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Weintek interfaces for controlling the position of a robotic arm

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Abstract. The paper presents the use of Weintek panels to control the position of a robotic arm, operated step by step on the three motor axes. PLC control interface is designed with a Weintek touch screen. The HMI Weintek eMT3070a is the user interface in the process command of the PLC. This HMI controls the local PLC, entering the coordinate on the axes X, Y and Z. The subject allows the development in a virtual environment for e-learning and monitoring the robotic arm actions.

1. Introduction

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.

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 [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].

PLC performs two main tasks of process automation:

- inspecting the process trough monitoring the status of PLC inputs, using sensors, buttons, limit switches, the state variables in the process, etc;

- processing information from inputs and generating the necessary commands to actuators of the automated process, according to a specific program.

The PLC monitors and controls a machine or process with the help of SIMATIC S7-1200, through the TIA Portal program, which provides interrogation I/O modules through input addresses (% I) and commands the process through output addresses (% Q), which are done in the LADDER language program [4], [5].

Not all PLCs 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.

2. Weintek - Human Machine Interface (HMI)

The ever-increasing demand to increase operation efficiency in industrial automation enables the traditional HMI into evolving to play not only an operator interface, but also the data exchange and process center. All data in the factory floor must be synchronized and centralized. The retrieve of factory data must be fast and easy. Furthermore, as the mobile device changes the business model in every industry field, it has also gradually changed it in industrial automation field. This leads the industrial automation trend towards improving plant visibility and mobility, accessing information in real time and allowing operational failure events to be resolved before downtime occurs [5].

Weintek Company is in general a HMI touchscreen producer, which facilitates the creation of a graphic interface for a high number of PLCs found on the market, designed for industrial use.

The eMT3070a series is a new generation of HMI from Weintek Company and it has the possibility to program the PLC and also to transfer the data between similar devices [5], [6]. It is integrated in a Sturdy Aluminum Casing, the screens are up to 12", 1024 by 768 pixel TFT display (Figure 1). As about communication protocols, it covers standard MPI, CANopen, EtherNET, Free Port protocol, etc. for different type of PLCs [7].

The interface is necessary in the commanding and monitoring of the process realized by the PLCs, because they do not have a screen.

Figure 1. Panels HMI 3000

3. The cMT-SVR Cloud Human Machine Interface

The cMT product splits the conventional all-in-one HMI into the server device and the display device.

The server device, cMT-SVR, performs the same task as the conventional HMI does. It connects with the PLC, inverter, motion controller and many more controllers to perform protocol conversion, event logging, recipe database maintenance, macro commands execution, and many more (Figure 2).

The visualization of the cMT-SVR can be shown on a variety of different platform display devices, e.g. PC, Panel PC, cMT-iV5, iPad, or Android tablets. Thus, system integrators can implement a flexible combination of cMT-SVRs and different display devices according to their applications.

This innovative architecture leverages the use of HMI in many industrial automation applications such as Marine, Oil & Gas, Metals, Smart home, and many more [8].

Figure 2. Cloud HMI cMT-SVR

4. Multiple monitoring screens

In the conventional HMI architecture, operators must operate the HMI in front of the machine, and only one operator can access one HMI at the same time. This is a very inefficient way.

Now, the cMT's distributed architecture greatly improves the monitoring efficiency on the plant floor. The cMT can be flexibly designed for multiple levels of operators (system engineer, plant manager, remote technician, and etc.) to access the needed information anywhere in the plant floor at the same time (Figure 3) [8], [9].

Figure 3. Support multiple platforms

5. The connection between PLC and HMI - Weintek

The programming of the SIMATIC S7-1200 automate is realized with the STEP 7 Basic V13 (TIA Portal V13) software. After creating the command program within the PLC, with the help of the LADDER Diagram, it is necessary to realize the link between the PLC and the HMI [10], [11].

The HMI must interpret (monitor) the commands received on the PLC inputs and it must command the outputs according to the program created in the PLC, but also according to the data introduced by the operator with the help of the Weintek interface. These interpretations are of different TAGs and

they are labels of the component elements within the program (inputs, outputs, markers, memory registry, etc.).

The TAGs are exported in order for them to afterwards be used in the Weintek interfaces, when objects are being created with the help of the EasyBuilderPro software. In order to do this, the TIA program is opened and the project saved from the corresponding file is selected (Figure 4).

