AUTOMATIC CAR PARK CONTROL WITH HMI AND PLC

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Abstract: Nowadays the technique becomes more developed, the intelligent industrial equipments gets an important role. Our model shows that a display control unit HMI (Human Machine Interface) and associated process control equipment PLC (Programable Logic Controller) how can make an intelligent industrial process.

1. INTRODUCTION

Today more and more car is on the road in our land. Parking as part of the traffic, is an increasingly determining factor in all around the world.

The growth of the economy and society is clearly justified the continuous expansion of the parking development and improvement. The most typical post-millennium phenomenon is exploded growing number of the car park. The number of cars grow is in proportion the reduce number of empty parking spaces. In the cities it is becoming harder to find parking spaces, which have a favorable price and location. The parking situation is always an important issue in the settlements.

Our goal is an advanced automatic parking garage model, and to establish a program that after the transformation and development of a real, in everyday life, auto garage control. Our goal a user interface design that is easy to use user friendly, dynamic and service in the field of application requirements.

2. THE PROJECT

In today's modern industrial processes get increasing emphasis the interconnection of system simulation and monitoring software. The reason for that whether it be a smart way to query the current process states and, if necessary, can be set up to intervene. Modeling an industrial process and demonstration of the real operation is not a simple task. The industrial process which is presented is a parking garage model. The automatic garage can be regarded as an intelligent building which is capable of operating without human intervention, perform tasks, give signals in case of failure.

The successful implementation of the following tasks to be solved:

- to draw a virtual model of the car park;
- must be set the operating range;
- manual and automatic operating modes must be separated;
- to provide for the basic control program;
- must be created the communication between the PC and the visualization software;
- need to be a communication between the PLC and the PC;
- PLC inputs and outputs must be wired in;
- testing;
- improving the operation of the process.

3. HMI AND VIJEO DESIGNER

The program's choice was motivated by the Twido PLC of Schneider Electric company ensure the communication. The Vijeo Designer is the Schneider Electric's own process design software. The program is suitable for visualize and simulation of various manufacturing processes. It can visualize any industrial process so that already existing elements can be used and even new items can be draw and operated it. Firstly by using the Schneider Electric company's software we made an own visualization program that is intended to display the virtual environment of the parking garage traffic and usage.

Vijeo Designer and Magelis HMI features:

- Video view and record function.
- View your images in real time from a camera connected to Magelis XBT GT/GK and GTW or iPC .
- Encoding/ decoding of your sequences with recording on demand in MPEG format on your Magelis XBT GT/GK and GTW, or in AVI format on your Magelis iPC.
- Simultaneous viewing of recorded and real time sequences.
- Display of the third party MPEG format streaming on Magelis iPC.
- Web Gate remote access function: handle your HMI applications via a simple internet navigator using architecture Ethernet.
- User-friendly data exchange thanks to the Data Manager function.
- User-friendly interface, it also offers functions such as multimedia capabilities and remote access for more efficiency.
- Simple or complex machine builders (automotive, electronic components, pharmaceutic products, chemical).
- Tertiary industry and infrastructure: building, food and beverage, water and waste treatment, etc.

Firstly we made parking garage model with Vijeo Designer's drawing tools. We have established cube bodies from lines and square sheets which are formed a cube-shaped 27-element array. Each element symbolizes a parking place.

Secondly we constructed the parking garage final form with the leading way and three square which indicate the number and occupancy of parking spaces on different floors.

