A MINI PROJECT REPORT

ON

DESIGN OF AUTOMATIC WASHROOM LIGHT SWITCH

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ACKNOWLEDGEMENT

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CERTIFICATE

I hereby certify that the work which is being presented in the T.E. Mini project Report entitled **"Design of Automatic Washroom Light Switch",** in partial fulfillment of the requirements for the complition of the **Third Year in Instrumentation & Control Engineering** and submitted to the Department of **Instrumentation & Control Engineering** of Government College of Engineering & Research,Awasari (Khurd) is an authentic record of my own work carried out during a period from **December 2019 to April 2020** under the supervision of **Prof. M R Bongulwar, Instrumentation & Control Department**.

Signature of Student

1.Ritesh Nemade(18161001)   2.Manju Shinde(18161015)   3.Atharva Kulkarni(18161024)

This is to certify that the above statement made by the student(s) is correct to the best of my knowledge.

Signature of Guide

Date:

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TABLE OF CONTENTS

ABSTRACT

This project is on design and construction of an automatic bathroom light. The system automatically turns ON bathroom light when the bathroom door is opened, and remains lit in the occupied state. When the door is opened again the lamp turns off after a very short delay. This automatic circuit saves energy and greatly assists your visitors, especially at night. The "single-chip" circuit, built around the popular decade counter CD4017 (IC1), is very compact, and can be powered from any 5VDC/500mA mobile phone travel charger/similar smps adaptor. After construction, try to enclose the whole circuit in a suitable plastic case for total convenience. Next, arrange the door switch (S1) such that when the door is closed it should be in closed state.

2)Components Required

- Reed Switch with Magnet (available as combination)

- LM741 Op-Amp IC

- CD4017 Decade Counter IC

- 5V Relay Module

- Lamp

- BC558 PNP Transistor

- 2 X 10KΩ Resistor

- 100Ω Resistor

- 820Ω Resistor

- Connecting wires

- Mini Breadboard

- 5V Power Supply

List Of figures

1)Introduction

In this project, I will show you how to design and build a simple Automatic Washroom Light Switch Circuit, which will automatically turn on the when you enter the washroom and turns it off when you leave.

We turn on the lights in our washroom when we enter it and turn them off when we leave. Sometimes, we forget to turn the lights off after leaving the washroom.This may lead to power wastage and also the lifetime of the light bulbs may decrease. To avoid these problems, I will show you how to make a simple circuit which will automatically turn the lights on when a person enters the washroom and it automatically turns it off when he/she leaves it. By automating the process this way, there are many advantages like, the person need not care about turning the light on or off whenever he/she is using the washroom. The circuit, which you will know about in a moment, does it automatically for that person.

The circuit is also designed to consume lesser power so that the circuit can be used in any household or public washrooms without worrying about the power bill.

❖ Chapter 2
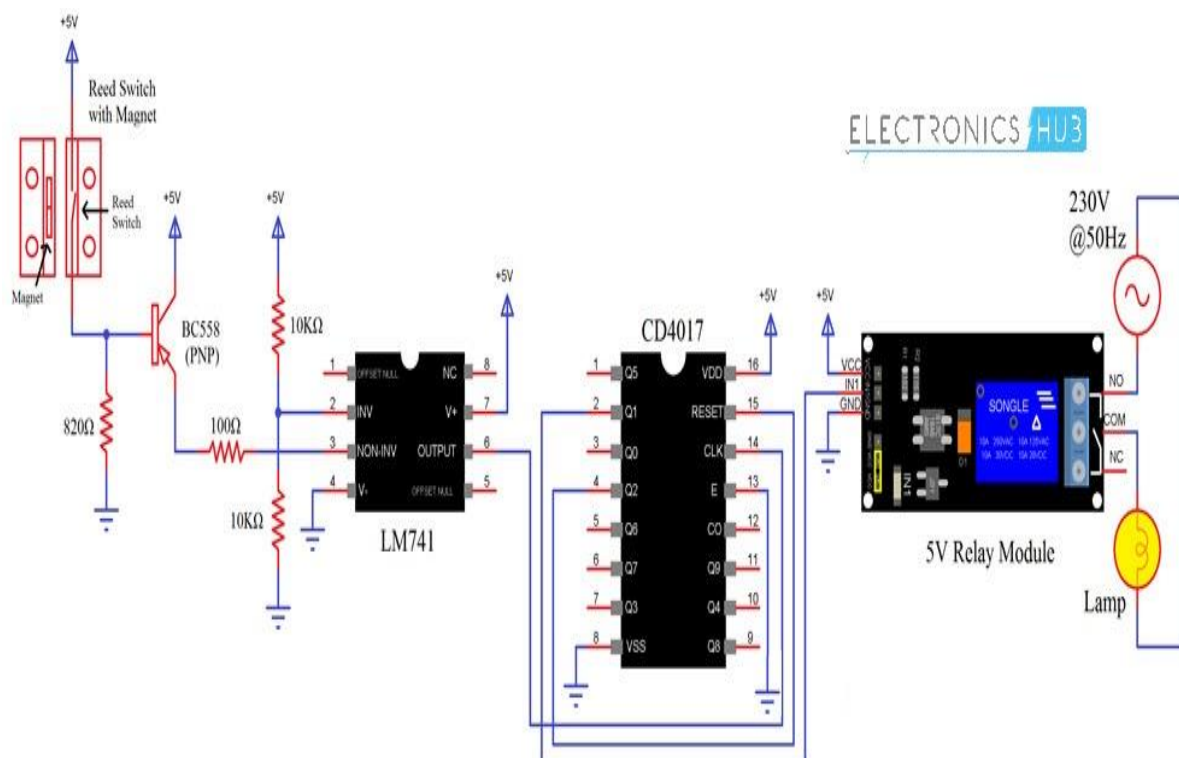
2.1)A Brief Note on Reed Switch

