

FLEXIBLE MOSQUITO POWER GUARD

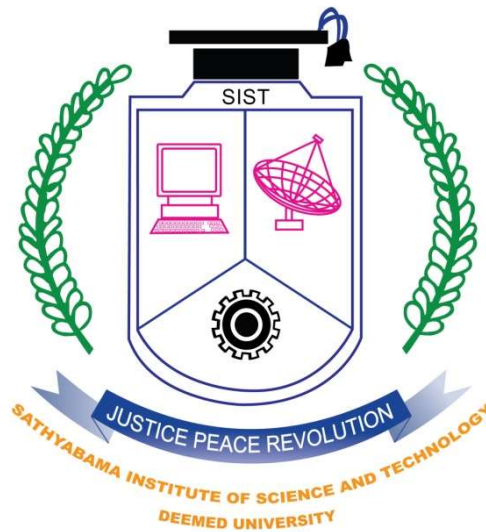
Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in
Electrical and Electronics Engineering

by

SARATHI S (Register No. 40140031)

SHANIK A (Register No.40140033)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A++" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2024



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

CATEGORY-I UNIVERSITY BY UGC

Accredited "A++" Grade by NAAC | 12B Status by UGC | Approved by AICTE

www.sathyabama.ac.in

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **SARATHI S** (Reg. No. 40140031) and **SHANIK A** (Reg. No. 40140033) who carried out the project entitled "**FLEXIBLE MOSQUITO POWER GUARD**" under our supervision from November 2023 to April 2024.


Dr. S. NIRMALRAJ
Internal Guide


Dr. S. RADHIKA
Head of the Department

Submitted for Viva voce Examination held on _____

Name:

Signature:

Internal Examiner

External Examiner

DECLARATION

We **SARATHI S** (Reg. No. 40140031) and **SHANIK A** (Reg. No. 40140033) hereby declare that the Project Report entitled “**FLEXIBLE MOSQUITO POWER GUARD**” done by us under the guidance of **Dr. S. NIRMALRAJ** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

1. 

2. 

DATE:

PLACE:

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr. N. M. Nandhitha, Dean, School of Electrical and Electronics** and **Dr. S. Radhika, Head of the Department, Dept. of Electrical and Electronics Engineering** for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Project Guide **Dr. S. NIRMALRAJ** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of our project work.

We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Electrical and Electronics Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

Mosquitoes are an important vector of disease transmission for human beings, including the West Nile virus, dengue, malaria, and Zika. There are many ways to control these but certain techniques of control, such as pesticides, may have negative effects on the ecosystem. Mosquitoes are ubiquitous carriers of disease that disperse throughout the world. Bed nets, insect repellents, mosquito bats, and kitchen insect killers are examples of prevention techniques. The proposed invention is a sophisticated mosquito-killing electric mesh designed for window/door installation, which can be attached as a window/door for commercial and industrial purposes. It modifies the concept of a mosquito bat insect killer. To develop a project under the domain Embedded Systems and Power Electronics with an innovative creation of a Flexible and affordable insect(mosquito) electric guard and to ensure safety with precautions measures. An ingenious mosquito killer or fly insect mesh employs electric pulses to zap intruders on contact. For added peace of mind, ultrasonic and passive infrared sensors automatically detect and help to deactivate the electric charge if someone approaches the mesh, preventing accidental contact, and the LCD displays a pre-warning message, the status of working, and alarms the buzzer. This innovative project merges effectiveness, ease, and security against pesky pests. The mesh incorporates an electrical system powered either by the Electric Board, with a voltage range of 20V to 24V. To safeguard the network circuit, a relay is implemented. Invention automatically powers on and off according to predetermined time settings. The perimeter of the mesh is fortified with plastic or rubber material, and its openable design allows for convenient opening and closing of the window. Additionally, a UV blue light is affixed to the window to attract mosquitoes into the room or hall, enhancing the efficiency of the mosquito or insect-killing system.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	v
	LIST OF FIGURES	viii
	LIST OF TABLES	ix
	LIST OF SYMBOLS AND ABBREVIATIONS	x
1	INTRODUCTION	
	1.1 GENERAL INTRODUCTION	1
	1.2 MOTIVATION FOR THE SELECTION OF PROBLEM	3
2	LITERATURE SURVEY AND EXISTING SYSTEM	
	2.1 MAJOR FINDINGS FROM LITERATURE SURVEY	4
	2.2 EXISTING SYSTEM BLOCK DIAGRAM	9
	2.3 OPEN PROBLEMS IN EXISTING SYSTEM	10
	2.4 DISADVANTAGES	10
	2.5 IEEE STANDARDS FOLLOWED	10
	2.6 CONSTRAINTS	11
	2.7 TRADEOFF	12
3	AIM AND SCOPE OF THE PRESENT INVESTIGATION	
	3.1 AIM OF THE PROJECT	14
	3.2 SCOPE OF THE PROJECT	14
	3.3 OBJECTIVES	15

	3.4	ADVANTAGES	16
4		HARDWARE AND PROJECT DESCRIPTION	
	4.1	BLOCK DIAGRAM OF POWER GUARD	18
	4.2	CIRCUIT DIAGRAM WITH EXPLANATION	19
	4.3	COMPONENTS	22
	4.3.1	Hardware Components	22
	4.3.2	Power supply circuit	32
	4.3.3	Aluminium Mesh	34
	4.3.4	Software Required	35
	4.4	WORKING MODULES	36
	4.5	FLOW CHART OF PWER GUARD	36
	4.6	ADVANTAGES	38
	4.7	APPLICATIONS	38
5		RESULT AND DISCUSSION	
	5.1	SIMULATION OUTPUT	39
	5.2	HARDWARE OUTPUT	41
	5.3	COST OF THE POWER GUARD AND ELECTRIC BILL	43
6		SUMMARY AND CONCLUSIONS	
	6.1	SUMMARY	46
	6.2	CONCLUSION	46
		REFERENCES	48

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
2.1	Block Diagram of Existing system	9
4.1	Proposed System Block Diagram	18
4.2	Circuit diagram of Proposed Diagram	20
4.3	Arduino nano	23
4.4	Arduino nano pin diagram	24
4.5	Ultrasonic Sensor	25
4.6	PIR Sensor	27
4.7	RTC DS1307	28
4.8	2x16 I2C LCD display	29
4.9	Buzzer	30
4.10	Relay	31
4.11	Power supply circuit for Arduino	33
4.12	Power Supply Circuit for mesh	33
4.13	Mesh layer	34
4.14	Flow chart of Power Guard	37
5.1	Simulation Output	39
5.2	Hardware Output	41

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
5.1	Cost of Power Guard	43
5.2	Electric Bill	44

LIST OF SYMBOLS AND ABBREVIATIONS

RTC – Real Time clock

TCP/IP – Transmission Control Protocol/Internet Protocol

PWM – Pulse with Modulation

LCD – Liquid Crystal Display

UV LED – Ultra Violet Light Emitting Diode

AC – Alternate Current

DC – Direct Current

PIR – Passive Infrared

MCU – Microcontroller

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Mosquitoes, infamous for their pivotal role in disease transmission, represent a significant threat to human well-being worldwide. Diseases such as malaria, dengue, Zika, and West Nile virus, spread by these blood-sucking insects, pose severe health risks to populations globally. In addition to the physical discomfort caused by mosquito bites, including allergic reactions and itching, their incessant buzzing and bites disrupt sleep and daily activities, contributing to a substantial economic burden through healthcare expenses and productivity losses. While traditional control methods, such as the widespread use of pesticides, have been effective to some extent, they often carry environmental consequences, raising concerns about their long-term sustainability.

Mosquito control encompasses a range of strategies aimed at curbing their population growth and reducing disease transmission. These strategies include the use of insecticides targeting both adult mosquitoes and their larvae, as well as source reduction efforts to eliminate breeding sites, such as stagnant water pools. Biological control methods, employing natural predators of mosquitoes, offer an environmentally friendly alternative to chemical pesticides. Another emerging approach involves genetic control, wherein sterile mosquitoes are released into the wild to disrupt breeding cycles and reduce population numbers.

Beyond these traditional and novel methods, a combination of measures is often necessary to effectively combat mosquito populations. Traps, mosquito bats, and kitchen insect killers provide additional tools for controlling mosquitoes indoors. Community education campaigns play a crucial role in raising awareness about mosquito-borne diseases and promoting preventive measures, such as the use of bed nets and insect repellents. Integrated pest management approaches, which combine various control methods tailored to specific contexts, have shown promise in achieving sustainable results while minimizing environmental impact. Ultimately, the success of mosquito control programs hinges on striking a delicate balance between environmental conservation and public health priorities. Sustainable solutions that prioritize the well-being of both humans and ecosystems are essential

for mitigating the threats posed by mosquitoes and the diseases they transmit. Active community engagement and collaboration between stakeholders are vital for the effective implementation of comprehensive mosquito control strategies, ensuring the health and safety of populations worldwide.

An electric mosquito swatter, commonly known as a mosquito bat, stands as a versatile and portable tool utilized for the eradication of mosquitoes and other flying insects. Resembling a tennis racket, it features an electrified mesh that delivers a lethal shock upon contact with pests. Activated by the user's swatting motion, this device swiftly dispatches mosquitoes in mid-air, offering an efficient and instantaneous means of insect control. Powered by rechargeable batteries, mosquito bats ensure functionality both during the day and at night, providing continuous protection against insect nuisances.

In parallel, kitchen insect killers represent specialized devices tailored for managing flying and crawling pests within kitchen and food preparation spaces. Available in various forms such as traps or electronic gadgets emitting ultraviolet light, they effectively lure insects towards their demise. Upon being attracted to the light source, insects meet their fate either through entrapment or electrocution, depending on the device's design. Certain models incorporate adhesive boards or trays to capture and contain insects, enhancing their efficacy in maintaining hygienic conditions and mitigating the risk of food contamination.

Despite their efficacy, traditional kitchen insect killers may face limitations in achieving optimal performance. In response to such challenges, innovative solutions have emerged, including the development of sophisticated insect-killing electric meshes tailored for installation on windows and doors. These advanced systems offer a discreet yet highly effective means of controlling insect populations, seamlessly integrating into indoor environments while providing enhanced protection against pests. Through the continual advancement of insect control technologies, individuals can safeguard their living spaces and food preparation areas against the persistent threat of mosquitoes and other insects, ensuring both comfort and hygiene.

This innovation, targeting commercial and industrial environments, aims to redefine mosquito control by reimagining the conventional mosquito bat. The following sections delve into the complexities of this pioneering endeavor, amalgamating ingenious technologies such as electric pulses, ultrasonic sensors,

passive infrared sensors, and programmable operational timing. The culmination of these advancements results in a remarkably efficient, user-friendly, and secure solution poised to combat pesky pests with unparalleled effectiveness.

1.2 MOTIVATION FOR THE SELECTION OF PROBLEM

Mosquitoes present a multifaceted threat to human health, transmitting deadly diseases such as malaria, dengue fever, Zika virus, and more, causing widespread suffering and economic hardship, particularly in vulnerable communities. Beyond direct health impacts, they disrupt daily life, impede socio-economic development, and pose a global health security risk. Controlling mosquito populations and developing effective prevention strategies are crucial steps in mitigating their far-reaching consequences and safeguarding human well-being. To address the mosquito problem in this project, a solution involving the reduction of mosquito populations is crucial. Implementing effective mosquito control measures, such as using mosquito power guard, can help reduce the number of mosquitoes in the vicinity automatically. By employing these methods, the mosquito count will decrease, alleviating the nuisance and health risks associated with mosquito bites.

CHAPTER 2

LITERATURE SURVEY AND EXISTING SYSTEM

2.1 MAJOR FINDINGS FROM LITERATURE SURVEY

Giovanni Benelli et al., (2016), Biological Control of Mosquito Vectors: Past, Present, and Future. Mosquitoes stand as the primary arthropod vectors of human diseases globally, facilitating the transmission of debilitating illnesses such as malaria, lymphatic filariasis, and arboviruses like dengue and Zika. Regrettably, most of these diseases lack effective treatments in the form of vaccines or medications, underscoring the critical importance of vector control as the primary preventive measure. However, the conventional reliance on insecticide-based strategies faces considerable challenges, notably the emergence of insecticide resistance. Consequently, substantial efforts have been directed towards developing alternative, environmentally sustainable methods. Biocontrol strategies have emerged as promising alternatives, aiming for sustainability while targeting a diverse array of mosquito species. In this review, we delineate non-insecticide-based approaches that have been implemented or are currently under evaluation. Additionally, we underscore the significance of leveraging mosquito behavioral knowledge to inform and enhance control strategies, thereby offering new avenues for combating mosquito-borne diseases.

