INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM, THALAMBUR, PERIYAPALAYAM-CHENNAI
ACCREDITED BY NAAC WITH 'A++' GRADE

SCHOOL OF COMPUTING SCIENCES

DEPARTMENT OF COMPUTER APPLICATIONS - PG

COGNITIVE AGRO-METABOLISM: ASCENDANT VERTICAL ECO-OPTIMIZATION MATRIX

A Project Report

Submitted to the VISTAS is partial fulfilment for the award of the degree of

MASTER OF COMPUTER APPLICATIONS

Submitted by

Name: ELAVARASAN S
Reg. No: 23304349

UNDER THE GUIDANCE OF

Dr. H. JAYAMANGALA MCA, M.Phil., Ph.D.

MAY – 2025

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
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BONAFIDE CERTIFICATE

This is to certify that the Main Project entitled **"COGNITIVE AGRO-METABOLISM: ASCENDANT VERTICAL ECO-OPTIMIZATION MATRIX"** is the original record by **ELAVARASAN S, REGNO: 23304349** under my guidance and supervision for the partial fulfilment of award of degree of MASTER OF COMPUTER APPLICATIONS, as per syllabus prescribed by the VISTAS.

GUIDE **HEAD OF THE DEPARTMENT**

Submitted for the Viva-Voce examination held on …… at VISTAS Pallavaram, Chennai.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

VCODEZ™
INNOVATING IDEAS

Date: 14-05-2025

Subject: Project Completion Letter

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Elavarasan S (Reg. No. 23304349),** from **Vels Institute of science, Technology & Advanced Studies** in the Department of **MCA (Computer Applications)** successfully completed his Project titled **"Cognitive Agro-Metabolism: Ascendant Vertical Eco-Optimization Matrix"** in the platform of **Java** in our company from January 2025 to April 2025.

All necessary details were provided from our side for the establishment of this project. We have noticed that, during the period, he has shown keen interest in his assignments and was also regular in attendance.

.

For VCODEZ

Vishnu S
Manager – Human Resources

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ACKNOWLEDGEMENT

"Let the beauty of the lord fall on us and establish the work of our hands". At the outset, I thank the ALMIGHTY GOD for his abundant blessings and for giving me the opportunity to carry out this project successfully.

I deeply wish to express my sincere thanks to **Dr. ISHARI K. GANESH M.Com., B.L., Ph.D.,** the founder and chancellor of VISTAS, **Dr. JOTHI MURUGAN,** Pro-Chancellor (P & D) VISTAS, **Dr. ARTHI GANESH,** Pro-Chancellor (Academics), **Dr. PREETHAA GANESH,** Vice-president, Vels Group of institutions.

I extend my thanks to **Dr. S. SRIMAN NARAYANAN** Th Vice-Chancellor, VISTAS for providing me necessary facilities. I wish to extend my heartfelt and sincere thanks to **Dr. M. BHASKARAN,** Pro Vice-Chancellor, VISTAS and sincere thanks to **Dr. P. SARAVANAN,** Registrar.

I extend my thanks to **Dr. A. UDHAYA KUMAR,** Controller of Examinations, VISTAS. I extend my reverential gratitude to **Dr. P. MAGESH KUMAR,** Director, School of Computing Sciences and **Dr. R. PRIYA ANAND MCA, M.Phil., Ph.D.,** and Head of Department for encouraging me to complete my work. I extend my deep sense of gratitude and sincere thanks to my project supervisor of **Dr. H. JAYAMANGALA MCA, M.Phil., Ph.D.** for helping me with her support, motivation and guidance throughout this research. Her valuable guidance and inspiration are the key factors that enabled me to complete this research successfully.

I sincerely express my gratitude's to **MY PARENTS, FRIENDS** and our **FACULTY MEMBERS** for their continuous prayers, supports and constant encouragement to reach the heights of success. Once again,

Once again, I thank the GOD almighty with whose profound blessings this work has been completed successfully.

DECLARATION

I, **ELAVARASAN S (23304349)** declare that the Main project entitled **"COGNITIVE AGRO-METABOLISM: ASCENDANT VERTICAL ECO-OPTIMIZATION MATRIX",** is a record of original work done by me in partial fulfillment of the requirements for the award of the degree of Master of computer applications in the year 2024-2025, under the guidance of **Dr. H. JAYAMANGALA MCA, M.Phil., Ph.D.** Assistant professor, Department of Computer Applications - PG, VISTAS. This project work has not formed the basis for the award of any degree.

Candidate's Signature

Elavarasan S

Abstract

This initiative pioneers the transformation of traditional agriculture by implementing vertical farming, employing hydroponics, aeroponics, and aquaponics to efficiently cultivate a diverse array of fruits and vegetables. This cutting-edge approach maximizes yield while significantly minimizing the consumption of time and space, resulting in a greater output of nutrient-rich produce crucial for meeting the increasing demand for healthy food in urban areas. The process commences with capturing client requests and assessing product availability to align cultivation strategies with market demand, enabling a responsive and efficient production cycle.

Upon registering requests, the project employs advanced cultivation techniques, including tailored nutrient solutions, climate control systems, and automated monitoring, to optimize growth conditions and ensure plants thrive in a controlled environment, thus boosting productivity. The harvesting phase prioritizes efficiency and precise timing to gather produce at its peak quality, enhancing flavour and nutritional value. Rigorous testing protocols then analyse the nutrient content and safety of the harvested produce, guaranteeing adherence to health standards and building consumer confidence. Comprehensive reports generated at each project phase consolidate vital data on operational effectiveness, resource utilization, and product quality, informing immediate strategies and laying the groundwork for future data-driven decision-making, continuous improvement, and adaptation to evolving market needs. This integrated approach to vertical farming not only increases the availability of fresh produce but also fosters a more sustainable urban food supply chain, addressing food security challenges and promoting healthier communities through meticulous planning, execution, and evaluation.

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INTRODUCTION

1.1 COMPANY PROFILE:

At VCodez, we are more than just a software solutions provider – we are innovators, problem solvers, and partners dedicated to driving success for businesses in a rapidly evolving digital landscape. Founded with a passion for technology and a commitment to excellence, we specialize in delivering tailored software solutions that meet the unique challenges of each client.

From startups to established enterprises, our team of expert developers, engineers, and consultants work collaboratively to design and implement custom applications, mobile solutions, and advanced technologies such as AI and cloud services. With a strong emphasis on quality, security, and scalability, we transform ideas into reality, ensuring that our clients remain competitive and future-ready.

1.2 INTRODUCTION TO PROJECT

With the global population steadily increasing, the demand for efficient and sustainable food production methods has never been higher, especially in urban areas where space is limited. Traditional farming, which relies heavily on land, water, and time, struggles to meet these demands. Vertical farming offers a promising solution, allowing for the cultivation of crops in stacked layers or vertically inclined surfaces. This innovative method not only maximizes space usage but also minimizes resource consumption, enabling year-round crop production in controlled environments. This project focuses on transforming agricultural practices through vertical farming, utilizing cutting-edge techniques such as hydroponics, aeroponics, and aquaponics to cultivate a wide range of fruits and vegetables. These methods enhance nutrient delivery, reduce water usage, and eliminate the need for soil, resulting in higher crop yields and better-quality produce. The goal is to increase food production while reducing resource consumption, making urban agriculture more efficient and sustainable.

The project begins by assessing client needs and market demand to align cultivation strategies with consumer preferences. Advanced techniques, including climate control systems, automated monitoring, and tailored nutrient solutions, ensure optimal growth conditions for the crops. By implementing precision agriculture, the project maximizes productivity and improves crop health. Harvesting is carefully planned to ensure produce reaches its peak quality, with rigorous testing protocols in place to guarantee the safety and nutritional value of the crops. Comprehensive reports are generated throughout the process, providing valuable insights into resource usage, operational efficiency, and product quality. These reports help refine production strategies and adapt to changing market conditions. Ultimately, the project aims to improve the availability of fresh, nutrient-rich produce while contributing to a more sustainable food supply chain. By leveraging innovative agricultural practices, this initiative promotes sustainability in urban farming and addresses the growing challenges of food security, creating a healthier and more resilient community.

1.3 PURPOSE OF THE SYSTEM

1 **Space Optimization**: By growing crops in vertically stacked layers, the system makes efficient use of available space, allowing for the cultivation of more crops in smaller areas. This is particularly advantageous in urban environments where land is limited and expensive.

2 **Water Conservation**: Unlike traditional farming, which relies on extensive water usage, the vertical farming system utilizes hydroponic and aeroponic techniques that consume up to 90% less water. The water recycling mechanism ensures that excess water is captured, purified, and reused, significantly reducing overall water consumption.

3 **Year-Round Crop Production**: The controlled environment allows for the cultivation of crops throughout the year, independent of external weather conditions. This ensures consistent food production and supply, reducing dependency on seasonal changes.

4 **Increased Crop Yield**: By optimizing growing conditions such as light, temperature, and nutrients, the system enhances plant growth, leading to higher yields compared to traditional farming. Plants grow faster and healthier, increasing overall productivity.

5 **Minimal Environmental Impact**: The system's efficient use of resources—such as water, energy, and nutrients—combined with renewable energy options and waste management practices (like composting and biogas conversion) contribute to a reduced environmental footprint. This promotes sustainable agricultural practices.

6 **Improved Food Security**: Vertical farming can be set up in urban areas close to consumers, reducing the need for long transportation and logistics. This not only lowers transportation costs but also ensures that consumers receive fresh, high-quality produce, improving food security.

7 **Scalability and Flexibility**: The modular design of the vertical farming system allows for easy expansion based on demand. Farms can be customized to grow different types of crops, from leafy greens to fruits and herbs, depending on market needs.

8 **Data-Driven Precision Farming**: Through the use of sensors, automation, and data analytics, farmers can monitor and optimize growing conditions in real-time. This precision farming approach ensures that plants receive the exact amount of nutrients and care they need, minimizing waste and maximizing yield.

