Department of Mechanical Engineering

University of Central Punjab

DESIGN AND FABRICATION OF SMART MOSQUITO KILLER MACHINE

Thesis submitted for the undergraduate degree in Mechanical Engineering
at the
University of Central Punjab

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Session 2019-2023
Department of Mechanical Engineering,
University of Central Punjab, Lahore Pakistan

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ABSTRACT

Mosquitoes are one of the main sources of transmission of many diseases, like dengue and malaria. As per World Health Organization (WHO) data, 0.725 million people die every year, worldwide, because of mosquitoes-borne-diseases. 0.6 million of these deaths are due to malaria alone. In Pakistan, large number of deaths due to dengue and malaria outbreaks are reported every year in different areas of country. Moreover, in the aftermath of heavy floods last year, exceptional increase had been observed in spread of mosquitoes-borne-diseases, especially in the flood hit areas. There are quite limited ways to prevent/control these diseases, one of them being mosquito killer traps. The aim of this project was to design and fabricate an advanced mosquito killer machine that can imitate human body conditions to lure the mosquitoes, manufactured locally and commercialized easily. In this project, UV light was used to attract mosquitoes. Electric heaters were used to maintain temperature equivalent to human body. Mist generator was used to maintain moisture, mimicking the human sweat. Suction fan was used to suck mosquitoes and direct them onto the mesh, which uses electrical spark mechanism to kill them. Triple luring mechanisms, i-e UV light, imitation of human moisture and body temperature makes it unique and more effective comparative to commercially available traps. Moreover, portable nature of this machine makes it suitable for both indoor and outdoor usage.

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CHAPTER ONE: INTRODUCTION

The main diseases caused by mosquitoes are malaria, dengue, zika, chikungunya and yellow fever. A smart mosquito killer machine is a device designed to detect, trap, and kill mosquitoes in a specific area. It uses sensors to locate mosquitoes and a trapping mechanism, such as a UV light or a fan, to capture and kill them. With its ability to work in a variety of settings, including homes, offices, and outdoor spaces, it provides an efficient and cost-effective solution to controlling mosquito populations. Furthermore, it has a compact and portable design, safe for use around humans and pets. Our model is preferable for both economical and domestically purposes as it is efficient because it contains UV light, spreads moisture and it will maintain temperature to attract mosquitoes. Furthermore, we added all functions in a machine that will attract mosquitoes and kill them by an electric current passing through meshes. The machine can work safely and properly because we didn't use any chemical or insecticides that may cause damage to living beings on earth as well as in water. The machine has low maintenance as it requires basic refill of moisture that can work for up to days and we used natural moisture which is easily available in the market and much cheaper than any other chemical used in conventional methods and electricity backup to operate for long period. And it is easy to clean as we just have to clean its bottom plate area because mosquitoes which are killed through electrical meshes will fall on that plate and we have to clean that plate by opening it from bottom. The smart mosquito killer machine is useful in preventing spread of diseases which are caused by mosquitoes like dengue, Malaria, Zika, Chikungunya and yellow fever and it is need of the people which are mainly living in remote areas and people who really affected by heavy floods this year in Pakistan.

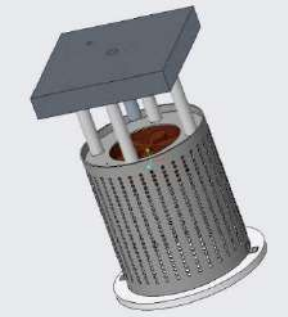


Figure 1.1 Cad design of project

1.1 Problem statement

WHO data shows 0.725 million deaths from mosquito-borne diseases. 0.6 million are due to malaria alone. In Pakistan, many deaths caused by dengue and malaria outbreaks every year. In the aftermath of heavy floods this year, exceptional increase of mosquitoes-born diseases has been observed, especially in flood affected areas. Liquid/vapors-based solutions have environmental concerns, expensive and for some, allergic to human skin.

1.2 Aims /Objective

Main aim of this project is to design and fabricate an advanced mosquito killer machine which can be manufactured locally, sustainable and cost effective. The smart feature of this machine will be that it will imitate the human body's condition which can be sweat and body temperature.

1.3 Significance of project

- It consumes lesser power.
- It is sustainable device.
- It is soundless device.
- It is maintenance free and manufactured locally.
- No smoke
- No allergy

1.4 Application of this project

Portable nature of this machine will make it suitable for both indoor and outdoor insect control in such places like

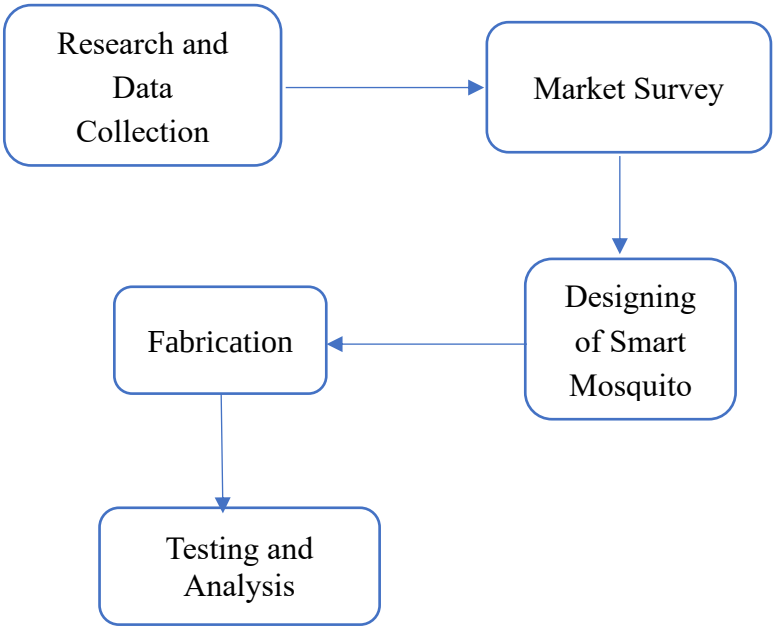
- Homes
- Offices
- Mosques
- Restaurant
- Flood areas

1.5 Scope of this project

The scope of a smart mosquito killer machine would include the following:

- The ability to detect and locate mosquitoes in the surrounding area using sensors such as infrared or ultrasonic.
- Implementation of a trapping mechanism to capture and kill the mosquitoes, such as a UV light or a fan.
- Ability to work in a variety of settings, such as homes, offices, and outdoor spaces.
- A compact and portable design, easy to move and place in different rooms or outdoor spaces.
- The ability to collect data on the number and type of mosquitoes caught, providing information on the population and potential health risks in the area.
- A design that is safe for use around humans and pets, avoiding exposure to harmful chemicals or pollutants.
- A cost-effective solution to controlling mosquito populations in the surrounding area.

