AUTOMATION IN CULTIVATION OF MICROGREENS

INNOVATIVE AND CREATIVE PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this Innovative and Creative Project report titled AUTOMATION IN CULTIVATION OF MICROGREENS is the bonafide work of

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INTERNAL EXAMINER	**EXTERNAL EXAMINER**

ABSTRACT

Microgreens cultivation refers to the practice of growing and harvesting young, edible seedlings of various vegetables and herbs. These miniature greens are harvested at an early stage of growth, typically within one to three weeks after germination. Microgreens are gaining popularity due to their high nutritional value, concentrated flavors, and attractive appearance, making them a sought-after ingredient in culinary dishes and garnishes. This abstract provides an overview of the key aspects of microgreens cultivation. It begins by discussing the selection of suitable seeds for microgreens production, emphasizing the importance of choosing high-quality, untreated seeds to ensure optimal germination and growth. The next section covers the various growing mediums used, such as soil, peat moss, vermiculite, or hydroponic systems, highlighting their advantages and considerations. The abstract then delves into the essential factors for successful microgreens cultivation, including light requirements, temperature control, and irrigation practices. It explains the significance of providing adequate light intensity and duration to promote healthy growth and vibrant coloration of the microgreens. Temperature regulation is crucial to create an optimal environment for germination and growth, while appropriate irrigation techniques help prevent mold or fungal growth. Furthermore, the abstract explores the harvesting and post-harvest handling of microgreens. It emphasizes the need for precise timing during harvest to ensure maximum flavour and nutritional value. Proper washing, drying, and packaging techniques are also discussed to maintain freshness and extend shelf life. Lastly, the abstract highlights the potential challenges and future prospects in microgreens cultivation. It addresses common issues like pest management, disease prevention, and scaling up production to meet market demands. Additionally, it mentions the increasing trend of urban and indoor microgreens farming, which allows for year-round cultivation and local food production.

ACKNOWLEDGEMENT

We wish to express our sincere thanks to all who have contributed to do this innovative and creative project through their support, encouragement and guidance.

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LIST OF ABBREVIATIONS

PH	POTENTIAL OF HYDROGEN
NFT	NUTRIENT FILM TECHNIQUE
SPI	SERIAL PERIPHERAL INTERFACE
PWM	PULSE WIDTH MODULATION
RTD	RESISTANCE TEMPERATURE DETECTOR
PM	PARTICULATE MATTER
LCD	LIQUID CRYSTAL DISPLAY
LED	LIGHT EMITTING DIODE

CHAPTER 1

INTRODUCTION

1.1 MICROGREENS SYSTEM

Microgreens is the natural diet for livestock. Its production to meet the current demand has become a greatest challenge among livestock farmers. Due to many reasons, Micro greens production has been facing a serious crisis and so the livestock productivity. Due to increasing intensive system of rearing livestock, the need for Microgreens is enormous. As the gap between the demand and supply of the green fodder for livestock becoming unconquerable, researchers and farmers are in search for an alternative or Microgreens production method, that would restore Microgreens and livestock production.

Hydroponics is the state-of-the-art technology that has revolutionized the Microgreens production in the 21st century. Hydroponics is a method of growing green fodder without soil in an environmentally controlled houses or machines. Many of the livestock farmers are switching to hydroponic Microgreens production from conventional production methods, as the Microgreens produced by this method are highly nutritious, provide sustainable Microgreens production round the year and conserve water.

Though this method has made a greatest impact in the Microgreens cultivation system, most of the farmers are facing some practical difficulties in profitably running the hydroponic machine for sustainable Microgreens production. This manual has been compiled with the essential manage-mental practices that have to be carried out for an economically sustainable Microgreens production.

1.2 MICROGREENS

Microgreens are vegetable greens (not to be confused with sprouts or shoots) harvested just after the cotyledon leaves have developed with one set of true leaves. They are used as a visual, flavor and texture enhancement. Microgreens are used to add sweetness and spiciness to foods

1.3 MICROGREENS GROWTH

Microgreens are generally described as being an easier plant to grow but may have complication ranging from preventing and managing fungus or mold growth to providing the right nutrients and growing media to the plants in order to ensure quality produce. Many small "backyard" growers have sprung up selling their greens at farmers markets or to restaurants. A shallow plastic container with drainage holes, such as a nursery flat or pre-packaged-salad box, will facilitate sprouting and grow out on a small scale. However, for commercial scale growing, specific trays better suited to growing and supporting microgreens are used. Growing and marketing high-quality microgreens commercially is more intensive, but also shows potential for providing better quality produce under controlled and sterile environments and could provide local communities with better nutritional diversity at scale. Artificial lighting is not necessarily needed for growing microgreens but is required for indoor commercial setups. Microgreens can grow under various lighting conditions, including indirect natural light and grow lights, but some source of light is necessary for them to have grown adequately enough for harvest. Different lighting conditions can change the flavors of the microgreens being grown. For instance, corn microgreens are sweet when grown in the dark, but become bitter when exposed to light due to photosynthesis processes taking place in the sprouting plants.

