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Digital Control of the Laboratory Railways Model with a PLC Automat

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Abstract: *The Topic of this paper is focused on description of the laboratory railway model and its control system which is based on PLC automat. On introduction are described main parts of the railway model which is located in departments laboratory (railway station, depot, works railway, storage track and sections of the railway).*
In first chapter are shortly described rules of the railway traffic (theory related to safety systems in railway). Also the safety system proposal for modelated railways is here (types of semaphores and their position in model). The second chapter describes tracking control system of this model (PLC system ABB line 800 and its components – central control unit, input/output units, communication units of industrial bus Profibus and power-supply unit) and the methods of its programming (with using of the PC computer and special development software ABB Control Builder). In the next are described algorithms for controlling of traffic on the railway model. In the last part, the possible evolutions of automatic systems are described here (proposal of manually controlled panel which will use PLC, visualisation of the tracking traffic, possibilities to control by using of the digital coder/decoder systems etc.).

Keywords: *control system, PLC, Profibus, railway model, railway traffic*

1 Introduction

For practical education of a logical control laboratory railway's model is developed in subject Control system fundamentals – as one of functional application applicable in exercisings. Running of the trains on it is operated by a programmable logical controller. The model is located in a wooden box with a clear cover (see Figure 1).

Figure 1 – Laboratory railway model

It is a model of trackage in gauge TT (1:120) and distance of rails is 12 mm. The model scheme is shown in Figure 2. Originally the running was managed by hand by the help of installed switches.

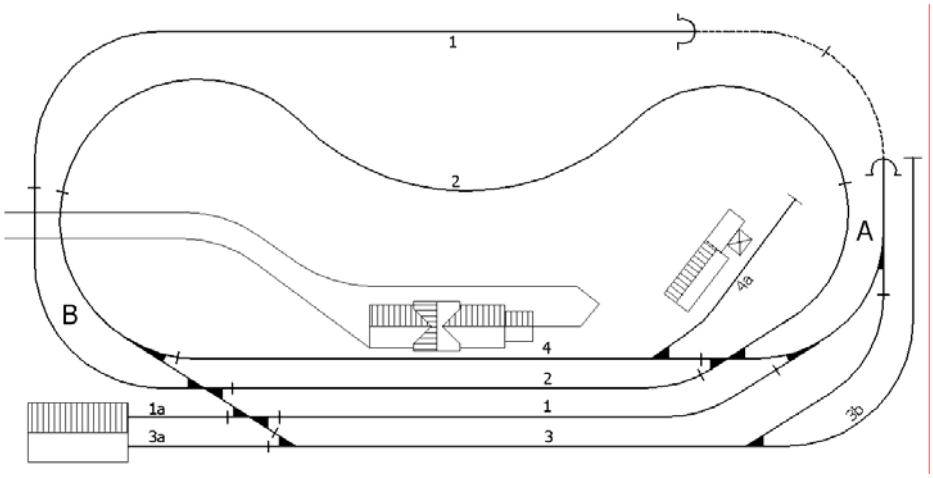

Figure 2 – Scheme of railways and objects

On the model there are two circuits closed by a station. Bypass is totalled by a season ticket tracks No. 1, which tie together on station track No. 1. Inner ring is totalled by a season ticket tracks No. 2, which tie together on station track No. 2. Running shed is modelled on fragmentary tracks 1a and 3a. It serves to ablactation of engines that are not using to running just at the moment. On the model there are four fragmentary in total. Railroad spur is dead-end track formed by the extension of station tracks No. 4, marked issue 4a. It serves for ablactation of wagons dutiny work on train or for locomotives at handling in depot.

2 Rules of the railways traffic

Running on the railroad track depends on a situation in the station. Trains will move one direction, namely clockwise. On wide track the trains will move independently of situation in station, but gateway to the station will be unstrung only at that time, if the train is able to continue in its ride. Practically at least one station track and adjusted train way must be free. If this won't be fulfilled, the train stops before entrance turn marker. The safe running in station must be made by rules for gateway of trains to the station from a wide track and departure of trains from the station to the wide track. Preferred station tracks for this transport are track No. 1 and No. 2. On making-up siding No. 3 it is possible to drive in set in case if its ride finishes there. Track No. 4, the closest station building, is primarily intended for reservation of the running on train, but if a shift won't be under way, it is able to be used for stopping the trains. According to proportions and complication of this model it is enough to suggest a station alarm system. On wide track the section blocking can not be use.

Alarm system must ensure especially:

- verification freedom and occupation of station tracks,
- it restraints throwing - over below vehicles,
- it restraints position of train roads on engaged track.

