

Industrial Automation Project: Metro Line System

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Abstract

Metro line system represents complex interconnection of various elements, that provide space for implementation of instructions and functions exploited via CODESYS and completed during the course. Underground system is not apparent example of the industrial system, nevertheless PLCs (programmable logic controllers) are well suited to handle required operations. For example information board includes information about time left for next train to come, exploits timer functions; many of other ones demanded specially designed functions. Also visualization of the destined system is substantial portion of the project, due to the fact that it takes special skill, and alternative approach to implement.



Figure 1: Train model used in visualization

1 Introduction

Underground system represents tightly interconnected system, where each operation command has effect on the overall system; additionally system can be subdivided into task groups according to assigned task. This model can be viewed from the perspective of the underground system operator, however it also provides the necessary information to potential passengers. Some additional safety features such as door closing prevention and emergency stop are exploited.

CODESYS programming environment allows to exploit functions and as well as visualizations required to successful accomplishment of above-mentioned project. Structure text PLC programming language was chosen, due to it's intuitiveness in comparison with alternatives; besides, although LLD (ladder logic diagram) is visually more convenient, such a complex system will create a significant amount of distractions, and will prevent focus concentration

2 Implemented logic conditions and functions

Design process of this system included, perspective of the train operator as well as general passenger view and experience that he/she has or could have or see in the generic tube line. Also some more specific functions were considered as potentially usable for instance the door closing mechanism that is not implemented in most of the metro lines.

- For train to begin ride operator must manually press the 'Go' button, and will go with constant speed
- Trains operate in a closed loop
- Trans are on the two parallel lines from each other

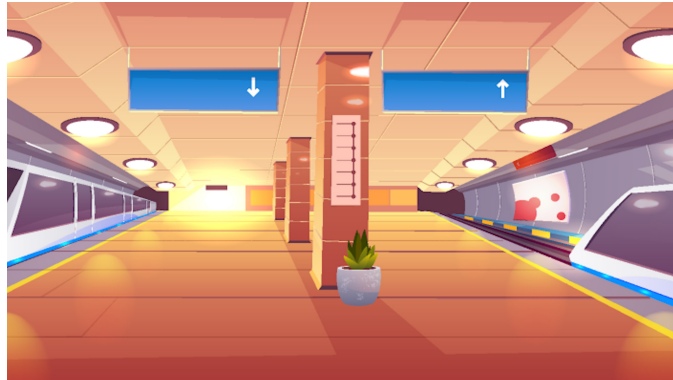


Figure 2: Visualization of 2 train station

- Train visualization is implemented via images and door visualization is also crucial part of the code
- When Emergency stop is pressed, operator will not be able to press "Go" on both trains
- If Photo Eye is activated doors will not close for some amount of time
- If some object is located between the doors, they will not be able to close. Then it will automatically wait for 3 seconds, and will try to close again. In case if some object appears again, logic will repeat itself, till there will be nothing
- Stations are designed in such way, that distance and respectively time for train to get to some station are not equal
- Operator and passengers will have information about time left for next train to come
- Information boards time will adjust to operate only if trains are active

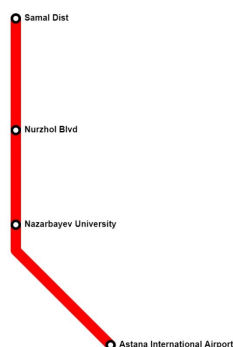


Figure 3: Metro system line schematics

3 Conclusion

In this project main aim was implementation of the PLC programming languages, ST was used particularly in this project. As well as the design and visualization of multi-functional system in CODESYS environment. During this project we elaborated the programming part using the timer and counters functions; besides, some tricks from Professor Tohid Alizadeh's YouTube channel. However, code processing was not smooth and easy, therefore we needed some extra time to reconsider the logic even for some minor at the first glance things, like door opening visualization and information boards. Figure 3 demonstrates the final visualization implemented in CODESYS, it includes 4 stations with time boards on them, train control boards and moving train visualizations.

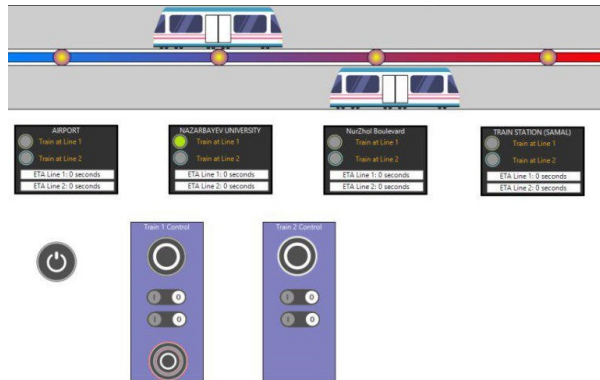


Figure 4: Final visualization of the project



Figure 5: Visualization for the project decoration with small Easter egg