# Color Mixing Machine Using PLC and SCADA

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*Abstract: -* This paper outlines the various stages of operations involved in the conversion of a manually operated color plants towards a fully automated color making plant.  Over the years the demand for high quality, greater efficiency and quantity has increased in this globalized world for various colors. The initial phase of the design focuses on passing the inputs of color mixing and making process with various components. With the help of mixing tanks all colors coming from the process will be mixed in the required proportion. Color will be mixed using mixed motor. Making color in industry will be used for food beverage industry. Generally from three colors, nine colors will be made with different proportions so it will be used in different petrochemical companies. The SCADA is used to monitor the system. PLC is also used for the internal storage of instruction for the implementing function such as logic, sequencing, timing, counting and arithmetic to control through digital or analog input / output modules various types of machines processes.

*Key-Words: -* Color, Automated, Quality, Efficiency, Mixing, Process, SCADA, Monitor, PLC

## 1 Introduction

### 1.1 RYB color model

RYB (an abbreviation of red–yellow–blue) is a historical set of colors used in subtractive color mixing, and is one commonly used set of primary colors. It is primarily used in art and design education, particularly painting.

RYB predates modern scientific color theory, which argues that magenta, yellow, and cyan are the best set of three colorants to combine, for the widest range of high-chroma colors. Red can be produced by mixing magenta and yellow, blue can be produced by mixing cyan and magenta, and green can be produced by mixing yellow and cyan. In the RYB model, red takes the place of magenta, and blue takes the place of cyan. However, reproducing the entire range of human color vision with three primaries either in an additive or subtractive fashion is generally not possible; see gamut for more information[1].

### 1.2 Color wheel

RYB (red–yellow–blue) make up the primary color triad in a standard artist's color wheel. The secondary colors (purple–orange–green) sometimes called (violet–orange–green) makes up another triad. Triads are formed by 3 equidistant colors on a particular color wheel. Other common color wheels represent the light model (RGB) and the print model (CMYK)



Fig.1  RYB model

### 1.3 Problem definition

Some factories still mix color manual so conventional equipment systems are prone to errors due to the involvement of humans in the

data collection and processing using complicated mathematical expressions.

Thus the required is a system that collects raw data, processes it and presents it in values which can be verified and compared with the standard values. In the coding process of this implementation with microcontroller, it requires a 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 [1].

## 1.4 Objective

Over the years the demand for high quality, greater efficiency and quantity has increased in this globalized world for various colors [2]. The initial phase of the paper focuses on passing the inputs of color mixing with various components. With the help of mixing tanks all colors coming from the process will be mixed in the required proportion [3]. Color will be mixed using mixed motor .making color in industry which will be used for food beverage industry. Generally from three colors we are making nine colors with different proportions so it will be used in different petrochemical companies.

Thus what we require is a system that collects raw data processes it and presents it in values which can be verified and compared with the standard values. In the coding process of this implementation with microcontroller, it requires a 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**.**

To making the different colors in the industry different methods are used that are given by the following-

- User can select one of the six colors which are shown on the HMI.
- User can create his own color with his own ratio of the three main colors.
- User can be operated that plant by using machine and human efforts or both.

## 1.5 Block Diagram of Color Making and Mixing Process

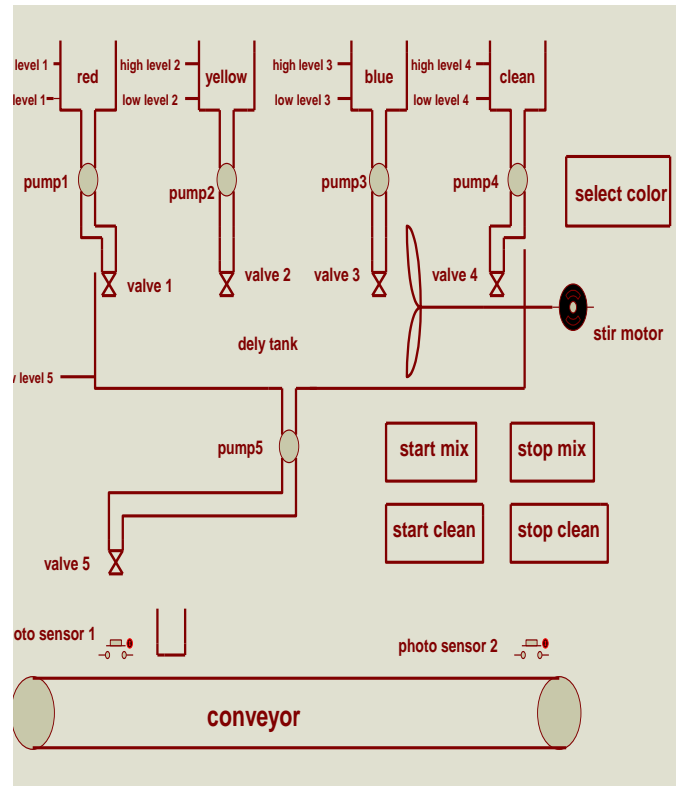Fig. 2 illustrates the block diagram of color making and mixing process



Fig.2 Block diagram of color making and mixing process

## 2 Component of The Design

A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnet field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°. A simple DC motor typically has a stationary set of magnets in the stator and an armature with a series of two or more windings of wire wrapped in insulated stack slots around iron pole pieces (called stack teeth) with the ends of the wires terminating on a commutator. The armature includes the mounting bearings that

keep it in the center of the motor and the power shaft of the motor and the commutator connections [4]. The winding in the armature continues to loop all the way around the armature and uses either single or parallel conductors (wires), and can circle several times around the stack teeth. The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created. The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a force on the armature which causes it to rotate [5]. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor. At high power levels, DC motors are almost always cooled using forced air.

# 3 PLC

## 3.1 Introduction
Programmable Logic Controller (PLC) is an intelligent system of modules, which was introduced in the control, & instrumentation industry for replacing relay based logic .Over a period of time, better I/O handling capabilities and more programming elements have been added along with improvement in communication [6].

