CONTROLLED MOVEMENT OF 3 AXIS DELTA ROBOT USING MAPP TECHNOLODGY

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ABSTRACT

In this project, a machine centric robot will be controlled for a certain process using Mapp Technology and HMI screen will be developed for the 3Axis's robot. A 3-Axis's Delta robot is controlled for the desired application. It has 2 drives connected to 3 motors, by controlling the drives and motors, a synchronized motion of the manipulator is performed which results in a robotic application, for example Pick-and-place tasks, Sorting. Operator can control the robot automatically and manually by giving commands through HMI as well. We have used mapp Technology for this Robotic Application. This robot will perform tasks on the basic of g-code and m-code (type of CNC programming) written on the program in automation studio 4.7.

Keywords: Automation studio 4.7, Mapp technology, HMI.

I.   INTRODUCTION

The aim of the paper is to offer remarkable levels of machine flexibility and accuracy by merging robotic controller with machine controller enabling remote access, increased efficiency and also save floor space. Robots are an integral part of automation industry. Traditionally, robots used in machines are self-contained, with their independent controller and its control cabinet.[1] The configuration, diagnostics and maintenance of robot are all performed using a dedicated system, with a specific robotic language. These robots have to be coordinated with the machines so that they can give the required output. This system requires dedicated controller for each machine and robot. Therefore, with help of machine centric robot which has only one or single controller like PLC is use. As this robot will no longer require a dedicated controller, all interfaces between the machine and the robot are eliminated, while the fact that all axes and sensors will now communicate on a common network increases precision and speed of response.[3] This also helps to increase the productivity of the machine and the output of the process.

In this project, a machine centric robot will be controlled for a certain process using Mapp technology and HMI screen will be developed for the robot. The objectives of the project are understanding a robot mechanically along with its features, specifications, electrical wiring and sensors used in the robot.

Furthermore, understanding synchronization between sensors and robot motion, studying the communication networks and applications. The main phase of the project will include user friendly programming of robot according to the specified application using Mapp Technology. Testing and debugging the robotic model on a third-party software, where the entire robot can be simulated and the program can be transferred and working of the robot can be examined and lastly developing and programming the HMI screen for the robot.
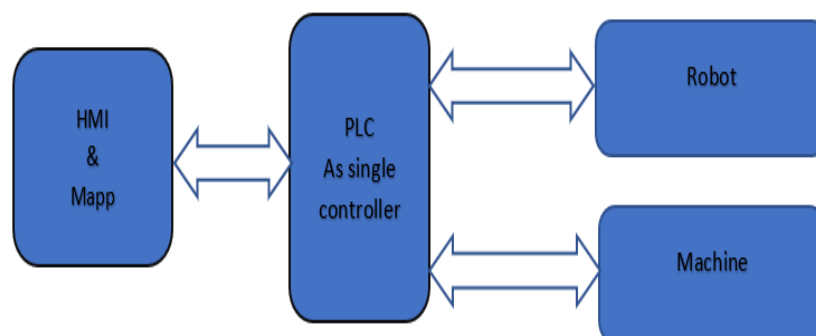
II.   BLOCK DIAGRAM

Figure 1

III. WORKING

In this project a 3 axis's delta robot is control by single controller like PLC call machine centric robotic (MCR). MCR is merging robotic controller with machine controller so that operator can easily control servo motor, I/O and visualisation by single industrial PC.[4] We have added map technology it provided user-friendly UI interface for HMI for a certain process using Mapp Robotics and HMI screen will be developed for the robot. A 3-Axis Delta robot is controlled for the desired application. It has a PLC X20CP1586 to which 2 motor drives are connected to 3 servo motors of delta robot for the movements by Ethernet cable The drivers have been used for communication between PLC and servo motors by controlling the drives and motors, a synchronized motion of the manipulator is performed which results in a robotic application, for example Pick-and-place tasks, Palletisation, Sorting.

Programming: programming of PLC is done in structure text, ladder diagram, G code and M code for the functionality of the delta robot as per the application. We import the MpDelta3axis This function block is used to configure a delta robot with three axes The MpLink of an MpDelta3Axis configuration is used for this function block. For initialization to take place, the robot must first be correctly configured the "AxesLinked" and "Ready To PowerOn" outputs in the "Info" structure can be used to check whether all axes are connected and whether the robot's axes can be switched on. This is done using the "Power" command and can be evaluated on the function block's "PowerOn" output (TRUE). The axes can then be homed using the "Home" command, with the homing parameters for each individual axis being used. A successful homing procedure is indicated by "IsHomed = TRUE". When using homing, it is possible to configure the order in which the axes should be homed. Once it successfully done it is possible to issue a wide range of commands move program, move direction, single step, jog parameters in which robotic file has been read by the program in which helix movement coordinates has given to the delta robot to perform the helix movements.