SYSTEM ANALYSIS

2.1 INTRODUCTION

The increasing demand for sustainable food production, coupled with rapid urbanization and limited agricultural space, has highlighted the need for innovative farming solutions. Traditional farming methods face challenges such as excessive land and water consumption, seasonal dependencies, and vulnerability to climate change. Vertical farming emerges as a revolutionary approach, integrating advanced technologies like hydroponics, aeroponics, and aquaponics to cultivate crops in controlled environments. This system analysis aims to evaluate the requirements, efficiency, and feasibility of implementing a vertical farming system that maximizes space utilization while minimizing resource consumption. By assessing factors such as infrastructure, automation, climate control, and nutrient delivery, the analysis provides insights into optimizing crop growth and ensuring year-round production. Additionally, the system's performance will be monitored through data collection, real-time sensors, and automation to enhance precision agriculture practices. The study will also focus on identifying potential challenges, including energy requirements, initial setup costs, and maintenance needs, to ensure the system’s long-term sustainability. Through this analysis, the goal is to develop a scalable and cost-effective vertical farming model that improves food security, supports urban agriculture, and aligns with sustainable development goals.

2.2 ANALYSIS MODEL

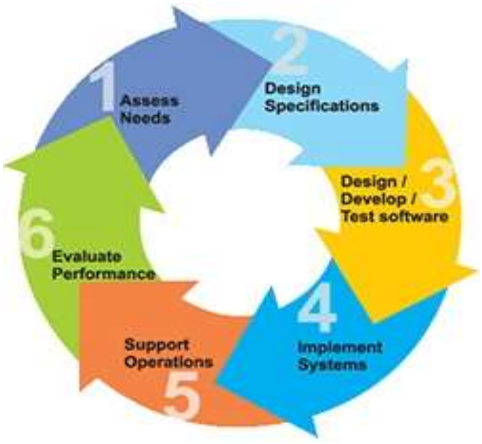
SOFTWARE DEVELOPMENT LIFE CYCLE

INTRODUCTION:

The System Development Lifecycle framework is designed to outline a complete development and implementation process suitable for developing complex applications. SDLC is a process followed for a software project, within a software organization. It consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process.

- Business – legislation regulatory requirements, policy, SOP's, guidelines etc.
- Process – how the business is implemented
- Data – the core business data elements collected for the business
- Application – the gate to the business collecting
- Infrastructure- the servers, network, workstations, etc.

2.3 SDLC PHASES:



Stage 1: Scheduling and Requisite investigation:

Requirement analysis is the most important and fundamental stage in SDLC. It is performed by the senior members of the team with inputs from the customer, the sales department, market surveys and domain experts in the industry. This information is then used to plan the basic project approach and to conduct product feasibility study in the economical, operational, and technical areas.

Planning for the quality assurance requirements and identification of the risks associated with the project is also done in the planning stage. The outcome of the technical feasibility study is to define the various technical approaches that can be followed to implement the project successfully with minimum risks.

Stage 2: Significant necessities:

Once the requirement analysis is done the next step is to clearly define and document the product requirements and get them approved from the customer or the market analysts. This is done through. SRS Software Requirement Specification document which consists of all the product requirements to be designed and developed during the project life cycle.

Stage 3: Scheming the product design:

SRS is the reference for product architects to come out with the best architecture for the product to be developed. Based on the requirements specified in the SRS, usually more than one design approach for the product architecture is proposed and documented in a DDS - Design Document Specification.

This DDS is reviewed by all the important stakeholders and based on various parameters as risk assessment, product robustness, design modularity, budget and time constraints, the best design approach is selected for the product.

Stage 4: Structure or Mounting the Product:

In this stage of SDLC the actual development starts and the product are built. The programming code is generated as per DDS during this stage. If the design is performed in a detailed and organized manner, code generation can be accomplished without much hassle.

Developers have to follow the coding guidelines defined by their organization and programming tools like compilers, interpreters, debuggers etc.are used to generate the code. Different high level programming languages such as C, C++, Pascal, Java, and PHP are used for coding.

Stage 5: Testing the Product:

This stage is usually a subset of all the stages as in the modern SDLC models, the testing activities are mostly involved in all the stages of SDLC. However, this stage refers to the testing only stage of the product, where product defects are reported, tracked, fixed and retested, until the product reaches the quality standards defined in the SRS.

Stage 6: Consumption in the Market and Safeguarding:

Once the product is tested and ready to be deployed it is released formally in the appropriate market. Sometime product deployment happens in stages as per the organizations. Business strategy. The product may first be released in a limited segment and tested in the real business environment (UAT- User acceptance testing).

The product may be released as it is or with suggested enhancements in the targeting market segment. After the product is released in the market, its maintenance is done for the existing customer base.

Software Requirements:

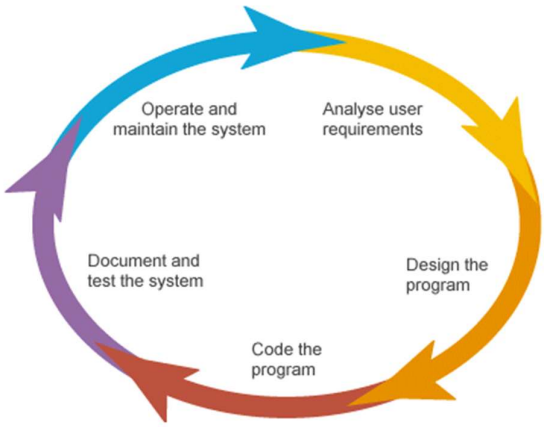
- **Front end** : core java, CSS, js, servlet
- **Web application** : J2ee Frameworks, Hibernate
- **Back end** : MySQL 5.1

2.4 HARDWARE AND SOFTWARE REQUIREMENT

Developing Kit			
	Processor	**RAM**	**Disk Space**
Eclipse	Computer with a 2.6GHz processor or higher	2GB	Minimum 20 GB
Database			
MySQL 5.0	Intel Pentium processor at 2.6GHz or faster	Minimum 512 MB Physical Memory; 1 GB Recommended	Minimum 20 GB
Heidi SQL 8.3	Intel Pentium processor at 2.6GHz or faster	Minimum 512 MB Physical Memory; 1 GB Recommended	Minimum 20 GB

SOFTWARE DEVELOPMENT LIFE CYCLE

The Software Development Life Cycle is a process that ensures good software is built. Each phase in the life cycle has its own process and deliverables that feed into the next phase. There are typically 5 phases starting with the analysis and requirements gathering and ending with the implementation. Let's look in greater detail at each phase:



Stage 1: Scheduling and Requisite Analysis

During the discovery phase our team conducts a detailed requirement analysis and creates a work-breakdown structure.

Stage 2: Scheming the product design

We identify the design and architecture of the project. SRS is the reference for product architects to come out with the best architecture for the product to be developed.

Stage 3: Structure or Mounting the Product

In this stage of SDLC the actual development starts and the product is built. Different high level programming languages

Stage 4: Testing the Product

Testing is the last phase of the Software Development Life Cycle before the software is delivered to customers. During testing, experienced testers start to test the system against the requirements.

Stage 5: Consumption in the Market and Safeguarding

Once the product has been fully tested and no high priority issues remain in the software, it is time to deploy to production where customers can use the system.

2.5 INPUT AND OUTPUT

The major inputs and outputs and major functions of the system are as follows:

Module 1: ADMIN

- **Input**:
  - Client requests (including details and required information)
  - Employee performance data and feedback
  - Reports from other modules (inventory, cultivation, harvesting, testing)
- **Output**:
  - Approval or rejection of client requests
  - Status updates on employee evaluations
  - Automated email notifications to employees
  - Comprehensive reports summarizing activities, client requests, and employee performance
  - Final approval of results from other modules

Module 2: INVENTORY STATUS

- **Input**:
  - User registration and inventory requests
  - Daily production reports of fruits and vegetables
  - Data on current inventory levels and production rates
- **Output**:
  - Approval or rejection of inventory requests
  - Email notifications with secure login credentials
  - Overview of client requests and their statuses
  - Calculations on availability of fruits and vegetables in stock
  - Comprehensive reports uploaded to the database

Module 3: CROP CULTIVATION

- **Input**:
  - User registration and cultivation requests
  - Data on crops required for cultivation (from Inventory Status)
  - Details on the number of crops grown, growing, or in planting phase
- **Output**:
  - Approval or rejection of cultivation requests
  - Email notifications with secure login credentials
  - Overview of Inventory Status and resource availability
  - Analysis of crop growth rates and production
  - Comprehensive reports uploaded to the system

Module 4: HARVEST SCHEDULE

- **Input**:
  - User registration and harvesting requests
  - Data reports on crop status and growth progress (from Crop Cultivation)

    - Information on expected yields and harvesting schedules
- **Output**:
    - Approval or rejection of harvesting requests
    - Email notifications with secure login credentials
    - Overview of crop growth data and anticipated harvest timelines
    - Analysis of harvesting data and strategies
    - Comprehensive reports uploaded to the database

Module 5: TESTING

- **Input**:
    - User registration and testing requests
    - Data reports on harvesting outcomes and yields (from Harvest Schedule)
    - Results from various crop evaluations
- **Output**:
    - Approval or rejection of testing requests
    - Email notifications with secure login credentials
    - Overview of harvest performance and crop testing data
    - Analysis and interpretation of testing results
    - Comprehensive reports summarizing testing outcomes uploaded to the database.

INPUT DESIGN

- Input design is a part of overall system design. The main objective during the input design as given below.
- Input States: User can maintain a database in MySQL server or SQL server for his/her business requirement.
- Input Media: At this stage choice has to be made about the input media. To conclude about the input media consideration has to be given to:
- In this section user can give the input for storage location and get the output from admin side.

2.6 EXISTING SYSTEM:

Traditional agricultural practices face numerous challenges that highlight the need for more sustainable and efficient solutions. One of the primary issues is extensive land use, which leads to deforestation, habitat loss, and soil degradation as the global population grows and demands more arable land. Additionally, conventional farming is resource-intensive, consuming vast quantities of water, fertilizers, and pesticides, which contribute to water scarcity, soil pollution, and environmental degradation Furthermore, traditional farming tends to have a lower yield per square meter compared to vertical farming, limiting productivity.

