

## An Effective based multi-colour led lamp circuit using AT89C2051 Microcontroller

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**Abstract:** As offered in the paper a red, green and blue (RGB) colour generator using AT89C2051 microcontroller (MCU). This is a simple and low-cost circuit for a multiple colour generator that can be built easily with a few additional components. The main objective of the project is to generate multiple colours from RGB primary colours as used in television displays, computer monitors and other colour displays for commercial applications like LED projectors.

**Key Words:** RGB, AT89C2051 microcontroller, LED, PWM.

### I. INTRODUCTION

The new high power and brightness RGB LEDs are going to be used in many different lighting applications as backlighting, general lighting systems, traffic signals, automotive lighting, advertising signs, etc. They are becoming popular mainly because it is possible to generate an easy multicolor light with special lighting effects and their brightness can be easily changed. On top of this, their long lifetime and small size make them the light source of the future. This paper describes how to drive RGB LEDs, how to calculate a power dissipation, how to design an over temperature protection, how to use a software PWM modulation and why over voltage protection should be implemented for this kind of application. Traditionally we can construct Magic lamp that produces different coloured lights with basic colour LEDs, thus producing a fascinating effect. This multi-colour led lamp circuit is based on two ICs namely NE555 which works as clock generator in Astable mode and CD4017 which is a decade counter. NE555 works in Astable mode generates a clock for the circuit, which provides an oscillating

wave to the output pin 3 of IC1. This output is set at certain frequency and given as input to decade counter (CD4017). We can vary the speed of oscillation with the help of VR1. The frequency of oscillation of 555 timer can be calculated by the formulae shown below:  $f = 1.44 / (R1 + 2 * (VR1) * C1)$ . After receiving the clock input CD4017 starts its counter from zero and it advances by one each time pin 14 goes high. When it reaches the ninth count, counter goes back to zero and the counter starts again. As the count progresses, respective pin goes high to provide the output. For instance in the circuit diagram shown, first is pin 3 which represents zero(Q0) meaning it will provide you the output first. The second is pin 2- it represents one(Q1), Similarly pin four represent two(Q2) and so on. CD4017 will count up to nine then it will reset again but in our circuit we are using it to count up to six. In this circuit we are using seven output pin and two input pins. The output are from pin 1 to 5, pin 7 and 10. Input pin are clock (pin14) and reset (pin15). We have connected the pin 6 to reset pin because we want after sixth count it will start counting again. Colour control of the circuit is based on simple switching logic using twelve 1N4148 diodes. We can also change the colour sequence by interchanging the output connection of decade counter.

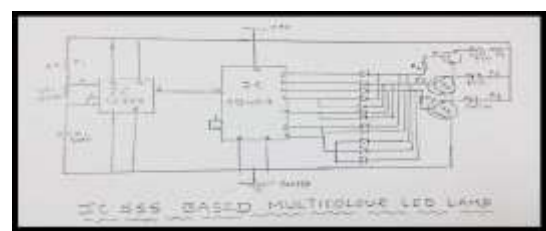


Fig.1. NE555 based multicolor LED circuit

## II. PROPOSED METHOD

The below mentioned hardware and software requirement of the project is useful to construct the circuit.

### A. Atmel's AT89C2051 Microcontroller

The Atmel AT89C2051 is a low-power, high-performance 8-bit microcontroller compatible with the MCS-51 instruction set and object code. The 20-pin AT89C2051, with its many hardware features, is especially attractive to 8051 developers because it is compatible with the 8051 and similar devices, and can reduce board space, components, and cost. In an application comprised of EPROM, address latch, an 8051, and other associated components, for instance, the 8051 offers enough on-chip digital I/O that additional external I/O components may not be required. In a similar AT89C2051-based system, however, a single AT89C2051 can replace the EPROM, latch, and 8051, providing the system software is limited to 2 KB.

The AT89C2051 features:

- 2 KB of on-chip Flash program memory.
- 128 bytes of internal RAM.
- Fully static operation: 0 Hz to 24 MHz.
- Instruction compatible with MCS-51.
- 15 I/O lines.
- Full duplex programmable serial port.
- Two 16-bit programmable timers.
- On-chip analog comparator.
- Low-power and power-down modes.
- Wide operating voltages: 2.7 V to 6 V.
- 20-pin DIP/SOIC package.

The use of static memory allows the device to be operated at zero frequency. It also affords two software-selectable save-power modes. Idle mode stops the CPU, retaining the contents of the internal RAM, allowing the timer/counter, interrupt system, and serial ports to function normally. Power-down mode saves the RAM contents but freezes the oscillator, disabling all other activity until the next hardware reset.

### B. RGB LED (common anode)

- A common anode RGB LED is nothing more complicated than three one colour

LEDs (one red, one green, and one blue) housed in a single package.

