IOT-BASED SMART LIQUID MOSQUITO KILLER FOR SMART HOMES: A PROSPECTIVE OF INDUSTRY 4.0 TECHNOLOGIES

Abstract

Mosquitoes kill at near about 2.7 million people each year. Currently, with over 100 million instances reviewed yearly, most reported cases will be verified. The mosquito population in India and other countries is rapidly expanding. The world's tropical and subtropical nations are susceptible to the mosquito-borne disease dengue fever. In recent decades, the global prevalence of dengue fever has skyrocketed.

Purpose: We have conventional mosquito-killing equipment that is not influenced by this reason for insect killing. In this automated world, we require machines that will decrease human involvement with the machine and will automatically recognize and execute on the surroundings. For example, eradicating mosquitos and providing a safe environment for humans to live in.

Findings: In the market, we are having Good Night, All Out such types of mosquitos killing machines. They are good but nowadays we need something better. This concept going to advance the mosquito-killing strategy and give us maximum output from mosquito-killing machines.

Impact on Technology: We are living in an exciting era of technical and digital change. We now have AI assistance, smart assistants, autonomous cars, cobots, sophisticated cancer detection systems, and of course the Internet of Things (IoT) at our fingertips because of recent advancements in data science. As a result, a smart mosquito killer based on the Internet of

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Things idea is being proposed as an addition to home automation.

Impact on society and environment: With the aid of IoT, we may create a machine that can be operated automatically by mobile phones, and 11timers, and will adapt to its surroundings. The proposed machine is designed to provide a safe atmosphere for humans while also utilising the utmost capacity of the machine to kill mosquitos.

Keywords: Industry 4.0 Technologies, Smart Home, Smart Mosquito Killer, Internet of Things, Home automation.

I. INTRODUCTION

The concept of "Industry 4.0" refers to the fusion of business, automation, and contemporary Internet of Things (IoT) technologies. IIoT stands for Industrial Internet of Things. Industry 4.0 is also known as IIoT. While IIoT has more industrial-focused applications, IoT is more consumer-oriented with features like Smart Homes, Home Automation, etc. In 2011 in Germany, the phrase "Industrie 4.0" was first used.

Internet of Things (IoT): The term "Internet of things" (IoT) is utilized to denote components that share data with other devices and systems through the Web or other network technology. The phrase "internet of things" has come under fire for being misleading because all a task is required to be associate to a grid and approachable separately.

1. **Home Automation System:** Home automation systems are a collection of interconnected smart devices that are incorporated into the home environment and accessible from a distance to simplify daily tasks and activities for residents. The usual function of this is to link controlled objects to a centralized location or "portal". The user interface for controlling the system employs ceiling terminals, tablets or desktops and laptops, a smartphone application, or a Web interface (UI) that may also be available off-site over the Internet.

   It provides significant opportunities for data sharing for personal security amongst relatives, friends, or other authorized individuals, and might potentially result in power-saving solutions with a positive impact on the environment.

   Modern homes are automated with lightbulbs, fans, and entertainment systems. We also desire automation in the medical field. The prevention of illnesses spread by mosquitoes makes mosquito-killing equipment very important in the health sector.

2. **Relation of Climate and Mosquitoes:** Climate change leads to global warming, which has gotten exacerbated due to the Earth's average surface temperature rising by around 0.7 °C over the past 100 years [2][3]. Scientists anticipate that the average global temp. of the Earth's surface will be added by 1°C to 3.5°C by the end of the twenty-first century. [4].

   Malaria and dengue fever have been disseminated globally and have a mosquito-vectored revival [7]. Asia and South Korea in particular have recorded a significant prevalence of Japanese encephalitis [8]. It is presently generally understood that exposure to mosquito bites can cause humans to get mosquito-borne illnesses such as filaria, encephalitis, dengue fever, etc. [9].

   According to research on diseases spread by mosquitoes in India, the period of respiratory infections may be prolonged, and encephalitis brought on by mosquitoes, such as Western horse encephalomyelitis and Saint Louis encephalitis, is expanding to northern India[10].

