

**Department of Electronic & Telecommunication
Engineering
University of Moratuwa**



EN1190 - Engineering Design Project

Project Report

Mosquito Net 2.0: Innovative Mosquito Net with Automated Folding and Fan-Controlled Comfort

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1 Introduction

Problem Description

This project proposes an improved mosquito net with a speed-controlled fan and automatic folding for maximum user comfort and convenience. By addressing existing limitations such as ,

- **Time-consuming:** Folding mosquito nets manually can be a time-consuming task, especially if the net is large or complicated in design. This can be inconvenient, especially when you are in a hurry or need to pack up quickly.
- **Incorrect folding:** Folding mosquito nets manually may result in improper folding, leading to creases and unevenly distributed folds. This can reduce the effectiveness of the net in protecting against mosquitoes and other insects.
- **Wear and tear:** Repeated manual folding and unfolding can cause wear and tear on the mosquito net, leading to premature damage and reduced lifespan.
- **Difficult storage:** Manually folded mosquito nets may not pack into a compact and tidy form, making them challenging to store neatly. This can take up unnecessary space and create clutter.
- **Reduced portability:** Improperly folded mosquito nets may be bulkier and more challenging to carry, especially during travel or camping trips.
- **Difficulty in installation:** When mosquito nets are not folded properly, it can be challenging to install them correctly, leading to gaps or sagging, which can compromise their protective function.
- **Hygiene concerns:** Mosquito nets that are not folded and stored correctly may accumulate dust, dirt, and insects over time, potentially posing hygiene issues.

To address these problems, We have Developed a mosquito net which comes with user-friendly folding mechanisms or storage system that simplify the process and ensure the net remains in good condition for an extended period. This project has the potential to positively impact people's daily lives.

Product Idea Validation

- **Easy folding mechanisms:** Design mosquito nets with user-friendly folding mechanisms with remote control, that simplify the folding process. Incorporate clear instructions or labels to guide users on how to fold the net correctly.
- **Compact storage:** Provide mosquito nets with specially designed storage that allow for easy and neat packing.
- **Durable materials:** Use high-quality, durable materials for the mosquito net construction to withstand frequent folding and unfolding without significant wear and tear.
- **Portability considerations:** Design mosquito nets with portability in mind, making them lightweight and easy to carry. Consider foldable or collapsible designs for increased convenience during travel.
- **Quick-release systems:** Integrate quick-release systems that allow users to fold and unfold the mosquito net effortlessly. This will save time and effort when setting up or packing up the net.

2 Our Device

Introducing the "Mosquito net 2.0 " - the ultimate mosquito net device designed to solve all the problems associated with manually folding mosquito nets. The Mosquito net 2.0 comes with a state-of-the-art automatic folding and unfolding mechanism, remote-controlled properties, and additional features to enhance user convenience and comfort.

Device Description

Automatic Folding and Unfolding Mechanism: The Mosquito net 2.0 features an advanced automatic folding and unfolding system. With just a press of a button on the included remote control, the mosquito net smoothly folds and unfolds, saving valuable time and effort.

- **Remote Control with User-Friendly Interface:** The remote control provided with the Mosquito net 2.0 is user-friendly and comes with four intuitive options. The options include Fold, Unfold, Fan, and Light. Users can easily control the mosquito net's functions from a distance.
- **Built-in Fan for Optimal Ventilation:** To enhance comfort during hot weather, the Mosquito net 2.0 comes with a built-in fan mounted inside the mosquito net. The fan ensures excellent ventilation while keeping mosquitoes and insects at bay.
- **Adjustable LED Light:** The Mosquito net 2.0 features an adjustable LED light mounted within the net. Users can turn the light on or off via the remote control, providing a convenient source of light inside the net.
- **Compact Storage Design:** When not in use, the Mosquito net 2.0 can be easily folded and stored in a compact and tidy form. The automatic folding mechanism ensures the net is folded correctly every time, preventing creases and wear.
- **Durable and High-Quality Materials:** Our Device is constructed using durable and high-quality materials, ensuring longevity and resistance to wear and tear.
- **Hygienic and Easy to Clean:** The mosquito net is designed with easy-to-clean materials, promoting hygiene and keeping it free from dust and dirt build-up.
- **Portable and Travel-Friendly:** To its compact design and automatic folding feature, the Mosquito net 2.0 is highly portable and perfect for travel or camping trips.