FIGURE 1.3 MICROGREENS GROWTH

1.4 MICROGREENS FORMING

Microgreens have three basic parts: a central stem, cotyledon leaf or leaves, and typically, the first pair of very young true leaves. They vary in size depending upon the specific variety grown, with the typical size being 1 to 1.5 in (25 to 38 mm) in total length. When the plant grows beyond this size, it is generally no longer considered a microgreen, instead being called a petite green. The average crop-time for fast-growing microgreens, such as many brassicas, is 10–14 days from seeding to harvest. Slower growing microgreens, such as beets, chard, and many herbs, may take 16–25 days to reach harvestable size. Both baby greens and microgreens lack any legal definition. The terms "baby greens" and "microgreens" are marketing terms used to describe their respective categories. Sprouts are germinated seeds and are typically consumed as an entire plant (root, seed, and shoot), depending on the species. Sprouts from almond, pumpkin, and peanut reportedly have a better flavor when harvested prior to root developments. Sprouts are legally defined and have additional regulations concerning their production and marketing due to their relatively high risk of microbial contamination compared to other greens.

FIGURE 1.4 MICROGREENS FORMING

CHAPTER 2

LITERATURE SURVEY

Joao Matos, Paulo J.S. Gonçalves and Pedro M.B. Torres (2015) proposed that the system is modular, and can adapt to the required amount of fodder to produce. Although it was designed for a small/medium dimension agricultural holding, near Castelo Branco, the system can be replicated to other companies.

Gurdeep Singh Malhi, Manpreet Kaur, Kartik Sharma and Gaurendra Gupta (2020) proposed the adoption of hydroponic fodder production system could help in quality fodder production under resource deficit condition in cost effective and sustainable manner.

Sungwon Lee and Sekwang Park (2013) proposed the intensity of illumination control system using photo sensor for providing consistent PPFD to crop regardless of change of outside natural light.

Jadwiga Treder, Anna Borkowska, Waldemar Treder, Krzysztof Klamkowski (2016) proposed the growth and development of tomato and cucumber transplants grown in controlled compartments witch artificial lighting using HPS and two LED different light spectra fixtures, with different ratio of B: R.

Pirapong Limprasitwong and Chaiyapon Thongchaisuratkrul (2018) proposed the automatic control system of plant nursery for planting shallot. The system can water automatically. Temperature can be controlled. The research also studied the effect of electrical light comparing with natural light.

Giuseppina Pennisi, Sonia Blasioli, Antonio Cellini, Lorenzo Maia,Andrea Crepaldi, Ilaria Braschi, Francesco Spinelli, Silvana Nicola,Juan A. Fernandez, Cecilia Stanghellini, Leo F. M. Marcelis, Francesco Orsini and Giorgio Gianquinto (2019) proposed the RB ratio of 3 provides optimal growing conditions for indoor cultivation of basil, fostering improved performances in terms of growth, physiological and metabolic functions, and resources use efficiency.

Leyla Bayat, Mostafa Arab, Sasan Aliniaeifard1, Mehdi Seif, Oksana Lastochkina and Tao Li (2018) proposed growing plants under monochromatic light reduced the plants' ability to cope with HL stress.

Kozai T, Niu G, Takagaki M (2015) proposed the rapid development of lighting technologies using light-emitting diodes (LEDs) has caused an increase in the application of this technology for lighting in closed horticultural systems.

Marios C. Kyriacou, Youssef Rouphael, Francesco Di Gioia,Angelos Kyratzis, (2016); proposed the Micro-scale vegetable production and the rise of microgreens

CHAPTER 3

HYDROPONICS SYSTEM

3.1 INTRODUCTION

Hydroponics is the cultivation of plants without using soil. Hydroponic flowers, herbs, and vegetables are planted in inert growing media and supplied with nutrient-rich solutions, oxygen, and water. This system fosters rapid growth, stronger yields, and superior quality. When a plant is grown in soil, its roots are perpetually searching for the necessary nutrition to support the plant. If a plant’s root system is exposed directly to water and nutrition, the plant does not have to exert any energy in sustaining itself. The energy the roots would have expended acquiring food and water can be redirected into the plant’s maturation. As a result, leaf growth flourishes as does the blooming of fruits and flowers. Plants sustain themselves by a process called photosynthesis. Plants capture sunlight with chlorophyll (a green pigment present in their leaves). They use the light’s energy to split water molecules they’ve absorbed via their root system. The hydrogen molecules combine with carbon dioxide to produce carbohydrates, which plants use to nourish themselves. Oxygen is then released into the atmosphere, a crucial factor in preserving our planet's habitability. Plants do not need soil to photosynthesize. They need the soil to supply them with water and nutrients. When nutrients are dissolved in water, they can be applied directly to the plant’s root system by flooding, misting, or immersion. Hydroponic innovations have proven direct exposure to nutrient-filled water can be a more effective and versatile method of growth than traditional irrigation.

