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RGBtooth: RGB Color based Data Communication Protocol

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Abstract- At present time data communication is a keyword to our life. It's a time of IOT revolution. Lots of devices around us communicate with each other or they send data to internet. Some of the popular data communication protocols are like Bluetooth, Zigbee, Infrared, wifi, Wlan etc. In this project a similar type of wireless data communication system is designed. Some of the key factors of data communications systems are wireless, covered distance, data transfer speed, security or encryption etc. In this paper we have proposed a RGB color based data communication system. In this system each device is a transceiver. Each device contains of 16bit RGB color sensing module and RGB led. To transfer data from one device to another transmitting module encode raw data to a 16bit combination. This 16bit combination is transferred to RGB led and the color of this 16bit combination will glow. The receiving module will read this color and decode the color into 16bit data. This data is the raw data which we want to receive from the transmitter.

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RGBtooth: RGB Color based Data Communication Protocol

Md. Shiblee Nooman ^α, Lutfeyara Begum Sweety ^σ, Silvia Shukla Karmokar ^ρ & Kaiser Habib ^ω

Abstract- At present time data communication is a keyword to our life. It's a time of IOT revolution. Lots of devices around us communicate with each other or they send data to internet. Some of the popular data communication protocols are like Bluetooth, Zigbee, Infrared, wifi, Wlan etc. In this project a similar type of wireless data communication system is designed. Some of the key factors of data communications systems are wireless, covered distance, data transfer speed, security or encryption etc. In this paper we have proposed a RGB color based data communication system. In this system each device is a transceiver. Each device contains of 16bit RGB color sensing module and RGB led. To transfer data from one device to another transmitting module encode raw data to a 16bit combination. This 16bit combination is transferred to RGB led and the color of this 16bit combination will glow. The receiving module will read this color and decode the color into 16bit data. This data is the raw data which we want to receive from the transmitter.

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I. INTRODUCTION

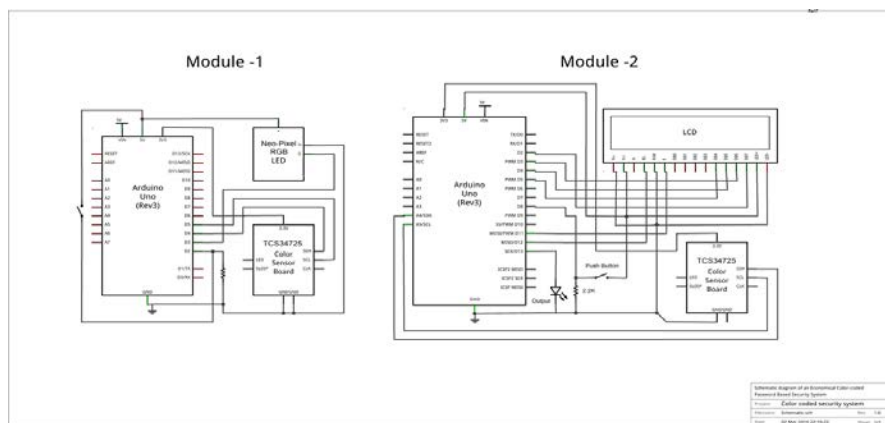
Data communication plays a key role in our present life. Around us most of the devices uses different types of data communication technique. Some of them are designed for very long distance like DTMF communication[1]. Some are designed for short distance wireless communication like Bluetooth [2], infrared [3] etc. Infrared has lost its popularity due to lower data

transfer rate. In this paper we have tried to design a protocol which works wireless but short distance communication. Infrared (IR) light is electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers (nm) to 1 mm. Infrared transfer data by only red light. But if we can increase the number of color combination and bit depth then it is possible to increase the data transfer speed. In this paper to transfer data, combination of three types of color is used. Any combination of red, green and blue can make a unique color. But the range of this combination depends on the bit depth of the color. Usually 8bit color combination is used in different purpose but in this project 16bit depth RGB color combination is used to encode the raw data. This increases the range of data combination and the data transfer rate also.

II. CIRCUIT DIAGRAM

Circuit consists of two module. Both of them can be data transceiver. But in this project we used first module as data transmitter and the second one as data receiver. First module consists of arduino uno which is the heart of the module. Adafruit TCS34725 Color Sensors is used to receive the colors as data. Neopixel rgb led is connected with arduino.

