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Arduino-Based Mosquito Trap Design

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ABSTRACT
Mosquitoes are widely recognized as carriers of dangerous diseases such as dengue fever, malaria, chikungunya, and Zika, which pose serious public health problems in tropical regions. Conventional mosquito control methods, including chemical spraying, coils, and fogging, have several disadvantages such as health risks, environmental pollution, and reduced effectiveness due to mosquito resistance. This study presents the design and implementation of an automatic mosquito trap based on Arduino Uno as a safer and environmentally friendly alternative. The system was developed by integrating temperature and humidity sensors, light sensors, a ultraviolet lamp, and a direct current fan, which were controlled by a microcontroller and relay modules. The operational logic was programmed so that the lamp activated in low light conditions with optimal temperature and humidity for mosquito activity, while the fan provided suction to direct mosquitoes into a container. The device was assembled and tested indoors to evaluate its automatic functionality. Results showed that the system consistently responded to environmental conditions by activating components without human intervention, effectively attracting and trapping mosquitoes. The prototype demonstrated reliable operation, low power consumption, and the potential for practical use in residential areas. This research indicates that an automatic mosquito trap designed with microcontroller technology can provide an effective and chemical-free solution for mosquito control, with the possibility of future development including improved design, alternative energy sources, and wireless monitoring capabilities.
***Keywords**: Arduino Uno; mosquito trap; ultraviolet lamp; temperature and humidity sensor; direct current fan*

INTRODUCTION

Mosquito-borne diseases remain a persistent public health challenge in tropical regions, particularly in countries such as Indonesia where climatic conditions support the survival and reproduction of mosquitoes. Dengue fever, malaria, chikungunya, and Zika are among the most dangerous diseases that continue to cause high rates of illness and, in many cases, mortality. The frequency of outbreaks, especially during the rainy season, illustrates the urgent need for sustainable mosquito control solutions that are effective and safe for both humans and the environment.

Conventional mosquito control methods that rely on chemicals such as insecticides, sprays, or fogging are still widely used in many communities. While these methods can temporarily reduce mosquito populations, they are associated with several drawbacks. Long-term exposure to chemical substances poses risks to human respiratory health, contributes to environmental pollution, and accelerates the development of resistance in mosquito populations. These limitations reduce the effectiveness of traditional methods and highlight the need for alternative solutions that are safer, more sustainable, and less dependent on chemical substances.

Advances in microcontroller technology provide new opportunities for the development of automated systems that can be applied in the field of mosquito control. Microcontrollers such as Arduino enable the integration of multiple sensors and actuators into a single device, allowing systems to operate autonomously with minimal human intervention. Several studies have shown that devices equipped with environmental monitoring and automatic control mechanisms can achieve higher efficiency and reliability in trapping mosquitoes. However, many existing prototypes are limited in scope, focusing primarily on single-parameter detection or lacking practical design considerations for household use.

This research addresses these gaps by presenting the design and implementation of an automatic mosquito trap controlled by Arduino Uno. The system integrates a temperature and humidity sensor as the primary environmental input, a ultraviolet lamp to attract mosquitoes, and a direct current fan to capture them into a container. The operational logic is programmed so that the device activates only when environmental conditions are suitable for mosquito activity. The objective of this study is to develop a functional prototype that demonstrates the feasibility of using microcontroller-based technology for mosquito control, providing a reliable, environmentally friendly, and chemical-free solution for residential applications.

METHOD

This research applied a prototyping method that involved iterative stages of design, assembly, and testing until a functional prototype was achieved. The approach was chosen because it allows step-by-step development, where the results of each stage can be used to refine and improve the system.

Research Type and Approach

The research was categorized as applied research with an experimental approach. The main focus was the design and implementation of both hardware and software components of an automatic mosquito trap controlled by Arduino Uno.

System Design and Procedure

The research began with a literature study to identify the requirements and specifications of the system. The design stage included the development of block diagrams, electronic circuits, and control algorithms. The hardware was assembled by integrating a temperature and humidity sensor (DHT11), a ultraviolet lamp to attract mosquitoes, and a direct current fan to capture mosquitoes into the container. The components were controlled by Arduino Uno through relay modules that served as electronic switches. The software was developed using the Arduino IDE, where the control logic was programmed to activate the actuators when environmental conditions were within the range of mosquito activity.