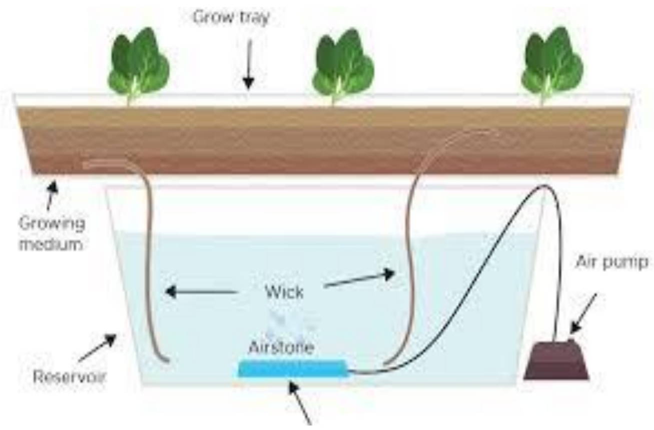

FIGURE 3.1 HYDROPONICS SYSTEM

3.2 WORKING OF HYDROPONICS SYSTEM

Hydroponics system work by allowing minute control over environmental conditions like temperature and pH balance and maximized exposure to nutrients and water. Hydroponics operates under a very simple principle: provide plants exactly what they need when they need it. Hydroponics administer nutrient solutions tailored to the needs of the particular plant being grown. They allow you to control exactly how much light the plants receive and for how long. pH levels can be monitored and adjusted. In a highly customized and controlled environment, plant growth accelerates. By controlling the environment of the plant, many risk factors are reduced. Plants grown in gardens and fields are introduced to a host of variables that negatively impact their health and growth. Fungus in the soil can spread diseases to plants. Wildlife like rabbits can plunder ripening vegetables from your garden. Pests like locusts can descend on crops and obliterate them in an afternoon. Hydroponic systems end the unpredictability of growing plants outdoors and in the earth. Without the mechanical resistance of the soil, seedlings can mature much faster. By eliminating pesticides, hydroponics produces much healthier and high-quality fruits and vegetables. Without obstacles, plants are free to grow vigorously and rapidly.

3.3 COMPONENTS OF A HYDROPONIC SYSTEM

3.3.1 Growing Media

Hydroponic plants are often grown in inert media that support the plant’s weight and anchor its root structure. Growing media is the substitute for soil; however, it does not provide any independent nutrition to the plant. Instead, this porous media retains moisture and nutrients from the nutrient solution which it then delivers to the plant. Many growing media are also pH-neutral, so they will not upset the balance of your nutrient solution. There are a host of different media to choose from, and the specific plant and hydroponic system will dictate which media best suits your endeavour. Hydroponic growing media is widely available both online and at local nurseries and gardening stores

3.3.2 Air Stones and Air Pumps

Plants that are submerged in water can quickly drown if the water is not sufficiently aerated. Air stones disperse tiny bubbles of dissolved oxygen throughout your nutrient solution reservoir. These bubbles also help evenly distribute the dissolved nutrients in the solution. Air stones do not generate oxygen on their own. They need to be attached to an external air pump via opaque food grade plastic tubing (the opacity will prevent algae growth from setting in). Air stones and air pumps are popular aquarium components and can be purchased easily at pet stores.

3.3.3 Net pots

Net pots are mesh planters that hold hydroponic plants. The latticed material allows roots to grow out of the sides and bottom of the pot, giving greater exposure to oxygen and nutrients. Net pots also provide superior drainage compared to traditional clay or plastic pots.