John-Thones Amenyo, et al., (2014), KOM (Keep Out Mosquitoes) project: Anthro-po-philic terraforming and manipulation of landscapes for mosquito vector control in malaria disease management and eradication. The ongoing KOM Project aims to create affordable and sustainable mosquito-free zones in malaria-endemic regions like sub-Saharan Africa. Mosquitoes serve as vectors for various diseases such as malaria, Chikungunya, dengue fever, and yellow fever, making their isolation from hosts crucial for breaking disease transmission. The project introduces the concept of KOMKOM (Keep Out Mosquitoes = Keep Out Malaria) and KIMKIM (Keep in Mosquitoes = Keep in Malaria) to engineer habitations as bio-zones on a landscape scale. This involves establishing mosquito-free zones (MFZ) or mosquito-confinement-containment zones (MCZ) through the deployment of mosquito-impenetrable walls augmented with BTK (bait-trap-kill) units for mosquito control. The project is currently in the concept development stage, focusing on

subsystems like KOM (KIM) walls, BTK units, airlock technology, and automating vector destruction. Additionally, the companion MedizDroids Project explores the use of UAVs, drones, and multi-copters for mosquito control, aiming to eliminate mosquitoes from KOM (KIM) zones.

Li Kefeng, et al., (2020), Design of Mosquito Killers Based on Intelligent Lighting Control over Solar Energy and High-Voltage DC, this design of the mosquito killer is based on intelligent lighting control over solar energy and high-voltage DC. The device consists of the frame, solar module, control module, mosquito killing module. The solar module is fixed on the top of the frame, which uses the solar energy to store electric energy. The control module, which is fixed inside the frame, is connected with the solar module through a circuit. It controls the opening or closing of the control module through light control and temperature control. The mosquito killing module, which is fixed at the lower part of the frame, is connected with the control module through a circuit. When the control module is enabled, the power is supplied by the solar module, the mosquito killing module is enabled and starts to lure mosquitos and kill them. When the control module is disabled, the circuit connection between the solar module and the mosquito killing module is disrupted, and the mosquito killing module is disabled. The mosquito killer of this design uses the solar energy to supply electricity, light control and temperature control to realize time control of mosquito killing, the ultraviolet color light to lure mosquitos to approach, and the high-voltage power to kill them. It features high mosquito killing efficiency, environmental protection, and energy saving.

Mohammad Zeyad, et al., (2019) Design Proposal of an Automatic Smart Multi-Insect (Mosquito) Killing System. The aim of this work is to create an automatic and low-cost mosquito killing device which will help to save human life from mosquito bite which is responsible for creating non-invented medicine diseases. This paper illustrates an idea of simple but smart mosquito catching window system. Due to the electrocution between the mesh structures of the device, mosquitoes as well as insects will be instantly killed when they will try to make their way through the window. Compared to available mosquito killing bat in the market, this system will hold up very low voltage that is enough to kill mosquito and concurrently not harmful for human being. This process uses microcontroller, ATmega328p that receives data from the adapter and helps to measure the input current and voltage

which is displayed in an LCD Display (16*2) by using a logic algorithm code. It also consists of a power supply unit which is mainly used to charge the battery. The controls are made by a mini switch and have one LED power indicator.

Alpha. M, et al., (2016) Design and Construction of a Tripler Circuit for a Mosquito Zapper. The objective of his project is to diminish mosquito populations by leveraging electronics. This endeavor involves crafting a high-voltage tripler circuit for a mosquito zapper, capable of electrocuting mosquitoes effectively. Additionally, it encompasses the development of a dedicated power supply unit primarily intended for battery charging purposes. The zapper features a mesh with dimensions of 33cm by 23cm, consisting of one inner mesh and two outer meshes. User controls include a push button and two mini switches, complemented by indicators for charging and power status.

LYU Henan, et al., (2020) Intelligent Lighting System Design Based on UV LED Technology with the Functions of Air Sterilization, Disinfection, Purification and Mosquito Control. In response to infectious disease outbreaks, real-time air disinfection and mosquito control can effectively curb virus and bacteria transmission, aiding in epidemic prevention. However, existing air sterilization and mosquito control products often offer only singular functions. This paper introduces a technical design that integrates air sterilization, air purification, and mosquito control into lighting systems. It employs high-power UV LED modules within the light, coupled with intelligent control technology for precise radiation dose control, system airflow, and module switching. With benefits like high disinfection efficiency, safety, compactness, self-cleaning, long lifespan, and low energy consumption, this design finds broad applicability in classrooms, offices, workshops, supermarkets, and other settings.

James R. Mars, et al., (2012) Portable electronic lighted insect zapper. The battery-operated insect destruction device is designed in a shape reminiscent of a squash or tennis racquet, featuring a wide opening to facilitate insect contact with its two outer grids and inner grid. It offers both manual and static techniques for insect contact and destruction. Positioned at the uppermost section of the housing is an open area exposing a narrow strip of central grid adjacent to two ground grids, allowing insects discovered along wall-ceiling corners or where walls meet at a 90-degree angle, or between walls and floors, to be exposed. This addresses scenarios

where insect contact with the central grid or ground grids through the main openings of the grid support area proves challenging.

Lu Quan, et al., (2020) Mosquito killing device. The mosquito killing device described in the utility model consists of a shell, inner seat, fan, and electric shock net. The shell is composed of detachable upper and lower shells, with the inner seat fixed within the upper shell. Within the inner seat lies a cavity to house the fan, alongside a working circuit and a push piece located on one side. The circuit connects to both the motor driving the fan and the electric shock net positioned below it. A control switch is integrated into the circuit, while the push piece's movement, triggered by the lower shell's placement onto the upper shell, controls the switch's state. Upon assembly, the lower shell pushes the push piece upward, activating the control switch and powering the circuit. Disassembly reverses this process, deactivating the circuit for safety.

Ramakrishnan.P, et al., (2022) IoT based Industrial Automation for Various Load using ATmega328p Microcontroller. Automation has become an integral part of our daily lives, revolutionizing industries by enabling the monitoring and control of various appliances. Industrial Automation, in particular, has emerged as a cornerstone, overseeing machinery, motors, fans, lights, and air conditioners, thereby ensuring operational safety and efficiency. With the promise of conserving energy, reducing time consumption, and minimizing human intervention, Industrial Automation strives to streamline processes while enhancing productivity. Central to its objectives is the constant monitoring and regulation of industrial equipment, coupled with prompt alerts to personnel during emergencies. In this context, this paper advocates for a novel approach to industrial automation, leveraging Arduino and the Internet of Things (IoT). The proposed system not only aims to detect potential fire hazards within industrial settings but also offers comprehensive control over essential loads such as lights and fans. By interfacing the Arduino processor with industrial machinery and establishing internet-based communication, the system facilitates remote monitoring via a user-friendly web interface. Moreover, its cost-effectiveness underscores its accessibility and viability for diverse industrial applications. In essence, this innovative automation technology empowers users to remotely manage industrial operations, ushering in a new era of efficiency and convenience.

Vignesh Natarajan, et al., (2022) Automatic Temperature Control of Electric Motor Using PIC Microcontroller. Embedded systems for automatic control are crucial in modern times. This study implements a temperature sensor in an electric motor to ensure its safety and longevity. By interfacing an LM35 sensor with a PIC16F877A microcontroller, the system monitors motor temperature and enacts safety measures. These include PWM-based speed control for a cooling fan and motor speed adjustment. Simulation in Proteus validates system efficacy, highlighting its potential for enhancing motor safety and energy efficiency.

Ayan Kumar Biswas, et al., (2013) Design of a Fiber-Optic sensing mosquito Trap. Mosquito traps are essential for monitoring mosquito populations and disease transmission. However, existing designs often lack efficiency and consume excessive energy. To address this, we developed a novel trap with a fiber-optic sensor for sensitive mosquito detection. Our prototype features a gentle capture mechanism that preserves mosquito morphology. By selectively powering the capture mechanism, energy consumption is greatly reduced. Programmable fan control based on the sensor detects and counts each mosquito entry. This versatile trap can be powered by renewable sources, making it suitable for remote areas. Experimental results demonstrate a high success rate in live mosquito detection.

Jincy Jose, et al.,(2023) Development of a Multipurpose Solar Powered Insect Pests Trap: KRISHI VIKAS. Pest management is one of the major expenditures that can drill a hole in a farmer's pocket. Pesticides have the potential to harm human health while also reducing soil fertility. In addition to killing insects, pesticides can be toxic to a host of other organisms, including birds, fish, and non-target plants. Though there are several models and designs available, it is a solar-powered system that is independent of conventional forms of energy. It is the best project due to its multipurpose use, eco friendliness, cost-effectiveness, energy-efficient nature, and ease of handling. It helps to catch all the high-risk sucking pests like whiteflies, aphids, capsids, shore flies, leaf miners, cabbage root flies, thrips, etc., thereby reducing the adult population and subsequent progenies in the fields. The residues of these trapped flies can be turned into manure, which reduces waste. This feature will protect the farmers from the attacks of predators like snakes, etc. It acts as a street light while detecting human interference during the night. So it is an energy-efficient system. The system has a mobile charging facility and provides 5 V DC output. It also has a facility for the owners to keep the necessary things in the

locker of the system while working. The Krishi Vikas were developed as an effective way of controlling insects in agricultural fields. It is both environmentally friendly and cost-effective for farmers. The system is fully automatic and powered by solar, it can be used in rural village areas where there is no electricity. The whole system is modeled in Proteus.

2.2 EXISTING SYSTEM BLOCK DIAGRAM

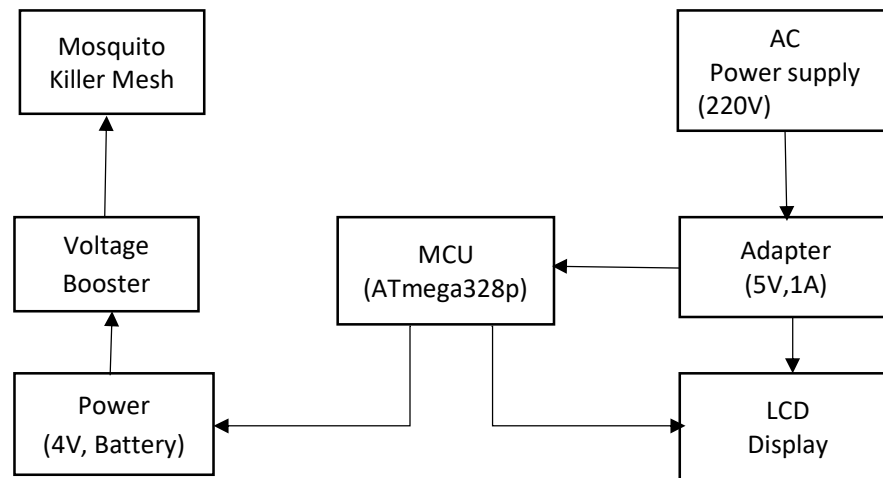


Fig: 2.1 Block Diagram of Existing System

The primary objective of this project is to devise an automated and cost-effective solution for mosquito control, thereby safeguarding human lives from the perils of mosquito-borne diseases, for which no definitive cure has yet been discovered. This paper proposes the concept of a sophisticated yet uncomplicated mosquito trapping window mechanism. By leveraging the phenomenon of electrocution occurring between the mesh structures integrated into the device, mosquitoes and other insects attempting to infiltrate through the window are promptly terminated. Unlike conventional mosquito-killing bats available in the market, this innovative system operates on significantly low voltage, adequate for exterminating mosquitoes, yet posing no threat to human health. Figure 2.1. Is represent a Block Diagram of existing system.