It is also labor-intensive, requiring significant manual effort for planting, maintenance, and harvesting, which can lead to labor shortages, especially in regions where fewer people are willing to engage in agricultural work. Many conventional farming systems lack technological integration, preventing farmers from utilizing advanced tools like automated monitoring, data analytics, and precision farming, which could enhance operational efficiency. Lastly, post-harvest losses remain a significant issue, with a large amount of produce wasted during harvesting, processing, and transportation, impacting both food availability and farmer profitability. These limitations demonstrate the need for innovative solutions like vertical farming, which offers a more sustainable, efficient, and productive approach to food production by leveraging technology to optimize resource use and reduce environmental impacts.

2.7 PROBLEMS IN PROPOSED SYSTEM

The proposed vertical farming system introduces an innovative and efficient approach to urban agriculture, designed to address the challenges of traditional farming and meet the growing demand for fresh produce in densely populated areas. This system is built on a modular design, allowing for easy scalability and adaptability, making it possible to expand operations based on demand. By utilizing advanced growing methods such as hydroponics and aeroponics, plants are cultivated in nutrient-rich water or mist, eliminating the need for soil. This not only conserves water but also ensures faster growth rates and higher yields. The crops are grown in vertical towers, maximizing space utilization and optimizing light exposure, air circulation, and overall crop health. A key feature of the system is its smart climate control, which maintains ideal growing conditions by monitoring and adjusting temperature, humidity, and CO2 levels through a network of sensors and automation.

The project also plans to implement a Community Supported Agriculture (CSA) program, which allows local consumers to receive fresh produce directly from the farm, strengthening community ties and supporting local food systems. In summary, the proposed system is a comprehensive, technologically advanced solution that aims to revolutionize the way we grow food in urban areas. By maximizing space, conserving resources, and increasing crop yields, it offers a viable and sustainable alternative to traditional farming practices. Through its emphasis on community engagement and education, the system also seeks to inspire a shift towards more sustainable food practices, promoting greater awareness of local agriculture and food security

Advantage of Proposed System:

1. **Space Optimization**: By growing crops in vertically stacked layers, the system makes efficient use of available space, allowing for the cultivation of more crops in smaller areas. This is particularly advantageous in urban environments where land is limited and expensive.
2. **Water Conservation**: Unlike traditional farming, which relies on extensive water usage, the vertical farming system utilizes hydroponic and aeroponic techniques that consume up to 90% less water. The water recycling mechanism ensures that excess water is captured, purified, and reused, significantly reducing overall water consumption.

3. **Year-Round Crop Production**: The controlled environment allows for the cultivation of crops throughout the year, independent of external weather conditions. This ensures consistent food production and supply, reducing dependency on seasonal changes.
4. **Increased Crop Yield**: By optimizing growing conditions such as light, temperature, and nutrients, the system enhances plant growth, leading to higher yields compared to traditional farming. Plants grow faster and healthier, increasing overall productivity.
5. **Reduction in Pesticides and Chemicals**: The use of Integrated Pest Management (IPM) minimizes the need for chemical pesticides, ensuring that the produce is safer and healthier for consumers. Biological controls and organic treatments are used to manage pests, promoting a more sustainable approach.
6. **Energy Efficiency**: Advanced LED lighting provides the necessary light spectrum for photosynthesis, using less energy compared to traditional farming practices. Renewable energy sources like solar panels can be integrated into the system, further reducing the carbon footprint.
7. **Minimal Environmental Impact**: The system's efficient use of resources—such as water, energy, and nutrients—combined with renewable energy options and waste management practices (like composting and biogas conversion) contribute to a reduced environmental footprint. This promotes sustainable agricultural practices.
8. **Improved Food Security**: Vertical farming can be set up in urban areas close to consumers, reducing the need for long transportation and logistics. This not only lowers transportation costs but also ensures that consumers receive fresh, high-quality produce, improving food security.
9. **Scalability and Flexibility**: The modular design of the vertical farming system allows for easy expansion based on demand. Farms can be customized to grow different types of crops, from leafy greens to fruits and herbs, depending on market needs.
10. **Data-Driven Precision Farming**: Through the use of sensors, automation, and data analytics, farmers can monitor and optimize growing conditions in real-time. This precision farming approach ensures that plants receive the exact amount of nutrients and care they need, minimizing waste and maximizing yield.

SOFTWARE REQUIREMENT SPECIFICATION

INTRODUCTION

The purpose of this document is to present a detailed description of the Web application system. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli. This document is intended for both the stakeholders and the developers of the system and will be proposed to the Regional Historical Society for its approval.

PURPOSE

The purpose of this Software Requirement Specification (SRS) is to help the project. It is provided with some requirements which are used in the Transaction Mercator System. All parts; design, coding and testing will be prepared with helping of SRS. The purpose of this document is to detail the requirements placed on the Transaction Mercator System and serves as a contract between the customer and the developers as to what is to be expected of the stock exchange, and how the components of the system are working with each other with external systems. This document will be checked by the group member's supervisor and it will correct by members if supervisor orders.

DEVELOPERS RESPONSIBILITIES OVERVIEW:

The developer is responsible for:

- Developing the system, which meets the SRS and solving all the requirements of the system?
- Demonstrating the system and installing the system at client's location after the acceptance testing is successful.
- Submitting the required user manual describing the system interfaces to work on it and also the documents of the system.
- Conducting any user training that might be needed for using the system.
- Maintaining the system for a period of one year after installation.

3.1 FUNCTIONAL REQUIREMENTS:

- Following is a list of functionalities of the browsing enabled system.
- An Activity with a UI that allows you to browser settings. Provide a second Activity that allows users to access the share with permission from the administrator. Handle activity lifecycle appropriately. A precondition for any points in this part of the grade is code that compiles and runs.
- Your application should allow a user to browse the shares, buy and sell the shares with specific metadata. The assignment requires you to create a UI for browsing and a UI for integrating the two.
- The Net beans provide a number of useful layout components, views, and tools that you may want to use to create your location browser. As with the final project, you should design your application to only use the buttons on the Key board and mouse as input. Your application should use the Key board, Mouse and keywords.

3.2 NON-FUNCTIONAL REQUIREMENTS:

- The system should be supported Net beans. The member should use the System browser. Each member should have a separate system.
- The system should ask the username and password to open the application. It doesn't permit to unregistered user to access the System.
- The system should have Role based System functions access. Approval Process has to be defined.
- The system should have Modular customization components so that they can be reused across the implementation.
- These are the mainly following:
- Secure access of confidential data. 24 X 7 availability
- Better component design to get better performance at peak time
- Flexible service-based architecture will be highly desirable for future extension

3.3 PERFORMANCE REQUIREMENTS

Performance is measured in terms of the output provided by the application. Requirement specification plays an important part in the analysis of a system. Only when the requirement specifications are properly given, it is possible to design a system, which will fit into required environment. It rests largely in the part of the users of the existing system to give the required specifications because they are the people who finally use the system. This is because the requirements have to be known during the initial stages so that the system can be designed according to those requirements. It is very difficult to change the system once it has been designed and on the other hand designing a system, which does not cater to the requirements of the user, is of no use.

The requirement specification for any system can be broadly stated as given below:

- The system should be able to interface with the existing system
- The system should be accurate
- The system should be better than the existing system

The existing system is completely dependent on the user to perform all the duties.

SYSTEM DEVELOPMENT ENVIRONMENT

4.1 INTRODUCTION TO JAVA

About Java:

Initially the language was called as "oak" but it was renamed as "Java" in 1995.The primary motivation of this language was the need for a platform-independent (i.e. Architecture neutral) language that could be used to create software to be embedded in various consumer electronic devices.

- Java is a programmer's language
- Java is cohesive and consistent
- Except for those constraints imposed by the Internet environment. Java gives the programmer, full control

Finally, Java is for Internet Programming where c was to System Programming.

Importance of Java to the Internet

Java has had a profound effect on the Internet. This is because; Java expands the Universe of objects that can move about freely in Cyberspace. In a network, two categories of objects are transmitted between the server and the personal computer. They are passive information and Dynamic active programs. In the areas of Security and probability. But Java addresses these concerns and by doing so, have opened the door to an exciting new form of program called the Applet.

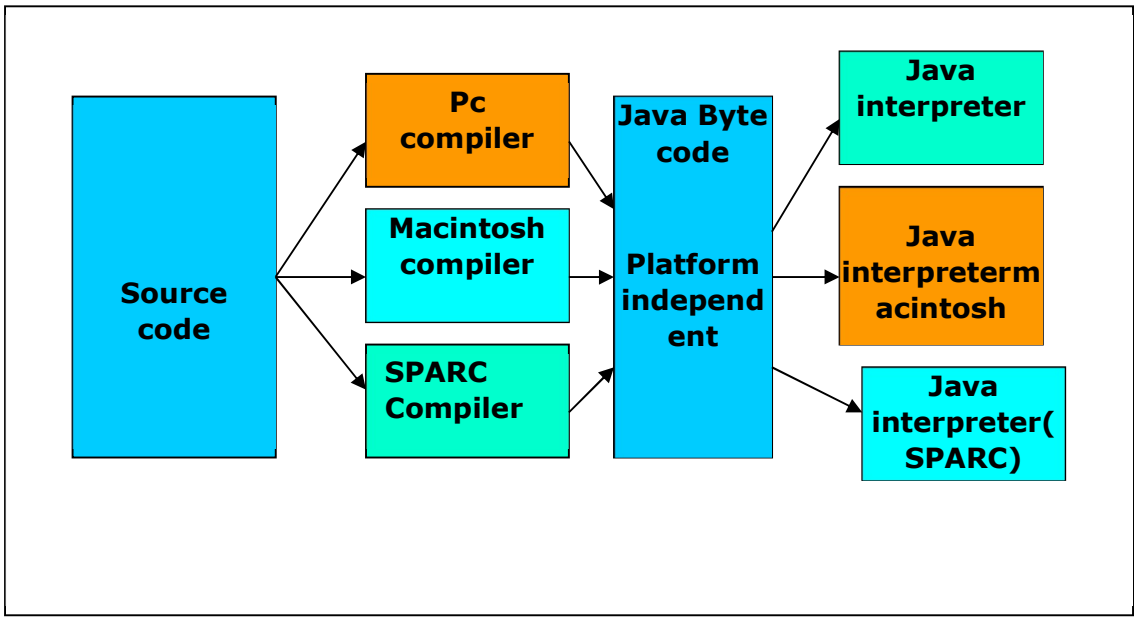
Applications and applets. An application is a program that runs on our computer under the operating system on that computer. It is more or less like one creating, using C or C++.Java's ability to create Applets makes it important. An Applet I son application, designed to be transmitted over the Internet and executed by a Java-compatible web browser. An applet I actually a tiny Java program, dynamically downloaded across the network, just like an image. But the difference is, it is an intelligent program, not just a media file. It can be reacted to the user input and dynamically change.

