Development of Automatic System for Apiary

https://doi.org/10.31713/MCIT.2019.64

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Abstract— **The basic stages of development of the remote automatic control system of apiary are given. Stages of development are suggested. Measurement methods are presented and analyzed. The choice of measuring instruments is made.**

Keywords— apiary, temperature, humidity, air quality, microprocessor device, automatic measurement, automatic control.

I. Introduction

To date, automation is one of the areas of scientific and technological progress that aims at the use of self-regulating technical means, economic-mathematical methods and control systems that release a person from the process of obtaining, transforming, transmitting and using energy, materials or information, reduce the extent of this involvement or the complexity of the operations performed. In order to facilitate people's work, automation is being done in various industries, agriculture and everyday life. Among all areas of interest is the installation of apiary management system that will automatically measure the temperature inside the hive, humidity, weight, monitor the amount of bees and carbon dioxide and send data to the server, so that the user can leave the house without knowing the state of the system.

The use of various sensors in the development of a device allows you to systematically obtain the necessary data on the operation of the system. Therefore, the accuracy of the measured values and the ease of use of the devices is important for proper control of the system. Many different sensors of temperature, humidity, weight, etc. are manufactured in the industry, but not all of them meet the requirements that apply to them. Therefore, ensuring the improvement of the operational and quality characteristics of a system for measuring and developing accessible and reliable is important and relevant today. All measuring instruments that will be used to control values should have high metrological characteristics and be easy to use. Automatic measurement of the required physical quantities in beekeeping is an important process as it will allow you to monitor the system remotely and also to control the measured parameters. With the help of specially installed sensors that are programmed to send data to a secure server on the Internet, the beekeeper can monitor the apiary from the comfort of his home. An authorized user can view the status of the hive at any time from a computer or mobile device. This system will allow you to track the efficiency of the apiary..

II. The purpose of the article

Development of a remote monitoring and control system of apiary.

III. Main Material

The beekeeper should be able to adjust the temperature in the hive at any time of the year. The optimal for the development of breeding - within plus 35 degrees. This is the temperature maintained by the bees themselves on most brood cells. Up to +34 0C, the temperature drops only at the edges of the cells. Breeding develops at a temperature of +32 degrees, but its development time increases. It is established that from the brood that develops at a temperature of + 28-31 degrees, the adult bees bred may have underdeveloped limbs - wings, legs and proboscis. A temperature below +26 degrees is not sufficient for breeding, which is also harmful above normal. Bees maintain the temperature in the hive, depending on the internal temperature and the temperature of the outside air. The individual body temperature at which they normally perform all the work ranges from 25 to 35 degrees. At a bee body temperature below 15 degrees, it loses its ability to fly. And if it gets colder in the hive, it dries. Maintaining a normal temperature and regulating it accurately and timely are extremely important for the normal life of bees [1].

Humidity in the hive is also very important. The internal relative humidity may be lower than or greater than the outside humidity. Moreover, the daily fluctuations in the relative humidity inside the hive are in contrast to the relative humidity of the outside air. It is interesting that in the daytime at a temperature of 17-25 ℃ and relative humidity of the outside air from 40 to 60% inside the hive, it is 48-84%, at night at a decrease in the temperature to 7-11 ° C and raising the relative humidity of the outside air to 90— 100% humidity in the nest is reduced to 30-60%. During winter, the bottom and walls of the hive, honeycombs, feed stocks, etc. are cooled and condensation is formed when cold and warm air collide. After reading the literature and analyzing it, it was determined that high humidity in the nest of bees is 90%, low - 20-25%, optimal for the development of the bee family ranges from 65-88% [2], [3].

Development and research of the proposed system of regulation is realized by the following algorithm:

1. Study of the life of bees to determine controlled parameters;
2. Determination of parameters of regulation of a beehive;
3. Selection of controller and sensors for implementation of the control system;
4. Development of the structural scheme of the pilot plant;
5. Programming of boards and sensors;
6. Definition of experimental research data.

The parameters of the automatic apiary adjustment system will be controlled using sensors (temperature, humidity, strain gauge, air quality and highway counting of bees), microprocessor board based on Espressif ESP8266 microcontroller and QAPASS1602A display.

After analyzing the means and methods of temperature measurement for the implementation of the instrument for measuring the temperature of small objects, a thermoresistive measurement method was chosen, which is based on the thermal change of the electrical resistance of a conductor or semiconductor. The principle of operation of thermosetting primary converters is based on the use of the property of change of electrical resistance of materials in the function of temperature change. For creation of thermosistive primary converters, materials with significant specific electrical resistance, high stability of temperature coefficient of electrical resistance, high reproducibility of electrophysical parameters, stability of chemical and physical properties during heating and inert to influence of the studied environment are used.

One of the most common methods for determining air quality is gas analyzer analysis. These are electronic devices consisting of a microcontroller / display / buttons and several or at least one sensitive element - a detector. Most often, the detector is a semiconductor device whose voltage-ampere characteristic depends on the concentration in the air of a particular substance. But this is not achieved due to the properties of the semiconductor itself, but due to the special chemical treatment of its surface, resulting in its electrical properties change dramatically in the presence of a certain substance.

Moisture measurement will be carried out with a hygrometer, the basis of which is a hygroscopic polymer film, on both sides of which are porous metal electrodes forming a capacitor with a capacity of about 500 pF. When the water molecules absorb a film of water, the volume of the film increases, the distance between the electrodes also increases, which leads to a change in the capacitance of the capacitor.

A capacitive hygrometer is used to measure relative humidity. The advantage of the device is its compactness (the dimensions of the device are 6 mm2), a weak dependence of the results of measurements on the outside temperature, the linearity of the scale in the range of 0-80% relative humidity, speed, small values of hysteresis. Hygrometers of this type are used in automated humidity control.

To measure the weight of the hive we use a load element (electronic sensor for measuring the weight and strength). When applied to the output, a weak electrical signal at the millivolt level appears on its output wires. It converts the power into a measurable electrical output. The load element consists of a metal core and a set of electrical resistances, which are converted when force is applied to it. But after removing the force, it returns to its original state. The reversibility of this material determines the quality and accuracy of the load element.

After building up the control system based the function algorithm was designed. Description to the algorithm:

- Connecting required libraries and defining variable names.
- Description of the variables used.
- Adjust the serial port speed, input and output peaks.
- Obtaining data on system operation.
- Send information to a secure server on the Internet.
- Get and display the distance on the screen.
- Organization of closed measurement cycle.
- Repeat cycle.

IV. Conclusions

The analysis on the development of automation in the field of beekeeping, methods and devices of measurement indicates the need to develop and research new inexpensive means of measurement and improvement of existing systemsIn this article the system of automatic apiary management is proposed, the algorithm of creation of the system is developed, the methods and means of measurement are investigated, it is shown that accurate and timely regulation of all parameters is extremely important for the growth and development of bees, as well as for the normal functioning of the system. Therefore, when creating an automatic microprocessor system for measuring apiary parameters, it is necessary to respond in time to changes in temperature and other environmental values in order to manage the system in a timely, accurate and qualitative way..

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