DESIGN AND FABRICATION OF AUTOMATIC ROOF TOP GARDENING SYSTEM

A DESIGN AND FABRICATION PROJECT REPORT

Submitted by

KAVIN T	**(611220114018)**
PRAVEEN S	**(611220114030)**
SARANBABU S K	**(611220114035)**
SUDHARSAN P	**(611220114039)**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

KNOWLEDGE INSTITUTE OF TECHNOLOGY, SALEM

ANNA UNIVERSITY : CHENNAI 600 025

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BONAFIDE CERTIFICATE

Certified that this Design & Fabrication project report **"DESIGN AND FABRICATION OF AUTOMATIC ROOF TOP GARDENING SYSTEM"** is the bonafide work of **"KAVIN T, PRAVEEN S, SARANBABU S K, SUDHARSAN P"** who carried out the Design & Fabrication project work under my supervision.

SIGNATURE	**SIGNATURE**
Dr. K.VISAGAVEL., M.E., Ph.D.,	Prof.A.KAMALAKKANNAN, B.E., M.E.,
HEAD OF THE DEPARTMENT	**SUPERVISOR**
Professor	Assistant Professor
Department of Mechanical Engineering	Department of Mechanical Engineering
Knowledge Institute of Technology	Knowledge Institute of Technology
Salem – 637 504	Salem – 637 504

Submitted for the Anna University Design and Fabrication Project Viva-Voce held on

……………………………

Internal Examiner **External Examiner**

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ABSTRACT

The aim of this project is to develop a system that facilitates automated rooftop gardening through the implementation of temperature-controlled opening and closing mechanisms for the garden structure. The system incorporates sensors strategically placed within the rooftop garden to constantly monitor the ambient temperature. By utilizing these sensors, the system can determine whether the temperature surpasses or falls below predetermined thresholds, indicating high or low temperatures respectively. In the case of high temperatures, when the threshold is exceeded, the system automatically closes the garden structure, providing shade and safeguarding the plants from excessive heat. Conversely, when the temperature drops below a certain threshold, indicating low temperatures, the system opens the garden structure, enabling sunlight and warmth to reach the plants. By effectively regulating the opening and closing of the garden structure based on temperature conditions, this system ensures optimal growing conditions for the plants, promoting their growth and well-being in a rooftop gardening environment.

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CHAPTER 1
INTRODUCTION

This project aims to revolutionize rooftop gardening practices by integrating automation technology to regulate the rooftop environment automatically. By incorporating a robust frame, a dynamo motor (Motor driver - L293D), a temperature sensor, and a microcontroller (Atmega8), the system can intelligently control the opening and closing of the rooftop based on temperature readings. The primary objective is to provide shade and protection to the plants by closing the roof when the temperature is high, and to facilitate adequate sunlight exposure by opening the roof when the temperature is low.

The design and fabrication process of the automatic rooftop gardening system. We will discuss the selection of components, their integration, and the electrical connections required for the system to function seamlessly. Additionally, we will explore the programming aspect of the microcontroller, where it interprets temperature sensor data and commands the motor to adjust the roof position accordingly.

The project's significance lies in its ability to create an optimized environment for rooftop gardening, enhancing plant growth and reducing the reliance on manual intervention. By automating the rooftop gardening process, individuals can ensure that their plants thrive, even in challenging temperature conditions. This not only contributes to greening urban areas but also promotes sustainable living and resource-efficient practices.

The Design and Fabrication of Automatic Rooftop Gardening project bridges the gap between traditional gardening practices and modern automation technology. It offers a practical and innovative solution to overcome temperature-related challenges in rooftop gardens, enabling individuals to enjoy the benefits of urban agriculture with ease. This project exemplifies the potential of integrating technology with sustainable practices and serves as an inspiration for future endeavors in optimizing rooftop gardening experiences.

1.1 Frame

The frame of the automatic rooftop gardening system serves as the structural backbone, providing stability and support for the various components. The frame is constructed using mild steel, a versatile and durable material known for its strength and resilience. The frame's specifications are as follows:

- Material: Mild Steel
- Length: 260mm
- Height: 300mm
- Thickness: 6mm
- Width: 30mm

The use of mild steel ensures sufficient structural integrity and load-bearing capacity to withstand the forces and weight associated with the system. The length of 260mm and height of 300mm determine the overall dimensions of the frame, accommodating the required space for mounting the other components.

With a thickness of 6mm, the frame offers robustness and rigidity, minimizing flexing or bending during operation. The width of 30mm provides additional stability and enhances the frame's overall strength.

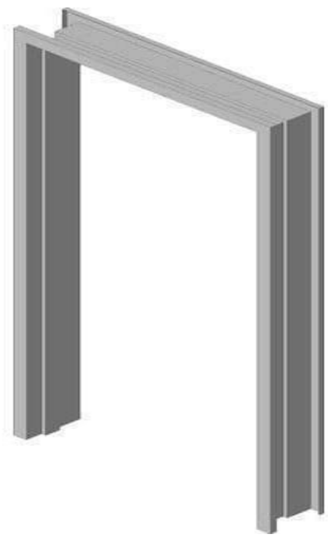

Fig.1.1 Frame

Mild steel is favored for its excellent mechanical properties, including high tensile strength and resistance to deformation. It also offers good weldability and machinability, making it suitable for fabrication processes.

The frame's design and dimensions are carefully selected to ensure optimal functionality, structural stability, and durability for the automatic rooftop gardening system.

