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# Automated Color-Making System for Dyeing Industry

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**Abstract:** *The mixing of dyes is a major technique in several industries such as textiles, paint, and leather. It can be done in improper proportions the result should be in vivid shades of color. So, the proposed method is used for the dyeing companion that works automatically with different dye ratios. The system will execute the color taking from the vessel using a syringe using a PIC microcontroller (PIC16F874A/877A). The syringe can be controlled by the keyboard and the values are displaced in LCD. The controller can give the choice of the user to choose parameters with a specific amount (green, red, and blue). The intensity of the color between 0 to 255 gives the values for each parameter. The specific amount of selected color is poured with empty vessels and mixed with a mixer at a suitable time. This method of design gives several periods of working involved in the color system mechanism toward a fully automated color-making system. This method is used to increase the productivity level and reduce the health problem faced by the workers.*

**Keywords:** Peripheral Interface Controller, RGB Colors, LCD, Keypad, Stepper Motor

## I. INTRODUCTION

In today's world, the necessity of greater efficiency, high quality, and automated machines has been boosting the industrial zone of different plants. Many industries need continuous inspection and monitoring regularly. There are high possibilities of errors that can occur at various stages if machines are being operated manually by human workers. The process of mixing fluid is the most important and challenging task in many productions. This process has vast applications in different areas of industrial sectors. Different types of mixing can be made, using color mixing or any other fluid mixing. The process of developing new colors by using a mixture of primary colors is called color mixing. It is either done manually or performed on a machine with a lot of human effort [1]. This paper takes a sincere attempt to explain the advantages the companies will face by implementing automation into them. The action of controlling primary color, making which plays a major role in many color-producing industries like color-wash, pigment making, and food beverage, and this paper automation was the most specific method involved. To self-operate the color plant and minimize human work, there is a need to develop it by using the software MPLAB X IDE and PIC MICRO CONTROLLER [2]. RGB stands for "Red Green Blue". RGB means three hues of light. The three tones of light can be mixed to create a different combination of colors. The RGB Color model is additive [3]. This may not be as apparent in today's society but color serves a big role as a way to express personality and taste. This is not just tied to fashion and clothes, but to all kinds of visual expressions, for example, art and furnishing [4].The idea also serves the people by preventing direct contact with dyes which in turn reduces medical illnesses such as skin cancer, vocal infections, and respiratory sickness. The dyeing is of different types such as yarn dyeing, fiber dyeing, piece, and garment dyeing [5]. Automation is the major method involved in the dyeing and printing process, as it involves many complex parameters that are very important. If even a small amount of milligrams is wrong in the dyeing recipe, the shade of the fabric will change. Different parameters like temperature, pressure, mixing time, etc. are very important for dyeing [6]. The coding process of this implementation with a microcontroller requires fast and efficient processing which on the other part depends on the length and subroutines of the coding process. Thus it provides a real challenge with systems involving [7]. The mixing methodology could be a complex and unpredictable plant. Mathematical modeling of the mixing of primary color has been taken into thought and action, to design a suitable controller (PIC controller) to assure zero

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steady states, quick control, and disturbance rejection [8]. Nowadays automated system plays a major role in modern technology.

## II. METHODOLOGY

This color system has a lot of unique techniques, which will give you a new experience altogether. Another interesting feature of this system is that is automatic. PIC microcontroller is used for logic, timer, counting, and fast working purpose. After completion of one full cycle buzzer turns ON.

***Stage 1***

According to the intensity of color, the values are being typed in the keypad (3*4) and the typed values can be displayed on an LCD (16*2). Then the total system continues to work automatically. The needle or syringe connected to the stepper motor goes to the respective vessels. The color is sucked from the vessel through a syringe or needle attached to the servo motor. This process works continuously and is coded in the PIC microcontroller.

***Stage 2***

The colors taken from the vessel are poured into the mixing container. Adding two primary colors only we can get a new color, for we have taken another empty vessel. The mixing of color inside an empty vessel is done by the mixer fixed inside the container.

***Stage 3***

Then finally, mixed colors are taken for reference by the worker to confirm. Based on the needs of the unique color, the values can be typed using the keypad connected to the PIC microcontroller. The whole system can be operated automatically using a relay without any drawbacks.

