COMP 1659 - Introduction to Smart Systems

Coursework – 2019/2020

Remote Controlled Light Switch

Final Report

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1. Introduction

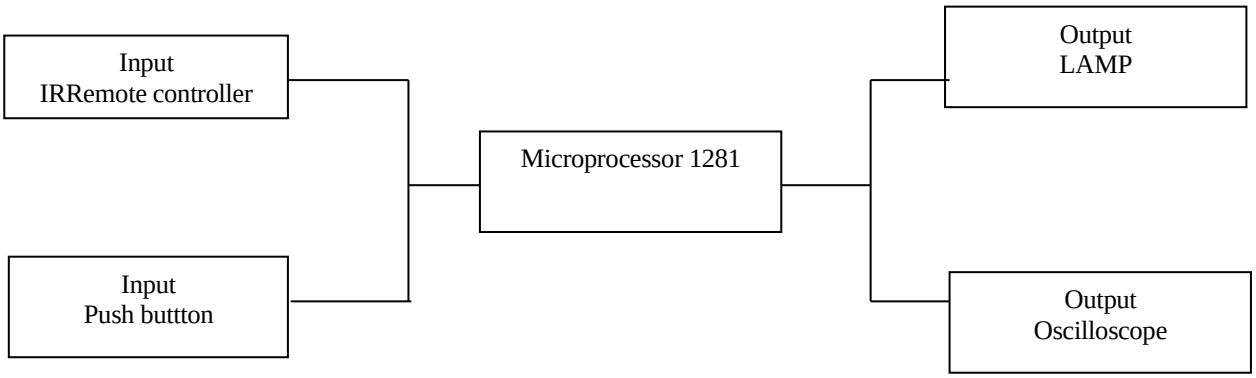
This project is based on making a remote controller to ON/OFF light. Here I used atmel atmega 1281 microcontroller. Microcontroller programmed by using ‘c’ language. Simulation done by proteus simulator by connecting other relevant components to the microcontroller pins. There are mainly two parts. One is transmitting part and the other is receiving part. Receiving section fixed and other one is the IR remote controller.

2. Tools and materials used

- Atmel Studio 7
- Proteus 8
- Atmega 1281
- Push Buttons
- Capacitors
- Crystals
- Lamp
- LEDS (Blue/Green/Red)
- Logic gates
- NPN Transistor
- Resistors

3. Introduction to control systems

3.1. Block diagram for Remote controlled light switch

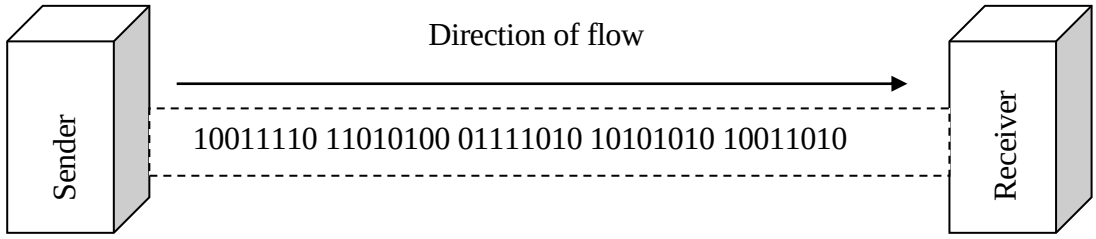


3.2. Difference between synchronize & asynchronized

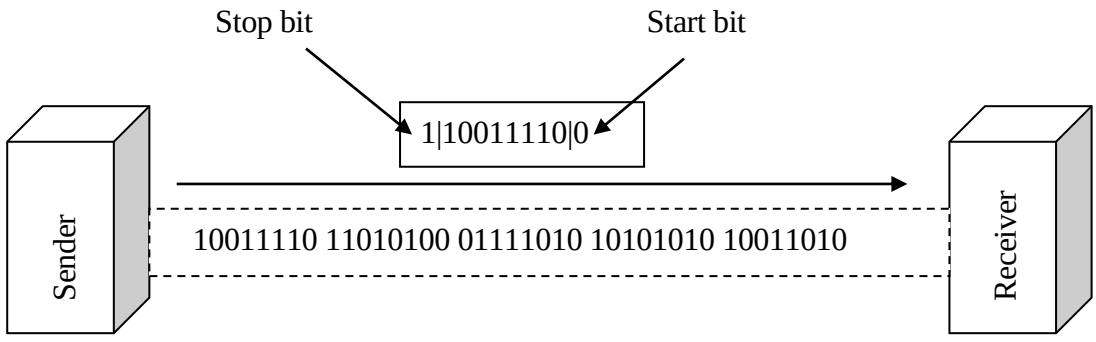
Synchronous implies that there is a clock involved and there is not clock involved in asynchronous. But in asynchronous parity bit add before transmission. Asynchronous is simple and used to transmit small amount of data. Synchronous transmission is used for transmitting large amount of data as it is efficient and has less overheads.