Reed Switch is one of the important components of this circuit and in fact the element which is used to detect the opening and closing of the door in this project is a reed switch. The following image shows a typical reed switch.

Automatic Washroom Light Switch Reed Switch Internal

A Reed Switch is a magnetically operated switch. It contains a magnetic sensitive switch, which when subjected to a small magnetic force, will either close or open (depending on its construction). There are two types of reed switches. One type with Normally Open Contact and the other with Normally Closed Contact. The Reed Switch used in this project is shown below. You cannot see anything as it is placed in a housing but the part with wires is the Reed Switch and the other part consists of a magnet.
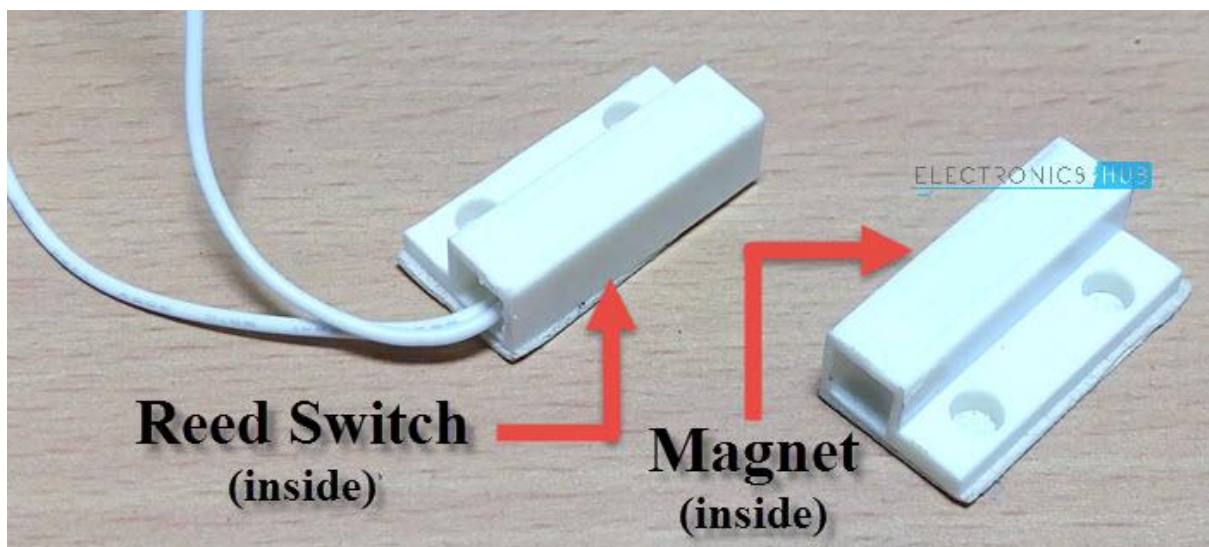
2.2)CD4017 Decade Counter IC

Features

- The supply voltage of this IC is 3V to 15V.

- It is compatible with TTL (Transistor -Transistor Logic).

- The clock speed or operational speed of CD4017 IC is 5 MHz.

This IC is also used in electronic industries, automotive industries, manufacturing medical electronic devices, alarms and in electronic instrumentation devices.

CD4017 Pin description

It has 16 I/O pins.

Output pins of CD4017(Pin 1 to 7 & 9 to 11)

- Pins 1 to 7 and 9 to 11 are outputs pins.

- These pins changes to 'high' level one by one (one after another) in a sequence. For each clock signal each pin goes high in a sequence.

Enable pin/Clock Inhibit(Pin 13)

- Enable pin enables the CD4017 IC.IC is enabled when the pin is active low.

- In order to disable or switch off the IC,this pin should be connected to active high input.When this pin is active high ,it ignores the clock signals.

Clock pin(pin 14)

- Clock signal provided to 14 th is responsible for sequential output.

- When the first clock pulse is detected pin 3 goes ,for next clock pulse pin2 goes high,like this sequence is formed.