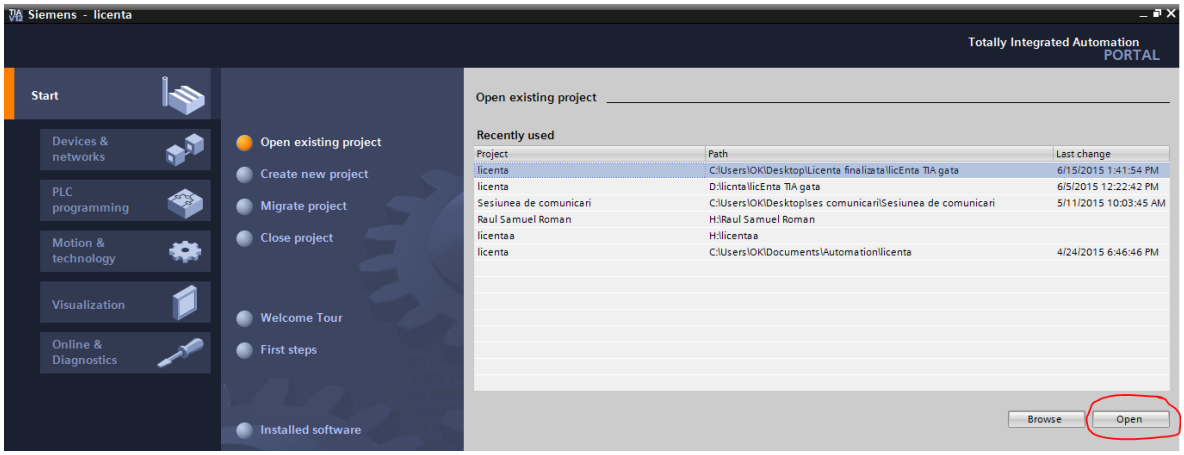

Figure 4. Open a new project in TIA Portal

The step of exporting the TAGs is done in the Devices file, where the PLC tags file is selected and "show all tags" is chosen. This will lead to a window for exporting them into an excel file (Figure 5). In this window, the "Constants" option must be ticked, for a complete exporting of the tags used in the program.

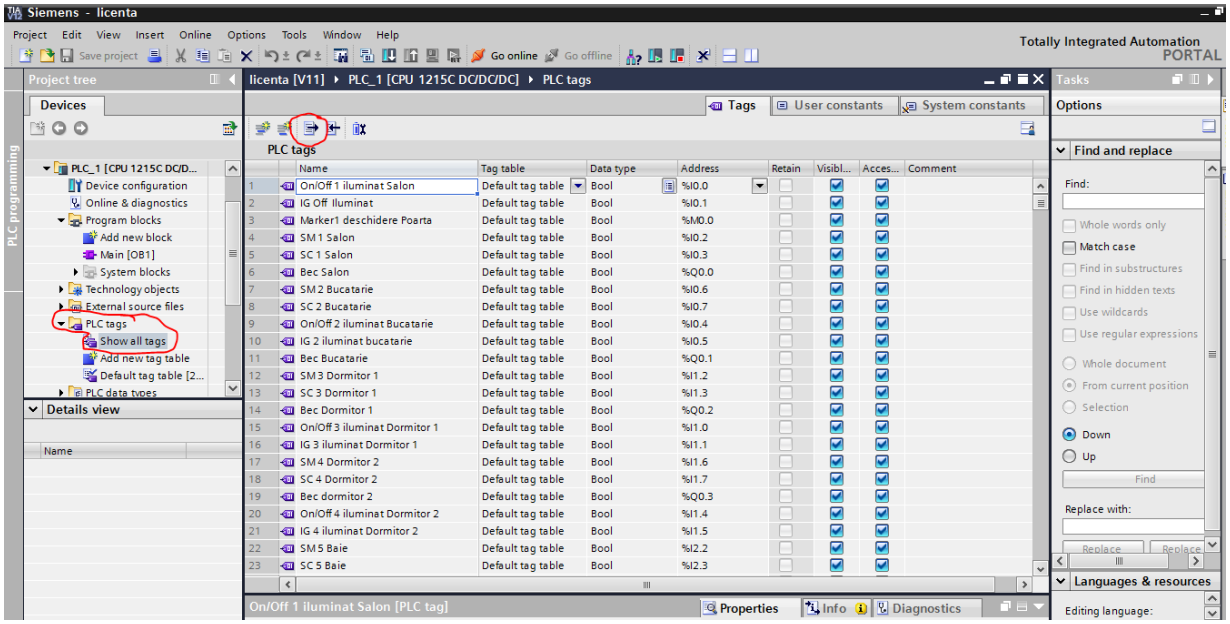

Figure 5. Tags export from TIA Portal program

After creating a new project in EasyBuilderPro for the Weintek HMI, we must proceed to realizing the link between the new project and the program, created with the help of the Ladder Diagram programming language in Step 7 (TIA Portal V13) software [12]. This is done by introducing a new device to the PLC (System Parameter Settings – Figure 6), Siemens AG in this case, and then Siemens

S7-1200 model and the type of communication between the PLC and the Weintek HMI are chosen (Figure 7).