Central to this process is the utilization of a microcontroller, specifically the ATmega328p, which receives data from the adapter and facilitates the measurement of input current and voltage. These crucial metrics are then visually

displayed on an LCD Display (16*2), enabled by a logical algorithmic code. Additionally, the system is equipped with a power supply unit primarily designated for battery charging purposes. User controls are simplified through the incorporation of a mini switch, complemented by an LED power indicator for enhanced user feedback and convenience. This system marks a notable advancement in the realm of mosquito control technology, offering an efficient and safe alternative to conventional methods. By harnessing the power of electronics and intelligent design, it not only addresses the pressing issue of mosquito-borne diseases but also underscores the potential for innovation in combating public health challenges.

2.3 OPEN PROBLEMS IN EXISTING SYSTEM

The previous system, while functional, had limitations in its not applicability to commercial areas, rendering it ineffective in those settings. Instead, it relied heavily on manual intervention, requiring individuals to engage in swatting mosquitoes manually. Moreover, its scope was confined to addressing smaller-scale mosquito populations, leaving larger areas susceptible to infestation and potential health hazards.

2.4 DISADVANTAGES

- Manual operation
- Cannot able to use commercial purpose
- Mosquito control process is slow

2.5 IEEE STANDARDS FOLLOWED

The Institute of Electrical and Electronics Engineers (IEEE) has developed numerous standards pertaining to Mosquito Killing Window Technology. Notable among these standards are:

1. IEEE Std 1666™-2011 - IEEE Standard for Software and System Test Documentation: This standard provides guidelines for documenting software and system testing, which may include testing procedures for power electronic devices such as bridge rectifiers.
2. IEEE Std 1003.1™-2017 - IEEE Standard for Information Technology -- Portable Operating System Interface (POSIX®): This standard defines a set of operating system interfaces, including input/output operations, which may be relevant for programming microcontrollers interfacing with ultrasonic or

PIR sensors, including time-related functions, which may be relevant for implementing real-time clock functionalities in microcontroller-based systems.

3. **IEEE Std 1159™-2019 - IEEE Recommended Practice for Monitoring Electric Power Quality:** This standard offers guidelines for monitoring and analyzing electric power quality, which may be relevant when assessing the performance of AC to AC converters in terms of voltage regulation, harmonic distortion, and other parameters.

2.6 CONSTRAINTS

1. **Safety:** The device must be safe for household use, especially around children and pets. It should comply with safety standards and regulations, ensuring that electrical components are properly insulated and protected.
2. **Effectiveness:** The device must effectively attract and kill mosquitoes and other flying insects. It should cover a sufficient area to be effective in a room or outdoor space.
3. **Energy Consumption:** The device should consume a reasonable amount of electricity to minimize energy costs. Energy efficiency is important, especially if the device is intended for continuous use.
4. **Durability:** The materials used in construction should be durable and able to withstand environmental conditions, such as humidity. Components like the electric grid should be designed to endure repeated use without degradation.
5. **Maintenance:** The device should be easy to clean and maintain to ensure optimal performance. Components like the collection tray for dead insects should be easily accessible and removable.
6. **Noise:** Excessive noise can be a nuisance, so the device should operate quietly to avoid disturbance, especially during the night.
7. **Aesthetics:** The design should be visually appealing and blend well with different room or outdoor aesthetics. It should not be an eyesore in the living space.
8. **Size and Portability:** The size should be appropriate for installation in windows or other desired locations. If portable, it should be lightweight and easy to move around.

9. **Cost:** The device should be affordable for the target market. Operating costs, including electricity usage and replacement parts (such as bulbs or grids), should also be considered.
10. **Environmental Impact:** Materials used in construction should be environmentally friendly and non-toxic. The device should not pose risks to non-target organisms or ecosystems.

2.7 TRADEOFF

1. **Effectiveness vs. Energy Consumption:** Increasing the killing power of the device, such as using stronger electric grids or brighter UV lights, may improve effectiveness but also increase energy consumption. There's a tradeoff between killing efficiency and the amount of energy required to operate the device over time.
2. **Safety vs. Effectiveness:** Adding additional safety features, such as protective grilles or sensors to prevent accidental contact, may reduce the device's effectiveness in attracting and killing mosquitoes. Balancing safety measures with the device's primary function of insect elimination is crucial to ensure both objectives are met satisfactorily.
3. **Noise vs. Effectiveness:** Increasing the power of fans or electric grids may produce more noise, which could be a nuisance, especially in indoor settings. There's a tradeoff between noise levels and the device's ability to effectively eliminate mosquitoes.
4. **Aesthetics vs. Functionality:** Designing a sleek and aesthetically pleasing device may require compromises in functionality, such as reducing the size of the killing grid or the capacity of the collection tray. Balancing visual appeal with effective mosquito elimination is essential to ensure consumer satisfaction.
5. **Cost vs. Quality:** Using higher-quality materials and components may improve the durability and longevity of the device but could also increase manufacturing costs. There's a tradeoff between keeping the cost of the device affordable for consumers and maintaining a certain level of quality and durability.
6. **Portability vs. Effectiveness:** Designing a portable device for outdoor use may require compromises in killing power or coverage area compared to

larger, stationary models. Balancing portability with effectiveness is essential to meet the needs of consumers who require flexibility in their mosquito control solutions.

7. **Environmental Impact vs. Effectiveness:** Implementing environmentally friendly materials and components may limit the device's effectiveness or increase manufacturing costs. There's a tradeoff between minimizing environmental impact and ensuring the device effectively controls mosquito populations.

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM OF THE PROJECT

The primary objective of this endeavor is to engineer an automated mosquito eradication device, aiming to mitigate the threat posed by mosquito bites, which often lead to the transmission of various debilitating diseases. This project introduces a concept for a straightforward yet intelligent mosquito trapping mechanism designed specifically for windows. By harnessing the principle of electrocution through the mesh structures of the device, mosquitoes and other insects attempting to penetrate the window are swiftly eliminated upon contact. In contrast to conventional mosquito-killing bats available in the market, this system operates at significantly lower voltage levels, adequate for mosquito extermination yet posing minimal risk to human health. Central to its operation is the utilization of a microcontroller, specifically the ATmega328p, which interfaces with the adapter to gather crucial data regarding distance and motion. This information is then intelligently processed using a logic algorithm embedded within the microcontroller's code, subsequently displayed on an LCD screen (16*2) for user convenience. Control functionalities are facilitated through a mini switch, complemented by a single LED power indicator, ensuring intuitive operation and user-friendly experience. This innovative system represents a significant leap forward in mosquito control technology, offering a safe, efficient, and accessible solution for safeguarding human well-being against the pervasive threat of mosquito-borne illnesses.

3.2 SCOPE OF THE PROJECT

In addition to its core function of eliminating mosquitoes, this advanced mosquito electric killing window system integrates cutting-edge technology to enhance user experience and operational efficiency. By incorporating preventive sensors, the device can detect potential issues or obstructions, automatically adjusting its operation to maintain optimal performance. This proactive approach eliminates the need for manual intervention, reducing user hassle and ensuring uninterrupted mosquito control.

Moreover, the system features automatic power supply management, intelligently regulating energy usage based on demand and environmental conditions. This innovative feature not only enhances convenience but also promotes energy conservation by minimizing electricity consumption. By optimizing power usage, the device not only reduces operational costs for users but also contributes to environmental sustainability. The seamless integration of these features serves to streamline operation and maximize the system's effectiveness in mosquito control. By combining advanced technology with a focus on energy efficiency, this mosquito electric killing window not only fulfills its primary objective of efficient mosquito control but also aligns with broader goals of promoting sustainable living practices and energy conservation.

3.3 OBJECTIVES

- **Mosquito Control:** The primary objective is to effectively control mosquito populations by attracting and eliminating them through the use of electric grids or other means of extermination. The device should target mosquitoes specifically while minimizing harm to non-target insects.
- **Safety:** Ensure the device is safe for household use, with features such as protective grilles or sensors to prevent accidental contact with the electric grid. Safety standards should be met or exceeded to minimize the risk of injury to users and pets.
- **Convenience:** Provide a user-friendly experience with easy installation, operation, and maintenance. The device should require minimal manual intervention and offer features such as automatic power management and easy-clean collection trays for dead insects.
- **Energy Efficiency:** Optimize energy usage to minimize electricity consumption while maintaining effective mosquito control. Implement features such as energy-efficient UV bulbs, smart power management systems, and low-power standby modes to reduce operational costs and environmental impact.
- **Effectiveness:** Ensure the device is capable of attracting and killing mosquitoes efficiently across a wide coverage area, whether installed in windows, outdoor spaces, or other locations. The killing mechanism should be reliable and consistent in eliminating mosquitoes.

- **Durability:** Design the device to withstand regular use and environmental conditions, with durable construction materials and components. The device should maintain its effectiveness and performance over time without significant degradation or malfunctions.
- **Versatility:** Offer versatility in installation options to accommodate different window sizes and configurations. Additionally, consider portability for outdoor use or travel, allowing users to effectively control mosquitoes in various settings.
- **Affordability:** Provide a cost-effective solution for consumers without compromising on quality, safety, or performance. The device should be accessible to a wide range of users while offering value for money in terms of mosquito control effectiveness and features.
- **Environmental Responsibility:** Minimize environmental impact by using eco-friendly materials, energy-efficient components, and sustainable manufacturing practices. Consider the lifecycle of the product, including recyclability and disposal considerations, to promote environmental sustainability.

3.4 ADVANTAGES

- **Convenience:** Users can set the device to automatically turn on and off at specific times, eliminating the need for manual intervention. This feature is particularly useful for users who may forget to activate the device or prefer not to bother with daily adjustments.
- **Energy Efficiency:** By scheduling the device to operate only during peak mosquito activity hours, energy consumption can be optimized. The device will not run unnecessarily during times when mosquitoes are less active, thereby reducing electricity usage and lowering operational costs.
- **Effective Mosquito Control:** Programming the device to turn on during the evening and night hours, when mosquitoes are most active, ensures maximum effectiveness in controlling mosquito populations. This targeted approach increases the likelihood of capturing and eliminating mosquitoes when they are most prevalent.

- **Customization:** Users have the flexibility to customize the time settings according to their specific needs and preferences. Whether they prefer to have the device on throughout the night or only during certain hours, automatic scheduling allows for personalized mosquito control strategies.
- **Sleep Quality:** For users who are sensitive to noise or light during sleep, automatic scheduling ensures that the device operates only when they are awake and active. This helps promote better sleep quality by minimizing disturbances caused by the device's operation.
- **Peace of Mind:** Knowing that the mosquito electric killing window will automatically activate and deactivate according to preset schedules provides peace of mind for users. They can trust that mosquito control is being consistently maintained without the need for constant monitoring.
- **Consistent Operation:** Automatic scheduling ensures consistent operation of the device, helping to maintain a mosquito-free environment over time. This reliability is essential for effective mosquito control, especially in areas where mosquito-borne diseases are prevalent.
- **Enhanced Safety:** By automatically turning off during daylight hours, the device reduces the risk of accidental contact with the electric grid or other components. This improves safety for household members, including children and pets.