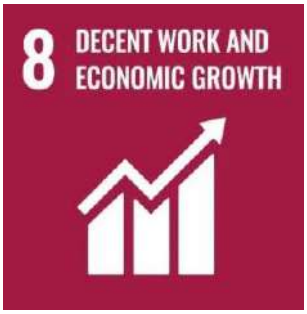
1.6 Methodology



1.7 Mapping with Complex Eng. Prob. Attributes

Traits	Details
WP1	Depth of knowledge required WK4 Engineering specialization WK5 Engineering design WK7 Engineering and society WK8 Research literature
WP3	Depth of analysis required
WP4	Familiarity of uses
EP2	Judgement

1.8 Mapping with UN SDGs



CHAPTER TWO: LITERATURE REVIEW

A literature review consists of all the previous work which has been done on the projects and conventional methods that are being used to kill mosquitoes. The methods include lotions, sprays, Rackets, coils, electric bulbs, electric liquid vaporizer, these are used to kill mosquitoes. Lotions and sprays can be applied on skin to repel mosquitoes. Electric Rackets can kill them by using current passing through meshes. LED light bulbs will attract them and kill them by using electric meshes and liquid vaporizer can kill mosquitoes by exposing fumes of chemicals into environment. These killing materials have environmental concerns and are causing damage to health. There is research on Odor Based Traps which uses Citronella Oil and Soapy Water to capture mosquitoes and also uses to repel by giving them unpleasant environment.
In our Smart Mosquito Killer Machine, first of all we use electrical meshes which contains high voltage current that when a mosquito passes through them, it kills them when passing electric current by giving spark. Second, we used Heating Coils that will produce a certain temperature which a mosquito can detect and coils will create a trap for them. Third, we used a UV LEDs which also serve as a trap to catch mosquitoes to interact with the machine. Fourth, we used Suction Fan which will suck when mosquitoes got closer to machine and forward them towards electrical meshes to kill them. These functions safe to operate and they are friendly environment and we built machine to operate at its maximum efficiency.

2.1 Method for killing mosquitoes

Following are the method for killing mosquitos of this project is given below

2.1.1 Mosquito lotion and spray

The lotions and sprays are easily available in the market and they can be used by directly applying to the skin to repel mosquitoes and other harmful flying objects. These chemicals use one or more active ingredients that produce a very strong aroma or smell those mosquitoes and insect don't like and create less chance to bite a person who has applied this lotion on the skin. The ingredients use in these products contains DEET, Picaridin, and Lemon Eucalyptus Oil. The mosquito repellent lotions and sprays are simple and easy ways to protect a person against mosquito bites and they can be applied directly on your skin and clothes when you go outside.[20]

Figure 2.1 King mosquito repellent [6]

Figure 2.2 Anti mosquito spray [7]

Advantages of mosquito lotion and spray include:

- They are portable and can be taken with you wherever you go, and they can offer quick and simple protection from mosquitoes.
- They can be used to treat specific skin conditions, like exposed skin or regions where mosquitoes are known to bite.[21]

Disadvantages of mosquito lotion and spray include:

- They can leave stains on fabric or objects and are messy to apply.
- They can have a strong odor that some people may find unpleasant.
- Many people may experience skin rashes or allergic reactions from them.
- Some of the chemical components in these products could be harmful to the environment.[21]

2.1.2 Electric mosquito repellent

A device that uses electricity to produce high-frequency sound waves that are intended to repel mosquitoes and other flying insects is known as an electric mosquito repellent. These devices are intended to repel mosquitoes from the area where they are put by emitting sound waves at a frequency that is supposedly unpleasant to them. Electric mosquito repellents work on the basis that the high-frequency sound waves they create would interfere with insects' capacity to communicate, navigate, and find food sources, making the environment around the device less appealing to mosquitoes. [19]

Figure 2.3 Electric mosquito repellent [8]

Figure 2. 4 GM -3200 mosquito repellent [9]

Electric mosquito repellents have the benefit of not using chemicals, making them safe for both people and dogs. Electric mosquito repellents are a more convenient option for many individuals than traditional chemical-based repellents because they don't smell bad and leave no residue. There is no scientific data to support the effectiveness of electric insect repellents, which is one of its disadvantages [19]. The effectiveness of electric mosquito repellents has been the subject of numerous investigations; however, the findings are confusing and unclear.

2.2.3 Electric mosquito racket

A device that uses electricity to kill mosquitoes is known as an electric mosquito racket. A mesh or wire grid is often attached to one end of a handle in the shape of a badminton racket. The grid emits a high voltage pulse that is used to instantly kill mosquitoes when it is powered, often from a battery. In place of chemical sprays or traps, the device is commonly used to reduce mosquito populations. [20]

Figure 2.5 Mosquito electric racket [10]

Advantages of electric mosquito rackets include:

- Since they effectively kill mosquitoes on contact, they may contribute to a decrease in the number of mosquitoes in a specific area.
- They are portable, lightweight, and easy to move, they are great for usage at home or while travelling.[21]

Disadvantages of electric mosquito rackets include:

- They only kill mosquitos that come into touch with the charged grid, they are ineffective against mosquitos that are hiding or flying away.
- They must be charged or replaced on a regular basis, which might be inconvenient.[21]

2.2.4 Mosquito coil vaporizer

A mosquito coil vaporizer is a device that heats a mosquito coil, causing it to emit mosquito-repelling smoke. The mosquito coil is a thin, spiral-shaped sheet of paper covered in pesticides and other substances. When the coil is heated, the chemicals evaporate and emit a mosquito-repelling smoke. Some mosquito coils also contain a slow-burning substance, such as wax, which emits a constant stream of smoke over several hours. When used as directed, they are generally considered safe, although they should be used with sufficient ventilation to avoid breathing in. [22]

Figure 2.6 Mosquito coil [11]

Advantages of electric mosquito coil vaporizer include:

- Mosquito coil vaporizers are simple to use and do not require electricity or batteries, making them an ideal outdoor solution.
- Mosquito coils are rather cheap, and a single coil can give several hours of protection from mosquitos. .[21][22]

Disadvantages of electric mosquito coil vaporizer include:

- Electric mosquito coil vaporizers can cause fires if not used properly or left alone. Unless the heated coils come into contact with flammable objects, they can start fires.
- The smoke and chemicals generated by mosquito coils can cause breathing disease, particularly in persons who have asthma or other lung diseases. [21][22]