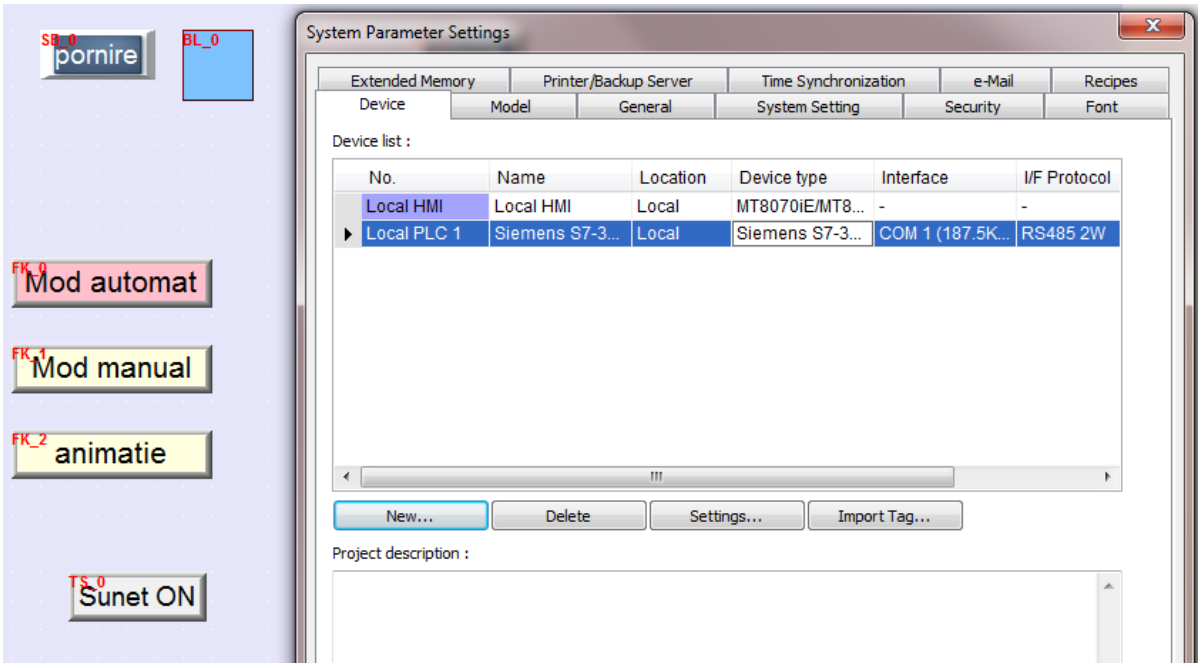

Figure 6. System Parameter Settings Windows

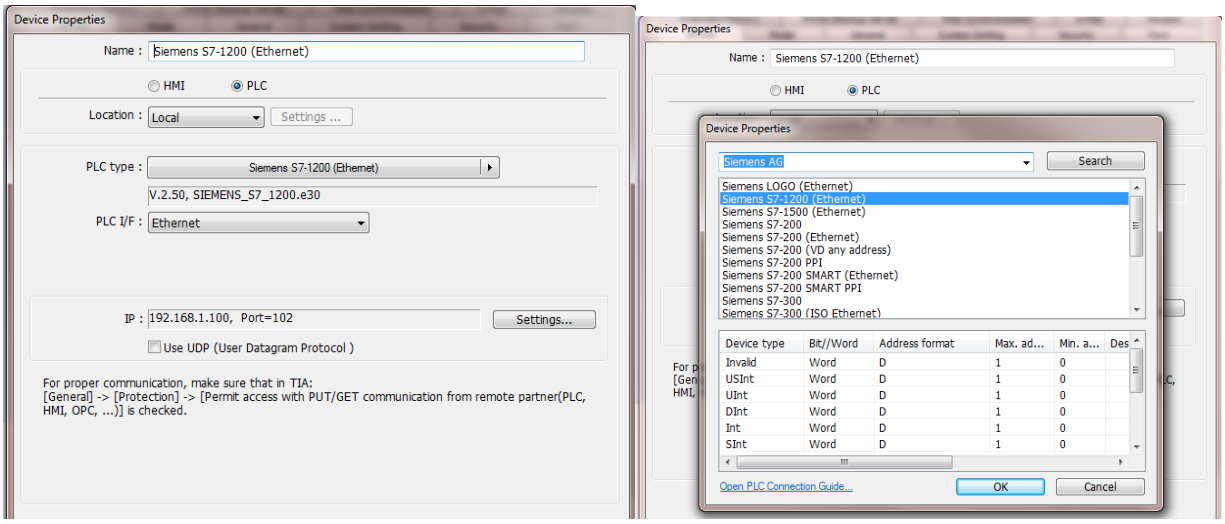

Figure 7. Selection of Siemens PLC and the connection type

Next, the importing of the tags is being done, the Import action leading us to the Import Tags window. Here, the path towards the Excel document is being selected, where