Internet of Things Based Electric Mouse Trap Using Telegram Application

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Abstrak

Penelitian ini mengembangkan perangkap tikus elektrik berbasis Internet of Things yang dipantau dan dikendalikan melalui aplikasi pesan Telegram. Permasalahan yang diangkat adalah perangkap konvensional menuntut pengguna hadir secara langsung untuk memeriksa dan menata ulang perangkap. Perangkap dirancang menggunakan mikrokontroler Arduino Nano V3, sensor inframerah, modul kamera, tiga motor servo, dan relai, serta dibangun dengan metode waterfall. Sistem mengirimkan notifikasi dan foto kepada pengguna setiap kali ada objek masuk ke dalam perangkap, sehingga pengguna dapat menentukan dari jarak jauh apakah objek disetrum atau dilepaskan melalui pintu samping. Pengujian dengan tikus hidup menunjukkan bahwa perangkap berhasil menangkap sasaran, melumpuhkan tikus dengan siklus setrum sepuluh detik, dan merespons perintah dalam rentang dua sampai lima detik bergantung pada kestabilan koneksi internet.

Kata kunci*: Internet of Things, Tikus, Perangkap Tikus, Arduino, Bot Telegram*

Abstract

This study developed an electric mouse trap based on the Internet of Things that was monitored and controlled through the Telegram messaging application. The problem addressed was that conventional traps required the user to be physically present to inspect and reset them. The trap was built with an Arduino Nano V3 microcontroller, an infrared sensor, a camera module, three servo motors, and a relay, and was developed using the waterfall method. The system sent a notification and a photograph to the user whenever an object entered the trap, so the user could decide remotely whether to electrocute the target or release it through the side door. Testing with live mice showed that the trap captured the target, immobilised a mouse using a ten-second shock cycle, and responded to commands within two to five seconds depending on connection stability.

Keywords *: Internet of Things, Mouse, Mousetrap, Arduino, Telegram Bot*

1. Introduction

Rat control techniques consist of four stages, namely monitoring, sanitation, trapping and use of chemicals (rodenticides) [1]. Existing rat population control methods, such as the use of conventional traps and chemicals, have several limitations. Conventional traps are often ineffective at efficiently catching rats, while the use of chemicals can pose unwanted environmental and health risks [2]. One of the problems faced by society is the presence of rats scattered throughout the human environment. Rats (Rattus rattus) are vertebrates that pose a nuisance and threat to human life. Furthermore, manually monitoring and controlling rat populations requires significant time and effort [3]. Conventional rat traps are generally more affordable than other rat control methods, such as electronic traps or professional services. Besides the health impacts, rats also cause significant economic losses, especially for farmers. Rats can cause up to 20% of agricultural land damage. Rats are difficult pests to control due to their adaptability and mobility [4].

The previous study [5] The author's reference, entitled "Design and Construction of an IoT-Based Mouse Trap and ESP32 Camera," aims to control the mouse population. This research method uses an experimental approach, starting with problem identification, field observations of the location and population of mice, followed by a literature review of effective mouse trap and sensor systems. The benefit gained from this research is the creation of a tool capable of catching mice effectively and safely.

Another study [6] which is also a reference for the author, entitled "Design and Making of IoT (Internet of Things) Based Automatic Mouse Traps to Eradicate Mice" aims to design IoT (Internet of Things) based automatic mouse traps as a solution to eradicate destructive mouse pests. This study uses an experimental method that begins with problem identification, field observations related to the location and population of mice, and continues with a literature study on effective mouse trap and sensor systems. The benefits obtained from this study are designing IoT (Internet of Things) based automatic mouse traps as a solution to eradicate mouse pests.

Another study [7] which is also a reference for the author, entitled "IoT-Based Rat Pest Trap System in Chicken Coops Using the C.45 Method" aims to reduce rats that roam and greatly disturb the chicken hatchery at the Chicken Farm location. This study uses the C4.5 Algorithm calculation method where this method is used to perform calculations in determining decisions, by calculating parameters to see the number of rats that enter the trap. The benefits obtained are reducing rat pests in chicken coops by using traps, which will result in a decrease in the number of rats and become a useful tool for the community in dealing with rat pests.