   In general, rising temperatures hasten the growth of parasites. On the other side, the environment can affect the host’s defensive mechanisms, vectors, infections, and behaviours. Although mosquitoes can only survive in a particular range of temperatures,

higher temperatures encourage them to feed on blood and reproduce [11]. Similarly, the pathogen's time to maturity is reduced, increasing the maturity rate. For instance, Anopheles mosquitoes, which spread the protozoa that cause malaria, only live for a few days; the higher temp. allow malarial parasites to grow more instantaneously and enable culex to spread the disease more swiftly. Additionally, rising temperatures broaden the area where mosquitoes may survive. Anopheles mosquitoes transmit falciparum malaria when temperatures are higher than 16°C. Yellow fever and dengue hemorrhagic fever are contagious illnesses spread by Aedes aegypti mosquitoes, which are prohibited when the temperature is 10°C or lower. These kinds of chilly conditions are fatal to Aedes eggs, larvae, and adults. Aedes benefit from higher temperatures for both quicker reproduction and disease transmission [12].

Thus, ongoing warming might potentially influence mosquitoes and diseases spread by them, which would then have an impact on human health. In addition to expanding their geographic ranges, diseases spread more rapidly as a result of rising global temperatures. Reiter Paul asserted that the old days of diseases like malaria, yellow fever, and dengue demonstrate that the environment is seldom the primary driver for the spread of these illnesses. Instead, human tasks and the ecological footprints such tasks have locally are more important drivers for their spread [13].

3. **Contribution of IoT in Home Automation:** IoT gadgets are a component of the broader idea of building automation, which can also include multimedia, security, and CCTV systems in addition to illumination, ventilation, and climate control. Lengthy benefits might include reducing energy use by ensuring that lights and appliances turn off automatically or by keeping families informed of use.

The basis of smart houses or automated houses may be a portal or terminals that control gadgets and equipment. For instance, manufacturers may utilise Apple's HomeKit to control their home interior and devices using an iPhone version of the iPhone and iWatch. A specific application or an iOS native software like Siri may be the case. This is demonstrated with the Smart Home Basics line of smart home appliances from Lenovo, which can be controlled without a Wi-Fi connection using Siri or the Home app from Apple. The Amazon Echo, etc. are a couple of examples of unique intelligent house centres that are available as unique tenets to loop various smart house devices. Along with the proprietary, for-profit systems, there are also quasi, fully accessible ecosystems like Home Assistant, OpenHAB, and Domoticz.

II. LITERATURE REVIEW

A small amount of work is carried out in this area. The lifespan of mosquitoes has been decreased by global climate change, and mosquitoes are now more often used as disease vectors. Only looked at three illnesses spread by mosquitoes: malaria, dengue fever, and Japanese encephalitis. Each year, millions of individuals pass away from such diseases and infect billions of people. Despite our efforts to control malaria transmission by employing a range of strategies, anopheles illnesses continue to place as one of the important issues (including pesticides). Thus, this essay reviews the various mosquito control approaches. Pesticides may have more detrimental impacts on people and the environment than beneficial ones when used to reduce mosquito populations. It will take more time to investigate the

consequences to people and the environment, even though the creation of genetically modified mosquitoes inspires fresh expectations for sustainable pest control [1].

The purpose of mosquito repellents is to make surfaces uncomfortable or unappealing to insects. In addition to secondary substances that help in distribution and aesthetic appeal, they frequently contain an active agent that repels mosquitoes. Although they come in a variety of forms, including creams, lotions, and oils, aerosol products are the most popular. Various compounds have been employed historically to deter mosquitoes. Smoke, plant extracts, oils, tars, and mud are a few examples. As the science of insect repellents advanced, specific chemicals were found and isolated. This made it possible to create new, more effective insect repellents. The most of responders find that using fluid mosquito repellent heaters is an effective technique to keep mosquitoes away both during the day and at night when you're inside, according to a survey of 30 respondents to learn about the various types of repellents they use and how effective those repellents are at keeping mosquitoes away. The majority of respondents named mosquito nets for doors and windows, insect repellent quick cards, mosquito fixes or stickers, roll-on mosquito repellent lotions that can be applied to clothing, mosquito repellent lotions and creams, as well as mosquito repellent quick cards and gels as the ideal repellents [14].

