Using HMI Weintek in command of an industrial robot arm

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Abstract. The present paper intends to highlight the utility and importance of HMI in the control of the robotic arm, commanding a Siemens PLC. The touch screen HMI Weintek eMT3070a is the user interface in the process command of Siemens PLC, in which the distances and displacement speeds are introduced on the three axes. The interface includes monitoring robotic arm movement but also allows its command by incrementing step by step the motion over axis.

1. Introduction
The strong development of the information technology, which led to the appearance of more and more performing computer systems, to the realization of complex software applications and to the creation of new equipment and technology in general, allowed the introduction of modern automation solutions on a large scale.

The automation of the manufacturing processes was required by the general effort of the industrial manufacturers to obtain high productivity and to improve the quality and reliability of products. The decrease of manufacturing costs and the improvement of work conditions are aimed.

The industrial robots appeared as a response to the human’s need to automate the manufacturing processes, especially the repetitive ones. The main activities that industrial robots can carry out are linked to the transporting and manipulating of objects and also to realizing some processes (painting, inspection, assembling, etc.). [1]

The utilization of PLCs presents a series of advantages, among which the reducing of manufacturing time and the decrease of costs are the most important. Mainly, any application that requires electric control needs a PLC. [2], [3]

The interface is necessary in the commanding and monitoring of the process realized by the PLCs, because they do not have a screen. EMT3070a is a touchscreen produced by Weintek Company, which facilitates the creation of a graphic interface for a high number of PLCs found on the market.
2. The structure of the industrial robot arm

Robots are one of the things indispensable to the functioning of society in the XXI century. Found in manufacturing processes (Figure 1), but also in other areas of interest, such as: entertainment, transportation, communications, medicine and agriculture, robots improve human performance from quantitative and qualitative point of view.

![Image of a robot arm]

**Figure 1.** Robot arm.

At the moment, industrial robots represent the meeting point of the recent discoveries in several fields: mechanics, automation, electronics, computers and actuation systems. The complexity of this branch is reflected on the mechanical architecture, as well as on the management system. [4]

2.1. Siemens PLC

The Programmable Logic Controllers are command and adjustment programmable automates that are used for industrial machines and processes. Their programming is done using dedicated software, developed by each PLC manufacturer, but having as common point the use of the Ladder Diagram (command electric schemes). [8]

2.2. The stepper motor

The auctioning of the robotic arm is done with the help of Nema 42 stepper motor, which are placed on the 3 displacement axis.

The Nema 42 stepper motor (Figure 2) has been developed firstly for users who restricted the available installation space and who want an engine with increased torque. The Nema 42 uses advanced magnetic technologies to offer a significantly higher torque level than that of a standard engine device.

![Step by step engine and Microstep Driver 2M2280]

**Figure 2.** Step by step engine and Microstep Driver 2M2280.
2.3. Microstep Driver 2M2282.3
Stepper drivers normally work by chopping up a supply voltage using an embedded PWM chip. Microcontroller based steppers drivers can achieve very high rotation speeds in stepper motors.

Using a microcontroller, it is possible to have extreme control over exactly how each individual coil is energized inside the motor. [5]

The command of the step by step engines involves the application of impulses on their windings, impulses that are realized with the help of Microstep Driver 2M2280 converter.

2.4. The Weintek interface
All PLCs do not dispose of a graphical interface control (Human Machine Interface - HMI), requiring the use of an HMI to enter input data and monitor progress made by the program.

Series eMT3070a is a new generation of HMI from Weintek Company and it has the possibility to program the PLC and also to transfer the date between similar dispositives. [6], [7]

Easy Builder Pro is software developed by Weintek for programming various types of graphical user interface to controlling and command the various types of PLCs. The software has a diverse library of images, buttons, graphics, and sound monitoring screen, but also allows the insertion of other elements that can be used to create interfaces, depending on the project conducted.