## 3.2 The Structure and Features of Programmable Logic Controller
PLCs have been used in industry in one form or another for the past twenty over years. The PLC is designed as a replacement for the hardwired relay and timer logic to be found in traditional control panels, where PLC provides ease and flexibility of control based on programming and executing logic instructions. The internal functions such as timers, counters and shift registers making sophisticated control possible and using even the smallest

PLC. The structure of a PLC can be divided into four parts. They are input/output modules, central processing unit (CPU), memory and programming terminal [7]. Figure 3 shows PLC structure
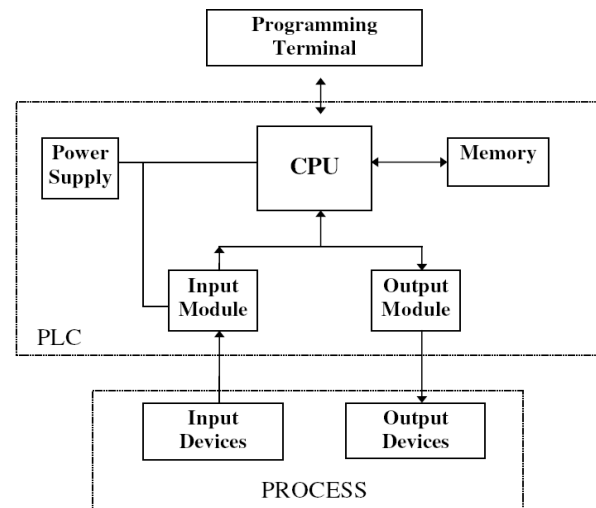
Fig.3 PLC structure

A programmable controller operates by examining the input signals from a process and carrying out logic instructions (which have been programmed into its memory) on these input signals, producing output signals to drive process equipment or machinery. Standard interfaces built-in to PLC allow them to be directly connected to process actuators and transducers without the need for intermediate circuitry or relays [8].

PLCs require shorter installation and commissioning times than do hard-wired systems[9]. Although PLCs are similar to conventional computers in term of hardware technology, they have specific features suited for industrial control:
- Rugged, noise immune equipment;
- Modular plug-in construction, allowing easy replacement or addition of units (e.g. input/output);
- Standard input/output connections and signal levels;
- Easily understood programming language;
- Ease of programming and reprogramming in-plant;

- Capable of communicating with other PLCs, computers and intelligent devices;
- Competitive in both cost and space occupied with relay and solid-state logic systems;

These features make programmable controllers highly desirable in a wide variety of industrial-plant and process-control situations [10].

# 4 The proposed PLC

The proposed PLC is MASTER-K120SE (K7MDR/DRT/DT30UK7M-DR30UE) which is shown in fig. 4
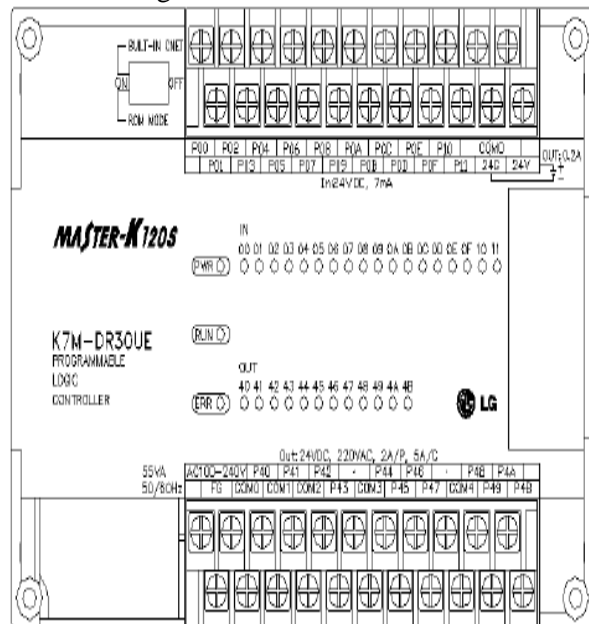


Fig.4 K7MDR/DRT/DT30UK7M-DR30UE

## 4.1 Features of MASTER-K120SE

MASTER-K120S series is extremely compact, to fit a wide range of applications and have following features.

- High speed processing of 0.1~0.9 s/step with an general purpose processor included .
- *Various built-in functions*
- The main unit can perform many functions without using separate modules. Therefore, it is possible to construct various Systems just using the main unit.
- *Input / Output Specifications*

Digital input that offers to MASTER-K120S series are made to use both of electric current sink and electric current source. To keep use coil load as an output module, maximum opening and shutting frequency is 1 second on and 1 second off.

The following diagram shows maximum life relay for relay output.

- Digital Input Specification

Number of input points      :           18 points
Insulation method        :        Photo coupler
Rated input voltage      :           DC 24V
Rated input current      :          7 mA
(Standard   Type   P0~P3:9mA,   Economic TypeP0,P1:9mA)
Operating voltage range  :        DC20.4 ~ 28.8V (ripple: less than 5%)
Max. simultaneous input points  :     100% simultaneously on
Input impedance      :       Approx.3.3 kΩ(Standard Type P0~P3:2.7 kΩ, Economic Type P0,P1:2.7 kΩ )
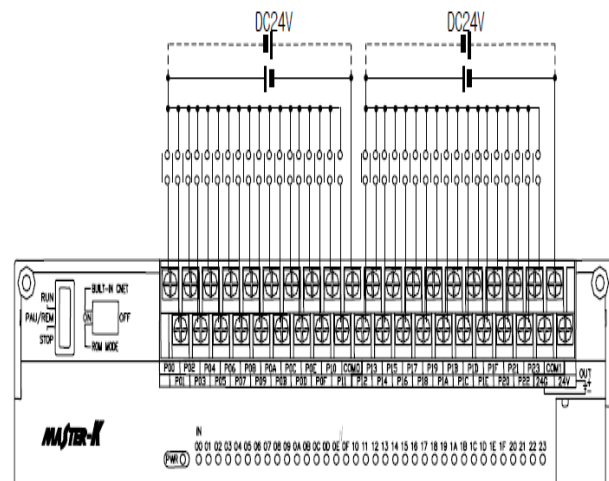


Fig.5 input wiring

- *Digital output Specification*

Output point            :     12 points
Insulation method      :     Relay insulation
Rated load voltage/current    : DC24V / 2A (r/load), AC220V / 2A (COS(θ) )
Min. load Voltage/current     : DC5V / 1mA

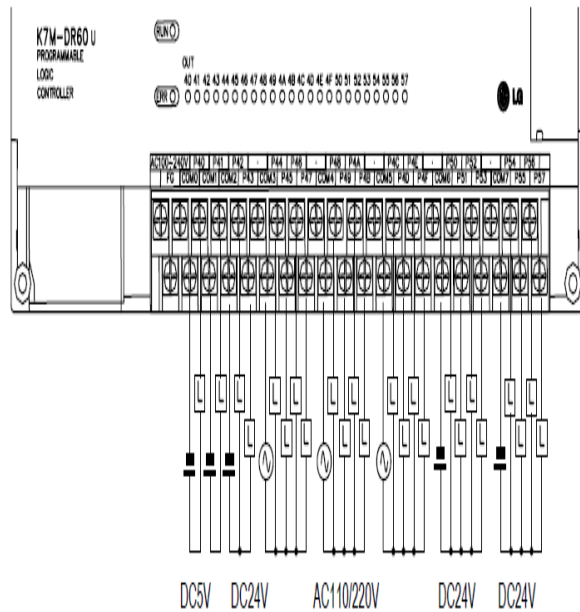| Max. load voltage/current | : | AC250V, DC110V |
| Current leakage when off (AC220V, 60Hz) | : | 0.1mA |
| Max. On/off frequency times/hr | : | 1,200 |



Fig.6 output wiring

# 5 Communication Functions

## 5.1 Introduction

MASTER-K120S's built-in Cnet communication uses only MASTER-K120S main unit for a dedicated communication. That is, it doesn't need a separate Cnet I/F module to facilitate the user-intended communication system by utilizing reading or writing of any area in CPU, and monitoring function.