The Solar-Operated Exterior Led Lighting Mosquito Capturing Unit in this study stands in contrast to the bulk of present mosquito safeguard and cultivated techniques employed by the general population, including the use of dengue netting, malaria swatters, anopheles lights, and other devices. In order to boost the concentration of carbon dioxide, they also put a photocatalyst coating on the mosquito snare, which increases the efficacy of mosquito capturing by helping to see the people's living ecology. In contrast to using reflecting optics, this was done in order to increase the area of physically catching insects and prevent parasite escape fans. Although mosquito-attractive temperatures, air movement, and co2 gas percentages have indeed been created recently, their placement possibilities have been limited by the location of the power source and the lack of systematic quantitative study of linked commodities. To imprison the impact of arresting more mosquitoes, the research uses the physical characteristics of the inciting factor more simply and less expensively which is suitable for usage by the general population. Future field-based mosquito traps might potentially benefit from the addition of light, colour, and photocatalysts at particular wavelengths to increase the attractiveness of dengue vector insects and be augmented by solar-powered systems. The goal of this research is to increase the range of mosquito traps and uncover other strategies for more successfully catching mosquitoes [15]. The proposed design and operation of an Internet of Things (IoT)-enabled gadget that would improve home automation by removing mosquitoes are the primary topics of this study.

III. NECESSITY OF STUDY

The following are a few critical social issues with standard mosquito repellents that were identified via study and survey:

- Mosquito can still spread illnesses including the Poliovirus, Calicivirus, Chikungunya, dengue, and influenza to people even when regular insect repellents are used. rashes, itching, and other skin infections that cause shortness of breath There could also be pain or chest tightness.

- People forget to switch off the Active+ mode in manual mode, which causes the beverage to be drunk more quickly.
- More human-machine interaction is occurring.
- Both, activate and deactivate modes are confusing for the user.
- To overcome the above major issue this system is proposed

IV. CONVENTIONAL MOSQUITO MACHINE AND ITS PARTS

Liquid mosquito repellent is a popular household item that is easy to use and replenish but whose operation is unclear to the majority of us. This knowledge will discuss the many exteriors and interior characteristics of a repellant, as well as how it functions.

Figure 1: Outer Body of Electrical Mosquito Repellant Machine

Figure 2: Backside of Repellent Electrical Plug Switch and LED

Figure 1 The front of a typical portable insect repellent is seen in the image above. This straightforward electrical gadget, which is made of light plastic, retains the repellant refill. There is a slider knob where the user may adjust how much liquid will be evaporated. A tiny rectangular aperture on the top of the repellant allows the vapours to escape. The electric plug seat and an LED that flashes while the repellent is in use are seen on the repellent's rear side in Figure 2. When the machine is in the ON state, the repellent's plastic body can tolerate the temperature increase.

Figure 3 The volume of the liquid evaporated is precisely proportional to the area of the wick that the repellent machine's heating element covers. The rate of vaporisation increases when more wick is placed close to the source of heat. The bottom portion of Figure 4 is seen in the figure below. This is where the liquid bottle is introduced and mechanically held by the machine. A knob switch is featured to aid the user in regulating the volume of liquid to be evaporated. The number of vapours will increase as the wick area under the heating element increases.