CHAPTER 4

HARDWARE AND PROJECT DESCRIPTION

4.1 BLOCK DIAGRAM OF POWER GUARD

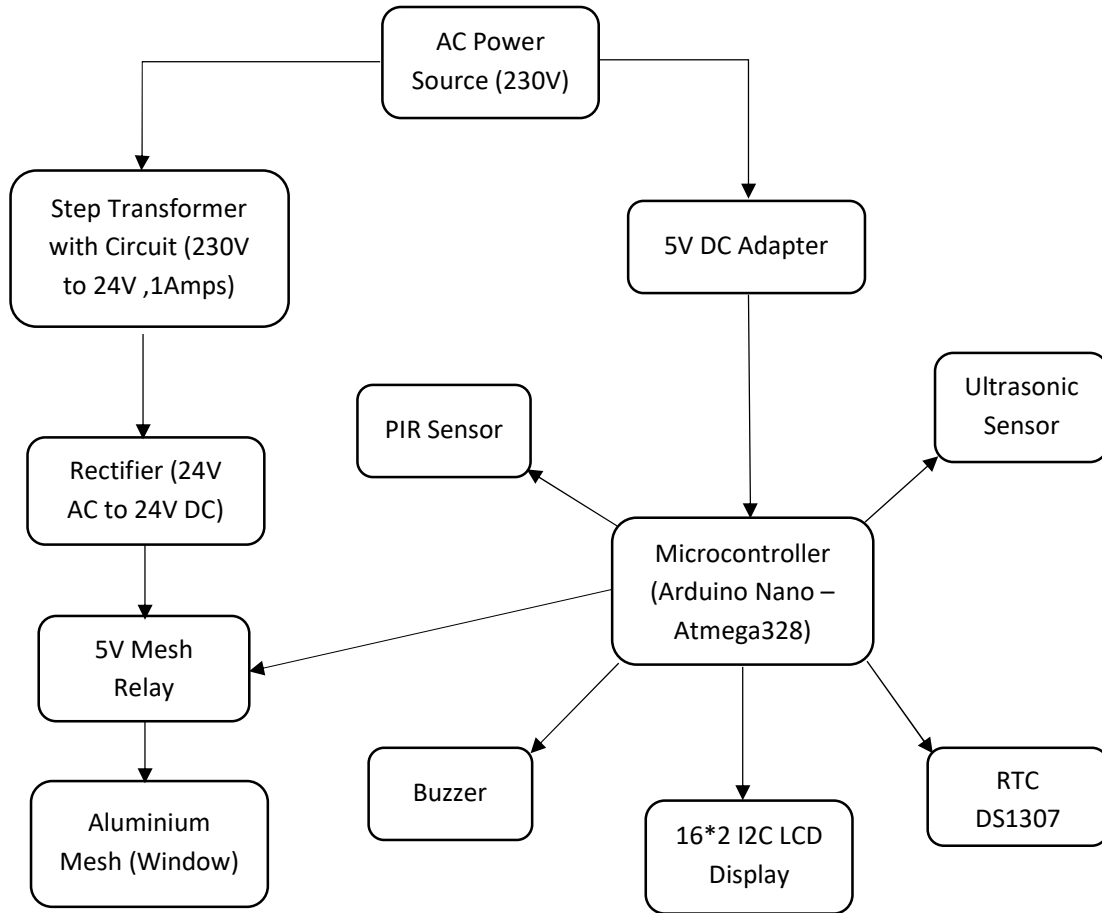


Fig: 4.1 Proposed System Block Diagram

A microcontroller, such as the ATmega328, stands as a self-contained device boasting memory, peripherals, and a processor, functioning as an embedded system. These specialized computers, known as embedded microcontrollers, are integrated into devices for specific purposes. They often require real-time functionality and minimal power consumption, making them essential components in various applications. Programming languages like C, C++, or assembly are commonly used to develop software for these systems, enabling control over a wide range of devices, from industrial machinery to consumer electronics.

In our project, we utilized an ATmega328p MCU to regulate voltage and current, contributing to the completion of our objectives. The block diagram of the proposed system is depicted in Figure 4.1. One of the most challenging tasks in developing an automated house system is selecting the appropriate programmable chip, which in this case is a microcontroller. To facilitate the hardware implementation, we converted 230V AC to 5V DC, suitable for the microcontroller, using a rated adapter with 5V and 1A specifications.

The system's architecture consists of a mesh comprising three layers: two negative layers and a positive middle layer. Furthermore, it incorporates automatic power on-off functionality facilitated by a relay and RTC DS1307 module. The inclusion of the real-time module enables control over the power supply based on pre-defined time settings. Users are alerted to potential hazards through visual signals on the I2C LCD panel and an accompanying buzzer for urgent notifications. Additionally, real-time updates on power status ensure users are informed of system conditions, enhancing situational awareness.

For added safety, ultrasonic and PIR sensors are implemented to detect motion and distance. Whenever either sensor detects activity, it sends a signal to the microcontroller, triggering appropriate responses. This comprehensive approach ensures the system remains responsive and adaptable to various scenarios, ultimately enhancing user safety and overall system performance.

4.2 CIRCUIT DIAGRAM WITH EXPLANATION

The proposed invention introduces a sophisticated solution for mosquito control in commercial and industrial settings. The described system's circuit was created with ease of use in mind. In the project, we used an I2C LCD (16*2), RTCDS1307, a buzzer, ultrasonic sensor, PIR sensor, rectifier, capacitor, transformer, etc.

In the initial phase of the system, a step-down transformer is employed alongside a dedicated circuit to facilitate the conversion of the incoming 230V AC voltage to a more workable 24V AC, with a targeted current output of 1 ampere. Subsequently, this AC power is further transformed into 24V DC through the utilization of a rectifier. The directed power is then channeled towards the mosquito metal mesh, a crucial component of the setup. Within the circuit lies a relay, serving a pivotal function in this arrangement and subject to the control of the

microcontroller. Functioning as a switch, the relay holds the responsibility of dictating the timing for permitting or halting the flow of power to the specified components, thereby regulating the system's operation effectively.

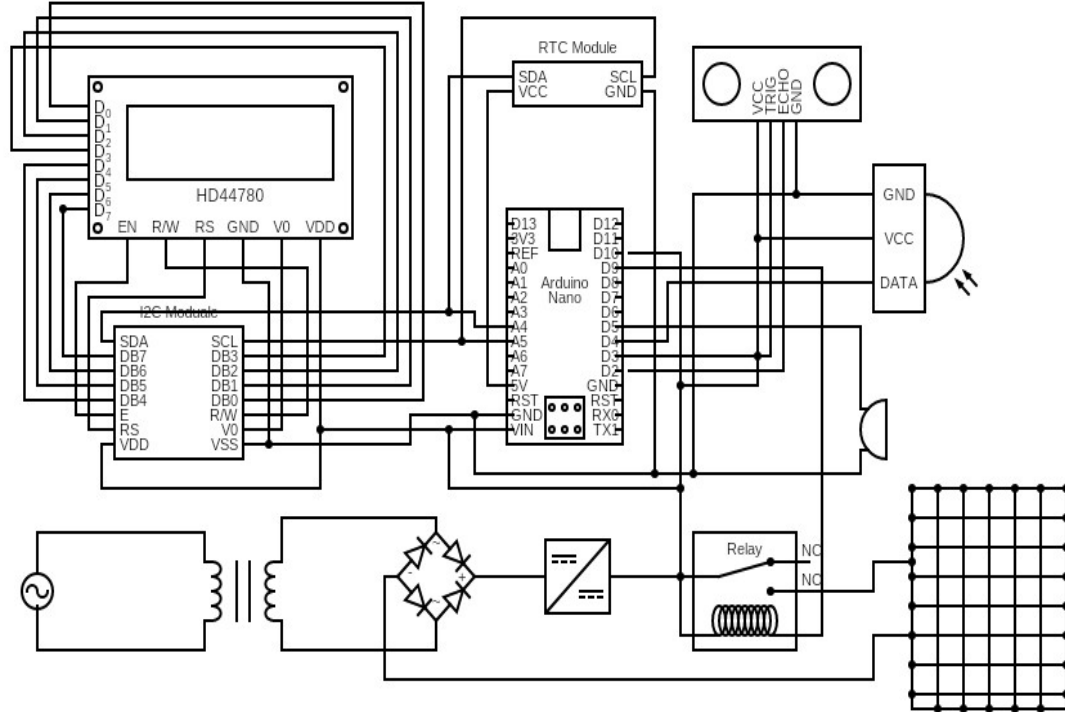


Fig: 4.2 Circuit Diagram of Proposed System

The automatic power on-off function using the RTC DS1307 module will be predetermined. This carefully designed circuit architecture ensures efficient power management and precise control over the mosquito control system's operation. By incorporating various components such as transformers, rectifiers, relays, and microcontrollers, the system achieves a high level of functionality while maintaining user-friendly operation. The use of dedicated modules like the RTC DS1307 adds an extra layer of automation, enhancing the system's reliability and versatility. Overall, this comprehensive approach to circuit design exemplifies the commitment to creating effective and user-friendly solutions for mosquito control in diverse environments.

Adding a layer of intelligence to the system, an ultrasonic sensor is integrated to detect the proximity of humans by measuring distances accurately. Concurrently, a Passive Infrared (PIR) sensor complements this functionality by detecting human

motion within its designated range. The heart of the system lies within the programmed code, which orchestrates the collection and processing of data obtained from the sensors. This data is then utilized to inform the system's response, enabling it to adapt and react according to the detected environmental conditions and human presence. Through this cohesive integration of hardware components and software intelligence, the system effectively manages power distribution and controls the operation of the motor and mesh, providing a responsive and dynamic solution tailored to its intended purpose. The Arduino Nano, acting as the brain of the system, executes the programmed logic to interpret sensor inputs and make real-time decisions. For instance, when the ultrasonic sensor detects a person approaching the designated area, and the PIR sensor confirms their motion, the Arduino Nano triggers the relay to interrupt power to the mosquito mesh, ensuring safety. In every status, information will be displayed on the I2C LCD, providing users with real-time feedback about the system's operation and status. This enhances user interaction and enables quick troubleshooting if any issues arise. Overall, this intelligent integration of sensors and control mechanisms, coupled with dynamic software logic, ensures optimal performance and user safety in mosquito control applications.

In Figure 4.2, the circuit diagram illustrates the initial phase of the system, where a step-down transformer is employed alongside a dedicated circuit to convert the incoming 230V AC voltage to a more workable 24V AC, with a targeted current output of 1 ampere. This transformed AC power is then further converted into 24V DC through the utilization of a rectifier. The directed power is subsequently channeled towards the mosquito metal mesh, a crucial component of the setup designed for effective mosquito control. Within the circuit, a relay plays a pivotal role, serving as a switch controlled by the microcontroller. The relay is responsible for dictating the timing for permitting or halting the flow of power to the specified components, thereby regulating the system's operation effectively. When triggered by the microcontroller, the relay enables or interrupts the power supply to the mosquito metal mesh, ensuring precise control over the system's functionality. Additionally, the automatic power on-off function using the RTC DS1307 module is predetermined, adding an extra layer of control and efficiency to the system. This module enables scheduled activation and deactivation of the mosquito control system based on predefined timings, enhancing energy conservation and

operational management. Overall, this integrated circuit design demonstrates a sophisticated yet efficient approach to mosquito control, leveraging transformers, rectifiers, relays, and microcontrollers to achieve precise control and automation. Through careful planning and implementation, the system ensures optimal functionality while prioritizing safety and energy efficiency in commercial and industrial settings.

Adding a layer of intelligence to the system, an ultrasonic sensor is integrated to detect the proximity of humans by measuring distances accurately. Concurrently, a Passive Infrared (PIR) sensor complements this functionality by detecting human motion within its designated range. The heart of the system lies within the programmed code, which orchestrates the collection and processing of data obtained from the sensors. This data is then utilized to inform the system's response, enabling it to adapt and react according to the detected environmental conditions and human presence. Through this cohesive integration of hardware components and software intelligence, the system effectively manages power distribution and controls the operation of the motor and mesh, providing a responsive and dynamic solution tailored to its intended purpose. The Arduino Nano, acting as the central processing unit, executes the programmed logic to interpret sensor inputs and make real-time decisions. For example, when the ultrasonic sensor detects a person approaching the designated area and the PIR sensor confirms their motion, the Arduino Nano triggers the relay to interrupt power to the mosquito mesh, ensuring safety.

Additionally, in every status, information will be displayed on the I2C LCD, providing users with real-time feedback about the system's operation and status. This enhances user interaction and enables quick troubleshooting if any issues arise. Overall, this intelligent integration of sensors and control mechanisms, coupled with dynamic software logic, ensures optimal performance and user safety in mosquito control applications.