A Delta Robot is a type of robot which consist of 3 arms connected at the joints at the base. Delta robot perform the helix task with help of mapp technology with better functionality for controlling and commands.

Mathematical formula for Helix movement given by:

The helix starts from appoint on the floor a distance 'r' from the room on the x-axis, here the formula for any point on the helix.

$$X=r*\cos(b*t) \quad Y=r*\sin(b*t) \quad Z=c*t$$

You will have to choos the constants r, b and c to fit your circumstances.

Now we have created mapp pages in automation studio like Mpuserxlogin. MpAlarm, MpFile. MpData, MpAudit all the pages already created in mapp function just configure their function block with UI functions through MpLink of the each functios.it gives user-friendly interface where all data can be saved and have the accessibility to upload the program from HMI screen.

IV. IMPLEMENTATION

This is the main page of the mapp technology in HMI in which all map function can be viewed as smart phone. For this project we used automation studio version 4.7, scene viewer and VNC viewer. automation studio for programming. VNC viewer for HMI and scene viewer for simulation of delta robot. For programming we used automation studio in which lot of functions have been provided like programming languages, troubleshooting tools and HMI design. We used 3 languages for programming these are structured text, ladder diagram and m-code g-code. By this software we can program and design HMI. We can simulate robot in a scene viewer.
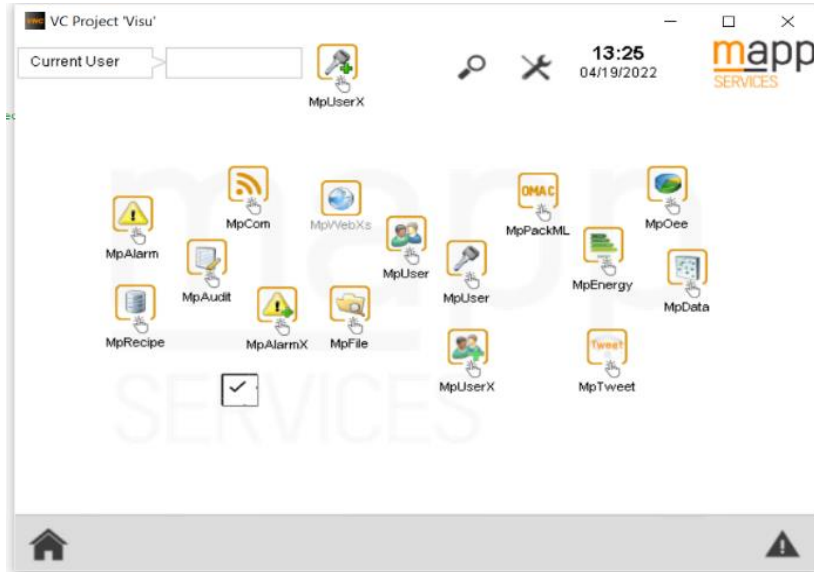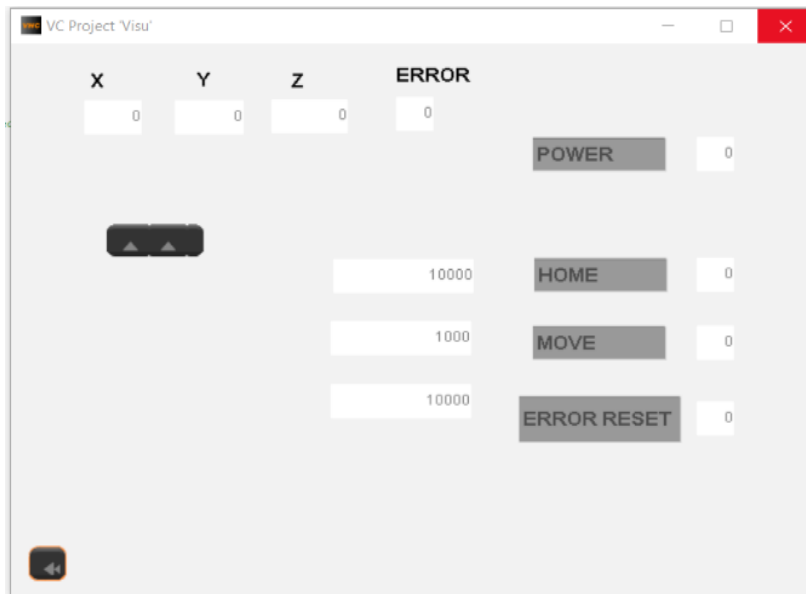
Figure 2: Credit-B&R Automation