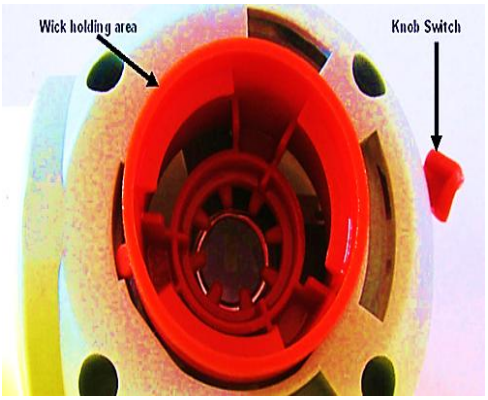

Figure 3: Knob Switch and Wick-Holding Area at Bottom of Repellent Device

Figure 4: Shows the arrangement of Wick Holds Liquid Bottle

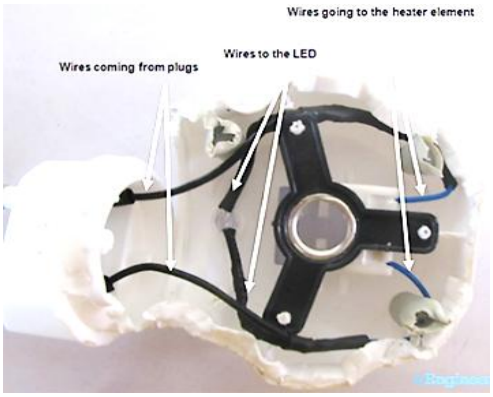

Figure 5: Shows the Wire Layout of the Repellent Machine

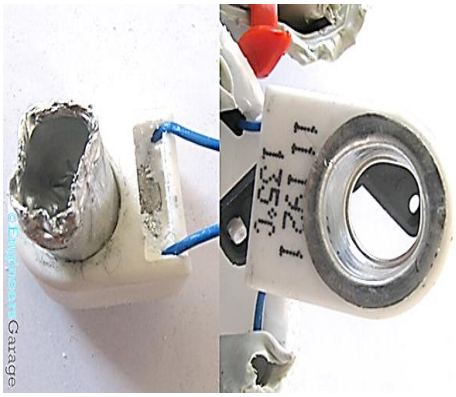

Figure 6: Shows the Heating Element of the Repellent Device

Figure 5 demonstrates how the repellent's internal wiring can be viewed when the plastic body is opened. Four wires are separated from the two that come from the plug seat. Out of these four wires, two are utilised to heat the element, which aids in evaporating the liquid in the refill, and the other two are connected to the LED to illuminate it.

The heating element of the device that wards off mosquitoes is seen in Figure 6. It is a hollow metallic cylinder-shaped ceramic Positive Temperature Coefficient (PTC) thermistor. A PTC thermistor's resistance rises as it becomes hotter. The use of a PTC is advantageous since it offers a cost-effective and effective way to act as a heating element. The PTC needs a temperature of roughly 135 °C to operate at its typical value in this situation. They have a quick response time since they may attain this temperature in a short amount of time.

Additionally, they have the propensity to restrict current, allowing for longer-lasting use of repellent machines. The metallic hollow cylinder helps to quickly heat the refill's wick.

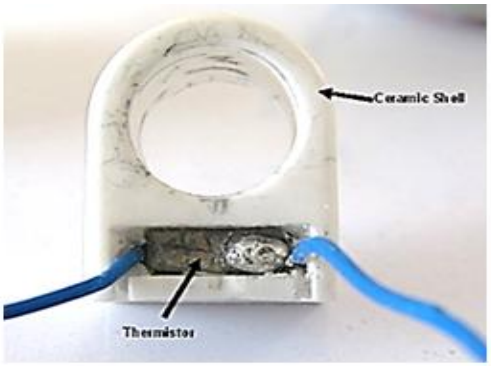

Figure7: Shows the Thermistor and Ceramic Shell of the Heating Element

Figure 8: Shows Thermistor with Wires Soldered

The thermistor and its ceramic casing are seen in Figure 7. Metallic coatings on the thermistor enable the wires to be soldered to it.The thermistor's positive temperature coefficient with its cables soldered on is shown in Figure 8. The cables are positioned on opposing sides to provide consistent heating.

V. IMPORTANT PARTS REQUIRED FOR IoT-BASED SMART LIQUID MOSQUITO KILLER FOR SMART HOMES

The typical mosquito machine will evolve into a smart mosquito machine with the use of Industry 4.0 technologies, such as IoT. The following are the major hardware elements of the suggested system for this development.