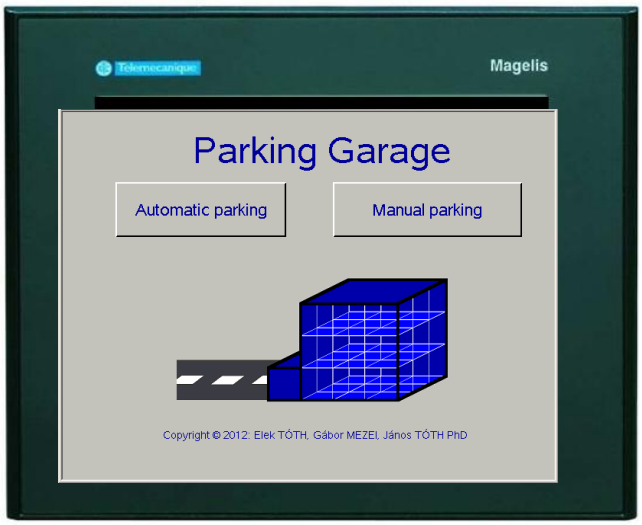

Figure 1. Main panel on the Schneider Magelis XBT GT 4230 screen

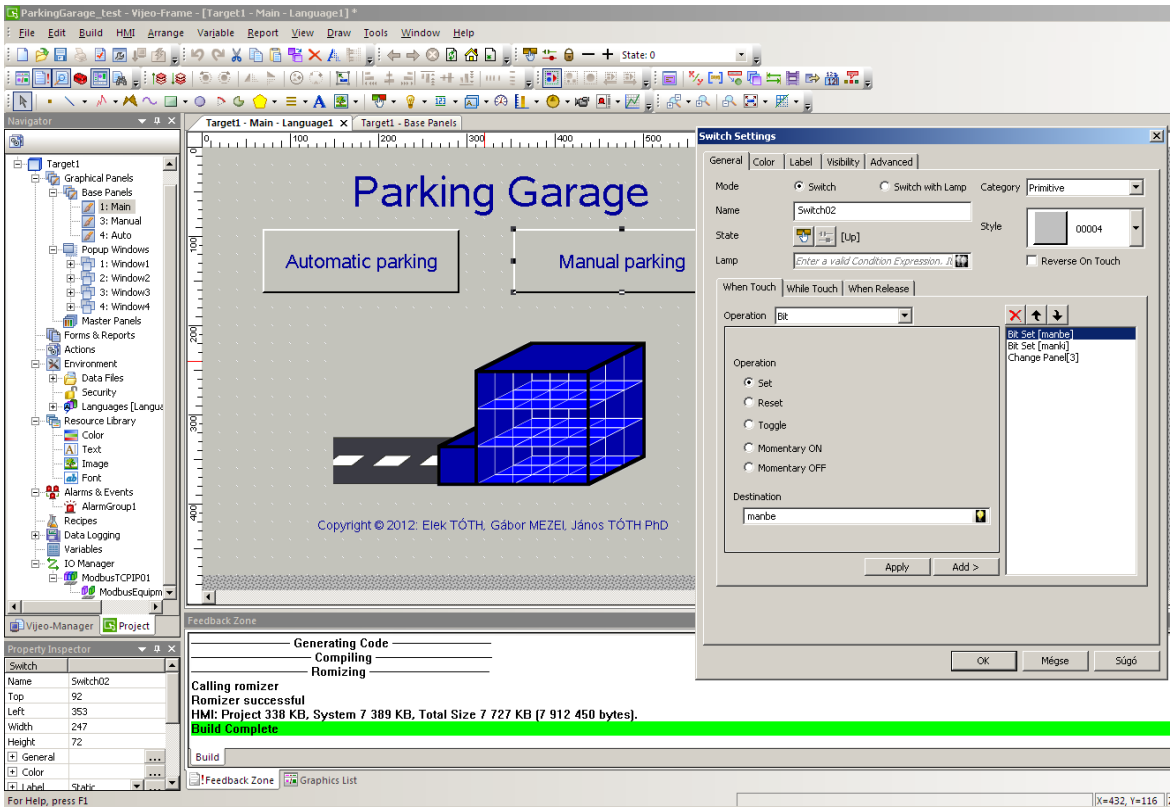

Figure 2. Vijeo Designer developing software main screen

We had to create variables for using the animations and switches. Two types of animation had been used in the program one of them shows the car's horizontal movement and the other one shows the parking place occupied by color-changing. The operation of animations can be achieved by increasing or reducing the variables. This can be done with scripts which is the engine of the program.