the tags exported from the PLC program are found (Figure 8).

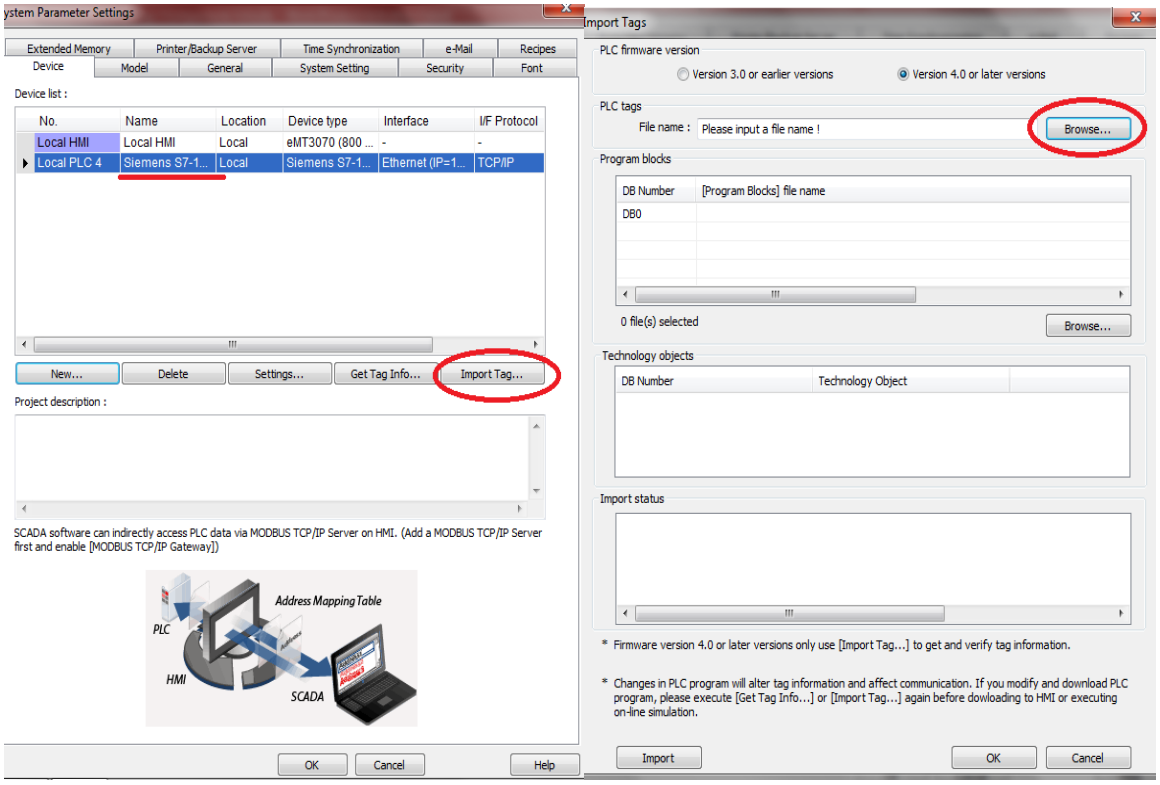

Figure 8. Tags import

At this moment, in order to define the buttons and the data in the Weintek HMI interface, the values used in the program should be considered and the next step is to press the Import button, on the bottom left side (Figure 9).