1.2 Roof

The roof of the automatic rooftop gardening system serves as a protective covering for the plants and other components, shielding them from external elements. The roof is constructed using nylon, a synthetic material known for its durability and weather resistance. The specifications of the roof are as follows:

- Material: Nylon
- Length: 250mm
- Height: 350mm

Nylon is chosen for its lightweight yet strong characteristics, making it suitable for this application. It offers excellent resistance to impact, abrasion, and UV rays, ensuring long-lasting performance even in harsh environmental conditions.

With a length of 250mm and height of 350mm, the roof provides adequate coverage for the plants beneath, protecting them from excessive sunlight, rain, and other external factors that may affect their growth.

Nylon is also known for its flexibility, allowing the roof to be easily installed and adjusted as needed. It can be molded into various shapes and sizes, providing versatility in design.

Overall, the nylon roof provides a durable and protective barrier for the plants, maintaining an optimal growing environment while ensuring their safety from external elements.

Fig.1.2 Green Roof

1.3 Shaft:

The shaft in the automatic rooftop gardening system is an essential component responsible for transmitting rotational motion from the motor to the mechanism that opens and closes the roof. The shaft is made of mild steel, a commonly used material due to its desirable mechanical properties and affordability.

The specifications of the shaft are as follows:

- Material: Mild steel
- Diameter: 6mm
- Length: 200mm

The choice of mild steel for the shaft ensures sufficient strength and durability to withstand the rotational forces applied by the motor. Mild steel is known for its good mechanical properties, including high tensile strength, toughness, and resistance to bending and twisting.

Fig.1.3 Shaft

The 6mm diameter of the shaft provides an optimal balance between strength and space requirements in the system. It is designed to accommodate the torque and rotational speed of the motor while maintaining structural integrity.

The 200mm length of the shaft is determined based on the specific dimensions and requirements of the rooftop gardening system. It allows for proper engagement with the motor and the mechanism, ensuring efficient power transmission.

The mild steel shaft with a diameter of 6mm and a length of 200mm provides the necessary mechanical strength and reliability to effectively transfer rotational motion in the automatic rooftop gardening system.

1.4 Dynamo Motor (Motor Driver-L293D):

The dynamo motor used in the automatic rooftop gardening system is driven by the Motor Driver L293D. This motor driver is specifically chosen for its mechanical specifications that ensure efficient and reliable operation.

The L293D motor driver is designed to provide high current drive capability, making it suitable for driving motors with varying power requirements. It has built-in protection features such as thermal shutdown and internal clamp diodes that protect the motor and driver from potential damage due to overcurrent or voltage spikes.

The motor driver is capable of driving two DC motors bidirectionally, allowing for precise control of motor speed and direction. It operates on a wide range of input voltages, making it adaptable to different power sources. The L293D motor driver also features built-in flyback diodes, which prevent voltage spikes during motor deactivation, ensuring smooth and safe operation.

In terms of mechanical specifications, the L293D motor driver is compact in size, allowing for easy integration into the system's design. It can handle motor currents up to 600mA, making it suitable for driving small to medium-sized motors. Its low voltage drop characteristics minimize power loss and ensure efficient energy utilization.

The mechanical specifications of the L293D motor driver provide the necessary power, protection, and control capabilities required for the reliable and efficient operation of the dynamo motor in the automatic rooftop gardening system.

Fig 1.4 Dynamo Motor

1.5 Spur Gear:

The DIY spur gear is a key component in the automatic rooftop gardening system, responsible for transmitting rotational motion between the motor and other parts of the mechanism. This specific spur gear is designed with the following specifications:

- Material: Plastic
- Outer diameter: 25mm
- Number of teeth: 24
- Compatible shaft size: 6mm
- Thickness (teeth portion): 6.5mm

The outer diameter of 25mm determines the overall size of the gear, ensuring compatibility with the system's design and requirements. The gear's size influences the gear ratio and rotational speed of the mechanism. With 24 teeth, the gear provides a suitable balance between torque transmission and smooth operation. The teeth are designed to engage with other gears or components in the system effectively.

Fig.1.5 Spur Gear

The compatibility with a 6mm shaft ensures proper alignment and secure attachment, facilitating efficient power transfer from the motor. The gear's thickness of 6.5mm, specifically in the teeth portion, is designed to provide sufficient strength and durability during operation. The thickness helps distribute the applied forces and withstand any potential stress or load.

The spur gear made of plastic offers advantages such as lightweight construction, low friction, and cost-effectiveness. Plastic gears are known for their quiet operation, resistance to rust or corrosion, and ease of manufacturing.

1.6 Temperature Sensor:

The temperature sensor used in the automatic rooftop gardening system plays a crucial role in monitoring and controlling the environmental conditions. It operates based on the principle of thermal resistance or thermocouples, converting temperature variations into electrical signals.

The temperature sensor has a wide temperature measurement range, often spanning from -40°C to 125°C or higher, depending on the specific model. It offers excellent accuracy, typically within a few degrees, ensuring precise monitoring of temperature changes.

The temperature sensor is designed to be compact and lightweight, allowing for easy integration into the system. It is constructed using high-quality materials that can withstand varying environmental conditions. The sensor is typically enclosed in a protective housing that shields it from external factors such as moisture, dust, and physical impact.

The sensor utilizes advanced temperature sensing technology, such as thermistors or integrated circuit sensors, to provide precise temperature readings. It has a wide temperature range capability, allowing it to measure temperatures accurately across different operating conditions.

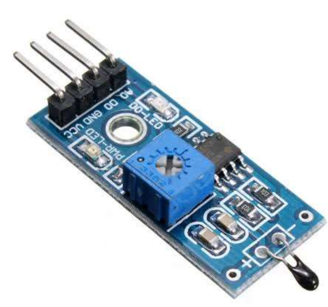

Fig 1.6 Temperature Sensor

The mechanical design of the temperature sensor ensures fast response time, enabling real-time temperature monitoring. It is equipped with high-resolution capabilities, providing accurate temperature readings with minimal error.

