STUDIA UNIVERSITATIS BABEȘ-BOLYAI
Engineering 65(1) 2020 doi:10.24193/subbeng.2020.1.18

Model of microprocessor centrifugal equipment for honey extraction

Eugen Răduca, Mihaela Molnar*, Nicolae Titu Fara

The paper presents a model of centrifugal equipment for extracting honey made around an ATmega 328 processor, with which the Arduino Uno module is equipped. The created model is functional, being tested, and the practical results obtained would allow the transition to prototype equipment. The created model is flexible, allowing to obtain flexible operating cycles, with variable speeds, soft settable, in both directions of rotation. The number of frames from which the bee honey can be extracted is variable depending on the juicer itself, which is driven by the motor.

Keywords: *model, extraction, honey, microprocessor*

1. Introduction

Honey is a natural product of honey bees, with remarkable properties, recognized and certified, used both in direct feed and in other areas of human importance, such as: food industry, curative medicine, aesthetic medicine, etc.

Honey is a bee product obtained by processing and processing nectar by bees and stored in honeycomb cells to feed the hive population. Obtaining honey is the main purpose of beekeeping today and in the past. Depending on the origin, the honey can be:

Flower honey - it is also called floral honey, which is made by bees by processing nectar and pollen from flowers;

Manna honey - also called extra floral honey or forest honey, is made from other substances derived from plants (sap from the leaves of trees such as pine, spruce or oak). It is darker in colour than flower honey, having strong antiseptic properties.

After the flowers from which the nectar was collected, in our country it is obtained:

Acacia honey; Linden honey; Rapeseed honey; Sunflower honey; Polyfloral honey (sometimes also called wildflower honey).

Regardless of the origin of the honey, it can be extracted by several techniques: Extraction of honeycomb pieces; Free flow from the honeycomb; Extraction by centrifugation; Honeycomb pressing; Melting honeycombs with honey.

Of these techniques, centrifugal extraction is the most widely used due to its advantages.

Extraction of honey, using centrifugal force, involves the introduction of honeycomb frames into a container of equipment, which rotates in both directions, with controlled speed and duration, depending on the characteristics of honey and environmental conditions (temperature). The rotation of the container can be done mechanically, manually, through a reducer, or electrically, using a drive motor. The container in which the honeycombs are deposited is usually made of stainless steel. In the container can be deposited 3-4 honeycombs with honey. The honeycombs in the hive have different sizes being in accordance with the type of hive used by the beekeeper. Depending on how the combs are positioned in the container, it can be radial or tangential. In Figure.1 are given two industrially produced equipments.

Figure 1. Industrially produced honey extraction equipment
a) manual b) electric

2. Model of microprocessor centrifugal equipment for bee extract

2.1. Block diagram of the model made

The block diagram of the equipment designed and made practically (of the model) is given in Figure 2, being composed of the following blocks:

BAl - Power supply unit
BCC - Command and control block
BAc - Drive block
BAf - Display block
REM - Honey extractor container

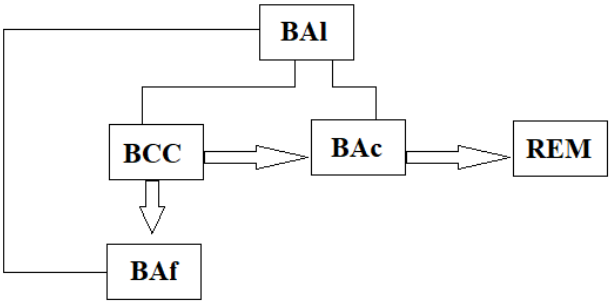

Figure 2. Block diagram of the model made

2.1.1. Power supply unit

The equipment is supplied in single phase from the national electricity network. In essence, the power supply is composed of a low-voltage transformer with several secondary windings that supply the voltages, subsequently rectified and filtered [1] used for the command and control, actuation and display blocks, respectively.