- The important thing to remember is, if we don't connect any clock signal to this input pin, it must be connected to either positive or negative voltage supply.

- It is not left unconnected as per the CMOS input standard rules.

- The clock input pin (pin number 14) responds only to the positive voltage signal or positive clock

Reset pin(Pin 15)

- Reset pin resets the output of the sequence.That is the current state of the output sequence is set to initial state.

- Reset pin should be connected to ground in order to reset the circuit.

Ground pin & supply pin(Pin 8 & Pin 16)

Pin number 8 acts as ground and it must be connected to negative supply voltage & pin number 16 is the supply pin for CD4017 and it is connected to positive voltage supply.

Carry out pin(pin12)

The pin 12 is supplied with the CARRY OUT signal. It completes one full cycle for every 10 clock cycles. This is used to 'ripple' the IC, which means to delay in counting operations.

Counting operation of CD4017 using waveforms
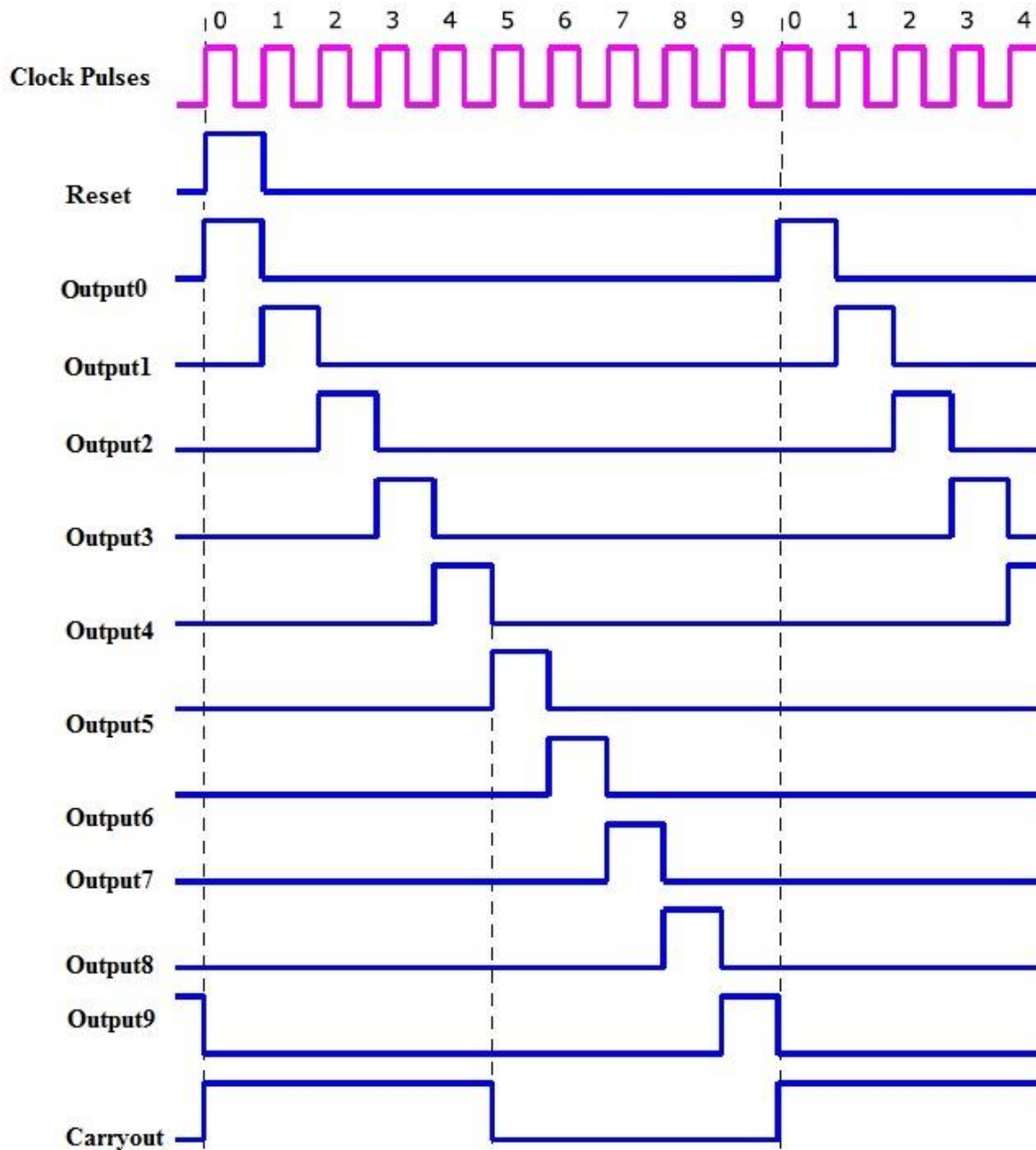
This is the timing diagram of the CD4017 with, shows us the comparison and also explains the counting sequence of the outputs, shifting from one pin to its next.

If we observe that, before applying the clock signal, the **RESET** is set to **High**, so the reset pin input sets all the output to their initial state.