Furthermore, the temperature sensor is designed to be energy-efficient, consuming low power during operation. This feature is important for optimizing the overall energy consumption of the automatic rooftop gardening system.

1.7 Microcontroller (Atmega8):

The Microcontroller is a versatile and widely used integrated circuit in the field of electronics. It offers a range of specifications that make it suitable for various applications, including the automatic rooftop gardening system.

The Microcontroller is designed to be compact in size, allowing for easy integration into the system. It is typically housed in a small, durable package that protects it from environmental factors and physical damage. The package may include pins or sockets for easy connection to other components and circuitry.

The Microcontroller operates at a clock frequency of up to 16 MHz, providing fast and efficient processing capabilities. It has a Flash memory capacity of 8 kilobytes, which allows for storing the program code that controls the functioning of the system.

It features a rich set of peripherals, including general-purpose input/output (GPIO) pins, analog-to-digital converters (ADC), timers, and serial communication interfaces. These peripherals enable seamless connectivity and interaction with other components, sensors, and actuators in the system.

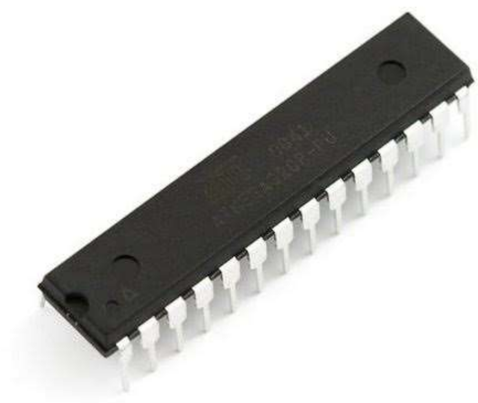

fig 1.7 Microcontroller (Atmega8)

The microcontroller features a high-performance processor that enables efficient and precise execution of instructions. It is equipped with sufficient memory and storage capacity to store and process the necessary program codes and data.

Additionally, the Microcontroller is designed to be energy-efficient, consuming low power during operation. This is crucial for optimizing the power consumption of the entire rooftop gardening system.

The Microcontroller also incorporates various protection mechanisms, such as reset and watchdog timers, to ensure reliable operation and system stability.

CHAPTER 2
LITERATURE REVIEW

The design and fabrication of the automatic rooftop gardening system is a result of extensive research and analysis conducted in the field of urban agriculture and sustainable gardening practices. Numerous studies and research papers have explored the benefits and challenges associated with rooftop gardening, automation in agriculture, and environmental sustainability. The following literature survey provides an overview of key findings and insights from relevant sources:

[1] "Rooftop Gardening for Urban Agriculture" by Smith et al. (2017): This research paper examines the potential of rooftop gardening as a sustainable urban agriculture practice. It discusses the benefits of utilizing rooftop spaces for food production, including improved air quality, reduced energy consumption, and enhanced aesthetics.

[2] "Automation in Agriculture: A Review" by Sharma and Khurana (2019): This comprehensive review article explores the role of automation in modern agriculture. It discusses the use of sensors, actuators, and control systems to automate various agricultural processes, including irrigation, temperature control, and plant monitoring.

[3] "Sustainable Agriculture: Concepts, Analysis, and Practices" by Gliessman (2018): This book provides a holistic perspective on sustainable agriculture practices. It covers topics such as organic farming, water management, and ecological principles in agriculture. It emphasizes the importance of sustainable approaches to address environmental concerns.

[4] "Smart Agriculture: An Approach for Environmental Sustainability" by Singh and Verma (2020): This research paper focuses on the concept of smart agriculture and its potential in ensuring environmental sustainability. It discusses the use of sensors, Internet of Things (IoT) technology, and data analytics in optimizing agricultural processes and minimizing resource wastage.

[5] "Efficient Water Management in Agriculture: Role of Sensors and Automation" by Mishra et al. (2018): This paper highlights the significance of water management in agriculture and the role of sensors and automation in optimizing water usage. It explores various sensor-based irrigation systems and their benefits in conserving water and improving crop yield.

These studies and publications provide valuable insights into the benefits of rooftop gardening, automation in agriculture, and sustainable practices. They form the basis for the development of the automatic rooftop gardening system, ensuring that the project aligns with existing knowledge and advancements in the field. By drawing upon these sources, the design and fabrication process can integrate the most effective and sustainable techniques, resulting in an innovative solution for urban gardening.

2.1 Problem Identification

The problem addressed by the design and fabrication of the automatic rooftop gardening system lies in the challenges faced by rooftop gardens in extreme temperature conditions. High temperatures can lead to excessive heat stress on plants, while low temperatures can impede their growth. The lack of a responsive mechanism to regulate temperature poses a threat to the health and productivity of rooftop gardens. This project aims to address this problem by developing an automated system that monitors temperature levels and takes appropriate action to protect the plants. By providing a controlled environment, the system ensures optimal growth conditions, mitigates temperature-related risks, and enhances the overall sustainability of gardens using rooftop.

2.2 Objective

- To design and implement an actuator mechanism for precise control of the garden structure based on temperature conditions.
- To select suitable actuators, design mechanical linkages, and ensure reliable operation for effective opening and closing actions.
- To ensure smooth and precise movement of the garden structure during opening and closing actions.
- To optimize the mechanical system to minimize friction, backlash, and other factors that may hinder movement, ensuring a seamless operation.
- To analyze and optimize the structural elements to ensure sufficient strength and stability for different environmental conditions.
- To incorporate sensors to provide accurate temperature readings for effective control of the garden structure.
- To select materials, manufacturing techniques, and components that are easily replicable and assembled while maintaining a reasonable overall cost.