Java Architecture

Java architecture provides a portable, robust, high performing environment for development. Java provides portability by compiling the byte codes for the Java Virtual Machine, which is then interpreted on each platform by the run-time environment. Java is a dynamic system, able to load code when needed for a machine in the same room or across the planet.

When you compile the code, the Java compiler creates machine code (called byte code) for a hypothetical machine called a Java Virtual Machine (JVM). The JVM is supposed to be executed the byte code. The JVM is created for the overcoming the issue of probability. The code is written and compiled for one machine and interpreted on all machines. This machine is called a Java Virtual Machine.

Compiling and interpreting Java source code.



During run-time the Java interpreter tricks the byte code file into thinking that it is running on a Java Virtual Machine. In reality this could be an Intel Pentium windows 95 or

Sun SPARCstation running Solaris or Apple Macintosh running system and all could receive code from any computer through the internet and run the Applets.

Simple:

Java was designed to be easy for the Professional programmer to learn and to use effectively. If you are an experienced C++ Programmer. Learning Java will orient features of C++. Most of the confusing concepts from C++ are either left out of Java or implemented in a cleaner, more approachable manner. In Java there are a small number of clearly defined ways to accomplish a given task.

Object oriented

Java was not designed to be source-code compatible with any other language. This allowed the Java team the freedom to design with a blank state. One outcome of this was a clean, usable, pragmatic approach to objects. The object model in Java is simple and easy to extend, while simple types, such as integers, are kept as high-performance non-objects.

Robust

The multi-platform environment of the web places extraordinary demands on a program, because the program must execute reliably in a variety of systems. The ability to create robust programs. Was given a high priority in the design of Java. Java is strictly typed language; it checks your code at compile time and runtime.

Java virtually eliminates the problems of memory management and deal location, which is completely automatic. In a well-written Java program, all run-time errors can and should be managed by your program.

4.2 SERVLETS/JSP

A Servlet is a generic server extension. Java classes that can be loaded dynamically to expand the functionality of a server. Servlets are commonly used with web servers. Where they can take the place CGI scripts.

A Servlet is similar to proprietary server extension, except that it runs inside a Java Virtual Machine (JVM) on the server, so it is safe and portable Servlets operate solely within the domain of the server.

Unlike CGI and Fast CGI, which use multiple processes to handle separate program or separate requests, separate threads within the web server process handle all servlets. This means that servlets are all efficient and scalable.

Servlets are portable; both across operating systems and also across web servers. Java Servlets offer the best possible platform for web application development.

Servlets are used as a replacement for CGI scripts on a web server; they can extend any sort of server, such as a mail server that allows servlets extend its functionality, perhaps by performing a virus scan on all attached documents or handling mail filtering tasks.

Servlets are objects that conform to a specific interface that can be plugged into a Java-based server. Servlets are to the server-side what applets are to the server-side what applets are to the client-side-object byte codes that can be dynamically loaded off the net. They differ from applets in than they are faceless objects (without graphics or a GUI component). They serve as platform independent, dynamically loadable, pluggable helper byte code objects on the server side that can be used to dynamically extend server-side functionality.

Attractiveness of servlets:

They are many features of servlets that make them easy and attractive to use these include:

- Easily configure using the GUI-based Admin tool]
- Can Be Loaded and Invoked from a local disk or remotely across the network.
- Can be linked together or chained, so that on servlet can call another servlet or several servlets in sequence.
- Can be called dynamically from within HTML, pages using server-side include-tags.
- Are secure-even when downloading across the network, the servlet security model and servlet and box protect your system from unfriendly behavior.

Advantages of the Servlet API

One of the great advantages of the servlet API is protocol independent. It assumes nothing about:

- The protocol being used to transmit on the net
- How it is loaded
- The server environment it will be running in

These quantities are important, because it allows the Servlet API to be embedded in many different kinds of servers.

There are other advantages to the servlet API as well these include:

- It's extensible-you can inherit all your functionality from the base classes made available to you
- It's small, simple, and easy to use.

Features of Servlets:

- Servlets are persistent. Servlet is loaded only by the web server and can maintain services between requests.
- Servlets are fast. Since servlets only need to be l\loaded once, they offer much better performance over their CGI counterparts.
- Servlets are platform independent.
- Servlets are extensible Java is a robust, object-oriented programming language, which easily can be extended to suit your needs.
- Servlets are secure
- Servlets are used with a variety of clients.

Every servlet must implement the javax. servlet interface. Most servlets implement it by extending one of two classes.javax.servlet.Generic Servlet or javax.servlet.http.HttpServlet. A protocol-independent servlet should subclass Generic-Servlet. While an Http servlet should subclass HTTP Servlet, which is itself a subclass of Generic-servlet with added HTTP-specific functionality.

4.3 JDBC

What is JDBC?

Any relational database. One can write a single program using the JDBC API, and the JDBC is a Java Api for executing SQL, Statements (As a point of interest JDBC are trademarks names and is not an acronym; nevertheless, Jdbc is often thought of as standing for Java Database Connectivity. It consists of a set of classes and interfaces written in the Java Programming language. JDBC provides a standard API for tool/database developers and makes it possible to write database applications using a pure Java API

Using JDBC, it is easy to send SQL statements to virtually program will be able to send SQL Statements to the appropriate database. The Combination of Java and JDBC lets a programmer writes it once and run it anywhere.

What Does JDBC Do?

Simply put, JDBC makes it possible to do three things

- Establish a connection with a database
- Send SQL statements
- Process the results
- JDBC Driver Types
- The JDBC drivers that we are aware of this time fit into one of four categories
- JDBC-ODBC Bridge plus ODBC driver
- Native-API party-Java driver
- JDBC-Net pure Java driver
- Native-protocol pure Java driver

An individual database system is accessed via a specific JDBC driver that implements the java.sql.Driver interface. Drivers exist for nearly all-popular RDBMS systems, through few are available for free. Sun bundles a free JDBC-ODBC bridge driver with the JDK to allow access to a standard ODBC, data sources, such as a Microsoft Access database, Sun advises against using the bridge driver for anything other than development and very limited development.

4.4 HTML

Hypertext Markup Language (HTML), the languages of the World Wide Web (WWW), allows users to produce web pages that included text, graphics and pointer to other web pages (Hyperlinks).

HTML is not a programming language, but it is an application of ISO Standard 8879, SGML (Standard Generalized Markup Language), but specialized to hypertext and adapted to the Web. The idea behind Hypertext one point to another point. We can navigate through the information based on out interest and preference. A markup language is simply a series of items enclosed within the elements should be displayed. Hyperlinks are underlined or emphasized works that load to other documents or some portions of the same document.

HTML can be used to display any type of document on the host computer, which can be geographically at a different location. It is a versatile language and can be used on any platform or desktop .HTML provides tags (special codes) to make the document look attractive. HTML provides are not case-sensitive. Using graphics, fonts, different sizes, color, etc., can enhance the presentation of the document. Anything that is not a tag is part of the document itself.

Basic Html Tags:

<! -- -->	Specific Comments.
<A>……</A>	Creates Hypertext links.
<B>……</B>	Creates hypertext links.
<Big>……...</Big>	Formats text in large-font
<Body>……. </Body>	contains all tags and text in the Html-document
<Center>……</Center>	Creates Text
<DD>……...</DD>	Definition of a term.
<TABLE>…… </TABLE>	creates a table
<Td>……...</Td>	indicates table data in a table.
<Tr>……...</Tr>	designates a table row
<Th>……. </Th>	creates a heading in a table.

4.5 JAVA SCRIPT

The Java Script Language

JavaScript is a compact, object-based scripting language for developing client and server internet applications. Netscape Navigator 2.0 interprets JavaScript statements embedded directly in an HTML page. And Livewire enables you to create server-based applications similar to common gateway interface (CGI) programs.

In a client application for Navigator, JavaScript statements embedded in an HTML Page can recognize and respond to user events such as mouse clicks form input, and page navigation.

For example, you can write a JavaScript function to verify that users enter valid information into a form requesting a telephone number or zip code. Without any network transmission, an Html page with embedded Java Script can interpret the entered text and alert the user with a message dialog if the input is invalid or you can use JavaScript to perform an action (such as play an audio file, execute an applet, or communicate with a plug-in) in response to the user opening or exiting a page.

SYSTEM DESIGN

5.1 INTRODUCTION

This project is dedicated to transforming traditional agricultural practices through the implementation of vertical farming, a cutting-edge approach that allows for the efficient planting and cultivation of a diverse range of fruits and vegetables. Utilizing three innovative methods—hydroponics, aeroponics, and aquaponics—this initiative aims to maximize yield while significantly reducing resource consumption in terms of time and space. The result is a higher output of nutrient-rich produce, essential for meeting the growing demand for healthy food options in urban environments. The process begins by capturing client requests and conducting a thorough assessment of product availability. This step ensures that the cultivation strategies align with market demand, allowing for a more responsive and efficient production cycle. Once requests are registered, the project implements advanced cultivation techniques to optimize growth conditions, such as tailored nutrient solutions, climate control systems, and automated monitoring.