4. THE INTELLIGENT PARKING GARAGE

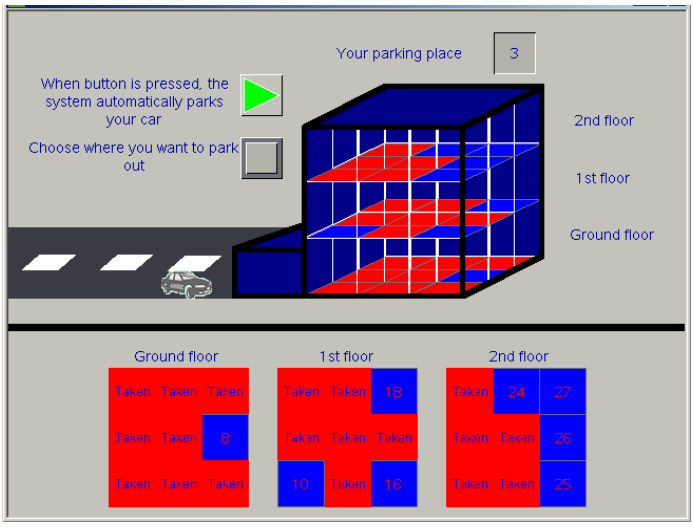

Figure 3. Automatic parking in panel

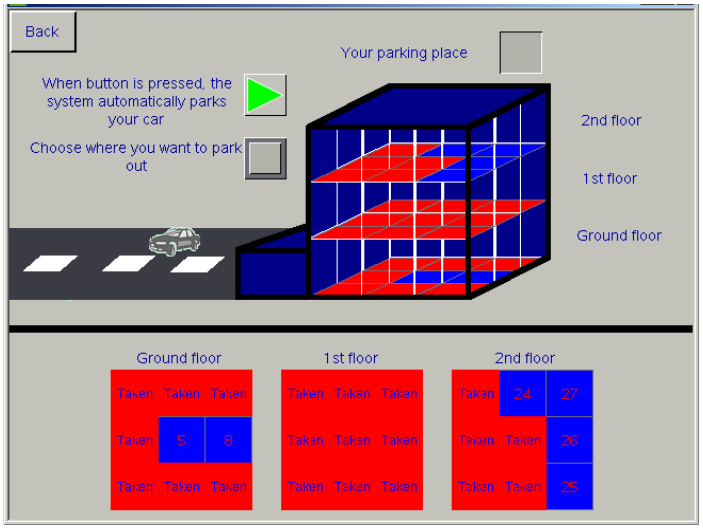

Figure 4. Automatic parking out panel

For car animating we created a variable and then attached to the car object. To the switch marked green triangle also must be added a variable and set so that for touching increase the value of the variable from 0 to 1.

```
int i= MoveCar.getIntValue();
i=i+1;
MoveCar.write(i);
if(i>8){
c.write(1);
switch (c.getIntValue()){
case 1:
if (t[0].getIntValue()<1)
{t[0].write(1);MoveCar.write(0);break;}
    .
    .
    .
case 27:
if (t[26].getIntValue()<1)
{t[26].write(1);MoveCar.write(0);break;}
}
mozog.write(0);
}
```

Figure 5. Part of automatic parking script

If an error occurs, the program indicates pop-up windows for the user. The pop-up windows can appear on that screen which is in use at the moment. For displaying switches, scripts or animations can be used. Editing occurs the same way as the main screens, size and placement can be changed and any object can be put on them.

In the program has four cases when pop-up window can appear:

- In the parking garage has no more room.
- In this place is not car.
- This place is already occupied.
- Emergency STOP.

Figure 6. Pop-up windows

5. PLC PROGRAMMING

An important step to establish communication between the PLC and the virtual environment. The Vijeo Designer supports the TCP/ IP communication therefore we had to choose a suitable device. We controlled the Designer software by Twido 40 I/O port device. In the Twido Suite environment can programming the PLC directly. We implemented the programming of the PLC through the ladder programming language.

Figure 7. Twido DLC40DRF PLC

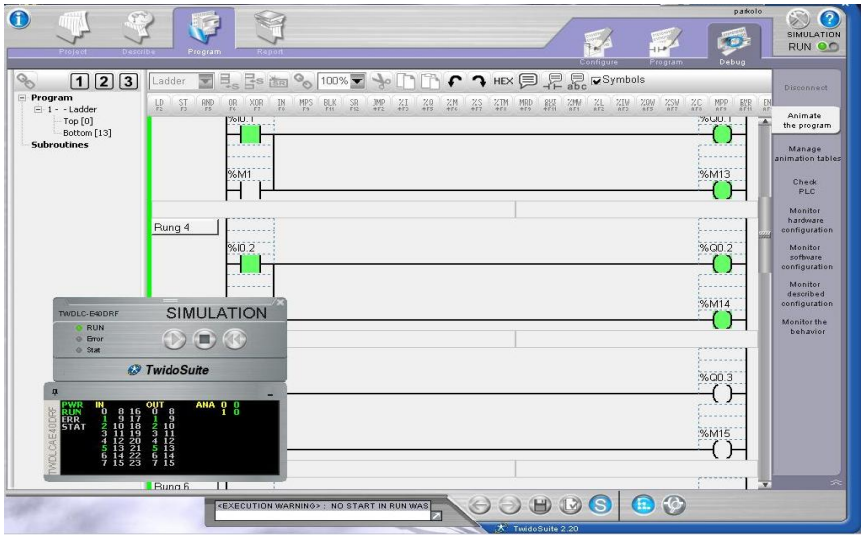

Figure 8. A part of Twido Suite ladder diagram

In the program each of these parking places include two components. One component realize the parking in with the robot arm and the other component realize the parking out.

The control program also includes several security features:

- While the automatic parking in/out process is using nothing will happen when pressed the control panel buttons. It was needed for smoothness operation of the automatic on / off parking process, .
- If the robot arm is in starting position the positive movement on Z axis does not allow until the robot arm does not move out the positive direction on X, Y. This is because the robot arm can jam at the end of the two-pronged fork-lift built around the base platform.
- Cross-locking: if a motor is working in one direction the controller instructed not to move the motor in the opposite direction so it have to wait until the previous kinetic process completed. If we give a sign to a motor we can be created a two-way movement short circuit.