Figure 3: Credit- B&R Automation

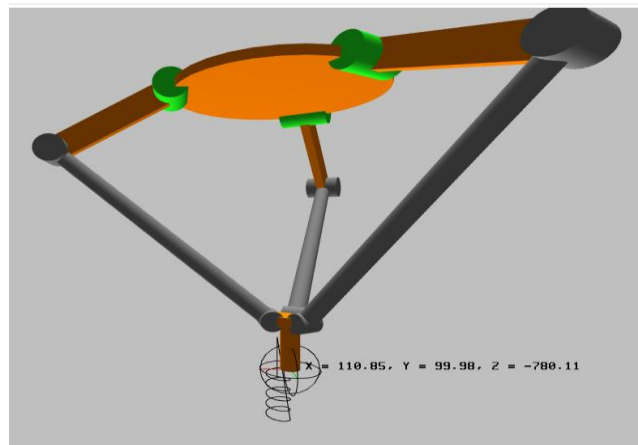This is the controll command page of the robot from robotic movent are given.

Figure 4: Credit- B&R Automation

This Delta robot as seen in simulation in scene viewer where the robot performs the task of helix movements.
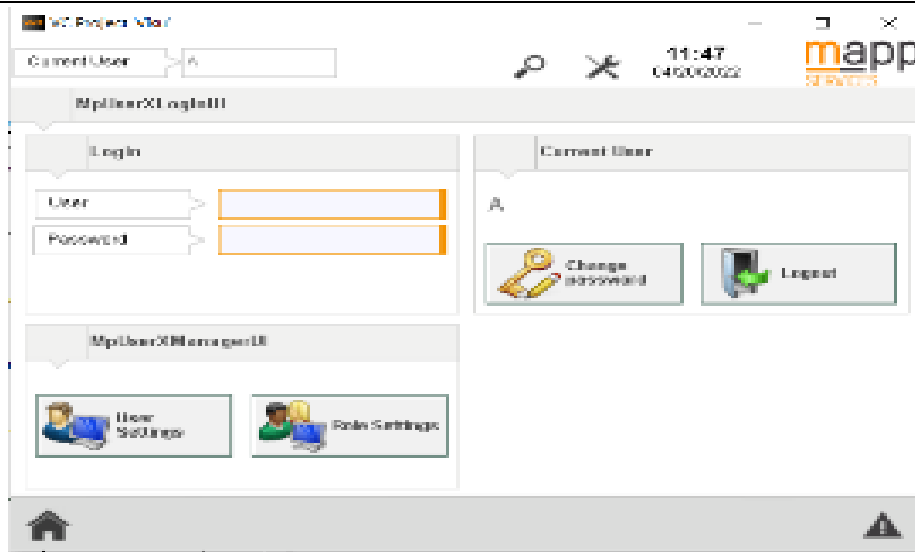
Figure 5: Credit- B&R Automation

MpuserXlogin page from here the operator can be login for getting over all control and monitor.
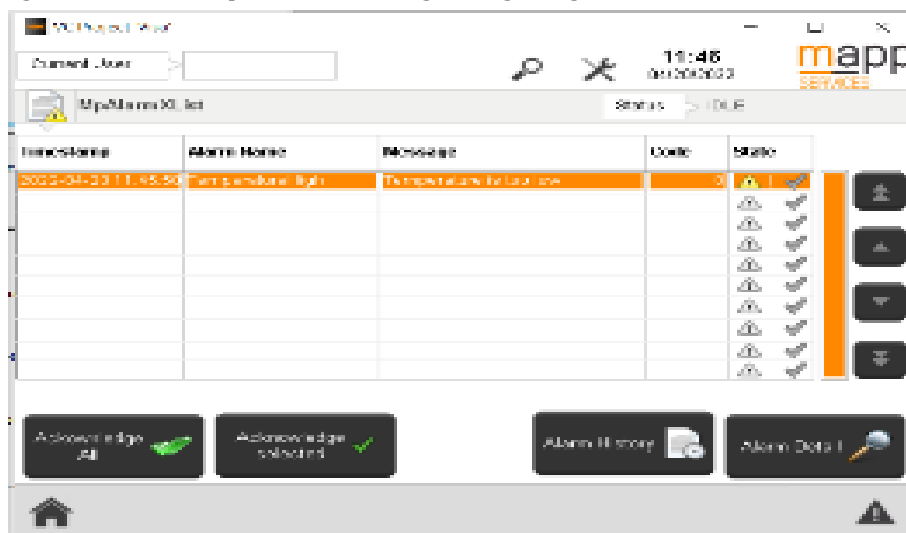

