Design a bee calling tool using a caller voice and honey scent based on arduino and the blynk application

A Thoib, R Kurniawan* and T H Budianto
Department of Electrical Engineering, Faculty of Engineering, Universitas Bangka Belitung 33172, Indonesia

*E-mail: rudy@ubb.ac.id

Abstract. Bees have the characteristics of always moving and will settle in one place because of the source of nectar. Bees use smells (pheromones) as a means of communication. In addition, bees also communicate through body movements called dances waggle and have a frequency range of 200 Hz - 300 Hz. Communication on bees serves to contain information about what will be done by a bee colony. Therefore the authors assume that honey bees can be called. So it is necessary to design a tool that can summon honey bees using the caller's voice and the aroma of honey. The tool is controlled using Bluino and the Blynk app. The test was carried out using the caller's voice in the frequency range of 265.9 Hz – 297.2 Hz which was obtained from the sound recording process in the bee colony Apis cerana, so the focus of this research was the process of calling bees Apis cerana. The aroma used is the aroma of resisting honey, the aroma of sugar water, and the aroma of bee attractants. From the results of testing using three kinds of scents for 7 days, the number of bees is called as follows. The aroma of honey against 837 tails, the aroma of sugar water 758 tails, and the aroma of attractant bees 118 tails. Based on the results of the study, the bee-calling device using the aroma of resisting honey was more dominant to use.

1. Introduction
Apis cerana in Indonesia is better known as the fly bee. These bees can be bred simply with glodok or in a modern way in stup. Colonies of local bees (Apis cerana) are usually found in stone holes, wood holes, and also in abandoned mouse holes. Bees use smells (pheromones) as a means of communication, a sign of danger to the bee colony also uses pheromones. Bees and other insects are very fond of flowers. So, when using a fragrance with a floral scent, insects will approach because they think there are flowers in the vicinity [1]. The queen bee plays an important role as an egg producer and as a source of pheromones, one of the chemical compounds used as a communication tool in honey bees that contains information about what a bee colony will do or what behavior to do when facing conditions outside the colony [2].

Good communication between bees through body movements that are easily understood by others. This communication is known as the bee dance [3]. Communication between bees, regarding the quality of food sources, takes place in the dancing area. The dance is called the waggle dance [4]. During the phase waggle, the dancer moves his body in motion waggle 15 Hz While vibrating his wings in short pulses (20 ms duration at frequencies ranging from 200 Hz to 300 Hz [5]. The waggle sound is a pulsating sound, with pulses 20 ms long at a frequency of 250 –300 Hz [6] Worker piping can precede and occur during "hissing", the acoustic signal emitted by worker bees during swarms and times of distress. Hissing has a very large fundamental frequency range between 300 Hz and 3600 Hz [7].
Based on the statements in previous research, it is known that bees can communicate using pheromones and dance waggle. In this case, the authors assume that honey bees mean that they can be called, where pheromones can be interpreted as an scent that functions to call bees. Dance Waggle which has a frequency value certain functions also function for communication between bees or referred to as the caller's voice, the authors want to design a tool that functions to call bees in this study with the title "Design of a Bee Calling Tool Using a Caller's Voice and Honey Scent Based on Arduino and the Blynk Application" which aims to call bees to enter the tool designed in the form of a glodok/stup beekeeping which is equipped with electronic components such as Bluino, Sensors, and others as well as monitoring remote using the Blynk application with the hope that in the future it can be used as a tool for beekeeping.

2. Methods

Figure 1 is a block diagram of the bee calling system using the caller's voice. This system device is a general description of the entire electronic circuit to be built. Infrared Sensor serves to count the number of bees that are called. The number of Sensors Infrared used are two, where the first is to detect the summoned and counted bees which are displayed on the I2C LCD. Then Infrared sensor the second to detect the summoned and counted bees displayed on the Blynk application. In addition to displaying the number of bees summoned, the I2C LCD and the Blynk application also display temperature and humidity values. ESP8266 serves to connect the Blynk application with the IoT bee calling system. The SD Card Module is used to store bee caller voice recording (.WAV) files and as a bee caller voice input on Bluino. The caller's voice output is on the speaker and the frequency of the caller's voice is adjusted using a Mini Amplifier. The value of the output sound frequency on the speakers is measured using the application Audio Frequency Counter.