- Rather than having 6 leads (a cathode and anode for each LED) it has only 4 one cathode for each colour, and one common anode. (see the schematic diagram below)
- A common anode RGB LED is the most popular type. It is most commonly found in either a 5mm bulb size or as a 5mm piranha form factor.

### C. Current Limiting Resistors (270 ohm) (red-purple-brown)

- Most LEDs are designed to work with a voltage between 1.5v and 3v. As most microcontrollers (including the Arduino) operate on 5 volts a current limiting resistor is required.
- Consult your LEDs datasheet for maximum ratings but we like to use 270 ohm resistors. This limits the current to ~20mA, well within most LEDs and microcontroller ratings.

The concept of primary colour mixing is shown in Fig.2.

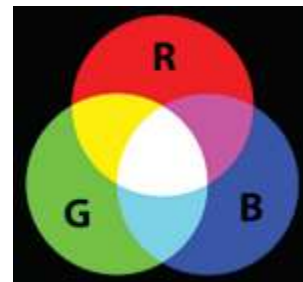


Fig.2: Concept of primary colour mixing [1].

Test Points	
Test point	Details
TP0	0V GND
TP1	+5V

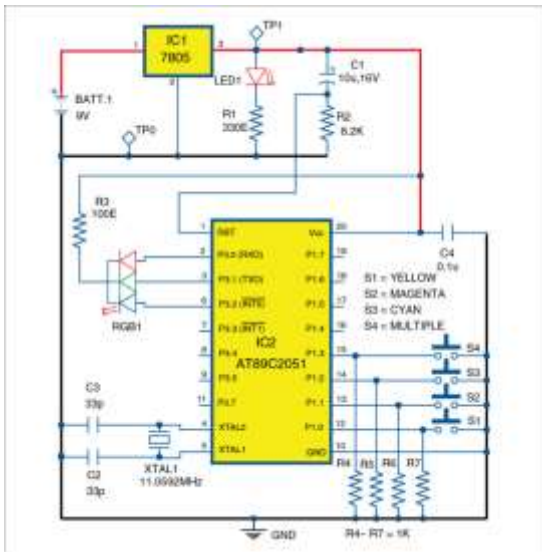


Fig. 3: Circuit of the RGB colour generator [1].

The circuit diagram for the multiple colour generator is shown in Fig. 3. The circuit requires a 9V battery, 7805 voltage regulator (IC1), Atmel AT89C2051 MCU (IC2) and a few other components. The 20-pin MCU performs the operation of multiple colour generation from RGB primary colours on pressing switches S1 through S4. In this project, we have used the concept of pulse width modulation (PWM) to change the colours of the RGB LED.

### III. PROJECT ORGANIZATION AND DISCUSSION

Initially, the circuit is powered by a +9V supply, which is connected to IC1 to maintain a constant +5V at its output. This constant output is fed to the MCU circuit. Port3 of IC2 is used to drive common-anode RGB LED, with P3.0 connected to red pin, P3.1 to green pin and P3.2 to blue pin of the RGB LED. Port1 is connected to the four tactile switches S1 through S4 for producing multiple colours.

When the circuit is switched on, red colour of the RGB LED glows for a preprogrammed time interval of three seconds. It then switches off for three seconds. This is followed by green and blue colours switching on and off in a similar manner and for the same time periods. Now, when we press switch S1, we get yellow colour (red+green), and if we press switch S2, we get magenta (red+blue). If

we press switch S3, we get cyan (blue+green), and if we press switch S4, we get multiple colours with the help of PWM technique.

**Software:** The software is written in embedded C language and compiled using Keilµvision 4 version compiler. It contains simple switch statements to produce different colours from primary colours. We have used Topwin 6 software to burn the hex code into the MCU using a Universal Topwin programmer board.

#### A. Software Used:

**1. KEIL µ Vision IDE:** KEIL µ Vision is an IDE (Integrated Development Environment) which is used to develop an application program compile and run it even the code can be debugged. It is a simulator where we can check the application code even in the absence of the hardware board.

**2. Flash Magic:** Flash Magic is used for burning the developed code on KEIL in to the microcontroller Chip. the serial port of PC is connected to the port of microcontroller through MAX232 to burn the program into the microcontroller

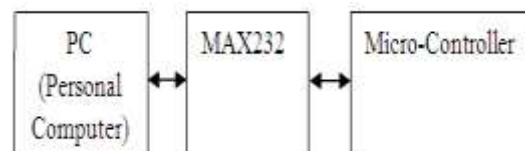


Fig.4. Programming process

### IV. CONCLUSION

As these three colors are considered as the primary colors in modern electronic display systems, RGB color model is used in most display systems like CRT, LCD, OLED etc. In this project, we designed an RGB LED Bulb, where the final color of the bulb can be controlled by varying the intensities of Red, Green and Blue LEDs individually. Here in this project we get multiple colours with the help of PWM technique.

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