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AUTOMATED DISPATCHING CONTROL SYSTEM OF THE MOBILE CONCRETE BATCHING PLANTS

Andrey Ostroukh[1], Yashar Nuruev[1], Dmitry Ephimenko[2], Sultan Zhankaziev[3] and Dmitry Moroz[4]
[1]Department "Automated Control Systems", State Technical University-MADI, Moscow, Russian Federation
[2]Faculty of "Logistics and Transportation Problems", State Technical University-MADI, Moscow, Russian Federation
[3]Department of "Traffic Safety", State Technical University-MADI, Moscow, Russian Federation
[4]Department of "Road Transport", State Technical University-MADI, Moscow, Russian Federation
E-Mail: ostroukh@mail.ru

ABSTRACT

This paper proposes an approach to the design of dispatching control system of the mobile concrete plant, which is a set of hardware maintenance, information, mathematical and software for control of technological objects. The proposed system is scalable and can include a control subsystem of mobile concrete plant, laboratory, subsystems, access control, and personnel management jobs. The system provides optimum automating the collection and processing of information for generating control signals and transmitting them without loss and distortion to the actuators in order to achieve the most efficient operation of process control object as a whole.

Keywords: concrete, mobile concrete batching plant, automated workstation, control, technological process, automated dispatch control system (ADCS).

1. INTRODUCTION

Quick and regular transportation and off-load of manufactured production are important constituent of industrial enterprise successful work. The main load in this task lays on automotive transport, which is optimal from different points of view. An enterprise should consider a lot of factors for high-quality transportation, among them: transportation costs prompt delivery, constantly changing traffic situation.

Today satellite communication facilities have been widely spread for this task solution. They are widely spread in the field of freight and passenger transportation control for continuous support of transport facility (TF) operation monitoring. Production transportation monitoring became an essential part of a whole enterprise process. It permits to reach previously unavailable opportunities during planning and enterprise workflow, to raise efficiency and to decrease production costs [1-20].

2. MODERN AUTOMATED DISPATCHING CONTROL SYSTEMS

Automated dispatching control systems (ADCS) of motor transport park are built on the basis of satellite navigation. The primary assignment of such systems is reliability support of centralized transport facility park control on industrial enterprise. ADCS solves next problems [1, 5, 18, 19]:

1. Improving scheduling and scheduled transport operations execution, improving enterprises production transportation;

2. Efficiency increase of transport facility use (decrease of involuntary loss of time on a line; sustainable rolling-stock and stockpile use and, as a consequence of this, decrease of transport maintenance costs);

3. Increase of operation safety of enterprises motor transport.

Notion of Control Point (CP) lies at the heart of transportation planning subsystem operation of modern dispatching system. CP is some spot of area, which pre-set required transport facility passage point (Figure-1).

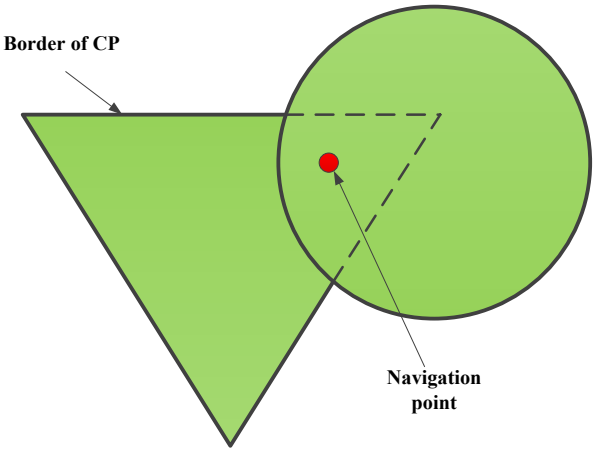

Figure-1. A hit of navigation point on CP.

Control points are used for transportation plans compound (TF should pass defined arranged set of CP's in a given time) and for TF's actual movement evaluating [1-20].

Different real infrastructure objects can be represented in the form of CP (objects of: load/off-load, filling/drain, construction, petrol station - etc.). When TF's navigational coordinate came into ADCS, system verifies its entry to each of polygon. Determination process of CP with its navigational coordinate, calls "linkage" of navigational coordinate and CP [2]. CP can be composed of polygon or geometric primitive: triangles, rectangles, parallelograms, circumferences. If CP consists of several primitives, then it's called complex Control Point. CP's area is a primitive pack area which compounds current CP.