Comparison Basis	**Synchronous Transmission**	**Asynchronous Transmission**
Meaning	It starts with a sequence of bits	It is using start and stop bit respectively following a character.
Transmission manner	Data sends in the form of frames	It sends 1 byte at a time
Synchronization	Same clock pulse present	Absent
Speed of transmission	Fast	Slow
Gap between the data	Does not exit	exit
Cost	Expensive	Not expensive
Examples	Video conferencing, Telephone conversation	Letters, Emails etc.

Synchronous Transmission



Asynchronous Transmission



Oscillator used to visualize and analyse the waveform of electronic signals.
In fact, devices draw a graph of the instantaneous signal and voltage as a function of time. Normally oscilloscope display alternating current (AC) or direct current (DC) waveforms having a frequency as low as approximately 1 Hz or as high as several MHz

3.4. Interrupt

Microcontrollers receive inputs from I/O ports. Interrupts are used to receive input generated by external events. Interruptions occur with a completely independent piece of code that drives the execution of programs.

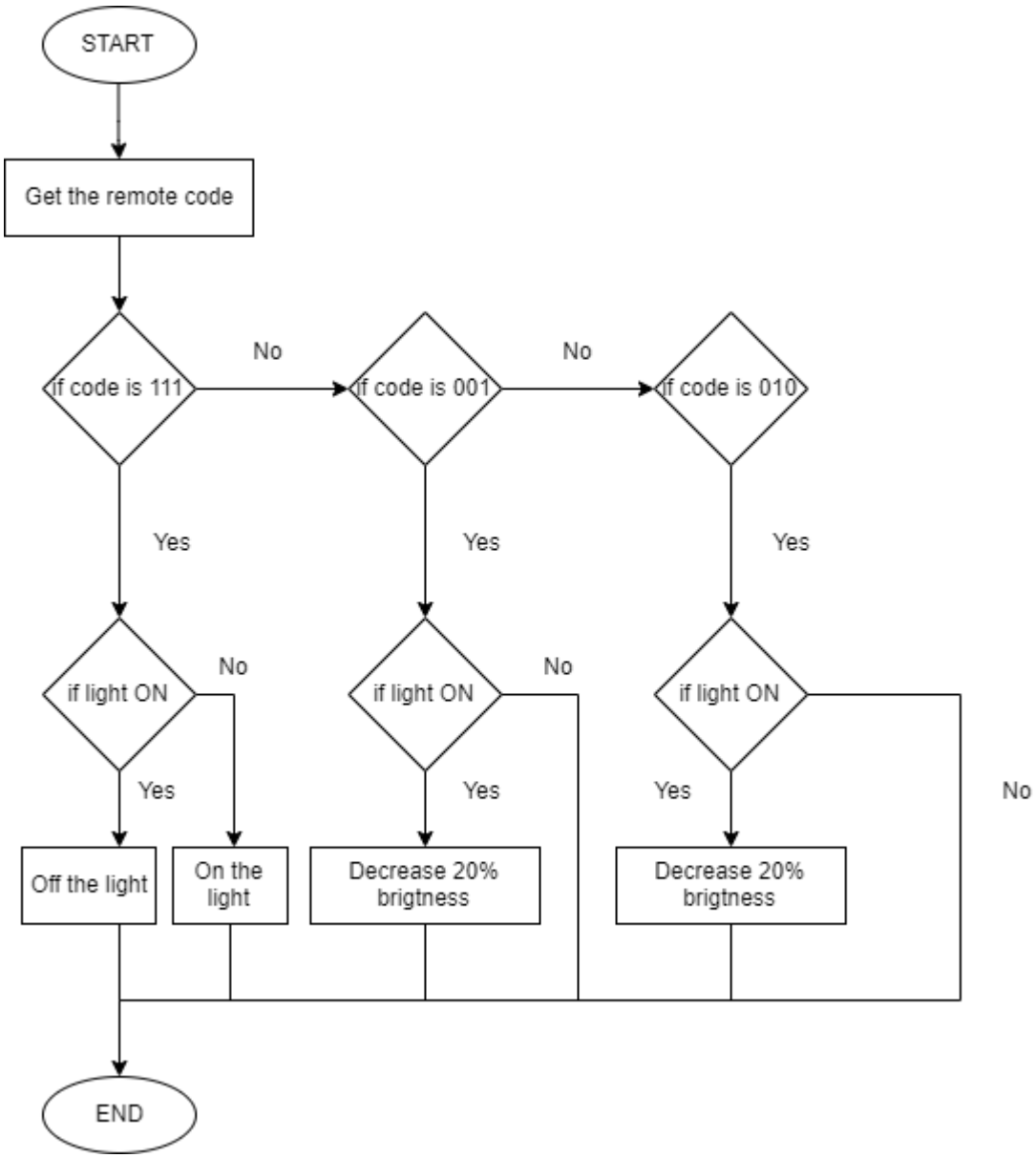
3.5. EICRA

External interrupt control registers control the triggering method for INT 3~0. This is used because we enabled the interrupt.

3.6. EIMSK

External interrupt mask register used to check the INT0 and INT1 interrupts are enabled.

3.7.Flowchart:



4. Design and Development

This section discusses the design and development of the Remote-Controlled Light Switch and how the remote control, push buttons works to get the output of the bulb.