2.2.5 Electric mosquito zapper

An electric mosquito zapper, also known as an electric insect killer, is a device that attracts and kills mosquitos and other flying insects by using UV light. The device generates UV light, which attracts insects, and then electrocutes them using an electric grid. Electric mosquito zappers are often use inside or outside, such as in yards, homes, offices, and decks. They can be an excellent method of controlling mosquitos and other flying insects, but they may also attract beneficial insects like bees and butterflies. [23]

Figure 2.7 Mosquito electric zapper [12]

Figure 2.8 Hemiua bug zapper [13]

Advantages of electric mosquito zapper include:

- Electric mosquito bug zappers are capable of successfully reducing mosquito and other flying insect populations on outdoor and indoor spaces.
- Electric mosquito bug zappers are simple to operate and do not require any additional chemicals or pesticides.[23]

Disadvantages of electric mosquito zapper include:

- Electric mosquito bug zappers can cause a fire if they aren't used properly or left unattended. If the heated coils come into contact with flammable objects, they can cause fires.
- Electric mosquito bug zappers may attract beneficial insects such as bees and butterflies in addition to the insect you want to kill.[23]

Table 2.1
Summary of mosquito trap

Method	Chemical	Advantage / disadvantage	Market price
Lotion	Diethyltoluamide	One of the safest and quickest way but it can cause skin irritation, allergies, rashes	250 Rs
Sprays	Pyrethrin	They just don't harm mosquitoes but highly toxic to native pollinators such as bees, butterfly	600 Rs
Coils	Pyrethrum powder	Safe insecticides for human but in closed room it can cause lungs cancer, asthma, and headache	200 Rs
Electrical Racquets	Electroshocks meshes with rechargeable battery	It is manually controlled as we have to kill mosquitoes by an equipment and it is also using battery trap	2k-3k Rs
Electrical liquid vaporizer	Allethrin	The chemical in the form of vapors block the chemo reception and also respiratory tracts of mosquitoes but chemical used in the cause allergic and respiratory problem	400 Rs

2.2 Electrical meshes for killing mosquito

A high-voltage electric current is passed across a mesh grid by an electric mosquito mesh. When mosquitos come into touch with the mesh, they are shocked and die. The mesh is powered by an electrical source, such as a battery or a power supply. It is important to understand that the electric mosquito mesh is not dangerous to people because the current is insufficient to cause harm.

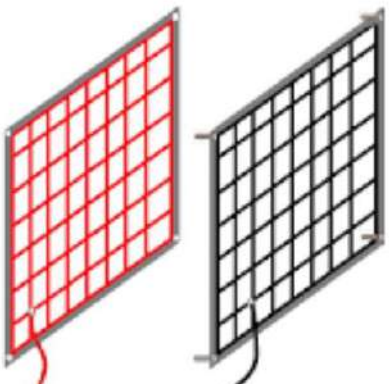


Figure 2.9 Mosquito killer mesh [14]

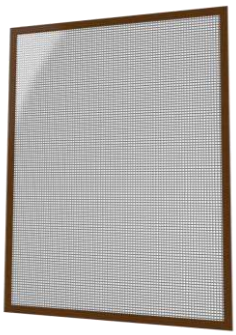


Figure 2.10 Mosquito net [15]

Electric mesh technology has been presented in the literature as a technique of killing mosquitos. The mesh is generally composed of a conductive metal grid that has been charged with a high voltage, typically in the thousands of volts range. When mosquitos come into touch with the mesh, they are electrified and die instantaneously. The goal of this technique is to be low-maintenance, as the mesh may be charged through power sources and does not require the use of chemicals or other toxic substances. Furthermore, it is useful in mosquito control because the high voltage of the mesh kills them effectively and rapidly. Overall, it is possible to conclude that electric mesh technology has great potential for controlling mosquitos and reducing the spread of vector-borne illnesses. However, A conclusion supporting the use of electric mesh technology to kill mosquitos would outline the important results of the research as well as the technology's possible drawbacks. The high voltage of the mesh, for example, may kill beneficial insects such as bees and butterflies, which can have a severe impact on the environment.

2.3 Odor based trap

An odor-based mosquito trap is a device that attracts and traps mosquitos by using certain fragrances or scents. The smell or fragrance is often a chemical compound that resembles the aroma of a person or animal, which mosquitoes are naturally attracted to for a blood meal. Once the mosquitos are drawn to the smell, the net traps or kills them.

2.3.1 Citronella oil

Researchers find out the receptors that a mosquito uses to detect carbon dioxide and body odor and in addition to this they also find the elements which are linked with receptors. They also find out that female mosquitoes have nerve cell which are called CPA neurons which can detect carbon dioxide. This ability helps them to find the target when someone exhales carbon dioxide. And they still can find target without sensing carbon dioxide. A group of researchers teamed up with Dr. Anand Sankar Ray at University of California, Riverside, to determine neurons and receptors that can attracted to skin odor. Their research was supported in part by NIH’s National Institute of Allergy and Infectious Diseases (NIAID). By putting these types of chemicals on human skin, the mosquitoes will repel due to unpleasant smell. To detect more specified elements, the team produced a computer simulation method to produce almost half a million chemical compounds in search of structures that might interact with the receptor. They developed 138 compounds that have unpleasant smell, less costly and easily available in the market. The researchers gave attention to citronella oil, which has a fruity smell.[1],[2]

Citronella oil is a natural mosquito repellant made from the leaves of many lemongrass plant species. Citronellal and citronellol are chemicals found in the oil that are known to repel mosquitoes and other flying insects. It has been used for years to reduce mosquito populations as a natural alternative to traditional pesticides. Citronella oil may be used to kill mosquitos in a variety of methods, including:

- Topical application applying the oil, such as massaging it on the skin or clothing.

- To release the fragrance into the air, burn citronella candles or use citronella oil in a diffuser.

Figure 2.11 Pure citronella oil [16]

The advantages of using citronella oil as a mosquito repellent include the following:

- Citronella oil is a natural and sustainable resource since it is extracted from the leaves of lemongrass plants. As a result, it is a less harmful alternative to chemical pesticides.
- Citronella oil is readily accessible and may be bought at many natural health stores as well as online.

There are certain drawbacks to using citronella oil as a mosquito repellent. Citronella oil may cause skin sensitivities or allergies in certain persons. It is usually preferable to test it first before applying it to the skin.

