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A Hygienic, cost effective, hand free & water conservative sensor faucet

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ABSTRACT: *The sensor faucets of the present world will serve the purpose of water conservation and impediment to infection control. But their prices confine them to a particular class of society. This paper explains our two designs which are 50% cost efficient relative to available sensor faucets. The first design is constructed by Infrared (IR) pair (IR transmitter & receiver). Generally active infrared (AIR) sensing technology is used in the hand free faucets. The receiver of this technique will demand a reflected ray (reflected by human hand) which activates the solenoid valve. Sothis design is complex and expensive. In our first design, the object is perceived when the IR rays path is disturbed. The sensor design of this approach will make things easy and cost efficient.The second design internal circuitry differs from the first design, But the sensing technique remains same. These designs will allow every section of society to use sensor faucets. The Association for Professionals in Infection Control and Epidemiology (APIC) reported that hand-washing causes a significant reduction in the carriage of potential pathogens on the hands and in health care. The water conservation, infection control and prevention can be made successful in developing countries like India.*
Keywords:-*Faucets, Sensors, Infrared, Design, Hygienic*

I. INTRODUCTION

The sensor faucets designing skill lies in ,"how it is detecting the object(human hand)". Generally active infrared (AIR) sensing & capacitance sensing are the two technologies on which the present day sensor faucets were designed. In our designs, "we used the infrared pair (IR transmitter & receiver pair) to sense the object i.e., human hand.

The automatic faucets were developed in 1950's but not for commercial use. Later in late 1980's these automatic faucets appeared for the commercial use-for the general public in the airport toilets. Then these faucets were available in the market in many different names like automatic faucets, hands-free faucets, touch-free faucets etc. But these faucets are limited to high class hotels, airports, restaurants, casinos, shopping malls etc. The main constraint for those faucets not being used by common people is that they are costly. This paper gives our two designs which are economically affordable by the common people.

Here, we explain the two designs we have built and tested. The complete circuit diagram with explanation has been detailed in the following section.

Contents:

II. FIRST DESIGN

The Basic design components are stated below:-
1) Infrared (IR) transmitter and receiver pair.
2) Solenoid valve.
3) Transistor (2N3904).

4) Resistors of 50Ω& 4.7kΩ.
5) Relay.
6) 5 volts power supply.
7) 220 volts AC power supply.

2.1 WORKING

The IR transmitter and receiver will work on infrared rays which are invisible to naked eye. The IR transmitter will emit the IR rays when a supply of 5 volts (DC) is given. The IR receiver exhibits two resistances based on the IR signals receivability. It shows a resistance of 2MΩ when the IR signals are absent or interrupted. Due to this high resistance the IR receiver acts like an open circuit as the currents are very small. The same IR receiver exhibits very less resistance (around 180Ω) when the IR signals are received. Here the IR receiver acts like a short circuit. The circuit diagram of the first design is shown in Fig 1.
The circuit diagram is shown below:-

