Design and Fabrication of Termite Scanner

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Abstract - *Termites cause severe damage to the building and wooden structures if they go unnoticed in the initial stages as they live in colonies by feeding on the cellulose-rich materials, they can disrupt the entire structure. To detect the presence of these termites thermal imaging technique can be used. Thermal sensors are devices which are used for tracking the temperature changes in a space or a system. Thus, by tracking the temperature variation, the presence of termites can be detected. The expected output of the temperature variation can be visualized on a screen in the form of thermal image.*

Key Words: **Termites, Thermal Imaging, Pest Control, Non-Destructive Testing, Environmental Monitoring**

1.INTRODUCTION

Termites are social insects belonging to the order of Isoptera. They are also known as "Silent Destroyers" as they pose significant threat to buildings and wooden structures. Termites live in colonies and feed on cellulose-rich materials, such as wood, paper and plant fibers, making them a considerable threat to wooden structures and other materials in buildings. Their presence in the initial stages of infestation remains hidden for extended periods before their presence becomes apparent. This hidden nature makes early detection challenging, allowing termites to cause substantial damage before the inmates are aware of the infestation.

2. HARDWARE

The major hardware components used in developing this portable termite scanner are NodeMCU ESP8266 development board, AMG8833 thermal image sensor and ILI9341 TFT LCD display.

2.1. NODEMCU ESP8266 DEVELOPMENT BOARD

The NodeMCU (Node Micro-Controller Unit) ESP8266 development board is an open-source development environment built using System-on-a-Chip (SoC) technology called ESP8266. It has high processing power with in-built Wi-Fi or Bluetooth and Deep Sleep Operating features. This development board can be powered using a Micro USB jack and VIN pin (External Supply Pin).

2.2. AMG8833 THERMAL IMAGE SENSOR

The AMG8833 thermal imaging sensor is a thermopile-type infrared sensor which detects the quantity of infrared ray by measuring the absolute temperatures in two-dimensional area of 8 x 8 (64 pixels). The sensor supports only I2C communication protocol.

Table -1: AMG8833 Thermal Image Sensor Specifications

Sl.No.	Feature	Specification
1	Number of pixels	64 (8 X 8)
2	Operating Voltage	3.3V
3	Viewing angle	60°
4	Accuracy	± 2.5°C (4.5°F)
5	Dimensions	25.8 mm x 25.5 mm x 6.0 mm

2.3. ILI9341 TFT LCD DISPLAY

The ILI9341 is a widely used TFT LCD display controller that is popular in the electronics and microcontroller community. Known for its compatibility with various microcontrollers and ease of integration, the ILI9341 supports vibrant and high-resolution colour displays with a resolution of 320x240 pixels.

Table – 2: ILI9341 TFT LCD Display Specifications

Sl.No.	Feature	Specification
1	Display Size	2.4 inch
2	Resolution	320 x 240
3	Display Panel	TFT
4	Pixel Size	0.153 X 0.153 mm
5	Driver	ILI9341
6	Interface	SPI
7	Operating Voltage	3.3V / 5V
8	Dimensions	70.50 X 43.30 mm

3. SOFTWARE

The project utilizes the Arduino Integrated Development Environment (IDE) for programming the NodeMCU ESP8266 development board. The IDE provides a user-friendly interface for writing, compiling and uploading the code to the NodeMCU ESP8266 module. In order to integrate various hardware components used in the termite scanner, the project also makes use of different library files including ESP8266 Wi-Fi Library, Adafruit AMG88xx Library, Adafruit ILI9341 Library and SPI Library for integrating the various hardware components used in the termite scanner.

By integrating these components effectively, the termite scanner offers an extensive solution for detecting and monitoring termite infestations using thermal imaging technology.