## 5.2 System Configuration Method

A) Communication program made by C or BASIC computer language on the user's computer, or utility program like FAM or CIMON can be used. Fig. 7 shows the communication with PC
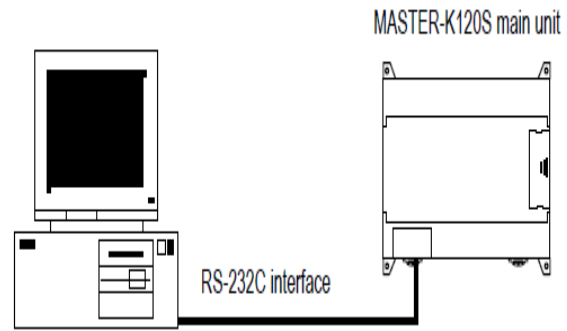


Fig.7 Communication with PC

B) Wiring method
Fig. 8 shows wiring method between PC and MASTER-K120S main unit.



Fig.8 wiring method

# 6 Software

## 6.1 KGLWIN

The programming software of LG Master K PLC's is named KGLWIN, KGLWIN is under windows package which you can use to write Ladder or mnemonic (statement) programs and to download it to PLC also to emulate the downloaded.

## 6.2 Features of KGL For Windows

KGL for Windows is the Programming and Debugging Tool for LG Master-K Series.
KGL for Windows has abundant Features as below

- Program Compatible between LG Master-K Series. A user can use the Program (*.PGM) created in LG Master-K Series for the Program created in other LG Master-K Series
- The Program, Parameter or Variable/Comment created in KGL-DOS or GSIKGL can be also used in KGL for Windows.
- PLC System Configuration by Project Structure. KGL for Windows manages the User-Defined Program as one Project including Parameter and Variable/Comment. Also a user can save a Program (*.PRG), Parameter (*.PMT), Variable (*.VAR) or Comment (*.CNT) respectively and the Stored each File can be used for other Project files.
- User Friendly Interface where easy and useful interface for Creating, Editing and Monitoring.
- Online Editing where a Real Time Editing is available in online mode. The Program edited in the online condition can be downloaded Automatically without stopping PLC Hardware.
- Monitoring the Information from PLCA user can easily monitor PLC status such as Error Status, Network Information and System Status
- Debugging and Self diagnosis (in New MASTER-K Series Trigger and forced I/O Enable are available for the accurate

## 6.3 Creating Program

Double-click KGL_WE.exe file to run KGLWIN. The Start-up Screen will be shown in fig. 8.
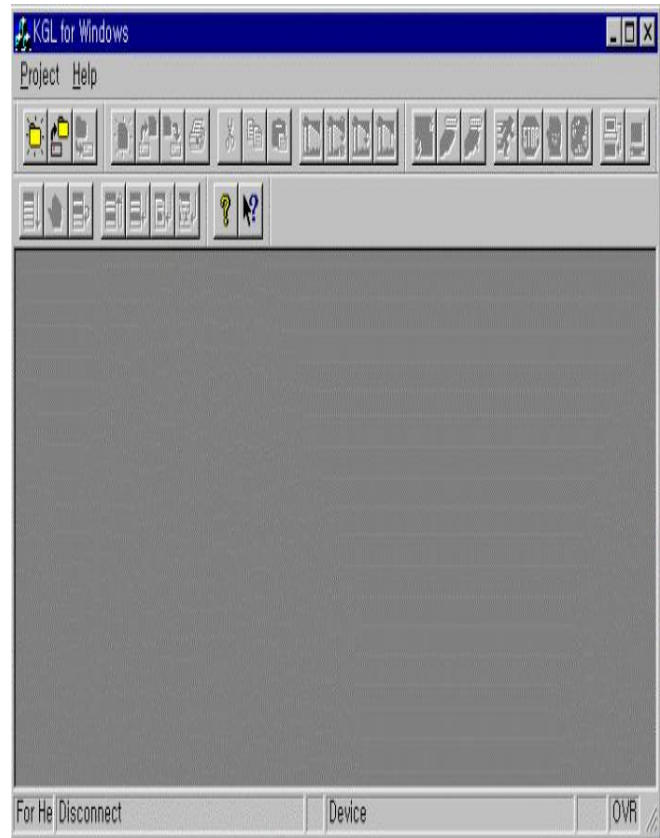

Fig. 8 The Start up screen

To create a new Project, select Project, New Project in the Start-up Screen will appear, select Blank Project in the dialog box and click OK button. Fig.9 shows this operation.
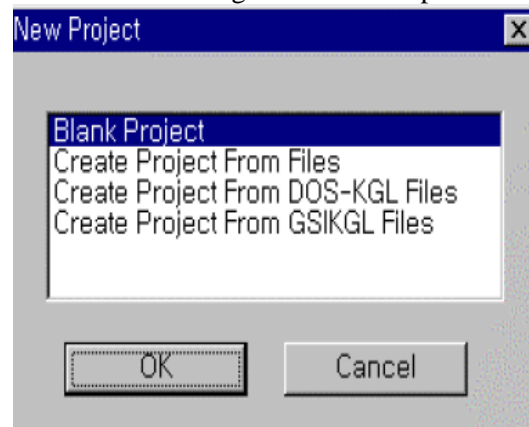

Fig. 9 selecting blank project

In the following dialog box shown in fig. 10, Type in PLC Type, Programming Language, Title, Company, Author and Description.

