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Rice pest repellent device (bird) using Telegram based on Internet of Things

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ABSTRACT

This research is aimed at designing a rice pest repellent device using IoT (Internet of Things) based telegrams, the purpose of this design is to improve monitoring and security of rice in the fields in an effort to minimize crop losses caused by rice pests in the form of sparrows and bondol. The tool designed will collect information data continuously from sensors installed around the rice through Internet of Things connectivity and the data can be accessed via telegram on the user's smartphone. With the ESP32 Devkit which acts as the brain of the programming and will move the cans around the rice fields connected to the rope by the servo motor if there is a movement detected by the PIR sensor, a notification will be sent to the telegram on the smartphone. It is hoped that there will be an increase in the efficiency of monitoring and security of rice plants in the fields with the implementation of the rice pest repellent device designer using IoT (Internet of Things) based telegrams.

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1. INTRODUCTION

Indonesia is one of the countries whose economic system uses agriculture as one of the business sectors for the community. Farming can play a role in meeting the needs of food consumption for the community. One of the most popular agriculture in Indonesia is rice farming, and rice plants are one of the primary needs for the general public, because rice plants themselves contain carbohydrates as a source of human energy [1]-[4]. As a result of the attack of the bondol bird, rice production has decreased by 30-50% [5]-[7].

Sparrows and bondol are types of pests from the bird class that eat grains, including also attacking rice plants to eat the seeds or grains of the rice plants. These birds will usually flock or form groups in eating rice plants which will start from morning until evening which is enough to make people feel worried because it is very detrimental. The group of birds will number at least 5, and each group of birds will easily join other groups. These bird pests will start to attack when the grains of the rice plants begin to turn yellow which causes direct loss of harvest. Usually, farmers use traditional methods to repel these pests, namely by stretching threads from one end to the other [8],[9]. However, there are still shortcomings in using human power itself, such as feeling tired for the human, and a lot of time will be wasted because humans must stand by at the farm until the bird pests are gone, and that is done every day. Therefore, it is hoped that there will be changes in this matter, in order to help ease the activities of the community.

With the development of current technology, it can ease all activities that will be done by humans. This is what drives humans to find and develop new things in creating or perfecting a work that is useful for society and producing tools that make it easier and lighten human work, some even take over human tasks. One of the developments in technology at this time is the internet, which can be used as a telecommunications media and a control system for other devices from a distance while still being connected

and connected [10]-[13]. The benefits of internet connectivity can be expanded if they are always connected is the concept of the Internet of Things (IoT). The initial idea of the Internet of Things was first introduced by Kevin Ashton in 1999 in one of his presentations [13]. The Internet of Things (IoT) is where all objects in the real world can communicate with each other using the internet network as a connection [13]-[15].

Research on the Internet of Things (IoT) itself has been widely carried out, such as a pest repellent for birds eating rice in rice fields based on Arduino Uno and a bird pest repellent based on the Internet of Things using the blynk application as a data information display [16]-[20]. Based on the above information, the author will use the ESP32 Devkit as the brain or controller to research and also use the telegram application as a display of information data and also send commands to start or stop the device in the form of messages. While the output, the researcher uses a milk can which will later be driven by a servo motor. The bird pests that will be expelled are sparrows and bondol birds. In this study, the author uses the ESP32 Devkit as a controller that functions to operate electronic devices remotely with faster performance than the Arduino Uno. This tool will use 4 PIR (Passive Infrared Receiver) sensors on the four sides of the protected area to detect the movement of bird pests that will approach, while the 20 Kg servo motor functions as a can driver using a rope as a connection for expelling bird pests.

2. METHOD

The purpose of the block diagram is to describe the main system, the main process and also the working relationships that exist in each component that is built. Figure 1. shows the form of the block diagram.