FIGURE 3.3.3 NET POTS AND TRAY

3.4 TYPES OF HYDROPONICS SYSTEM

3.4.1Ebb and flow systems

Ebb and flow hydroponics work by flooding a grow bed with a nutrient solution from a reservoir below. The submersible pump in the reservoir is equipped with a timer. When the timer starts, the pump fills the grow bed with the water and nutrients. When the timer stops, gravity slowly drains the water out of the grow bed and flushes it back into the reservoir. The system is equipped with an overflow tube to ensure flooding doesn't surpass a certain level and damage the stalks and fruits of the plants. Unlike the previous systems mentioned, the plants in an ebb and flow system are not constantly exposed to water. While the grow bed is flooded, the plants drink up the nutrient solution through their root systems. When the water ebbs and the grow bed empty, the roots dry out. The dry roots then oxygenate in the interval before the next flood. The length of time between floods is dictated by the size of your grow bed and the size of your plants. Ebb and flow systems (also called flood and drain systems) are one of the most popular hydroponic growing methods. The abundance of oxygen and nutrition the plants are supplied with encourages quick and vigorous growth. The ebb and flow system are easily customization and versatile. The grow bed can be filled with an assortment of net pots and a variety of fruits and vegetables. Perhaps more than any other hydroponic system, the ebb and flow system allow you to experiment with your plants and media. Ebb and flow systems can accommodate almost any type of vegetation. Your primary limitation is the size and depth of your grow tray. Root vegetables will require a much deeper bed than lettuce or strawberries. Tomatoes, peas, beans, cucumbers, carrots, and peppers are all popular ebb and flow crops. In fact, you can even attach trellises directly to the grow bed. “Grow rocks” and expanded clay pebbles (hydro ton) are some of the most popular growing media in ebb and flow hydroponics. These are cleanable and reusable, lightweight, and while they do retain moisture they will also drain. This is an important quality in ebb and flow systems.

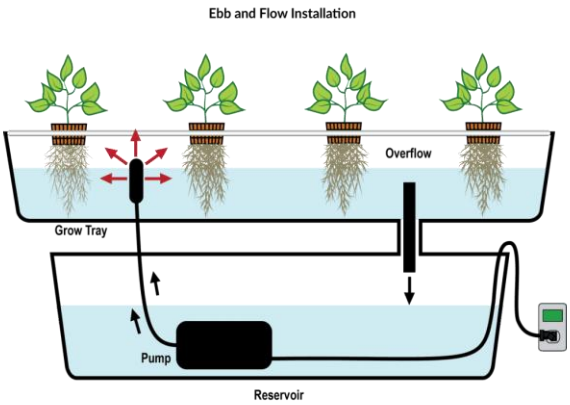

FIGURE 3.4.1 EBB AND FLOW SYSTEM

3.4.2 Drip systems

In a hydroponic drip system, the aerated and nutrient-rich reservoir pumps solution through a network of tubes to individual plants. This solution is dripped slowly into the growing media surrounding the root system, keeping the plants moist and well-nourished. Drip systems are the most popular and widespread method of hydroponics, especially among commercial growers. Drip systems can be individual plants or massive irrigation operations. There are two configurations of drip system hydroponics: recovery and non-recovery. In recovery systems, more popular with smaller, at-home growers, the excess water is drained from the grow bed back into the reservoir to be recirculated during the next drip cycle. In non-recovery systems, the excess water drains out of the growing media and runs to waste. This method is more popular among commercial growers. Though non-recovery drip systems can sound wasteful, large-scale growers are very conservative with water usage. These drip systems are designed only to deliver precisely the amount of solution required to keep the growing media around the plant dampened. Non-recovery drip systems employ elaborate timers and feeding schedules to keep waste to a minimum. If you are growing plants in a recovery drip system, you will need to be attuned to the fluctuations in the pH of the nutrient solution. This is true of any system where wastewater re-circulates into the reservoir. Plants will deplete the nutrient content of the solution as well as alter the pH balance, so the grower will need to monitor and adjust the solution reservoir more than they would need to in a non-recovery system. Growing media can also become oversaturated with nutrients, so they will need to be washed and replaced periodically.

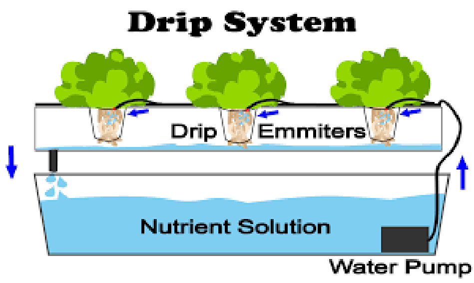

FIGURE 3.4.2 DRIP SYSTEM

3.4.3 Aeroponics

Aeroponics systems suspend plants in the air and expose the naked roots to a nutrient-filled mist. Aeroponics systems are enclosed frameworks, like cubes or towers, that can hold a multitude of plants at once. Water and nutrients are stored in a reservoir, and then pumped to a nozzle that atomizes the solution and distributes it as a fine mist. The mist is usually released from the top of the tower, allowing it to cascade down the chamber. Some aeroponics continuously mist the plant's roots, much like NFT systems expose the roots to the nutrient film at all times. Others function more like the ebb and flow system, spraying the roots with mist in intervals. Aeroponics do not need substrate media to survive. The root's constant exposure to air allows them to drink in oxygen and grow at an accelerated rate. Aeroponics systems use less water than any other form of hydroponics. In fact, it takes 95% less water to grow a crop aeroponically than in an irrigated field. Their vertical structure is designed to take up minimal room and allows for numerous towers to be housed in a single location. With aeroponics, great yields can be produced even in confined spaces. Furthermore, because of their maximized exposure to oxygen, aeroponic plants grow faster than other hydroponically grown plants. Aeroponics allow for simple harvesting year-round. Vine plants and nightshades like tomatoes, bell peppers, and eggplants all perform well in an aeroponic environment. Lettuce, baby greens, herbs, watermelons, strawberries, and ginger all also flourish. However, fruiting trees are too large and heavy to be grown aeroponically, and underground plants with extensive root systems like carrots and potatoes cannot be grown.