## III. BLOCK DIAGRAM

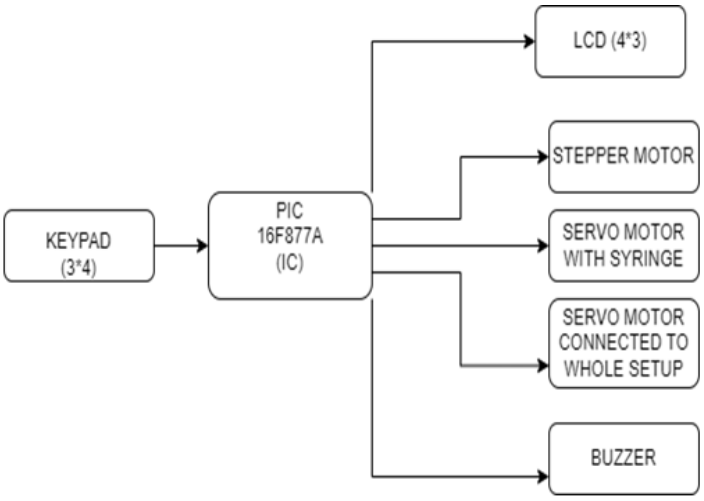


Fig.1. Overview of hardware setup

The steps involved in the project describe that input is typed using the keypad and it is displayed in the LCD display. According to the values typed the stepper motor works and also the servo motor works to suck the primary color present in the respective vessel. Finally, the color is ready for reference.

## IV. HARDWARE SETUP

In this paper, I am using PIC16F877A (40Pins): the most common chip of all, it's a general purpose in the electronics field.PIC includes many features such as 8K Program memory, 368 Bytes RAM, 256 Bytes EEPROM, 33 I/O Pins, 8 channels ADC with 10Bit resolution, 2 CCP (PWM), SPI, I2C, USART (RS232), Timers 0,1 and 2, and 2 Comparator modules. When compared to other existing microcontrollers it has minimum power consumption and an easily programmable interface. It is available in a cheap amount and provides simple interfacing to analog circuits. PIC16F877A microcontroller belongs to the PIC micro Family and this microcontroller which is popular in modern

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technology, starts with beginners until all professionals. Because very easy to use PIC16F877A and use FLASH memory technology so that can be write-erased until thousand times.

The PIC16F877A Microcontroller consists of an inbuilt

- 35 CPU instructions,
- Input and Output ports
- Analog and Digital converters,
- Timers (T0,T1,T2),
- counters, interrupts,
- serial communication (SPI, I2C), internal oscillator, and CCP/PWM modules
- memory (program memory, Electrically Erasable Programmable Read Only Memory)

Which to gather makes the IC a powerful microcontroller for beginners to start with. A Random Access memory is the one that decides the speed of our microcontroller. The RAM consists of register banks within it, each of which is assigned a specific task. The register can be classified into two types.

- General Purpose Register (GPR - 31)
- Special Function Register (SFR - 6 )

As the name suggests the GPR is used for general register functions like addition, subtraction, etc.

These operations are limited to 8-bit. Each register present in the general purpose register (GPR) iswritable (W)and readable (R). They cannot function any operation on their own unless it is being coded by the software (MPLAB X IDE).

Whereas the special function register (SFR) is used to operate complex special functions, which also involves 16-bit handling,

These SFR registers can be used for read (R) purposes only and we cannot write (W) anything in the SFR register.

So, these types of registers have a predefined function to perform, which is set at the time of manufacturing and they just display the result to us, using which we can perform some related operations.