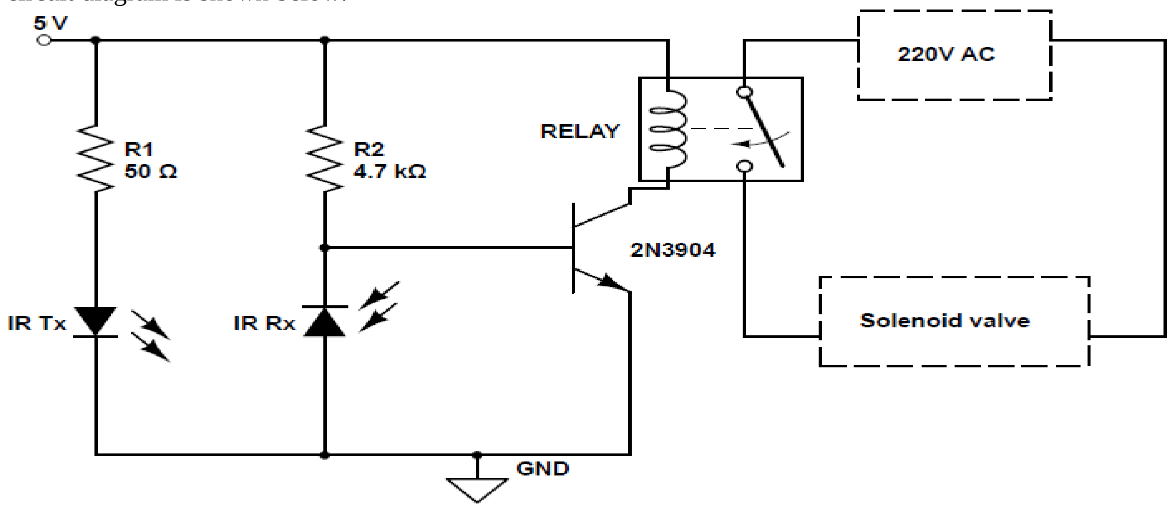

Fig 1: Circuit diagram of the First design.

2.2CASE 1WHEN IR SIGNALS ARE UNINTERRUPTED

As we have stated earlier, the IR receiver shows very less resistance as the IR signals are received and we can consider it as a short circuit. Hence the current across 4.7KΩ resistor moves to the ground directly via IR receiver as it is short circuited. The current does not enter in to the path of base of transistor as the resistance in this path is much higher relative to the IR receiver internal resistance. The current directions for this case are shown in Fig 2.

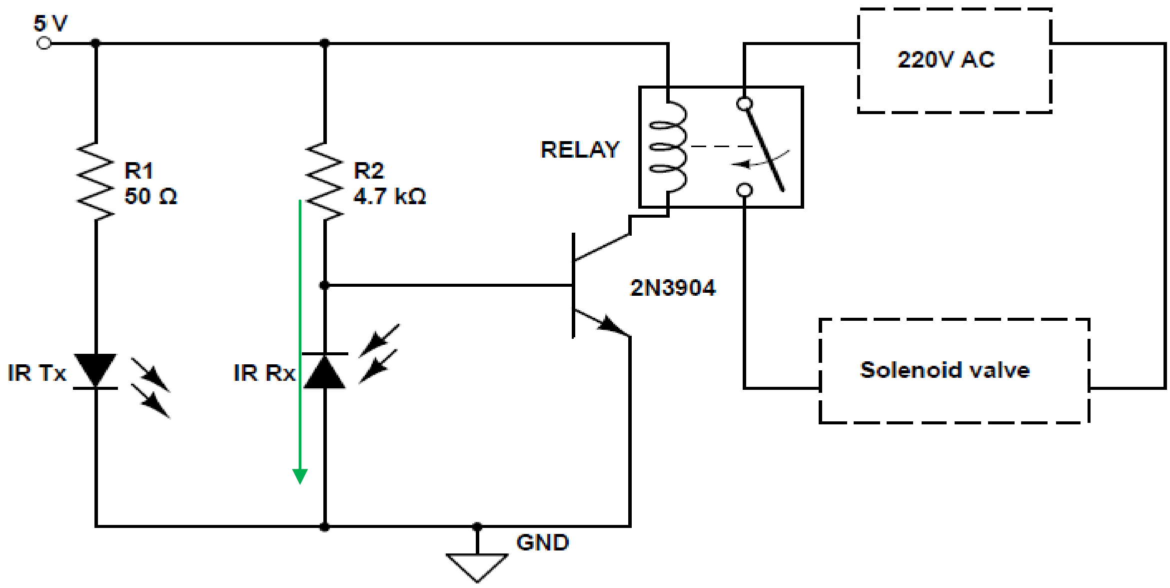

Fig 2: Current directions when the IR signals are uninterrupted.

2.3 CASE 2WHEN IR SIGNALS ARE INTERRUPTED BY AN OBSTACLE

In this case, when the obstacle, say human hand, is placed in between the path of IR rays i.e., (IR receiver don't receives IR rays emitted from the IR transmitter), the resistance of the IR receiver will be around 2MΩ which can be considered as an open circuit since the currents are very low. Hence the current across 4.7KΩ resistor will move towards base of the transistor and reaches the ground via emitter of the transistor. This current is the base current or triggering current for the transistor. This triggers the transistor to ON state which in return results to the activation of the relay which is in series with 5 volts DC supply and the collector. The current directions for this case are shown in Fig 3.