3 Technical specifications

Performance in quantitative terms

✓ Consumptions

- **Nema17 stepper motors**
 - Current 2.6 A
 - Voltage 12 V
 - Power 31.2 W
- **HX1388 IR receiver**
 - Voltage 3.3 V
 - Power 35mW
- **LED light strip (60xLED's)**
 - Voltage 230 V
 - Power 3.5 W
- **Fan**
 - Voltage 12 V
 - Power 1.92W
- **ATmega328pu Micro controller**
 - Power 5-10 mW

Total Power in maximum Working mode ~37 W

✓ Product dimensions

- Height 29cm
- Diameter 22 cm
- Weight 8 Kg

✓ Warranty terms

- A 6 month warranty for the Circuitry and 1 year warranty for the other components will be provided except motors.

4 Product Architecture

Block diagram

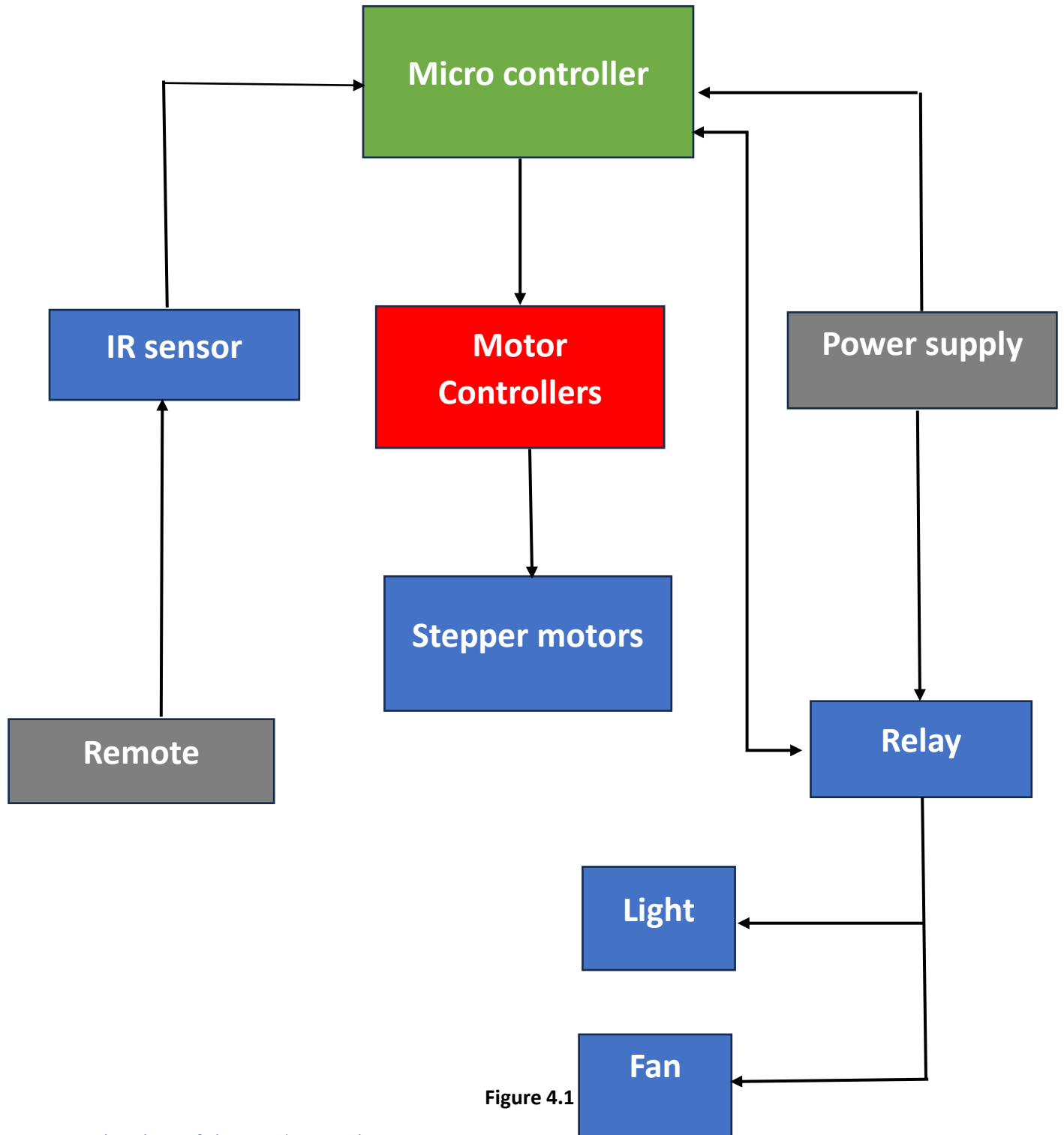


Figure 4.1

3D sketches of the Product Architecture

Side cross section of our product

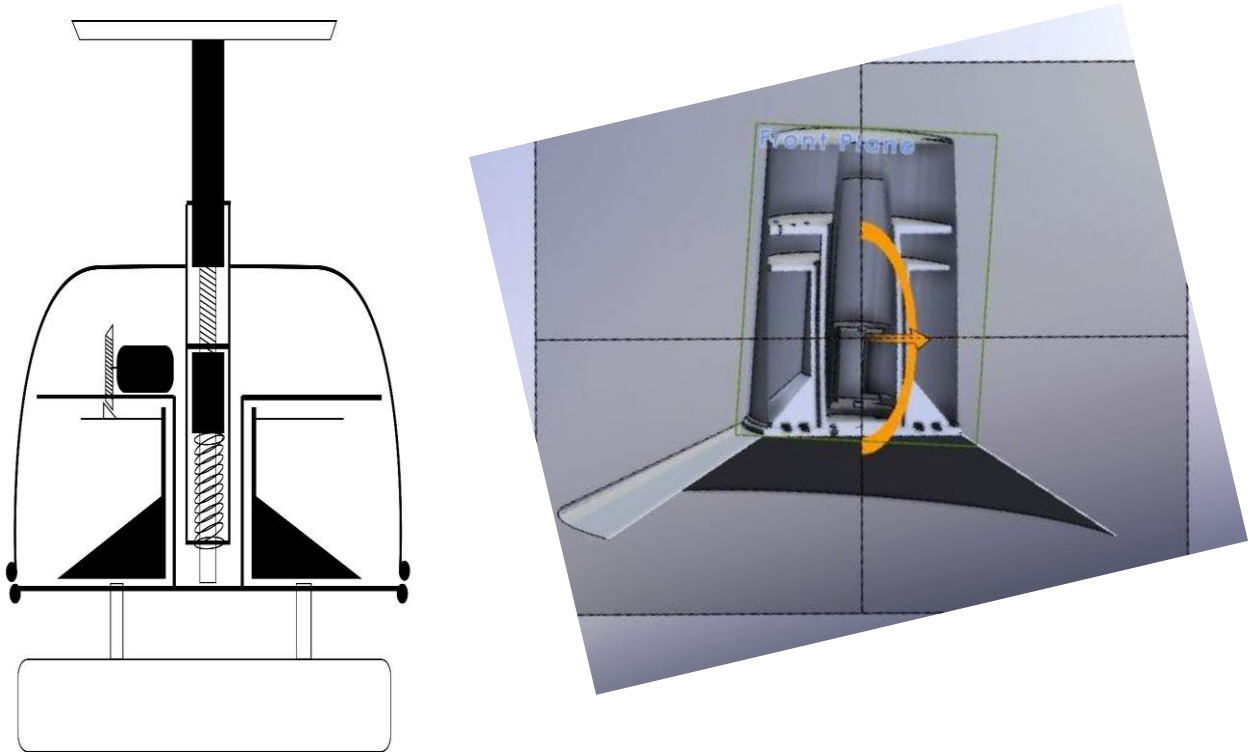


figure 4.3

Functionality of the Blocks

- **Stepper motors**
 - To Fold and Unfold the net by rotation.
 - To lift and lower the external lid structure which is visible in the above figure.
- **Stepper Drivers**
 - To Control the Function of the Stepper Motors (Direction/Speed/Acceleration)
- **Relay**
 - To Switching the Light and the fan according to the IR Signal
- **Remote**
 - To control the functions of the Device through the remote
- **IR receiver**
 - To receive the IR signal from the remote.
- **Power Supply**
 - To supply a constant voltage of 12 V with current rating 5A
- **Micro Controller**
 - Program Execution: The microcontroller executes a program written in a high-level programming language, such as C/C++, that is compiled and uploaded to its Flash memory. The program defines the behavior of the system and how it responds to different inputs and events.

- Timers and PWM: The microcontroller has built-in hardware timers that can generate precise time intervals and perform tasks at specific time intervals. It also supports Pulse Width Modulation (PWM) output, which is useful for controlling the speed of motors, brightness of LEDs, and other applications that require varying output levels.