### 4.1 Pin Configuration

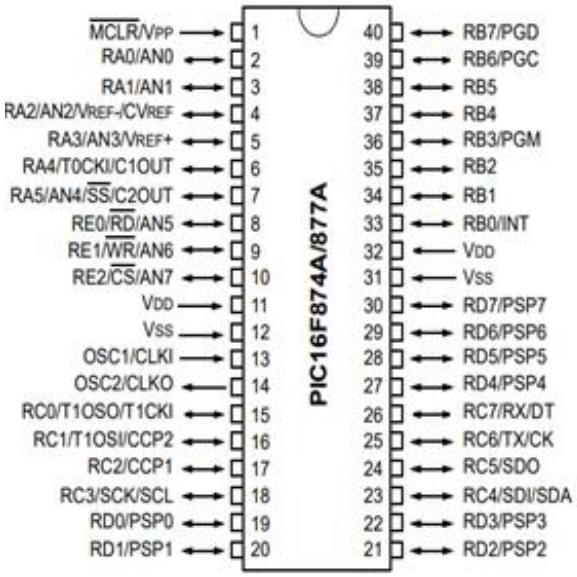


Fig.2.The general block diagram of the PIC Architecture

PORTB is connected to a keypad, PORTC is connected to an LCD, and PIN 13 and PIN 14 are connected to the 20MHZ crystal oscillator for giving the clock pulse to the microcontroller.PIN 17 (CCP) is connected to the stepper motor for the entire movement of the servo motor.

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Fig.3.PIC16F877A Chip

### 4.2 LCD (liquid crystal display)

So Now, we know that LCD has 16 pins and each character has (5*8=40) 40 Pixels, and for 32 Characters we will have (32*40) 1280 Pixels. Further, the LCD should also be instructed about the Position of the Pixels.

It will be a confusing task to handle everything with the help of MCU. The integrated circuit (IC) like HD44780 which is manufactured by Hitachi and is inbuilt or mounded on LCD Module itself.

The function of this HD44780 is to fetch Commands and Data from the PIC microcontroller and display them on the LCD screen for our vision.

#### 4.2.1 Pin Configuration For LCD

PIN15=RC0 is connected to RS (register select).
PIN16=RC1 is connected to EN (enable).
PIN17=RC2 is connected to PIN (D4).
PIN18=RC3 is connected to PIN (D5).
PIN23=RC4 is connected to PIN (D6).
PIN24=RC5 is connected to PIN (D7).

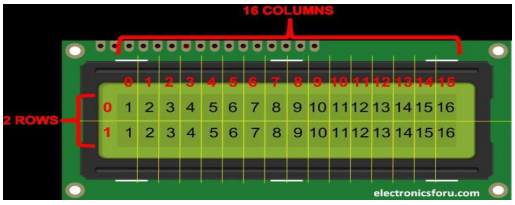


Fig.4.Liquid Crystal Display

### 4.3 Keypad

Keypad is the major object used as the input device for the microcontroller unit to read the digital signal, like a switch input. In a few applications where 9, 12, and 16 keys are needed for input purposes, if we add each key to a microcontroller port, we will end up using 16 I/O ports. In this paper we conclude that R1, R2, R3, & R4 as rows and C1,C2,C3 as columns. From the interior view of the keypad, we can understand that 12 push buttons are present. We have set the rows as LOW(0) and columns as HIGH(1) for our project. Any key which is in HIGH condition, assoon as the key is pressed becomes a LOW condition. After the key is released the key will become again HIGH because of the pull resistor.

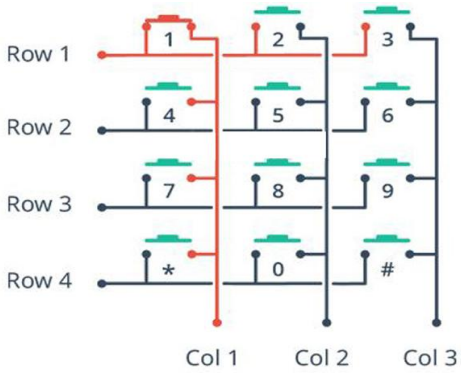


Fig.5. Interior view of the keypad

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#### 4.3.1 Pin Configuration For Keypad

PIN33=R1 (row1); PIN37=C1 (column1);
PIN34=R2 (row2); PIN38=C2 (column2);
PIN35=R3 (row3); PIN39=C3 (column3);
PIN36=R4 (row4);
From our understanding, we can write the condition,

- R1=low , R2=R3=R4=high;
- R2=low , R1=R3=R4=high;
- R3=low , R1=R2=R4=high;
- R4=low , R1=R2=R3=high;

### 4.4 Stepper Motor

A stepper motor can be applied to many projects. Stepper motors are used in automotive gauges and machine tooling automated production equipment. A stepper motor is used inside medical scanners, and samplers, and is also found inside digital dental photography, fluid pumps, respirators, and blood analysis machinery. The stepper motors can also be used in disk drives, matrix printers, etc. The circuit can be used in robotic applications and also used in mechatronics applications.