Then the output of the first output pin 3 will be high. Next this output is shifted to its next output pin and this sequence continues till the next clock cycle.

Let us see some examples in which CD4017 is used.

4017 -Decade Counter
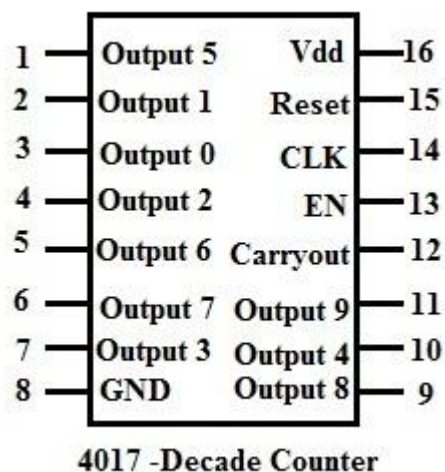
2.3)Relay

The advantage of using a 5V relay in this project is that the power supply for the relay can be directly given from the Arduino UNO board itself. Let us now see some basics of a relay. A relay is a type of a switch that acts as an interface between microcontrollers and AC Loads.
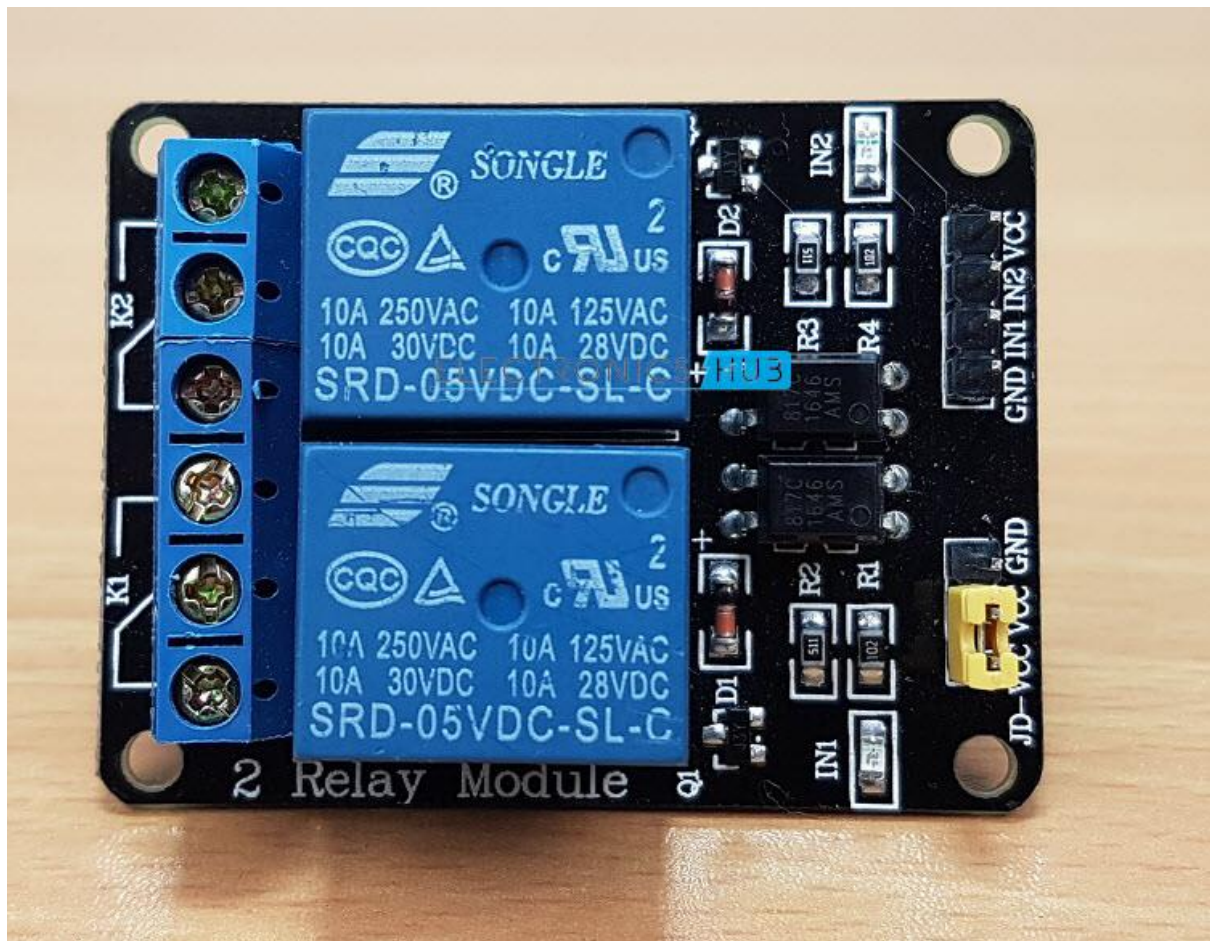
A simple Single Pole – Single Throw (SPST) relay, like the one used in this project consists of 5 Terminals: 5V, GND, Normally Open (NO), Normally Close (NC) and Common (COMM). Since we need to control this relay with the help of Arduino, a transistor is used with an additional pin called Control Pin on the Relay Module.

