Automation of pharmaceutical warehouse using groups robots with remote climate control and video surveillance

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Abstract. In this paper, we present a complex solution for automation pharmaceutical warehouse, including the implementation of climate-control, video surveillance with remote access to video, robotics selection of medicine with the optimization of the robot motion. We describe all the elements of local area network (LAN) necessary to solve all these problems.

Key words: pharmaceutical warehouse, swarm robotics, travelling salesman problem, WiFi-conditioning, LAN video surveillance, cloud technology MyDlink.

1 Introduction

Automation pharmaceutical composition requires deliberate on all sides integrated solution that combines a number of information technology. In Ukraine the regulations determined that the entity performing the activity of wholesale pharmaceuticals must provide storage of medicines and their range [4].

It is necessary to solve the problem:

– coordinate system sufficiently large number of robots (swarm robotics) in order to perform tasks which individual works can not achieve alone;

– design of the entire local area network (LAN) of pharmaceutical warehouse based licensing requirements for this type of objects;

– organization climate control in work-room structure in accordance with the requirements for temperature and humidity profile of each agent alone medicine;

– designing surveillance systems based on blind spots and storing the received video data over time;

– identification bar codes in various formats, very small size, damaged and reflective packages;

– assembly robots for the fastest route selection according the essential medicine list.

2 Background

2.1 Pharmaceutical warehouse with computer/robotic technology

As required by Ukraine state building codes floor area pharmacy depot storage should be at least 30 square meters [1].

Then for the maintenance of such facilities is seen appropriate installation robots (Robowarehouse) Rowa Vmax (3 units) and Rowa Smart (3 units) as fig. 1.