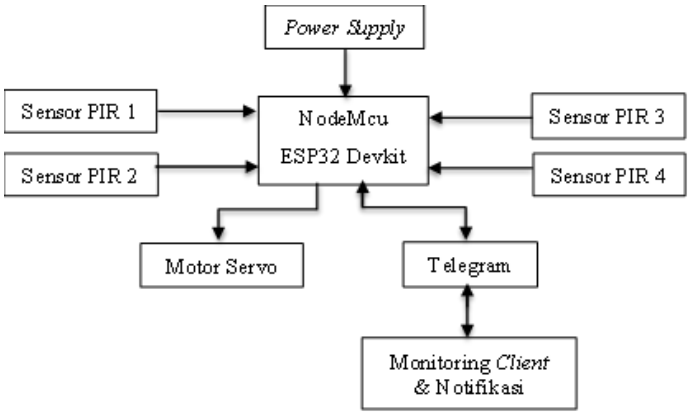


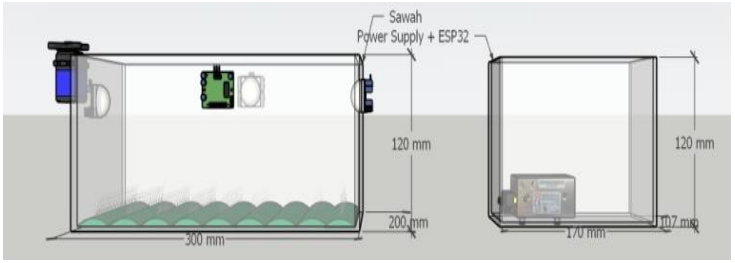
Figure 1. Diagram block

The following are the functions of the block diagram in Figure 1: The power supply functions to supply power or electrical voltage to the entire device, the NodeMcu ESP32 Devkit is a controller or controller that functions as a data processor sent by the PIR (Passive Infrared Receiver) sensor which is ordered by the client via the telegram bot, the servo motor here is the driver of the rice pest repellent (bird) so that the rope connected to the servo motor vibrates back and forth which can create a sound on the can, the PIR (Passive Infrared Receiver) sensor is used to detect the movement of bird pests around the area, Telegram is used to send start and stop commands to the research tool that has been sorted remotely. Telegram here also functions to display information data obtained from the PIR sensor later. Client Monitoring & Notification: The client will access the telegram to monitor and only the client can access the telegram bot page. Meanwhile, notifications have a function to warn users about conditions around the rice plants if there is an abnormality. The internet itself is a connection or communication network. This network will connect data to the telegram application on the smartphone.

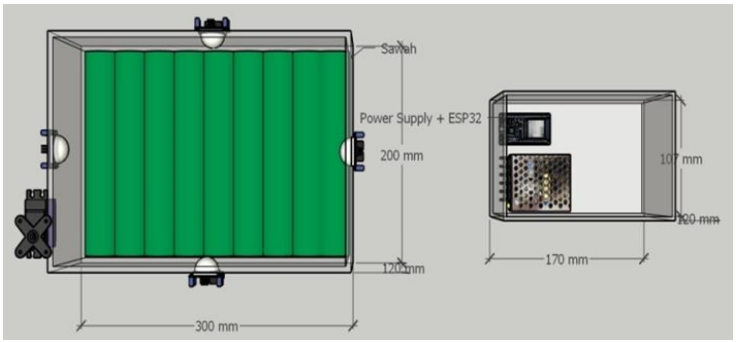
ESP32 Devkit will receive information from the PIR (Passive Infrared Receiver) sensor, which information is the detection of bird pest movements in the scope of its area, around 6-7 M. Then ESP32 Devkit will send the information with the help of an internet network to the application that has been provided, namely telegram. ESP32 Devkit has an important role as the center of all systems. The PIR (Passive Infrared Receiver) sensor in this final project functions as a monitor and detector of bird pest movements around its area. While telegram on the smartphone there is a telegram bot that functions as an activation and deactivation of the system from the tool. When start is activated on the telegram application, the application command will be sent to the ESP32 Devkit using the internet network as a connection link.