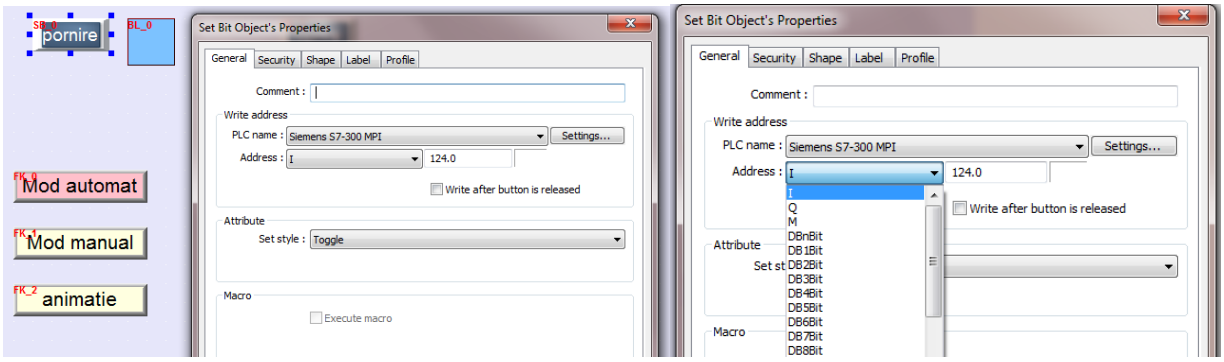

Figure 9. Tags import

6. The security levels on Weintek HMI

The user interface that we have created for the simulation operation of the robotic arm is made of five windows (main menu (Figure 10), X axis, Y axis, Z axis and animation (monitoring)). At the time of the simulation, navigation between windows is performed using specific buttons (Function Keys) [13].

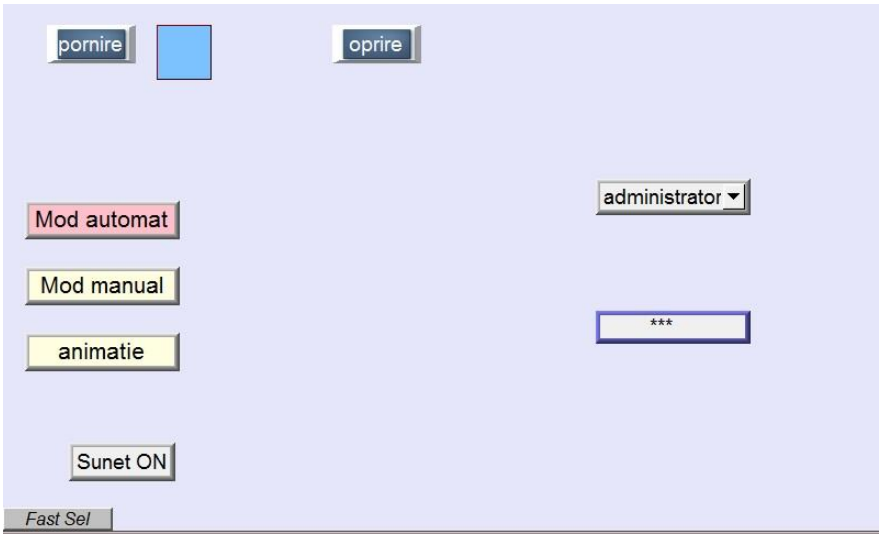

Figure 10. Main menu panel

Interfaces allow the creating of different security levels that can be divided into categories of users. Each user access can be set to different interfaces of the program, up to 12 users can be set and who have individual levels of security:

- Administrator - has access to all buttons, windows and all functions available;
- User - has access to all the windows but not to all buttons and available functions;
- Guest - has access only to monitoring.

To use the interface, one has to be logged in with username and password created in the HMI list (Figure 11).