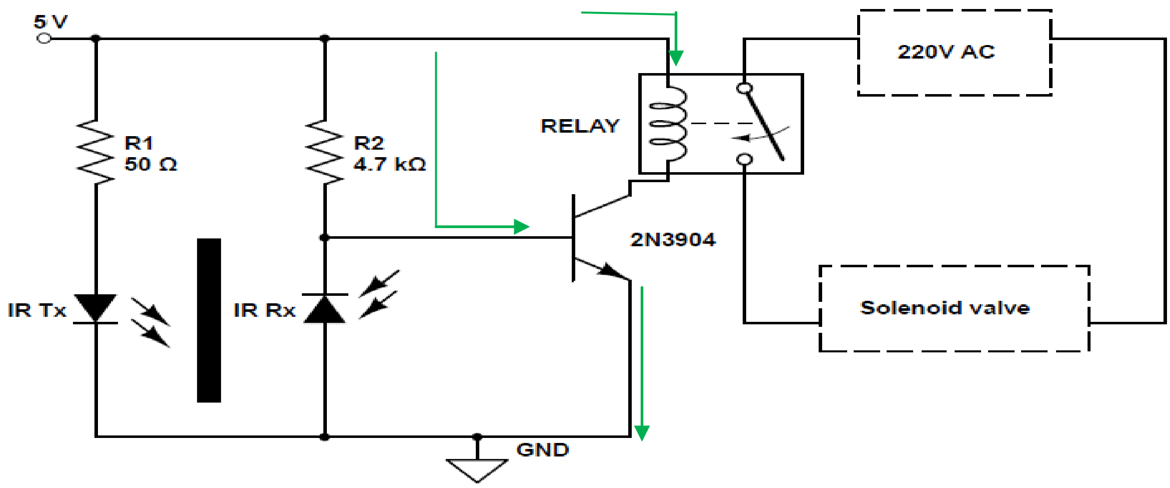

Fig 3: Current directions when the IR signals are interrupted

III. SECOND DESIGN

The basic design components are:-
1) Infrared (IR) transmitter and receiver pair.
2) Solenoid valve.
3)12V dc supply.
4) IC 741op-amp (operational amplifier).
5) 5volts Zener diode.
6) Relay.
7) Resistors.

3.1 WORKING

In this design, the transistor is replaced by an operational amplifier (op-amp). This op-amp demands a particular voltage (say 1V) as a reference voltage. This voltage is also obtained from the main DC supply given by dropping excess voltage using a resistor.
Since op-amp output is considerably high, zener diode of 5 volts is used in order to provide the constant voltage for the relay. The circuit diagram of the second design is shown in Fig 4.

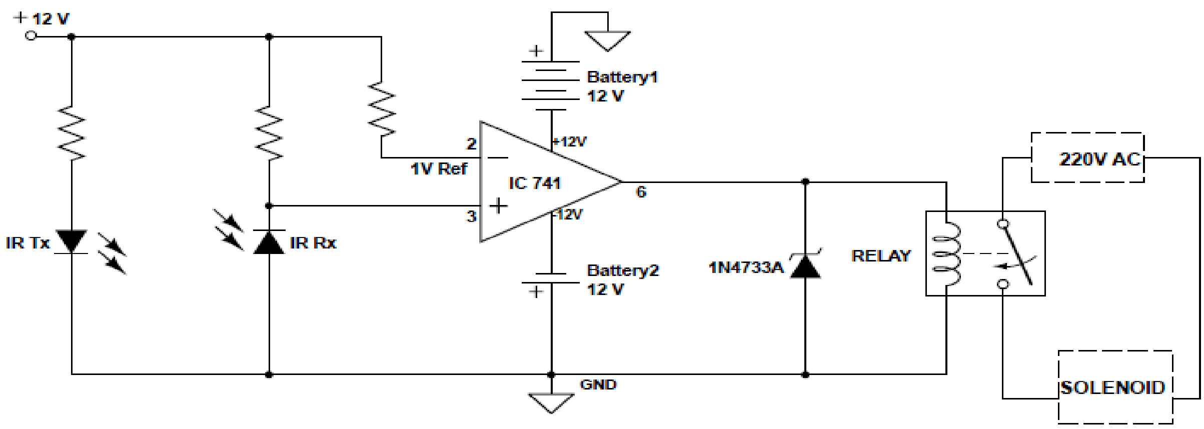

Fig 4: Circuit diagram of the second design.