After receiving the command from the telegram application, the entire system will be active and the ESP32 Devkit is ready to receive information data and sensor detection. If there is suspicious movement around the area, the PIR (Passive Infrared Receiver) sensor will detect the discrepancy and send the information directly to the ESP32 Devkit, then the ESP32 Devkit will process the information obtained, after which the ESP32 Devkit will send the information data to telegram using the internet network, so that a notification will appear in the application on the user's smartphone. Then after that the ESP32 Devkit will order the servo motor to move, and the servo motor will move back and forth with the rope as a connection between the cans. The can will move by itself because the servo motor is directly connected to the can using a rope. So if the servo motor moves back and forth, the can will be active and the can will stop when the servo motor receives the command to stop. There are several cans in this final project, so that they make a louder sound.

Hardware design here consists of mechanical design and electronic design. Mechanical design is making a design for the mechanics of the tool and electronic design is making an electronic circuit of the tool. Mechanical design is a design or outline of the tool to be made. This tool consists of a box for the power supply and esp32 components which has a height of 120 mm and a width of 107 mm. There is also a mini rice field shape with a PIR sensor on each side as a detector and also a servo motor. The following is the mechanical image form seen in Figure 2.



(a)



(b)

Figure 2. Mechanical design. a) side view, b) top view.

Electronic design is a design or picture of the electronic circuit of the device. So this electronic design will describe the installation of several components that are interconnected so that they can operate as desired. To see more clearly the form of the electronic design can be seen in Figure 3.

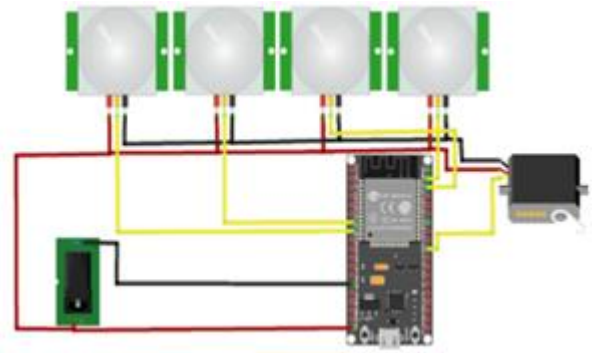


Figure 3. Electronic circuit design

The software design of the tool in this study that will be made includes the telegram software and Arduino IDE software. This study uses Arduino IDE which is software that uses the C/C++ language in its programming, Arduino IDE is useful as a text editor to create, edit, code certain programs, and upload to the specified board. Arduino IDE is not only used for Arduino Uno programming but can also be used for others. Here is the form of Arduino software. The Telegram application is software used for chatting (a service for replying to messages instantly) based on the cloud that focuses on speed and security. Cloud-based means that users are facilitated in accessing one Telegram account from different devices and simultaneously. Here is the form of the Telegram application interface. A flowchart is a graphical description of the steps and sequence of procedures of a program. This flowchart is another alternative to replacing the algorithm. The flowchart aims to describe a stage of solving a problem simply. The flowchart in Figure 4 is a description of the program steps to give commands to activate the entire system of the tool to be created.