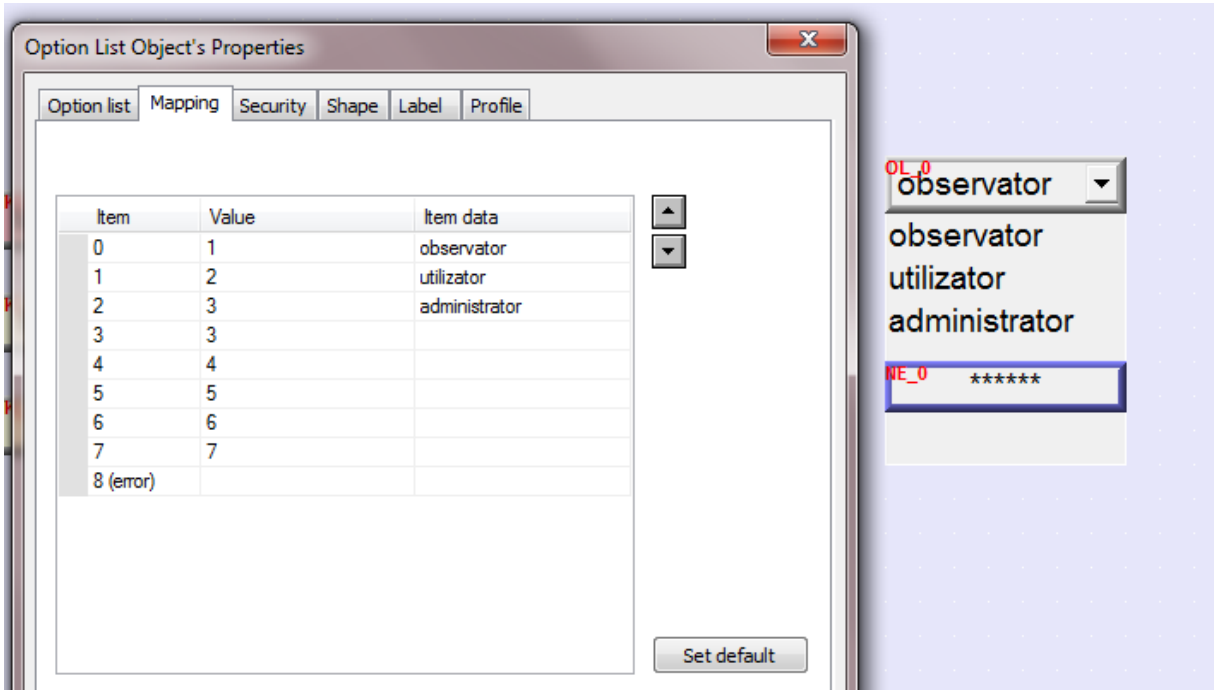

Figure 11. Users name list defined

The Option List Object button was used within the security level (Figure 12), where the usernames and passwords have been defined. The LW-9219 register is predefined with the function of commuting among the maximum 12 users created. Also, for the introduction of the user's password chosen from the list, we need to use a predefined LW-9220 register (Figure 13).