Figure 1 : Circuit Diagram of RGB transmitter & Receiver



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5v Dc & ground pin of Arduino connected with vcc of rgb led & color sensor. Through I2C the color sensor communicates with arduino. SDA & SCL of arduino is connected with the color sensor respectively. SDA is on Digital 20 and SCL is on digital 21. The LED pin can be pulled low to turn off the LED. By connecting wire directly to ground to turn it off completely. Connecting the LCD screen to Arduino through following pins:

- LCD RS pin to digital pin 12
- LCD Enable pin to digital pin 11
- LCD D4 pin to digital pin 5
- LCD D5 pin to digital pin 4
- LCD D6 pin to digital pin 3
- LCD D7 pin to digital pin 2

Additionally, wire a 10K pot to +5V and GND, with it's wiper (output) to LCD screens VO pin (pin3).

III. CIRCUIT DIAGRAM

- List of equipments:-

a) Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2.

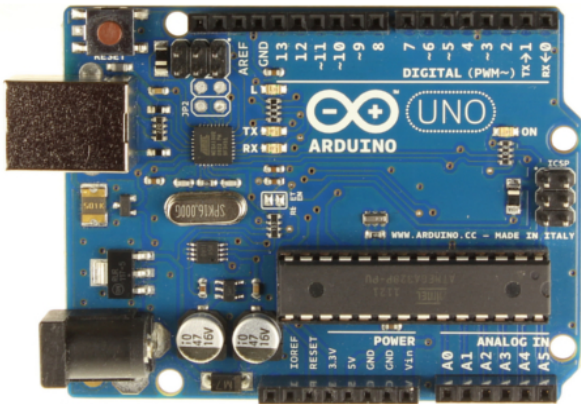


Figure 2 : Arduino Uno front side

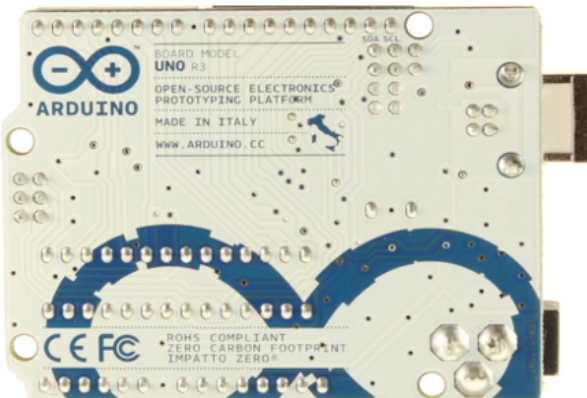


Figure 3 : Arduino Uno rear side.

b) Liquid Crystal

The LiquidCrystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

This example sketch prints "Hello World!" to the LCD and shows the time in seconds since the Arduino was reset.



Figure 4 : output of the sketch on a 2x16 LCD

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins:

A register select (RS) pin that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instructions on what to do next. A Read/Write (R/W) pin that selects reading mode or writing mode. An Enable pin that enables writing to the registers. 8 data pins (D0 -D7). The states of these pins (high or low) are the bits that you're writing to a register when you write, or the values you're reading when you read.

There's also a display contrast pin (Vo), power supply pins (+5V and Gnd) and LED Backlight (Bklt+ and Bklt-) pins that you can use to power the LCD, control the display contrast, and turn on and off the LED backlight, respectively.

The process of controlling the display involves putting the data that form the image of what you want to display into the data registers, then putting instructions in the instruction register.

c) Flora RGB Smart newPixel

It runs at 'high speed' 800KHz communication. These pixels have full 24-bit color ability with PWM taken care of by the controller chip. Since the LED is so bright, you need less current/power to get the effects you want. The driver is constant current so its OK if your battery power changes or fluctuates a little.

Each pixel draws as much as 60mA (all three RGB LEDs on for full brightness white). In theory, the Flora can drive up to 500 pixels at 30 FPS (it will run out of RAM after that).

