

INTELLIGENT STORAGE AND ACCOUNTING SYSTEM

Varchenya I. V., Savenko A. G.

Institute of Information Technologies of the Belarusian State University of Informatics and Radioelectronics
Minsk, Republic of Belarus
E-mail: savenko@bsuir.by

The paper presents a software and hardware complex for automation and intellectualization of storage and inventory control of goods at an enterprise, implemented on the Raspberry Pi hardware platform with voice control and visual light indication for request processing. The developed software and hardware system for storage and inventory control can be easily scaled and adapted to the specifics and needs of various enterprises and will automate and facilitate this process.

INTRODUCTION

In the modern world, there are many solutions that automate work in production, agriculture and everyday life. All such solutions are controlled using a specific list of commands hidden from the average user under the interfaces of various mobile and computer applications.

This paper presents a developed project for the automation and intellectualization of a system for storing and inventorying goods, which includes developed software and hardware and a prototype of the system. The prototype of the proposed system is intended for storage and inventory control of radio components at an enterprise engaged in the repair of electrical equipment. The system itself is easily scalable by appropriately changing the system hardware (sensors, sensors appropriate for the task, etc.).

I. PROPOSED SOLUTION

The smart storage and inventory control system is implemented in hardware on the basis of a Raspberry Pi microcomputer, which allows you to economically and ergonomically build the structure of the physical part of the project to manage the system. The Raspberry Pi is a single-board microcomputer, originally developed as a low-cost system for teaching computer science, which subsequently became much more widely used and popular than its developers expected [1].

Peripheral devices are connected to the Raspberry Pi microcomputer, such as: weight sensors (to determine the presence and quantity of stored parts), LED display devices (to visualize found storage containers or display search errors), microphone (for receiving incoming voice commands) and other devices, depending on the specifics of the storage system. The strain gauge and the HX711 chip are a combination that will allow you to create devices for measuring weight or pressure exerted on the surface of the sensor, and then transmit these readings (with high accuracy) to a microcomputer board. For light indication of search results (a specific rack or container) based on a voice search query (in green), as well as for indicating the absence of search results (in red), it is proposed to use LED display devices.

An example of a diagram for connecting LED display devices for a rack with sixteen storage containers placed on it (the developed physical model of the prototype) is shown in Fig. 1.

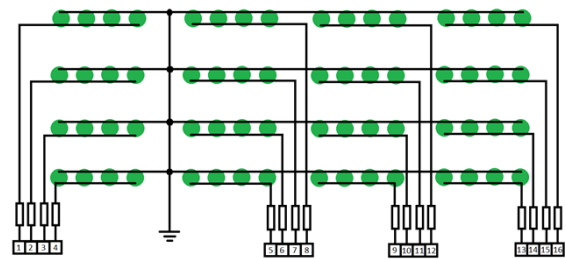


Figure 1 – Example of connecting LED display of a rack

For software control of the system, a software tool has been developed that implements control via a voice interface and does not require special training of employees. The developed software tool uses a number of technologies that implement the following functions:

- processing voice commands;
- processing information read from the weight sensor;
- processing information about placed parts;
- data output via LED indication.

This functionality solves the following tasks:

- voice control software;
- storing information about placed parts;
- input of weight sensor data;
- outputting data to indicator LEDs;
- taking into account operating modes with the physical model.

The general operating algorithm of the system management software involves receiving commands to search for stored parts, add parts for storage, and remove (remove) parts from storage. After starting the program, the LED on the physical model of the system lights up, which serves as an indicator of the operation of the software. Next, the user needs to say the control command out loud.