A "Ray tracing method" can be used for navigational coordinate ingress of CP's area evaluation

(Figure-2). This algorithm is used in computational geometry for spot ingress of closed polygon evaluation, but it doesn't take into account inaccuracies which are concerned with navigational equipment operation.

These inaccuracies can be neglected, as CP's areas rarely can be more than 500 meters. So the effect of cartographic projection distortion wouldn't make large inaccuracies in such scales [2].

During ACDS operation system marks CP's with their navigational coordinates, if they have once. It is called CP's include. Include shows which of CP's were passed by TF's and which of CP's appeared "false". This approach is based on TF's time spent on CP evaluation.
From data of included and false CP's, ACDS allows to define actual value of fulfilled transport work, and it can also compare findings with planned values which were specified before TF's leave on a line.

CP's use has been shown itself as a good approach, but it doesn't have only advantages. The main disadvantages of CP's approach are [4]:

Manual input: Enterprise dispatching centres specialists mark CP's by hand. This process is laborious, monotonous and tiring. Therefore a human element influences on efficiency.

CP's are static: Once entered in a database CP's can be only updated or deleted, but it practically never happens. If such system would be scaled to a regionwide or countrywide coverage, then data in a database would take much space that entails systems slow operation.

CP's are discrete and detached: CP sets fixed area. If TF passed not through defined CP in some reason, it means that transportation plan was disrupted. Though it couldn't be so in some reasons.

From all observations above it is suggested to swerve from static manual transportation planning to automatic dynamic planning. It doesn't mean that human element would be fully excluded. It is impossible. But human element influence would be minimized.

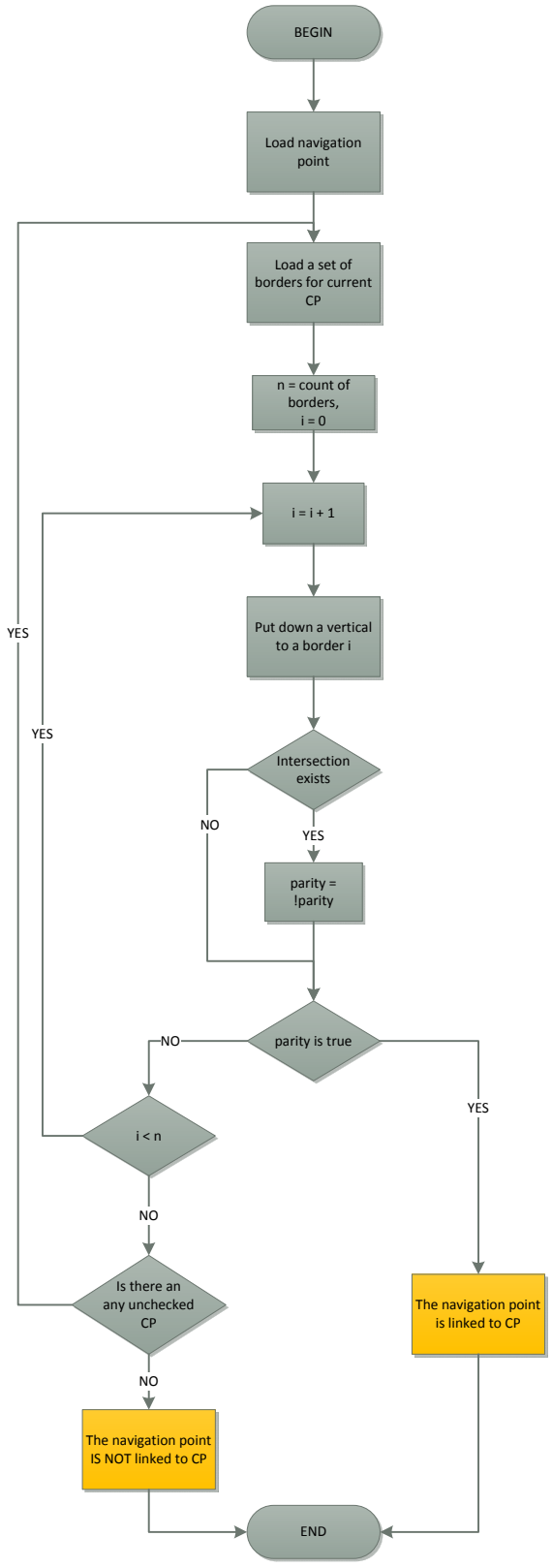

Figure-2. Algorithm of linkage of navigation point ad CP.