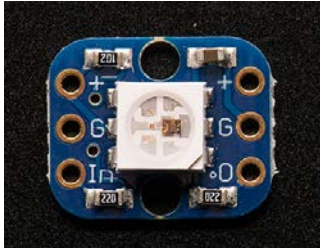


Figure 5 : Neopixel RGB Led

The TCS34725, which has RGB and Clear light sensing elements. An IR blocking filter, integrated on-chip and localized to the color sensing photodiodes, minimizes the IR spectral component of the incoming light and allows color measurements to be made accurately. The filter means getting much truer color, since humans don't see IR. The sensor also has an incredible 3,800,000:1 dynamic range with adjustable integration time and gain.

It has supporting circuitry as well, such as a 3.3V regulator so you can power the breakout with 3-5VDC safely and level shifting for the I2C pins so they can be used with 3.3V or 5V logic. Finally, it has a neutral 4150°K temperature LED with a MOSFET driver onboard to illuminate what you're trying to sense. The LED can be easily turned on or off by any logic level output.



Figure 6 : TCS34725 RGB Color Sensor

IV. HARDWARE IMPLEMENTATION

In Transmitting module RGBtooth word is decoded and transmitted through rgb led. Here is some of the snap shots of encoded colors for the data RGBtooth.

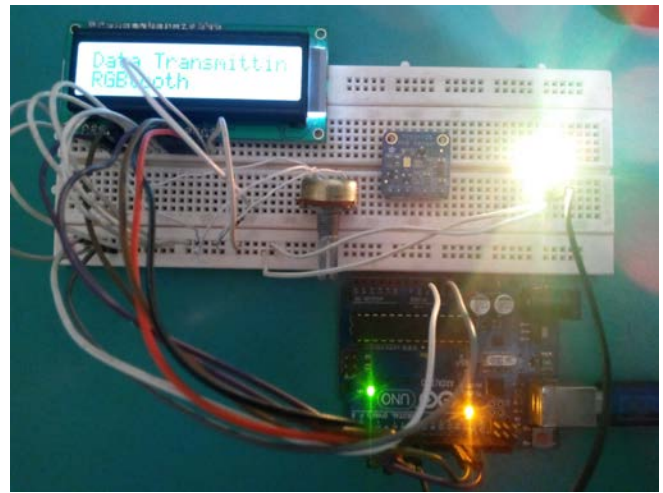


Figure 7 : Data Transmitting 1

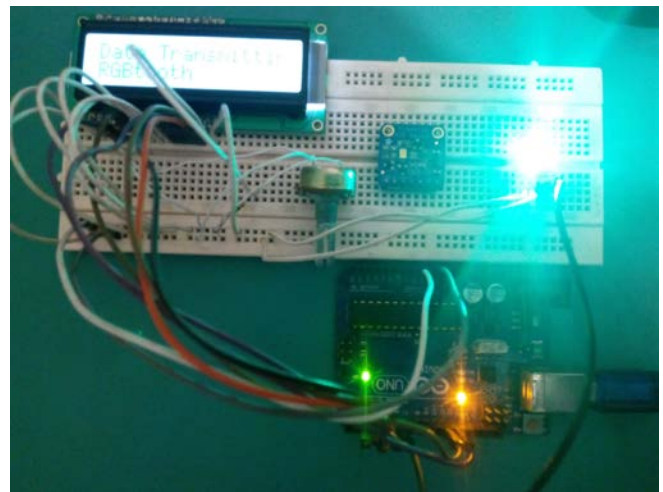


Figure 8 : Data Transmitting 2

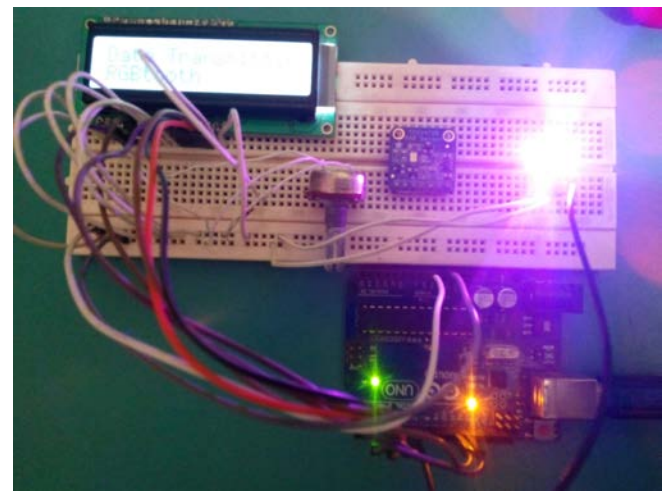


Figure 9 : Data Transmitting 3

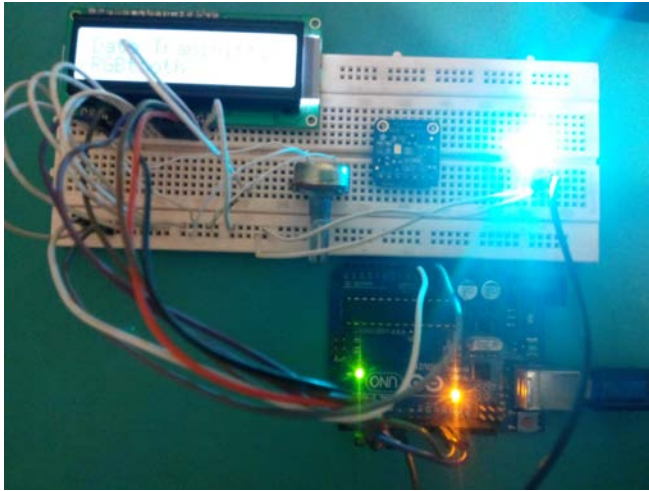


Figure 10 : Data Transmitting 4

Bellow the hardware implementation of data receiving is also shown.

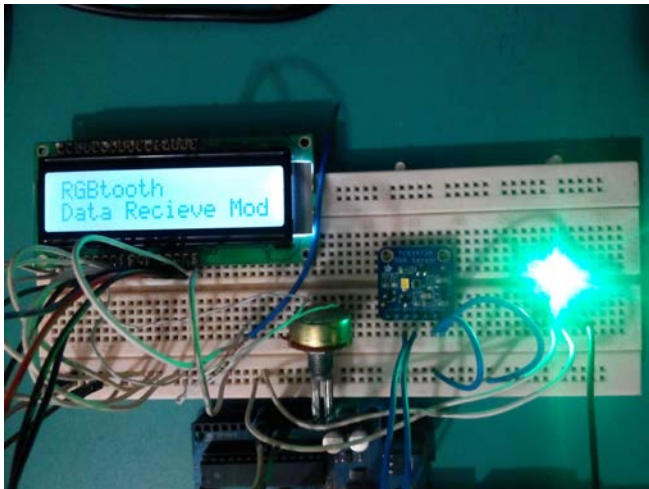


Figure 11 : Data Receiving Module

V. MAIN TECHNOLOGY USED

In the portion of the code we used arduino.cc lcd library, adafruit color sensor library & RGB led library. Bellow some of the important codes are shown.