2. Research Method / Proposed Method

The process of planning and building an Internet of Things (IoT)-based electric mouse trap uses the waterfall method, which is a systematic and sequential approach in developing an electric mouse trap. Waterfall is a structured and sequential approach that allows implementation to remain focused on each stage of development with full attention, from the initial planning stage to the implementation stage [8].

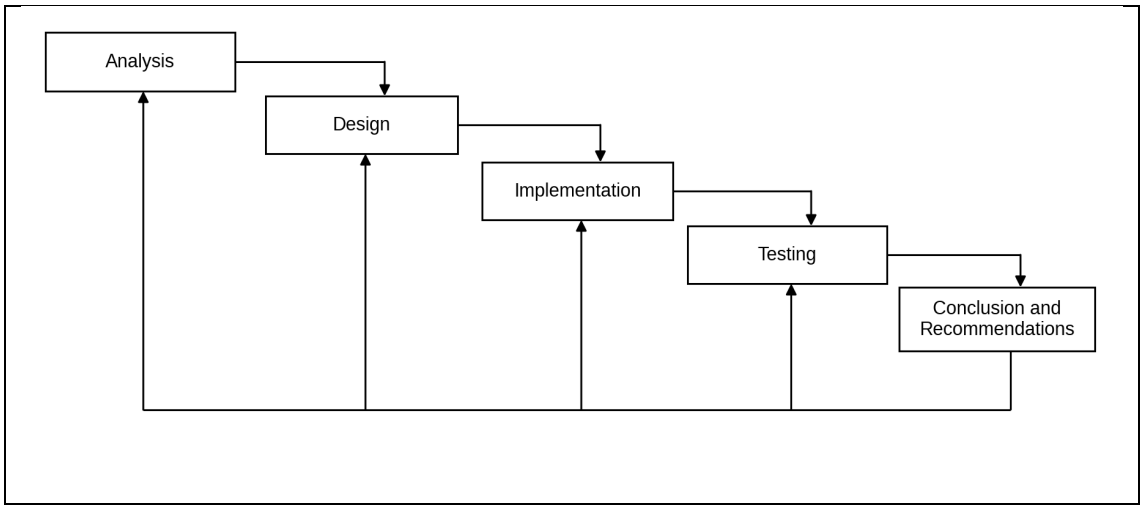


Figure 1. Waterfall Method

Figure 1 illustrates the Waterfall model of the Software Development Life Cycle (SDLC). System development begins with analyzing the tool to be built, then designing the tool and implementing it directly. The tool is then tested and then proceeds to conclusions and recommendations.

3. Literature Study

This discussion explains the results of system design and program implementation. The system design will be explained using a flowchart, and the implementation will be explained from assembling the tool and using the Telegram Application Bot.

3.1. Tool Overview

An illustration of the design of the Internet of Things (IoT) based Electric Mouse Trap can be seen in Figure 2.