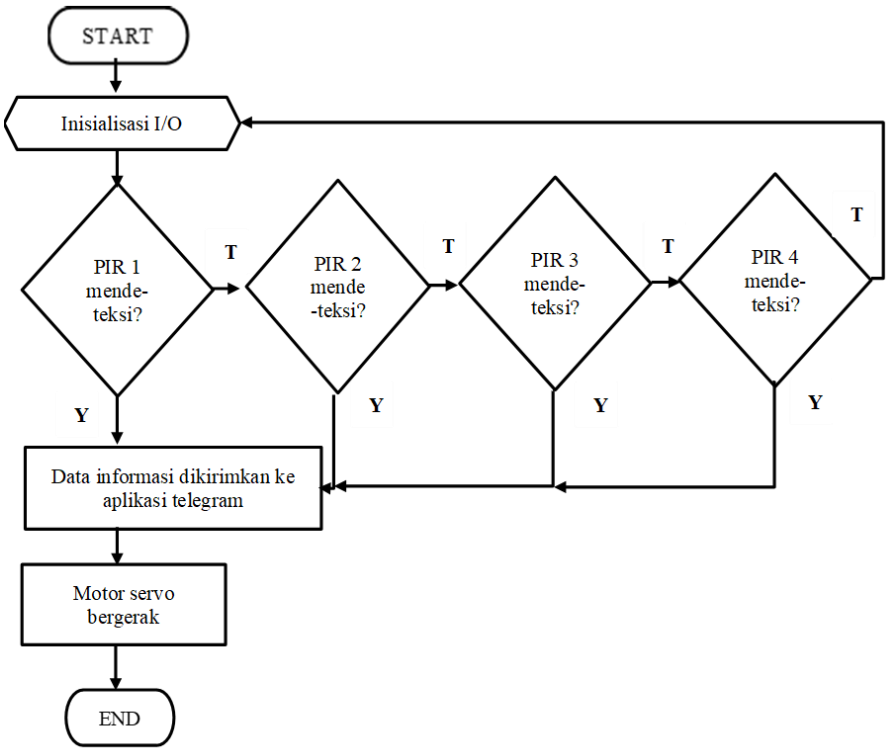


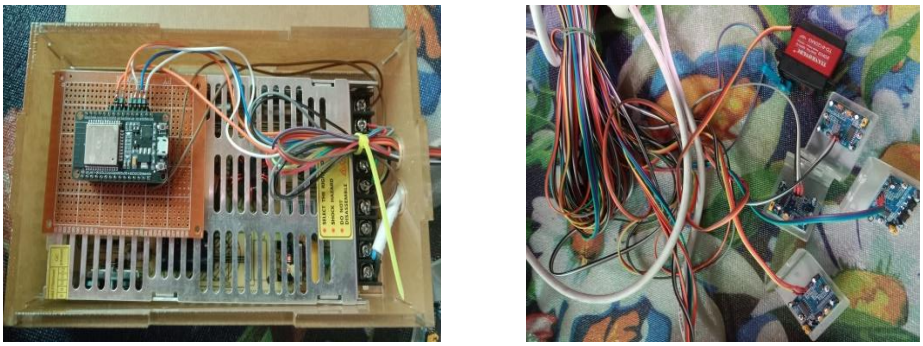
Figure 4. Tool flowchart

3. RESULTS AND DISCUSSION

The testing of this research tool was conducted in several rice fields owned by residents in the village where the researcher lives, namely in Pesisir Selatan district. Figure 5 shows the rice fields of residents where the proposed tool was tested.

Figure 5. Rice fields where the tool was tested

The resulting form of the tool design will be shown in Figure 6. below, where the tool consists of several interconnected components, namely: PIR sensor, servo motor, NodeMcu ESP32, power supply. The following is a picture of the design form on the research tool hardware.



(a) (b)

Figure 6. Result of tool making. a) Controller and power source, b) Detector and driver.

PIR sensors are installed on four sides of the rice fields, these sensors work after being triggered by infrared radiation. When the sensor is activated on four sides of the rice fields, the sensor will detect changes in the level of infrared radiation, so that it will produce an output. After conducting research, the range of distance that can detect to repel birds is only up to 7 m, if it is more than that then it will not be detected. Figure 7 shows the placement of the PIR sensor during the research.