5 Circuit

Components and their functions

- **DC power jack**
 - providing 12 V input to the PCB
- **LM7805 Voltage Regulator**
 - Regulates the input voltage to 5 V output, which is input to the circuit.
- **Two 10uF Capacitors**
 - To protect the circuit from sudden voltage surges.
- **16MHz Crystal Oscillator and 22 pF capacitors**
 - Clock Generation: The microcontroller (e.g., ATmega328P on Arduino Uno) requires a clock signal to synchronize its internal operations. The crystal oscillator generates a precise clock signal with a specific frequency, typically 16 MHz for Arduino Uno. This clock signal regulates the timing of instructions execution, data transfers, and other tasks.
 - Capacitors are used to stabilize and fine-tune the oscillation frequency of the crystal, ensuring accurate and reliable clock signals for the microcontroller.
- **LED and Resistors**
 - The power indicator LED
 - Resistors are for Current limiting and Voltage divider purposes.
- **Push Button**
 - To reset the Program.
- **ATmega328pu micro controller**
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 - Memory Management: The ATmega328P-PU manages its program and data memory effectively, allowing for the efficient execution of the program and storage of variables and constants.
- **Female pin Headers**
 - Digital Control pin outs

6 Testing

Aspects we followed when testing the circuit.

Visual Inspection: Before applying power, visually inspect the circuit for any loose connections, soldering issues, incorrect component placements, or physical damage. Ensure that all components are properly seated, and the circuit layout matches the schematic.

Power Supply: Verify that the power supply voltage and current ratings match the circuit's requirements. Incorrect voltage levels can damage components, and insufficient current may lead to erratic behavior. T

Safety Precautions: Take appropriate safety precautions, such as using the correct voltage, proper grounding, and avoiding contact with live circuits. Use safety equipment like safety goggles and gloves when necessary.

Voltage Checks: Use a multimeter to measure voltages at critical points in the circuit. Verify that the voltage levels match the expected values as per the circuit design.

Current Measurement: Measure the current flowing through critical components to ensure they operate within their rated limits. This is particularly important for power-hungry components like motors or high-power devices.

Temperature Check: Monitor the temperature of components, especially power regulators and other high-power elements. Excessive heat can indicate inefficiencies or improper operation. This can be addressed by adding heat sinks.

Short Circuit and Overload Protection: Check for short circuits, with a multimeter in continuity checking mode and ensure the circuit has adequate protection against overcurrent or overvoltage conditions.

Boundary Conditions: Test the circuit's performance under various boundary conditions, such as extreme temperatures, input voltage variations, or high-frequency operation.