This level of precision in the cultivation phase is critical for ensuring that the plants thrive in a controlled environment, leading to increased productivity. In the harvesting module, efficiency and timing are paramount. Careful planning allows for the collection of produce at its peak quality, enhancing both flavor and nutritional value. Rigorous testing protocols are then conducted to analyze the nutrient content and safety of the harvested fruits and vegetables. These tests are essential for ensuring that all produce meets health standards, providing consumers with confidence in the safety and quality of their food.

MODULES:

1. Admin.
2. Inventory Status.
3. Crop Cultivation.
4. Harvest Schedule
5. Testing

5.2 MODULE DESCRIPTION

MODULE 1: ADMIN

The ADMIN module is designed to facilitate the management of client requests and monitor employee status within the system. With this module, the ADMIN can upload client requests, ensuring all necessary information is captured for efficient processing. A user-friendly interface allows the ADMIN to view submitted client requests, complete with status updates and detailed information, while filters and search functionalities enable quick access to specific requests based on various criteria. The ADMIN has the authority to check employee status and approve or reject updates based on performance evaluations and client feedback. This decision-making process includes automated email notifications to inform employees of their approval or rejection status, utilizing customizable templates for consistent communication.

Additionally, the module provides the ability to generate and view comprehensive reports summarizing activities, client requests, and employee performance, often accompanied by visual representations for easier data interpretation. After reviewing reports, the ADMIN can approve the results from various modules, ensuring accuracy and accountability while offering remarks or suggestions for improvement. Finally, the module includes a secure logout feature to protect sensitive information, confirming that only authorized personnel can access ADMIN functions. Overall, the ADMIN module streamlines the workflow, enhances communication, and ensures that client requests and employee statuses are managed effectively.

MODULE 2: INVENTORY STATUS

The Inventory Status module is designed to streamline the management of inventory requests and daily reporting for fruits and vegetables. Initially, users must register their requests within the system, which then require approval from the ADMIN. Upon submission, users await an email notification confirming whether their request has been approved. Once approved, users will receive a password from the ADMIN, enabling them to log in securely to the system. Upon logging in, users can access the Request Overview, which provides a comprehensive view of all client requests and their statuses. This overview helps users track the progress of their requests and facilitates communication with the ADMIN. Additionally, users are required to upload daily reports detailing the production rates of fruits and vegetables.

These reports not only reflect current inventory levels but also provide insights into production efficiency. After reviewing the daily reports uploaded by themselves or others, users can conduct necessary calculations to assess the availability of fruits and vegetables in stock. This includes analyzing production rates and determining the quantities of various items currently on hand. Finally, users compile their findings into a comprehensive report, which is then uploaded to the database for future reference and analysis

MODULE 3: CROP CULTIVATION

The Crop Cultivation module is designed to facilitate the effective management of crop growth and production tracking. Initially, users must register their cultivation requests within the system, which then undergoes a review process by the ADMIN. After submission, users await an email notification to confirm whether their request has been approved. Upon receiving approval, users will be issued a password by the ADMIN, allowing them to log in securely to the system. Once logged in, users can access the Request Overview, which provides critical insights into the Inventory Status, including detailed reports on the types and quantities of crops required for cultivation. This overview is essential for users to understand the availability of resources necessary for successful crop growth.

After reviewing the Inventory Status, users are responsible for uploading data regarding the number of fruits and vegetables that have recently been grown, are currently growing, or are in the planting phase. This information is vital for tracking progress and ensuring optimal crop management. Following data entry, users engage in necessary processing to analyze growth rates and overall production. Finally, they compile their findings into a comprehensive report, which is then uploaded to the system for future reference and evaluation. The Crop Cultivation module enhances operational efficiency, supports informed decision-making, and fosters accountability in crop management processes

MODULE 4: HARVEST SCHEDULE

The Harvest Schedule module is designed to streamline the management and scheduling of crop harvesting processes. Initially, users must register their harvesting requests within the system, which then require ADMIN approval. After submitting a request, users will receive an email notification indicating whether their request has been approved.

Once approved, they are provided with a password by the ADMIN, enabling secure login to the system. Upon logging in, users can access the Request Overview, which includes crucial data reports from the Crop Cultivation module. This overview allows users to review essential information regarding crop status, growth progress, and anticipated harvest timelines. Armed with this data, users can then upload details related to their upcoming harvests, including expected yields and harvesting schedules.

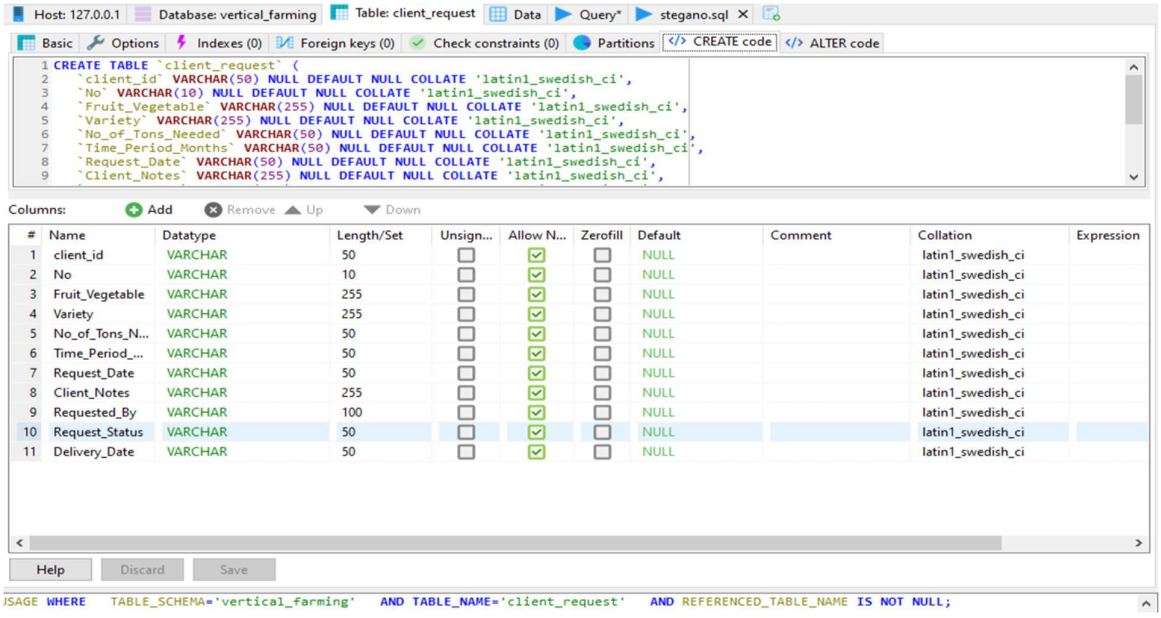
After inputting the necessary information, users engage in processing to analyze the data further and optimize their harvesting strategies. Finally, they compile their findings into a comprehensive report, which is then uploaded to the database for record-keeping and future reference. The Harvest Schedule module enhances operational efficiency, improves communication among stakeholders, and ensures a well-organized approach to managing harvest activities.