Figure 7. Sensor placement

Table 1. PIR sensor test results

Distance (m)	PIR sensor output				Notifications
	PIR 1	PIR 2	PIR 3	PIR 4	
1	1	1	1	1	Yes
2	1	1	1	1	Yes
3	1	1	1	1	Yes
4	1	1	1	1	Yes
5	1	1	1	1	Yes
6	1	1	1	1	Yes
7	1	1	1	1	Yes
8	0	0	0	0	No
9	0	0	0	0	No
10	0	0	0	0	No

A servo motor is an electromechanical device made using a closed loop system (servo) as a driver in a circuit that will produce torque and speed based on the electric current and voltage given to it by the user. The servo motor is used to move the connecting rope between several cans, while the cans function as sound generators to scare away bird pests that approach at a certain distance. While the rope that the researcher used was a srampat rope which is usually used for fishing nets. Table 2 describes the results of the servo motor testing.

Table 2. Condition of servo motor and can

No.	Distance (m)	Motor Condition	Can Condition	Voltage on Motor (V)
1	1	Active	Sound	3.5
2	2	Active	Sound	3.5
3	3	Active	Sound	3.3
4	4	Active	Sound	3.4
5	5	Active	Sound	3.5
6	6	Active	Sound	3.5
7	7	Active	Sound	3.4
8	8	Not active	No sound	3.8
9	9	Not active	No sound	3.7
10	10	Not active	No sound	3.8

Telegram is used to display the interface of reading PIR sensor information data and also telegram can be used to start and stop the tool from working. Telegram application testing aims to determine the performance of the application whether it can work according to the expectations of the initial system design, so that it can work well. The appearance of the telegram when the researcher starts the research which begins with the START message sent to the telegram bot, which means the tool starts to carry out its work in monitoring and securing rice in the rice fields. After that, the PIR sensor will search for information data by detecting movement around the sensor's range, if the sensor detects the movement of bird pests around the rice in the rice fields, the sensor will send the information data and be displayed by the telegram bot, namely as in Figure 8 below.