Control commands are implemented as follows: after the command is read by the microphone, the voice is converted into text. Voice commands are sent to the voice command input unit. At this stage, voice commands represent vibrations of the air environment, perceived by the microphone, pro-

duced by the user. Next, the signal enters the unit for analyzing the received signals from the microphone. Afterwards, the text string is divided into components in the voice command processing unit, according to the list of possible voice commands, and a command is issued to change the entry in the storage file. If the command is recognized, then the corresponding processing method is launched: searching, deleting, adding and changing the number of parts. If the command is not recognized, an error indication is displayed. Information from the weight sensor is analyzed, and then the activation indication command is set in the corresponding block. The indication command generates an error indication command or an indication of a specified cell in the corresponding blocks. Next, activation, error, and specified cell indication commands are sent to the command transmission unit to the microcontroller, which generates control signals on the microcontroller I/O ports. The program ends with a user interrupt. In the case of searching for a part, there can be two outcomes: the part is found and the part is not found. In the first case, the required cell will be highlighted using indicator LEDs. In the second, an error indication will be displayed. In the case of a command to add a new part – the necessary one (with already similar parts or, if there are none, the empty cell will be highlighted. The command to add a part can be of two types: with and without specifying the quantity (then the quantity is considered equal to one). The part removal command can also be with or without specifying the number of radio parts. For example: “Remove voltmeter.” Or: “Remove ten relays.” When you enter a command to change the number of parts, the presence of similar parts is checked. If the check is passed, then the cell with similar details will be highlighted; if not, then the empty cell will be highlighted. The removal command must indicate the number of parts to be removed. In the case of a command to remove a radio component, the corresponding indication of the removal of a part from a certain cell will be displayed and their quantity will be changed. During the development of the software, the following modules were developed, the hierarchical model of which is presented in Fig. 2. The operation of the application begins after the software control module is launched, which contains the code that implements the main algorithm through calls to methods from other modules. The constants module stores unchangeable parameters with information about the name of the information storage file, the values of the pin numbers that control the LEDs, the pin numbers for processing information from the weight sensor, and string values for working with voice commands. The command reader module represents a set of methods that is responsible for reading voice commands directly through the microphone and converting voice commands into

text strings. The text parsing module provides a set of methods that converts text strings into a set of parameters that the program can understand. It also prepares information for recording in an Excel file for storage.

The electronics control module includes two main blocks of code: an LED control unit and a weight sensor reading unit. The LED control unit contains methods for displaying a specific cell, as well as for displaying an indication of an error and removal of a radio component from the cell. The weight sensor reading block contains methods for tracking changes in the weight of the system, as well as a method for processing user clicks to activate the system. The module for working with Excel files contains methods for working with stored information. These are methods for searching, adding, deleting and changing the number of parts.

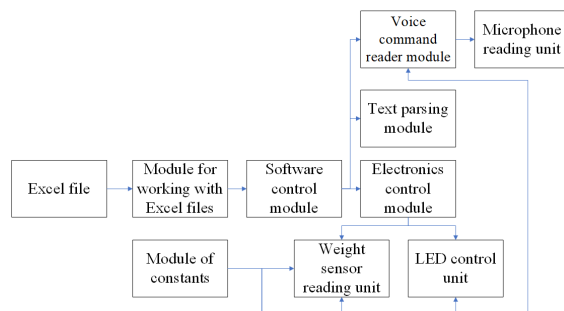


Figure 2 – Software structure

For the correct operation of the application, as well as to fill it with information, a storage file is also used, which is an Excel file consisting of one table with dimensions N by M cells, which corresponds to the dimensions of the physical model of the storage rack, where N is the number of shelves of the rack, M is the number cells (containers) on the shelf of the rack.

Each table cell in an Excel file can contain an unlimited number of records. Each entry is a structure consisting of the name of the stored parts, a colon and a space sign, and a number indicating the number of radio parts. If there are several records in a table cell, they are separated by a line break. All this allows you to use the file not only through voice control of the software, but also in manual mode.

II. CONCLUSION

A software and hardware intelligent system for storage and inventory control of radio components for enterprises has been developed, which can easily be scaled and adapted to the specifics and needs of various enterprises and will automate and facilitate this process.

BIBLIOGRAPHY

1. 3d-diy.ru. [Electronic resource]. – Access mode: <https://3d-diy.ru/wiki/arduino-platy/obzor-plat-raspberry-pi/>. Access date 10.10.2023.