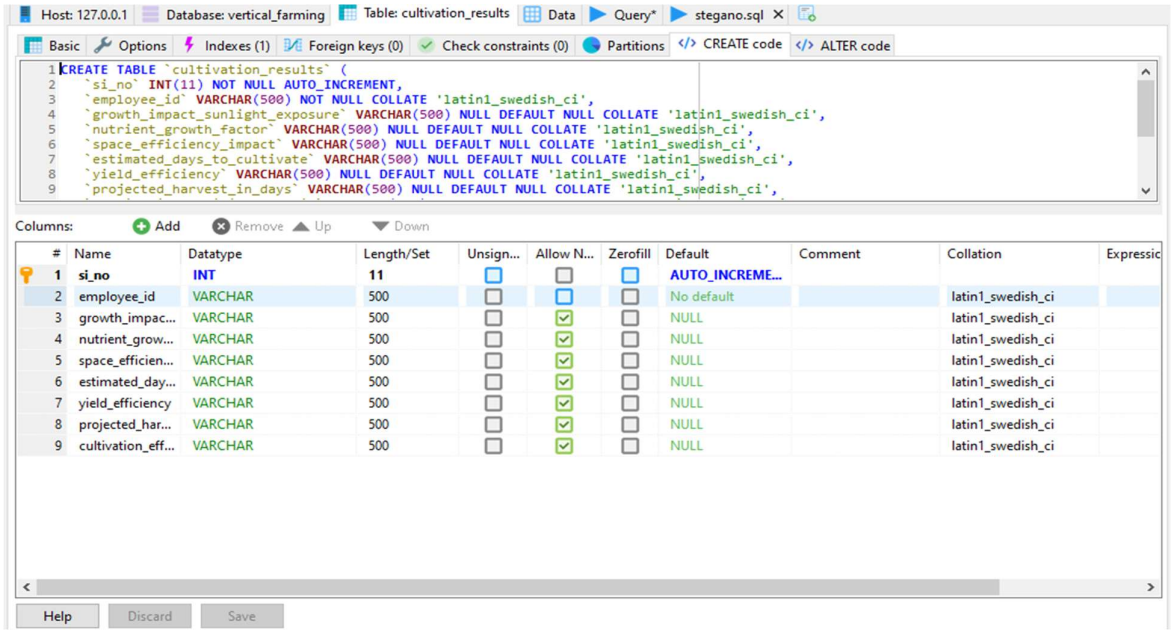
MODULE 5: TESTING

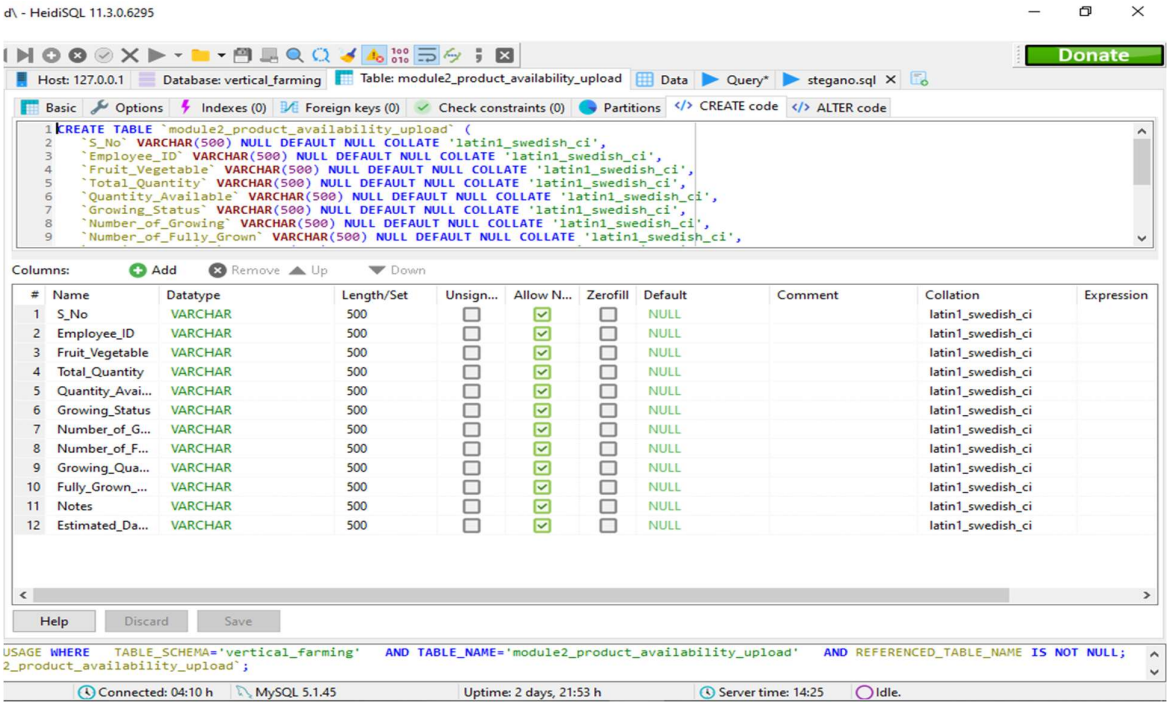
The Testing module is designed to facilitate the systematic evaluation of crop harvesting processes and results. Users must begin by registering their testing requests within the system, which subsequently requires approval from the ADMIN. After submitting their request, users will receive an email notification informing them of the approval status. Once approved, users are provided with a password by the ADMIN, enabling them to securely log into the system. Upon logging in, users can access the Request Overview, which contains critical data reports related to harvesting activities.

This overview allows users to review important information regarding harvest outcomes, yields, and overall crop performance. After analyzing this data, users are required to upload relevant testing data, which may include results from various evaluations conducted on the harvested crops. Following the data upload, users engage in processing to interpret the results and derive meaningful insights. This analysis culminates in the creation of a comprehensive report that summarizes the testing outcomes. Finally, users upload this report to the database, ensuring that all findings are documented and accessible for future reference. The Testing module enhances the rigor and reliability of crop evaluation processes, fostering informed decision-making and continuous improvement in agricultural practices.

5.3 DATABASE SCREENSHORTS:






d\ - HeidiSQL 11.3.0.6295
Donate
Host: 127.0.0.1
Database: vertical_farming
Table: module2_product_availability_upload
Data
Query*
stegano.sql
Basic
Options
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Foreign keys (0)
Check constraints (0)
Partitions
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ALTER code
CREATE TABLE `module2_product_availability_upload` (
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`Employee_ID` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Fruit_Vegetable` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Total_Quantity` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Quantity_Available` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Growing_Status` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Number_of_Growing` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Number_of_Fully_Grown` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expression
1 S_No VARCHAR 500 NULL latin1_swedish_ci
2 Employee_ID VARCHAR 500 NULL latin1_swedish_ci
3 Fruit_Vegetable VARCHAR 500 NULL latin1_swedish_ci
4 Total_Quantity VARCHAR 500 NULL latin1_swedish_ci
5 Quantity_Avai... VARCHAR 500 NULL latin1_swedish_ci
6 Growing_Status VARCHAR 500 NULL latin1_swedish_ci
7 Number_of_G... VARCHAR 500 NULL latin1_swedish_ci
8 Number_of_F... VARCHAR 500 NULL latin1_swedish_ci
9 Growing_Qua... VARCHAR 500 NULL latin1_swedish_ci
10 Fully_Grown_... VARCHAR 500 NULL latin1_swedish_ci
11 Notes VARCHAR 500 NULL latin1_swedish_ci
12 Estimated_Da... VARCHAR 500 NULL latin1_swedish_ci
Help
Discard
Save
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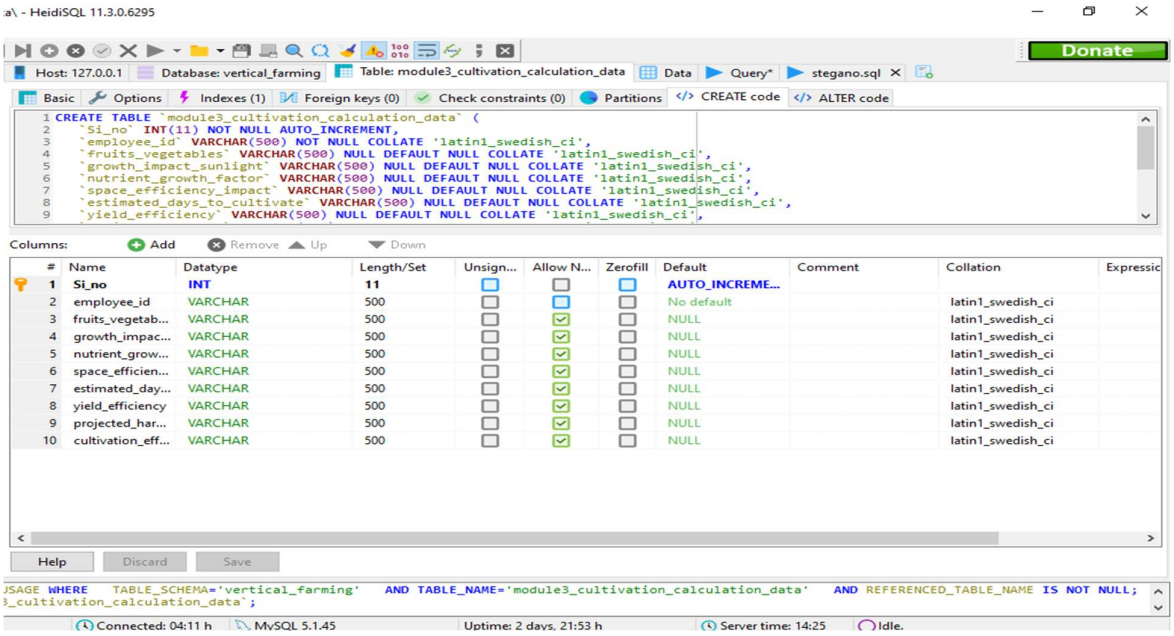
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Data
Query*
stegano.sql
Basic
Options
Indexes (1)
Foreign keys (0)
Check constraints (0)
Partitions
CREATE code
ALTER code
CREATE TABLE `module3_cultivation_calculation_data` (
`Si_no` INT(11) NOT NULL AUTO_INCREMENT,
`employee_id` VARCHAR(500) NOT NULL COLLATE 'latin1_swedish_ci',
`fruits_vegetables` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`growth_impact_sunlight` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`nutrient_growth_factor` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`space_efficiency_impact` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`estimated_days_to_cultivate` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`yield_efficiency` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expressic
1 Si_no INT 11 AUTO_INCREME...
2 employee_id VARCHAR 500 No default latin1_swedish_ci
3 fruits_vegetab... VARCHAR 500 NULL latin1_swedish_ci
4 growth_impac... VARCHAR 500 NULL latin1_swedish_ci
5 nutrient_grow... VARCHAR 500 NULL latin1_swedish_ci
6 space_efficien... VARCHAR 500 NULL latin1_swedish_ci
7 estimated_day... VARCHAR 500 NULL latin1_swedish_ci
8 yield_efficiency VARCHAR 500 NULL latin1_swedish_ci
9 projected_har... VARCHAR 500 NULL latin1_swedish_ci
10 cultivation_eff... VARCHAR 500 NULL latin1_swedish_ci
Help
Discard
Save
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Server time: 14:25
Idle.