#### A. Working of Stepper Motor

The stepper motor consists of four electromagnets connected to four pins. These four pins are named A,B,C, and D.The motor consists of a shaft, rotor ball bearing, and winding. The current supplied by the drive creates the magnetic field that is used to rotate the shaft of the motor.
The upperward electromagnet is activated so the teeth will be at A. Another three B,C and D electromagnets will be deactivated. Thereafter, when we turn off the upper electromagnet and turn ON the rightward electromagnet the teeth rotate in a clockwise direction. Then after, again when we turn OFF the rightward electromagnet and turn ON the downward electromagnet the teeth will rotate in the clockwise direction.Then after, again when we turn OFF the downward electromagnet and turn ON the leftward electromagnet the teeth will rotate in the clockwise direction. According to this repeated condition, the stepper motor rotates step by step. The stepper motor has been placed near the water vessel default. The syringe is connected to the servo motor for sucking and releasing purposes. After the sucking and releasing processes everytime the syringe has to get into the vessel and get out of the vessel.This whole setup is again attached to another servo motor that is used to allow the syringe inside the vessel and get out of the vessel.

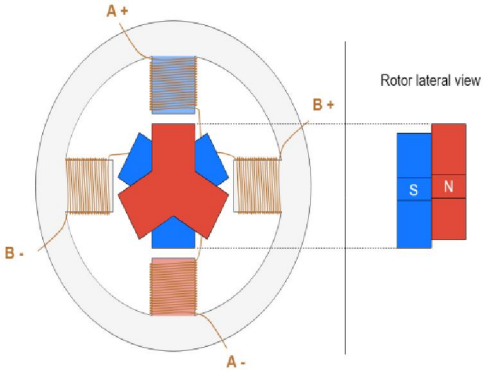


Fig.6. Interior view of stepper motor

### 4.5 Servo Motor

A Servo motor is a type of actuator that allows us to control the motor at an angle. In our project, we are using hobby servo motors. Hobby refers to money less and an easy way for controlling motion. There are two types of servo motors based on their angular rotation 180-degree motor and 360-degree motor. We are using a 180-degree (MG9995 servo motor). Servomotors are rated in kg/cm. For example:(3 kg/cm,6kg/cm). The servo motors are different from normal

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motors because servo motor encoders are present. This encoder allows high-speed and high-precision control according to the given position and speed commands. One of the hardware elements that form the core of the servo system is the encoder which generates the speed and position feedback. In some cases, the encoder is inbuilt into the servo motor.

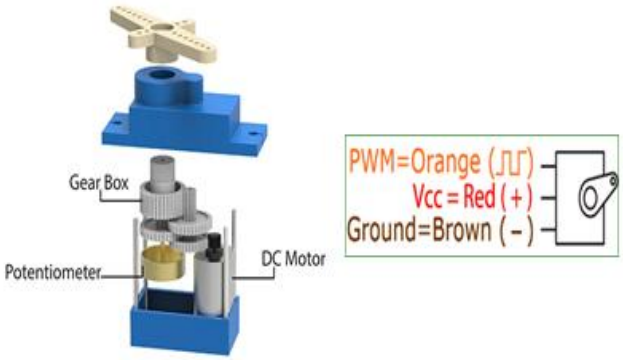


Fig.7. Interior view of the servo motor

The servo motor consists of three pins.
PIN 1= PWM signal
PIN 2 =VCC(+) power
PIN 3 = VSS (-) ground

**4.5.1 Pin Configuration**
PIN 25 =RC6 (servo motor 1 for syringe movement)
PIN 26 =RC7 (servo motor 2 for color sucking )

## V. IMPLEMENTATION

The syringe first gets into the vessel and suck the water and releases the water into the same vessel for cleaning the syringe.Then,the stepper rotates and moves the whole stand to the right-hand side for sucking the three primary colors (RED,GREEN, and BLUE). The stepper motor rotates according to the RED, GREEN, and BLUE values.