4.3 COMPONENTS

4.3.1 Hardware Components

The list of hardware components that are required are:

- Arduino Nano

- Ultrasonic sensor
- PIR sensor
- RTC DS1307
- I2C LCD (16*2)
- Power Supply Unit
- UV Led
- Relay
- Voltage Booster Circuit
- buzzer

4.3.1.1 Arduino Nano

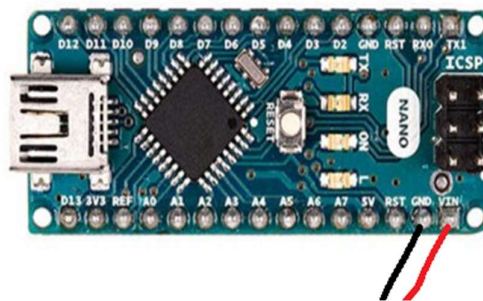


Fig: 4.3 Arduino Nano

Arduino is an open-source electronics platform known for its easy-to-use hardware and software. Arduino boards are capable of reading inputs from various sensors, buttons, and converting them into outputs to control relays, activate LEDs, or even publish data online. The boards are programmed using the Arduino programming language, which is based on Wiring, and the Arduino Software (IDE), which is based on Processing. Over the years, Arduino has become the brain behind thousands of projects, ranging from everyday objects to complex scientific instruments. A global community of makers, including students, hobbyists, artists, programmers, and professionals, has formed around this open-source platform. Their collective contributions have resulted in a wealth of accessible knowledge that benefits both novices and experts alike. Figure 4.3. Is represent by arduino nano image. Arduino originated at the Ivrea Interaction Design Institute as a tool for fast prototyping, specifically targeting students without prior experience in electronics and programming. As it gained popularity, Arduino boards evolved to meet new

needs and challenges. The product range expanded from simple 8-bit boards to include options tailored for IoT applications, wearables, 3D printing, and embedded environments. All Arduino boards are completely open-source, allowing users to build and modify them independently to suit their specific requirements. Similarly, the Arduino software is also open-source and continuously evolving thanks to contributions from users worldwide. The Arduino Nano is one type of microcontroller board designed by Arduino.cc. It features a microcontroller such as the Atmega328, also used in the Arduino UNO. Despite its small size, the Nano is versatile and suitable for a wide variety of applications, offering flexibility and ease of use to its

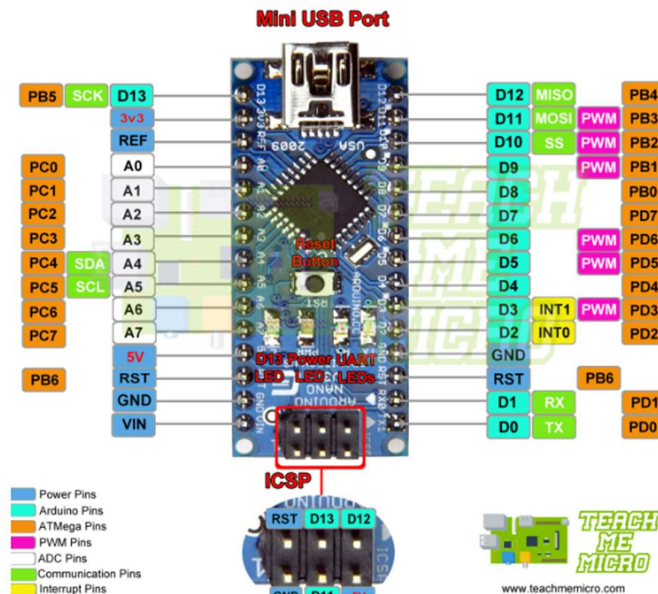


Fig: 4.4 Arduino Nano Pin Diagram

users.

The Arduino Nano is a compact microcontroller board based on the ATmega328P chip. It offers a range of digital and analog pins for interfacing with sensors, actuators, and other electronic components. Figure 4.4 is represented by the Arduino Nano pin diagram. Here's a brief description of the pinout of the Arduino Nano:

Digital Pins (D0-D13): These pins can be configured as digital input or output. They support digital signals (LOW or HIGH).

Analog Pins (A0-A7): These pins can be used as analog inputs. They support analog signals, allowing for analog readings from sensors.

Power Pins: Vin - Input voltage to the Arduino Nano. It can be powered by an external power source ranging from 7V to 12V.

5V - Provides regulated 5V output, typically used to power external sensors or modules.

3.3V - Provides regulated 3.3V output, suitable for powering low-voltage components.

GND - Ground pins for connecting to the ground of the circuit.

Reset Button: Allows you to reset the microcontroller.

TX and RX Pins: These are used for serial communication (TX for transmission and RX for reception).

USB Connector: Used for programming the Arduino Nano and for serial communication with a computer.

ICSP Header: In-Circuit Serial Programming header for programming the microcontroller using an external programmer.

Power LED: Indicates that the board is powered.

TX/RX LEDs: Indicate the transmission and reception of data through the TX and RX pins.

Crystal Oscillator: Provides the clock signal for the microcontroller.

Aref Pin: Reference voltage for analog inputs.

4.3.1.2 Ultrasonic Sensor



Fig: 4.5 Ultrasonic Sensor

Ultrasonic sensor function based on the principle of echolocation, akin to how bats navigate in darkness. Emitting short bursts of ultrasonic waves, typically ranging from 20 kHz to 200 kHz (beyond human hearing), these waves traverse through the air until encountering an object. Upon striking the object's surface, the waves bounce back towards the sensor, detected as echoes. By measuring the time taken for these waves to travel to and from the object, the sensor calculates the distance using the speed of sound in the medium (usually air), employing the formula: $\text{Distance} = \text{Speed of Sound} \times \text{Time taken} / 2$. Ultrasonic sensors exist in

various types, including single-transducer and dual-transducer designs. Figure 4.5 represents by ultrasonic sensor. Single-transducer sensors utilize the same transducer for both transmitting and receiving ultrasonic waves, while dual-transducer sensors employ separate transducers for each function, potentially enhancing performance and accuracy.

These sensors offer notable advantages, such as:

1. Non-contact operation: Ultrasonic sensors detect objects without physical contact, making them suitable for scenarios where contact may be impractical or detrimental.

2. High accuracy: They provide precise distance measurements with minimal error, facilitating reliable object detection and positioning.

3. Versatile applications: Ultrasonic sensors find utility across diverse industries and applications, including robotics, automation, industrial control, automotive systems (e.g., parking assistance, collision avoidance), level sensing in tanks, containers, and even medical devices.

However, ultrasonic sensors have limitations. They may struggle in environments with high noise levels or acoustic interference, and their performance can be influenced by factors like temperature, humidity, and the material properties of detected objects. Additionally, their range may be comparatively limited compared to technologies like LiDAR or radar. Despite these constraints, ultrasonic sensors remain widely valued for their reliability, accuracy, and versatility across numerous practical applications.

Trigger Pin (Trig): This input pin serves to initiate the emission of ultrasonic pulses. When a pulse of a specific duration is applied to this pin (typically a short duration HIGH signal), the sensor emits ultrasonic waves.

Echo Pin: The output pin provides a pulse signal in response to the ultrasonic waves reflected back to the sensor. The duration of this pulse corresponds to the time taken for the ultrasonic waves to travel to the object and return, crucial for distance calculation.

Echo Output Indicator LED (Optional): Certain ultrasonic sensors feature an additional indicator LED connected to the echo pin. This LED illuminates or blinks upon receiving the echo pulse, offering a visual indication of the sensor's operation.

Mode Selection Pins (Optional): Some ultrasonic sensors may incorporate mode selection pins for configuring different operating modes or adjusting sensitivity

settings. These pins enable users to tailor the sensor's behavior to meet specific application requirements. Understanding the functions of these pins allows users to correctly interface the ultrasonic sensor with a microcontroller or other control circuitry, facilitating accurate distance measurement and object detection capabilities.

4.3.1.3 PIR Sensor



Fig: 4.6 PIR Sensor

A Passive Infrared (PIR) sensor functions as an electronic device designed to detect infrared radiation emitted by objects within its field of view. It operates on the principle that all objects, above absolute zero temperature, emit heat energy in the form of infrared radiation. Widely employed for motion detection, PIR sensors find applications across security systems, lighting control, and home automation, among others. PIR sensor is shown in Figure 4.6.

Working Principle: As an object enters the sensor's field of view, it emits infrared radiation. The pyroelectric sensor within the PIR detects variations in this infrared radiation as the object moves across its range. These alterations in infrared radiation induce shifts in the electric charge generated by the pyroelectric sensor. Subsequently, the signal processing circuitry interprets these charge fluctuations, prompting the generation of an output signal upon detecting motion.

Detection Modes: Single-Zone Detection: In this mode, the sensor focuses on detecting motion within a single detection zone, ideal for straightforward motion detection tasks. Multi-Zone Detection: Operating in this mode, the sensor divides its field of view into multiple zones, enabling more refined motion detection and direction determination. Overall, PIR sensors serve as dependable and cost-effective solutions for motion detection, with applications spanning various

industries and environments. Their straightforward design, effectiveness, and adaptability render them essential components in contemporary electronic systems.

4.3.1.4 RTC DS1307

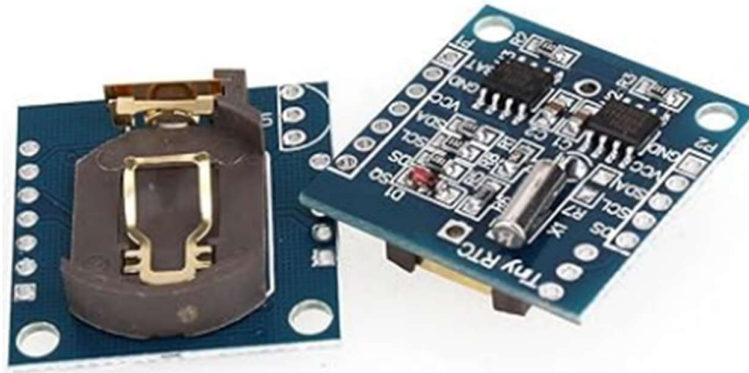


Fig: 4.7 RTC DS1307 Module

Real-time clocks (RTCs), as their name suggests, are modules designed to keep track of time. The DS1307 Real Time Clock (RTC) IC, an 8-pin device utilizing an I2C interface, is a notable example. Featuring 56 bytes of battery backup SRAM, the DS1307 functions as a low-power clock/calendar. It provides data for seconds, minutes, hours, day, date, month, and year, with automatic adjustment for month-end dates, especially for months with fewer than 31 days. RTCs are available as integrated circuits (ICs) and serve the dual purpose of tracking time like a clock and managing dates like a calendar. A key advantage of RTCs is their provision for battery backup, ensuring uninterrupted clock/calendar operation even during power outages. Figure 4.7 is represented by the RTCDS1307 module. They consume minimal current to maintain operation. RTCs find widespread use in various applications, including embedded systems and computer motherboards. This article focuses on exploring one such RTC, the DS1307. Overall, the DS1307 RTC is a dependable and extensively utilized component, offering accurate timekeeping and convenient features for a multitude of applications.

4.3.1.5 I2C LCD

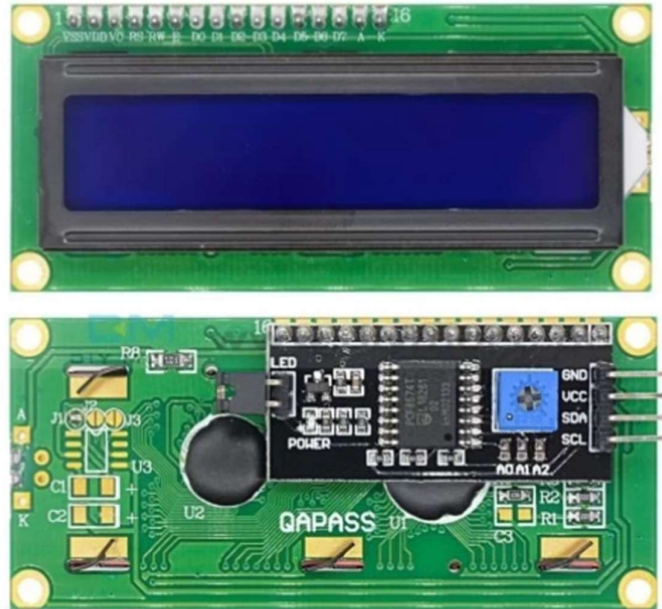


Fig: 4.8 I2C LCD

The I2C LCD, revolutionizing electronic communication in projects favoring minimal wiring and I/O conservation, simplifies connectivity with just two wires (SDA and SCL) via the I2C protocol. This streamlined method reduces clutter and integrates effortlessly into microcontroller projects on platforms like Arduino, Raspberry Pi, and embedded systems. Available in various sizes and configurations, I2C LCDs cater to diverse needs from basic text to intricate graphics, empowering creators. Widely embraced in DIY electronics, home automation, instrumentation panels, and education, they enhance functionality and user experience by providing crucial visual feedback. I2C LCD is shown in Figure 4.8.

