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An Experimental Study on Termite Tracker using Moisture sensor and Thermal camera

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Abstract: *One of the ideas is using moisture sensor which detects the moisture using electrical conductivity. There are several test methods available for the detection of moisture in these things one of them was ASTM methods they were used widely for the testing of timber and walls. The moisture content (MC) of porous building materials is often estimated via measurement of the resistance between two electrodes inserted into the material. The most common material to which this technique is applicable is wood. In general, the MC reading obtained is affected by several internal and external factors. Also in addition we have thermal imaging camera in order to capture the moisture or mostly used for termite tracking. Thermal cameras are passive sensors that capture the infrared radiation emitted by all objects with a temperature above absolute zero. The infrared thermal imaging camera was used so that we could visualize the moisture and also some other objects since it are thermal one. The result can be interfaced into an app. The expected output of the project is to create a model used to control the damage on building due to water by various stages which leads to heavy repair cost and maintenance. They are also help in process of extending life of the building using smart application of home products. the termites are mostly considered as cancer to various materials a thus to prevent them at earlier stages we could use this model and tend to reduce their impact on the building materials. The thermal imaging is also one of the newest model used for tracking of moisture and tends help in monitoring the temperature of the building to find the nest of termite if already present or in process of moving same applies to water leakage and finds the acute position of leakage for repair without much efforts.*

Keywords: *ASTM methods, Android Application, Electrical conductivity, Moisture sensor, Thermal imaging camera.*

I. Introduction

The main objective of the problem is to address the various parts, which are mostly affected by moisture and termite, which are hidden dangers to the structural deterioration. The increase in moisture and termite nest may lead complete destruction of structure in extreme and most of the conditions. The moisture is commonly available in atmosphere as humidity, through rainfall, capillary rise or through leaks in various waterfront structures. The entry of moisture may be in various amounts depending on the source but regardless of the amount, the damage may be attributed directly to the durability of the structure and the strength of the soil. Thus, we need to provide extreme durability of the structure against moisture but we can also measure the amount of moisture entering the building and may control them at early stage to prevent various problems in the future. Also the by measuring moisture ewe can completely avoid the entry of the wet wood termite which depend on moisture for living. The base of measuring moisture in the prototype uses ARDIUNO UNO type moisture sensor. The next phase is to track the termite which uses the same ARDIUNO based thermal camera to ensure the identification of the termite. The following pages will have a detailed explanation about the process used for tracking and their results. The main objective is to achieve complete tracking of termite and moisture at early stages and to remind the consumer to protect their building and save various cost effects. The result is displayed in an application in the phone for the convenience of the consumer.

II. Objective

2.1 Moisture Measurement

Average rainfall of USA, Finland, Scotland and India are tropical countries are greatly affected by the heavy rainfall and by relative humidity. When the relative humidity reaches 100%, the air will be saturated and humidity affects the strength of the building causing condensation, mold growth, slip hazards, damage tom equipment, corrosion and decay of the building fabric and the poor performance of the insulation and dampness.

Relative humidity also leads to health issues to the residents due to mold growth on the surface of the building. The Relative humidity is around 70% in Chennai, which contains almost 70 % of the Tamil Nadu population, and it is a metropolitan city developing into smart city where construction is difficult to carry out due to certain reasons like to traffic and high population. In addition, the waste generated in the building are high to be disposed which can be reduced if detected at initial stage.

2.2 Termite Tracking

Subterranean termites can consume 15 pounds of wood per week. They enter the buildings through the foundation by building mud tunnels within or over the walls in order to prevent the foundation termiticides are filled along the sides of the foundation. Unprotected buildings and wooden structures are prone to termite damage. If the termites are present inside the surface of a building it can be detected at a early stage because damage happens from inside out. Termite can be control by pre constructional anti termite treatment is the process where the termite can be found in the early Stage itself and this process will provide chemical barrier against the sub-terrain termites and benefits of this process are less expensive, fewer obstacles because pre anti termite treatment is lesser then post anti termite treatment.