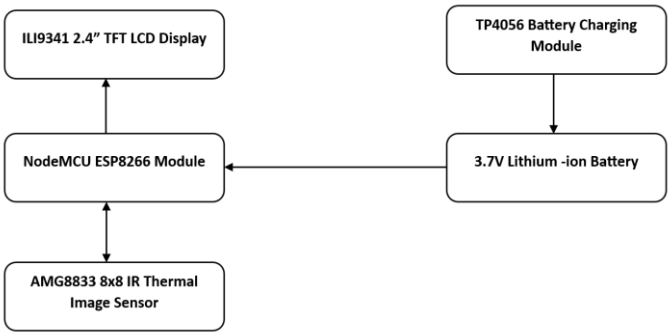
4. METHODOLOGY

4.1. THERMAL IMAGING

Utilizing thermal imaging technology has emerged as a highly effective methodology for the detection of termites, providing a non-intrusive and efficient means to identify these destructive pests. Termites, while consuming cellulose-rich materials such as wood, emit heat during their feeding activities. Thermal cameras excel in capturing these subtle temperature differentials, enabling professionals to precisely locate termite infestations concealed behind walls, within structures, or beneath the soil. This advanced technology proves particularly valuable in early detection, serving to thwart extensive structural damage before termites can inflict irreparable harm. By visualizing the thermal signatures associated with termite activity, technicians can thoroughly assess the scope of infestations, facilitating the implementation of targeted treatment strategies to mitigate potential structural compromises.

The incorporation of thermal imaging in termite detection not only enhances the accuracy of inspections but also obviates the necessity for invasive methodologies like drilling or structural disassembly. This non-destructive approach not only optimizes time and resource utilization but also minimizes disruption to property owners. Thermal cameras offer a lucid visual representation of temperature differentials, empowering pest control professionals to discriminate between areas affected by termite infestations and those that remain termite-free. Consequently, thermal imaging has become an integral component of contemporary pest management strategies, presenting an effective and environmentally conscientious solution for identifying and addressing termite issues within residential and commercial contexts.

4.2. BLOCK DIAGRAM



4.3. WORKING

Figure – 1: Termite Scanner Prototype

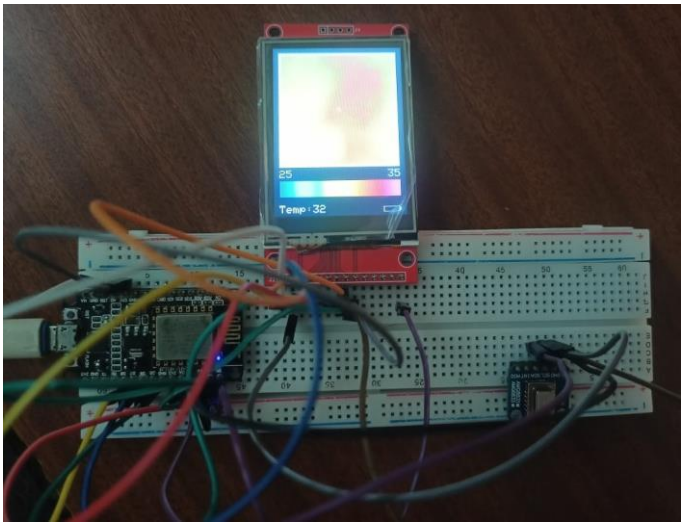
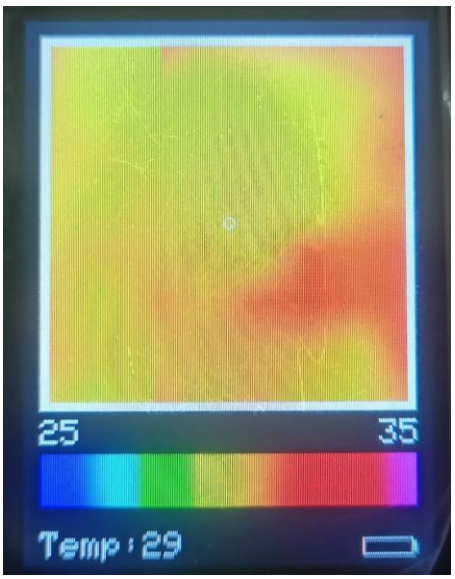


Figure – 2: Analyzed Thermal Image



The Termite Scanner utilizes Thermal Imaging Technology and is a sophisticated device constructed with the NodeMCU ESP8266 microcontroller, AMG833 Thermal Sensor, and ILI9341 Display. This innovative tool offers an effective solution for detecting termites efficiently. Acting as the central processing unit, the NodeMCU ESP8266 coordinates the integration of thermal imaging data, ensuring accurate and real-time analysis. The AMG833 Thermal Sensor, functioning as a high-resolution thermal camera, captures infrared radiation emitted by objects within its field of view, revealing subtle temperature variations indicative of termite activity.