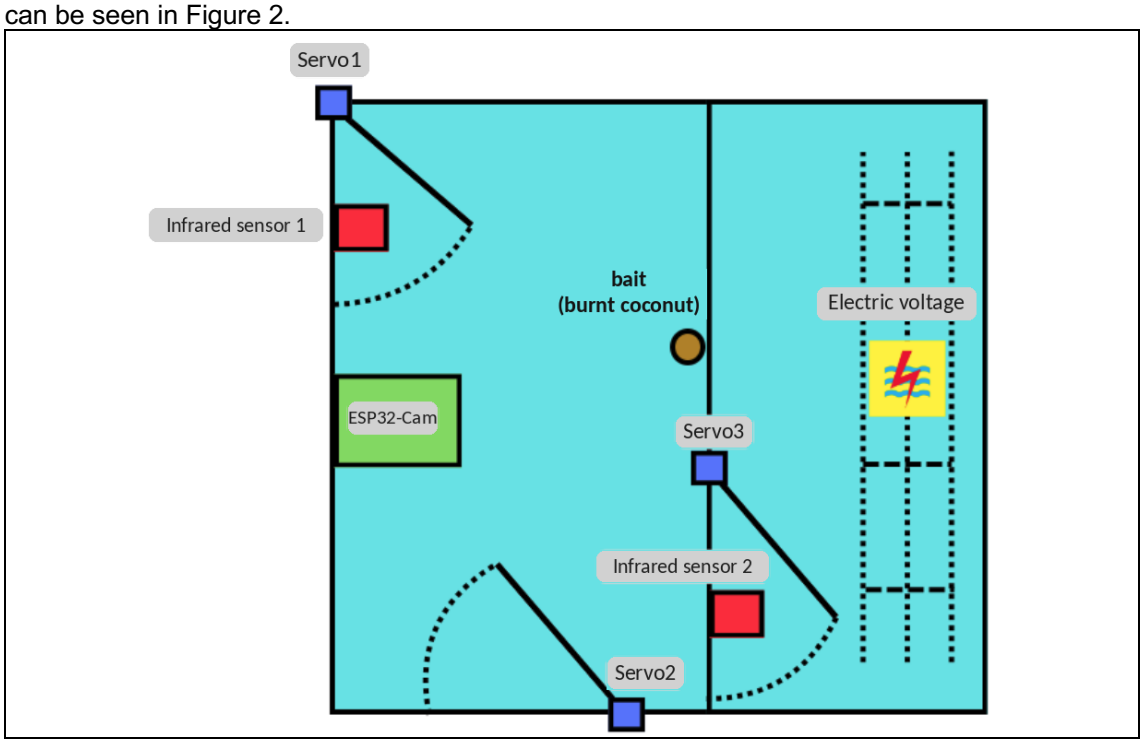


Figure 2. Tool Overview

Figure 2 is a design of an Internet of Things (IoT) based Electric Mouse Trap which consists of several tools, namely Arduino Nano v3 which has the task of being a microcontroller board that will move all commands to each of the other components, a servo motor that aims to open and close the door, The e18-d80nk Infrared Sensor has the task of detecting an object by reflecting infrared light[9], ESP32 cam as monitoring incoming objects, Relay, and 12V Adapter as an electric current controller

3.2. System Design

The design of an Internet of Things-based automatic mousetrap with a Telegram application requires several components to support its performance.A Telegram bot is a robot programmed to carry out user-generated commands. A bot is a Telegram account operated by a device with AI capabilities. Telegram allows third parties the freedom and openness to develop new Telegram bots [10]. Figure 3 shows the design of an automatic mouse trap system using the Telegram application.

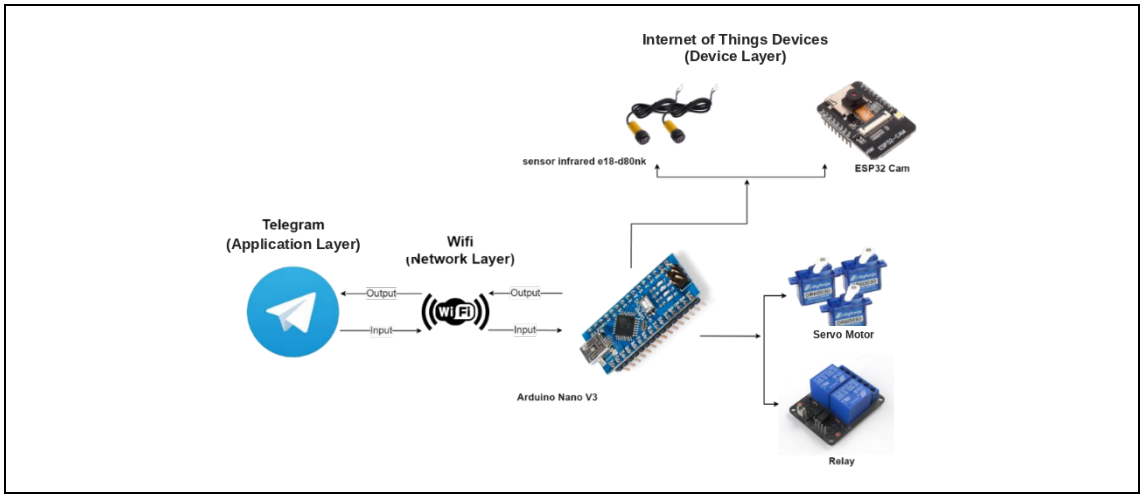


Figure 3. System Design

This design uses the Telegram app to control a trap connected to a Wi-Fi network. Data obtained from the infrared sensor and ESP32 Cam is processed by an Arduino Nano v3 to drive a servo and send information to the Telegram app. The Telegram app can then be used to activate a relay to electrocute the rat.