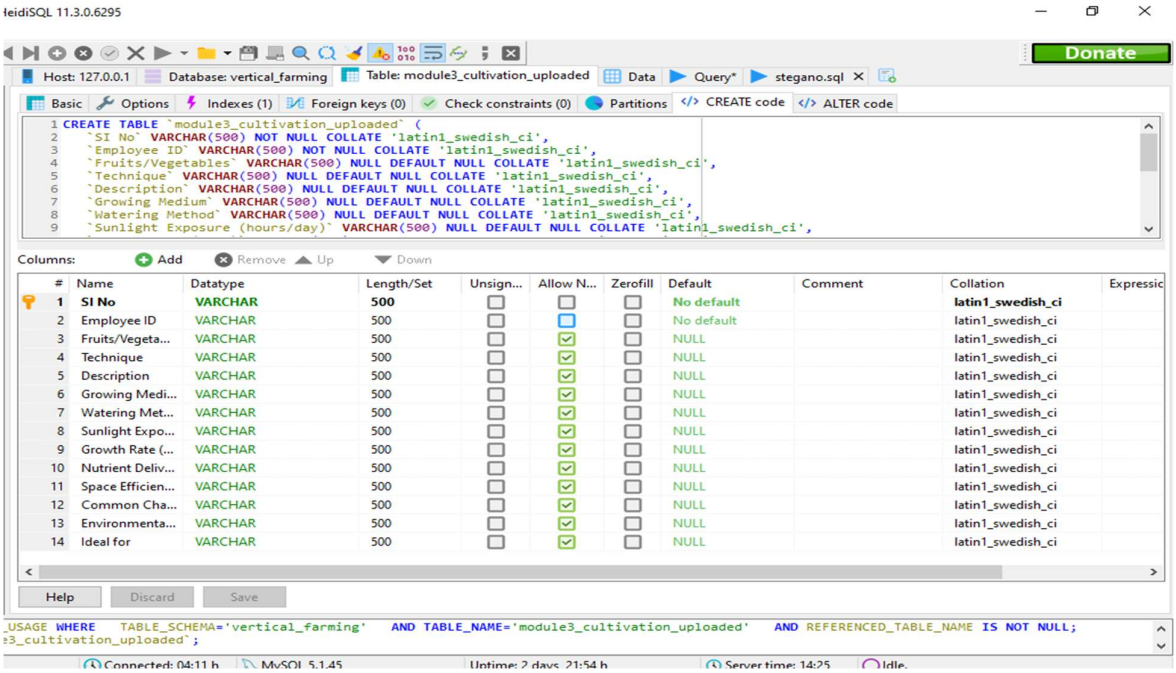
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Table: module3_cultivation_uploaded
Data
Query*
stegano.sql
Basic
Options
Indexes (1)
Foreign keys (0)
Check constraints (0)
Partitions
CREATE code
ALTER code
CREATE TABLE `module3_cultivation_uploaded` (
`Sl No` VARCHAR(500) NOT NULL COLLATE 'latin1_swedish_ci',
`Employee ID` VARCHAR(500) NOT NULL COLLATE 'latin1_swedish_ci',
`Fruits/Vegetables` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Technique` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Description` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Growing Medium` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Watering Method` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`Sunlight Exposure (hours/day)` VARCHAR(500) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expressic
1 Sl No VARCHAR 500 No default latin1_swedish_ci
2 Employee ID VARCHAR 500 No default latin1_swedish_ci
3 Fruits/Vegeta... VARCHAR 500 NULL latin1_swedish_ci
4 Technique VARCHAR 500 NULL latin1_swedish_ci
5 Description VARCHAR 500 NULL latin1_swedish_ci
6 Growing Medi... VARCHAR 500 NULL latin1_swedish_ci
7 Watering Met... VARCHAR 500 NULL latin1_swedish_ci
8 Sunlight Expo... VARCHAR 500 NULL latin1_swedish_ci
9 Growth Rate (... VARCHAR 500 NULL latin1_swedish_ci
10 Nutrient Deliv... VARCHAR 500 NULL latin1_swedish_ci
11 Space Efficien... VARCHAR 500 NULL latin1_swedish_ci
12 Common Cha... VARCHAR 500 NULL latin1_swedish_ci
13 Environmenta... VARCHAR 500 NULL latin1_swedish_ci
14 Ideal for VARCHAR 500 NULL latin1_swedish_ci
Help
Discard
Save
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MySQL 5.1.45
Uptime: 2 days, 21:54 h
Server time: 14:25
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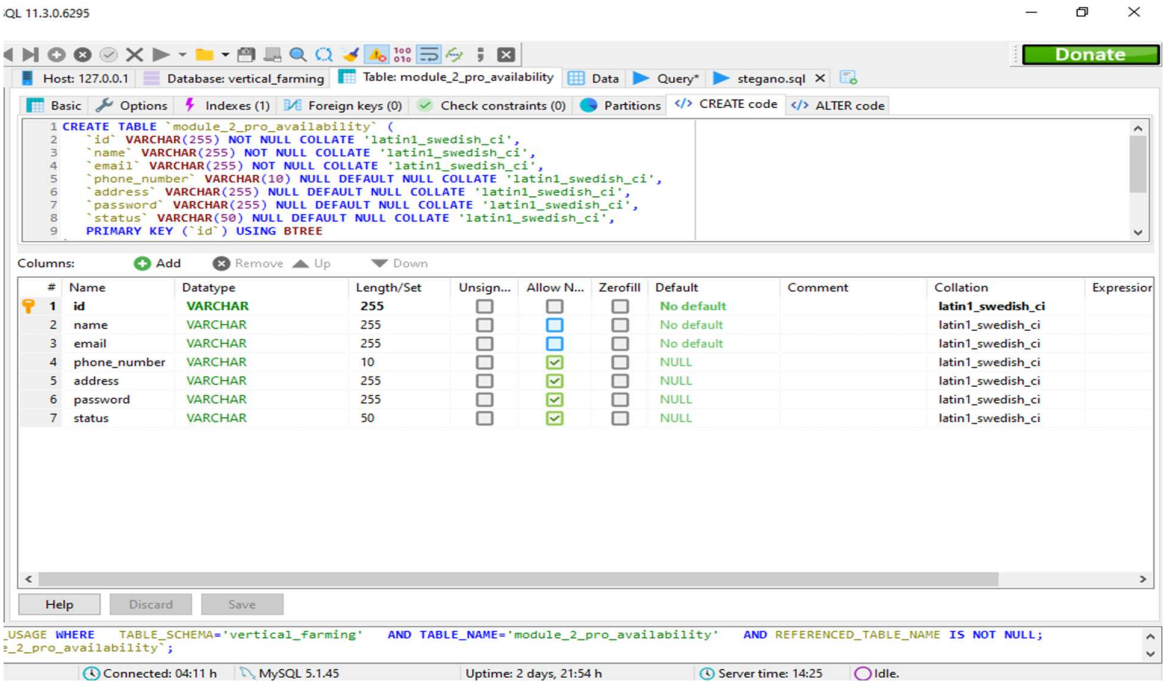
QL 11.3.0.6295
Donate
Host: 127.0.0.1
Database: vertical_farming
Table: module_2_pro_availability
Data
Query*
stegano.sql
Basic
Options
Indexes (1)
Foreign keys (0)
Check constraints (0)
Partitions
CREATE code
ALTER code
CREATE TABLE `module_2_pro_availability` (
`id` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`name` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`email` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`phone_number` VARCHAR(10) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`address` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`password` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`status` VARCHAR(50) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
PRIMARY KEY (`id`) USING BTREE
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expressior
1 id VARCHAR 255 No default latin1_swedish_ci
2 name VARCHAR 255 No default latin1_swedish_ci
3 email VARCHAR 255 No default latin1_swedish_ci
4 phone_number VARCHAR 10 NULL latin1_swedish_ci
5 address VARCHAR 255 NULL latin1_swedish_ci
6 password VARCHAR 255 NULL latin1_swedish_ci
7 status VARCHAR 50 NULL latin1_swedish_ci
Help
Discard
Save
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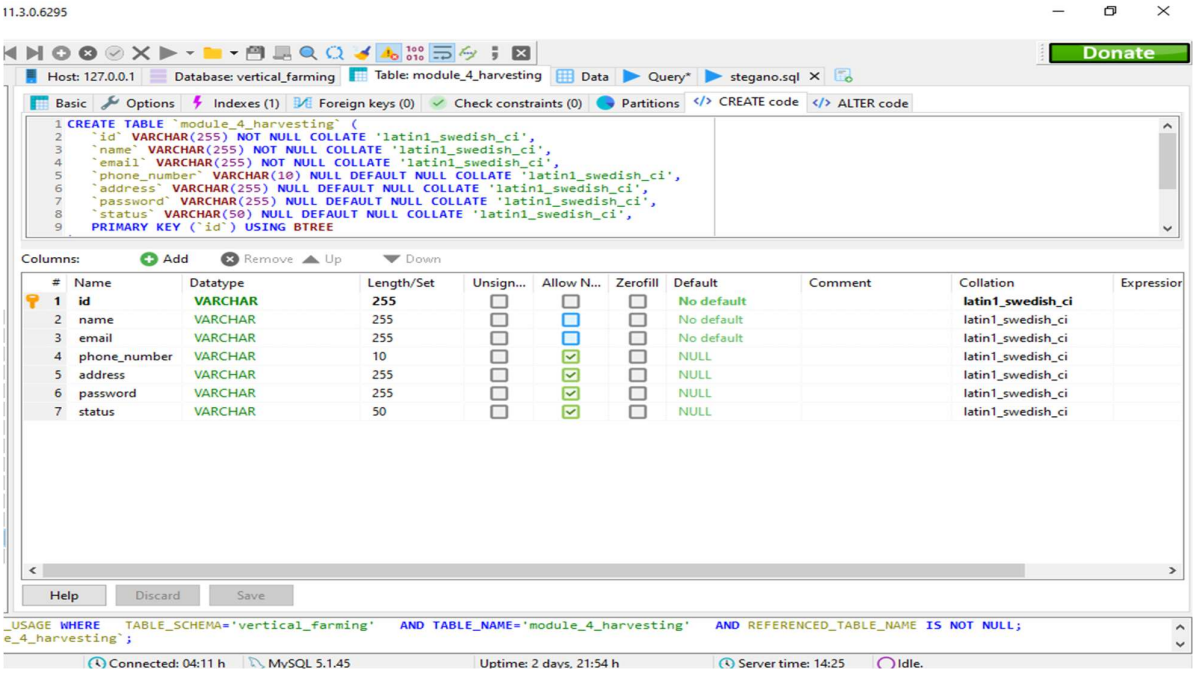
MySQL 5.1.45
Uptime: 2 days, 21:54 h
Server time: 14:25
Idle.