FIGURE 3.4.3 AEROPONICS

3.5 HYDROPONIC TECHNOLOGY

Hydroponics is a scientific way of growing plants/crops in water without any soil in a controlled environment. In hydroponic technology, water is enriched with well-balanced nutrients which are essential for plants growth and better yield. When it comes to green fodder production, hydroponic technology takes the pressure off the land to grow green fodder for the livestock/animals. Generally, water, nutrients, and sunlight are major inputs to the hydroponic system. Using, hydroponic system, fodder crops like Barley, Oats, Maize, and Sorghum can be cultivated for producing high quality of nutritious green fodder for livestock/ dairy animals. Hydroponic green fodder results in good health of dairy animals apart from high dairy yield. Apart from this, the hydroponics system can be used for growing wheat grass, paddy saplings in 7 to 10 days of time for optimum growth of the crop. Green fodder obtained from hydroponics consists of grass with grains, roots, stem, and leaves. Whereas conventionally grown fodder consists of a stem and leaves only.

CHAPTER 4

CULTIVATION OF MICROGREENS

4.1 INTRODUCTION

Microgreens cultivation is a straightforward and rewarding process that can be done in a small space. To get started, choose the seeds of vegetables, herbs, or edible flowers known for their tender greens, such as radish, broccoli, kale, or basil. Prepare shallow trays or containers with good drainage and fill them with a sterile potting mix or soilless medium. Sprinkle the seeds evenly and densely over the medium, gently pressing them in. Mist the seeds with water and place the trays in a well-lit area, receiving 4-6 hours of direct sunlight daily or supplemented with artificial grow lights. Maintain consistent moisture, proper temperature (60-75°F/15-24°C), and good air circulation. Monitor and care for the microgreens, removing debris and avoiding overwatering. Harvest the greens when the first true leaves appear, using clean scissors to cut them above the soil level. Rinse and store them in airtight containers in the refrigerator or use them immediately for their vibrant flavor and high nutritional value. Cultivating microgreens offers a delightful way to grow your own fresh and healthy greens at home.

CHAPTER 5

HARDWARE DESCRIPTION

5.1 INTRODUCTION

The hydroponics system requires an artificial environment to cultivate Microgreens. The following components are used to setup the hydroponics system

- Arduino nano
- Arduino IDE tool
- Sensors
- Actuators
- Controller
- Power supply

5.2 ARDUINO NANO

The Arduino Nano is a small-sized microcontroller board based on the ATmega328P chip. It is a compact version of the popular Arduino Uno, offering similar functionality in a smaller form factor. The Nano is designed for projects that require a compact and lightweight solution while still providing the power and flexibility of an Arduino board. It has a wide range of inputs and outputs, including digital and analog pins, PWM capabilities, and communication interfaces such as I2C and SPI. With its small size and versatility, the Arduino Nano is ideal for applications where space is limited, such as wearable electronics, robotics, and small-scale automation projects.

5.3 ARDUINO IDE TOOL

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

5.4 SENSORS

A sensor is a device that detects the change in the environment and responds to some output on the other system. A sensor converts a physical phenomenon into a measurable analog voltage (or sometime a digital signal) converted into a human-readable display or transmitted for reading or further processing. The sensor required for farming is illustrated here.

5.4.1 Humidity Sensor

It is electronic devices that measure and report the moisture and air temperature of the surrounding environment.

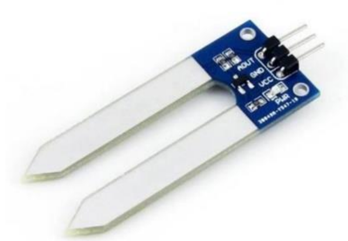

FIGURE 5.4.1 HUMIDITY SENSOR

5.4.2 Temperature Sensor

It is a device which is used for measuring of anything or any place in temperature sensor, RTD (resistance temperature detector) elements are used for measuring a temperature.