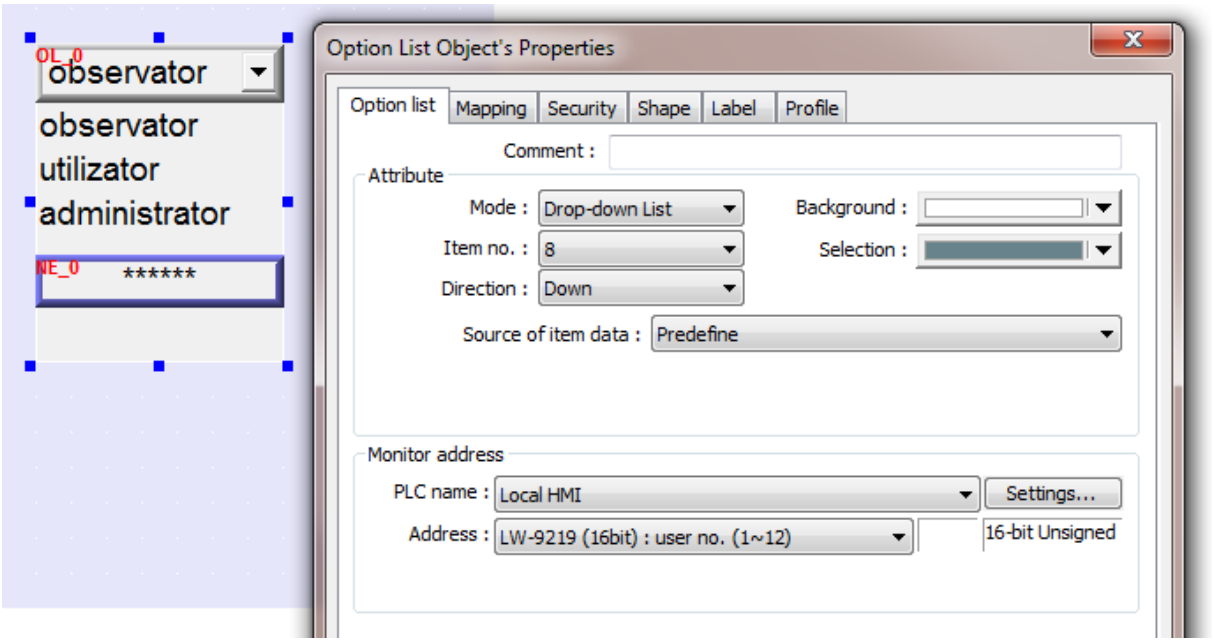

Figure 12. Create the Users list

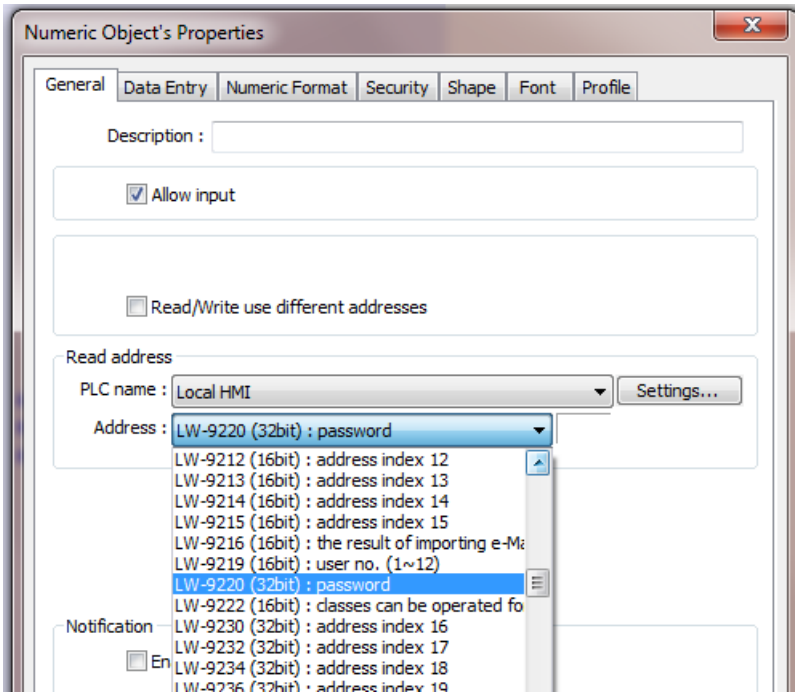

Figure 13. Create password input

In order to establish the security class of each category of objects, we choose System Parameters from the Edit menu. In the System Parameter window, we choose the Security menu, where a list of

users with their order number and their Password field appears. Also, the security classes with the access for each user are set here (Figure 14).

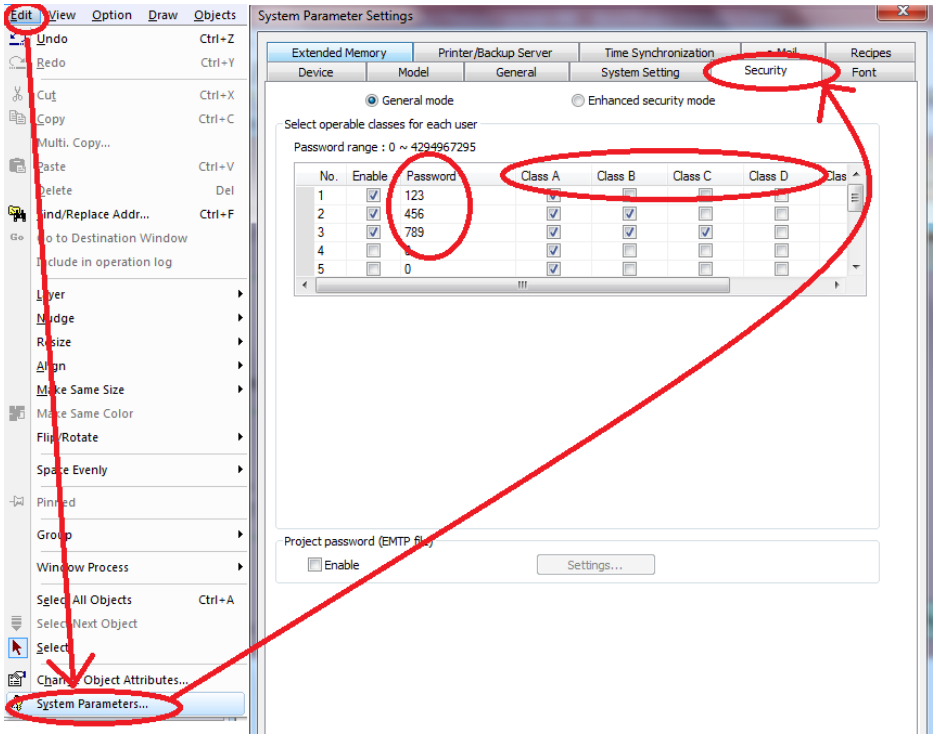

Figure 14. Setting the passwords and security classes

The Mod Manual button (Figure 15) is set like the robotic arm moving in X and Y directions, after the direct values set by the user Administrator, who has security level Class C. Otherwise, we can only monitor the moves on the axis as users of security level Class A (Figure 16).