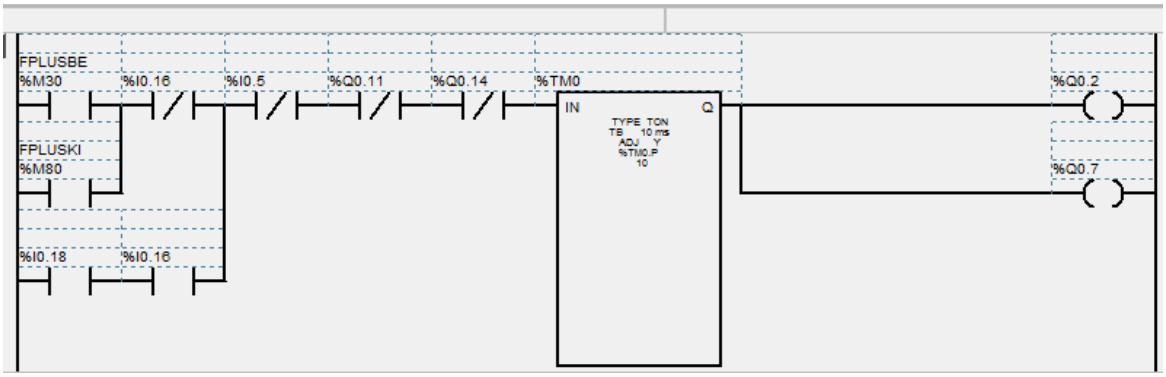

Figure 9. Y axis positive vertical motion control

6. SUMMARY

Our goal was to create a fully-autonomy functioning automatic car park. Our model was made that its operating principles and algorithms necessary to move the appropriate changes and expansions can be controlled a car park and its operation which is used in

everyday life. One of the biggest challenge was the communication between the devices as a common language had to speak for carried out a task. We implemented a demonstration face, which will be presented the parking garage simulation. In the automatic mode the vehicle can self-park in or out. In the manual mode the user can specify which location he wants to park. We can not parking to an already taken place because the control software does not prohibit it and also indicating it an error message.

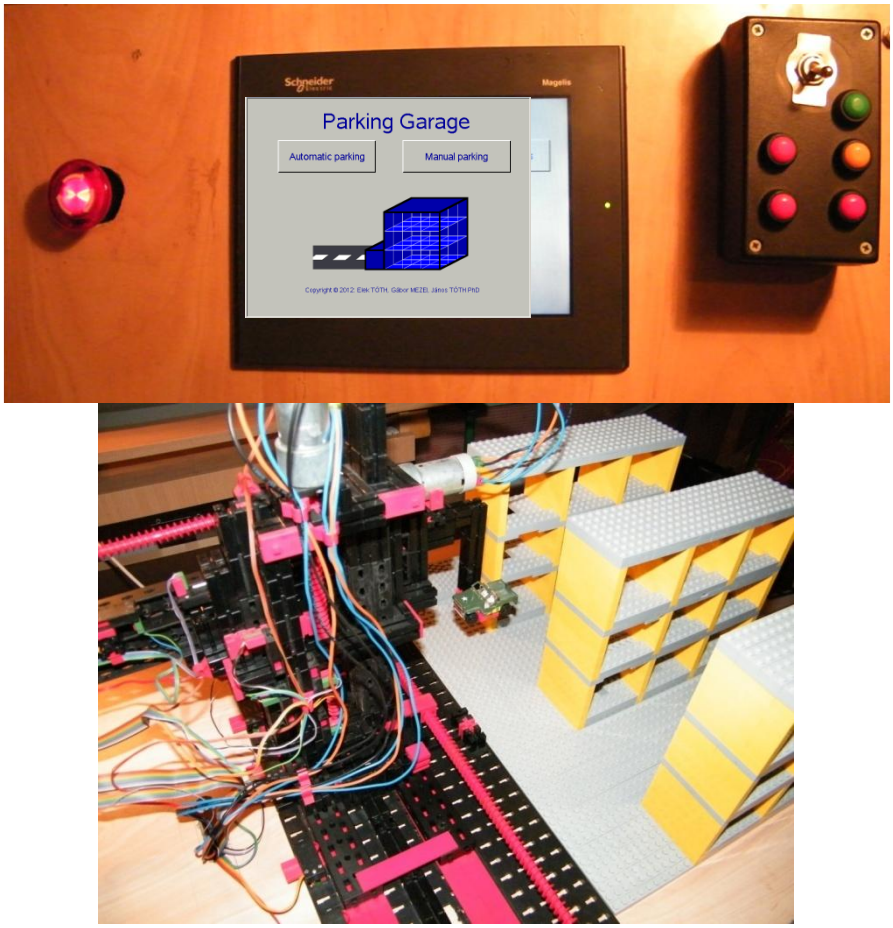

Figure 10. The finished parking garage

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