Coil
Terminals

N/O

N/C

ELECTRONICS HUB

Common

5V Relay Pins

❖Chapter 3
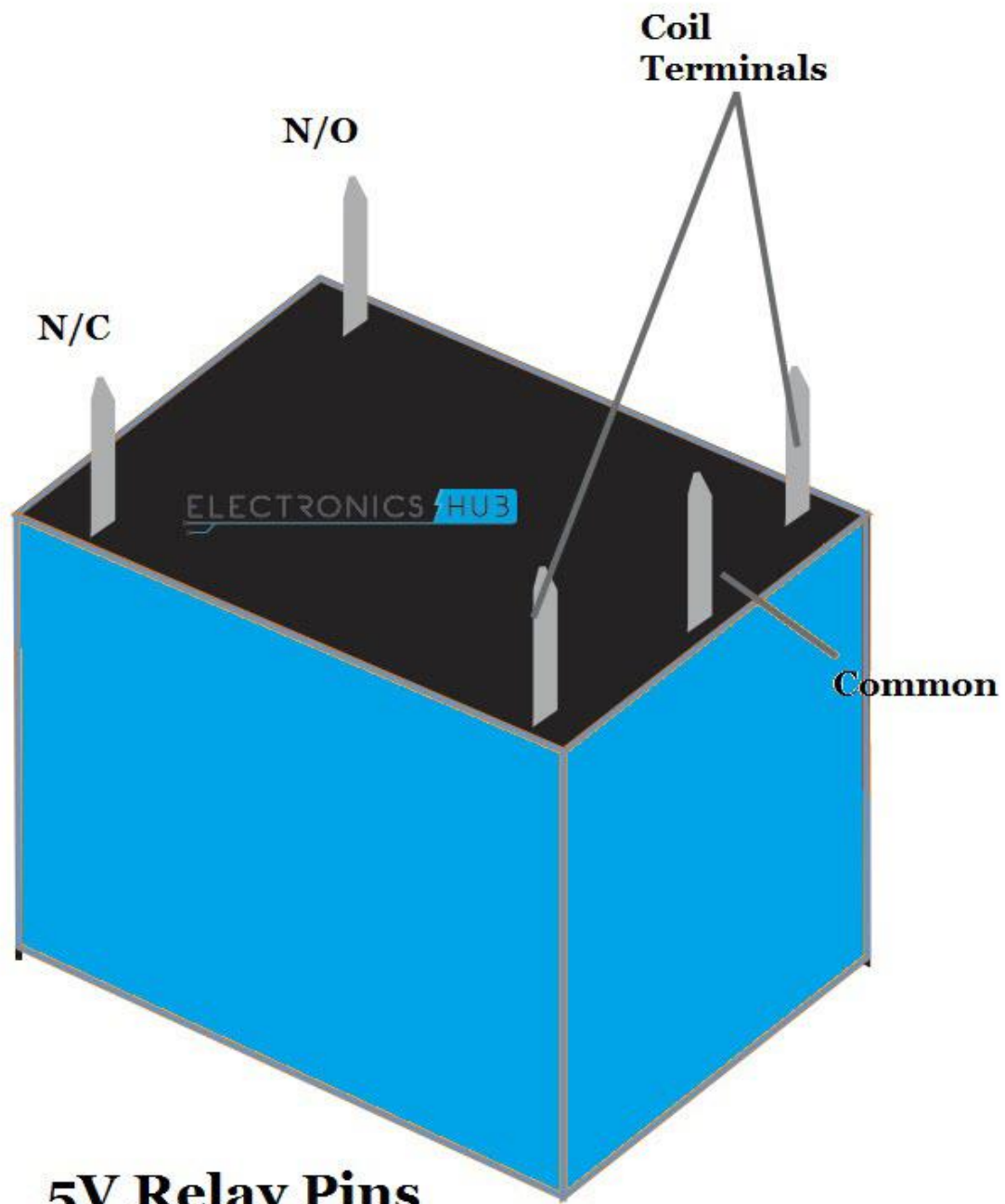
3.1)Circuit Design:

The first important component is the LM741 Op-Amp. It is being operated in comparator mode. Pin 2 is the inverting input of LM741 and its input is given from two 10KΩ Resistors.

One end of the Reed Switch is connected to +5V supply while the other end is connected to base of a PNP Transistor (BC558). Also, the base of the transistor is pulled down with the help of a resistor.

