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Information system for control of transportation in the enterprise

The structure and basic algorithms of information control system of transport operations at the enterprise work are presented. The basis of the system is a wireless mesh-topology network based on the IEEE 802.15.4 standard and the Lightweight Mesh protocol stack.

At many enterprises, including in the aviation industry, transport is carried out both inside and outside industrial premises. For example, at an airport, transportation takes place both inside hangars or terminals, and between them. The main vehicle is the car drivers. At the same time, the waiting time and the fulfillment of the request depend on the timely notification of the driver of the car driver about the need to service one or another production site. Calling an automaker or other vehicle is simpler than a mobile phone or radio, but this way has several drawbacks:

- it is impossible to send an application to all free vehicles at the same time;
- the controller cannot send the vehicle closest to the polling station;
- the worker has to wait for the confirmation of acceptance of the application from the driver to whom he is calling;
- the driver of the vehicle may in time not notice the incoming call, especially in conditions of increased noise;
- complexity of controlling the work of drivers.

It is also important to get information on the location of each vehicle in the traffic control system to improve the performance of the controller.

Since all this can lead to significant loss of time, stopping of production lines and inefficient or inappropriate performance of drivers, it is necessary to automate the process of calling vehicles and controlling their movement in order to improve the efficiency of transport.

System requirements

The structure and algorithms of the operation of the information control system of transport operations at the enterprise should provide for an increase in the efficiency of transport operations at the expense of:

- unloading from unnecessary actions of workers;
- timely and visual provision of information to the driver of the vehicle on incoming applications, time of execution, etc.;
- the ability of the dispatcher to monitor and effectively manage transport traffic in real time;
- saving history of all events in the system and other information in the database in order to analyze and compare the effectiveness of work at different times, as well as resolving conflicts.

Also, an important requirement is the reliable operation of the system in conditions of significant electromagnetic and acoustic noise, which are inherent in industrial premises.

Development of the structure of the system

Under such a scheme, which involves: a) a worker in a production site; b) the driver of the vehicle; c) Dispatcher, you can distinguish three types of devices in the system (Fig. 1):

1) Workbench panels, which are installed at each workstation, whose functionality includes notifying the call controller;

2) Call receivers that are installed in the cab of the driver of the vehicle and equipped with a display for displaying current information, including a list of applications from the polling stations, as well as buttons for acceptance of the application and transition to the crash mode;

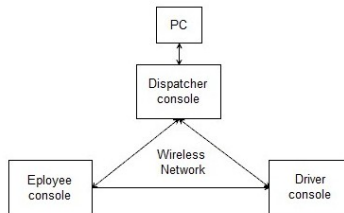3) Dispatcher, which has a connection to a personal computer with installed special software with a database.

Fig. 1. Structure of the system of control of transportation

Combine devices into a wireless mesh network

When developing such a system, the first question arises: how to implement the information exchange between all devices in the system, taking into account the complex operating conditions and a wide coverage area (some shops can have an area of hundreds of square meters).

It should be borne in mind that:

- For this system is characterized by the exchange of short informative messages, the size of several bytes (new call, call accepted, etc.)
- High demands on speed of exchange are not put
- Elements of the system are more or less evenly distributed over the area;
- The use of wired communication is undesirable because it requires additional installation and maintenance costs.

Given this, you can combine them into a wireless network with a cellular topology (so-called mesh networks) according to the IEEE 802.15.4 / ZigBee (1) standard. The IEEE 802.15.4 standard describes the order of physical data exchange between devices (frequencies 868 MHz, 902 MHz and 2.4 GHz), and at the channel access level (MAC). The ZigBee and similar technologies are a stack of top-level protocols that are superstructures above the IEEE 802.15.4 standard and determine the routing of packets in the network, the rules for connecting new devices, and network organization, etc.

This standard is quite widespread, well documented and supported by many manufacturers who produce ready-made radio modules. In addition, it is possible to determine the location of each device without using GPS, by measuring the received signal strength indicator (RSSI) from the nearest stationary devices whose coordinates are known (2). Vehicles determine their location relative to neighboring devices, transmit this information through the mesh network to the control center, where this information is used to display the location of devices on the map.

For these and some of its other modules, the manufacturer has developed its own Lightweight Mesh (3) stack that complies with the IEEE 802.15.4 standard and covers only the basic ZigBee functionality but is not compatible with it (2). This functionality is quite enough to meet the requirements of the vehicle control system. It should also be noted that Lightweight Mesh is supplied free of charge in the form of a ready-made software code, which can be modified at its own discretion.

Thus, the use of ready-made solutions in the form of ZigBit radio modules coupled with Lightweight Mesh significantly reduces the timing and cost of developing the system. A combination of all devices in the wireless mesh network provides:

- noise immunity due to the use of alternative routes of information transmission;
- Low energy consumption due to the lack of powerful transmitters. Each node of the system is sufficient to maintain communication with neighboring nodes only.
- self-organization and self-rehabilitation of the system.

Summary

The proposed structure and algorithms of work of the information control system of transport operations at the enterprise allow maximally increase the efficiency of transport operations. The dispatcher is given the opportunity to monitor the operation of the system in real time, record all events, and analysis of work in order to identify deficiencies or calculate salary. The use of ready-made solutions based on IEEE 802.15.4 improves system reliability while reducing the system's development time and cost.

References

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