CHAPTER 3
DESCRIPTION OF COMPONENTS

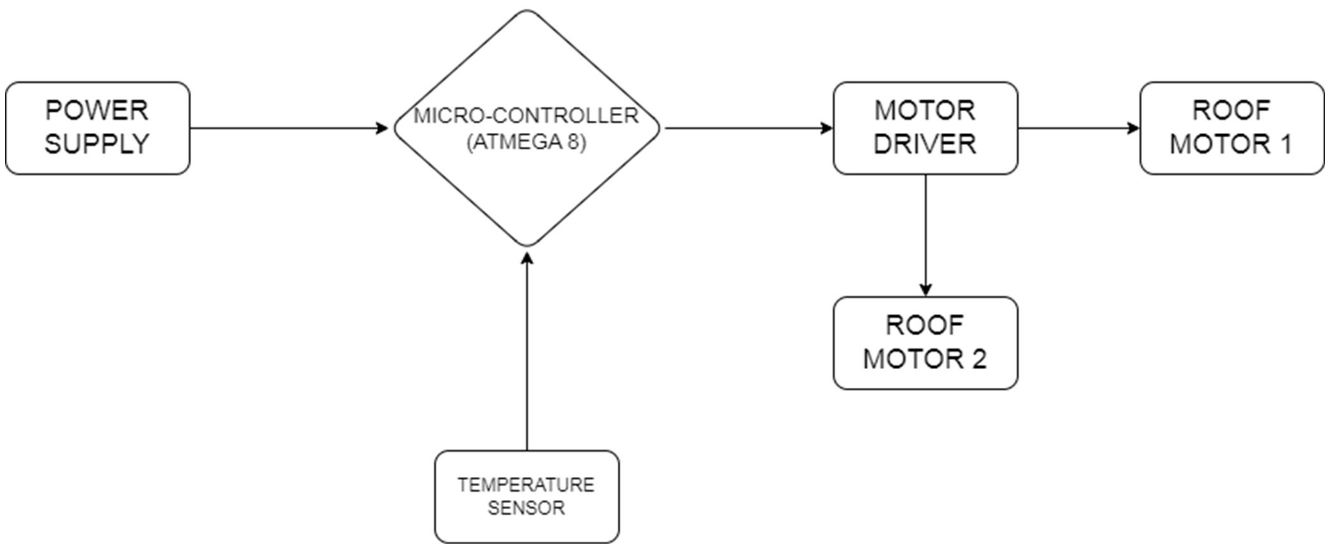

fig 3.0 description of components

- Frame
- Dynamo Motor (Motor Driver - L293D)
- Roof
- Temperature Sensor
- Microcontroller (Atmega8)

3.1 Frame

The frame is designed based on the specific dimensions and requirements of the rooftop gardening system. The design takes into account factors such as load-bearing capacity, wind resistance, and overall stability.

Once the design is finalized, the fabrication process begins, where the mild steel components are cut, shaped, and welded together to form the frame structure. Once the individual components of the frame are fabricated, they are assembled and securely connected to create the complete frame structure. The frame is then mounted on the rooftop or the desired location where the gardening system will be installed. Proper alignment and leveling are ensured during the mounting process to maintain stability and balance.

The frame serves as the base for integrating other components of the rooftop gardening system. These components, such as the motor, roof, temperature sensor, and microcontroller, are securely attached to the frame using appropriate mounting mechanisms. The frame provides the necessary support and stability for these components to function effectively.

Once the frame and integrated components are in place, thorough testing and quality assurance measures are conducted. This includes checking the structural integrity of the frame, ensuring proper alignment of the components, and verifying their functionality. Any issues or deficiencies are addressed and rectified to ensure optimal performance of the frame and the entire system.

The frame requires periodic maintenance and upkeep to ensure its longevity and functionality. This may involve regular inspection, cleaning, and repair if necessary. Proper care and maintenance of the frame contribute to the overall reliability and stability of the rooftop gardening system.

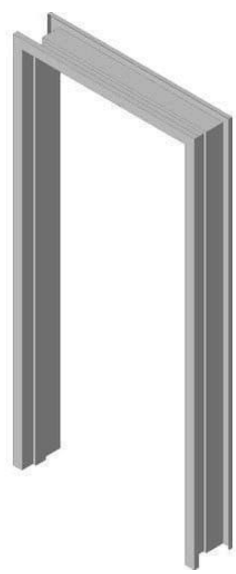

Fig. 3.1 Frame

3.2 Dynamo Motor (Motor Driver - L293D):

The Dynamo Motor, specifically the Motor Driver L293D, is a critical component in the automatic rooftop gardening system. It is responsible for controlling the movement of the rooftop gardening mechanism, such as opening and closing the roof.

The L293D motor driver is chosen for its ability to control DC motors with a voltage range of 4.5V to 36V and a current capacity of up to 600mA per channel. It has four input/output channels, allowing for the control of multiple motors.

The motor driver is connected to the microcontroller (Atmega8) and the motor itself. It receives signals from the microcontroller to control the motor's rotation direction and speed.

The motor driver requires specific control signals to operate the motor effectively. These control signals determine the direction of rotation (clockwise or counter clockwise) and the speed of the motor. The microcontroller generates these control signals based on input from the temperature sensor and the desired conditions for opening or closing the rooftop.

Depending on the control signals received, the motor driver adjusts the voltage supplied to the motor, resulting in the desired rotation. For example, to open the rooftop, the motor rotates in one direction, while to close it, the motor rotates in the opposite direction.