FIGURE 5.4.2 TEMPERATURE SENSOR

5.4.3 AIR Quality sensor

An air quality sensor is a device that measures and monitors the quality of the air in its immediate surroundings. It detects various pollutants, gases, and particles present in the air, providing valuable information about the overall air quality. These sensors can measure parameters such as carbon dioxide (CO2) levels, particulate matter (PM), volatile organic compounds (VOCs), and other harmful gases

FIGURE 5.4.3 AIR QUALITY SENSOR

5.4.4 Ultrasonic sensor

An ultrasonic sensor is a device that uses sound waves at frequencies beyond the range of human hearing to detect and measure distances or objects. It works on the principle of sending out ultrasonic pulses and measuring the time it takes for the pulses to bounce back after hitting an object. The sensor consists of a transmitter that emits ultrasonic waves and a receiver that detects the waves reflected by objects in its path.

When the ultrasonic waves encounter an object, they reflect back to the sensor, and the receiver detects these reflected waves. By calculating the time taken for the waves to travel back and forth, the sensor can determine the distance between itself and the object

FIGURE 5.4.4 ULTRASONIC SENSOR

5.5 ACTUATOR

An actuator is a device that produces a motion by converting energy and signals going into the system. The motion it produces can be either rotary or linear. An actuator is a device that produces a motion by converting energy and signals going into the system. The motion it produces can be either rotary or linear.

5.5.1 16x2 LCD module with I2C interface

A 16x2 LCD module with I2C interface is a popular display module that combines a 16-character by 2-line alphanumeric LCD (Liquid Crystal Display) screen with an I2C communication interface. This module simplifies the process of connecting and controlling an LCD display with a microcontroller or other devices that support I2C communication The I2C interface allows for two-wire communication between the LCD module and the microcontroller, reducing the number of required GPIO pins on the microcontroller. The I2C interface typically utilizes an I2C backpack or converter module that handles the low-level I2C protocol details, such as generating clock signals and addressing the LCD module.

FIGURE 5.5.1 16X2 LCD MODULE WITH I2C INTERFACE

5.5.2 Relay module

This is a 5v 3-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that works under AC 250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by microcontroller. From the picture, you can see that when the signal port is at low level, the signal light will light up and the Optocoupler relay (it transforms electrical signals by light and can isolate input and output electrical signal) will conduct, and then the transistor will conduct, the real coil will be electrified, and the normally open contact of the relay will be closed. When the signal port is at high level, normally closed contact of the relay will be closed. So, you can connect and disconnect the load by controlling the level of the control signal port

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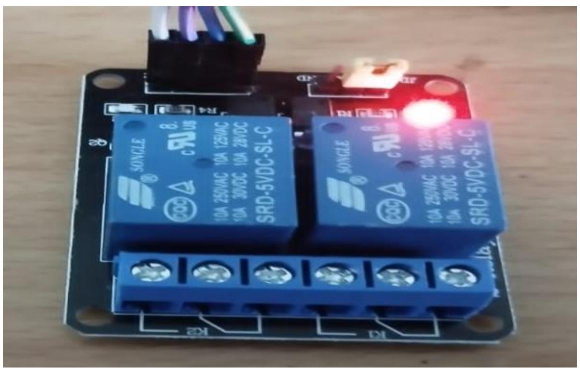


FIGURE 5.5.2 RELAY MODULE

5.5.3 water pump module

A water pump module is a compact electronic device designed to control the operation of a water pump. It typically includes a pump, a motor driver circuit, and control logic, all integrated into a single module. The module is designed to simplify the setup and operation of water pumps in various applications. The water pump module is typically used in systems that require water circulation, such as aquariums, hydroponics, irrigation systems, or water-cooling systems. It provides a convenient and reliable solution for controlling the flow and pressure of water

FIGURE 5.5.3 WATER PUMP MODULE

5.6 CONTROLLER

The digital computer (both the hardware and the software) acts as a controller to the automated system. The controller functions in a manner analogous to the human brain. With the help of this controller, the system is able to carry out the assigned tasks. The controller controls the tasks of entire system. In other words, the controller controls the system.

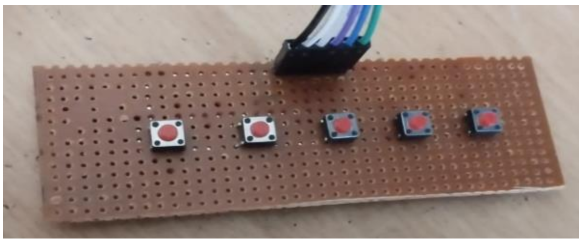


FIGURE 5.6 CONTROLLER

5.7 POWER SUPPLY

The circuit uses standard power supply comprising of a step-down transformer from 230v to 12v and 4 diodes forming a Bridge Rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470microf to 100microF. The filtered dc being UN regulated IC LM7805 is used to get 5vconstant at its pin no 3 irrespective of input dc varying from 9v to 14v.Theregulated 5volts dc is further filtered by a small electrolytic capacitor of 10 micro farad for any noise so generated by the circuit. One LED is connected