The emitter of the transistor is connected to the Non-inverting input of the Op-Amp while the collector of the transistor is connected to +5V.
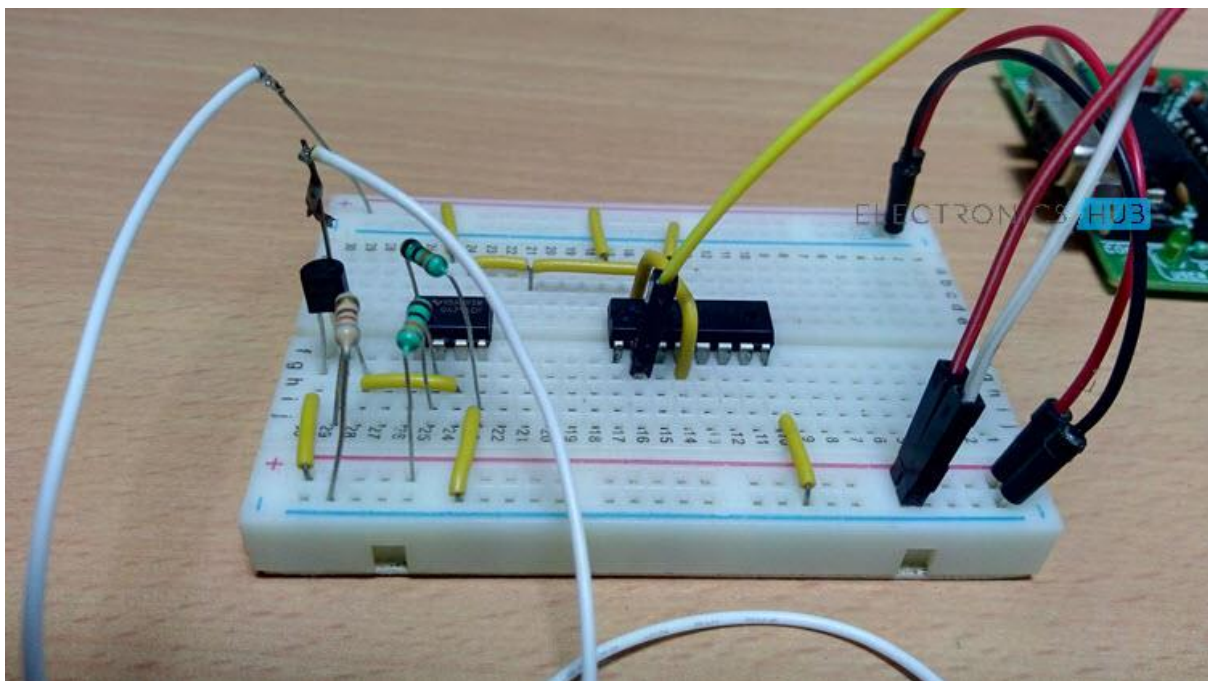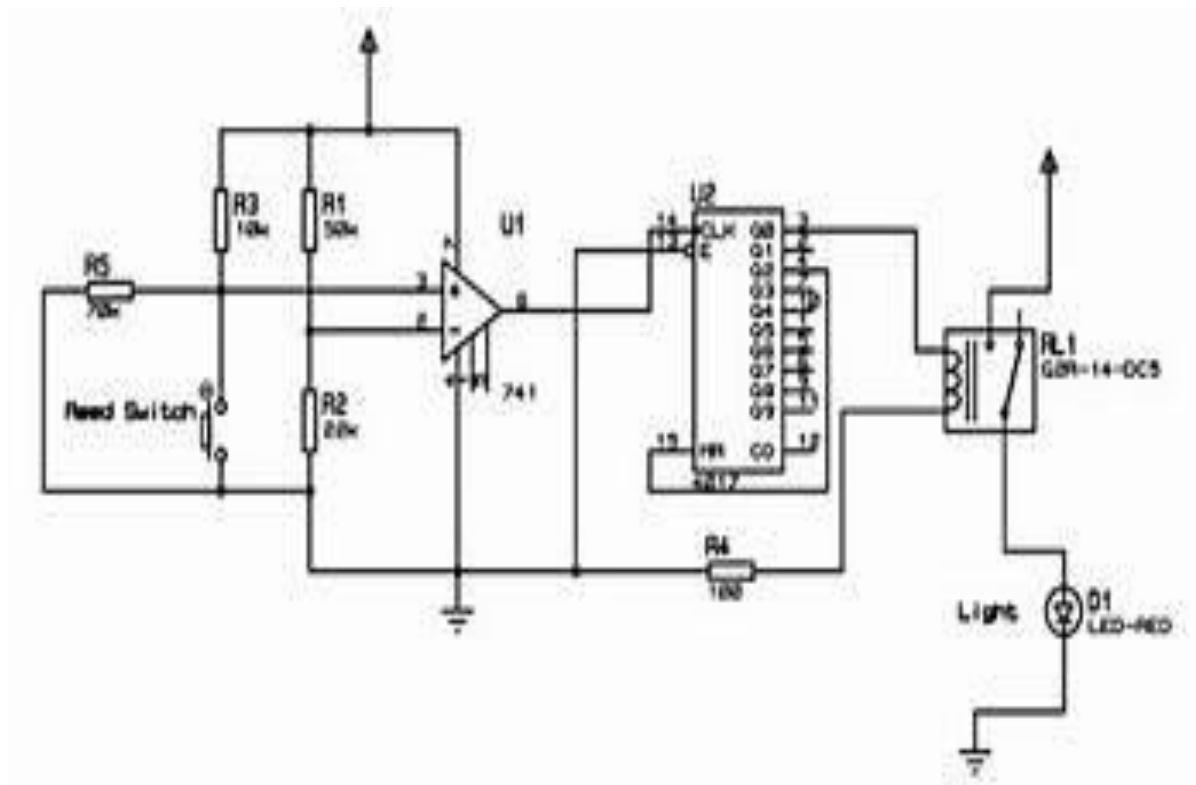