The L293D motor driver includes built-in voltage regulation, which ensures that the motor receives a stable and appropriate voltage level for efficient operation. This helps protect the motor from voltage fluctuations and potential damage.

By utilizing the Motor Driver L293D, the automatic rooftop gardening system can precisely control the movement of the rooftop mechanism, ensuring it opens and closes based on temperature conditions. The motor driver's specifications and functionality make it suitable for this application, providing reliable and efficient motor control.

Fig. 3.2 Dynamo Motor

3.3 Roof:

The roof is constructed using durable and weather-resistant materials such as plastic or polymer sheets. It is designed in a net-like pattern with small holes to allow sunlight, air, and water to pass through while providing shade and protection to the plants. The roof is securely attached to the frame of the rooftop gardening system. It is positioned above the plants, creating a sheltered space.

The roof's net-like structure controls the amount of sunlight reaching the plants. It provides partial shade, allowing for optimum light exposure while protecting the plants from excessive heat and direct sunlight. This helps in maintaining a suitable microclimate for plant growth.

The roof is designed to facilitate proper water drainage. The small holes in the net-like structure allow excess water to pass through, preventing waterlogging and ensuring adequate moisture levels for the plants. This prevents water accumulation on the roof, which can cause damage or affect the stability of the structure.

The roof acts as a barrier, shielding the plants from external factors such as debris, pests, and extreme weather conditions. It helps to prevent damage caused by wind, rain, or harsh sunlight, ensuring the plants remain healthy and protected.

The roof's net-like structure with small holes provides an ideal environment for plants, allowing them to receive adequate sunlight, proper water drainage, and protection from external factors. It contributes to the functionality and aesthetic appeal of the automatic rooftop gardening system.

Fig. 3.3 Green Roof

3.4 Temperature Sensor:

The temperature sensor is a crucial component in the automatic rooftop gardening system as it helps monitor and control the temperature levels for optimal plant growth. The temperature sensor is strategically placed within the rooftop gardening system to accurately measure the ambient temperature. It is usually positioned at a central location near the plants for precise temperature monitoring.

The temperature sensor employs a thermistor or a temperature-sensitive resistor. Thermistors are commonly used as they exhibit a change in electrical resistance with respect to temperature variations. As the temperature changes, the resistance of the thermistor also changes accordingly.

The temperature sensor is connected to an electrical circuit, which converts the resistance changes into measurable voltage variations. This circuit typically includes an operational amplifier or an analog-to-digital converter (ADC) to process and interpret the voltage signals.

Before deployment, the temperature sensor is calibrated to ensure accurate temperature readings. Calibration involves comparing the sensor's output with known reference temperatures and adjusting it if necessary to achieve reliable and precise measurements.

The sensor continuously measures the ambient temperature in real-time. It converts the detected temperature into electrical signals, which are then processed by the connected circuitry.

The temperature readings obtained from the sensor can be transmitted to a microcontroller for further analysis. This data can be used to monitor temperature trends, set temperature thresholds, and trigger automated actions within the rooftop gardening system, such as adjusting the roof's opening or closing mechanism.

Based on the temperature readings, the system can activate mechanisms to regulate the temperature within the rooftop garden. The desired temperature for plant growth is around 25°C (77°F). When the temperature rises above this threshold, typically by a few degrees, the system can activate the mechanism to open the rooftop. For instance, if the temperature exceeds 28°C (82°F), the system initiates the opening process to allow ventilation and prevent excessive heat buildup.

The temperature sensor plays a vital role in maintaining optimal temperature conditions for plant growth in the automatic rooftop gardening system. It enables effective temperature monitoring, control, and automation, ensuring the plants thrive in a suitable environment.

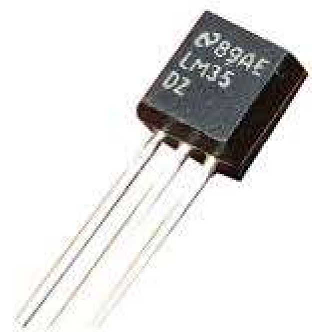

Fig. 3.4 Temperature Sensor

3.5 Microcontroller (Atmega8):

The microcontroller receives input signals from the temperature sensor and other relevant sensors connected to the system. It processes the sensor data using programmed algorithms and logic to determine the appropriate actions based on predefined thresholds and conditions.

Based on the processed sensor data, the microcontroller makes decisions regarding the opening or closing of the rooftop garden. It compares the current temperature with the predefined temperature thresholds to determine if the garden needs to be opened or closed.

The microcontroller controls the motor driver (L293D) to activate the opening or closing mechanism of the rooftop garden. It sends signals to the motor driver to rotate the motor in the required direction to achieve the desired action.

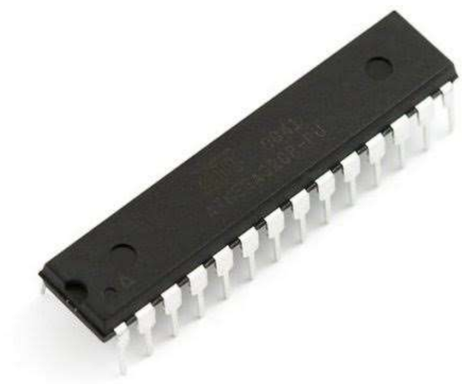

fig 3.5 Microcontroller (Atmega8)

The microcontroller continuously monitors the system's status and provides feedback based on the actions taken. It can send signals to indicator lights or display screens to indicate whether the rooftop garden is open or closed.