```
#include <Adafruit_NeoPixel.h>
#define PIN 6 //RGB Led
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
```

Here we have converted the text RGBtooth into different colors.

Text	R	G	B	t	o	o	t	h
Ascii	82	71	66	116	111	111	116	104

Each three digit combines and create a color to transmit those three digits.

```
colorWipe(strip.Color(82, 71, 66),50); // RGB
colorWipe(strip.Color(116, 111, 111), 50); // too
colorWipe(strip.Color(116, 104, 0), 50); // th
```

Here 50 means the light will be displayed for 50mili seconds. This time period is adjustable and it varies the data transmission speed. At best the RGB led is capable of transmitting data at 800khz speed and each time it combines 24bits of data. So approximately the highest amount of data transfer speed can be achieved in theory $24 \times 800\text{Khz} = 19200\text{Khz}$. Which equals to 18.75Mhz. But in this experiment to get the data value accurately we have used much lower data transfer speed.

VI. FURTHER APPLICATIONS

- ✚ Color based password lock system.
- ✚ Secret Data communication.
- ✚ Inside Fiber optic cable.
- ✚ Cell phone for data communication.

VII. CONCLUSION

Although it is a very new concept about data communication but still it is possible to transfer higher rate of data through this process. The accuracy can be increase through encapsulating all the lights which emits. An encryption technique like start bits, stop bits, parity bits can make this communication more stable. This new communication technique can be used in many different fields.

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