Pin 1 of LM741 i.e. its output is connected to the CLK input of CD4017 i.e. its Pin 14. Pin 2 of CD4017 is connected to the input of the relay while Pin 4 is connected to Pin 15.

Rest of the connections can be easily understood from the circuit diagram.

3.2)CIRCUIT DIAGRAM:

3.3)Working:

Before continuing with the working of the circuit, I will first explain the intended setup of this circuit. The reed switch is fixed to the wall near the door while the magnet is fixed to the door. This means that the reed switch will always be in closed state as the door is closed when the washroom is not in use (which is assumed as starting point) and the magnet will be near the switch.

Assume you opened the door and entered into the washroom and then closed the door behind you. This action will make the switch open (when the door is opened first) and close (when you close the door).

As a result, the output of the Op-amp goes HIGH (when you open the door)and then goes LOW (when you close the door). This in turn will cause the counter to produce a HIGH output at its Pin 2. Since Pin 2 of CD4017 is connected to the relay, the light will be turned ON.
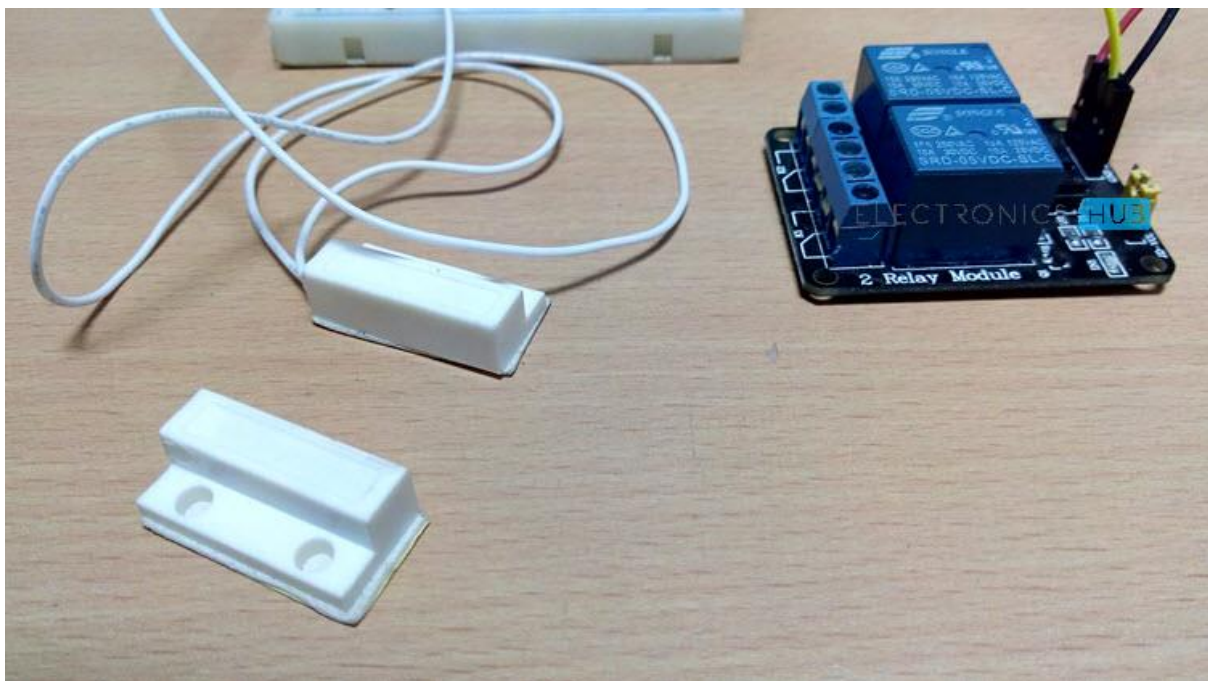
Now, when you are done with your business in the washroom, you will once again open the door, come out of the washroom and close the door. This action will once again cause the same action i.e. switch will open and close and output of Op-Amp will become HIGH and then LOW.

But, since the Pin 4 of CD4017 is connected to the Reset pin, all the outputs will become LOW and hence the relay will be turned OFF, which in turn switches off the light.