The I2C protocol, also known as Two-Wire Interface (TWI), facilitates interaction among devices through a master-slave architecture. Originating from Philips Semiconductor, it's esteemed for simplicity and versatility. Suitable for various applications, including sensor connections and display interfacing, it simplifies connectivity with just two wires (SDA and SCL) for seamless communication. This streamlined approach reduces wiring complexity, boosting compatibility across platforms. With its widespread support, the I2C LCD protocol remains indispensable, offering a convenient means to integrate visual feedback into modern electronic designs.

The I2C LCD module typically features four pins, crucial for its integration with other devices and microcontrollers. Here's a concise breakdown of each pin:

VCC (or VDD): This pin serves to supply power to the LCD module. It generally operates within a voltage range of 5V to 3.3V, contingent upon the specific module in use. Ensuring the correct voltage is applied is essential to prevent module damage.

GND: Acting as the grounding point, this pin completes the circuit by connecting to the power supply's ground.

SDA (Serial Data Line): Among the two communication lines integral to the I2C protocol, SDA facilitates data transmission between the microcontroller and the LCD module.

SCL (Serial Clock Line): SCL, the counterpart to SDA, furnishes the clock signal crucial for synchronizing data transmission between the microcontroller and the LCD module.

4.3.1.6 Buzzer



Fig: 4.9 Buzzer

A buzzer serves as a compact and effective component for incorporating sound functionality into our projects or systems. Its small and streamlined 2-pin structure renders it highly adaptable, allowing for effortless integration on breadboards, perf boards, and even PCBs. This versatility has made it a ubiquitous choice across various electronic applications, owing to its convenience and ease of use. Figure 4.9 is represented by 5V buzzer.

Two common types of buzzers are typically available in the market. The one depicted here is a straightforward buzzer that, when powered, emits a continuous "Beeeeeeppp...." sound. The other variant, known as a readymade buzzer, appears

bulkier and generates a "Beep. Beep. Beep." sound due to its internal oscillating circuit. However, the buzzer shown here is widely preferred because it offers flexibility for customization with additional circuits to seamlessly integrate into various applications. This buzzer operates by simply connecting it to a DC power supply ranging from 4V to 9V, including the option of using a standard 9V battery. Nonetheless, it is advisable to utilize a regulated +5V or +6V DC supply for optimal performance. Typically, the buzzer is paired with a switching circuit to control its activation and deactivation according to the desired timing and interval requirements.

4.3.1.7 Relay

A relay functions as an electromechanical apparatus employed to regulate the passage of electrical current within a circuit. Its applications span across a multitude of industries, encompassing industrial automation, telecommunications, automotive systems, home appliances, and electronic devices. Renowned for their capacity to manage high currents or voltages via a low-power control signal, relays stand as indispensable elements within numerous electrical and electronic systems.



Fig: 4.10 Relay

A typical relay comprises several integral components, including a coil, an armature, and contacts. When a control signal, usually a low-voltage electrical current, energizes the coil, it generates an electromagnetic field that attracts the armature a movable part linked to the contacts. This movement, prompted by the magnetic field, induces the contacts to either open or close, depending on the relay's type and setup. Within a relay, the contacts serve as the switching elements dictating the flow of electrical current. Typically, there are two sets of contacts: normally open (NO) and normally closed (NC). In the default state, NO contacts remain open, while NC contacts are closed. Upon energizing the coil, the armature shifts, altering the contacts' state. In NO relays, current flows as the contacts close,

whereas in NC relays, current is interrupted as the contacts open. Relays manifest in diverse types and configurations, encompassing electromechanical relays, solid-state relays (SSRs), latching relays, and reed relays, among others. Electromechanical relays leverage physical contacts and mechanical motion for current switching, whereas SSRs employ semiconductor devices, omitting mechanical parts. Latching relays maintain two stable states and don't demand continuous power to uphold their state, while reed relays utilize a hermetically sealed glass tube housing contacts activated by a magnet's position. In summary, relays stand as indispensable electromechanical devices for managing electrical current flow in circuits. Their coil-armature-contact mechanism, coupled with the capacity to switch high currents or voltages with minimal control signal power, renders them pivotal across various applications. Ensuring proper selection, installation, and operation of relays is paramount to their dependable performance across different systems and contexts.

4.3.2 Power Supply Circuit

Two power supply modules are used for the invention:

- 1.Circuit for Arduino nano
- 2.Circuit for mesh

4.3.2.1 Power Circuit for Arduino Nano

The 5V adapter circuit plays a critical role in ensuring a consistent power supply to the Arduino Nano, thereby enhancing its operational reliability. By connecting the 5V adapter to the Vin pin of the Arduino Nano, with the positive terminal linked to Vin and the negative terminal to GND, a stable 5V power supply is delivered to the microcontroller. To further bolster stability, capacitors can be integrated across the power lines to eliminate any potential noise or voltage fluctuations. This meticulous setup guarantees that the Arduino Nano receives an uninterrupted power flow, essential for its optimal functioning across diverse applications. In essence, the 5V adapter circuit serves as a robust power solution, vital for maximizing the performance of the Arduino Nano.

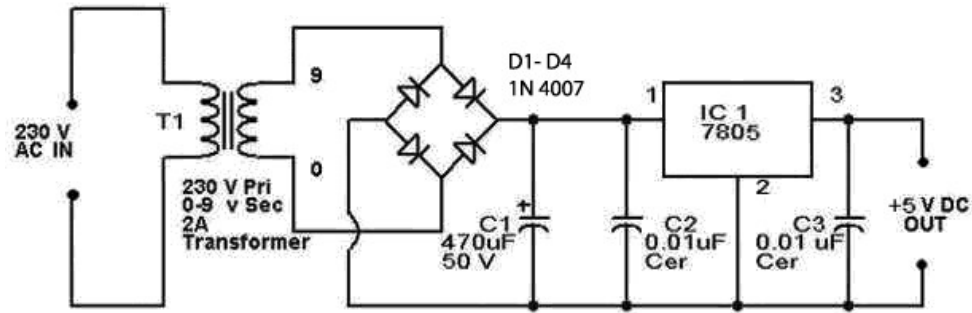


Fig: 4.11 Power Supply for Arduino nano

4.3.2.2 Power Circuit for Mesh

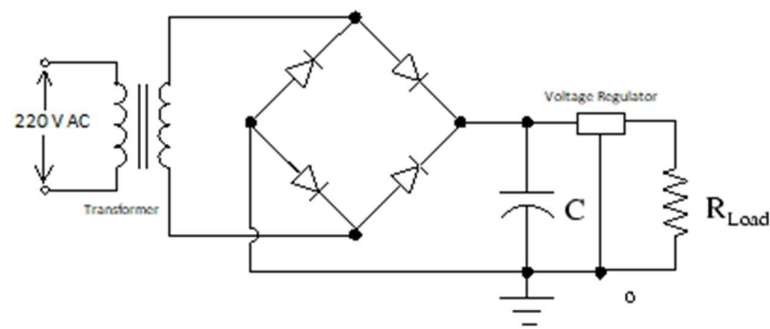


Fig: 4.12 Power Circuit Diagram for Mesh

The AC230V to 20V DC adapter employs a bridge rectifier and transformer to convert alternating current (AC) from the mains power supply into direct current (DC) suitable for powering electronic devices. The transformer's primary coil is connected to the AC mains, while the secondary coil is linked to the bridge rectifier. The bridge rectifier consists of diodes arranged in a specific configuration, allowing it to rectify the AC voltage into pulsating DC. As a result, the alternating current is converted into a unidirectional flow of current. Subsequently, filtering capacitors are typically integrated to smooth out the pulsations, ensuring a steady output voltage. Through this process, the adapter efficiently transforms high-voltage AC into a stable 20V DC output, providing a reliable power source for various electronic applications.

4.3.3 Aluminium Mesh

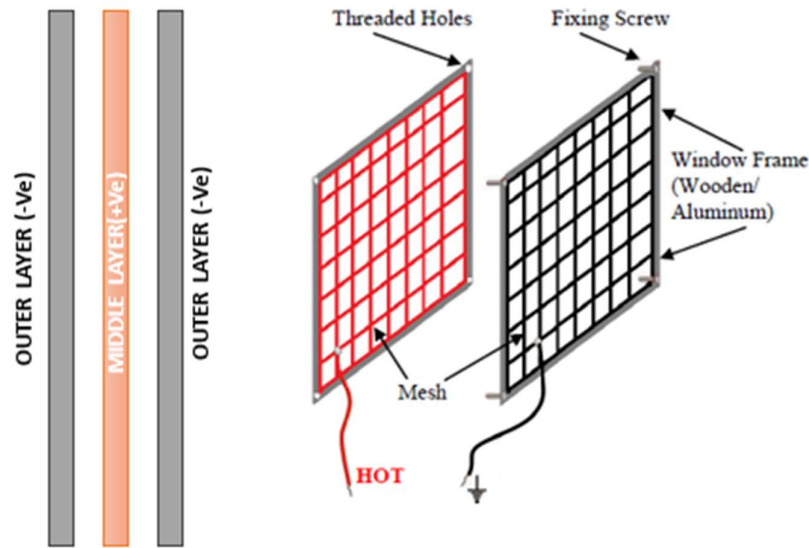


Fig: 4.13 Mesh Layer

The mosquito power guard mesh layer stands out as a pioneering solution crafted to combat insect intrusion, particularly the persistent presence of mosquitoes within indoor environments. Positioned as a protective shield affixed over windows or doors, it adeptly bars pests while facilitating the free circulation of air. Setting itself apart from traditional mosquito nets or screens, this innovative mesh layer integrates an electric grid system. Three layer of mesh is shown Figure 4.13.

This electric grid operates with low-voltage pulses upon insect contact, swiftly dispatching them without recourse to harmful chemicals or odors. This eco-conscious approach offers a safe and sustainable alternative to conventional insect repellents, aligning with contemporary environmental sensibilities. Furthermore, select models are equipped with intelligent sensors capable of detecting human proximity. These sensors play a vital role, automatically deactivating the electric grid to prevent inadvertent contact, thus enhancing safety measures. Additionally, the electrical configuration is meticulously designed, with the two outer layers serving as the negative supply and the middle layer designated as the positive supply. This structured arrangement optimizes functionality and safety, ensuring the overall effectiveness and reliability of the mosquito mesh layer. With its amalgamation of efficacy, user-friendly operation, and minimal maintenance requirements, the

mosquito bat mesh layer emerges as a steadfast solution for both households and businesses seeking comprehensive pest control measures.

Middle Layer – Positive supply

Outer Layer – Negative supply

4.3.4 Software Required

4.3.4.1 Arduino IDE and C language

Arduino, renowned for its open-source nature and user-friendly hardware and software, enables individuals to translate diverse inputs ranging from sensor-detected light to button activations and even social media messages into tangible outputs like motor movements, LED lighting, or online content publication. This functionality is achieved by directing instructions to the microcontroller housed on the Arduino board, utilizing the Arduino programming language (based on Wiring) and the Arduino Software (IDE) built upon Processing. Over the years, Arduino has become the cornerstone of numerous projects, spanning from everyday gadgets to complex scientific instruments. Originating from the Ivrea Interaction Design Institute as a rapid prototyping tool tailored for students new to electronics and programming, Arduino swiftly gained widespread adoption. As its popularity surged, the Arduino board evolved to address evolving needs, transitioning from rudimentary 8-bit boards to a diverse range of offerings catering to IoT applications, wearables, 3D printing, and embedded systems. Crucially, all Arduino boards are entirely open-source, allowing users to construct and customize them to suit their specific requirements. Similarly, the software remains open-source, continuously improving through the collaborative efforts of a global community of users.