With its ability to detect heat patterns associated with termite presence, the AMG833 Thermal Sensor identifies distinct thermal signatures in active termite galleries or infested areas. The NodeMCU ESP8266 processes this thermal data using intelligent algorithms, facilitating the identification of potential termite hotspots and mapping the extent of infestations. The ILI9341 Display serves as the user interface, presenting thermal images and highlighting areas of concern. This interactive display empowers users, including pest control professionals and homeowners, to visualize and interpret thermal information, enabling targeted interventions and preventive measures.

The seamless integration of the NodeMCU ESP8266, AMG833 Thermal Sensor, and ILI9341 Display in the Termite Scanner not only improves the efficiency of termite detection but also provides a user-friendly and accessible tool for the early identification of termite infestations.

4. RESULT AND DISCUSSION

The presence of termites in the wooden structure is inferred by analyzing the temperature variation in the wooden structures. Different tree barks are analyzed for the presence of termites.

Figure – 3: Neem Tree

Figure – 4: Mango Tree

Figure – 5: Moringa Tree

Table – 3: Test results of the termite scanner

Testing Material	Temperature of the bark	Temperature of infected tree bark
Neem Tree	28°C	30°C
Mango Tree	26°C	29°C
Moringa Tree	31°C	35°C

5. CONCLUSION

In conclusion, a significant advancement in the field of pest control is the development of a handheld termite scanner that makes use of thermal imaging technology. Termites, often known as “Silent Destroyers”, are a serious threat to wooden structures, therefore it is important to detect and treat them as early as possible to minimize the damage.

The AMG8833 thermal sensor, NodeMCU ESP8266 development board and ILI9341 TFT display are integrated to provide a non-intrusive and effective termite infestation detection method in the termite scanner. With the use of thermal imaging technology, infested areas may be precisely

identified and mapped out by capturing the minute temperature differences linked to the termite activity.

Overall, the termite scanner is a useful tool for both homeowners and pest control professional, facilitating early detection of termites and intervene to protect against termite-induced structural damage. By offering a clear visual representation of temperature variations, the termite scanner empowers users to make informed decisions regarding targeted treatment strategies and preventive measures. The use of thermal imaging not only improves accuracy of inspections but also removes the need for invasive methodologies, minimizing disruption to property owners.

REFERENCES

[1] Fang, Z.; Li, H.; Ma, Y.; Zhang, M.; Gao, S.; Chen, B.; Shen, J.; Zhang, D. "A Wireless System for Monitoring Termite Activity Using Electromagnetic Induction with Non-Looping Method." Appl. Sci. 2023, 13, 11956. https://doi.org/ 10.3390/app132111956

[2] Dr. S Jayakumar, K Srinivasan, R Pirainila, G Amitha Stains Mary, "An Experimental Study on Termite Tracker using Moisture sensor and Thermal camera", IOSR Journal of Engineering, 2019.

[3] M Farkhanda, "Biosensors for termite control", IOP Conference Series: Materials Science and Engineering, 2013, doi:10.1088/1757-899X/51/1/012014

[4] Yoshiyuki Yanase, Yoshihisa Fujii, Shogo Okumura, Tsuyoshi Yoshimura, "Detection of Metabolic Gas Emitted by Termites Using Semiconductor Gas Sensors", Forest Products Journal, Vol. 62, No. 7/8.

[5] Adel Abdalrahman Ziyed, Ahmed Y. Qasim, Raad S. Mahmod, Waleed A. Obaid, Muhanad M. Mohammed, "Investigating and Present of the Thermal Imaging Camera", International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 2, February 2015.