On modelling yard there are luminous markers used (see Figure 3). In the station there are used:

- three-signed schedule marker (L1 L4, S1- S4) – white - red - green light,
- four-signed entrance turn mast marker (1L, 2L, 1S, 2S) – yellow - white - red - green light,
- two-signed advance signal entrance turn markers (Pr1L, Pr2L, Pr1S, Pr2S) – yellow - green,

- two-signed lining up mast marker (Se1a, Se3a, Se3b, Se4a) – white - blue.

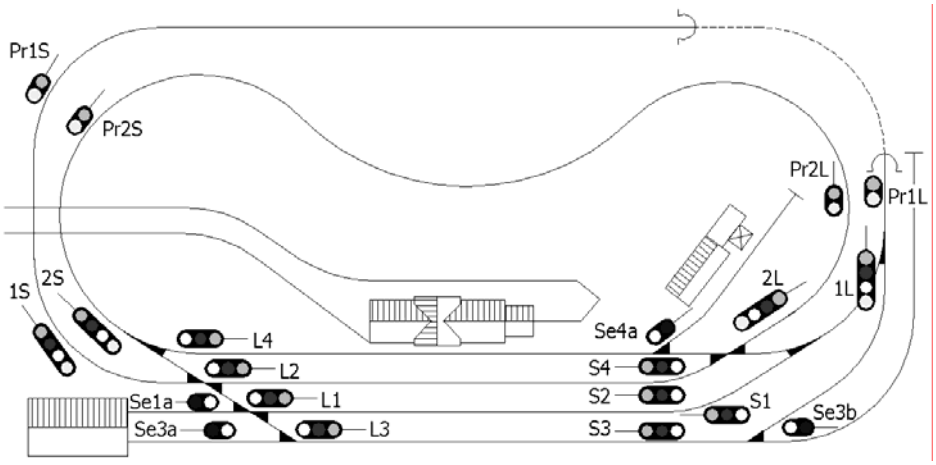

Figure 3 - Location of luminous markers (semaphores) on the modelling yard

For recognition of the real position of the trains on yard 26 position sensors are used. For system management the whole yard is divided on 12 separately fed sections. In terms of the programme we can drive 4 simple points and 3 junction points, 2 points it is possible to control by hand only.

3 Tracking control system

For system management on modelling yard we use PLC of ABB firm - series 800xA. It is a modular PLC that is made up from single functional units:

- central control unit AC 800M (type PM860),
- input/output units (DI801/DO801),
- communication modules Profibus CI854A, CI830,
- power-supply unit SD823.

PLC is programmable from a personal computer equipped by Control Builder programme. For program scheduling programming method Ladder diagram was used. Designed management system does not allow us to operate direct in the intervention to the running on yard. That is why the programme is created so, to running had to be managed automatically in simplified form depending on its instantaneous state. At run programme operator intervention is not necessary. Indeed it is necessary to start, let us say to stop programmed roads. Programme is created for running two train sets and before its initiation definite fundamentals must be observed. The first is an ablactation of an old manual operating yard by turning off of all sections and an alternative is that the trains must be built on 1. and 2. station track.

4 Possibilities to development of railways model

Presently, the system of management trains on panel is buckthorn clockwise, but we must also respect the possibility of turned - up direction ride. Therefore on our model there are already installed the markers and position sensors of trains for retrace.

Power supply of the entrance turn sections is effected for both entrance turn tracks together. This seems like unfit solving, because it stops to gateway one's train to the station, while second faces entrance turn marker. This limitation is possible to remove by fission of entrance turn sections separately for every track.

Present way of driving yard prohibitive operator intervention (except initiation and deadlock). Everything is controlled automatically by the help of PLC, whereat the programme

runs. For possibility of a manual drive it would be suitable to create a control desk. This would enable more varicoloured and funnier work with the model.

It is thought also about a usage of software visualization of agents type InTouch, ControlWeb for visualization of the yard running on a computer screen. It is also supposed that the operator could operate by hand.

5 Conclusions

The theme of this paper is focused on description of the laboratory railway model and its control system which is based on PLC automat. On introduction are described main parts of the railway model. In second chapter are shortly described rules of the railway traffic (theory related to safety systems in railway). Also the safety system proposal for modelated railways is here (types of semaphores and their position in model). The third chapter describes tracking control system of this model and the methods of its programming. In the next are described algorithms for controlling of traffic on the railway model. In the last part, the possible evolutions of automatic systems are described here.

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