3.4)Block Diagram:
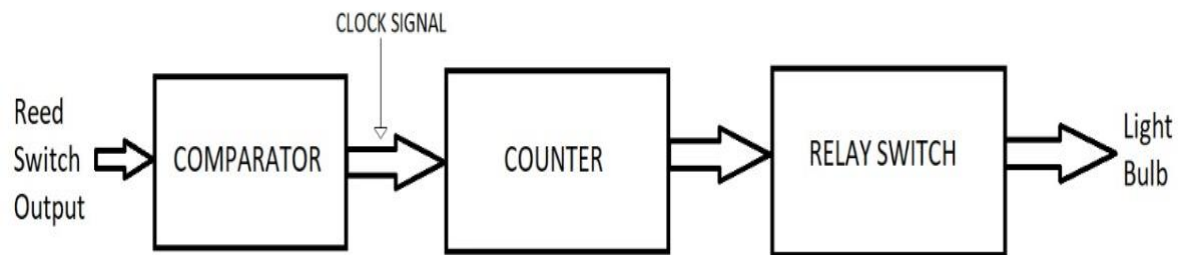
Result:

We turn On the lights in our washroom when we enter it and turn them off when we leave. We sometimes forget to turn Off the lights after leaving the washroom. This may lead to power wastage and also the lifetime of the lights may decrease. To avoid these problems, we are going to make a circuit which automatically turns On the lights when a person enters the washroom and it automatically turns it Off when he leaves it.

By automating this, there are many advantages like, the person need not care to turn On the light always when he is using the washroom. The circuit which we are doing does it automatically for that person. Also, the person need not turn it off after using the washroom. There is no fear that he forgets to turn it Off. The circuit is also designed to consume lesser power so that the circuit can be used in any household or public washrooms without worrying about the power bills.The operation of the circuit is as follows. When the door of the washroom is opened and closed, the circuit turns switches On the light using a relay. When the door opens and closes for the second time, the circuit turns Off the light by turning off the relay.

The element which is used to detect the opening and closing of the door is a reed switch. There are two types of reed switches. We are using the one which will be closed in normal state and open when there is a magnetic field nearby. A reed switch electrically is just a relay kind of component but unlike a relay which activates when a coil voltage is supplied, the reed switch activates when a magnetic field is detected in the vicinity. The circuit is given a power supply of 9V. The pin-16 of IC 4017 is given 9V. The pin-8 of 4017 is given to ground.

The circuit uses IC 741 op-amp as a comparator arranged such that its output is high by default when the door is closed. The circuit is attached to the door frame whereas a permanent magnet is attached to the door in such a way that it comes closer to the reed switch when it is closed. The IC 4017 is made to alternate between each door open and door close. When the door is opened and closed for one time, the circuit turns On the relay and the the Light turns ON. When the door is opened and closed for the next time, the circuit turns Off the relay and the light turns off. The IC 4017 is capable of counting upto nine counts but we are restricting it to count only two and reset back. The ability this IC to adjust the count value as desired helped us in this project to use it as

a one bit counter.When the door is closed, the reed switch opens and hence the op-amp output which is the 6th pin of IC 741 is HIGH. When the door is closed, the pin-6 of IC 741 is turned Off. When the door is closed back, it triggers the IC 4017 decade counter and hence the relay toggles ON and OFF for each door open and close operation.

5.1)SCOPE OF THE PROJECT:

This work automatically turns On the lights when a person enters the washroom and it automatically turns it Off when he leaves it. This circuit is also designed to consume lesser power so that the circuit can be used in any household or public washrooms without worrying about the power bills.

In this circuit, we use reed switch which is used to detect the opening and closing of the door. A reed switch electrically is just a relay kind of component but unlike a relay which activates when a coil voltage is supplied, the reed switch activates when a magnetic field is detected in the vicinity.

5.2)APPLICATIONS OF THE PROJECT:

Apart from using this device as a bathroom lighting system, this device can be used for other purposes such as:

- Useful for automatic outdoor lighting or garden lighting at home.
- Useful for automatic switching of street lights.
- Useful for switching the hoardings on and off automatically.
- Useful for self-switching operation of displaying title hoardings of companies.

5.3)SIGNIFICANCE OF THE PROJECT:

This system is simple and low cost automatic bathroom light circuit. The light automatically turns on when the bathroom door is opened, and remains lit in the occupied state. When the door is opened again the lamp turns off after a very short delay. This automatic circuit saves energy and greatly assists your visitors, especially at night.

5.4)LIMITATION OF THE PROJECT:

One of the problems of this device is that any anything can trigger the device, such as breeze, movement of animals inside the bathroom can trigger the system.

5.5)CONCLUSION:

From the system we can conclude that an approach is taken to control the washroom light switch using counter IC and Reed switch. As nowadays lots of electricity is wasted in day today life but by using this type of system we can take a small part by saving some energy and can be contributed to large amount of power saving.

6)REFERANCES:

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