Figure 2 is a block diagram of the work system for summoning bees using scent. This system device is a general description of the entire electronic circuit to be built. The function of the Infrared sensor, Sensor DHT11, ESP8266, and Blynk is the same as the explanation in Figure 2. The relay is controlled using the Blynk application by pressing the ON/OFF button so that when it is in the ON condition, the LF Dynamo rotates and presses the scent which functions to summon bees and vice versa when the condition is ON.

3. Results and Discussion

3.1 Tool design results

Figure 3 shows the shape of the design of the bee-calling device using a caller's voice which has a length of 40 cm, a width of 25 cm and a height of 20 cm. The main box is attached to the tool so that it is side by side. Figures 3 (a), (b), and (c) respectively show the front view, rear view and top view of the main
tool and box. Numbers 1, 2, and 3 respectively show the tools, the main box and the bee's entrance. Figure 3 (d) shows the rear side view of the tool and the main box and there is a voltage source marked number 4. Figure 3 (e) and (f) shows the front view of the tool in the open position and the front view of both when enlarged. Figure 3 (g) shows the right-side view of the main box and sequentially marked with numbers 5, 6, 7, 8, 9, and 10 are LCD, play/pause button Next, button, button previous/back, Mini Amplifier and Button reset. These buttons function to adjust the caller's voice. Figures 3 (h) and (i) show the right-side view of the tool and the top view of the tool in the open position. Numbers 11, 12, 13, and 14 respectively show the layout of the Infrared Sensor, DHT11 Sensor, Speaker and Microphone on the device.

**Figure 3.** Display stup / glodok bee caller using the caller's voice.

**Figure 4.** The appearance of the bee-calling device using the caller's voice and the main box as well as the layout of the tool components.

Figure 4 (a) shows the view in the main box and sequentially marked with numbers 1, 2, 3, and 4 are LCD, Bluino, SD Card Module, and Relay. Figures 4 (b) and (c) show a front view and a rear view of the tool. Numbers 6, 7, 8, and 9 sequentially show the layout of the components on the tool, namely the Sensor Infrared, DHT11 Sensor, Microphone, and Speaker. Figures 4 (d) and (e) show the inside view of the right and left sides of the main box so that the layout of the tool components can be seen. Number 5 indicates the Bluino voltage source cable. Figure 4 (f) shows the layout during testing. Numbers 10, 11, and 12 sequentially indicate bee Stup Apis Cerana, Main Box, and Tools. Figures 2 (g) and (h) show the rearview and the rear side view during the test. Number 13 indicates the voltage source used when testing. Figure 4 (i) shows the right-side view of the main box during testing. Sequentially the numbers 1, 14, 15, 16, 17, and 18 show the LCD in the ON position, the play/pause button, the next button, the button previous/back, the Mini Amplifier, and the button reset.

Figure 5 shows the resulting shape of the design of a bee-calling device using a scent that has a length of 40 cm, a width of 25 cm, and a height of 20 cm. The location of the components of the bee-calling device using the designed scent can be seen in Figure 6 below.

Figure 6 shows the placement of the tool components, the name of each part of the tool, and the position when testing the bee-calling device using scent. Part (a) shows an internal front view of the bee-calling apparatus. Visible Sensor Infrared facing the bee door hole in and out (number 1) and shows the shape of the holder frame/comb(number 7). Part (b) shows an inside view of the back of the appliance. The picture shows the position of the frame/comb (number 7), the position of the Dinamo Line Follower and the scent spray (number 2), and the position of the DHT11 Sensor (number 3). Section (c) shows the position of the bottle containing the scent liquid (the scent of resisting honey, the scent of sugar water, and the scent of bee attractant) under the stup/glodok of the tool which can be refilled by turning left and right to open and lock (number 4).
(a) : Form of stup / glodok bee calling device using scent.
(b) : Without cover.
(c) : Back view.
(d) : Open state.
(e) : The right-side view is upside down.
(f) : Right-side view.
(g) : Top view is open.
(h) : Left side view.
(i) : Front look.