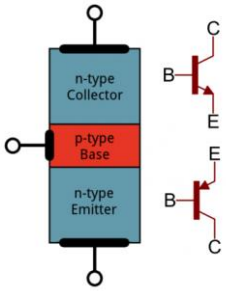
4.1. Input output combination and development

In this project I used Atmega 1281 microcontroller, push buttons, capacitors, crystal, lamp, leds (blue/green/red), logic gates, npn transistor and resistors. An IR remote control transmits pulses of infrared light that represent specific binary codes. This corresponds to binary commands, such as power on / off and decreasing light intensity. IR receiver decodes light pulses into binary data that microprocessor devices can understand. Then the microcontroller executes the corresponding command. Here I set following command patterns for IR remote;

111 – Turns ON/OFF lights
001 – Increase intensity
010 – Decrease Red colour

So, by above bit patterns we can on/off or increase light intensity and decrease red colour.
There is a push button in the circuit. Push buttons are digital inputs and are most commonly used for user commands or sensors. The button basically consists of two pieces of metal separated by a spring. A plastic cap that, when pressed, brings into contact two pieces of metal to close the electrical circuit. When metal bits are separated, the current does not circulate. You can also establish a connection by clicking on it.

4.2. NPN Transistor



Purpose of using a npn transistor is to control a high-power light. The control input enters the base, the output is tied to the collector, and the emitter is held at a fixed voltage. In the microcontroller, I / O pins can be programmed high or low to turn the lights on or off.