7 PCB DESIGNING

Schematic diagram

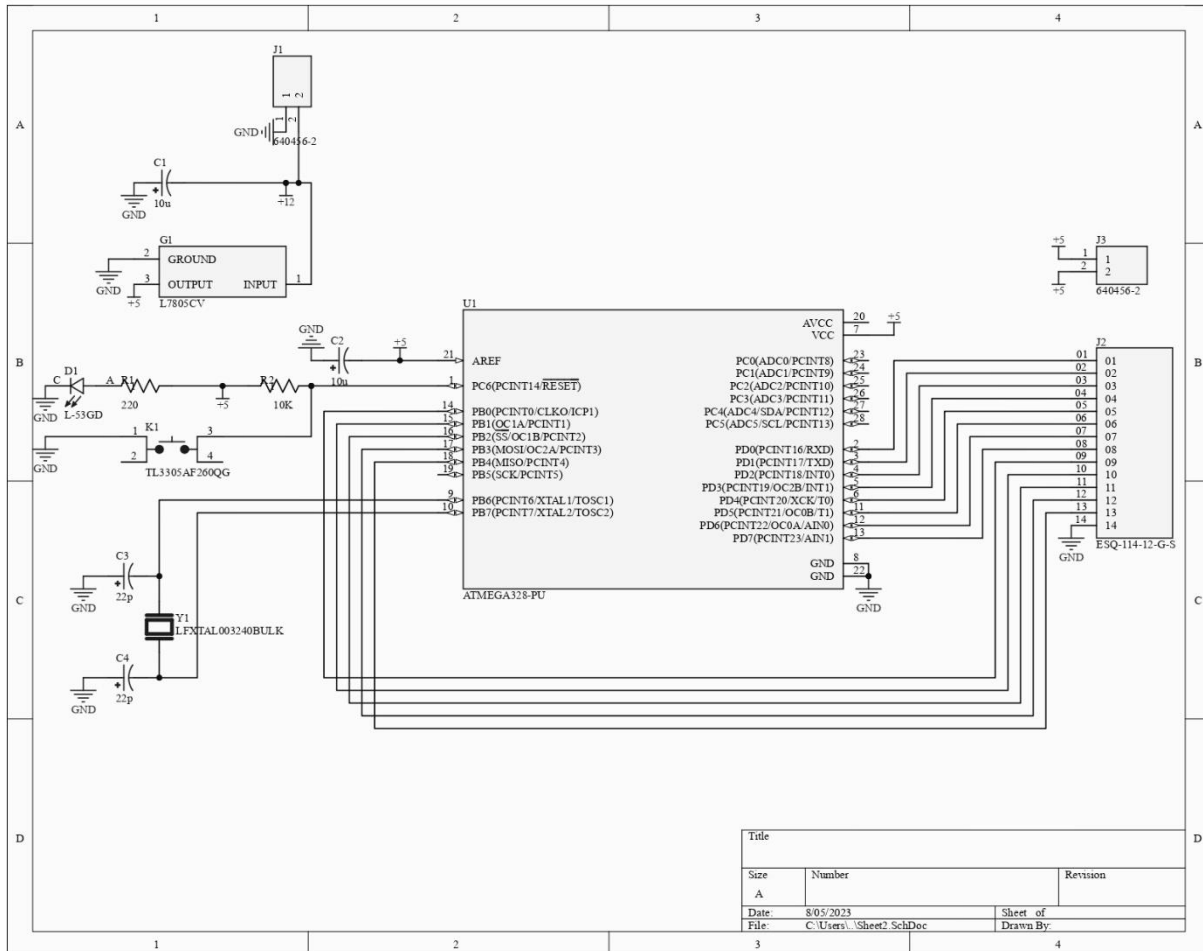


Figure 7.1

PCB diagrams