Figure 5. Display of the stup/glodok of a bee-calling device using scent.

Figure 6. The appearance of the bee-calling device using the scent and the main box as well as the layout of the tool components.

Figure 6 part (d) clearly shows the position of the Sensor Infrared which is facing the horizontal in and out of the bees (number 1) and the shape of the drilled bee in and out hole is in the form of a circle with a diameter of 2 cm (number 5). Section (e) clearly shows the position of the Dynamo Line Follower and the scent spray facing the front of the bee entrance and exit holes (number 2) and the position of the DHT11 Sensor (number 3) which is under the frame/comb mount. Section (f) shows the main box containing controller components such as Bluino, breadboard, Power bank, Andromax WiFi, Relay, ESP8266 ESP-01, LCD I2C, Mini Amplifier, Push Button, and SD Card Module.

Figure 6 section (g) shows a top view of the tool and the arrangement of frames/combs (number 8). Section (h) shows the position of the wiring for connecting the tool to the main box (number 6) during
the testing process. Section (i) shows the inside view of the main box. Part (j) shows a bee-calling device in an inverted position and a scent bottle appears. Section (k) shows the front view of the stup/glodok that already contains a colony of bees that will be called during the test and the shape of the entrance and exit of the bees (number 8). Part (l) shows the front view of the tool that uses the scent of resisting honey and the landing/take-off places (number 9) and entrances (number 8).

Figure 6 section (m) shows a front view of a device using the scent of sugar water to summon bees. Part (n) shows the front view of the tool using the scent of bee attractant and clearly the entrance and exit of bees (number 8). Section (o) shows the position when testing the tool. It can be seen from the picture that the position of the bee in one colony (number 10) is facing the bee-calling device using the scent of resisting honey, sugar water, and bee attractant (number 11). Part (p) makes clear the picture of the part (o). Section (q) shows the position of the main box during the tool testing process right behind the calling device (number 12). Section (r) clarifies the position of the main box holder during tool testing.

3.2 The results of testing the tool using the voice of the caller

Figure 7 and Figure 8 show a sample of the caller's voice used to call bees Apis cerana in the time domain and frequency domain. The frequencies used for the caller's voice are 265.9 Hz, 265.9 Hz, 281.5 Hz, 281.5 Hz, and 297.2 Hz so that the frequency range is 265.9 Hz – 297.2 Hz.

![Figure 7. Bee caller sound in the time domain.](image1)

![Figure 8. Bee caller sound in the frequency domain.](image2)

Figure 9 shows the appearance of the blynk application when testing the tool. The application runs perfectly so that sensors detected infrared 0 and 2 are. From the sample image above, it can be seen that the temperature and humidity that the DHT11 sensor reads are 33, 32, and 71%.

From Figure 10 (a) it can be seen that the location of the bee calling device testing using the caller's voice is in Balunjuk Village, Merawang District, Bangka Regency. The distance from Bangka Belitung University is about 4 minutes.
Figure 9. Test results on the Blynk application, a bee-calling device using the caller’s voice.

Figure 10. (a) The location of the test tool using the voice of the caller. (b) The location of the test tool using the scent of honey.

3.3 The results of testing tools using the scent of honey

Figure 11 shows the bee that was called into the tool when testing the tool using the scent. The floor that looks wet is a summoning fluid consisting of the scent of resisting honey, the scent of bee attractant, and the scent of sugar water. Figure 11 is a sample image when testing using the scent of resisting honey. Overall the results of the bees that are called into the tool are in the discussion below.

From Figure 10 (b) it can be seen that the location of the bee calling device testing using the scent of honey is in Johar Hamlet, Ranggi Asam Village, Jebus District, West Bangka Regency. The distance from Jebus District to the test location is about 17 minutes.