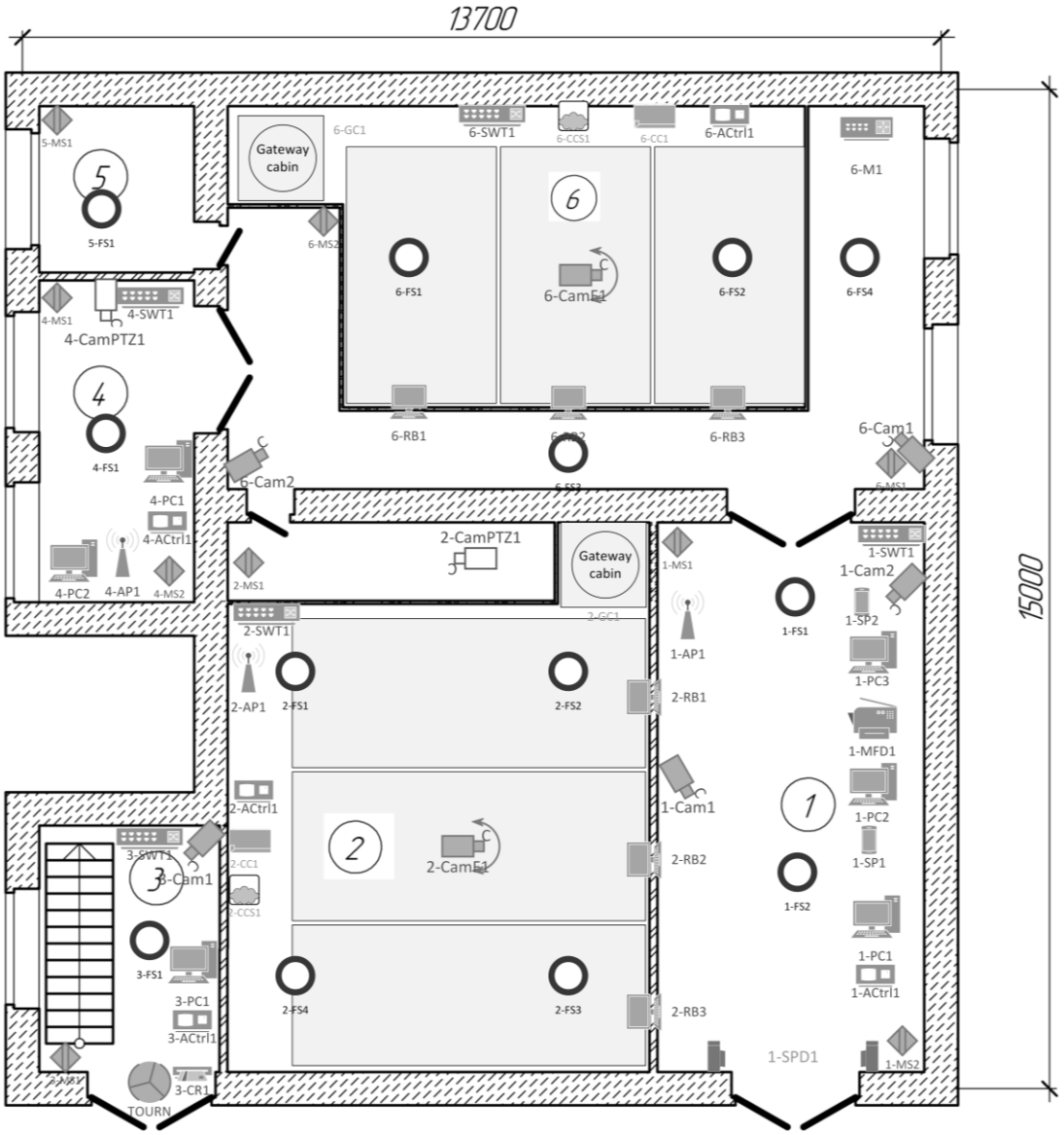

Fig.1. **Location of equipment in the pharmaceutical warehouse**

2.2 Designing of video surveillance

There was selected with software application D-Link Product Selector Pro three types of cameras: D-Link DCS-7000L, D-Link DCS-6010L and D-Link DCS-5222L, which in interaction are able to provide through-clock video surveillance indoors pharmaceutical warehouse [5].

There was visualized and approximate location of cameras covering observation zones using software environment Surveillance Floor Planner Pro (fig. 2).

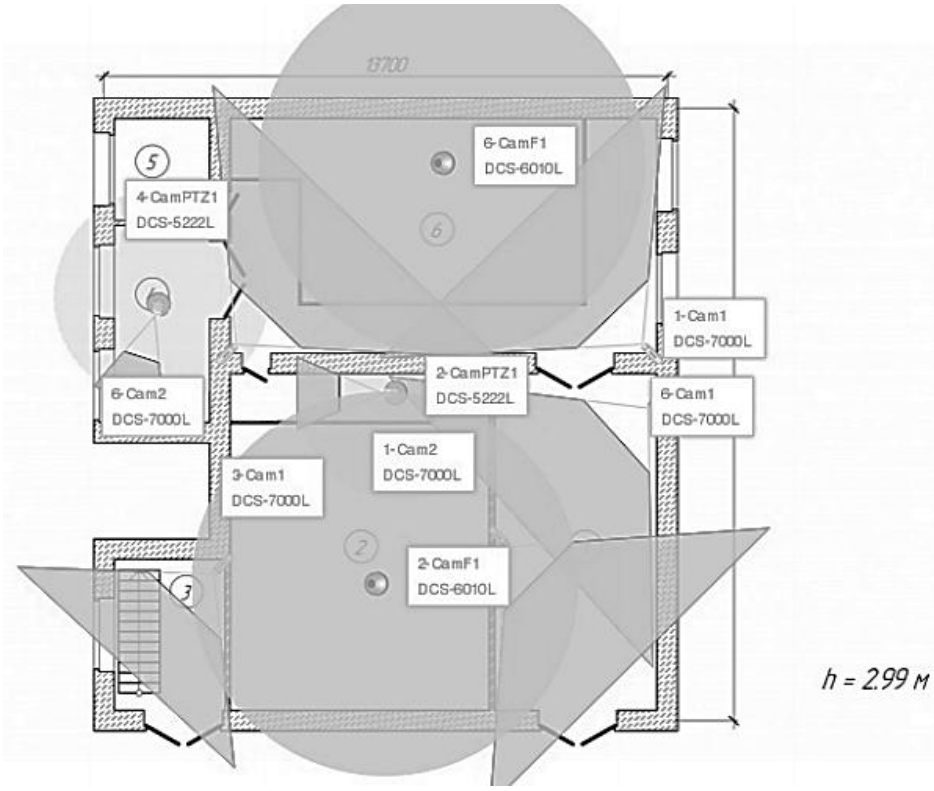

Fig. 2. **Observation zones of the surveillance system**

2.3 Local area network of pharmaceutical warehouse

Pharmaceutical warehouse shall be composed of the production premises with total area (zone) for collection and storage of various groups of medicine not less than 250 square meters. In addition, the medicine, which made trading operations, require special storage conditions [4].