III. Working

3.1 Arduino board specifications

The Arduino was a new innovation which is popular due to its online ide and also it is easy to code compared to other products available. Also it is economical and useful .The main advantage of the board is that it is an open source platform which consists of piece of hardware and software along with an online IDE which runs and helps us to develop the program based on our need. It also consist of a 5V battery, microprocessor, analog and digital pins, and an LED light to detect the output along with the USB cable which is used to connect the other required devices to the board to the per specifications. The Arduino platform [6] has become well acquainted with people into electronics. Unlike most previous programmable circuit boards [7], the Arduino does not have a separate piece of hardware in order to load new code onto the board; you can simply use a USB cable to upload. The software of the Arduino uses a simplified version of C++ [8], making it easier to learn to program, and it provides you with an easier environment that bypass the functions of the micro-controller into a more accessible package. Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF): The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

3.2 Moisture Sensor

Moisture sensor measures the volumetric content of water inside the soil and gives the moisture level asoutput it is equipped with both analog and digital output so it can be used in both modes. It consists of two probes that allow the current to pass through the soil and receives the resistance value to measure the moisture value. Increase in moisture level is directly proportional to high electrical conductivity which means there exists less resistance. In case of dry soil electrical conductivity will be poor which leads to more resistance.

Table: Input and output result of the moisture sensor

Input voltage	3.3 – 5V
Output voltage	0 – 4.2V
Input current	35mA
Output current	Both analog and digital

3.3 Thermal Camera

The thermal imaging sensor is a one kind of sensor used to determine an image based on the absolute temperature of the object. The image is formed based on the object's heat signature. These devices record the present signatures of the devices based on their heat pattern and do not require a beam such as active infrared devices. The range of thermal imaging is ranges from -50^{0}C to 2,000^{o}C. The light which is focused is scanned by a phased collection of IR detector elements. These elements produce a much expanded temperature pattern denoted to as a thermogram. It only takes regarding one-thirtieth of a second for the array of detector to get the data of the temperature to form the thermogram. This temperature data are found from several thousand points in the field of view of the detector array.

3.4 Thermal Imaging Working

- The Thermogram formed by the detector elements is transformed into electrical impulses.
- The impulses are directed to a signal-processing unit, a circuit card with a chip that reads the information from the fundamentals into data for the display.
- The signal-processing unit sends the data to the display where, it seems as several colors depending on the strength of the infrared radiation. The combination of all the impulses from all of the elements makes the image. It is quite forthright to examine everything during the day, but at nighttime you will be able to see slight or no. This imaging allows you to see once more.

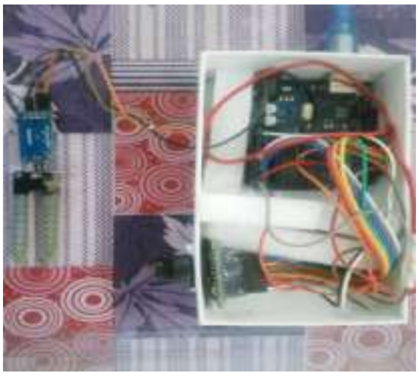

Fig 1: protoype model

IV. Result And Discussion

The soil moisture sensor consists of two probes, which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value a bolometer is a simple sensor that absorbs thermal radiation, and changes resistance as a result. This change in resistance can be electrically measured, and the incident radiation (which should be a function of the object's temperature) can be determined.

Fig 2: The tested wood and concrete

Table: Test results of the termite tracker

Testing material	Dry state	Saturated state	Normal state
	MC	MC	MC
Wood	0-3%	100%	12-23%
Concrete	0%	90%	10-15%
Soil	0%	100%	20-25%

A bolometer is a large thing, so in this case, the small array of sensors in the cameras are micro bolometers. The above-mentioned data are entered after absorbing and testing for the materials with various moisture content over a wide range. The project could currently sense moisture up to 0.25m which is enough to measure till reinforcement of the bars, The product was completed its prototype stage which could measure the almost all materials. As above mentioned India is one of the largest countries with second largest population in the world such a country could use these type of advanced projects to increase the safety of building and ensuring the safety of the people in it. Also the thermal imaging camera generates thermograms which could be read for accurate location of moisture and termite nest.

Fig 3: Final output in the application format

V. Conclusion

- As per various investigations and studies with various physical methods we can say that the acceptable moisture content is found to be around 10-12% for normal building and walls.
- In case of sub-mediterrain or wet wood termites we can accept moisture level up to 15% of moisture the termite growth and movement are not aggravated after which the movement may be high.
- The surrounding humidity and pH of the concrete or wooden materials also affects the growth of the termites and surrounding moisture.

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