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Bee Hive Status Control System

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ABSTRACT

Nomadic beekeeping, one of the branches of honey production, requires the presence of hives in different places at different times of the year. Adapting to the difficult conditions of nomadic beekeeping forces the living conditions and standards. With the help of today's technology, it is necessary to continue this profession more easily and prevent the opposite situations in the nomadic beekeeping sector. This study can be followed up at certain intervals from distant distances. The information that will be received through the sensors in the Hive and from the environment will be sent to the central system through radio frequency waves and the information that will be analyzed will be transmitted to the user via SMS. The bee hive, which is far from the hive farm, will have information about the hive. This will make nomadic beekeeping more efficient.

KEYWORDS: *Arduino, beekeeping, communication*

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1. INTRODUCTION

When the beekeeping sector in the world is examined, we see that the yield is higher than in Turkey. As the reasons for this, it is seen that beekeeping is not done professionally in our country and bee production does not take the necessary dedication. It is seen that communication has become very important in today's technology. Despite this communication technology, it is seen that the bee industry does not benefit from this technology. It is seen that a large part of the agriculture and livestock sector in Turkey does not use technology actively. In particular, there is no solution sought for the problems of nomadic beekeepers or beekeepers with a small number of beehives. It is aimed to increase the efficiency in production by using today's communication technology to the problems in this sector with low cost and to provide convenience to people who make beekeeping and honey production with this technology. With this system, it is aimed that the nomadic beekeepers can follow the hive very easily and higher profits at low cost. Being a system that can be used for many years, the manufacturer does not continue to spend any money in terms of cost and the system works with an easy logic, which will also provide reliability for the manufacturer. In addition, the system can be used in the agricultural sector if desired (Anonymous, 2012).

In line with the studies carried out, it aims to take precautions by communicating with nomadic producers with their hives. It is aimed to compare the situation by measuring the humidity and temperature for the hive. This is an important condition for hive productivity.

Beekeeping; It has a very important position in animal activities because it provides income in a short time and can be done with little capital without being dependent on a certain land asset. Because of the low operating costs in beekeeping, less labor required compared to other production branches, and the fact that the products can be easily preserved and sold at a price, it provides employment, income and healthy nutrition opportunities to the rural population in developing countries (Koçak, 2018; Seğmenoğlu, 2018). One of the most important tools and equipment used in beekeeping is hives, which are indispensable inputs of beekeeping. Bees use tree and stone cavities as shelters under natural conditions. However, with the development of beekeeping as an agricultural activity, bees have been taken to different shelters by

humans. In the development process of beekeeping, bee shelters have been developed and reached today's modern hives (Anonymous, 2018). An example of a modern hive is shown in Figure 1 with its dimensions.

Figure 1. Beehive and its dimensions

The relationship between the number of hives and honey yield per hive is given in Table 1. The number of enterprises with the number of hives between 151 and 250 is 28.2%. In the enterprises with the number of hives 251-350, the number of enterprises with an efficiency of over 45 kg is 4.5%. The number of enterprises with a yield per hive between 26-44 kg constitutes the weight with 63.6%. The reason for this is that these people do not see beekeeping as a second job, they carry out beekeeping activities professionally, and they gain more efficiency per hive by using their experience and knowledge in beekeeping (Öztürk, 2013; Semerci, 2017).

Table 1. Relationship between number of hives and yield per hive (Öztürk, 2013; Semerci, 2017)

Number of Hives (Piece)		Yield per Hive ≤25	26-34	35-44	≥45	Total
≤150	N	5	12	9	5	31
	%	4.5	10.9	8.2	4.5	28.2
151-250	N	5	8	9	9	31
	%	4.5	7.3	8.2	8.2	28.2
251-350	N	2	10	9	5	26
	%	1.8	9.1	8.2	4.5	23.6
≥351	N	2	5	8	7	22
	%	1.8	4.5	7.3	6.4	20.0
Total	N	14	35	35	26	110
	%	12.7	31.8	31.8	23.6	14.5

Koçak (2018), using fuzzy logic with Arduino, designed a system for remote monitoring and control of beehives. In this study, the monitoring and control of the temperature and humidity in the hive was provided. The aim of the study is to increase honey yield and reduce the negative effects of air and humidity on bees.

Özkul (2014), a beehive was designed with a PIC controlled thermoelectric module in order to improve the living environment of bee colonies and to strengthen the colony, in the study of keeping the internal temperature of the beehive stable with a PIC-controlled thermoelectric module.

Kaya (2007), This research was carried out to determine the effects of overwintering honey bee colonies with empty honey on top, on temperature and relative humidity, which are the most important parameters inside the hive.