Tools and Materials

The main components used in this research included Arduino Uno, DHT11 temperature and humidity sensor, two relay modules, a ultraviolet lamp, a 12-volt direct current fan, a 12-volt adapter, jumper cables, and a breadboard for circuit assembly. The Arduino IDE software was used to develop and upload the control program.

Data Collection Technique

Data were collected through direct observation of the system's response to changes in environmental conditions. The parameters observed included the accuracy of sensor readings and the automatic activation of the ultraviolet lamp and fan according to the programmed logic.

Data Analysis

The collected data were analyzed descriptively by comparing the test results with the predefined system specifications. The analysis focused on evaluating the accuracy of environmental detection, the reliability of automatic operation, and the feasibility of applying the prototype in residential environments.

RESULT AND DISCUSSION

At this stage, an Arduino-based mosquito trap was successfully designed and tested in an indoor environment. The system consists of a DHT11 temperature and humidity sensor, an Arduino Uno microcontroller as the control unit, a relay module, an ultraviolet lamp to attract mosquitoes, and a 12-volt direct current fan to draw mosquitoes into the trap container. The system operates by monitoring environmental conditions, particularly temperature and humidity. When these parameters reach a range favorable for mosquito activity, the Arduino automatically activates the ultraviolet lamp and the fan to trap mosquitoes.

Testing was carried out in three main scenarios. First, with the system off, all components were inactive, there was no detection of environmental parameters, and the device displayed no response. Second, when the system was on and the environmental conditions were not favorable for mosquito activity, the sensors detected values below the threshold, and the Arduino did not activate the lamp or the fan. Third, when the sensor readings indicated conditions suitable for mosquito activity, the Arduino responded by turning on the ultraviolet lamp and fan. The lamp successfully attracted mosquitoes, and the fan provided sufficient suction to capture them in the container.

The test results for each component indicated that the entire device functioned properly. The Arduino Uno successfully read data from the sensor and processed it in real time. The DHT11 sensor accurately detected environmental parameters, the relay modules functioned as intended to switch the devices on and off, the ultraviolet lamp provided effective attraction for mosquitoes, and the fan operated reliably to capture them. Thus, the system demonstrated automatic, efficient, and accurate performance in trapping mosquitoes.

This system has the advantage of operating without chemicals, making it safe for household use, environmentally friendly, and energy-efficient, since it only works under specific conditions. Furthermore, the design is simple, practical, and does not require constant human intervention. These results are consistent with findings from previous studies that highlighted the effectiveness of combining ultraviolet light and airflow in mosquito traps. Overall, this system provides a simple yet effective solution for mosquito control in residential environments.

Result

The prototype of the automatic mosquito trap controlled by Arduino Uno was successfully designed and implemented according to the planned specifications. The system consisted of a DHT11 sensor for monitoring temperature and humidity, a ultraviolet lamp as an attractant, and a 12-volt direct current fan that functioned as a suction mechanism to capture mosquitoes into the container. All components were controlled by the Arduino Uno microcontroller through two relay modules.

Testing was conducted in an indoor environment under various conditions of temperature and humidity. The results showed that the system was able to read environmental parameters in real time and respond automatically. When the temperature was within the range of 25–35 degrees Celsius and the humidity exceeded 50 percent, the microcontroller activated the relay, turning on both the ultraviolet lamp and the fan. The ultraviolet lamp effectively attracted mosquitoes to the device, while the fan generated sufficient suction to direct the mosquitoes into the trap container.