Figure 6: Credit- B&R Automation

MpAlarm this function give the indication directly when unwanted event happens and operator can be acknowledge the events and also checks the history of alarm.
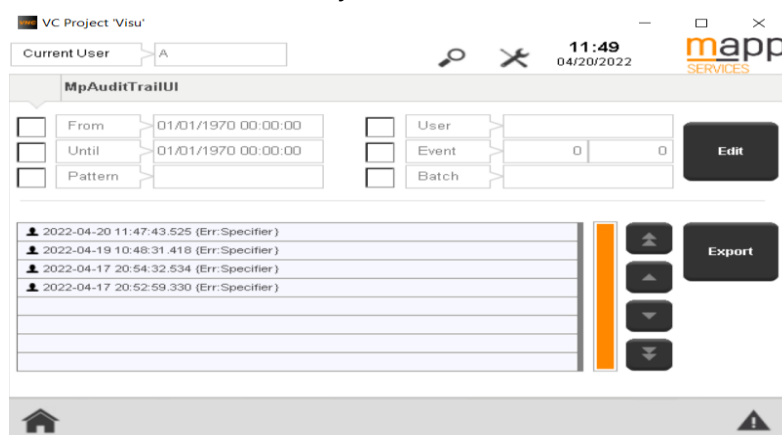

Figure 7: Credit- B&R Automation

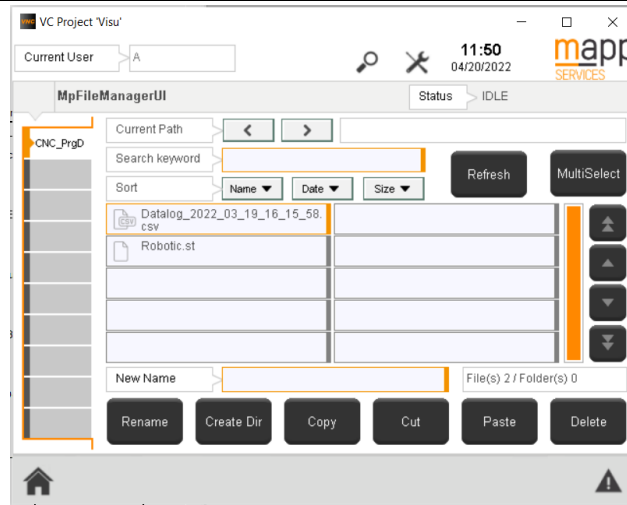MpAudit function perform the audit if overall task of thre robot.

Figure 8: Credit- B&R Automation

MpFile function provided the accessing the all files and view in the file folders.
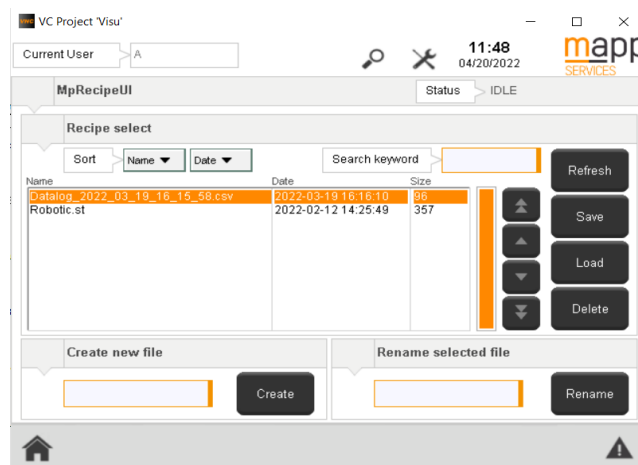
Figure 9: Credit- B&R Automation

MpRecipe function where we can the upload the programs and deleted its on the HMI screen.