Fig. 10 Project property

Click OK button. Then, Project, Message and Program Windows are displayed automatically as shown in fig. 11.
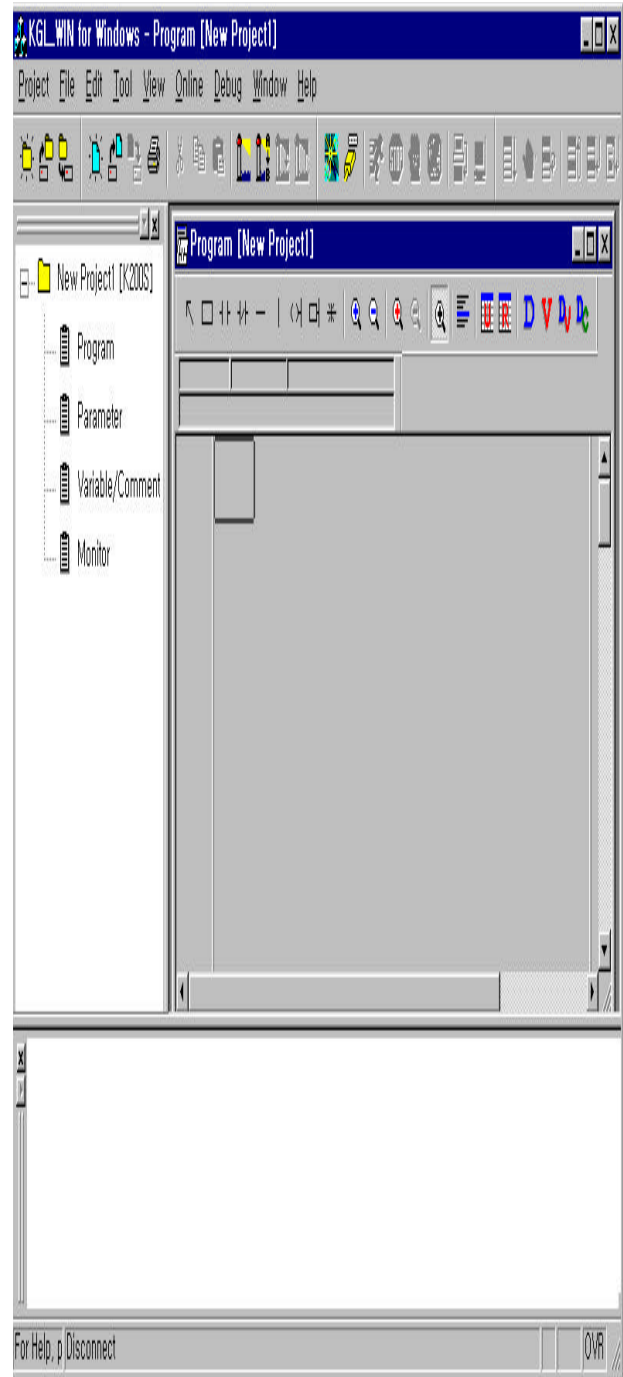


Fig. 11 Window of the new project

You can also create a new Project using already created files from KGL-DOS or GSIKGL as well as KGLWIN

## 6.4 Classification of Inputs and Outputs

The classifications of inputs and outputs are shown in table 1

Table 1
Classification of inputs and outputs

| Inputs | | outputs | |
|--------|--------|--------|--------|
| P0 | start NO | P40 | Stir motor |
| P1 | stop NC | P41 | conveyor |
| P2 | photocell NO | P42 | Pump 1 |
| P3 | low level 1 NC | P43 | Pump 2 |
| P4 | low level2 NC | P44 | Pump 3 |
| P5 | low level 3 NC | P45 | Pump 4 |
| P6 | low level 4 NC | P46 | Pump 5 |
| P7 | low level 5 NC | P47 | Lamp 1 |
| P8 | start clean NO | P48 | Lamp 2 |
| P9 | stop clean NC | P49 | Lamp 3 |
| PA | photocell 2 NO | P4A | Lamp 4 |
| PB | high level 1 NO | | |
| PC | high level 2 NO | | |
| PD | high level 3 NO | | |
| PE | high level 4 NO | | |

## 7 LSIS OPC Server

OPC (OLE for Process Control) is a communication standard based on OLE/COM/DCOM technology which forms the new means of exchanging information between MS Windows applications.

It offers greater interoperability between the control /command /supervision applications, the industrial equipment (PLCs, sensors, actuators) and the office management applications. OPC defines standard objects, methods and properties built on the COM (Component Object Model) concept to allow real time data servers like DCS, PLCs and field equipment to communicate their data to OPC clients [11].

### 7.1 Adding Channel
A) Channel
Channel is the medium through which information is transmitted from a sender (or transmitter) to a receiver. LG OPC server supports Ethernet (TCP/IP UDP) and serial communication.
B) Choosing channel
The following window will be shown in fig. 12 after clicking button or [Tools]-[Register PLC]-[Add Channel]. There are Ethernet and serial in channel format.
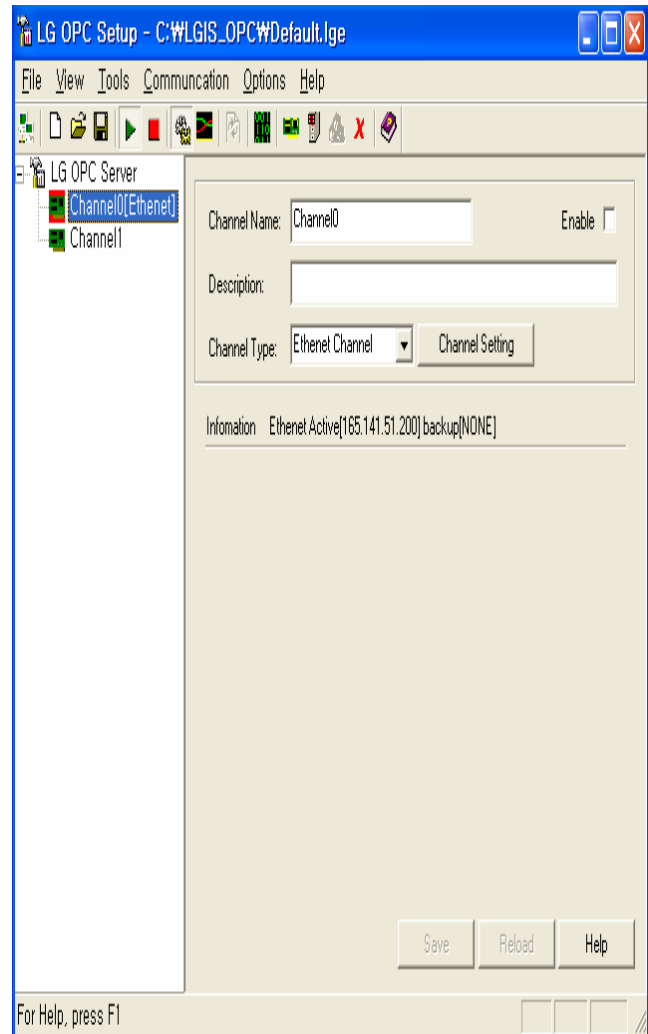


