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INTERNET OF THINGS-BASED AUTOMATIC FEEDING PROTOTYPE FOR ELAEIDOBIUS KAMERUNICUS ENCLOSURE

Dwi Winarti[1], Asril[2], Alfitra May Setiawan[3]

Informatics Engineering, Faculty of Computer Science, Dharmas Indonesia University
dwi28896@gmail.com[1], asrilmkom@gmail.com[2], 2102011005@undhari.ac.id[3]

ABSTRACT

The Internet of Things (IoT) is a fast-evolving technology that has been successfully applied in various sectors, including agriculture and plantations. One of its promising applications is in the field of pollinator management, particularly for Elaeidobius kamerunicus, a beetle species that plays a vital role in the pollination process of oil palm trees. This study aims to design and implement a prototype of an automatic feeding system based on IoT technology, intended to support the maintenance and breeding of these pollinator insects. The system uses an ESP32 microcontroller as the main controller, the RTC DS3231 module for scheduling automated feeding at specific times, and a Telegram Bot as the user interface for remote control and status notifications. The system is designed to operate in two modes: automatic mode, which activates the feeding mechanism at a preset time (08:00 AM), and manual mode, which allows the user to activate feeding via commands sent through Telegram. Testing results show that all hardware and software components-including Wi-Fi connectivity, RTC module, relay, blower, and Telegram integration-function correctly and as intended. This prototype provides a simple, practical, and adaptable technological solution for individual oil palm farmers to manage pollinators without interfering with their daily routines. The system also holds significant potential for future development and broader implementation in precision agriculture.

Keywords: *Internet of Things, ESP32, RTC DS3231, Telegram Bot, Elaeidobius Kamerunicus, Automatic Feeding System*

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INTRODUCTION

The development of technology has brought significant changes across various sectors, including the plantation sector. The Internet of Things (IoT) is one of the technologies capable of providing alternative solutions to improve productivity. IoT has been implemented in numerous fields, ranging from healthcare and transportation to agriculture and plantations. In the agriculture and plantation sectors, the Internet of Things (IoT) offers opportunities for resource management and environmental monitoring. One such application is the management of pollinating insects such as *Elaeidobius Kamerunicus*, which plays a crucial role in the pollination process of oil palm trees.

The Oil Palm Pollinating Insect, or *Elaeidobius Kamerunicus*, is one of the key factors in the successful pollination of oil palm trees. A shortage of this pollinating insect can lead to a decrease in the fruit set of oil palms, which in turn reduces the weight of the palm fruit bunches and the oil extraction rate. Tegal Asri Village, located in Rimbo Bujang Subdistrict, Tebo Regency, is the research site chosen by the author. The majority of the population in this area are oil palm and rubber farmers. However, in the local oil palm plantations, pollination is still entirely dependent on natural processes and the use of fertilizers to support

fruit formation. Based on the author's observations, none of the villagers have managed *Elaeidobius kamerunicus* beetles as a method to enhance oil palm fruit development. This is primarily because the beetles' feeding activity occurs in the morning, a time when most villagers are already working on their farms. Therefore, to manage these pollinating beetles effectively, a dedicated enclosure equipped with an automatic feeding system is required so that it does not interfere with the farmers' primary work. Based on the above statement, the author designed a "Internet of Things-Based Automatic Feeding Prototype for *Elaeidobius Kamerunicus* Enclosure" aimed at providing an alternative approach to managing this oil palm pollinating weevil. This system enables the delivery of feed in the form of pollen through an automatic spraying mechanism.

METHODS

This research employs a prototyping method approach, aimed at designing and developing a prototype system for automatic feeding in *Elaeidobius kamerunicus* enclosures based on the Internet of Things (IoT). The research stages consist of the following:

a. Problem Identification

Examining field issues related to farmers' limited time in routinely feeding oil palm pollinating weevils.

b. Literature Review

Collecting references from journals, books, and articles related to IoT, the ESP32 microcontroller, RTC DS3231, Telegram Bot, and *Elaeidobius Kamerunicus*.

c. Requirements Analysis

Determining the hardware requirements (ESP32, blower, relay, RTC, etc.) and software (Arduino IDE, Fritzing, Telegram) used in the system.

d. System Design

Creating flowcharts, block diagrams, and circuit schematic designs to illustrate the overall operation of the device.