A. Software

1. Automation Studio

Figure 10: Credit: https://www.br-automation.com › en-in

The automation studio is a software that is used for circuit design, simulation and project documentation. automation studio provides programming languages like ladder diagram, structured text, functional block diagram etc. It provides troubleshooting and diagnostic tools.

1. Programming languages

- **Structured Text**

e-ISSN: 2582-5208

International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022   Impact Factor- 6.752   www.irjmets.com

This language is supported by the IEC 61131-3 standard. It is high level language.

- **Ladder Diagram**

programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware.

- **G Code and M Code**

The G code is written in an alphanumeric format and is responsible for the movements of these machines. It tells the machine where to start, how to move, and when to stop when fabricating a part.

The M code is a set of auxiliary commands that control all the machine's non-geometric actions. It is used with G-code to switch various machine function ON and OFF.

2. VNC Viewer

Figure 11: Credit: https://www.br-automation.com › en-in

VNC Viewer is used for showing the screen contents of a remote computer on the client computer and can also send keyboard and mouse signals.

3. Scene Viewer

Figure 12: Credit: https://www.br-automation.com › en-in

A scene viewer is an OpenGL-compatible 3D visualization tool. It shows simulation of robots.

4. Mapp Technology

In industry, so many operations, processes are carrying out. For each operation or process, there is a risk of malfunction, security so functions like alarm, user login and management are necessary. To record data, for audit some functions are used. These types of functions are compulsory in all industries. So rather wasting time on designing these functions for each application, some software blocks are used. That result, reducing the time for designing that function that is not deserving for quality work.

Mapp provides readymade templates and widgets for those functions.

Mapp Services:

1. Mapp UserX management

Figure 13: Credit: https://www.br-automation.com › en-in

mapp UserX sets up user management. Roles and users are created using the user role system in Automation Studio and then managed using MpUserX. This includes access rights, user data, password

2. Mapp AlarmX: Alarm Management

Figure 14: Credit: https://www.br-automation.com › en-in

mapp AlarmX collects and manages both mapp alarms and user alarms. The alarms are configured using Automation Studio, managed in the application and then displayed in an HMI application or exported as a file.

3. Mapp Recipe Management

Figure 15: Credit: https://www.br-automation.com › en-in

mapp Recipe provides all of the functions necessary for simple yet high-speed recipe management. This includes reading and writing as well as a connection to Visual Components 4.

4. Mapp Audit: Event Management

Figure 16: Credit: https://www.br-automation.com › en-in

mapp Audit can log different events. These can come from the HMI application, MpUser or user-defined events. The user can determine the format in which the events are stored in a file.

5. Mapp Data: Data Logging

Figure 17: Credit: https://www.br-automation.com › en-in

mapp Data makes it possible for users to back up values of defined process variables (PVs). This data is stored in CSV files.

6. Mapp file

Figure 18: Credit: https://www.br-automation.com › en-in

mapp File provides a file management system as well as a connection to the HMI application to display files.

V.   ADVANTAGES

1. This system saves the time required for making new mapp pages for HMI screen.
2. This system also saves floor space and money by merging the robot controller with machine controller.
3. Due to single machine controller response time will be increase.
4. Changing the programs through the HMI screen can be possible in mapp technology.

VI.   PROGRAMMING

➢ PLC Main Program in Structure text.

```
PROGRAM _INIT
    (* Insert code here *)

    MpDelta3Axis_0.Enable := TRUE;

    MpDelta3Axis_0.Override := 100.0;
    DeltaParameters.ProgramName := 'CncProg';     //File stored on FileDevice


END_PROGRAM

PROGRAM _CYCLIC
    (* Insert code here *)
    MpDelta3Axis_0.MpLink := ADR(g3AxDeltaA);
    MpDelta3Axis_0.Parameters := ADR(DeltaParameters);
    MpDelta3Axis_0();

    SimPos[0] := LREAL_TO_REAL (MpDelta3Axis_0.X);
    SimPos[1] := LREAL_TO_REAL(MpDelta3Axis_0.Y);
    SimPos[2] := LREAL_TO_REAL(MpDelta3Axis_0.Z);


END_PROGRAM

PROGRAM _EXIT
    (* Insert code here *)

    MpDelta3Axis_0.Enable := FALSE;
    MpDelta3Axis_0();

END_PROGRAM
```