3.2 CASE 1 WHEN IR SIGNALS ARE UNINTERRUPTED

In this case, the receiver receives the signal transmitted from the transmitter and thus it is short circuited .Total current passes through the receiver and enters the ground. As the voltage at 3rd pin is less than the reference voltage at 2nd pin, the op-amp output is negative offset voltage which makes the zener diode to act like a short circuit which drains away entire current in to the ground. Thus relay will be off and solenoid valve remains inactive. The current directions for this case are shown in Fig 5.

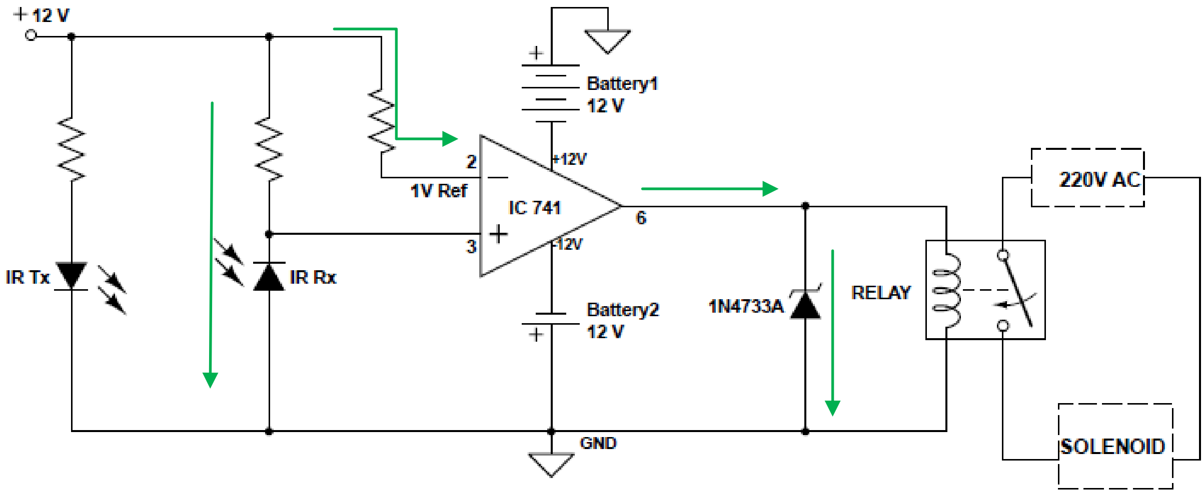

Fig 5: Current directions when the IR signals are uninterrupted

3.3 CASE 2 WHEN IR SIGNALS ARE INTERRUPTED BY AN OBSTACLE

In this case, the receiver doesn't receive IR rays from the transmitter. Hence the receiver acts like an open circuit i.e., shows a resistance of 2MΩ. This makes the receiver current to move in to op-amp .This current develops a voltage which is more than the reference voltage. Hence the op-amp gives an amplified output voltage at the output pin i.e., 6th pin which is sufficient to trigger the relay. In order to maintain a constant voltage, a zener diode is placed at the output pin of the op-amp. When the relay is triggered, the solenoid valve is activated and the water flows out. The current directions for this case are shown in Fig 6.