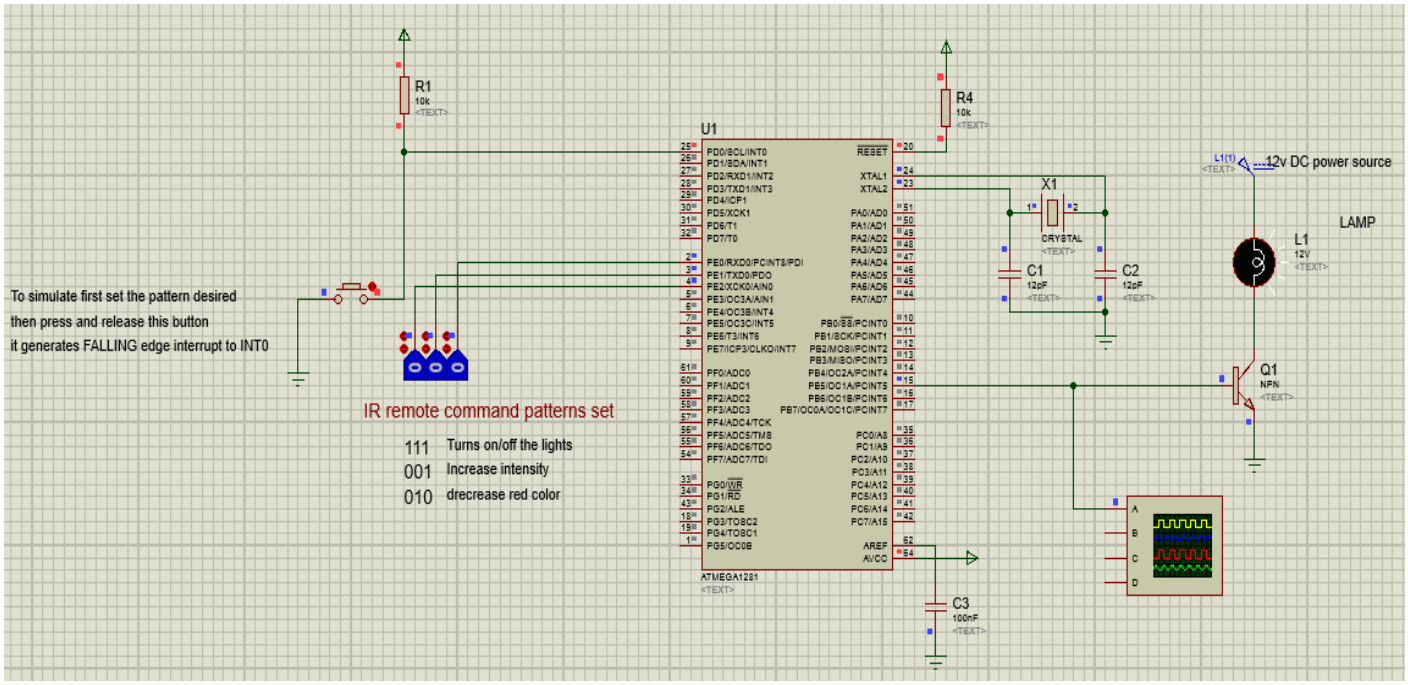
4.3. Crystal oscillator

Crystal oscillators are used in microcontrollers to provide clock signals. This crystal oscillator is used to generate the clock pulses needed to synchronize all internal operations.

4.4. Capacitors

A capacitor is a passive bipolar electronic component used to store electrostatic energy in an electric field.
The shapes of practical capacitors vary widely, but they all contain at least two electrical conductors separated by a dielectric.