2. BEE HIVE STATUS CONTROL SYSTEM

Arduino, Sim800l GSM module, RF wireless transceiver, temperature, humidity and rain sensor, solar panel, battery are used to provide humidity and temperature control in the beehive designed with Arduino.

Two different systems were used in this study. In the system in the hive, 2 sensors were used to measure the temperature and humidity inside the hive. The data received from these sensors will be sent to the main system by RF transmitter. The data subject to control in the main system will send an SMS, which will inform the user with the Sim800l GSM module. A warning message will be sent when any hive is disconnected from the main system. Figure 2 shows the hive control system flow diagram.

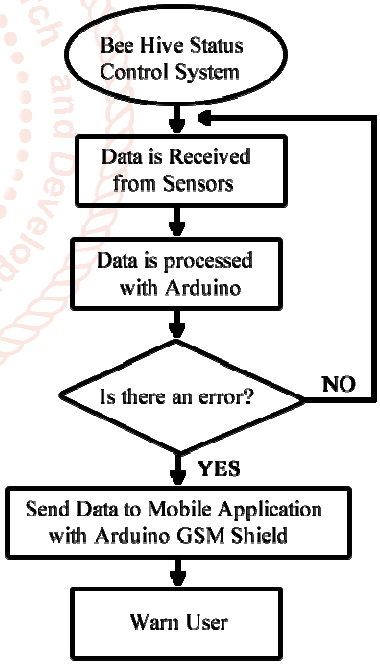

Figure 2. Beehive status control system flow diagram

The solar panel is placed on the cover of the main system to meet the electrical energy requirement of the system. The energy taken from the panels will be stored in the 12V battery. The system will be powered from the battery. The system in the hives will be fed with a 9V battery. To fix the power problem, the arduino will run in power saving mode.

The hardware of the beehive status control system consists of two separate systems. hive system; It is an arduino system with sensors and a radio frequency

transmitter powered by a 9 volt battery. central system; It is the system where the radio frequency receiver and gsm module are located. The battery fed by the solar panel is the power source of the central system. These two systems communicate with radio frequency transceiver at certain periods.

The beehive system is the system that has been thought for every hive. Arduino uno controller is used in this system. Necessary connections of temperature, humidity and rain sensors have been made in order to receive data from the hive. The received data will be sent to the central system by radio frequency transmitter. It is powered by a 9 volt battery. The designed system prototype and connections are shown in Figure 3.

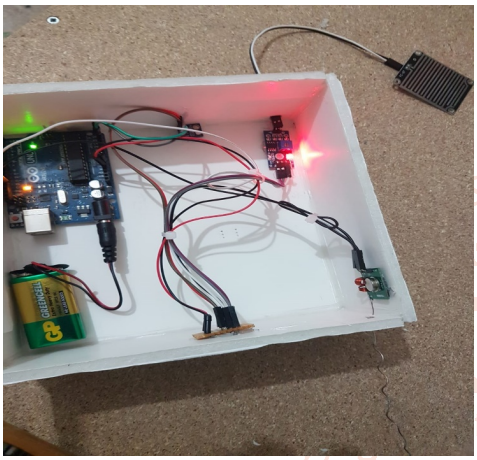

Figure 3. Beehive system prototype

The central system is the information collection point in the hive field and the system that is planned to send this data. The system, which will read the information in the Arduino mega with the radio frequency receiver, is coded to send an information message at the intervals determined by the GSM module. In this system, the solar panel charges the battery. A diode connection is made to prevent reverse current from the battery to the panel. In order to be able to feed with a 12 volt battery, the voltage is reduced to 6 volts with the regulator. Figure 4 shows the prototype of the central system and its connections.

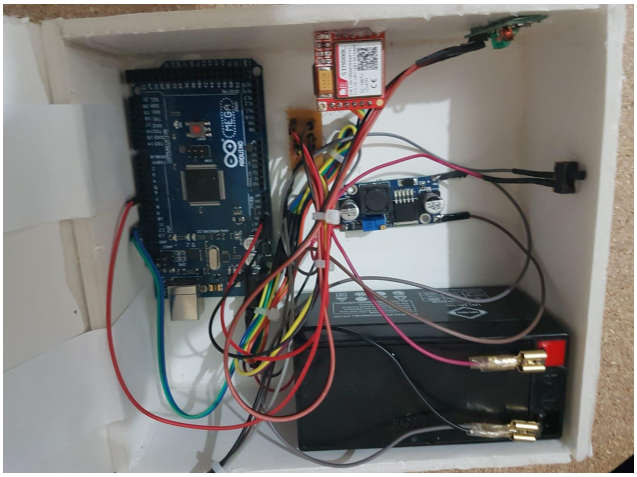

Figure 4. Prototype of the central system

Temperature, humidity and rain conditions are sent in the message sent with the gsm module. The content of the message sent is shown in Figure 5.