Embedded C comprises language extensions for the C Programming language introduced by the C Standards committee to address compatibility issues across various embedded systems. Historically, embedded C programming necessitated nonstandard C language extensions to accommodate unique features like fixed-point arithmetic, multiple memory banks, and basic I/O operations. Embedded C largely adopts the syntax and semantics of standard C, including main () function, variable declarations, data types, conditional statements (if, switch, case), loops (while, for), functions, arrays, strings, structures, unions, bit operations, macros, and more. In the early days of microprocessor-based systems, programming was predominantly done using assemblers and then stored in EPROMs. However, there was no efficient mechanism to debug programs, and the

use of LEDs and switches for verification was costly and unreliable. With time, reliance on microprocessor-specific assembly language diminished, and embedded systems transitioned to using C as the preferred programming language. Today, C stands as the most prevalent language for programming embedded processors and controllers, reflecting its widespread adoption and suitability for embedded system development.

4.4 WORKING MODULES

- MODULE -1

Monitoring the distance and motion of the human.

- MODULE-2

In LCD, the Distance and motion warning will display.

- MODULE-3

Power on and off with respect of predetermine time setting.

- MODULE-4

Human approach the mesh automatically relay will get off.

. Figure 4.12 illustrates a flowchart depicting the algorithmic code of the proposed mosquito killing system for Windows.

4.5 FLOW CHART OF POWER GUARD

Figure 4.14 Represent by flow chart of coding algorithm.

Turn on the power guard: This step involves activating a mechanism or device responsible for guarding the power supply. It ensures that power is available for subsequent operations.

Display the welcome message: After powering up, the system displays a welcoming message. This serves as an indication that the system is operational and ready for use.

Check if RTC module is found: The system checks for the presence of a Real-Time Clock (RTC) module. If the module is detected, it proceeds to the next step. If not, it displays a message indicating that the RTC module is not found.

Check the predetermined time: The system verifies if the current time matches a predetermined schedule. If it does, the system displays the date and time. If not, it proceeds to the next step.

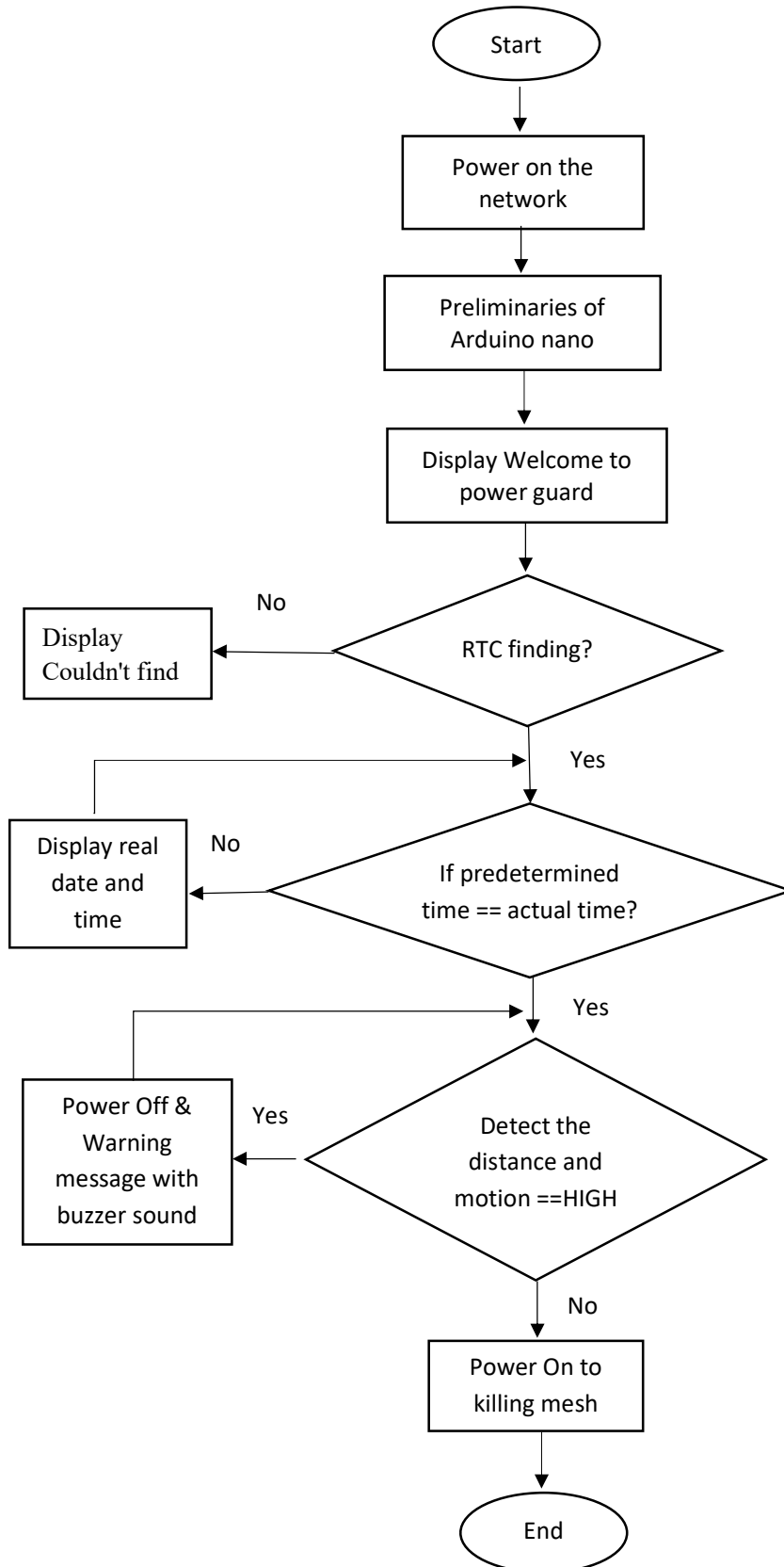


Fig: 4.14 Flow Chart of Power Guard

Monitor human approach to the mesh: The system utilizes sensors to detect any human presence approaching the mesh within a 70cm distance. If someone is detected, it turns off the power to the mesh and provides a warning message. If no human is detected, it maintains power to the mesh.

4.6 ADVANTAGES

- Low power Consumption
- Cost-effective
- Automatic Function
- Easy to deploy
- Scalability

4.7 APPLICATIONS

- Hospital area
- Industries
- Community areas
- Home

software, provides a virtual environment for testing and refining the code logic before deployment onto the physical hardware. This iterative process allows for thorough debugging and optimization, ultimately enhancing the system's performance and reliability. The algorithmic code, depicted in the flowchart, outlines the sequential execution of tasks within the mosquito killing system. Each step is meticulously planned to ensure efficient operation and responsiveness to external stimuli, such as human presence and environmental conditions. Moreover, the graphical user interface enhances user interaction by providing intuitive controls for monitoring and adjusting system parameters in real-time.

Overall, the integration of hardware and software components in the proposed mosquito killing system exemplifies a holistic approach to design and implementation. By leveraging both simulation tools and physical prototypes, developers can iteratively refine their designs, leading to more robust and effective solutions for pest control and environmental management.

To operate the described system, start by activating the power supply and providing power to the Arduino Nano. The Arduino Nano is integrated with an ultrasonic sensor, which plays a crucial role in accident prevention by continuously monitoring the distance from the sensor to any individuals in its vicinity. If the ultrasonic sensor and PIR sensor detect people within the specified range, the Arduino Nano utilizes its programming logic to send a signal to a relay. This relay, in turn, interrupts the power supply to the metal mesh, ensuring the safety of individuals in close proximity. Conversely, if the PIR sensor and ultrasonic sensor do not detect anyone within the predetermined range, the metal mesh power supply remains active continuously, allowing normal system operation. This dynamic response mechanism helps optimize energy consumption and ensures the mesh remains operational only when needed. Furthermore, the timing for the automatic power on-off function, utilizing the RTC DS1307 module, will be predetermined. In summary, this integrated system showcases a sophisticated combination of ultrasonic sensing, relay control, and RTC module integration, demonstrating a versatile application that ensures both safety and adaptability in different scenarios.

The system's architecture enables seamless interaction between hardware components, ensuring timely responses to changing environmental conditions while prioritizing user safety. By integrating multiple sensors and control mechanisms, such as the ultrasonic sensor, PIR sensor, relay, and RTC module, the system

achieves a high level of functionality and reliability. Additionally, the predetermined timing for power management adds an extra layer of efficiency, allowing for precise control over energy consumption and system operation. Moreover, the design emphasizes modularity and scalability, facilitating easy integration with existing infrastructure and potential future upgrades. This adaptability ensures the system remains relevant and effective in addressing evolving needs and challenges. Overall, the described system represents a sophisticated yet practical solution for accident prevention and energy optimization, showcasing the potential of advanced sensor technologies in enhancing safety and efficiency in various applications.

5.2 HARDWARE OUTPUT

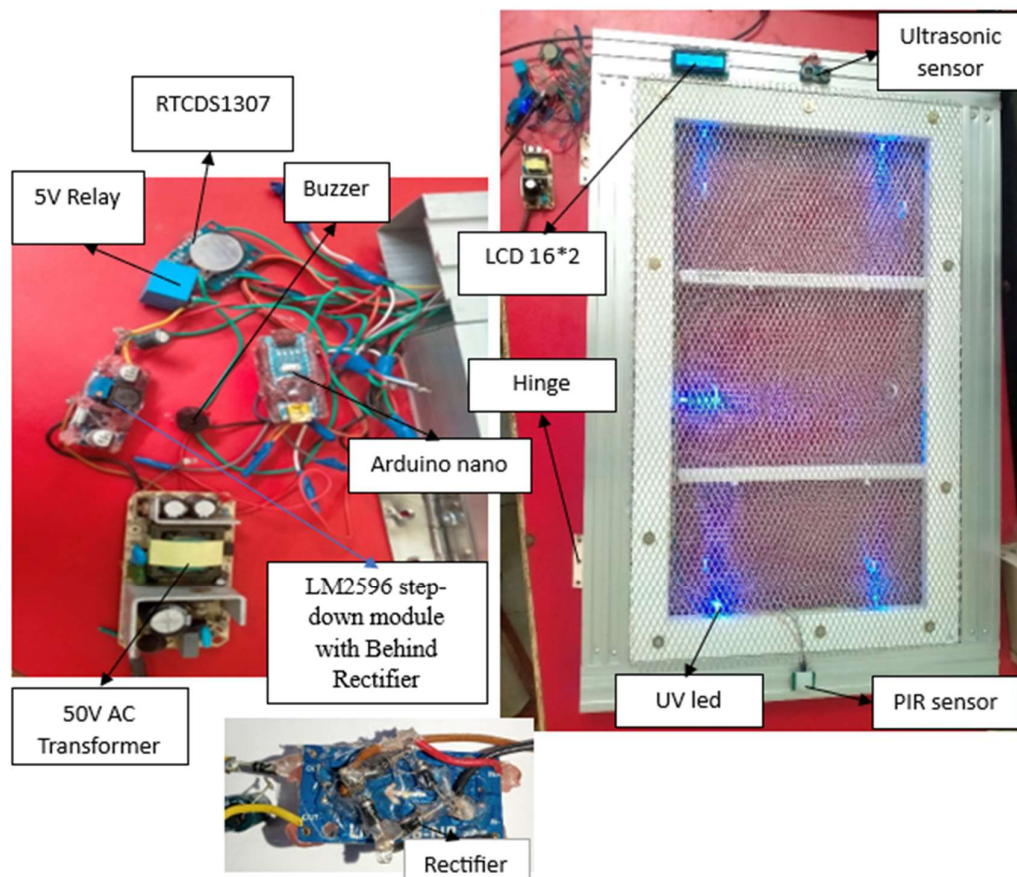


Fig: 5.2 Hardware Output

Developing a comprehensive circuit design involves both hardware implementation and software simulation, each playing a crucial role in ensuring the system's functionality and reliability. In this context, the software design, as

illustrated in Figure 3, is a key aspect of the process. The simulation phase, utilizing Arduino 1.8.3, provides a virtual environment for testing and refining the system's operation before physical implementation. Additionally, aiding in visualizing the system's architecture and interconnections. Initially, the ATmega328p loads the system file, initiating the initialization process to execute specific tasks essential for system operation. These tasks include comprehensive checks of the overall system, monitoring distances, and detecting human motion. Subsequently, individual tasks are reset to facilitate the execution of commands in a structured manner, ensuring optimal performance and responsiveness. Hardware of flexible mosquito power guard is shown in Figure 5.2.