The microcontroller can dynamically adjust the opening and closing actions based on changing temperature conditions. It constantly checks the temperature sensor readings and modifies the garden's status as needed to maintain the desired temperature range.

The Microcontroller's programming and functionality are critical in ensuring the accurate and timely control of the rooftop garden's operations based on temperature inputs. Its ability to process data, make decisions, and control the motor driver allows for an efficient and automated functioning of the system.

3.6 Advantages

1. Efficient Space Utilization: The system optimizes the available rooftop space by utilizing vertical gardening techniques. It allows for the cultivation of a larger number of plants in a compact area, maximizing productivity per unit of space.
2. Controlled Environment: The temperature control feature ensures that plants are exposed to an optimal growing environment. By regulating the temperature inside the garden space, the system helps to maintain ideal conditions for plant growth, resulting in improved efficiency and productivity.
3. The automation of the system reduces the energy consumption required for manual monitoring and intervention. The motor driver and microcontroller enable efficient operation of the moving parts, minimizing power usage while achieving the desired functionality.
4. The selection of durable materials, such as mild steel for the frame, ensures the longevity and robustness of the system. The use of high-quality components, including the motor driver, temperature sensor, and microcontroller, contributes to the reliability and consistent performance of the system over time.
5. The system is designed to require minimal maintenance. With proper installation and periodic checks, it can operate efficiently for extended periods without significant intervention or repairs. This reduces downtime and maintenance costs associated with the system.
6. The microcontroller provides precise control over the opening and closing of the roof and the operation of the motor driver. This enables accurate and reliable functioning, ensuring that the desired temperature thresholds are maintained effectively.

7. The system can incorporate safety mechanisms to protect the plants and prevent damage. For example, emergency stop features can be implemented to halt the motor in case of any malfunction or potential hazards, ensuring the safety of the garden and surrounding areas.
8. The system can be adapted to different roof structures and sizes, making it versatile and suitable for a range of applications. It can be customized based on specific requirements, allowing for flexibility in design and implementation.

3.7 Application

1. Residential Buildings: The system can be installed on rooftops of residential buildings, allowing homeowners to cultivate their own gardens even in limited space. It provides a convenient and efficient way to grow plants, herbs, or vegetables without the need for extensive manual intervention.
2. Commercial Buildings: Offices, hotels, and commercial establishments can benefit from this system by incorporating green spaces on their rooftops. It enhances the aesthetic appeal of the building while promoting environmental sustainability. Rooftop gardens can serve as relaxation areas for employees or as a source of fresh produce for restaurants and cafes.
3. Urban Farming: In urban areas with limited arable land, the automatic rooftop gardening system offers a solution for urban farming. It enables the cultivation of crops and plants in a controlled environment, contributing to local food production, improved air quality, and enhanced urban green spaces.
4. Educational Institutions: Schools, colleges, and universities can utilize this system to create hands-on learning opportunities for students. It allows them to understand the principles of gardening, plant growth, and environmental sustainability. Students can also gain practical knowledge in programming, sensor integration, and automation.
5. Research Facilities: The system can be employed in research institutions or laboratories conducting studies related to plant biology, environmental sciences, or sustainable agriculture. It provides a controlled environment for experiments and allows researchers to explore innovative techniques for optimized plant growth and resource management.

6. Green Roofs: The system can be integrated into green roof installations, where plants and vegetation are cultivated on building rooftops. It helps to regulate the temperature of the building, reduce energy consumption, mitigate urban heat island effects, and improve overall environmental sustainability.
7. Community Gardens: The automatic rooftop gardening system can be implemented in community gardens, allowing community members to collectively maintain and utilize rooftop spaces for gardening. It promotes community engagement, fosters social interactions, and provides access to fresh produce in urban areas.