1. Switch Mode Power Supply:

Figure9: Shows Switch Mode Power Supply

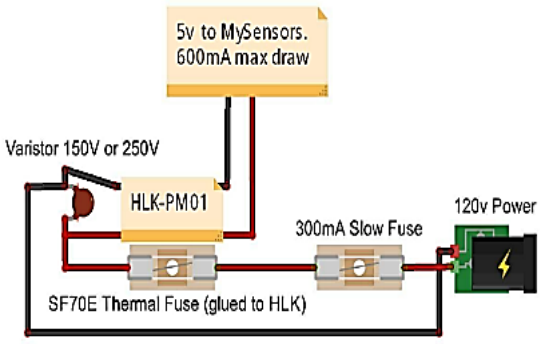

Figure10: Shows Circuit Switch Mode Power Supply

The Hi-Link HLK-PM12 Hi-link 12V 3W - AC to Voltage regulator unit is a Circuit board polycarbonate protected regulating jump voltage regulation device. Its 3-watt power rating and range of 12 Volts from 120-volt AC to high-voltage AC make it useful.Its incredibly small size makes it ideal for usage in spaces with limited space that require a 12-volt supply from the mains.

This module has numerous benefits, including minimal temperature increase, low energy consumption, highly reliable, highly efficient, highly secure insulation, etc. It is mostly used in instrumentation, communications systems, smart appliances, and mechanizationsectors, among others.

2. **Node Microcontroller Unit:** The Node MCU ESP8266 developer kits come with the ESP-12E unit, which contains the Embedded system and Tensilica Xtensa 32-bit LX106 RISC CPU. This IC supports RTOS and has a programmable clocked freq. range of 80 to 160 MHz.

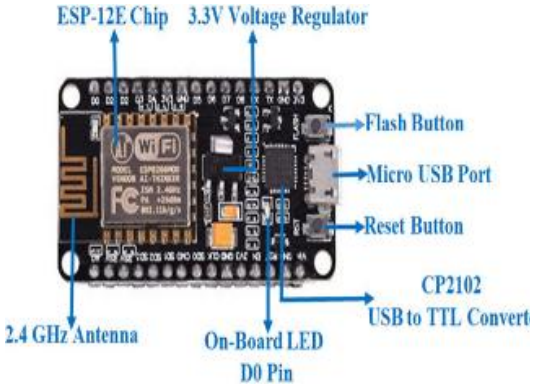

Figure11: Shows the Node MCU Development Board

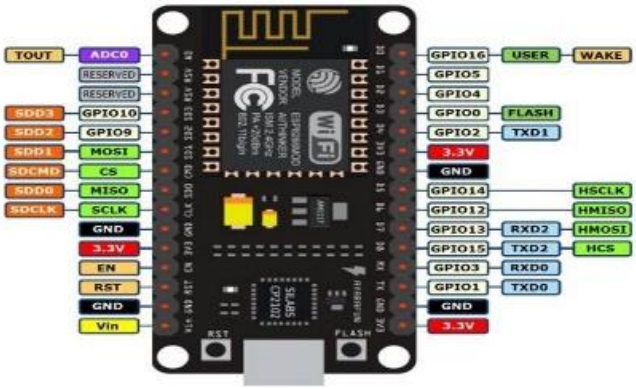

Figure12: Shows Node MCU Pin Diagram

Node MCU features 4 Megabytes of Flash storage and 128 Kilobytes of memory for saving data and programmes. It is perfect for IoT applications because of its potent processor, built-in Wi-Fi and Bluetooth, and Deep Sleep Functioning potential. The Micro USB connector and the VIN pin may accustomed to charge the Node MCU (External Supply Pin). The integrations with UART, SPI, and I2C are supported.

3. **Relay Module:** The quad 5V relays in the 4-channel relay module, along with the associated switching and isolating components, make it simple to incorporate a microcontroller or sensor with the fewest number of parts and linkages.