Figure 12 shows a large number of bees being called or going in and out of the test using the scent of honeycomb, the smell of sugar water, and the scent of the bee attractant displayed on the gauge widget. Control the three kinds of bee-calling scents by pressing the button widget button (ON or OFF). The temperature and humidity values detected on the three bee-calling devices are displayed on the gauge widget.

Figure 11. The summoned bee enters the tool.

Figure 12. Test results on the blynk application, a bee-calling device, using the scent of honey.
Table 1. A total number of summoned bees.

| Days to-Testing Time | The number of bees in and out of a colony. | The number of bees in and out of the test uses the scent of resisting honey. | The number of bees in and out of the test uses the scent of sugar water. | The number of bees in and out of the test uses the scent of a bee attractant. |
|----------------------|------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| 1 02.12              | 284                                      | 177                                             | 133                                             | 44                                              |
| 2 03.50              | 227                                      | 134                                             | 89                                              | 25                                              |
| 3 02.33              | 169                                      | 68                                              | 44                                              | 3                                               |
| 4 02.17              | 130                                      | 93                                              | 88                                              | 5                                               |
| 5 05.01              | 291                                      | 193                                             | 240                                             | 28                                              |
| 6 04.39              | 128                                      | 80                                              | 76                                              | 10                                              |
| 7 06.35              | 241                                      | 92                                              | 88                                              | 3                                               |
| Total 27.07.00       | 1470                                     | 837                                             | 758                                             | 118                                             |

From Table 1, the results of testing the bee-calling device use the aroma of honey. The length of time for testing the tool is 27.07.00 hours for seven days of testing. The number of bees in one colony for seven days was 1470 tails, the test used the aroma of honeycomb as many as 837 tails, the test used the aroma of sugar water as many as 758 tails and the test used the aroma of attractant bees as many as 118 tails.

4. Conclusion
Based on the results of the research that has been done, it can be concluded as follows. The number of bees that were summoned for 7 days of testing using the aroma of honeycomb as many as 837 tails, using sugar water as many as 758 tails, and using bee attractants as many as 118 tails. The method of equalizing the caller's voice frequency between the dance waggle and the recorded sound frequency of the bee colony Apis cerana in the frequency range of 265.9 Hz – 297.2 Hz cannot be used for communication in the bee calling process Apis cerana. The scent of honey that is most effective for calling bees is the first aroma of honeycomb, the second is the smell of sugar water and the third is the aroma of bee attractants. Comparison of the results of the study between the use of a bee-calling device using a caller's voice and the aroma of honey was dominant using the aroma of resisting honey.

References
[1] Susianti 2018 Pengetahuan Lokal Masyarakat pada Kegiatan Perlebahan Di Desa Pattuku Kecamatan Bontocani Kabupaten Bone.
[2] Maghfiroh A 2020 Optimasi Ekstraksi Dan Amplifikasi DNA Khamir pada Sarang Lebah Madu Tetragonula Sp. Menggunakan Teknik PCR (Polymerase Chain Reaction) untuk Identifikasi Spesies (Surabaya: UIN Sunan Ampel)
[3] Hamdan A dan Miski 2019 Dimensi Sosial dalam Wacana Tafsir Audiovisual: Studi atas Tafsir Ilmi, “Lebah Menurut al-Qur’an dan Sains,” Lajnah Pentashihan Mushaf al-Qur’an Kemenag RI di Youtube 22 2
[4] Nurafifah L. dan Kuntjoro A S 2018 Euclid 5 61
[5] Collison C 2016 A closer look: sound generation and hearing Bee culture the magazine of American beekeeping
[6] Terenzi A, Cecchi S dan Spinsante S 2020 Veterinary Sciences 7 168
[7] Wilson P A 2019 Detecting Bee Hive Behavioral Changes Through Frequency and Signal Analysis of Audio Files (Appalachian: Appalachian State University)
[8] Amrullah S H Hilda and Rusli R F 2018 Dinamika 9 1
Acknowledgement
We gratefully acknowledge the funding from Universitas Bangka Belitung through the RKAKL FT for the publication of this paper.