Table 1 Example of Table Form

Group	Pre test	Treatment	Post test
Experiment (E)	O1 = Measuring environmental conditions without tools	X1 = Application of Arduino-based mosquito trap	O3 = Results of mosquito count measurements after treatment
Control (C)	O2 = Measuring environmental conditions without tools	X2 = Without the use of traps (control)	O4 = Results of mosquito number measurements without treatment

The results of the mosquito trap test are as shown in the following graph:

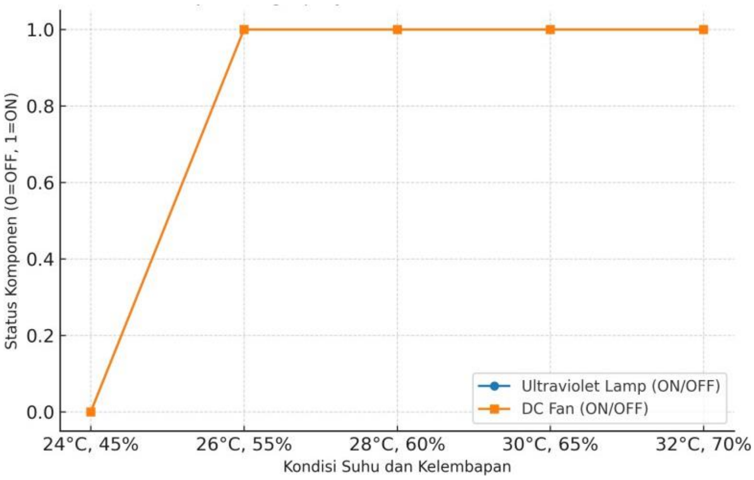

Figure 1. Mosquito Trap Performance

The system functioned consistently across repeated trials. It responded without the need for human intervention, successfully demonstrating its ability to work autonomously. The captured mosquitoes inside the container during testing confirmed that the device was effective in performing its intended function.

Discussion

The results demonstrate that the integration of temperature and humidity as environmental parameters is an effective basis for activating a mosquito trap. These parameters are strongly correlated with mosquito activity, as mosquitoes tend to be more active in warm and humid conditions. By using this approach, the device is able to operate only when there is a high probability of mosquito presence, improving both efficiency and energy conservation.

Compared to conventional mosquito control methods, this system offers several advantages. It operates without chemicals, making it safer for human health and more environmentally friendly. The automatic operation also provides greater convenience for users, as the device can function continuously without the need for manual activation. Furthermore, the system consumes relatively low power since its components are only active when environmental conditions trigger their operation.

In comparison to previous studies that primarily used ultraviolet light as the sole attractant, this research adds value by integrating environmental condition monitoring as the trigger mechanism. This selective activation not only improves energy efficiency but also increases operational effectiveness.

Despite these advantages, some limitations should be noted. The prototype was tested only in indoor environments, so its effectiveness outdoors has not been fully evaluated. The storage capacity for captured mosquitoes is still limited, which restricts its use to small-scale applications. Additionally, the device has not been integrated with wireless monitoring or data logging features, meaning that users must manually check the trap.

Overall, the findings of this research highlight the feasibility of using microcontroller-based technology for mosquito control. The developed system is effective, eco-friendly, and energy-efficient, making it suitable for residential use. With further development, such as increasing container capacity, integrating renewable energy sources, and adding wireless monitoring systems, the device could be optimized for broader applications in mosquito control efforts.

CONCLUSIONS

This research successfully designed and developed a prototype of an automatic mosquito trap based on Arduino Uno. The system integrated a DHT11 temperature and humidity sensor to monitor environmental conditions, a ultraviolet lamp as an attractant, and a 12-volt direct current fan to capture mosquitoes into the container. The test results showed that the device operated automatically according to the programmed logic, activating the trapping components when environmental conditions were within the range that supports mosquito activity.

Compared to conventional methods, the device offers several advantages: it is safe for human health because it does not use chemicals, environmentally friendly, practical due to its automatic operation, and energy-efficient as it only activates when necessary. However, the system still has some limitations, such as limited trapping capacity, testing limited to indoor environments, and the absence of remote monitoring features.

Overall, this study demonstrates that microcontroller technology can be applied as an alternative solution for effective and sustainable mosquito control. With further development, such as improving the device design, utilizing renewable energy sources, and integrating Internet of Things-based monitoring, this automatic mosquito trap has the potential to be widely implemented in residential areas as well as public facilities.

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