2.3.2 Soapy water

Researchers find out the receptors that a mosquito uses to detect carbon dioxide and body odor and in addition to this they also find the elements which are linked with receptors. They also find out that female mosquitoes have nerve cell which are called CPA neurons which can detect carbon dioxide. This ability helps them to find the target when someone exhales carbon dioxide. And they still can find target without sensing carbon dioxide. A group of researchers teamed up with Dr. Anand Sankar Ray at University of California, Riverside, to determine neurons and receptors that can attracted to skin odor. Their research was supported in part by NIH's National Institute of Allergy and Infectious Diseases (NIAID). By putting these types of chemicals on human skin, the mosquitoes will repel due to unpleasant smell. To detect more specified elements, the team produced a computer simulation method to produce almost half a million chemical compounds in search of structures that might interact with the receptor. They developed 138 compounds that have unpleasant smell, less costly and easily available in the market. The researchers gave attention to soapy water. Although mosquitoes are drawn to the carbon dioxide that people and other animals exhale, soapy water can be used as a natural mosquito repellant. When soap is applied to water, it forms a barrier on the surface that breaks surface tension. This makes it harder for mosquitoes to land and stay on the water. They will fall into the sea and perish if they try to land. Furthermore, certain types of soap include ingredients that repel mosquitos. [1],[2]

It is important to note that soap water is not a long-term solution for mosquito population management; rather, it is a temporary method to repel a few mosquitoes surrounding you. It is not a substitute for other mosquito control strategies such as using a mosquito net, repellent, and removing standing water.

Figure 2.12 Soapy water [17]

2.4 Coil Heater with thermocouple

A thermocouple coil heater is a type of heating equipment that employs a coiled resistance wire as the heating element. The thermocouple is a safety device that monitors the temperature of the heater and turns it off if it becomes too hot. The coil heater creates heat by sending an electric current through the resistance wire. The heat is subsequently dispersed across the surrounding environment. The thermocouple is a temperature-sensitive device that is located near the heating element. It is constructed from two distinct types of metal wires that are linked at one end. The thermocouple creates a modest electrical voltage as the temperature of the heating element rises.

Figure 2.13 Mechanism of coil heater [18]

In industrial and commercial applications such as furnaces, ovens, and heaters, coil heaters with thermocouple mechanisms are often employed. They are well-known for their toughness, efficiency, and safety features. They may be produced from a variety of metals, including copper, iron, nickel-chromium alloys, and so on.

Temperature range:

The temperature range of a coil heater with a thermocouple mechanism can typically range from a few hundred to several thousand degrees Celsius.

- The temperature range of copper coil heaters with thermocouples is 600-700°C.

- The temperature range of a type K thermocouple (chromel-alumel) is -270 to 1250°C.
- The temperature range of type J thermocouples (iron-constantan) is -210 to 760°C
-

2.5 Questions or Gaps:

Is this model economical meaning to say that the conventional methods which are already present in the market and the products which we use to kill mosquitoes have health hazards and environmental concerns. They have severe effects on lungs and also can cause cancer and also polluting aquatic life. And the electric mosquito repellents like Racquets and Liquid Vaporizer are very costly as they need battery backup and refill to operate, so they are not cost effective.

CHAPTER THREE: CALCULATIONS & DESIGN METHODOLOGY

This chapter focuses on the essential calculations for the Electric Mesh, Fan, UV Light, Humidifier, and Heaters, which are integral components of the smart mosquito killer machine. We also explore the modeling process for each component, utilizing CAD software to design and integrate them into the machine effectively. These calculations and modeling steps are crucial in the development of a highly efficient smart mosquito killer machine.

3.1 Calculations

3.1.1 Power Consumption of Electric mesh

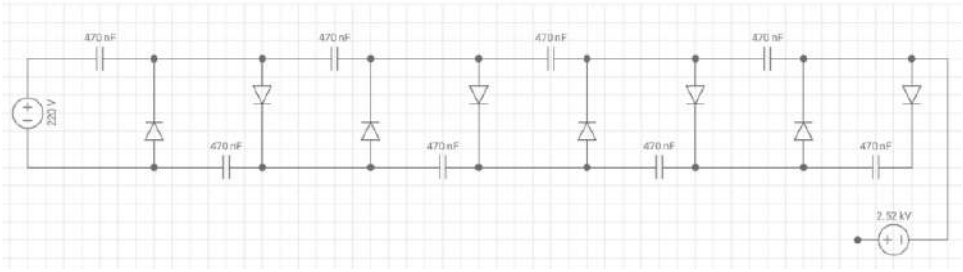


Figure 3.1 Electric mesh circuit

Capacitance= 0.47uf =630v

$Quantity_{capacitor}$ = 8

By using rule of thumb multiply:

Output voltage = $\frac{Capacitance \times Quantity_{cap}}{2}$

Output voltage = $\frac{630*8}{2}$

Output voltage =2520v

To find power consumption:

Main voltage = 220v

P.E = $\frac{1}{2}CV^2$

P. E=$\frac{1}{2}(0.47\times10^{-6})\times220^2$

P. E=0.0113 joule

P. E= 0.0904 joule (for 8 capacitor)

$$P.E_{(kwh)} = \frac{P.E}{3600000}$$

$$P.E_{(kwh)} = \frac{0.0904}{3600000}$$

$P.E_{(kwh)}$= 2.5111×10^{-8} kwh

3.1.2 Power Consumption of suction fan

Voltage = 220v
Current = 140mA
Hour = 1hr

Power = voltage × current
Power = $220\times140\times10^{-3}$
Power = 30.8 w
Power consumption = $\frac{Power*hour}{1000}$
Power consumption = $\frac{30.8\times1}{1000}$
Power consumption = 0.0308 kwh

3.1.3 Power Consumption of UV light

Voltage = 12v
Current = 152mA
Hour = 1hr

Power = voltage × current
Power = $12\times152\times10^{-3}$
Power = 1.82 w
Power consumption = $\frac{Power*hour}{1000}$
Power consumption = $\frac{1.82\times1}{1000}$
Power consumption = 0.00182 kwh

3.1.4 Power Consumption of Mist Maker

Voltage = 5v
Current = 500mA
Hour = 1hr

Power = voltage × current

Power = $5\times500\times10^{-3}$

Power = 2.5w

Power consumption = $\frac{Power*hour}{1000}$

Power consumption = $\frac{2.5\times1}{1000}$

Power consumption = 0.0025 kwh

3.1.5 Power Consumption of Coil heater

Voltage = 12v
Current = 480mA
Hour = 1hr

Power = voltage × current

Power = $12\times480\times10^{-3}$

Power = 5.76w

Power consumption = $\frac{Power*hour}{1000}$

Power consumption = $\frac{5.76\times1}{1000}$

Power consumption = 0.00576 kwh

3.1.6 Total Energy Consumption

i. Energy consumption of fan= E_{Fan} = 0.0308 kwh
ii. Energy consumption of LED= E_{Led} = 0.00182 kwh
iii. Energy consumption of Mist maker= E_{Mist} = 0.0025 kwh
iv. Energy consumption of heater= E_{Heater} = 0.00576 kwh
v. Energy consumption of capacitance= E_{Cap} = 2.511× 10^{-8} kwh

Total energy = $E_{fan} + E_{LED} + E_{mist} + 2(E_{heater}) + E_{cap}$

Total energy= 0.0308+0.00182+0.0025+2(0.00576) +2.511× 10^{-8}

Total energy= 0.0466 kwh

3.2 Creo cad modelling of component

3.2.1 Suction fan

Suction fan is designed in Creo with help of holes, sketching, extrude and pattern command.

