the human hand as an object when it will approximate to the machine the it will send a feedback to Arduino Uno card [5].

Fig. 5: IR sensor

the ultrasonic sensor in Fig.6 work with the same principle of the infra-red one and is able to detect liquid. that why it will better being used for the detecting liquid level. by sending sound waves from the transmitter, which then bounce off of an object and then return to the receiver. You can determine how far away something is by the time it takes for the sound waves to get back to the sensor.[6]

Fig. 6: Arduino's Ultrasonic sensor HC-SR04

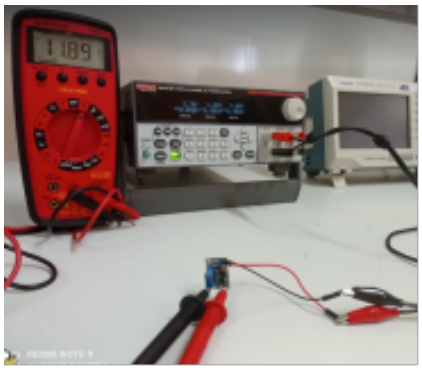
This actuator in the Fig 7 can move to push and pull a chosen mass that will be the lever in our case along its full stroke length. The speed of travel is determined by the gearing of the actuatortor and the load or force the actuator is working against at a given point in time. When power is removed, the actuator stops moving and holds its position, unless the applied load exceeds the backdrive force which is 4kg or 40N, in which case the actuator will back-drive.[7, **?**]

Fig. 7: Mini linear actuator

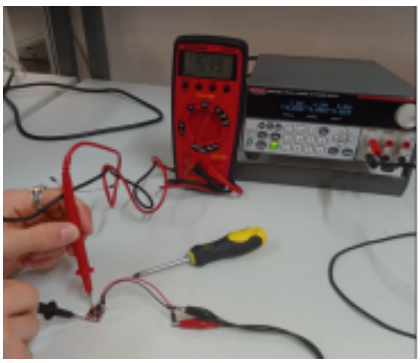
5 result

For that the transistor BS170 will provide a range of intensity between 50mA and 300mA. While using 8v from 2 batteries, we have instrumented the boost converters

in order to get 5v and 12v inputs respectively from Q5KJ and B6289Y. as shown in the Fig 8a and Fig 8b.



(a) Calibrating the B6289Y



(b) Calibrating the Q5KJ

As a result the circuit combining sensors with Arduino uno and the actuator using breadboard was established in the Fig 9.

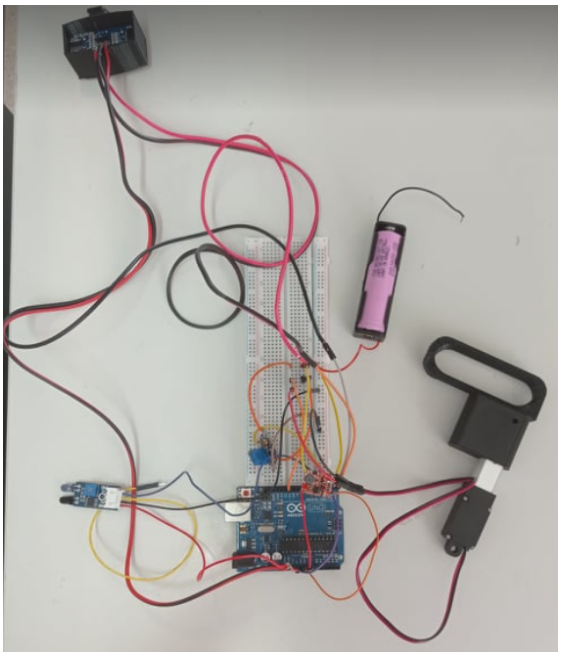


Fig. 9: Arduino's IR Sensor

6 Conclusion and further work

The system can be improved by using wireless sensor or adding a connection module to the HC-SR04. It's also possible to reduce the space of the electronic layout as the ATmega can be directly added the circuit programming it in stead of the whole card. The machine's design can be reproduced in a more suitable way.

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