To fulfill all these requirements the net diagram of warehouse's LAN has developed, tailored all necessary components (fig. 3).

The control over conditioners has envisaged with WiFi-ports. Capacity of the network attach storage (NAS) was calculated to keep for at least three years the documents confirming the purchase or sale showing the date, name, number and series received and delivered the medicine, information about the customer (supplier) and details of its license [4].

Remote control of climate control system and viewing video surveillance possible through the use of “cloud”-technology. The proposed solutions as “cloud”-technologies used MyDlink-technology from D-Link Company. Such decisions can not only view your video remotely, and identify objects present in them.

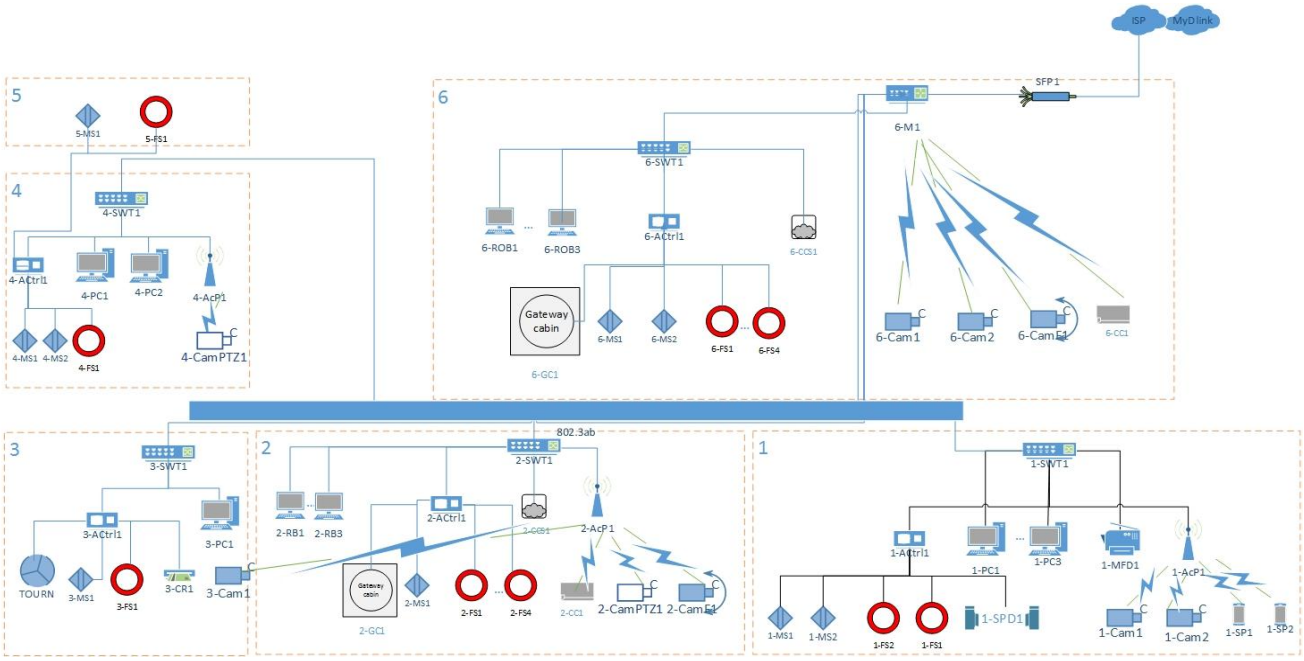

Fig. 3. *Netdiagram of the pharmaceutical warehouse’s LAN*

Mydlink allows the user, regardless of its location, access DB on a NAS with LAN video recording from any Internet-connected computer, laptop or mobile device on Android, iOS, BlackBerry or Windows Phone 5 platform. Also allows you to remotely control the parameters of indoor climate with robots and, if necessary, change the mode of WiFi-conditioners.