CHAPTER 6

SOFTWARE DESCRIPITION

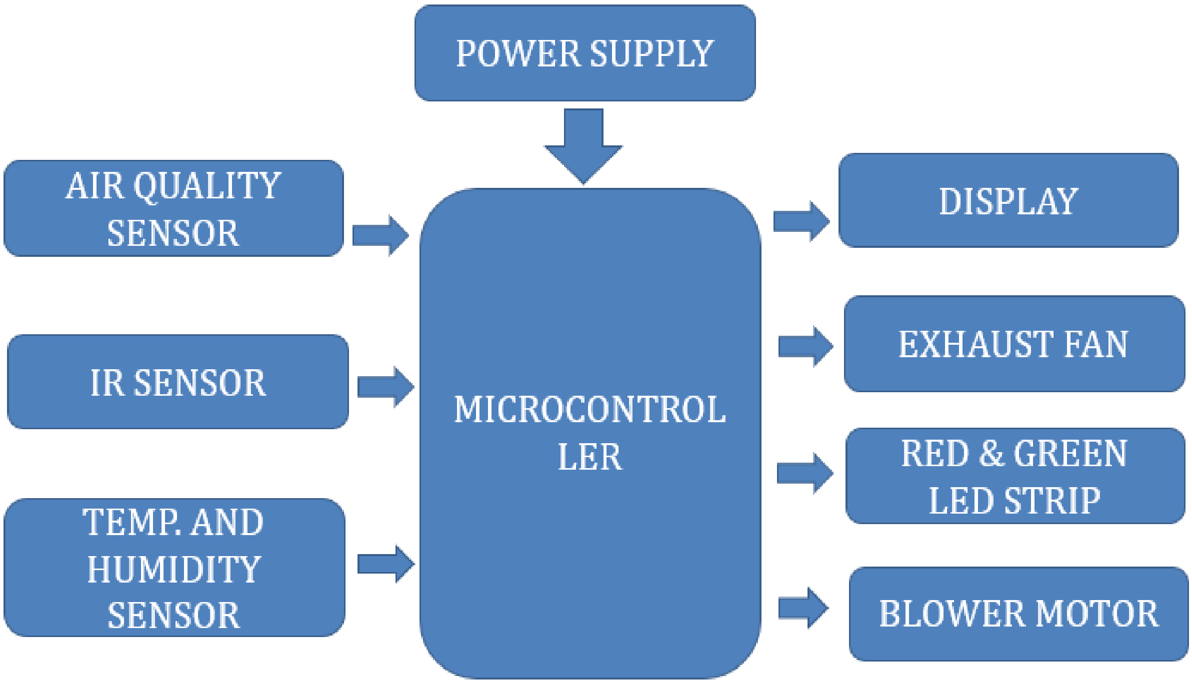
6.1 INTRODUCTION

Arduino is a both an open-source software library and an open-source breakout board for the popular AVR micro-controllers. The **Arduino IDE** (Integrated Development Environment) is the program used to write code, and comes in the form of a downloadable file on the Arduino website. The **Arduino board** is the physical board that stores and performs the code uploaded to it. Both the software package and the board are referred to as **"Arduino."** Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