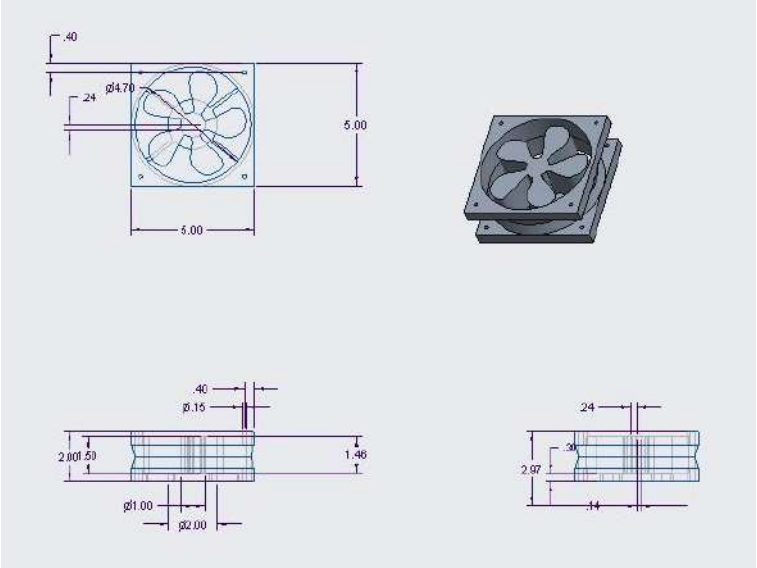


Figure 3.2 Creo model of suction fan

3.2.2 Base

The base is designed in the Creo with the help of sketching and extrude command.

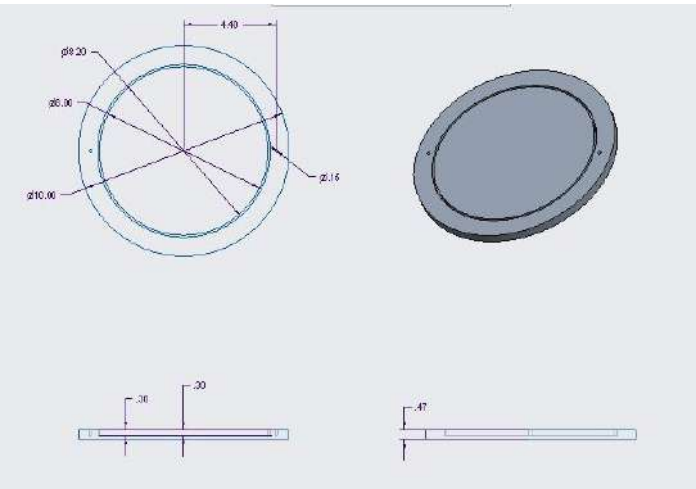


Figure 3.3 Creo model of base

3.2.3 Heating rod

The heating rod is designed in Creo with the help of sketching, circle and extrude command.

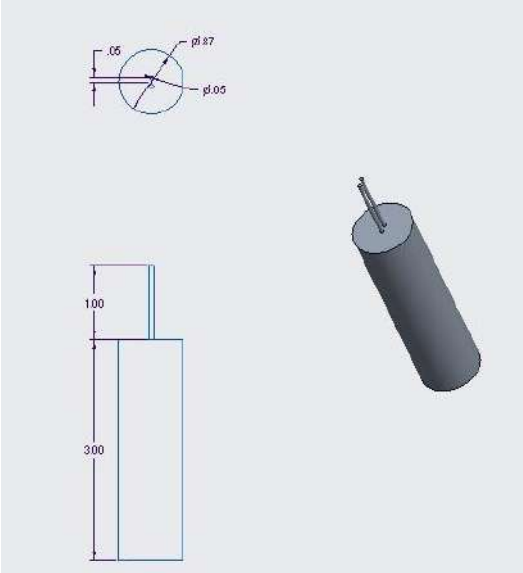


Figure 3.4 Creo model heating rod

3.2.4 Outer Case

The outer case is designed in the Creo with the help of sketching, circle, holes and extrude command.

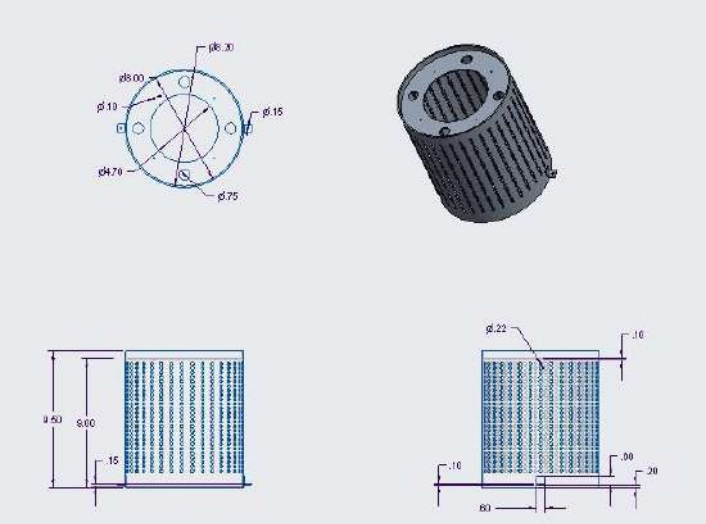


Figure 3.5 Creo design of outer case

3.2.5 Arduino box

The Arduino box is designed in the Creo with the help of sketching, rectangle, and extrude command.