3.3. Flowchart

The flowchart of the tools used in this research can be seen in Figure 4. The options and actions taken to run the program are displayed in the flowchart. The steps are shown graphically, with connecting lines or arrows.

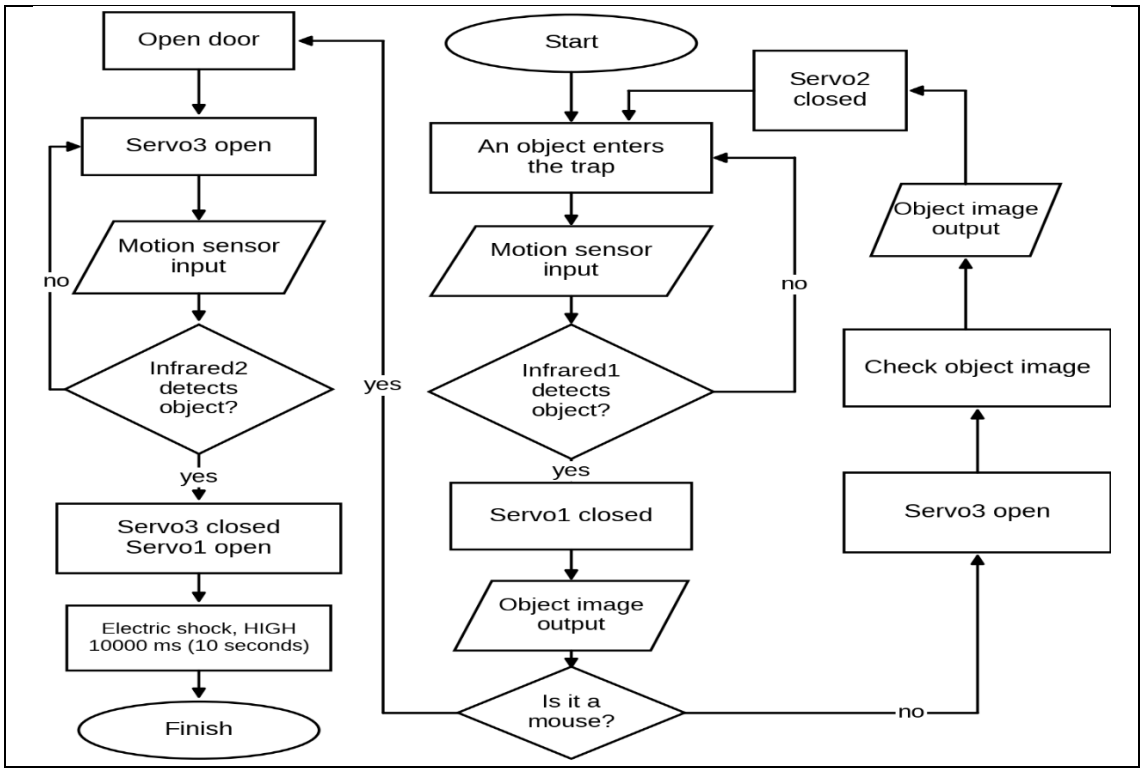


Figure 4. Feature Schema

The Automatic Mouse Trap flow diagram in Figure 4 connects the trap to a power outlet and a wireless network is the initial stage of operation of this device. Servo1 (Gate1) will close the trap door as soon as an object enters. Next, the system will take a picture of the object and

send it to you using Telegram Bot. If the object is not a mouse, then it can be released by opening the side door (servo3) using the /release command then we can also check whether the object has left the trap by giving the /check command, if the object has left the trap then we can give the /close command to close the door again. Furthermore, if the one that enters is a mouse then we can give the /opengate command to open gate 2 which leads to the deepest part of the trap, if the mouse has entered gate 2 and is detected by the Infrared2 sensor then gate2 (servo2) will close and gate1 (servo1) will open.