2.1.2. Command and control block

The command and control block is implemented with an Arduino Uno card [2], having as central unit the ATmega 328 P processor, is given in Figure 3. The program based on which the necessary functions and commands are performed is presented in [3], and the meaning of the Arduino Uno card pins this module is connected to the other blocks in the equipment is given in Figure.4, details being presented in [4].

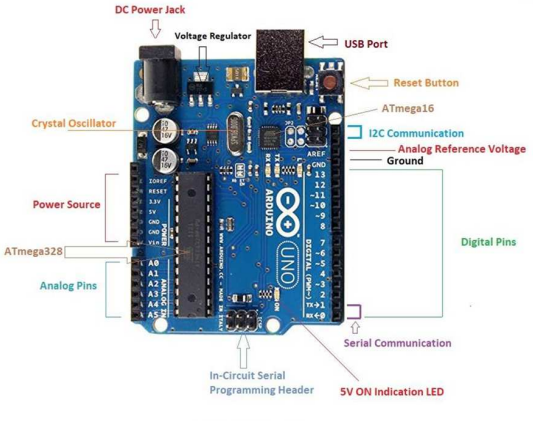

Figure 3. Arduino Uno card

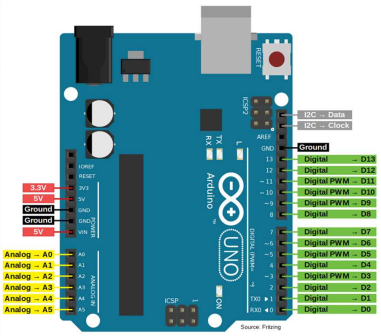

Figure 4. Arduino Uno card pins

2.1.3. Drive block

The drive block is a direct current unit having as load a direct current motor coupled to the vertical axis of the honey extractor container.

The drive block has variable voltage up to 30V, current up to 15 A and 400 W power for DC power supply is obtained through a PWM module (Figure.5) compatible with the Arduino system, equipped with two MOS transistors type BA7U2 [5].

The polarity change at the terminals of the DC motor is done by a module containing two independent relays (Figure.6), provided with protection diodes connected in antiparallel with the coils that can be controlled by optocouplers, for galvanic isolation from the control device (Arduino Uno board). Since the coils are supplied via a control circuit, the mode needs a supply voltage for it (5V). The actuation of a relay is signalled by the lighting of the corresponding LED.

Each relay has a normally closed contact (NC) and a normally open contact (NO) with respect to the common point (COM) and by properly connecting them in the circuit the reversal of the polarity of the supply voltage of the electric motor is obtained. Only one relay will be ordered for each direction of rotation [6].

Given the 400 W power at the output of the PWM module and the current on the 10A relay contacts, no changes in the wiring diagram are required when operating a normal-sized container, except for the DC motor to be chosen according to the load on which must drive it (normal size container).

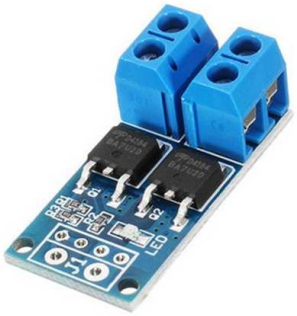

Figure 5. PWM module

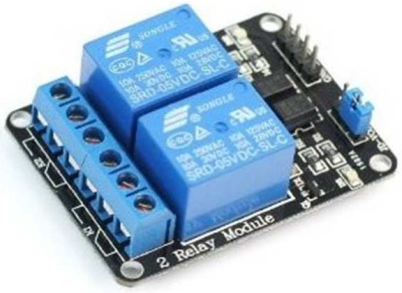

Figure 6. Two-relay module

2.1.4. Display block

An LCD1602 [7] display is used to display the messages generated by the Arduino Uno card, referring to the state of the installation according to the stages of the program installed in the memory (Figure 7). The adaptation between the Arduino Uno card and the display [8] is done through the I2C adapter module (Figure 8).