3. MOBILE CONCRETE BATCHING PLANTS

In contrast to the stationary use of mobile concrete plants (Figure-3) allows you to actively implement the construction projects with complex logistics, or located at a great distance from the existing infrastructure, thereby minimizing transportation costs for delivery of concrete from stationary concrete plants on the object, and thus reduces the costs of the company and increases the profitability of the work, modernize your production and opens up opportunities for further improvement.

Figure-3. Mobile concrete batching plant MOBILE MASTER 100 LION.

Hardware of the mobile concrete batching plant (in this case MOBILE MASTER 100 LION, manufacturer ELKON, Turkey) consists of a SIEMENS control panel, SIEMENS controller, personal computer and printer.

4. MULTI-LEVEL STRUCTURE OF THE AUTOMATED DISPATCHING CONTROL SYSTEM OF MOBILE CONCRETE BATCHING PLANTS

Mobile concrete batching plant control system has a three-tier structure [1-8] and can include multiple geographically distributed plants connected into one technological system integrated into enterprise resource planning (ERP) system (Figure-4).

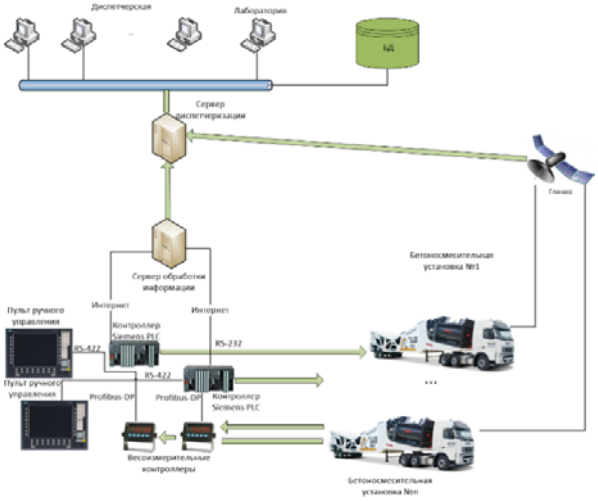

Figure-4. Automated dispatching control system (ADCS) of mobile concrete batching plants.

The automated dispatching control system may consist of the following subsystems:

- concrete plant;
- dispatching service;
- laboratory;
- jobs administrative personnel.

The database of each of production associated with the enterprise management system and allows you to share information in real time.

This ADCS is necessary for the control of the engineering equipment, diversity geographically and located in hard to reach places. ADCS is a complete solution for the automation of all the components of the process of dispatching control and management, including [12-21]:

- technological monitoring;
- production accounting;
- control of production events;
- monitoring of the equipment;
- creation of production reports.

The whole point of scheduling is to visualize information on the work of engineering systems and the ability of the operator to operate the equipment directly from the control room. The status information of the engineering equipment received from the local controllers and automation are transmitted to the server. The treated process data with the required analytical information provided to the scheduling server and displayed on the workplace computer screens operators in the visual dynamic graphics.

Subsequently, the processed data generated in different types of messages, which are then archived in long term storage. On the basis of the information available at any time, reports are generated. Scheduling system provides key advantages in the management of the object:

- permanent centralized control of engineering systems;
- rapid response in emergency situations;
- reducing the influence of the human factor;
- optimization of workflow, reporting system.

5. CONCLUSIONS

Dispatching - it is a complete and comprehensive automated control of the enterprise, production technology, product quality as a result of increasing technology, labor and accounting discipline. The main advantage of the system is that it is fully autonomous (no human error); It captures only the facts that have taken place in real time; can do the analysis, forecast, control according to certain criteria; It allows you to clearly indicate the responsible person, in whose jurisdiction is a specific situation which has arisen in the course of industrial relations. The information generated by such a system can be used in strategic planning, management accounting, in the development and setting targets for the

year, quarter, month, for a work shift. If necessary, the system can act as the primary source for the accounting of financial accounting software. Management System is an essential part of the process control and manufacturing automation systems. With its use simplifies the internal workflow, saves time for our newsletter and approval of documents, especially when using electronic signature executives.

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