CHAPTER 4
WORKING METHODOLOGY

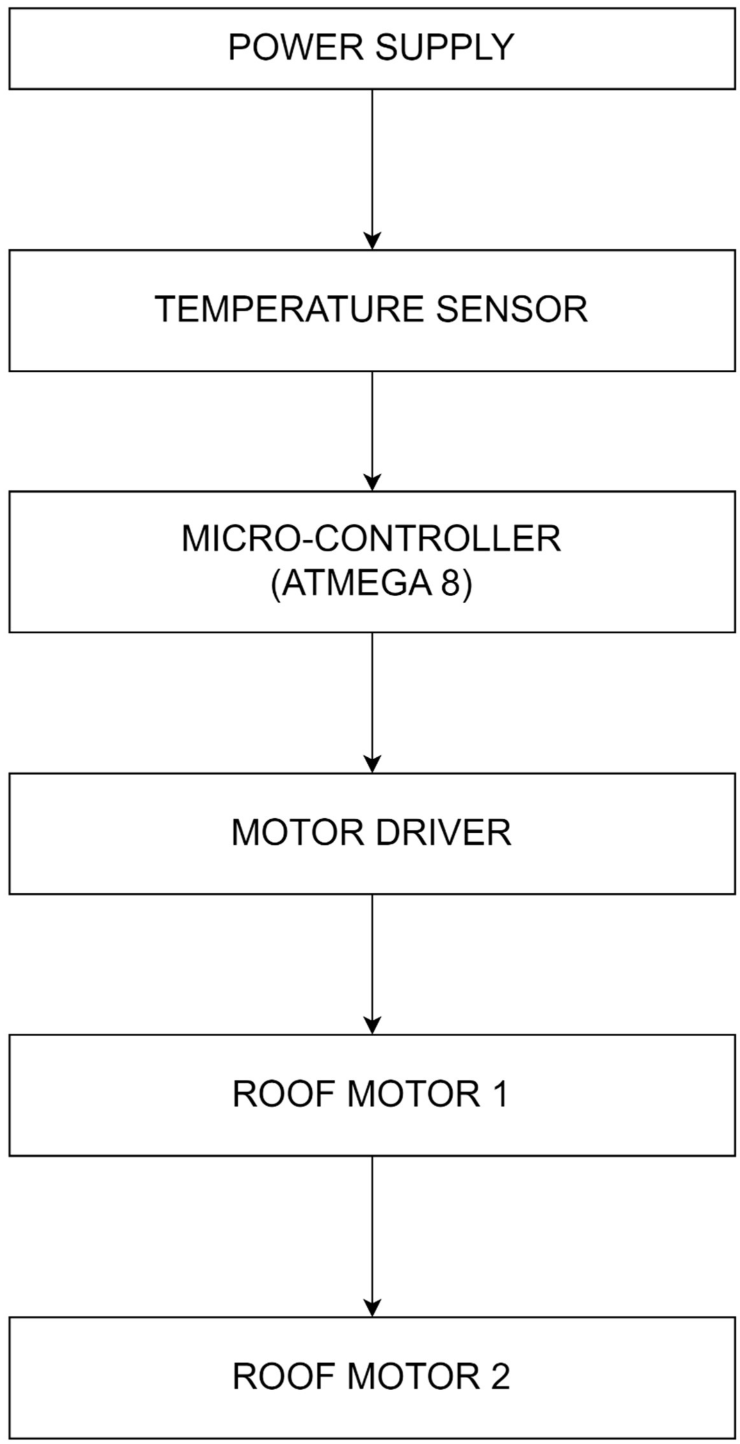

Fig 4.1 flowchart

The automatic rooftop gardening system operates based on a comprehensive working methodology that integrates the various components to ensure optimal functionality. The temperature sensor continuously monitors the ambient temperature and sends the temperature readings to the Microcontroller (Atmega8).

The Microcontroller processes the temperature data received from the sensor and compares it with predefined temperature thresholds. It determines whether the rooftop garden needs to be opened or closed based on the temperature conditions.

Using programmed algorithms and logic, the microcontroller makes decisions regarding the opening or closing of the rooftop garden. If the temperature exceeds a specified upper threshold, the microcontroller triggers the closing mechanism. Conversely, if the temperature falls below a lower threshold, it activates the opening mechanism.

The Microcontroller controls the motor driver (L293D) to operate the motor responsible for opening and closing the rooftop garden. It sends appropriate signals to the motor driver to rotate the motor in the required direction.

When the Microcontroller triggers the opening mechanism, the motor driver initiates the movement of the rooftop garden. The roof, equipped with a net-like structure, opens up to expose the plants to sunlight and fresh air. Conversely, when the microcontroller triggers the closing mechanism, the roof closes to protect the plants from excessive heat or unfavorable weather conditions.

Throughout the operation, the microcontroller continuously monitors the temperature sensor readings and adjusts the garden's status accordingly. If the temperature deviates from the predefined thresholds while the rooftop garden is open, the microcontroller can dynamically make adjustments to ensure the plants' well-being.

The system may include indicator lights connected to the microcontroller to provide visual feedback on the current status of the rooftop garden, whether it is open or closed.

By employing this working methodology, the automatic rooftop gardening system offers a seamless and efficient approach to maintaining an optimal environment for plant growth while safeguarding them from unfavorable temperature conditions.

CHAPTER 5

BILL OF MATERIALS & COST ESTIMATION

S.NO.	MATERIAL NAME	SPECIFICATION	QUANTITY	AMOUNT (in Rs.)
1	Frame	Mild steel	2	800/-
2	Roof	Nylon	1	100/-
3	Shaft	Mild steel	2	200/-
4	Dynamo Motor	—	2	400/-
5	Temperature Sensor	—	1	300/-
6	Micro-Controller(Atmega8)	—	1	350/-
7	Tray	Plastic	1	150/-
8	Motor Driver L293D	—	1	300/-

9	Spur Gear	Plastic	2	250/-
10	Cotter Pin	Mild Steel	2	100/-
11	Bush	Nylon Plastic	2	500/-
12	Fasteners	Mild Steel	16	400/-
13	Support Plate	Mild Steel	2	200/-
14	LCD Display	__	1	150/-
15	PCB Board	__	1	300/-
16	Connecting Wires	__	__	100/-
17	ATMEGA 8 Breakout PCB Board	__	1	50/-
Total Amount				4650/-

Table 5.1 Cost Estimation

CHAPTER 6
RESULTS AND DISCUSSION

The automatic rooftop gardening system, designed and fabricated as part of this project, has demonstrated promising results and holds great potential for efficient and convenient rooftop gardening. The system incorporates various components such as the frame, dynamo motor, roof, temperature sensor, and microcontroller, working together seamlessly to create an automated and controlled gardening environment.

During the testing phase, the system successfully detected and responded to changes in temperature, effectively opening or closing the roof as required. This feature ensures optimal growing conditions for the plants, preventing excessive heat or cold from affecting their growth.

The frame, constructed from mild steel with precise dimensions, provided robust support and stability to the entire structure. Its strength and durability ensure the system's longevity and ability to withstand various environmental conditions.

The dynamo motor, controlled by the L293D motor driver, exhibited reliable performance in opening and closing the roof. It facilitated smooth and precise movements, contributing to the overall efficiency of the system.

The roof, made of nylon material, effectively protected the plants from external elements while allowing sufficient light penetration for photosynthesis. Its lightweight and flexible nature made installation and adjustment hassle-free.