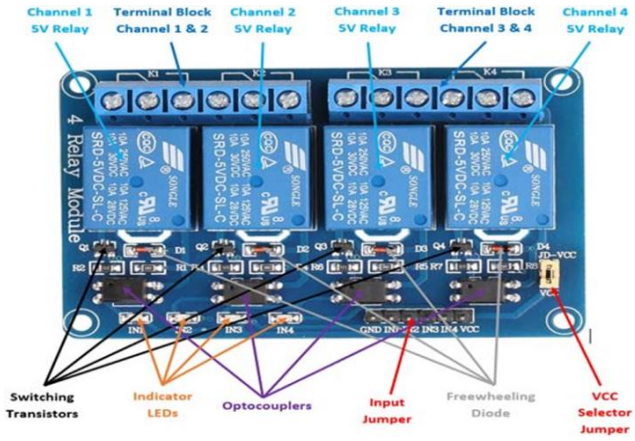

Figure13: Shows a Four-Channel Relay Module

Each of the 6 port serial data packets is combined by 2 relay. The screw design of the connections makes it easy and versatile to join to the main power wire. The 4 switches on the package are 5V-compatible, so they activate when there is about 5 volts throughout the coils. The body of each relay has markings for the connections that correspond to 250VAC, 30VDC, and 10A in each instance.

4. **MQ 6 Sensor:** Gases like butane and LPG can be sensed or recorded using the MQ-6 Gas sensor.

Figure 14: Shows MQ 6 Sensor

When you simply need to ascertained one particular gas, the MQ-6 sensor module's built-in Digital Pin allows it to function without the aid of a microcontroller. The analogue port, which is likewise TTL driven and operates on 5V and can be utilised with the majority of popular IC, must be used to measure the gas in ppm.

5. **Heating Unit:** It is a hollow metallic cylinder-shaped ceramic Positive Temperature Coefficient (PTC) thermistor. A PTC thermistor's resistance raises as it becomes hotter. There are two coils inside of this.

Figure 15: Shows MQ 6 Sensor

For low heat impedance and superb heat transfer efficiency, it uses an aluminium tube and a PTC ceramics heat source. Surface insulation and good security are two important characteristics of this PTC ceramic air heater.

VI. IMPORTANT PARTS REQUIRED FOR IoT-BASED SMART LIQUID MOSQUITO KILLER FOR SMART HOMES

The design of the proposed machine is done in Solid work CAD Software. The CAD model of important parts is shown below;

1. CAD Model of Outer Body :

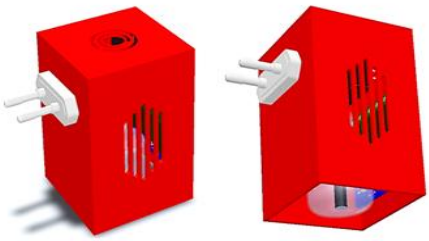

Figure16: Shows a CAD model of the Outer Body of the Proposed Smart Mosquito Machine

2. CAD Model of Internal Parts :

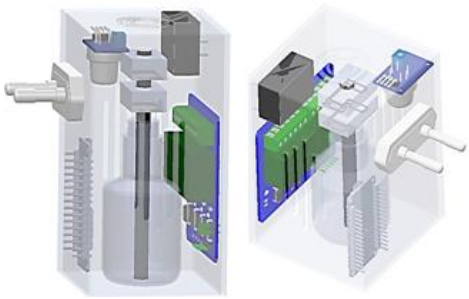

Figure17: Shows a CAD Model of the Arrangement of the Internal Body of the Proposed Smart Mosquito Machine

3. CAD Model of Transfluthrin Liquid Bottle for Mosquito Machine:

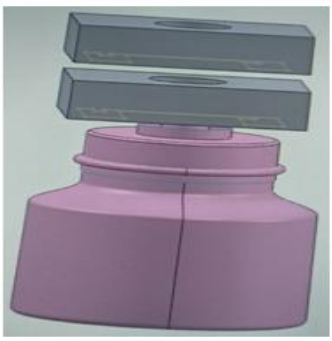

Figure 18: Shows a CAD model of the Transfluthrin Liquid Bottle of the Proposed Smart Mosquito Machine