Fig. 12 Choosing channel name

After selecting channel and [Channel Setting], you are able to do the specific setting as shown in fig. 13.
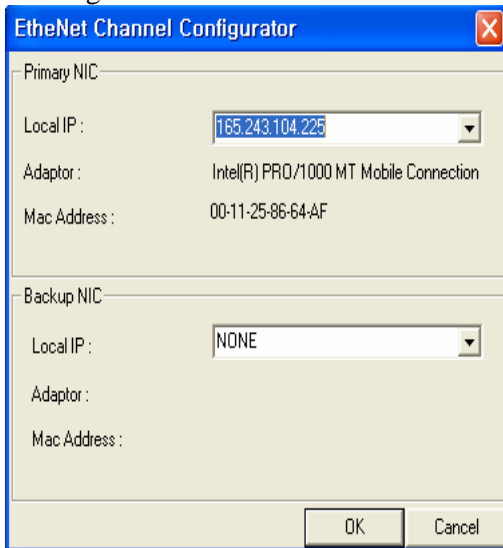


Fig. 13 Ethernet Channel Configuration

There is a setting information screen for Primary Network Interference Card (NIC) and Backup NIC. Local IP address is to display current IP address of PC. Communication is done by the selected channel for a specific network card. In case of redundancy configuration, select a proper network adaptor with IP setting between Ethernet configurations. The windows of these operations is shown in fig. 14 and fig. 15
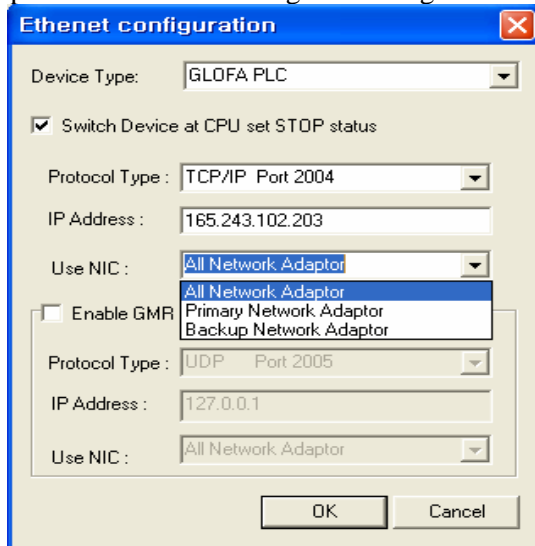


Fig. 14 Ethernet configuration
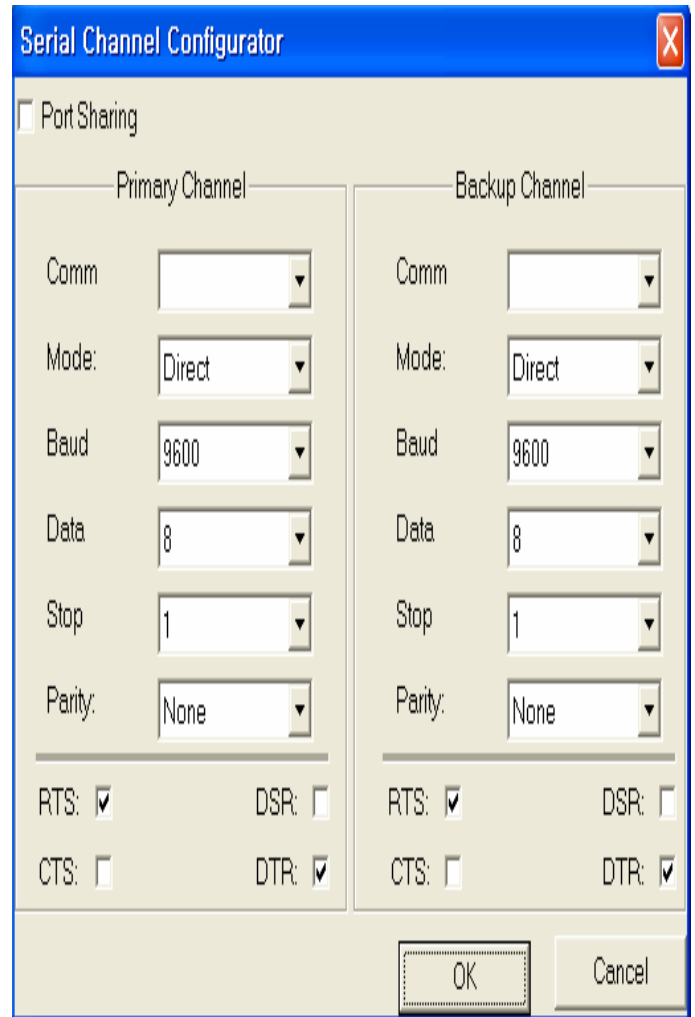


Fig. 15 Serial channel configuration

The parameters in this channel
- Port Sharing: to share a port among several devices like a dial-up modem.
- Comm.: communication port selection.
- Mode: to select the device type to connect.
- Direct: direct communication with serial port.
- Radio: to activate flag setting for radio modem (example, Key On Time..)
- Telephone: communication by dial-up modem.
- Baud: Baud rate for communication.
- Data: data bit setting.

- Stop: stop bit setting.
- Parity: parity bit setting.

RTS, CTS, DSR and DTR: signal selection to use a flow control.

## 7.2 Add Device

A) Device

The device is the equipment that communicates with OPC server.

B) Choosing Device

You will see the following window after clicking button or [Tools]-[Register PLC]-[Add Device].How to add device is shown in fig.16
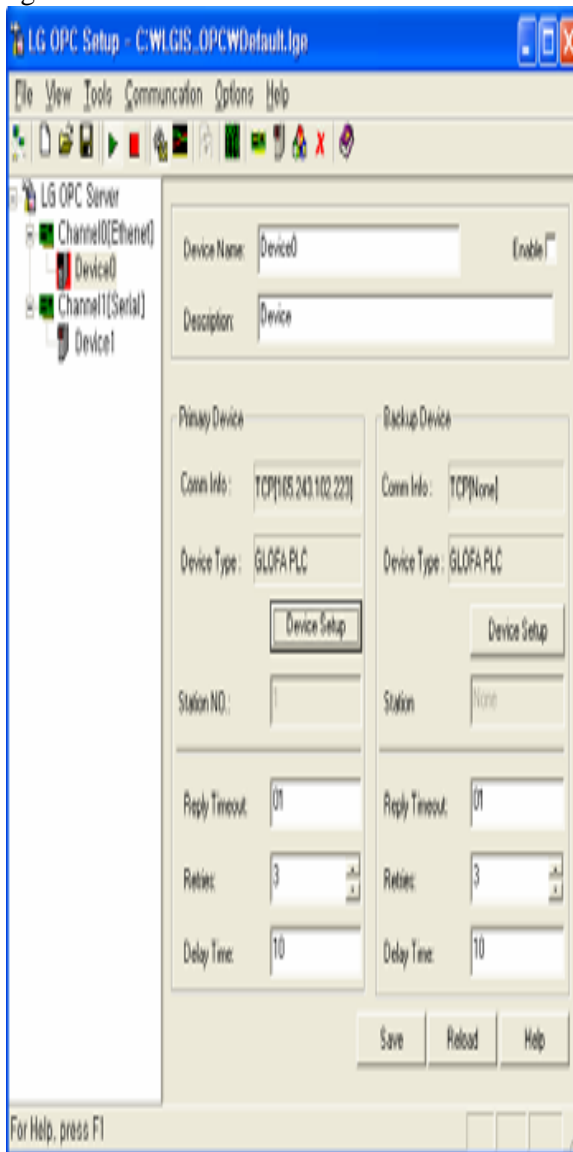