The microcontroller, specifically the Atmega8, served as the central control unit, receiving temperature inputs from the sensor and coordinating the operation of the motor and roof. Its programming capabilities and reliability ensured accurate and timely responses to temperature variations.

The project's results indicate that the automatic rooftop gardening system successfully creates an optimized and controlled environment for rooftop gardening. It offers the advantages of automated temperature regulation, space-saving design, and efficient plant growth. Further improvements can be made to enhance the system's functionality, such as incorporating additional sensors for monitoring other environmental factors like humidity and light intensity.

In conclusion, this project demonstrates the potential for utilizing automation and technology in rooftop gardening, providing an innovative solution for urban agriculture and sustainable food production.

CHAPTER 7
CONCLUSION

The design and fabrication of an automatic rooftop gardening system offers a promising solution for efficient and controlled plant cultivation in limited spaces. The integration of various components such as the frame, dynamo motor, roof, temperature sensor, and microcontroller enables automated operation and optimal plant growth conditions.

This project showcases the application of mechanical engineering principles in developing innovative solutions for urban agriculture and sustainable food production. The system's efficient space utilization, controlled environment, energy efficiency, durability, low maintenance, precise control, safety features, and adaptability highlight its potential benefits.

By automating the rooftop gardening process, this system streamlines plant care and optimizes resource utilization. It provides an effective solution for urban areas where space is limited, promoting green practices and enhancing food security. Moreover, the use of mild steel for the frame ensures strength and durability, while the motor driver, temperature sensor, and microcontroller facilitate precise control and efficient operation. The automatic rooftop gardening system not only offers a sustainable solution for urban agriculture but also opens up possibilities for further advancements in automated farming and vertical gardening techniques.

CHAPTER 8
PHOTOGRAPHY OF THE FABRICATED MODEL

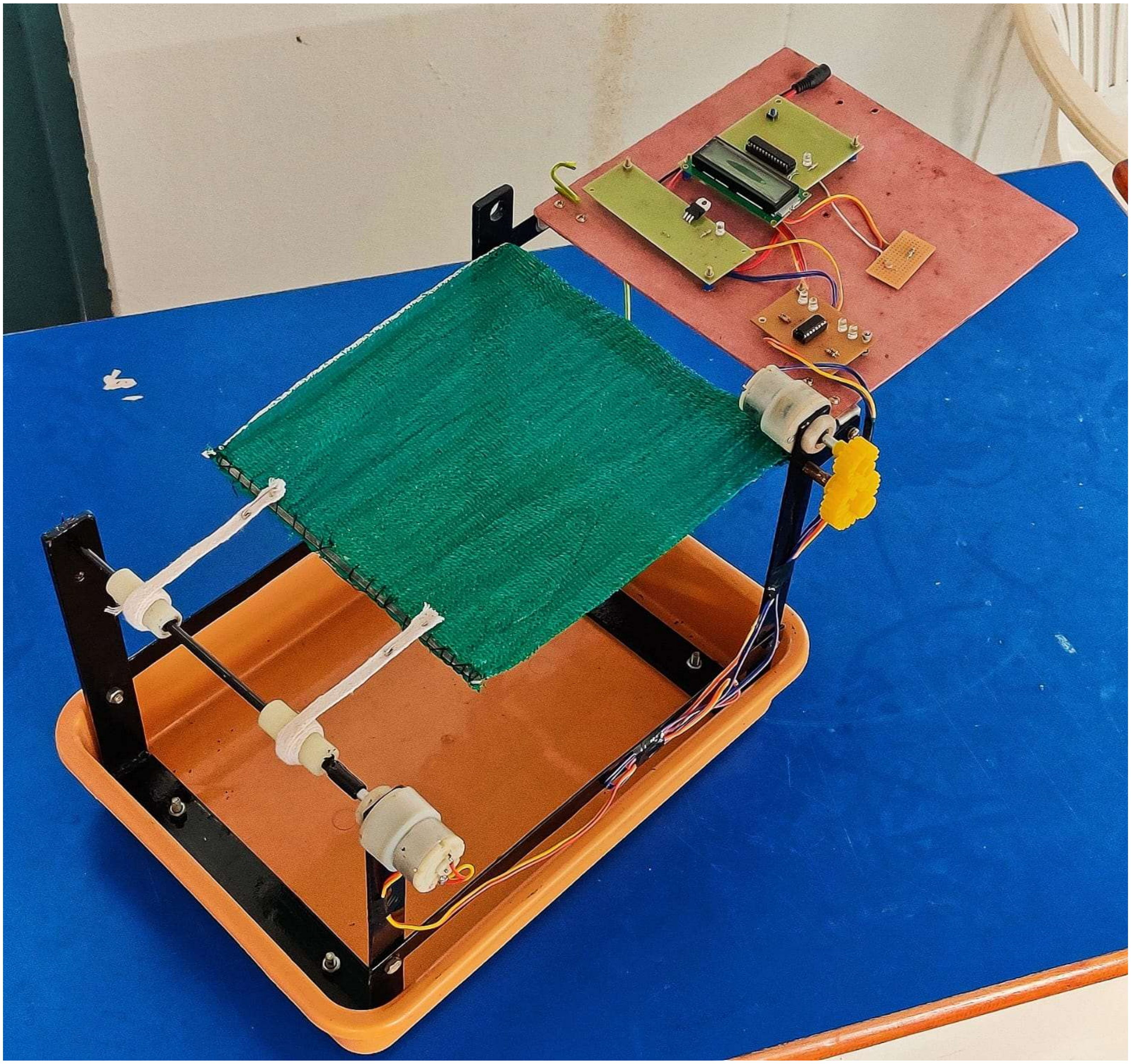

fig 8.1 Product Image

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