4.5. Circuit Diagram

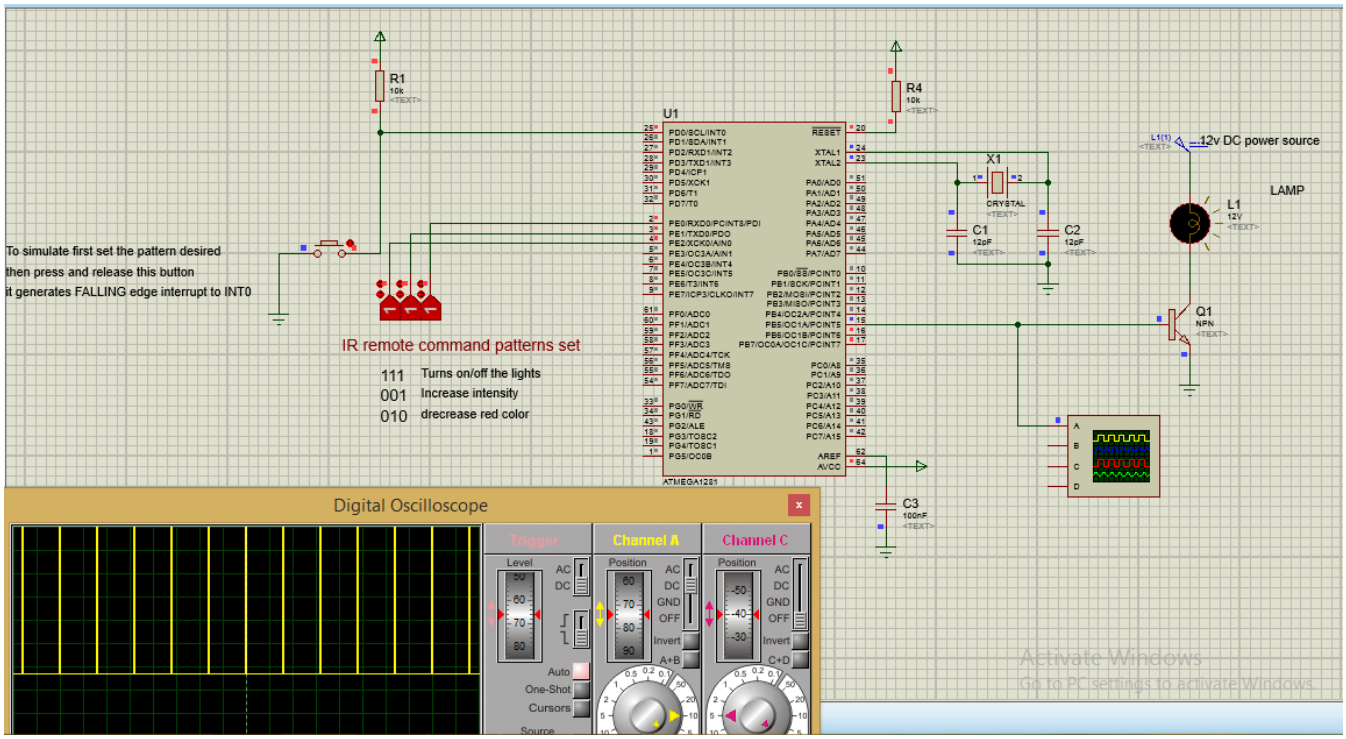


5. Testing

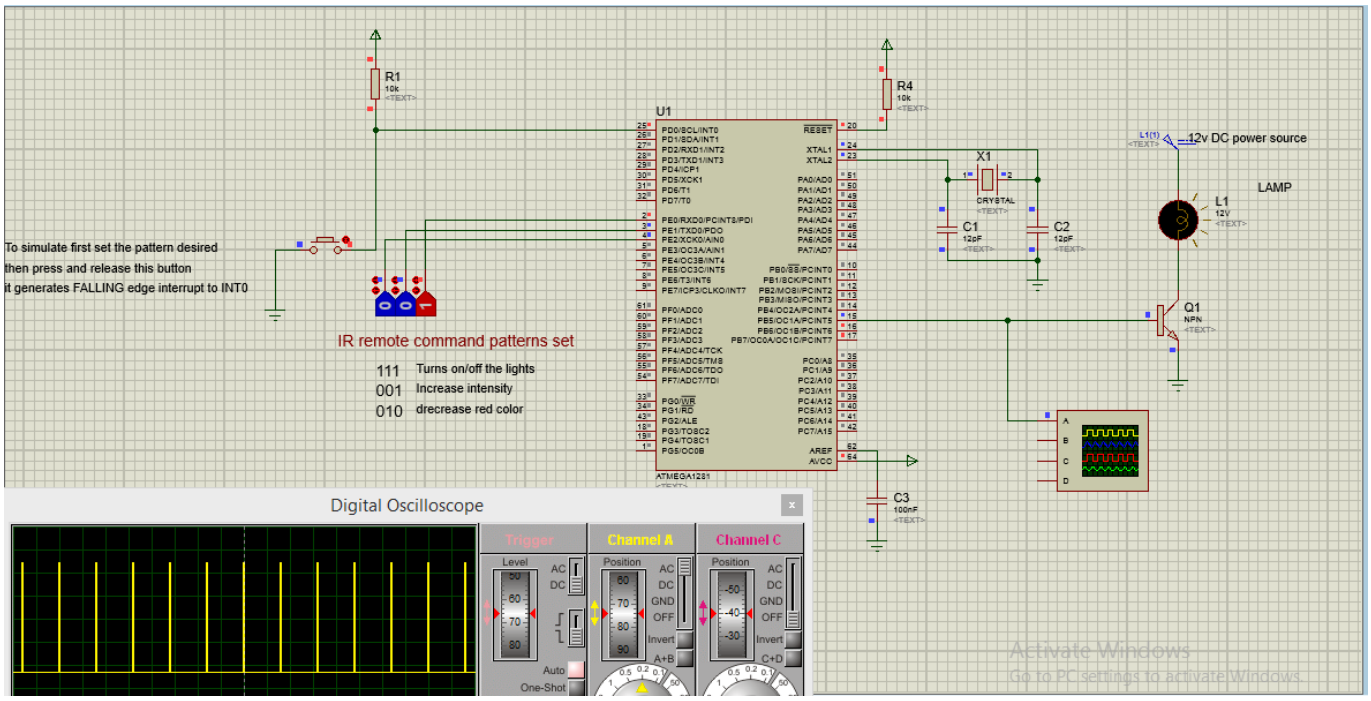
In order to test the outcomes, we need to make 3 test scenarios.