4. Circuit Diagram:

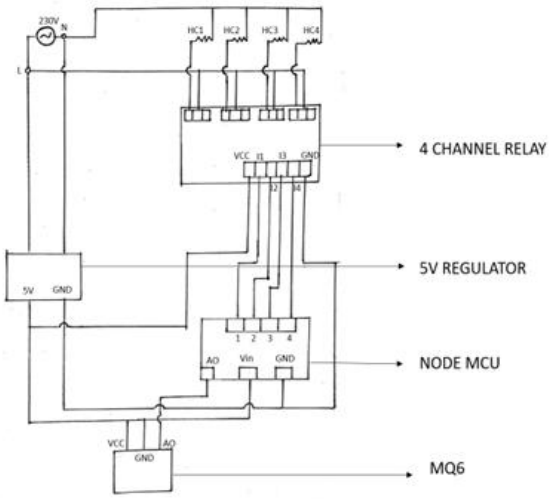

Figure 19: Shows a Circuit Diagram of the Proposed Smart Mosquito Machine

VII. WORKING OF PROPOSED SMART MOSQUITO MACHINE

An app is used to manage this device. For this platform, a customized Blynk webserver has been put up. The Java service known as Blynk Server, which runs on an Online platform, is in charge of relaying communications between the Blynk smartphone app and numerous micro-controller circuits. This software allows users to control our system. This smartphone software offers several options for various purposes.

The Node MCU, which controls the whole system, receives the information from the server.The four-channel relay module, which is installed inside the system and comprises four 5V relays together with the necessary switching and isolating components, enables a simple and low-component interface with a microcontroller or sensor.It has a 5V direct current to 230V alternating current since it needs an AC supply (i.e. Amplifier). Therefore, the coil is supported in heating by HLK-PM12 Hi-link 12V 3W - AC to DC amplifier. Its incredibly small size makes it ideal for usage in spaces with limited space and those that require 12V power from the mains. Because the voltage source for this Power Supply Module is a switching source, voltage grid fluctuations are not a concern.

The fluid inside the coil begins to evaporate as it begins to heat up. Through an app, you may regulate the coil heating process and alter the intensity of the coil. These coils are positioned within the mosquito-repellent machine's heating element. It is a hollow metallic cylinder-shaped ceramic PTC thermistor. A PTC thermistor's resistance rises as it becomes hotter. There are two coils inside of this. uses an aluminium tube and PTC ceramic heating components for low thermal conductivity and great heat transfer efficiency. Surface insulation and good security are two features of this PTC ceramic air heater.

Just above the liquid coil, an MQ 6 gas sensor is positioned to measure the density of the evaporating gas. Gases can be detected or measured with the MQ-6 Gas sensor. When you simply need to detect one specific gas, the MQ-6 sensor module's built-in digital pin

enables it to function without the aid of a microcontroller. The microcontroller unit receives the observed data and regulates the quantity of heating so that no extra liquid is dissipated.

VIII. FEATURES OF THE ANDROID APP

This programme has a slider that acts as an on/off switch and allows the user to control how much liquid will be evaporated.

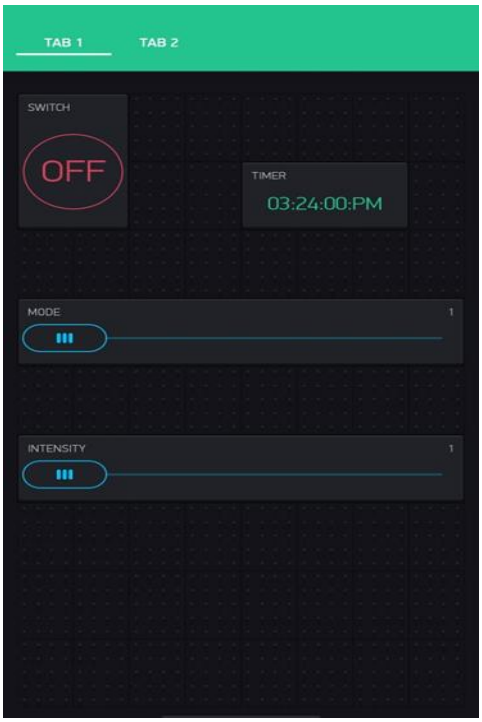

Figure20 Shows an Android App screen for the ON/OFF Tab

A little circular aperture on the top of the repellant allows the vapours to escape. The mode selected will determine the coil's heating strength and how much liquid will be evaporated.