Fig. 16 Adding Device window

The parameters of adding device window is as follow

- Enable: communication proceed after ticking it off.
- Station NO: In case of serial communication, type PLC station.
- Station number is ignored in Ethernet communication.
- Retries: If OPC server transmits a command to PLC and receives no response during the setting Time (second), it repeats this process as many times as set in Retries. Without any Response after retries, it reports a communication error to system and initialize the port.
- Delay Time: In case of a communication error, restart communication after delay time.

## 7.3 Choosing Data Block

A) Data Block

Data block is a PLC register block. OPC server does not read the data by the user's request but copies a registered block to CPU memory at fixed periods (cache type of OPC support) [12]. But it makes an output directly (device type of OPC). Fig. 17 shows how to determine block name
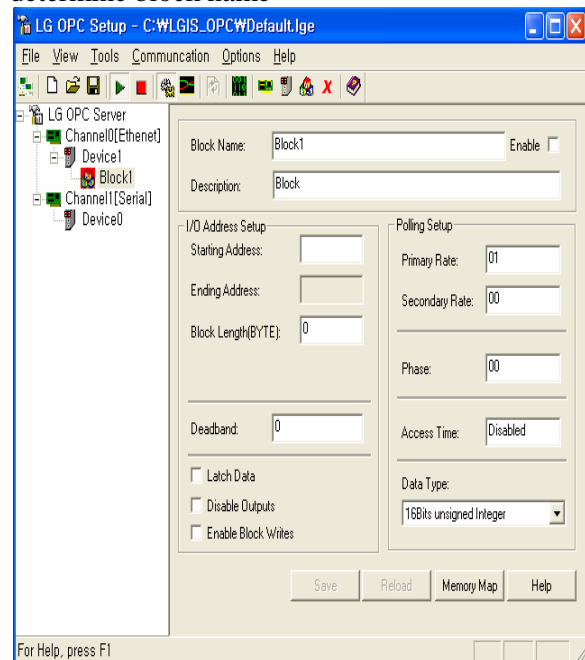


Fig. 17 Determining block name

B) Data Block Setting

It is used to set a register to read. Here, address means a PLC address. It is set as block and you are not supposed to use bit address (it is available to register a separate item). In case of an inverter and IGS, a number is used for a memory because they have only one memory type which is classified as follow

- Starting Address: first address to communicate
- Ending Address: last address to communicate
- Block Length (BYTE): total data size to communicate with a device (unit: byte)

C) Deadband:

After reading a value from a device, no update is made unless there is a change in a data value. If you set it as 0, it updates its value whenever it communicates with a device.

D) Latch Data

In case of a communication error, it latches the previous value. Unless it is selected, all the output values are cleared to 0.

E) Disable Outputs

It is used to deactivate output.

F) Enable Block Writes

If Enable Block Writes selected, in case of a separate output point, it doesn't make an output to PLC. Instead it stores the data in a temporary memory and transmits the entire block to the output.

G) Primary Rate

It is used to set a communication period to read data from PLC.

H) Secondary Rate

In case of a communication failure, it communicates with the device at secondary rate, if selected. It is disabled without selection. In case of a frequent overrun, you are able to reduce its frequency by constant value input at this section.

I) Phase

Each device has its own communication thread. And if a period of the block of the same device is equal, its data are transmitted to PLC at the same time. At this moment, with a phase selection, the command is sent to PLC

with the registered delay. Fig. 18 Timing sequence after and before applying phase
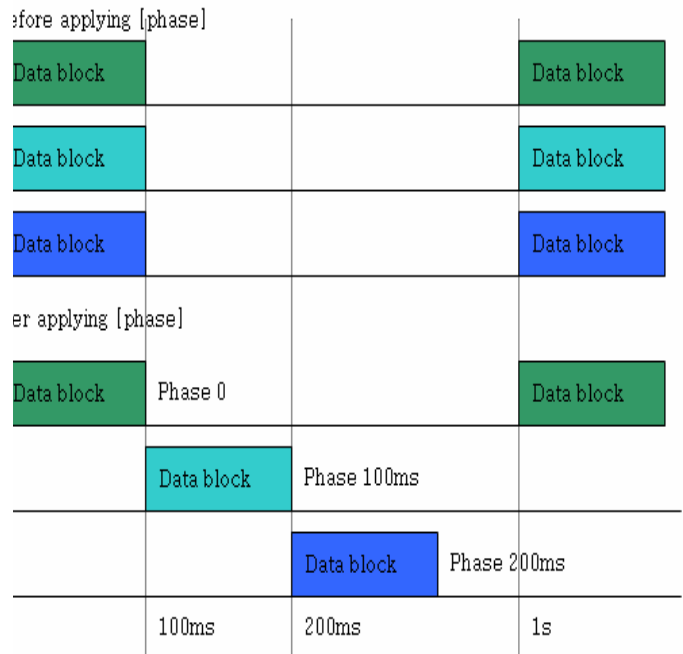


Fig. 18 Timing sequence after and before applying phase

J) Access Time

This has no relationship with OPC server operation. OPC server runs during this setting time (Access Time) and stops its communication. It is disabled with null data. In this case, it continues communication.

K) Data Type

To select a data type. The data type is as follows.