The graphical user interface (GUI), developed using the C++ programming language, serves as a user-friendly platform for interacting with the system. It facilitates the implementation of various functionalities, including distance measurement, motion detection, and power supply control. By providing an intuitive interface, the GUI enhances user experience and enables seamless operation of the system. Expanding on the software simulation aspect, Arduino 1.8.3 offers a versatile platform for prototyping and testing Arduino-based projects. It provides a range of tools and libraries to facilitate the development process, allowing developers to simulate different scenarios and evaluate system performance in diverse environments. This simulation capability proves invaluable in identifying and addressing potential issues before deployment, thereby minimizing risks and ensuring the system's effectiveness and reliability.

In summary, the integration of hardware implementation and software simulation is essential for achieving a robust and functional circuit design. Through software simulation, developers can refine algorithms, test system behavior, and optimize performance, ultimately leading to the successful implementation of the mosquito killing system and other complex electronic projects. To initiate operation of the described system, begin by activating the power supply to provide power to the Arduino Nano. Integrated with an ultrasonic sensor, the Arduino Nano serves a pivotal role in accident prevention by continuously monitoring the distance between the sensor and any individuals within its vicinity. Should the ultrasonic sensor and PIR sensor detect individuals within the specified range, the Arduino Nano employs its programmed logic to transmit a signal to a relay. This relay, in response, interrupts the power supply to the metal mesh, thereby ensuring the safety of

individuals in close proximity. Conversely, if the PIR sensor and ultrasonic sensor fail to detect anyone within the predetermined range, the power supply to the metal mesh remains active continuously, allowing normal system operation to proceed uninterrupted. This dynamic response mechanism not only optimizes energy consumption but also ensures that the mesh remains operational only when necessary, thereby enhancing overall efficiency.

Moreover, the timing for the automatic power on-off function, facilitated by the RTC DS1307 module, will be pre-established, further enhancing the system's efficiency and reliability. In summary, this integrated system exemplifies a sophisticated fusion of ultrasonic sensing and relay control, showcasing its versatility and adaptability in ensuring safety across various scenarios.

5.3 COST OF THE POWER GUARD AND ELECTRIC BILL

Table 5.1 Cost of Power Guard

SI.No	Name of the Component	No. of Components	Price in Rupees
1	Aluminum mesh (1Squarefeet = Rs.20)		Rs.20 *12 * 3 layer = 720
2	RTC DS1307	1	Rs.41
3	I2C LCD (16*2)	1	Rs.150
4	Ultrasonic sensor	1	Rs.80
5	PIR sensor	1	Rs.45
6	50v, 1A AC adapter	1	Rs.200
7	diode (1N4007)	4	Rs.5
8	Stepdown Module (LM2596)	1	Rs.45
9	led	1	Rs.5
10	Power supply cable and wire		Rs.150
11	Frame (1Squarefeet = 100)	1	Rs.100 *12 = Rs.1200
12	others		Rs.300
Total Cost			Rs.2941 (35.29USD)

Above the table 5.1, the overall cost of the proposed system is presented. In considering mosquito control, there exists a wide array of mesh bats available in the market, each varying significantly in cost, ranging from as low as 500 rupees to as high as 4000 rupees (approximately 6 to 48 USD). The diversity in pricing reflects

the varying degrees of precision and stability exhibited by these products. Factors such as the quality of materials used, the effectiveness of the design in trapping mosquitoes, and additional features contribute to the pricing structure. Moreover, consumer preferences and brand reputation also play a significant role in determining the perceived value and consequently the price of these mesh bats. As a result, consumers are presented with a range of options catering to different budgetary constraints and expectations regarding performance and durability.

Table 5.2 Electric Bill

Time (hour)	Power (W) Max.	Units	Price Charge in Rupee
1	19.6	0.0196	Rs.0.05 (0.0006 USD)
8	156.8	0.1568	Rs.0.47 (0.0056 USD)
24	470.4	0.4704	Rs.1.4 (0.0168 USD)
168 (one week)	3292.8	3.292	Rs.9.87 (0.118 USD)
672 (one month)	13171.2	13.171	Rs.39.51 (0.473 USD)

Adjacent to Table 5.2 lies crucial information regarding power consumption and pricing according to the Indian government tariff schedule. When examining the electric mosquito killing window, it's imperative to delve into its power consumption dynamics and the associated costs. The electric mosquito killing window operates by utilizing electricity to attract and exterminate mosquitoes efficiently. However, this convenience comes with a corresponding power consumption that must be accounted for in households or establishments.

Understanding the electricity consumption of the electric mosquito killing window is essential for consumers to make informed decisions regarding its usage. Typically, these devices feature varying power ratings depending on their size, functionality, and efficiency. It is advisable for consumers to refer to the manufacturer's specifications to ascertain the exact power consumption of the device they intend to purchase. Moreover, the cost of operating the electric mosquito killing window should be considered, especially in regions with regulated electricity tariffs like India. The Indian government tariff schedule outlines the pricing structure for electricity consumption, which includes different rates for varying levels of usage.

Therefore, consumers need to factor in the electricity charges associated with running the electric mosquito killing window, ensuring that it aligns with their budgetary considerations.

In addition to the direct monetary cost, it's also essential to recognize the environmental implications of electricity consumption. Opting for energy-efficient models and employing responsible usage practices can contribute to minimizing both financial expenditure and environmental impact. Ultimately, by understanding the power consumption dynamics and associated costs outlined in the Indian government tariff schedule, consumers can make informed decisions regarding the utilization of electric mosquito killing windows, balancing convenience with economic and environmental considerations.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

The paper presents the development and deployment of an innovative power supply control system that integrates a transformer module with an Arduino Nano, leveraging the capabilities of the ATmega328P MCU. Central to this system's functionality is its ability to provide real-time status updates via an LCD display, thereby enhancing user interaction and feedback. Furthermore, the incorporation of sensors for detecting human presence and motion ensures timely warnings and activates a buzzer alarm, thereby enhancing safety measures. The system's effectiveness is further augmented by the integration of UV lights, which enhance mosquito attraction, making it a potent tool for pest control. Operating at a voltage of 20 volts, the system minimizes hazards and incorporates automatic power management features programmed for evening activation and dawn deactivation.

In comparison to existing systems, this innovative power supply control system offers superior speed, versatility, and automation, rendering it highly suitable for commercial and industrial applications. Its reliability, affordability, and user-friendly setup promise widespread adoption and acceptance in various settings. The seamless integration of advanced features, coupled with its robust performance, positions this system as a frontrunner in the realm of power supply control solutions, offering unprecedented levels of efficiency and effectiveness for diverse applications.

6.2 CONCLUSION

This paper presents the development and implementation of an innovative power supply control system utilizing a transformer module interfaced with an Arduino Nano, leveraging the capabilities of the ATmega328P MCU. A crucial feature of this system is its ability to provide real-time status updates via an LCD display, enhancing user interaction and feedback. Moreover, employing sensors for detecting both human presence and motion enables the system to issue timely warnings and trigger a buzzer alarm as necessary, ensuring heightened safety measures. The integration of UV lights further augments its functionality, facilitating enhanced mosquito attraction. Central to its design is the dual-purpose functionality

aimed at stepping down high voltage while concurrently serving as a mosquito-killing device for windows, effectively balancing human welfare with pest control. Notably, the device operates at an output voltage of 20 volts, markedly lower than conventional mesh devices designed for mosquito elimination, thus minimizing potential hazards. Additionally, the system features an automatic power management mechanism, programmed to activate during the evening and deactivate at dawn, orchestrated by a microcontroller for seamless operation. Compared to existing mosquito-killing mesh systems, this innovation boasts superior speed, versatility, and automation, catering to diverse user needs. Furthermore, its reliability, affordability, and user-friendly setup make it an ideal solution for both commercial and industrial applications, promising widespread adoption and utility.

REFERENCES

- [1] Giovanni Benelli, Claire L. Jeffries and Thomas walker, "Biological Control of Mosquito Vectors: Past, Present, and Future", National library of Medicine NCBI, PMC5198200, 2016.
- [2] Sangeeta Jadoonanan, John-Thones Amenyo, Salim Ghabode, Aerren Kublal, Tahseen Tabassum, "KOM (Keep Out Mosquitoes) project: Anthropophilic terraforming and manipulation of landscapes for mosquito vector control in malaria disease management and eradication", IEEE Xplore, 2018.
- [3] Supriatna. A. K., Anggriani Melanie. N, Husniah. H, "The optimal strategy of wolbachia-infected mosquitoes release program: An application of control theory in controlling dengue disease", IEEE Xplore, 2017.
- [4] Maria Kristin Sondang Sihombing, Hartono Hartono, "Optimal Control of the Spread of Dengue Fever Using Dynamic Programming", IEEE Xplore, 2019.
- [5] Lucy S Tusting, Julie Thwing, David Sinclair, Ulrike Fillinder, Christian Bottomley, John Gimnig, Kimberly E Bonner, Steven W Lindsay, "Mosquito larval source management for controlling malaria", National library of Medicine NCBI, PMC4669681, 2015.
- [6] Li Kefeng, Yu Lijun, "Design of Mosquito Killers Based on Intelligent Lighting Control over Solar Energy and High-Voltage DC", IEEE Xplore, 2020.
- [7] Mohammad Zeyad; Susmita Ghosh; MD. Rakibul Islam; S.M. Masum Ahmed; Prodip Biswas; Eftakhar Hossain "Design Proposal of an Automatic Smart Multi-Insect (Mosquito) Killing System" IEEE Xplore, 2019.
- [8] Alpha. M, Adoyi Emmanuel, Jummai D. Makama T.O. Daniel, Salaudeen, Islamiyat T, Bello I.A., Kure N., "Design and Construction of a Tripler Circuit for a Mosquito Zapper", American Journal of Engineering Research (AJER), vol. 5, no. 8, p. 256-260, 2016.
- [9] LYU Tiangang, LYU Henan, Wang Yuefei, "Intelligent Lighting System Design Based on UV LED Technology with the Functions of Air Sterilization, Disinfection, Purification and Mosquito Control", IEEE Xplore, 2021.

- [10] Mars. J. R.: "Portable electronic lighted insect zapper"ed: Google Patents, 2012.
- [11] Diana Yuan, Wei-Cheng Hsiao, Wei-Hsiung Tseng, Hsiao-Yi Lee, Yi ChianChen,Hsin-Yi Ma,and Cheng-Han Chan, "Applying Physical Optics to Design Solar-Powered Outdoor UV LED Mosquito Trapping System", IEEE Xplore, 2018.
- [12] Lu Quan, Yang Guang and Cheng Jianli, "Mosquito killing device", Google Patents, 2020.
- [13] P.Ramakrishnan. M. E., Hari Prasath S, Harish L, KrishnaKumar E, "IoT based Industrial Automation for Various Load using ATmega328p Microcontroller", IEEE Xplore, 2020.
- [14] Rengarajan Sundararajan, Vignesh Natarajan, Vasanth Viswanathan, Sri Hari Ravi Shankar, "Automatic Temperature Control of Electric Motor Using PIC Microcontroller", IEEE Xplore, 2022.
- [15] Ayan Kumar Biswas;Nahian Alam Siddique;Bing Bing Tian;Enoch Wong;Kevin A. Caillouët;Yuichi Motai, "Designof a Fiber-Optic sensing mosquito Trap", , IEEE Sensors Journal. 2013.
- [16] Ying Zhang Grasso, Hong Jiang, Jun-Ping Wang, Yu-Long Cheng,Yan-Lai Zhou, "Insect Biocontrol Method and Device: Attract-Infect-Release (AIR) Technology" ed: Google Patents, 2017.
- [17] Jincy Jose, Muhammed Salih U P, Development of a Multipurpose Solar PoweredInsect Pests Trap: KRISHI VIKAS, IEEE Xplore, 2023.