2.4 Robot movement optimization

For the issuance of medicines with each robotic warehouse seeks to speed up as much as possible, route calculation for each of the robots.

Theoretically, this problem is reduced to the classical travelling salesman problem (TSP).

The essence of the problem is to find the shortest closed path traversal multiple nodes (points, storage areas) given by its coordinates [3]. When the amount of issue lists more than 30 positions to find the optimal path is the task of optimizing the transport logistics and requires the use of special techniques. To solve this problem may be used one of types of learning algorithms for modelling complex scientific systems in science and engineering [6; 7].

Theoretical and experimental research in swarm robotics systems [2] has demonstrated the success of the application for such tasks the genetic algorithm (GA) and ant colony optimization (ACO).

The pharmaceutical warehouse system is chaotic, different types of medicines could be located on the same shelf. The described below data model was made for using this chaos properly. Here every production unit has its own placement parameters such as number of shelving, number of shelf and special position code. The data model was built in a software environment ARIS Platform (fig. 4).

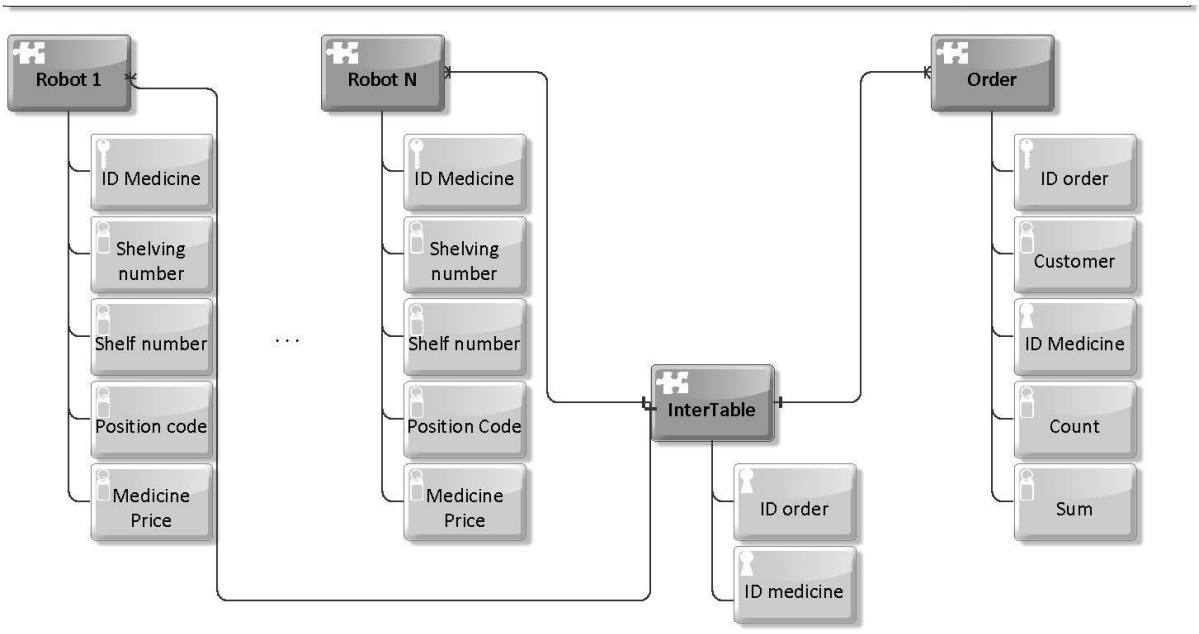

Fig.4. Data Model for Pharmaceutical Warehouse

Note, however, that these algorithms can not be guaranteed in finding the most optimal route. Its purpose is to short time to find an acceptable solution to this

problem, optimality which will vary in direct proportion to the amount of time spent on his search. That is, these algorithms will optimize your decision as much as you have time for it.

3 Conclusions

In this paper, we presented an complex solution of computer/robot automation for pharmaceutical warehouse. This decision introduces a number of information technology for fulfillment requirements to pharmaceutical warehouse (climate control by Wi-Fi, video surveillance with remote access to video recording by cloud technology MyDlink, et al.). The use of the two algorithms (GA and ACO) is reviewed to optimize swarm robotics' motions. In the future, it is important to the improvement of the class to reduce the length of the robots' route, reduction in processing time medicine address list.

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