- Byte (String)
- 16-bit Signed Integer
- 16-bit Unsigned Integer
- Float: 32-bit Float
- Bool (Digital)
- Date and Time
- 32-bit Unsigned Integer
- 32-bit Signed Integer
- Double (64Bits): 64-Bit Float

L) Address Define

When OPC client checks registered tags, their types are determined as set here. Data type matters because LG OPC server creates

registered tags automatically. In case of [Address Define], it is set as variable type automatically. Fig. 19 shows matrikon OPC explorer.
Example) %MW0-> 16-Bit Unsigned Integer
%MD0 -> 32-Bit Unsigned Integer
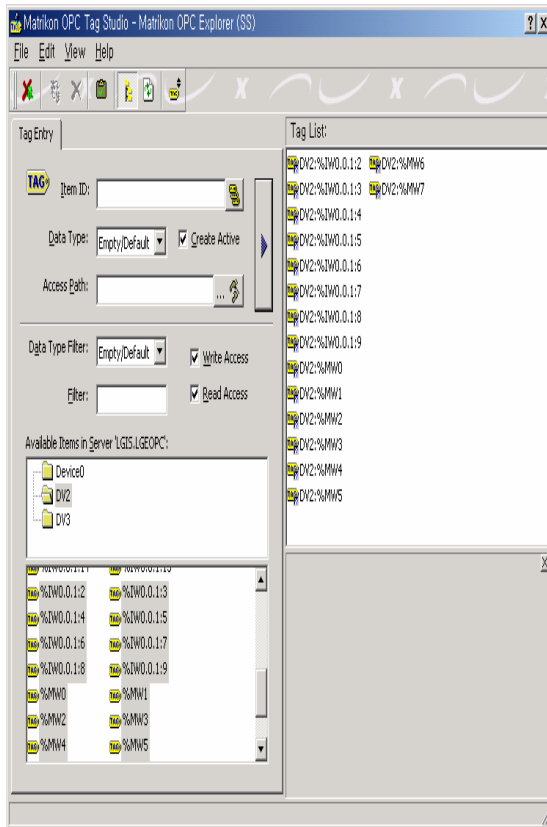M000 -> 16-Bit Unsigned Integer



Fig. 19 Matrikon OPC explorer

## 7.4 Proficy*HMI/SCADA – iFIX*4.5

Proficy HMI/SCADA – iFIX 4.5* delivers a wide range of features and benefits to address virtually every marKet and class of user, from end user customers to the largest OEMs. The focused is on making both infrastructure improvements, long requested usability updates, and added some exciting new capabilities.

### 7.4.1 Features of Proficy*HMI/SCADA – iFIX*4.5

- *Graphic Dynamo Management*

Previously, each Dynamo instance added to a picture was unique, and the Dynamo Library was just a place to store them for later use.

iFIX 4.5 delivers Dynamo Management: the ability to use Dynamos from the Dynamo Library, and retain connections so they can be updated in the future. If you improve the Dynamo in the Library, you can then search your entire application or displays of choice and update the instances auto matically. There are new tools to support this feature: a Dynamo Toolbar, a Build Dynamo Wizard, a Dynamo Updater Wizard, and a Quick Dynamo Updater. All Dynamo update processes are displayed and documented in a log file. Dynamos now include names, version numbers, and instance names. Dynamo connections and dimensions are automatically retained throughout the process.

- *Higher Precision Math*

The iFIX 4.5 Process Database now offers higher precision math capability. Calculations are performed with up to 15 digits of precision. The range of numbers iFIX will manage extend to +- $3.40282300000000 \times 10^{38}$ The iFIX Process Database has always been ideal for intensive math and logic with its Function Block orientation. Now, with enhanced precision, it delivers excellent support for applications involving Steam Tables, Flow equations, or extended Totalizations. This new functionality is delivered through addi tional block fields (E_CV for example for Extended Current Value) enabling compatibility with existing iFIX installations.

- *iFIX 4.5 with Change Management Delivers Advanced Difference Reporting*

The integration with Change Management now offers Process Database Difference Reporting. Reporting also now applies to user.fxg files, VBA scripting in pictures, and Dynamos files and associated Dynamo scripting[3].

- Enhanced Functionality for Multi-Monitor Environments

The management of an application across multiple monitors can be challenging. iFIX 4.5 delivers several features to make this easier.

First, the iFIX WorkSpace will automatically span multiple monitors when entering run mode. iFIX now supports the ability to create multiple instances of a graphic, each with its own unique set of tags (through the use of Tag Groups). This means you can now have a graphic for a Production Line, or a PID Loop - opening it as many times as necessary to display multiple lines at the same time, or manage multiple PID Faceplates simultaneously. Finally, a new Coordinate Tool aids in the placement of displays by showing mouse coordinates that you can copy and past into commands to launch a display.

- *Block Alarm and Alarm Summary Enhancements*

FIX 4.5 Process Database Blocks now deliver an Alarm Occurrence Counter, counting the number of alarm transitions between acknowledgements. Operators can now be aware of the complex lifecycle of an alarm, prior to acknowledging the last instance. To support this feature, two new data-base fields, "A_ALMOCCUR" and "F_ALMOCCUR," were added to every block that supports alarms. Additionally, the Alarm extension fields now support upper and lower case data. The Alarm Summary display has been enhanced for an improved operator experience. Column fonts are now selectable, the User Defined Fields now support the new Alarm Counter and Alarm Summary text is available for Dynamic Language Switching [13].

- *Auto Alarm Manager Supports TCP/IP*

the Auto Alarm Manager (AAM) enables a SCADA node to connect to a remote Client node through either a dial-up or WAN connection, and then transfer Alarm Messages. Alarms can automatically be acknowledged upon a successful transfer. Support exists for both primary and backup connections. While past support required NetBIOS networking, the AAM
in iFIX 4.5 requires TCP/IP communications. This offers excellent support for managing remote sites, building management systems or remote manufacturing processes (such as in specialty gas production or well sites).

- *Enhanced Click Event Wizard*

The new Multiple Command Script Wizard enables you to create a sequence of commands, using one or more Command Experts, triggered by one of these types of events: a mouse click on an object in a picture, a time-based or event-based Scheduler entry, or a Key Macro. The Multiple Command Script Wizard generates VBA in the background. All Click Event Wizard VBA created by the Wizard can be customized in the Visual Basic editor. This Wizard, in addition to maximizing ease of use, is a very effect tive way to learn VBA expressions, customizing what was generated automatically for your specific needs.

- *Installation Customization*

iFIX 4.5 delivers several features enabling installation customization. These features include the ability to create a scripted install, where all installation questions are answered by the script. The setup.exe includes new command-line options. You can install additional SIMs with your iFIX install, or other programs. You can include a different initial graphic (splash screen) that displays when you first load the iFIX product install CD. The iFIX 4.5 installation panels can be customized to the user requirements, highlighting their particular installation or use of the iFIX product. The installation menu can be customized, adding or removing installation choices and launching additional CD content. Finally, the iFIX CD has been organized to cleanly
accept additional content (typically application files or user utilities), enabling their installation along with the iFIX installation.

- *Remote Management*

iFIX 4.5 now supports the remote management capabilities of Microsoft SMS (Systems Management Server). You can now stop iFIX, install SIMs, restart iFIX, remotely and automatically through the use of Microsoft SMS.