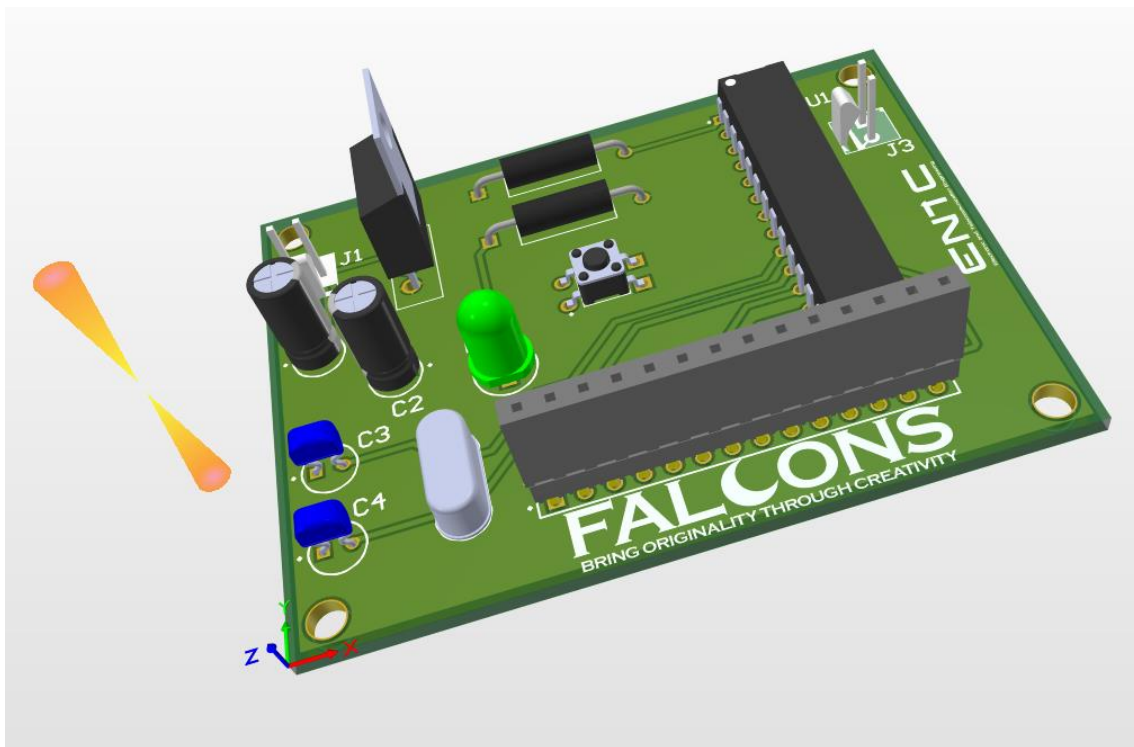
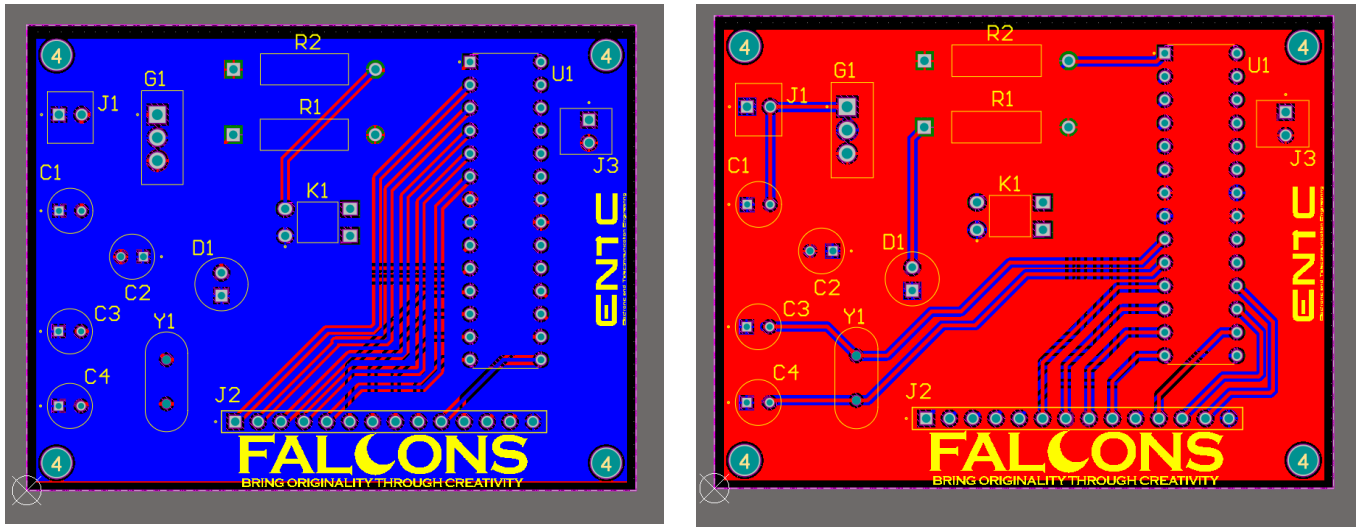
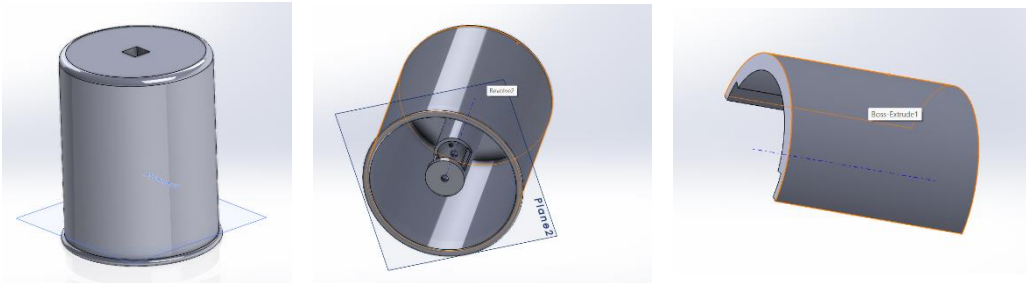