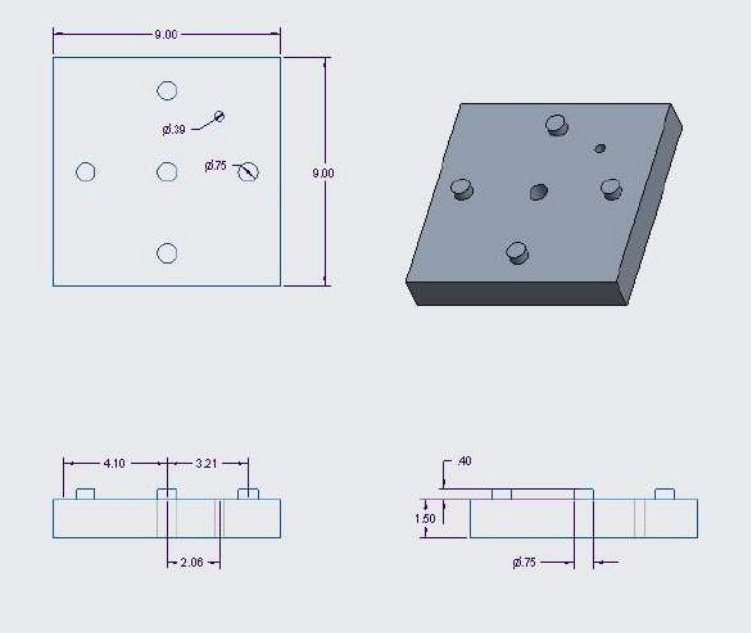


Figure 3.6 Creo design of Arduino

3.2.6 Exploded of smart mosquito killer machine

Figure 3.7 Exploded of mosquito killer machine

3.2.7 Assembly of smart mosquito killer machine

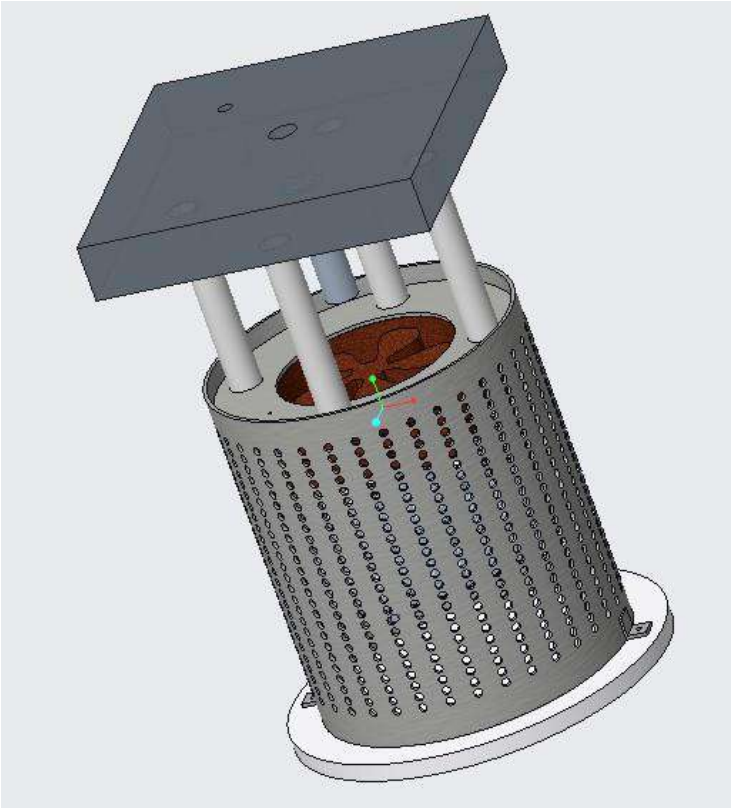


Figure 3.8 Assembly of smart mosquito killer machine

CHAPTER FOUR: MATERIAL SELECTION & FABRICATION

In this chapter, we focus on the material selection for the different components of the smart mosquito killer machine based on the design and calculations from the previous chapter. For the Electric Mesh, a high-conductivity and durable material is chosen to handle the required voltage. The suction fan is used to enhance airflow efficiency. UV Light requires utilized to attract mosquitos and then kill them when they come into contact with the light.Lastly, the heaters are constructed from heat-resistant materials to withstand elevated temperatures. These carefully selected materials and specifications ensure the fabrication of an effective and reliable smart mosquito killer machine.

4.1 Material selection

4.1.1 Suction Fan

A suction fan that suckers or drags air and things into it via airways or air pipes.

Figure 4.1 Suction fan [24]

Table 4.1
Specification of Suction fan

Material	Plastic
Dimension	5in×5in
Voltage	220v
Current	0.14A
Power	30.8w

4.1.2 UV light

A UV light can be utilized to attract mosquitos and then kill them when they come into contact with the light.

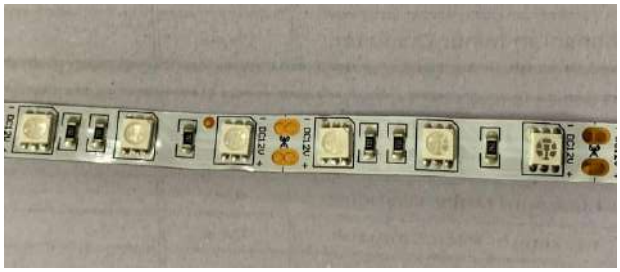


Figure 4.2 Ultra violet light [25]

Table 4.2
Specification of UV light

Length	10in
Color	Blue
Voltage	12V
Current	0.152A
Power	1.82W

4.1.3 Mist maker

A mist maker, also known as a moist generator, is a device that uses different methods to produce mist or fog. Its principal use is to provide a visually pleasant fog or mist effect for aesthetic or functional purposes.

Figure 4.3 Mist maker

Table 4.3
Specification of Mist maker

Material	Plastic
Internal Diameter	0.63in
External diameter	1.97in
Voltage	5V
Current	0.5A
Power	2.5W

4.1.4 Coil heater

A coil heater is a type of electric heating element that is made up of coiled wire that is covered in a protective sheath. It is intended to create heat for specialized applications requiring localized or focused heating.

Figure 4.4 Coil heater

4.1.5 Base:

Base is basically used to collect the mosquito that kill with help electric mesh and suction fan.

Figure 4.5 Base

Material:

- Teflon

4.1.6 Heating rod

Table 4.4

Material selection of heating rod

Material	**Corrosion resistance** (mm/year)	**Thermal conductivity** W/(mk)	**Electrical conductivity** **(**siemens/meter)
Steel	0.02- 0.03[5]	45[3]	$1.46*10^{6}$[4]
Aluminium	0.03- 0.11[5]	85- 251[3]	$38*10^{6}$[4]
Brass	0.1133[5]	147[3]	$15.9*10^{6}$[4]
Copper	1000[5]	398[3]	$58.14*10^{6}$[4]

Figure 4.6 Aluminium rod

Table 4.5

Specification of Aluminium rod

Material	Aluminium
Length	5in
Internal diameter	0.75in
Outer diameter	0.87in

4.1.7 Outer Case

Figure 4.7 Outer case

Material:

- Mild steel

4.1.8 Arduino box

The Arduino box used to incorporate all the necessary components circuit within this box, we ensure a compact and organized arrangement of supplies. This efficient design provides a convenient and effective solution for combating mosquitoes