Figure 5. Notification message

The aim of the hive design, in which temperature and humidity values are reached using communication with Arduino, is to facilitate the follow-up with a cheap system and to minimize the follow-up cost. Long-lasting and high-quality data transmission of the temperature and humidity sensors to be used in the hive system designed with Arduino uno is important for the stable operation of the system. It is important to design suitable for the hive in order to use the sensors for a long time in production. In order to increase the efficiency in production, it is necessary to monitor the humidity and temperature values in order to examine the natural events, observe the climatic conditions and take precautions against the diseases. Humidity and temperature values are important indicators for a healthy production of hive fields. In order to monitor the data received from the sensors, information is provided to the manufacturer from the system at certain periods. The system allows time for the manufacturer to take necessary measures according to the information flow during the follow-up of the data. Beehive status control system diagram is given in figure 6.

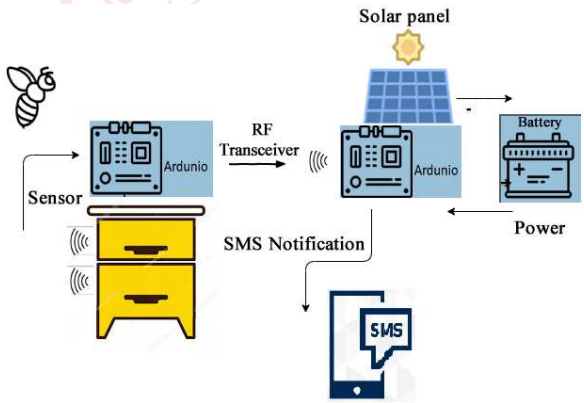

Figure 6. Beehive status control system diagram

In the studies carried out, the hive automation was carried out in order for the bees to produce honey under more suitable conditions. It generally appeals to fixed producers due to the development of a separate control system for each hive and the problems that the system will cause in integration with the hive. As shown in the beehive status control system diagram in Figure 6, the overall system is built on a star topology. After the beehive systems around the central system collect the data in the hive via arduino and sensors, the rf transmitter will send the data to the central system

by modulation. By applying the RF receiver ask demodulation process in the central system, the received data will send an information message with AT commands to the number registered via the sim card inside the sim800l module at 12 hour intervals.

Figure 7. The designed hive

In Figure 7, the designed hive and systems are shown. Framed modern hives are used for reasons such as higher efficiency than modern hives, ease of working in the care and feeding of bees, and ease of bee transport for wandering beekeepers. When the system is integrated into the beehive, it should be placed in a way that does not disturb the bees.

In order for the system to be long-lasting and usable, the power supply of the central system was met with a solar panel among renewable energy sources. The solar panel connected to the 12 volt battery charges the battery. 12 volts is reduced to 5 volts with the regulator. Thanks to the reduced voltage, connection to the arduino mega can be made. The beehive system is powered by a 9 volt battery. Thanks to the regulator on the Arduino uno, the voltage is reduced to 5 volts. With these feeding methods, the system has been made continuous. Making a separate system for each hive and consuming too much power for control requires a separate power supply for each hive. This makes the system costly. Since the star topology system is used, the cost of the system is reduced and the continuity and reliability of the system are increased.

3. CONCLUSIONS

This study should be tried in different regions so that people who are wandering and nomadic beekeepers can follow their hives, and this study should be expanded in line with the wishes of the producers. In order to monitor the status of the hives of the mobile beekeeper producers, instead of going to the hives in different regions and analyzing them, they are always supervised from a distance. This situation reduces the insecurity problem of the producer and makes his work easier. With the designed system, the producer, who can remotely analyze the temperature and humidity inside the hive, can intervene earlier and increase efficiency. The fact that the temperature and humidity values in the hive can meet with the manufacturer at certain periods makes the system a long-lasting system with low cost and useful for manufacturers.

In this study, communication was made between the hive control system and the central system in order to reduce the cost. The fact that it can be added to the system according to the number of hives increases the applicability of the system in terms of cost.

The easy integration of the system on the hive makes it possible for the beehives in use to be included in the system easily. With the expansion of the system, it will be seen that the travel costs of the producers who do this work as mobile and nomadic in honey production will decrease, the income level will increase and the amount of honey production will increase. In fixed hive farms, its use should be expanded since the situation inside the hive can be monitored. Thanks to the rain sensor, the number of rainy days in the region can be monitored and its suitability for beekeeping can be checked. In case the hive is knocked down or the connection is broken, the manufacturer can react more quickly to this situation as information cannot come from the hive. Since the system is powered by solar panels, panel selection may vary from region to region. Depending on the situation of the region, wind energy can also be used. It is thought that the usability of the hive can be increased by adding various sensors to the designed system.

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