Figure 7.2

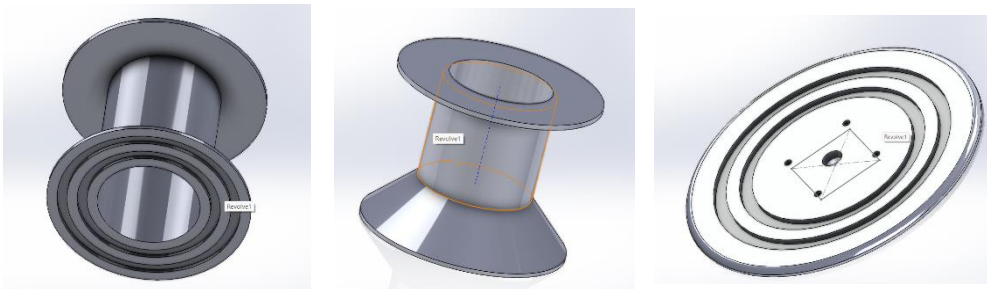
8 Enclosure Designing

3D Designed parts

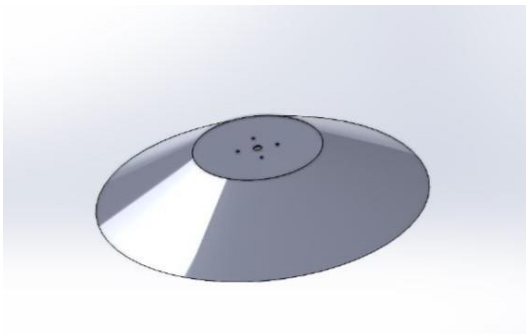
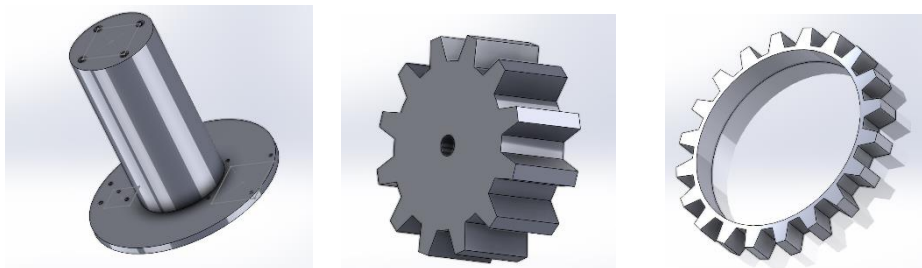
- Outer enclosure



- Rotating Bobin and Groves to bearings



- Circuit base and mounting plate, Gears



9 Marketing, Sales, and After-Sale Service considerations

When it comes to marketing an automatic folding mosquito net with a fan mounted in it, it is important to target the right audience. We can focus on marketing the product to individuals and families living in areas with high mosquitoes. We can also target individuals who have had negative experiences with traditional mosquito nets and are looking for a more convenient and effective solution. In terms of sales, we can consider partnering with local retailers, online marketplaces, or even setting up our own website to sell the product. It is important to provide clear and detailed product information, including how to use and care for the product, and to offer competitive pricing. After-sale service is also an important consideration. We can provide a warranty or guarantee for the product, as well as a customer service hotline or email for any questions or issues customers may have. It is important to respond to customer inquiries and complaints promptly and professionally to ensure customer satisfaction and repeat business.

10 Project bill of quantities

This is the estimated total cost of expenses for this device

Product name	quantity	Price (Rs)
Linear stepper motor (non captive)	1	8000
Nema17 stepper motor	1	3000
Relay module	1	200
IR receiver	1	100
100uF /10uF capacitors	4	120
Resistor 220 /10k	8	40
Crystal oscillator	1	60
Stepper Drivers	2	160
Vero board(dot board)	1	10
Soldering iron roll	1	700
Wires roll	1	800
Power supply 12V 5A	1	1440
Plug top	1	280
Male and female pin headers	2	200
LM7805 Voltage regulators	1	20
ATmega328p micro controller	1	1200
Push button	1	5
Wire to board connectors(1x2)	1	50
DC power jack	1	10
Mosquito net	1	900
DC fan 12V	1	200
LED light strip 230V	1	580
Total cost		18 075

11 Task Allocation

- Product Idea, Initial and Final Sketches – Pramidu Saumyajith
- Enclosure Designing – Kisal Thennakoon
- PCB Designing, Programming – Dineth Perera, Shemal Perera

Installation Guide

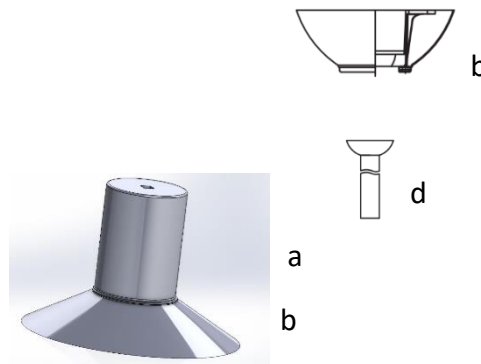
1. TOOLS AND MATERIALS REQUIRED

- Philips screw driver
- Blade screw driver
- 11 mm wrench
- Step ladder
- Wire cutters



2 Package Content

- Device
- Hanger bracket assembly
- Extension hood
- Downrod



SAFETY RULES

1. To reduce the risk of electric shock, insure electricity has been turned off at the circuit breaker or fuse box before beginning.
2. All wiring must be in accordance with the National Electrical Code and local electrical codes. Electrical installation should be performed by a qualified, licensed electrician.
3. The device must be mounted with a minimum of 7 feet clearance from the device to the floor.
4. Do not use water or detergents when cleaning the fan or fan blades. A dry dustcloth or lightly dampened cloth will be suitable for most cleaning.