1. When input is 111
2. When input is 001
3. When input is 010

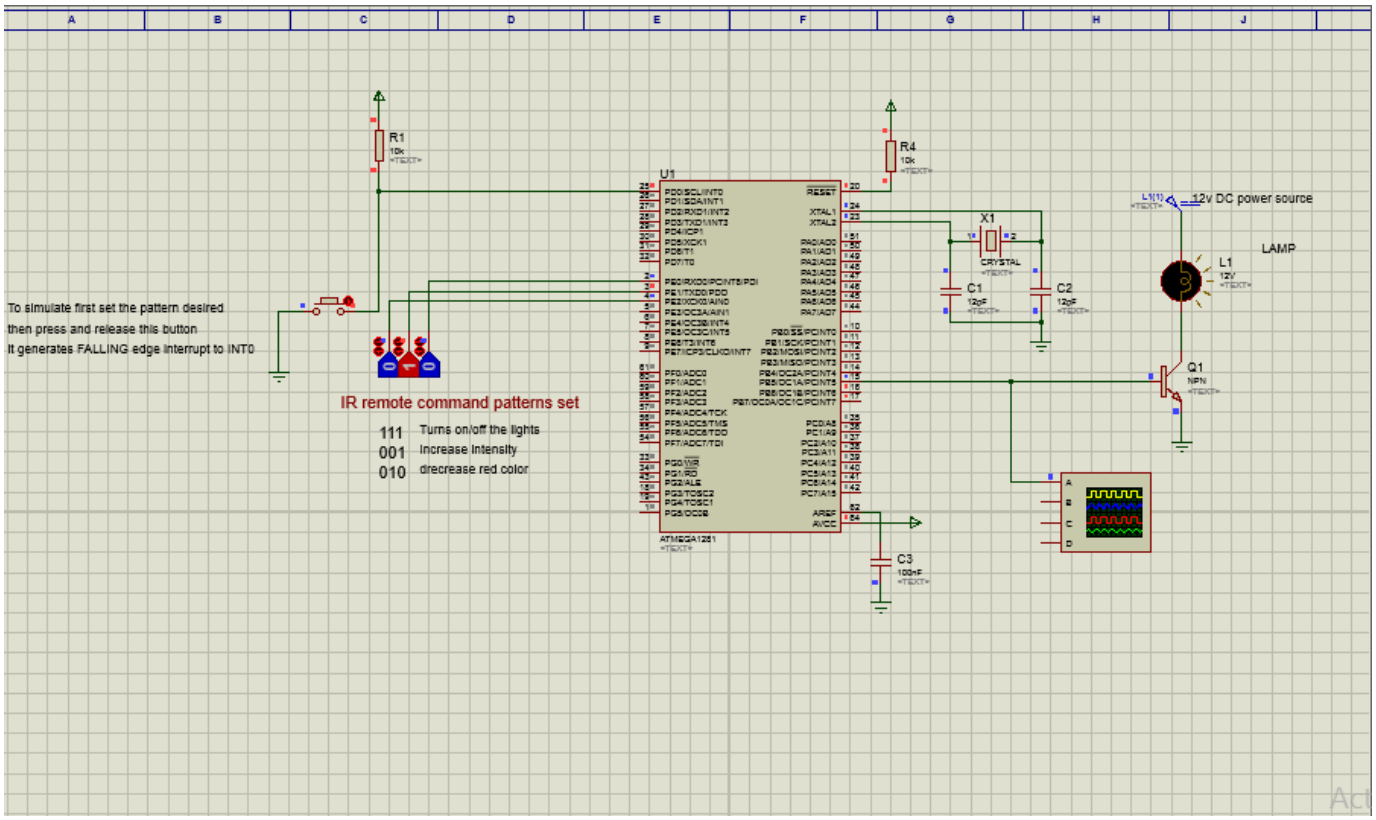
5.1. When input is 111



5.2. When input is 001



5.3. When input is 010



5.4 Program code listings:

```
#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdbool.h>
#include <util/delay.h>

bool isLightOn = true;
int lightIntensity = 0;

int main(void){
    /* enable FALLING edge interrupt on INT0 pin*/
    EICRA = 0b00000010;         //set falling edge interrupt on INT0 pin
    EIMSK = 0b00000001;         //enable external interrupt on INT0
    sei();                      //enable globe interrupts

    /* configure the PWM signal generator

             < --- PWM pedio -->
              _ _ _ _          _ _ _ _          _ _          _ _ _ _
    |        |      |        |      |        |    |        |
    |        |      |        |      |        |    |        |
    |_ _ _ _ |      |_ _ _ _ |      | _ _ _ _|    |_ _ _ _ |
             <------>                 <--->
        PWM Duty cycle              PWM duty cycle

    PWM period is defined by the PWM mode and TOP value (refer data sheet page 128)
    PWM duty cycle is define in OCR1A  registers
    */
```

```
    DDRB = 0b00100000;          //make PORTB PD7 output
    TCCR1A = 0b10101001;        // set OC1A pin to clear automatically the TCNT1 value equals to OCR1A
                                //fast PWM mode 8bit
    TCCR1B = 0b00001001;        //prescale value 1:1

    /* infinite loop */
    while (1) {
        OCR1A = lightIntensity;
        _delay_ms(100);
    }
}

/*this is the interrupt function
  This function executed on every time someone generate falling signal on
  PD0 -- INT 0

  below is the falling edge


  _ _ _
       |        5V
       |
       ?        falling edge
       |
       |_ _ _ _ 0V


 */
```

```
ISR(INT0_vect){
    int code =  PINE;

    switch (PINE){
        case 0b00000111:                    //if port reads as 111 ON or OFF the system based on previous condition
            if (isLightOn){                 //if already on
                lightIntensity = 0;         //set light to full off
            }else{                          //if already off