Interfaces allows creating different security levels that can be divided into categories of users. Each user access can be set to different interfaces of the program, you can set up to 12 users whom have individual levels of security:
- Administrator - has access to all buttons, windows and all functions available;
- User - has access to all the windows but no to all buttons and available functions;
- Guest - has access only to monitoring.

3. Robotic arm interface command
User interface that we have created for the simulation operation of robotic arm is made of five windows (main menu X axis, Y axis, Z axis and animation (monitoring)). At the time of simulate, navigation between windows is performed using specific buttons (Function Keys).

Main Menu panel (Figure 3) present major information to any user, while having windows (screens) for additional axes robotic arm that works. This panel consists of buttons with which we communicate with the other interface windows, buttons and switches automatic and manual start and stop the operation of the program.

![Figure 3. Main menu panel.](image)

Start and stop buttons are buttons of starting and stopping set the programmed bit, we're still here and start and stop lights working distance when inputs I124.0 (start) and I124.1 (stop) operates the same from the PLC program.
3.1. **X axis menu**

Accessing window X axis is done by pressing the X axis in the Main Menu window. In this window you can find the main buttons for operating the robotic arm on direction of X (Figure 4).

![Figure 4. Main of X axis.](image)

The numerical indicators, No. of steps/1mm at a speed of 200, Multiplication, Counter value, No. of steps/1mm at a speed of 1000 and numerical button Number setting in X axis windows, its will be finding also on the windows of Y and Z axis.

Setting the numeric button (MW16) with this button entering the distance (in millimeters) that we want to move the robotic arm (Figure 5)

![Figure 5. Entering the set of interface.](image)

Numeric indicator *No. of steps/1mm at a speed of 200* (MW8) indicates how many steps must be at a speed of 200 steps in order to move a millimeter.

The button Axa X (M1.0) starts axis x along with relay output time (timer) and output counter.

LED Axa X (M1.0) indicates the function on X axis, the button works when the X axis button is pressed. The button *forward sense* (M0.3) controls robotic arm in the forward direction.

The interface consists of windows which make it possible to navigate between the X, Y and Z of the robotic arm. It performs the following commands:

- Establish starting and stopping application with Weintek panel,
- Set the distance you want to made the arm on the axes X, Y and Z,
- Setting impulses which they receive stepping motors, engines impulses have different configurations from 200 to 12800 pulses.
- Setting the direction of movement of the robotic arm in the X, Y and Z.
3.2. Animation (monitoring)

In this window is represented the functioning of the robot arm on the directions X and Y accessing is done from the Main Menu window. Window animation follows the movement of the robotic arm on the X and Y directions in both automatic and manual modes.

3.2.1. Automatic mode. Animation works automatically by default (Figure 6). This shows how the robotic arm moves in X and Y was set as the range of movement of the arm on axis.

![Figure 6. Automatic mode.](image)

Manual button controls the animation in the desired mode, automatic mode is when the manual button is not activated.

3.2.2. Manual mode. The animation works in manual mode only after we manually switched OFF button in the ON state.

Manual mode shows the arrow buttons with which move around the robotic arm on the X and Y.

In manual mode (Figure 7) robotic arm moves in X and Y directions only when we action on the displacement arrows on the axis or enter the place where we want to move around the arm by entering a numeric value by pressing X or Y. Also in manual mode we can setup the value of how we want to operate in automatic mode.

Numeric buttons X and Y shows us the value of the arm on the X and Y, when it is in automatic or manual mode.

![Figure 7. Manual mode.](image)
4. Conclusions
The interface has been designed so that the displacement moves on X, Y and Z of the robot arm to be controlled by using the eMT3070a interface. It allows to start and stop the application on the panel Weintek, as well as monitor the movement on the axes.

PLC programming has the advantage of creating artificial intelligence by implementing control algorithms in the software and the ability to perform movements based on data provided by the sensors imposed by the developer.

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