This application has the following modes, including;

- Normal Mode
- Active Mode
- Child Mode
- Old Age Mode

1. **Normal Mode:** Only two heating coils will be active in normal mode. It will be energy efficient.

2. **Active Mode:** All four heating coils will be on in Active mode.The beverage is drunk more quickly.

3. **Child Mode and Old age Mode:** Every mode has a unique set of options. The liquid stops vaporising in each of these modes once it reaches a predetermined threshold. This option was added because too many of these gases can be detrimental to certain age groups.

4. **Intensity Slider:** This is additionally known as a custom mode. Users may configure their system to meet their specific requirements. The quantity of active heating coils has a direct relationship with intensity.

5. **Timer:** An electrical circuit called a timer has a clock built into it.

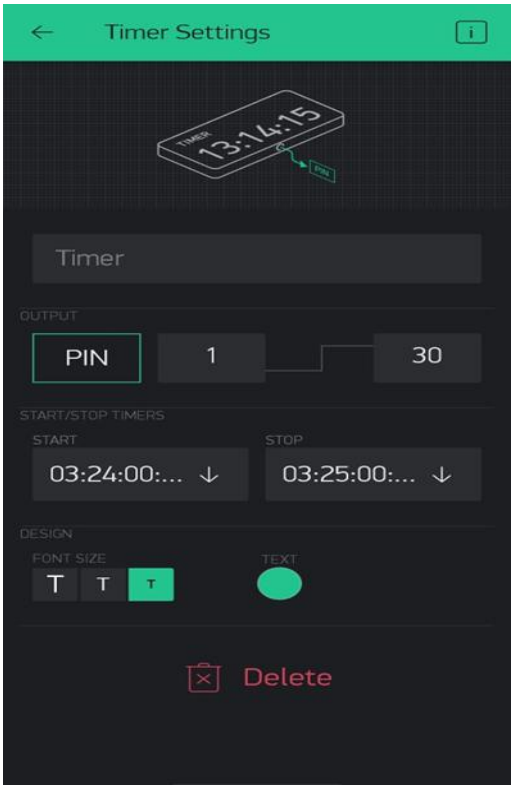

Figure 20: Shows an Android App screen for the Timer Setting Tab

The timer switches the system on and off according to the times you specify, acting as a conduit between the power supply and the light. The controls on these gadgets range from circular dials to digital settings.

IX. RESULT AND DISCUSSION

The user will receive the following special benefits from this suggested system:

- Applying four heating coils to the mosquito killer device will give it the most operating power. To avoid the illness spread by mosquitoes
- Because more power will aid in the reduction of mosquitoes.

- Zero manual control can be achieved with the use of IoT, and machines may be made more user-friendly.
- A clever machine that will automatically adjust to the atmosphere of the room using the MQ6 sensor and timer.
- The mobile application blink enables user control of the equipment.
- The user has the option to select one of four machine power levels: Normal, Active, Active+ or Ultra Mode.
- This inexpensive product, with an estimated cost of up to Rs. 2500/- roughly, will be a competitive one on the market.

X. CONCLUSION

Home automation is a relatively widespread practice today. to withstand the launch of a new product. It must have a mechanism that can be managed remotely. This device that may be operated remotely draws customers to the goods. On these factors, the system is suggested. It gives an automated system that can be controlled remotely with one click.

As a result of several mosquito-borne illnesses such as the Zika virus, West Nile virus, Chikungunya virus, dengue, and malaria, people are dying in large numbers. It is crucial to create a device that would lower mosquito populations in homes and workplaces.

The suggested Internet of Things-based mosquito killing device will be a comprehensive system that, thanks to its completely automated capabilities, will assist in reducing the number of mosquitoes in Modern days.

XI. ACKNOWLEDGMENT

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