MOUNTING OPTIONS

If there isn't an existing CUL listed mounting box, then read the following instructions. Disconnect the power by removing fuses or turning off circuit breakers. Secure the outlet box directly to the building structure. Use appropriate fasteners and building materials. The outlet box and its support must be able to fully support the moving weight of the Device. Do not use plastic outlet boxes. Figures 1, 2 and 3 are examples of different ways to mount the outlet box. Note: You may need a longer downrod to maintain proper clearance when installing on a steep, sloped ceiling. (Fig. 3) To hang your Device where there is an existing fixture but no ceiling joist, you may need an installation hanger bar as shown in Figure 4.

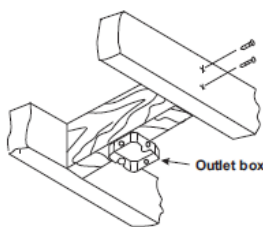


Figure 1

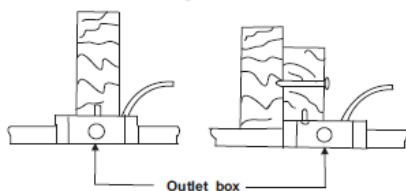


Figure 2

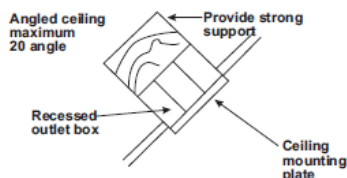


Figure 3



Figure 4

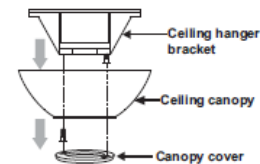


Figure 5

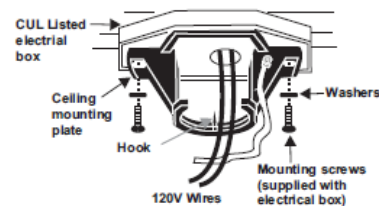


Figure 6

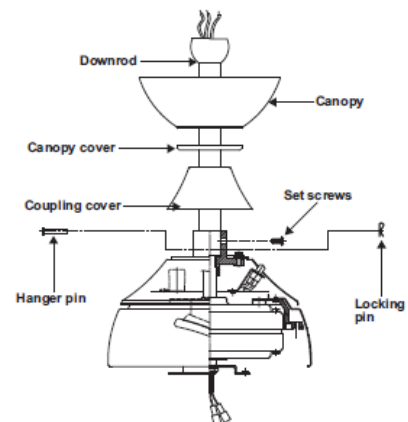


Figure 7

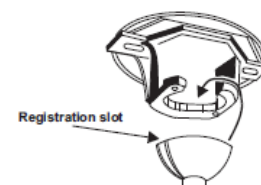


Figure 8

HANGING THE FAN

REMEMBER to turn off the power. Follow the steps below to hang your device properly:

Step 1. Remove the decorative canopy bottom cover from the canopy by turning the cover counter clockwise. (Fig. 5)

Step 2. Remove the hanger bracket from the canopy by removing the non-slotted screws from the bottom of the mounting bracket and loosening the slotted screw a half turn from the screw head. Next, turn the canopy counter clockwise to removing the hanger bracket from the canopy. (Fig. 5)

Step 3. Pass the 230-volt supply wires through the center hole in the ceiling hanger bracket as shown in Fig. 6.

Step 4. Secure the hanger bracket to the ceiling outlet box with the screws and washers provided with your outlet box.

Step 5. Remove the hanger pin, locking pin and set screws from the top of the device assembly.

Step 6. Route wires exiting from the top of the device through the coupling cover, canopy cover and canopy, then through the ball/ downrod. (Fig. 7)

Step 7. Align the holes at the bottom of the downrod with the holes in the collar on top of the device housing (Fig. 7). Carefully insert the hanger pin through the holes in the collar and downrod. Be careful not to jam the pin against the wiring inside the downrod. Insert the locking pin through the hole near the end of the hanger pin until it snaps into its locked position, as noted in the circle inset of Fig. 7.

Step 8. Place the downrod ball into the hanger bracket socket. (Fig. 8)