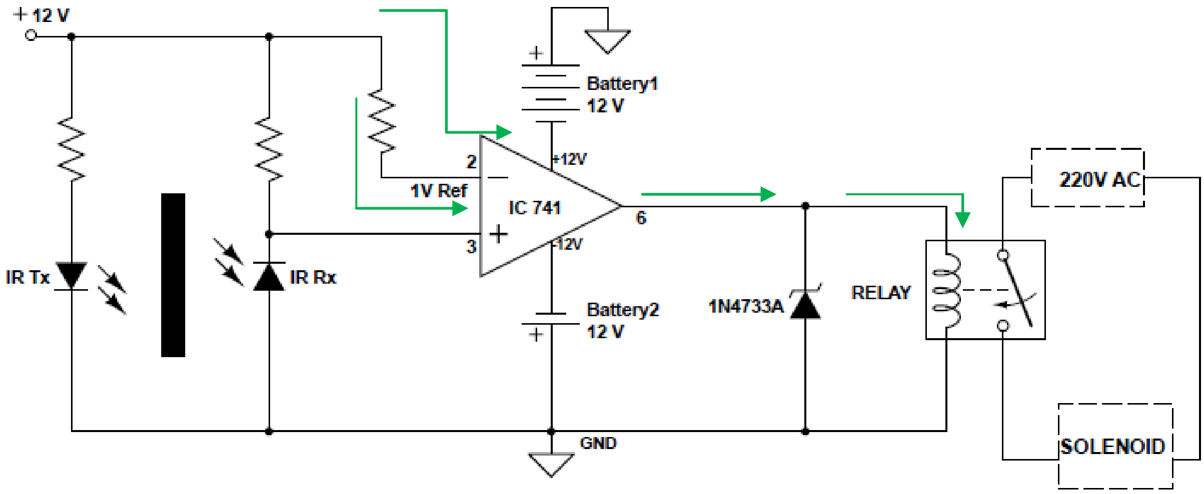

Fig 6: Current directions when the IR signals are interrupted

IV. EXPERIMENTAL WORK

The above shown circuits are practically examined and tested for any errors. For testing the practicality we have taken real life scenarios. The solenoid valve is supplied with a 220V A.C supply and the D.C supply required for the circuit is taken from the A.C supply. The circuit works very fine without any noticeable delay i.e. the time between placing the hand by interrupting the IR rays and the solenoid valve to release the water cannot be noticed by the humans. This circuit works shows a very good response, thus satisfying the requirements of the objective with we have started.