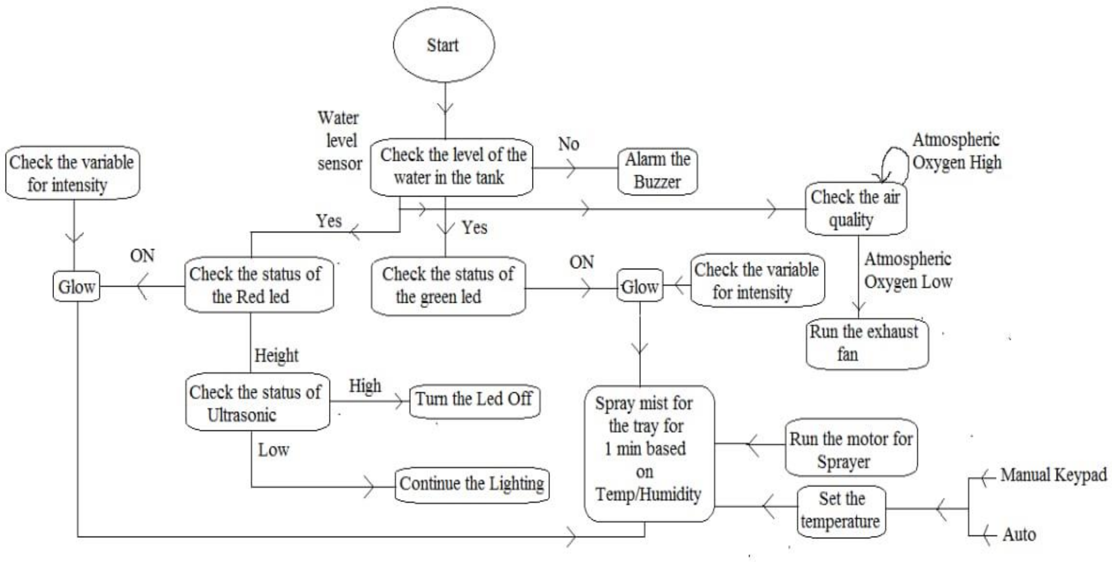
CHAPTER 7

PROPOSED SYSTEM

7.1 BLOCK DIAGRAM



7.2 FLOW CHART



7.3 WORKING

In our proposed working system contain Arduino nano board, Arduino IDE tool, sensors, controller and power supply. Humility sensor check the moisture and air temperature of the surrounding environmental. Temperature sensor sense room temperature will be high this sensor automatically turns on the water pump motor to from the water tank, to level the temperature sensor indicates. Essential Water collect from the recycle water tank. Controller can able to carry out the assigned tasks and it controls the tasks of entire system. most automation system gets their energy from electricity. All parts of the automation system are powered by a power supply

CHAPTER 8

RESULTS AND DISCUSSION

8.1 MONITORING DETAILS OF MICROGREENS CULTIVATION SYSTEM:

The condition of the actuators can monitor using the system. Here the condition of LED, motor and Sensors can be monitored by connecting the system and we can monitor it whenever we want. The humidity, temperature and moisture are measured using the sensors. Temperature sensor and humidity sensor is used here and its condition is monitored using the system.

8.2 MONITORING ANALYSIS

8.2.1 motor condition

Parameter	Date	Time	Level
Motor condition	23/05/2023	21:50	0
		22:00	1
		22:10	0
		22:20	0

Table 8.2.1 Motor condition

The values taken at different times with motor and are shown table 8.1

8.2.2 Light Condition

Parameter	Date	Time	Level
Grow LED	23/05/2023	21:50	0
		22:00	0
		22:10	0
		22:20	0

Table 8.2.2 Light condition

8.2.3 Humidity condition

Parameter	Date	Time	Level
Humidity	23/05/2023	21:50	78
		22:00	78
		22:10	75
		22:20	73

Table 8.2.3 Humidity condition

8.2.4 Temperature condition

Parameter	Date	Time	Level
Temperature	23/05/2023	21:50	28
		22:00	28
		22:10	28
		22:20	28

Table 8.2.4 Temperature condition

8.3 HARDWARE PROTOTYPE

The hardware model of our prototype is shown in the figures and the fodder growth is also shown at different stages.

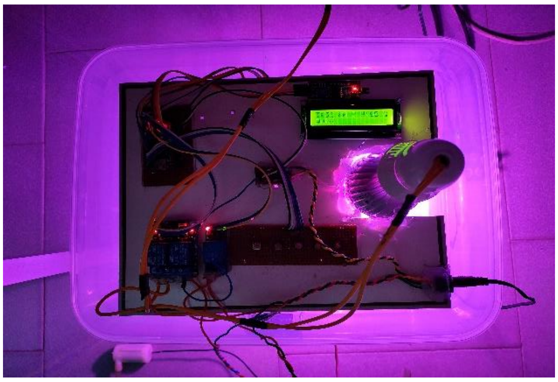


FIGURE 8.3 PROTOTYPE OF CULTIVATION IN MICROGREENS

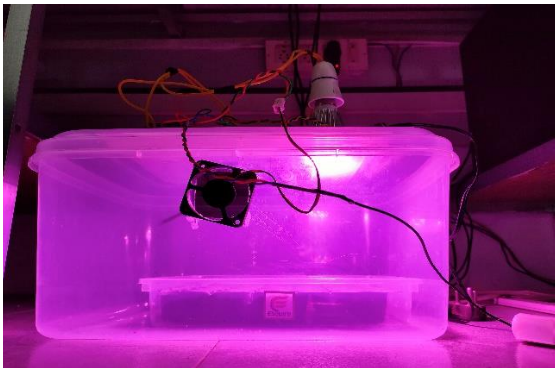


FIGURE 8.3.1 PROTOTYPE OF CULTIVATION IN MICROGREENS

FIGURE 8.3.2 MUNG BEAN SEEDS DAY 1

FIGURE 8.3.3 MUNG BEANS SEEDS DAY 2

CHAPTER 9
CONCLUSION

From experimental results, it can be summarized that Automation in cultivation of microgreens could run correctly. The LED setup help the plants to grow quickly. The sensors which we used understands the environment and the supply the water correctly requirements for the fodder growth. The remaining water is recycled again for future use. The proposed system for hydroponics is energy efficient and sustainable one. The small farmers who don't have enough land for microgreens cultivation can make use of this system. The Automation in cultivation of microgreens makes the microgreens to grow quickly so that the production will increase and can also be used according to the need of the microgreens. Hence it is an energy efficient and sustainable system.

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