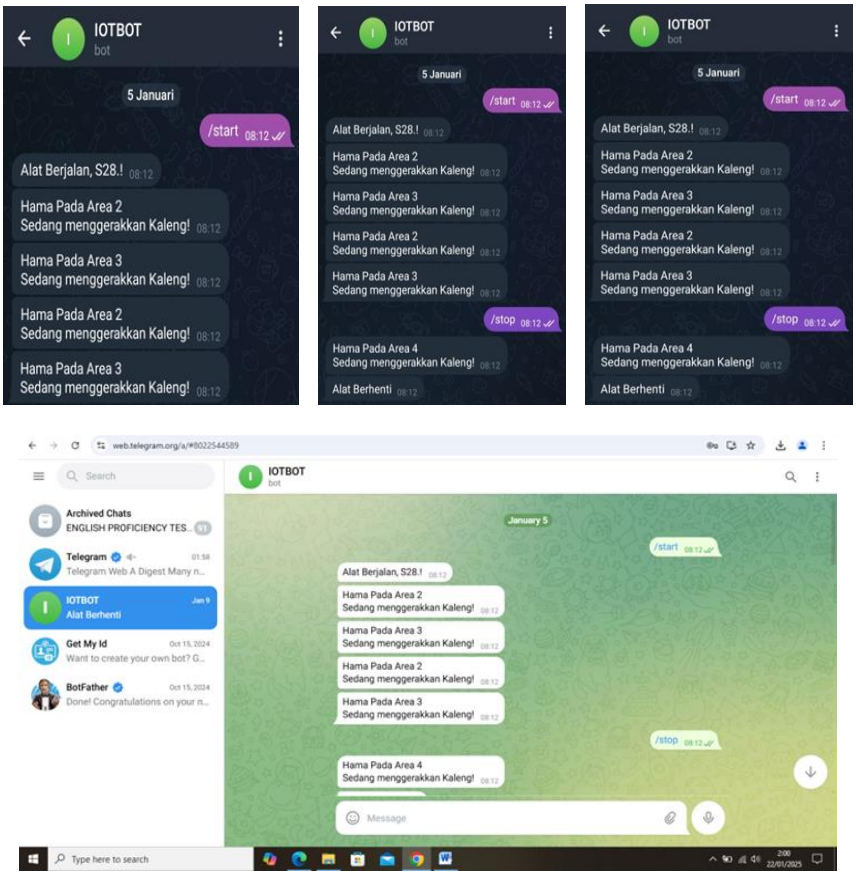


Figure 8. Telegram display

4. CONCLUSION

From the test results of the rice pest repellent device in the form of sparrows and bondol birds using IoT-based telegrams, it can work according to the expected design and all components used can work well. Testing on the PIR sensor to see the performance of the PIR sensor according to the target of achieving the distance reached, which is 7 m the furthest detection distance. Testing on the servo motor, the movement is still not fast enough but can still move and produce sound. All testing of the design tool begins with sending information data from the PIR sensor sent properly and can also produce the expected output, so that the use of this research tool can be implemented as IoT technology.

REFERENCES

[1] N. Liundi, A. W. Darma, R. Gunarso and H. L. H. S. Warnars, "Improving Rice Productivity in Indonesia with Artificial Intelligence," *2019 7th International Conference on Cyber and IT Service Management (CITSM)*, Jakarta, Indonesia, 2019, pp. 1-5, doi: 10.1109/CITSM47753.2019.8965385

[2] E. K. Purwaningsih, P. Adi Wibowo Putro, D. I. Sensuse, Kautsarina and R. R. Suryono, "The Architecture for Rice Stock Information System in Indonesia," *2021 4th International Conference of Computer and Informatics Engineering (IC2IE)*, Depok, Indonesia, 2021, pp. 210-214, doi: 10.1109/IC2IE53219.2021.9649153.

[3] I. A. Supriyono, E. Sediyono, I. Setyawan, I. K. Timotius and M. Madani, "Green Energy Harvest Monitoring of Watering System for Smart Farming Using IoT," *2023 11th International Conference on Cyber and IT Service Management (CITSM)*, Makassar, Indonesia, 2023, pp. 1-6, doi: 10.1109/CITSM60085.2023.10455443.

[4] E. Suryani, R. A. Hendrawan, U. E. Rahmawati, A. D. Wulandari, Damanhuri and S. -Y. Chou, "Social Farming Development to Improve Farming Desire and Profit: A System Thinking Approach," *2022 International Conference on Computer Engineering, Network, and Intelligent Multimedia (CENIM)*, Surabaya, Indonesia, 2022, pp. 290-294, doi: 10.1109/CENIM56801.2022.10037381.

[5] T. K. Hariadi, G. Wimala, N. Hayati, Widyasmoro, K. Purwanto and P. Prihatmoko, "Design of Automatic Birds Repellent System for Rice Field Using Microcontroller and Solar Panel," *2024 4th International Conference on Electronic and Electrical Engineering and Intelligent System (ICE3IS)*, Yogyakarta, Indonesia, 2024, pp. 144-148, doi: 10.1109/ICE3IS62977.2024.10775638.

[6] C. S. Elphick, P. Baichich, K. C. Parsons, M. Fasola and L. Mugica, "The Future of Research on Waterbirds in Rice Fields," *Bioone Complete*, vol. 33, no. 1, pp. 231–243, 2024.

[7] R. Soemandi and M. Mutholib, "Bird Pest in Rice Fields and Control Measures in Indonesia," *Inonesian Journal of Agricultural Science*, vol. 4, no. 2, pp. 80–86, 2003.

[8] Y. Ito, M. Ken'ichi, A. Usup and Y. Yuki, "A sustainable way of agriculture livelihood: edible bird's nests in Indonesia," *Ecosystem Health and Sustainability*, vol. 7, no. 1, 2021.

[9] S. Khan, F. Malik and A. M. Jan, "Evaluation of Birds Pests on Rice Crop and Their Management Practices," *Journal of Agricultural Sciences*, vol. 11, no. 2, pp. 23–31, 2019.