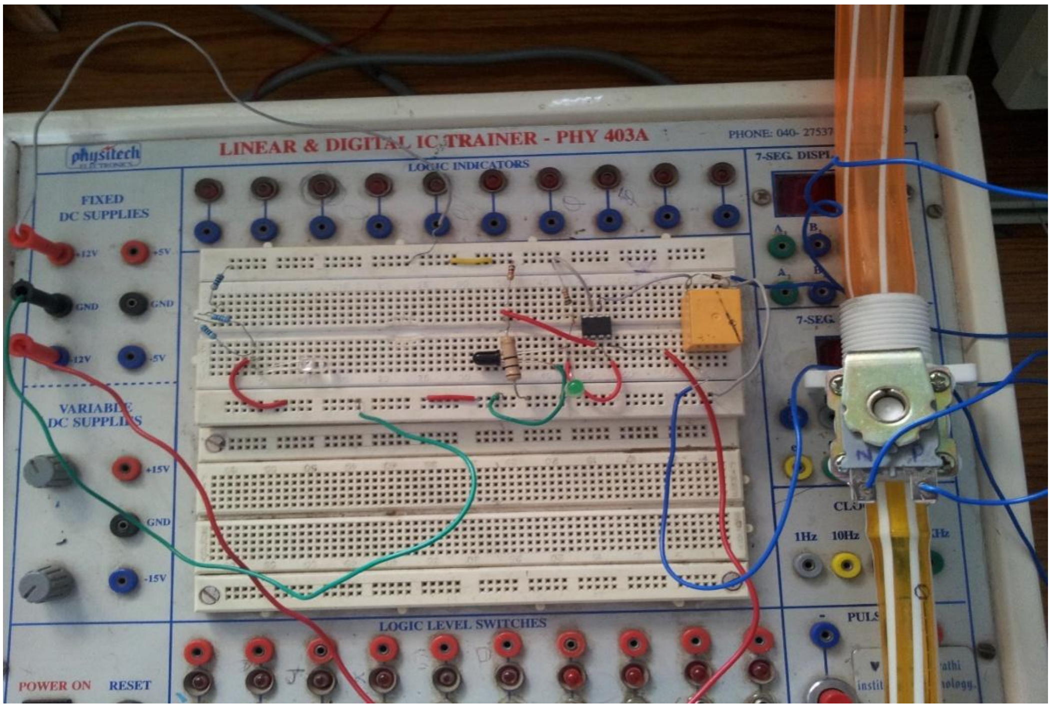

Fig 7: Implementation of the circuit practically

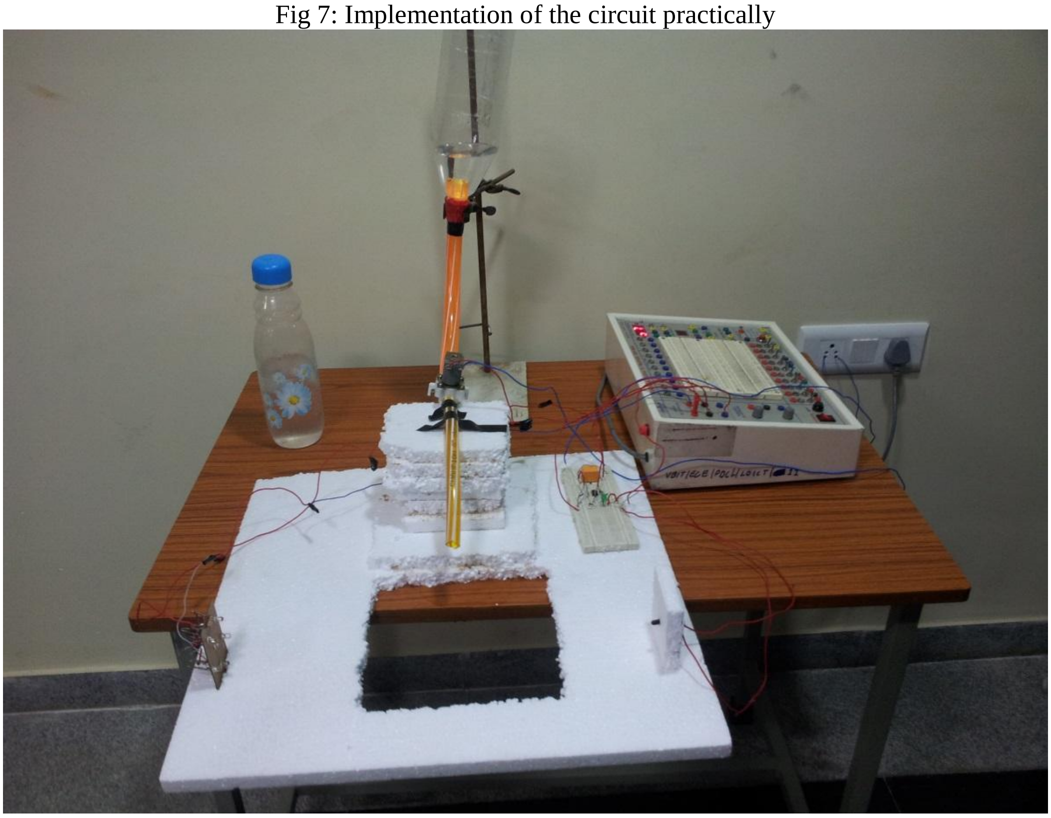
Fig 8: Implementation of the circuit in real life scenario

V. CONCLUSION

We have presented two designs for a hygienic hands free faucet. While both the designs are efficient the first design is based on a simple transistor so it very cost effective yet the second design is more reliable because of the use of an IC (Integrated Circuit). One has to properly maintain these faucets since any accumulation of dust on the sensors could interrupt the IR rays causing water loss. The implementation of these designs can help building the hands free faucets at a very low price thus making hygienic hands-free and water conservative faucets accessible to every section of a developing country like India.

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