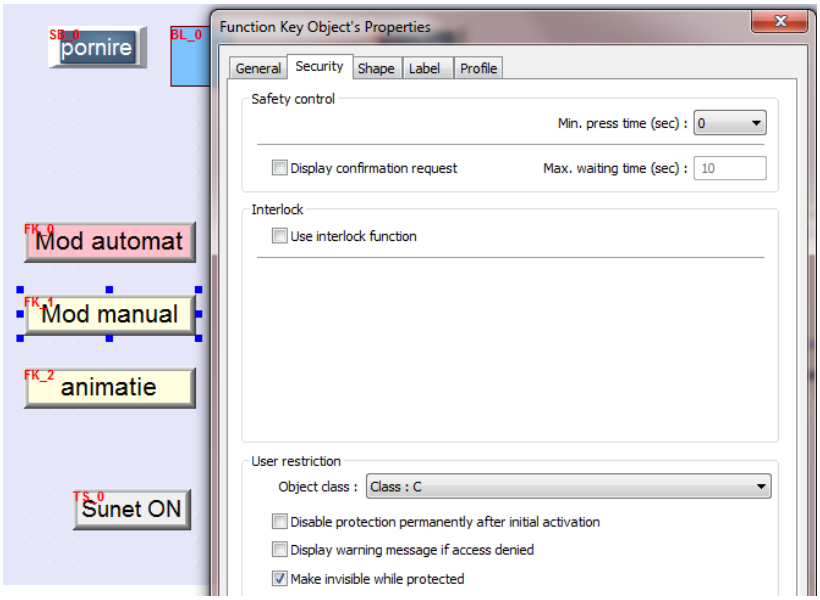

Figure 15. Setting security class C

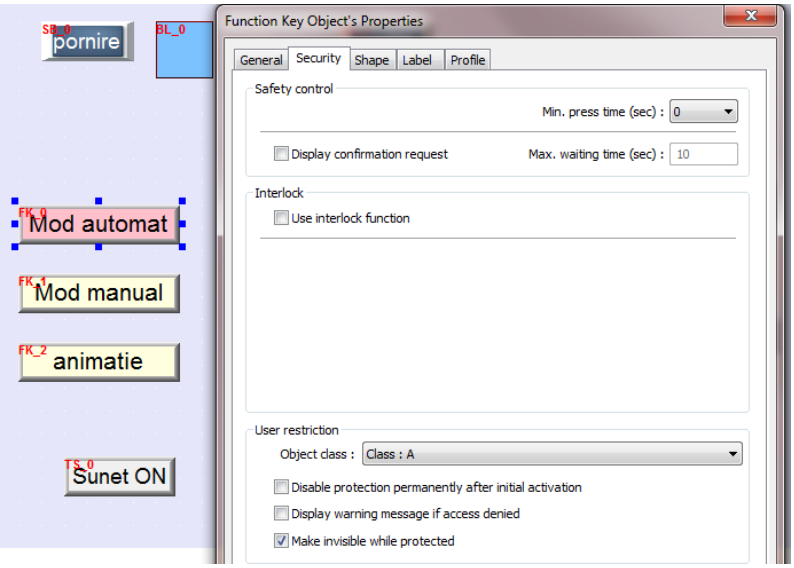

Figure 16. Setting security class A

The program realized in the PLC ladder diagram language, makes the movement on the three axes of the arm in direct connection with the HMI through the rights given to Users by the security level classes. The PLC command console is built with the help of a Weintek touch screen for introducing the distances and displacement speeds on the three axes.

7. Conclusions

The HMIs are very important for controlling the PLC programs, because we can't enter the data or find process results without the interface.

The PLC command console is built with the help of a Weintek HMI touch screen.

For introducing the distances and displacement speeds on the three axes, we depends on the HMI configuration about users access levels to some windows. Some menu windows are only for monitoring but others are for service and we can control the robotic arm more precisely.

The HMI must interpret the commands received on the PLC inputs and it must command according to the data introduced by the operator with the help of the Weintek interface.

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