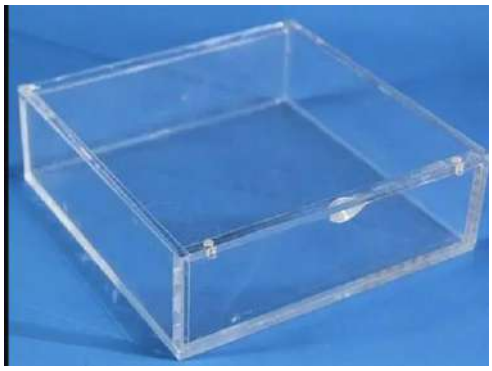


Figure 4.8 Acrylic box

Material:

- Acrylic sheet

4.1.9 Electric mesh

To control mosquitoes, electric mesh can be used to form an electrical barrier. The mesh has small holes to prevent mosquitos from going through. When mosquitos come into touch with the electric mesh, they are shocked, successfully deterring them from approaching a certain region

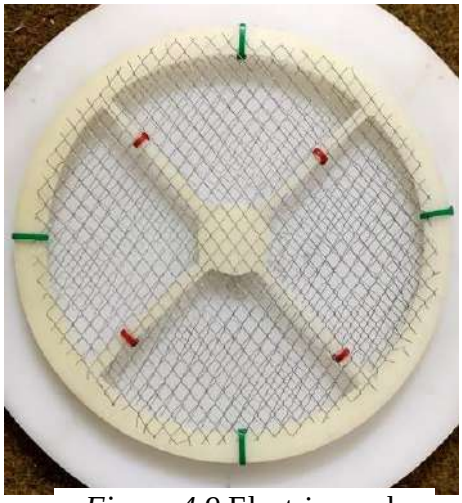


Figure 4.9 Electric mesh

Material:

- Mild steel mesh
- Teflon

4.1.10 Fastener

The fastener is commonly used to refer to devices that seal or secure the opening of a container.

Figure 4.10 Fastener

Material:

- Teflon

4.2 Fabrication

4.2.1 Outer case

First of all, the metal sheet serves as the primary component, which is utilized to mold it into a circular shape by the help of circular die and then to fix out with the help of arc welding. At the top of the metal sheet, four holes are drilled at precise distances to accommodate the placement of heating rods. These heating rods, along with an attached Arduino box, contribute to the functionality of an advanced mosquito killer machine.

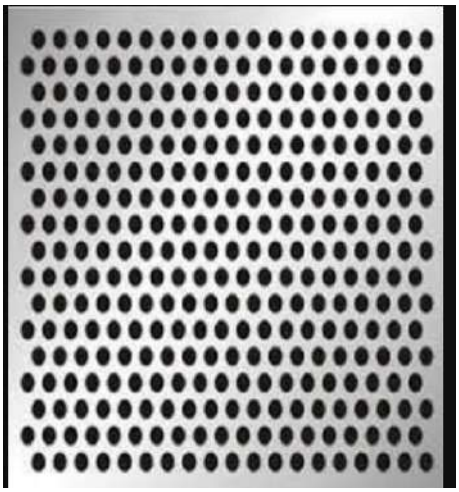


Figure 4.11 Round hole mild steel sheet

Figure 4.12 Assembling a dustbin

Figure 4.13 L-bracket

Figure 4.14 Outer case

Table 4.6
Specification of Outer case

Material	Mild steel
Length	9.5in
Mesh thickness	0.07in
Diameter	8in
Hole Diameter	0.22in
Distance b/w two hole	0.09in
Plate Diameter	4.7in

4.2.2 Arduino Box

First of all, the acrylic sheet serves as the primary component. Using laser cutting techniques, the acrylic sheet is carefully shaped into a box structure, offering durability and transparency. After the box is formed, we proceed to drill five holes into the sheet. Four of these holes are specifically designed to accommodate the heating rods, which play a crucial role in the functionality of the device. The fifth hole is strategically placed to allow for the adjustment of a mist maker, responsible for generating fumes that attract mosquitoes.

Figure 4.15 Acrylic sheet

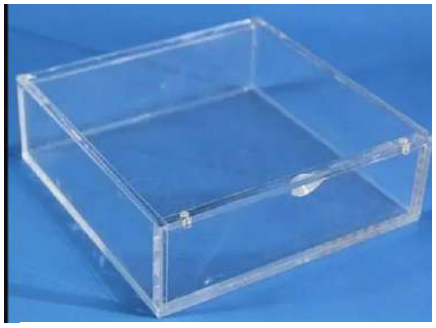


Figure 4.16 Acrylic box

Figure 4.17 Box hinges

Figure 4.18 Arduino box

Table 4.7
Specification of Arduino Box

Material	Acrylic sheet
Dimension	9.5in× 9.5in
Height	1.5in
Heating rod hole	0.75in
Mist maker hole	0.39in

4.2.3 Electric mesh

Utilizing a piece of nylon sheet, we employ machining techniques to shape it into a circular. We attach mild steel mesh to both the upper and lower parts of the nylon sheet.

Figure 4.19 Nylon sheet

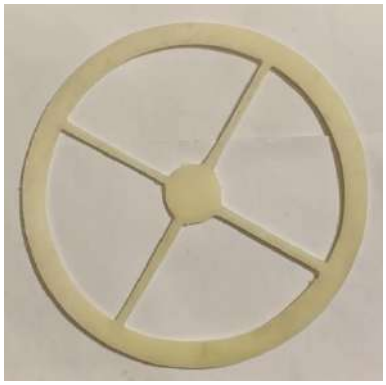


Figure 4.20 Circle of acrylic sheet

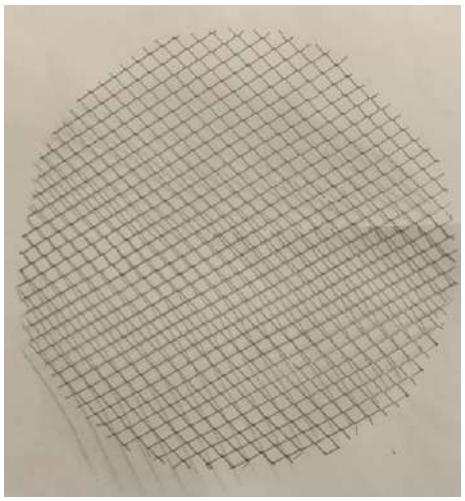


Figure 4.21 Mild steel mesh

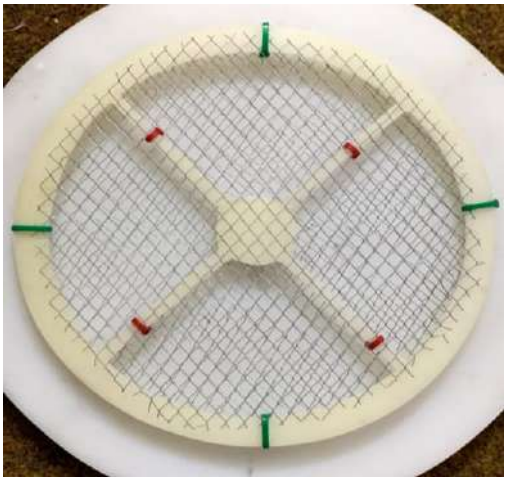


Figure 4.22 Electric mesh

Table 4.8
Specification of Electric mesh

Material of frame	Nylon
Material of mesh	Mild steel
Diameter of frame	7.8in
Mesh size	0.24in×0.24in
Distance b/w two mesh	0.12in