4. Result and Discussion

This section presents the results of the tests carried out on the Internet of Things based electric mouse trap and discusses what those results mean for rodent control. Testing was divided into three stages: assembly of the hardware, capture of an object identified as a mouse, and release of an object that was not a mouse. In every stage the Telegram bot acted as the only user interface, so each stage also tested the communication path between the trap and the user.

4.1. Tool Assembly Test

IoT device assembly refers to the process of assembling the electronic components and hardware needed to create a device connected to an IoT network. This assembly process involves several steps, including preparation, component installation, connection, and testing.

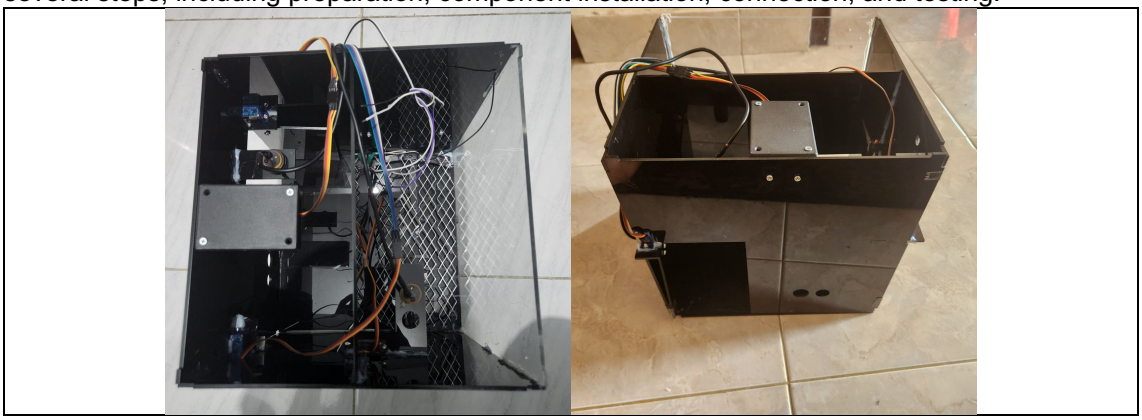


Figure 5. Mouse Trap Test

Figure 5 shows the final assembly of the mousetrap. The image above shows the device assembled according to the specified design and components. The trap has two chambers: a trap chamber and a stun chamber for executing the target.

The assembly test showed that the components could be combined into a single working unit. The Arduino Nano V3 drove the three servo motors and the relay, while the ESP32-Cam operated as a separate module that supplied the images sent to the user. The two-chamber layout separated the function of holding an object from the function of executing it, so that an object could be inspected before any decision was taken.

4.2. Object Capture Test

The following is a test when trying to catch an object that is known to be a mouse and trying to catch and electrocute it.

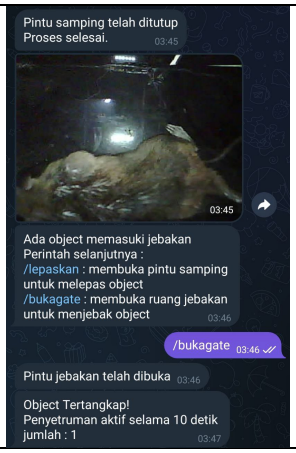


Figure 6. Object Capture

Figure 6 shows the command to capture an object that has entered a trap. Sending the */bukagate* command to the bot will open the middle door (servo3) and direct the object into the stun chamber where it will be executed.

The capture test showed that the sequence designed in the flowchart ran as intended. The first infrared sensor detected the object entering the trap, Servo1 closed the entrance, and an image of the object was sent to the user through the Telegram bot. Only after the user had seen the image and issued the /bukagate command did Servo3 open and direct the object into the stun chamber, where the relay was activated for 10 seconds until the mouse was helpless.

4.3. Object Release Test

The following is a test when an object enters the trap and it is known that the object trapped is not a mouse and is about to be released.