[10] Y. A. Putra and M. Yuhendri, "Smart Monitoring Pompa Air Otomatis Berbasis Human Machine Interface Dan Internet Of Things," *JTEIN J. Tek. Elektro Indones.*, vol. 4, no. 2, pp. 863–876, 2023.

[11] H. Tran-Dang, N. Krommenacker, P. Charpentier and D. -S. Kim, "Toward the Internet of Things for Physical Internet: Perspectives and Challenges," *IEEE Internet of Things Journal*, vol. 7, no. 6, pp. 4711-4736, June 2020, doi: 10.1109/JIOT.2020.2971736.

[12] J. A. Ansere, G. Han, L. Liu, Y. Peng and M. Kamal, "Optimal Resource Allocation in Energy-Efficient Internet-of-Things Networks With Imperfect CSI," *IEEE Internet of Things Journal*, vol. 7, no. 6, pp. 5401-5411, June 2020, doi: 10.1109/JIOT.2020.2979169.

[13] A. F. Ikhfa and M. Yuhendri, "Monitoring Pemakaian Energi Listrik Berbasis Internet of Things," *JTEIN J. Tek. Elektro Indones.*, vol. 3, no. 1, pp. 257–266, 2022.

[14] S. K. Jagatheesaperumal, Q. -V. Pham, R. Ruby, Z. Yang, C. Xu and Z. Zhang, "Explainable AI Over the Internet of Things (IoT): Overview, State-of-the-Art and Future Directions," *IEEE Open Journal of the Communications Society*, vol. 3, pp. 2106-2136, 2022, doi: 10.1109/OJCOMS.2022.3215676.

[15] F. Samie, L. Bauer and J. Henkel, "From Cloud Down to Things: An Overview of Machine Learning in Internet of Things," *IEEE Internet of Things Journal*, vol. 6, no. 3, pp. 4921-4934, June 2019, doi: 10.1109/JIOT.2019.2893866.

[16] M. Yuliana, I. C. Fitrah and M. Z. S. Hadi, "Intelligent Bird Detection and Repeller System in Rice Field Based on Internet of Things," *2023 IEEE International Conference on Communication, Networks and Satellite (COMNETSAT)*, Malang, Indonesia, 2023, pp. 615-621, doi: 10.1109/COMNETSAT59769.2023.10420717.

[17] R. F. Rahmat, T. Ramadhani, D. Gunawan, S. Faza and R. Budiarto, "Mel-frequency Cepstral Coefficient-Vector Quantization Implementation for Voice Detection of Rice-Eating Birds in The Rice Fields," *2018 Third International Conference on Informatics and Computing (ICIC)*, Palembang, Indonesia, 2018, pp. 1–6, doi: 10.1109/IAC.2018.8780469.

[18] S. Phetyawa, C. Kamyod, T. Yooyatiwong and C. G. Kim, "Application and Challenges of an IoT Bird Repeller System As a result of Bird Behavior," *2022 25th International Symposium on Wireless Personal Multimedia Communications (WPMC)*, Herning, Denmark, 2022, pp. 323–327, doi: 10.1109/WPMC55625.2022.10014932.

[19] Y. Siahaan, B. A. Wardijono and Y. Mukhlis, "Design of birds detector and repellent using frequency based arduino uno with android system," *2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE)*, Yogyakarta, Indonesia, 2017, pp. 239–243, doi: 10.1109/ ICITISEE.2017.8285503.

[20] A. Muminov, Y. C. Jeon, D. Na, C. Lee and H. S. Jeon, "Development of a solar powered bird repeller system with effective bird scarer sounds," *2017 International Conference on Information Science and Communications Technologies (ICISCT)*, Tashkent, Uzbekistan, 2017, pp. 1–4, doi: 10.1109/ICISCT.2017.8188587.