4.2.4 Coil heater

When manufacturing Coil heater, steel is the preferred material for creating a durable hollow rod with a length of 3in. Inside this rod, nichrome wire is utilized for its excellent heating capabilities. However, to ensure efficient heat generation and conduction, a ceramic material known as Magnesium oxide is employed.

Figure 4.23 Stainless steel rod

Figure 4.24 Magnesium oxide

Figure 4.25 Nichrome wire coil

Figure 4.26 Coil heater

Table 4.9
Specification of Coil heater

Rod material	Stainless steel
Wire material	Nichrome
Length	3in
Internal diameter	0.75in
Outer diameter	0.87in

4.2.5 Fastener

Using a Teflon pipe, a process involving turning, facing, and drilling is employed to transform it into a bolt-shaped fastening component.

Figure 4.27 Teflon pipe

Figure 4.28 Fastener

Table 4.10
Specification of Fastener

Material	Teflon
Length	0.85in
Outer diameter	1.03in
Inner diameter	0.75in
Inner hole	0.31in

4.2.6 Base

To create an 8-inch circle on a Teflon sheet, mark the center, draw the circle, and make a 6mm groove inside the boundary using suitable intervals. Use machining tools to cut along the groove safely.

Figure 4.29 Teflon sheet

Figure 4.30 Teflon circle

Figure 4.31 Base

Table 4.11
Specification of Base

Material	Teflon
Diameter	10in
Groove	0.24in
Height	0.47

CHAPTER FIVE: TESTING

5.1 Outdoor Testing

Our comprehensive outdoor testing of the Smart Mosquito Killer Machine yielded insightful results regarding its efficiency in combating mosquitoes. As we deployed the machine in an outdoor setting, we carefully observed its performance and evaluated its ability to eliminate these pesky insects. During the testing phase, we were particularly impressed by the machine's exceptional efficacy outdoors. It consistently demonstrated a high success rate in killing mosquitoes, far surpassing our expectations. The large number of mosquitoes present outside provided ample opportunities for the machine to showcase its effectiveness

Figure 5.1 Outdoor testing of machine during day

Figure 5.2 Outdoor testing of machine during night

By deploying the Smart Mosquito Killer Machine outdoors, we were able to analyze its capacity to tackle a substantial number of mosquitoes. The machine's maximum kill rate was achieved due to the high mosquito density in the outdoor environment. It effectively targeted and eliminated a significant proportion of the mosquito population, providing evidence of its efficacy.

*Figure 5.*3 Sample of outdoor testing

5.2 Indoor Testing

In our extensive indoor testing of the Smart Mosquito Killer Machine, we conducted a thorough evaluation of its efficiency in eliminating mosquitoes within indoor environments. After careful analysis and observations, we have concluded that while the machine displayed a commendable level of effectiveness indoors, it did not achieve the same level of efficiency as it did when operating outdoors. The outdoor testing clearly demonstrated a higher kill rate, where the machine successfully eradicated a larger number of mosquitoes due to the higher mosquito population present outside.

Throughout the indoor testing process, we closely monitored the performance of the Smart Mosquito Killer Machine and assessed its ability to capture and neutralize mosquitoes within enclosed spaces. The device demonstrated its capacity to attract and trap mosquitoes effectively, reducing the indoor mosquito population to a significant extent. Despite the relatively lower efficiency indoors, the Smart Mosquito Killer Machine still provided a satisfactory level of mosquito control within confined spaces

Figure 5.4 Indoor testing of machine

Figure 5.5 Sample of indoor testing

Table 5.1

Cost of our project

Component Expenses			
Item Name	**Item description**	**Units**	**Prices**
1	Arduino box	1	2000
2	Mist maker	1	400
3	UV light	1	700
4	Supporting rod	4	200
5	Base	1	800
6	Outer case	1	2500
7	Suction fan	1	800
8	Electric mesh	2	50
9	Teflon frame	1	450
10	Fastener	8	700
11	W1209 controller	1	400
12	Converter	2	1200
13	Coil heater	2	800
		Total Cost	1100 Rs

CHAPTER SIX: CONCLUSION AND FUTURE DIRECTION

6.1 Conclusion

A potential method of mosquito control is represented by smart mosquito killer machine that include UV light, suction fan, electric mesh, mist makers, and heaters. Smart mosquito killing machine that incorporate UV light work as a potent attractant, drawing insects to the machine. Suction fans are added to increase the capture rate by luring mosquitoes into a confinement area and keeping them from escaping.

In conclusion, our outdoor testing of the Smart Mosquito Killer Machine demonstrated its exceptional efficiency in exterminating mosquitoes. The device consistently achieved maximum kill rates due precision extermination mechanism, and impressive performance, this machine has proven to be a reliable solution for effective mosquito control in outdoor settings.to the substantial number of mosquitoes present in outdoor environments.

Our indoor testing of the Smart Mosquito Killer Machine revealed that the device had a good level of efficiency in eliminating mosquitoes within confined spaces. However, it did not reach the same level of effectiveness as it did in outdoor testing. The lower mosquito population found indoors compared to outdoor environments contributed to the relatively lower kill rate observed during indoor testing. Nonetheless, the machine's performance indoors still provided significant mosquito control benefits.

6.2 Future direction

To increase their efficiency and overcome current limits, future work in the development of smart mosquito killer machines might concentrate on a number of areas. To increase mosquito capture rates, researchers can look more into and refine the design of mosquito traps. The effectiveness of mosquito killing devices may be considerably increased by examining and perfecting the usage of lures and attractants. To further improve mosquito capturing rates, research can concentrate on creating novel attractants that imitate human odors or other powerful mosquito attractants. Emerging technologies like machine learning, artificial intelligence, and sensor networks can be used by intelligent mosquito killer devices to enhance their performance. Machine learning techniques, for instance, may be used to examine mosquito behavior patterns and enhance capturing methods.

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