➢ Robotic Programing in Structure text.

```
VAR CONSTANT
   P1 : McPointType := (Pos:=(X:=0,Y:=100,Z:=-700));
   P : McPointType := (Pos:=(X:=0, Y:=0,Z:=-500));
   PC : McPointType := (Pos:=(X:=100, Y:=0,Z:=-700));

END_VAR

PROGRAM _MAIN
    Feedrate(5000);
    MoveL(P1);
    CirclePointRelative();
    MoveCWAngle(PC, 1800, Point:=P);



END_PROGRAM
```
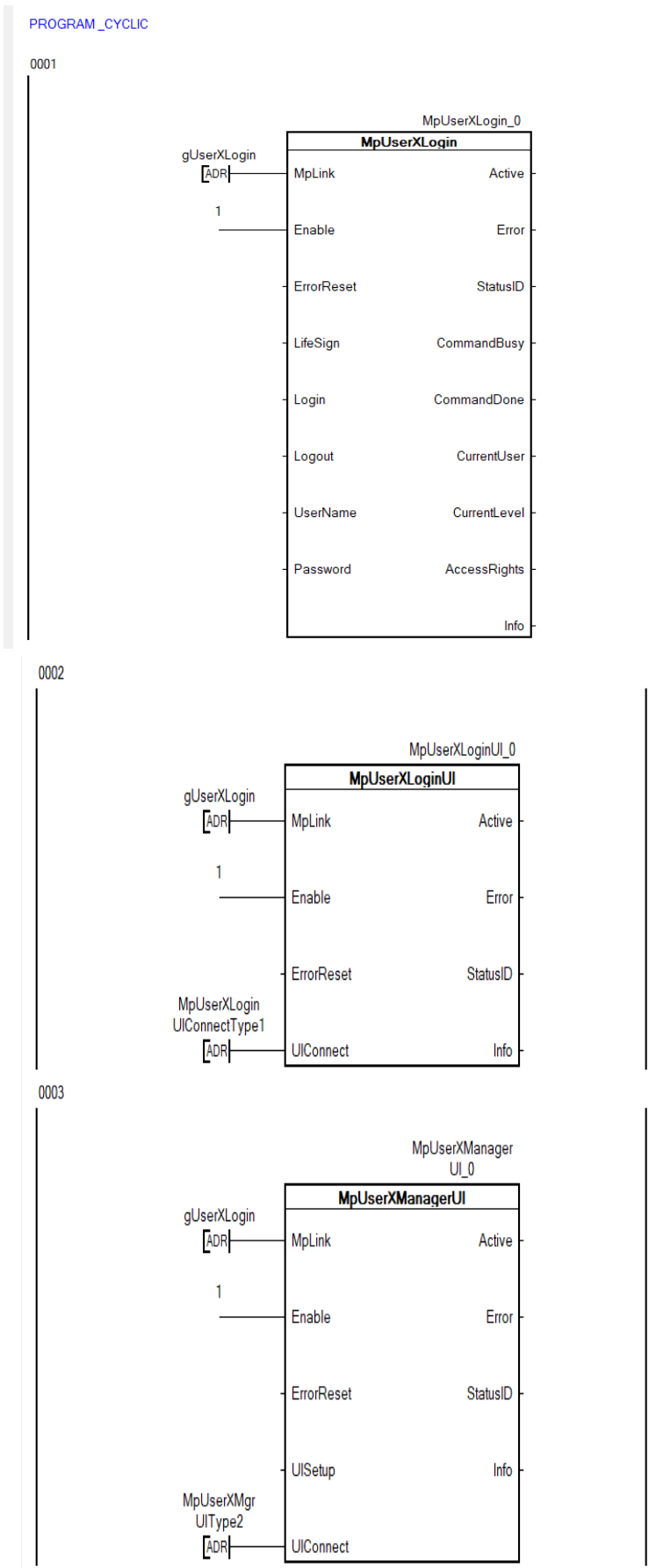
> Mapp HMI programming in Ladder diagram.

VII.   CONCLUSION

Current scenario in industry is traditionally robots are self-contained with their independent controller and its control cabinet. Configuration, diagnostics and maintenance of robots are all performed using dedicated system with specific robotic language. Now in Our Project to control and gives the command to the 3axis robot by Mapp technology with the help of single controller PLC for smooth and safe control called Machine Centric Robot (MCR). Whole project is do in the simulation format; no hardware is use in the project.

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