                lightIntensity = 255;       //set light to full ON
            }
            isLightOn = !isLightOn;         //reset the status
            break;
        case 0b00000001:                    //if port reads as 001 then increment the brightness
            if(isLightOn && lightIntensity + 50 <  255){
                lightIntensity += 50;
            }
            break;
        case 0b00000010:                    //if port read as 010 decrement the brightness
            if(isLightOn  && lightIntensity - 50 >= 0){
                lightIntensity-= 50;
            }
    }
}
```

5.5 Code Explanation:

When IR signal came to the sensor its voltage becomes zero. Therefore, added two interrupts. In the falling edge timer is triggering and its starts to count. Then after its again rise the signal and stop the timer. After stopping the timer, the pwm length is matching to the relevant number.

PWM mode means the width of the signal is increasing according to the time.

6. Critical Evaluation

I have designed and successfully completed the Remote-Controlled Light Switch System implementation. I have made configuration with embedded C programming language, and I used Proteus 8 software for simulations. I managed to identify the problems and the resources through the Proteus simulation software by using this software, to resolve the problems by reducing them.

The first test scenario was when I press the ON button to start the system. The design works perfectly, therefore. I learned how microcontrollers works and how interrupts work with it. Also learned to draw flow diagrams and c programming. This project can used for smart home concept and it make our works very easier.

APPENDIX

Introduction to Smart Systems
Coursework 2019/2020
Designing, Developing and Testing an Embedded Open-loop Controller
Interim Report

The embedded application I have implemented is: **Remote Controlled Light Switch**

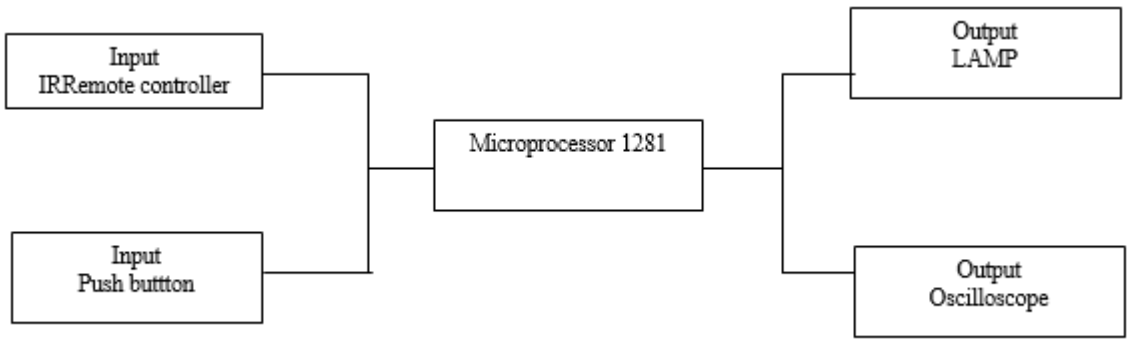
1. Overall description and requirements analysis

Remote controlled light switch is an operating of a light using IR remote controller by programming a microcontroller and relevant components. We can switch ON/OFF and also can increase and decrease the light intensity.