**Case 1:**
If the value for red is 10% and for green is 30% and for blue is 10%, then the stepper motor first runs 2 steps to the red vessel for sucking the red color for (10%). After sucking the red color the syringe goes to the empty vessel and the syringe releases the red color into the empty for mixing. again the syringe goes to water for cleaning purposes. For this, the stepper motor must rotate 8 steps in opposite direction. The syringe again goes into the water vessel for sucking the water and release the water into the same vessel for cleaning purpose. After the syringe goes to the green vessel. Now, the stepper motor is to run 4 steps for sucking the green color for (30%) and after sucking the color from the vessel the whole stand moves to the righthand side (4 turns) for releasing the color into the empty vessel. Again, the syringe goes to the water vessel (8 turns)for cleaning the syringe. After cleaning the syringe goes to the blue vessel(6turns) for the sucking process and goes to the empty vessel for releasing the color .after this complete process the whole stand stops at the default place (water vessel). Once this stand reached the default place the buzzer becomes ON and makes a noise that the complete cycle has been finished. Now the mixer can start mixing the three primary colors R,G, and B.

## VI. RESULT & DISCUSSION

The color present in the mixer vessel is completely mixed using the mixer. After the mixing process, the color is taken for our reference.

**6.1 Stimulation**
Before going to the hardware setup,we can see the output using the simulation software (PROTEUS DESIGN ISIS PROFESSIONAL).The stimulation diagram is given below for reference.

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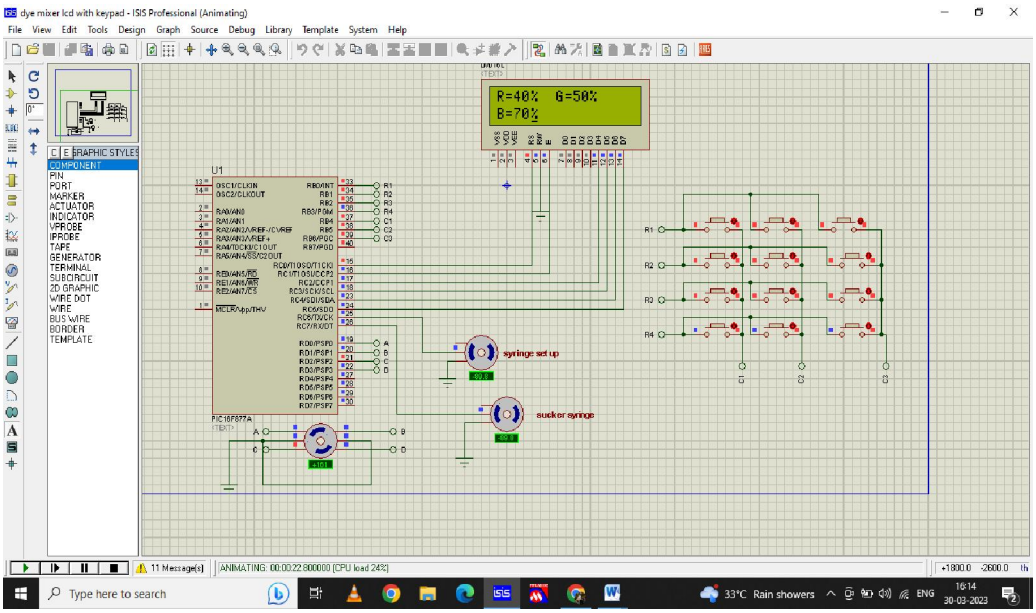


Fig.8. Stimulation result for the system

## VII. CONCLUSION

The main objective of the project is to reduce human error and increase efficiency. The development of new technology in industries has made machines work as automatic which leads to an increase in the production level and quality of products. For this, we can implement using the PIC microcontroller. The main advantage of this system is fully automated. To automate the process in the modern world, researchers are using many techniques like PLC, AUDRINO, and MICROCONTROLLER. In the empty vessel, the dc motor is fixed to mix the colors present in the vessel. using this same idea we can also develop the project using an STM microcontroller. This paper will give an idea to establish the upcoming dye, paint, and liquid mixing industries.

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