Figure 7. Display type LCD1602

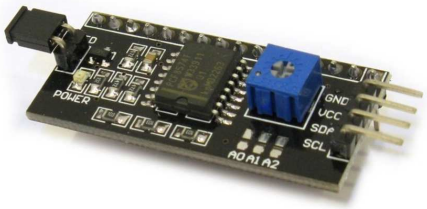

Figure 8. I2C LCD1602 adapter

2.1.5. Honey extractor container

The radial honey extractor container, for 4 frames, is made of sheet metal on a small scale of 5: 1, and can be seen in Figure 9.

Figure 9. Model of centrifuge container made

2.2. Model of centrifugal equipment with microprocessor for bee honey extract made

The realized model is in Figure.10, where it can be observed that on a support plate are arranged the modules indicated in block diagrams from Figure.2. In addition, a series of clamps for connections between blocks can be seen. The electric DC drive motor is not directly visible as it is located under the extractor container.

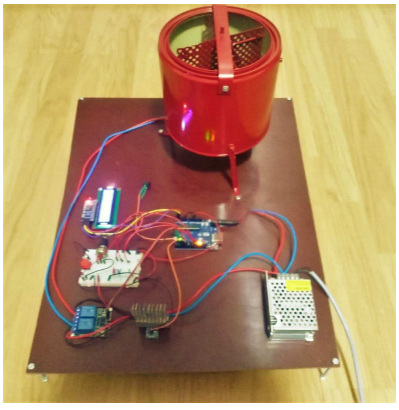

Figure 10. Model of centrifugal equipment with microprocessor for bee honey extract made

3. Tests and experiments

Given the existing experience in the field as well as the experience of the authors, it was established that the proposed model should carry out the process of extracting honey in three stages: in the first and third stage it rotates directly for 15 seconds and in the stage of the second centrifuge rotates counter clockwise for 20 seconds. As specified the speed can be adjusted in each of the 3 stages.

The maximum measured speeds obtained were 144 rpm for the direct rotation situation and 180 rpm for the reverse engine rotation.

4. Conclusions

The model will be used to make a 1: 1 scale installation, when a larger container driven by a suitable power motor will be used.

Instead of the container for 4 radial frames, one for 3 frames or a tangential extraction container can be used. Of course, if the type of container used is replaced, its maximum rotational speeds will be adjusted, the change being more significant only when switching: radial type - tangential type.

The mechanical reducer, used in the case of manual juicers, can be removed. The equipment is flexible, programmable and does not significantly charge the cost price compared to an existing electric extractors. The equipment has the technical characteristics in accordance with the legislative ones.

References

[1] Răduca E., *Electronică aplicativă*, Editura Orizonturi Universitare, Timisoara, 2010.

[2] https://www.theengineeringprojects.com/wp-content/uploads/2018/06/Introduction-to-Arduino-UNO.jpg (downloaded at 2020).

[3] Fara N.T., *Model de automatizare a unei centrifuge de stors miere,* Dissertation Paper, "Eftimie Murgu" University of Reşiţa, 2020, pp. 44-50.

[4] https://diyi0t.com/arduino-uno-tutorial/ (downloaded at 2020).

[5] https://ardushop.ro/2506-thickbox_default/modul-comutator-pwm-de-putere.jpg (downloaded at 2020).

[6] https://ardushop.ro/158-thickbox_default/modul-releu-2-canale.jpg (downloaded at 2020).

[7] https://ardushop.ro/134-thickbox_default/lcd-1602.jpg (downloaded at 2020).

[8] https://ardushop.ro/226-thickbox_default/modul-i2c.jpg (downloaded at 2020).

Addresses:

- Prof. Dr. Eng. Eugen Răduca, Babeș-Bolyai University, Faculty of Engineering, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, e.raduca@uem.ro
- Assist. Prof. Dr. Eng. Mihaela Molnar, Babeș-Bolyai University, Faculty of Engineering, Piaţa Traian Vuia, nr. 1-4, 320085, Reşiţa, m.molnar@uem.ro
  (**corresponding author*)
- Eng. Nicolae Titu Fara, TMK Reșița, Str. Lalescu Traian, 36, Resita, fara.nicolaetitu@yahoo.com