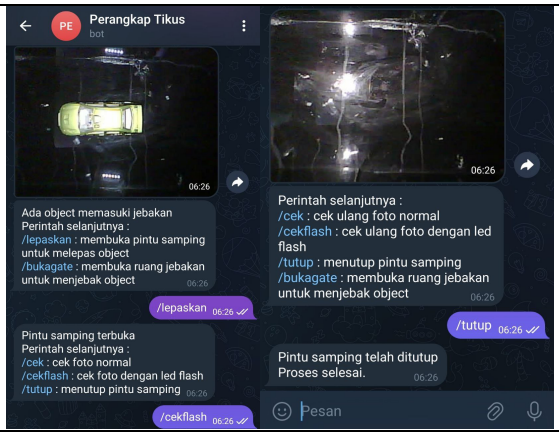


Figure 7. When Releasing an Object That Is Not a Mouse

Figure 7 is a command if you want to release an object that is not a rat. By sending a release command to the bot and the tool will open the side door (Servo2) so that the object can come out of the trap by itself, we can also ensure that the object has left or is still in the trap by giving the command /check or /cekflash to see the situation inside the trap.

The release test showed that the system could also be used without harming the object. When the image sent by the bot showed that the trapped object was not a mouse, the /lepaskan command opened the side door driven by Servo2 and the object left the trap on its own. The /cek and /cekflash commands allowed the user to confirm that the trap was empty before the /tutup command closed the side door again. This shows that the decision to execute an object rested with the user and not with the device.

4.4. Telegram Bot Command Set

All interaction between the user and the trap took place through a Telegram bot. The bot sent a notification and an image whenever the first infrared sensor was triggered, and then waited for a command. Table 1 lists the commands accepted by the bot together with their functions.

Table 1. Telegram bot commands and their functions

Command	Function
/bukagate	Opens the gate between the trap chamber and the stun chamber so that the object is moved into the stun chamber
/lepaskan	Opens the side door driven by Servo2 so that a non-target object can leave the trap by itself
/cek	Sends a still image of the inside of the trap without the flash
/cekflash	Sends a still image of the inside of the trap with the LED flash active
/tutup	Closes the side door and ends the release process

4.5. System Response Time

The responsiveness of the system was measured from the moment a command was sent through the Telegram bot until a reply was received. The response time ranged from two to five seconds and depended on the stability of the internet connection at the location of the trap. Because both the notification and the image travelled over the same connection, a weak signal delayed the image more noticeably than the text message. The relay was activated for 10 seconds, the duration set in the firmware and confirmed by the bot in its reply message.

4.6. Discussion

The results indicate that combining a microcontroller, infrared sensors and a camera module with a messaging application produces a trap that can be operated without the user being present at the site. This addresses the main weakness of a conventional trap, which has to be checked manually and gives no indication of whether it has been triggered.

The most important difference between this system and the traps reported in earlier studies lies in where the decision is made. The traps described in [5] and [6] automate the capture itself, while the system in [7] applies the C4.5 algorithm to classify the trapped pest. In the system built here the image is sent to the user and the shock is triggered only after an explicit command, so a non-target animal is released rather than executed. The cost of this design is that the system cannot operate unattended: if no command is given, the object stays in the trap chamber.

Several limitations were observed. The infrared sensor detects any object that passes in front of it and cannot distinguish a mouse from another animal, so identification still depends on the user reading the image. The image quality also depends on the lighting inside the trap, which is why the flash command was provided. Finally, the whole system depends on a stable internet connection; when the connection is weak the notification and the image are delayed, and the user's response is delayed with it. Adding automatic image classification and a local fallback mode would reduce both limitations.

5. Conclusion

Various conclusions can be drawn from the problem formulation, research objectives, research findings, and discussion. The Arduino Nano V3 microcontroller, which can be controlled remotely via the Telegram application using the Telegram Bot API, plays a crucial role in the successful implementation of the system. The electric mousetrap to be built using the Telegram application is assembled according to the plan and design. This mousetrap has been tested using real mice and is capable of catching mice or releasing objects other than mice from the trap, and is capable of electrocuting mice with a 10-second shock cycle until the mouse is helpless inside the trap. This system has proven effective and responsive, with an average response time for sending commands and receiving responses from the Telegram Bot ranging from 2–5 seconds, depending on the stability of the internet connection.

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