- *Custom Product Branding*

In special cases, where Vendors use iFIX as a component of their own more complex offering, it becomes beneficial to rebrand iFIX, removing most of its identity and replacing it with a new brand. This has been done many times in the past. iFIX 4.5 offers special branding tools making this easier than ever before. iFIX is available today, under many different prod uct names, addressing vertical market needs around the world. This level of Branding is only available through our OEM Edge program.

## 7.5 Picture

Fig. 20 shows the operation of selection of the color as a result of mixing different ratio of the basic colors
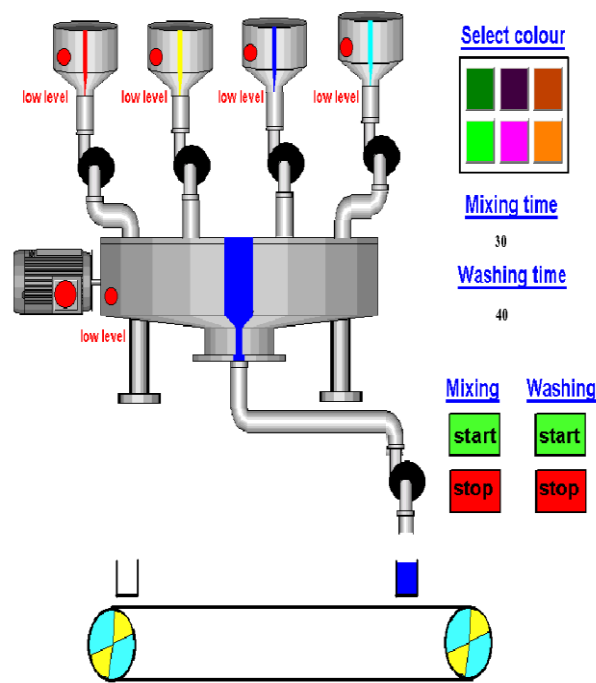


Fig. 20 SCADA operation

## 8 Results

1- User can select one of the six colors which are shown on the HMI.

2- User can determine the time of stir motor

3- User can determine the time of washing

4- The six colors can be obtained from mixing basic colors by the following ratio shown in table 2

Table 2 Obtaining six colors from mixing basic colors

| Color | Red (volume) | Yellow | Blue |
|---|---|---|---|
|  | — | 45 ml | 45 ml |
|  | — | 72 ml | 18 ml |
|  | 60 ml | ___ | 30 ml |
|  | 90 ml | ___ | 10 ml |
|  | ___ | 12.85 ml | 77.15  ml |
|  | ___ | 45 ml | 45 ml |

## 9 The Proposed technique

Using PLC and SCADA system to obtain different colors gives good results related to using microcontroller system

Table 3 shows the comparison of the proposed technique for obtaining different colors and the technique of microcontroller.

Table 3 Difference of proposed technique with previous one in obtaining different colors

| Technique \\ Parameter | PLC and SCADA | Microcontroller |
|---|---|---|
| Quality | High | Low |
| Efficiency | High | Low |
| Accuracy | High | Low |
| Cost | High | Low |

# 10 Conclusions

The most important aspect of any color industry mixing which is main part is controlled using PLC. The method that has to be used relies on varied objectives like superior quality, increased efficiency, high profit and other such points depending upon the purpose of the company that implies it. With the prime objective of catering to these necessities and the needs of the Industrial sector, significance has been given here to automation. This design presented here has kept in mind, the ceaseless changes that are relentlessly taking place in the contemporary scenario of the industrial segment.

Emphasis has been given to the automation process that is now rapidly taking its place in all plants across the globe. The design has furnished itself to study the integral parts of the entire process involved, their implementation and the problems that may show up have also been given their due importance. The design work consists of distribution of any kind of liquid or semi-liquid into different plants from a main buffer storage tank. This distribution takes place automatically using the Programmable Logic Controller (PLC). The main reservoir and the plant, where the process is taking place are situated far apart physically.

All the process of this system is automatically done, like this sensing of the raw color material, opening and closing of the valve (in tank), process taking in the plant like heating and churning, and removal of the raw color material. The successful operation with PLC have opened possibilities for adapting automation commercially in all available plants

The implementation of the process should provide the user with two options:
1-User can select one of the six colors which are shown on the HMI.
2-User can create his own color with his own ratio of the three main colors.

# 11 Future Works

The following trends can be put in the consideration for the future work

1- Using keypad in the proposed design to insert code of color to obtain the desired color
2- Using analog level sensor and motion sensor to make advanced simulation and control on SCADA
3- Making protection from fire by using smoke and fire sensor
4- Using Digital Scales to obtain the accurate degree of color

*References:*
[1] S.T.Sanamdikar andVartak C., "Color making and mixing process using PLC", International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Vol. 2, No. 5, PP.170-174,.
[2] Ezell, Barry, "Scenarios One and Two: Source toNo 1PS to No 1 Tank to No 2 PS to No 2 tank (High level) for a Master-Slave SCADA System", SCADA Consultants, SCADA Mail List, scada@gospel.iinet.au, August 1997.
[3] Rockwell Automation SCADA System Selection guide Allen-Bradley, Publication AG-2.1., 1998.
[4] Knight. U. "The Power System and its Operational and Control Infrastructure in emergencies" from contingency planning to crisis management.
[5] Analysis of Fault-Tolerant systems, "IEEE transactions on Computers", Vol.38, No.6, 1989, PP.134-138.
[6] Gary Dunning, "Introduction to Programmable Logic" Controllers, Edition third, PP.628.
[7] Clarence A. Phipps, "Fundamentals of electrical control", Publisher The Fairmont Press, Inc. 1999,Edition2,illustrated,213, PP. 162,164,165.
[8] Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Publisher PHI prentice hall India, Fourth Edition,, PP. 438,439.
[9] Jones R., Haufe P., Sells E., Iravani P., Olliver V., Palmer C., Bowyer A., RepRap – the replicating rapid prototyper, Robotica(2011),vol. 29, pp 177-191.
[10] Parraman, P.Laidler & Y. Wang, " Pixel Perfect; Working with CMYK & RGB – a comparison of printed samples",CREATE – Colour Research for European Advanced

Technology Employment (Training event 2), University of the West of England, Bristol, 13th-17th October 2008, PP.312-317.

[11] Parraman, A. Rizzi & J.J. McCann, "Measuring HDR rendering for color appearance: an experiment", in IS&T/SPIE Electronic Imaging 2009, San Jose (California – USA), 18-22 January 2009, PP.506-512.

[12] Parraman, A. Rizzi, "User preferences in colour enhancement unsupervised Methods for Printing", IS&T/SPIE Electronic Imaging 2007, San Jose, USA, 28 January –1 February 2007, PP. 456-460.

[13] Parraman, "From drypoint to inkjet", Printed on Paper Conference, The Sage Conference Centre, Gateshead, UK, 5th-7th September 2007,PP.789-806.