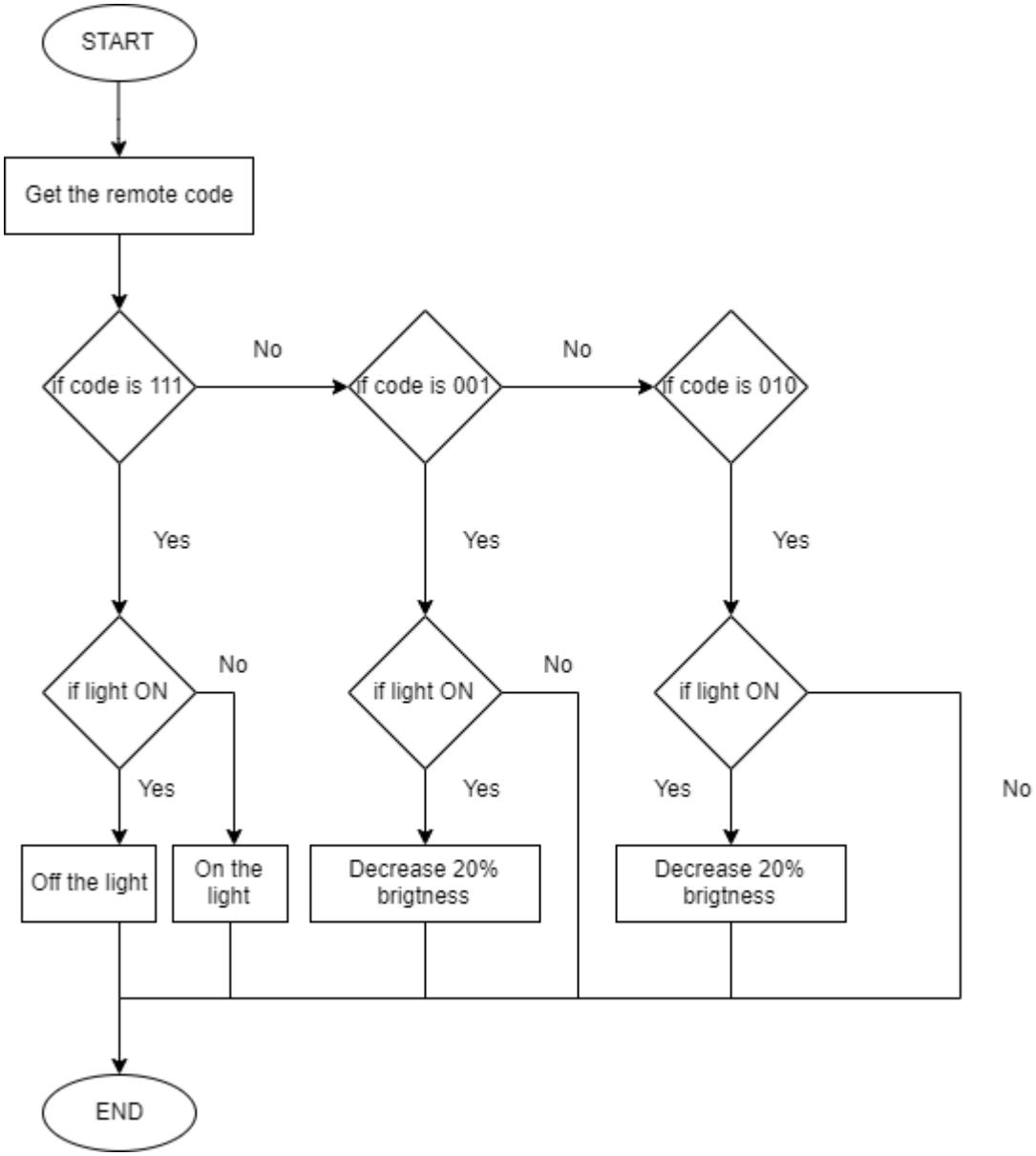
2. Tools required

- **Atmel ATMega1281 Microcontroller**
- **Atmel Studio**

3. Initial design



4. Flow Chart for the Application



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