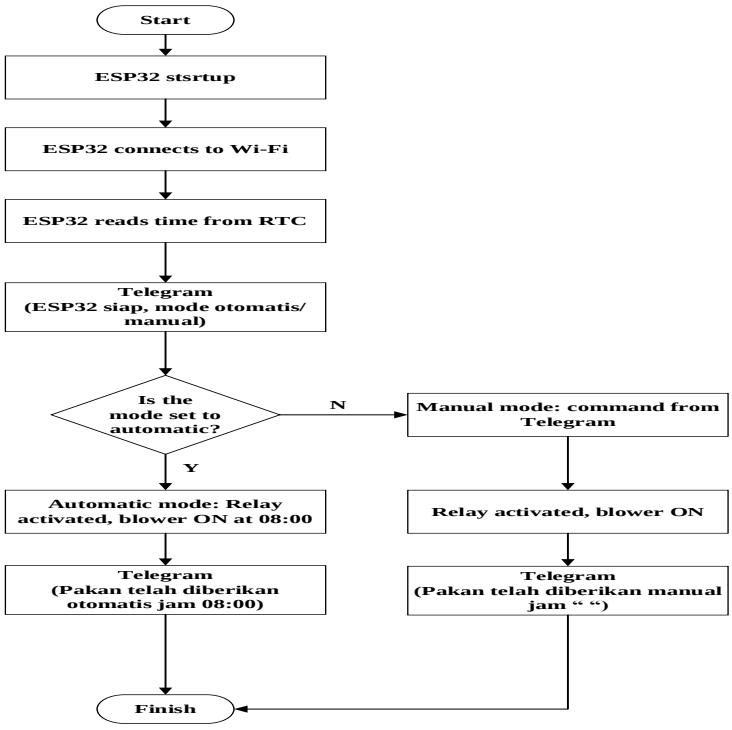

Figure 1. Flowchart

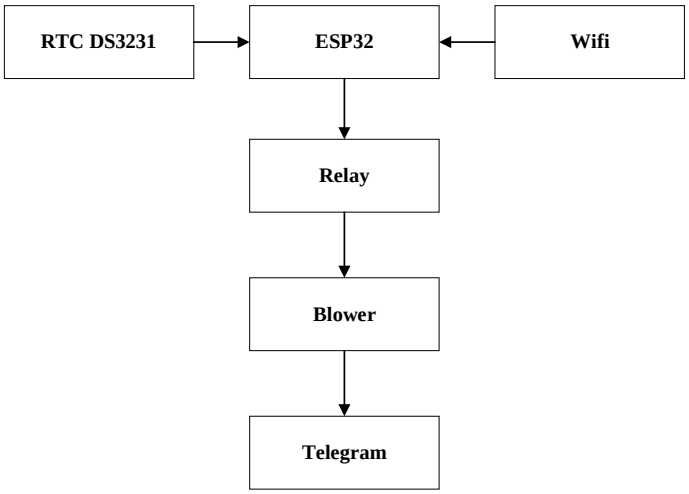

Figure 2. Block Diagram

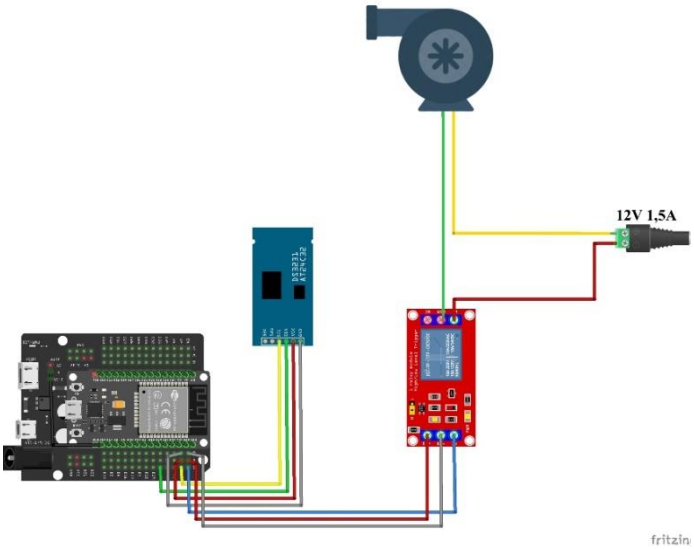

Figure 3. schematic designs

e. Prototype Development

Assembling all components based on the design and integrating them through programming in Arduino IDE, with Telegram support for communication.

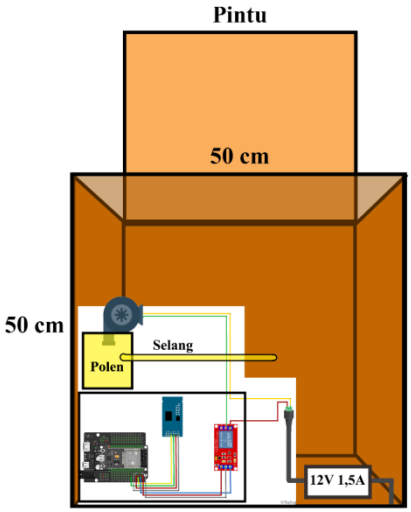

Figure 4. Enclosure Design Integrated with the System

f. Testing and Evaluation

Testing is conducted on all components, including WiFi connectivity, RTC, relay, blower, and the sending and receiving of notifications via Telegram. Evaluation is carried out to ensure the system functions according to specifications.

RESULTS

The results of the system prototype development and testing show that the automatic feeding system for the Elaeidobius kamerunicus enclosure functions as designed. The results of the testing can be seen in the table below:

Table 1. Testing Results

Mode	Telegram	User command via Telegram	System Response	Status
Automatic	Mode diubah ke OTOMATIS	No input command	The relay and blower will automatically activate at 08:00 and send a message to Telegram.	Success
Manual	Mode diubah ke MANUAL	/hidupkan	The relay and blower activate when the /hidupkan command is received, and a message is sent to Telegram.	Success
Automatic	Mode diubah ke OTOMATIS	/hidupkan	The relay and blower remain inactive, and the system sends a message to Telegram “Perintah ini hanya bisa digunakan saat mode MANUAL”	Success

DISCUSSION

The prototype of the automatic feeding system for Elaeidobius kamerunicus cages developed in this study demonstrates that Internet of Things (IoT) technology can be functionally and adaptively applied to support agricultural activities, particularly in the management of oil palm pollinating insects. By utilizing the ESP32 microcontroller, the RTC DS3231 module, and Telegram Bot, the system is capable of operating in two modes-automatic and manual-both of which perform according to design and provide appropriate responses to users. Nevertheless, the system still has room for further development, such as adding a blower failure monitoring feature and cloud-based historical data storage to support long-term monitoring and enhance overall system reliability.

CONCLUSIONS

This research successfully developed a prototype of an automatic feeding system for Elaeidobius kamerunicus cages based on the Internet of Things (IoT), utilizing the ESP32 as

the main controller, the RTC DS3231 for automatic scheduling, and Telegram Bot as the communication and remote control interface. The system operates in two modes, automatic and manual, both of which function properly and are capable of sending feeding time notifications via Telegram. The test results indicate that the system functions properly

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