11.3.0.6295
Donate
Host: 127.0.0.1
Database: vertical_farming
Table: module_4_harvesting
Data
Query*
stegano.sql
Basic
Options
Indexes (1)
Foreign keys (0)
Check constraints (0)
Partitions
CREATE code
ALTER code
CREATE TABLE `module_4_harvesting` (
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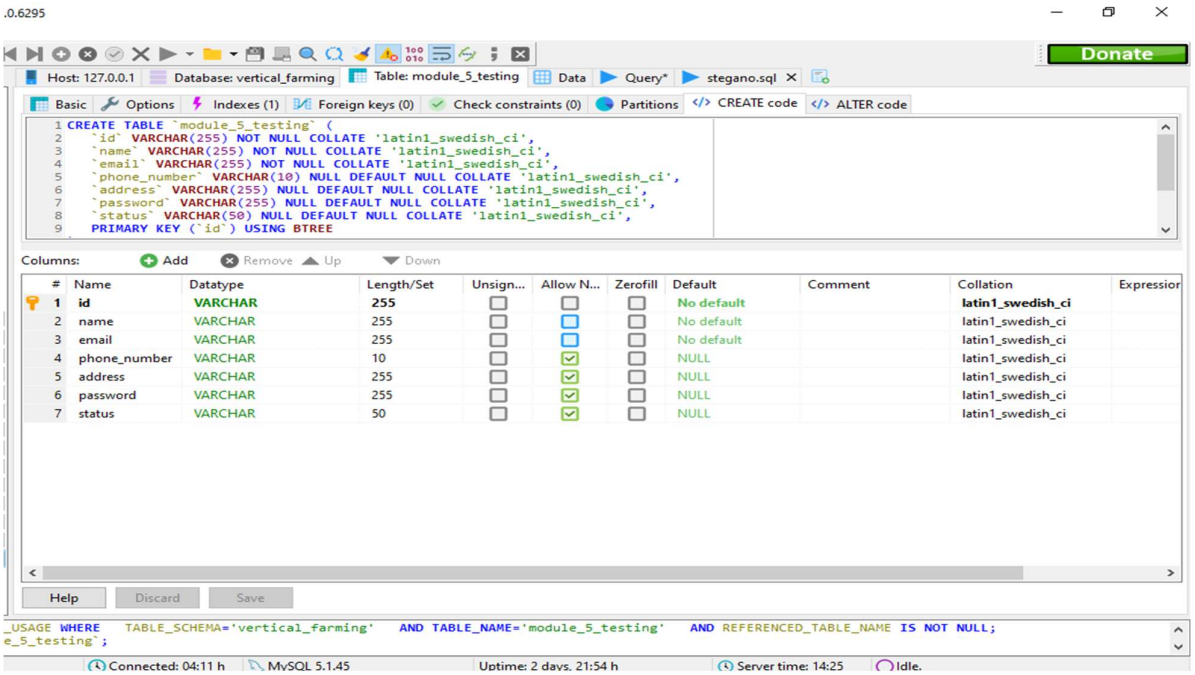
`name` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`email` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`phone_number` VARCHAR(10) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`address` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`password` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`status` VARCHAR(50) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
PRIMARY KEY (`id`) USING BTREE
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expressior
1 id VARCHAR 255 No default latin1_swedish_ci
2 name VARCHAR 255 No default latin1_swedish_ci
3 email VARCHAR 255 No default latin1_swedish_ci
4 phone_number VARCHAR 10 NULL latin1_swedish_ci
5 address VARCHAR 255 NULL latin1_swedish_ci
6 password VARCHAR 255 NULL latin1_swedish_ci
7 status VARCHAR 50 NULL latin1_swedish_ci
Help
Discard
Save
_USAGE WHERE TABLE_SCHEMA='vertical_farming' AND TABLE_NAME='module_4_harvesting' AND REFERENCED_TABLE_NAME IS NOT NULL;
e_4_harvesting`;
Connected: 04:11 h
MySQL 5.1.45
Uptime: 2 days, 21:54 h
Server time: 14:25
Idle.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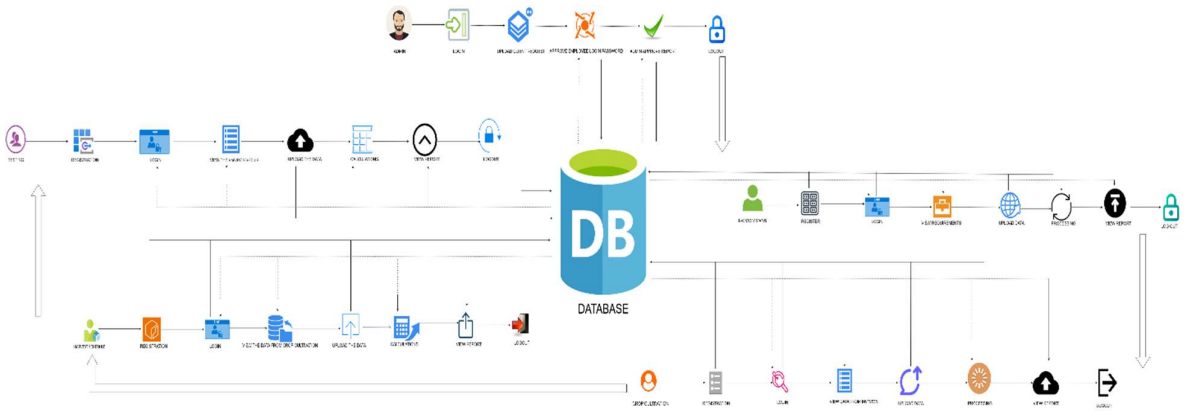
Donate
Host: 127.0.0.1
Database: vertical_farming
Table: module_5_testing
Data
Query*
stegano.sql
Basic
Options
Indexes (1)
Foreign keys (0)
Check constraints (0)
Partitions
CREATE code
ALTER code
CREATE TABLE `module_5_testing` (
`id` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`name` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`email` VARCHAR(255) NOT NULL COLLATE 'latin1_swedish_ci',
`phone_number` VARCHAR(10) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`address` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`password` VARCHAR(255) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
`status` VARCHAR(50) NULL DEFAULT NULL COLLATE 'latin1_swedish_ci',
PRIMARY KEY (`id`) USING BTREE
Columns:
Add
Remove
Up
Down
Name Datatype Length/Set Unsign... Allow N... Zerofill Default Comment Collation Expressior
1 id VARCHAR 255 No default latin1_swedish_ci
2 name VARCHAR 255 No default latin1_swedish_ci
3 email VARCHAR 255 No default latin1_swedish_ci
4 phone_number VARCHAR 10 NULL latin1_swedish_ci
5 address VARCHAR 255 NULL latin1_swedish_ci
6 password VARCHAR 255 NULL latin1_swedish_ci
7 status VARCHAR 50 NULL latin1_swedish_ci
Help
Discard
Save
_USAGE WHERE TABLE_SCHEMA='vertical_farming' AND TABLE_NAME='module_5_testing' AND REFERENCED_TABLE_NAME IS NOT NULL;
e_5_testing`;
Connected: 04:11 h
MySQL 5.1.45
Uptime: 2 days, 21:54 h
Server time: 14:25
Idle.

5.4 SYSTEM ARCHITECTURE:



5.5 E–R DIAGRAMS

- The relation upon the system is structured through a conceptual ER-Diagram, which not only specifics the existing entities, but also the standard relations through which the system exists and the cardinalities that are necessary for the system state to continue.
- The Entity Relationship Diagram (ERD) depicts the relationship between the data objects. The ERD is the notation that is used to conduct, the date modeling activity the attributes of each data object noted, is the ERD can be described resign a data object description.
- The set of primary components that are identified by the ERD are
    - Data object
    - Relationships
    - Attributes
    - Various types of indicators.

The primary purpose of the ERD is to represent data objects and their relationships.

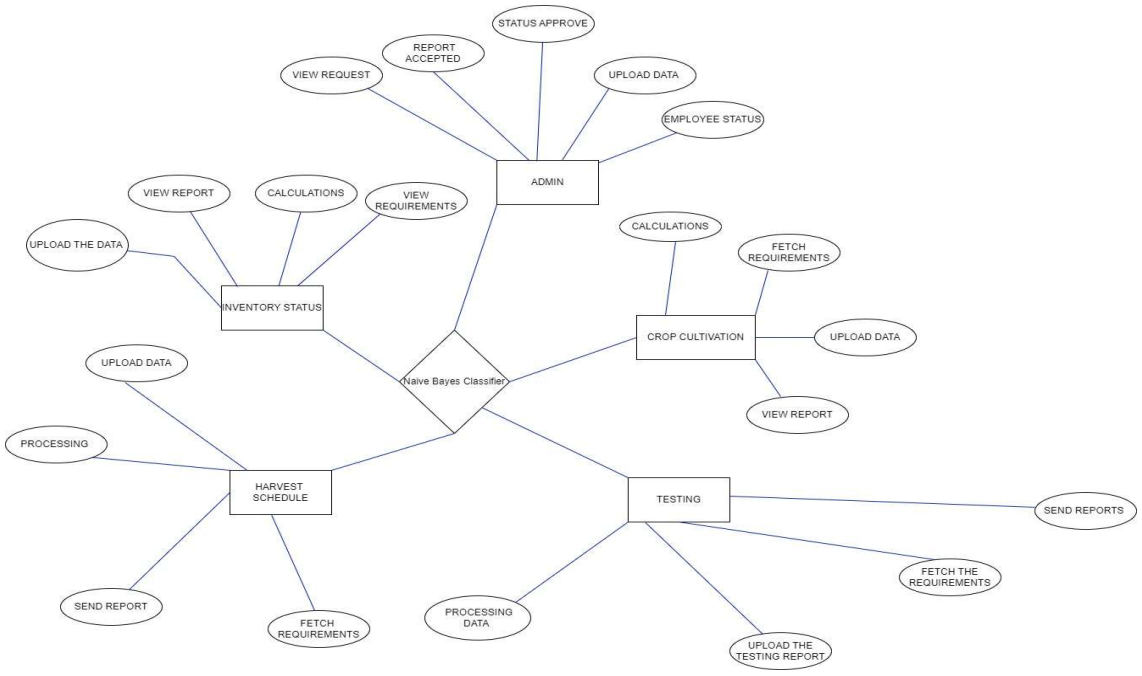
5.6 FLOW DIAGRAMS

A data flow diagram is a graphical tool used to describe and analyze the movement of data through a system. These are the central tool and the basis from which the other components are developed. The transformation of data from input to output through processing, may be described logically and independently of physical components associated with the system. These are known as the logical data flow diagrams. The physical data flow diagrams show the actual implements and movement of data between people, departments and workstations. A full description of a system actually consists of a set of data flow diagrams.

The idea behind the explosion of a process into more process is that understanding at one level of detail is exploded into greater detail at the next level. This is done until further explosion is necessary and an adequate amount of detail is described for analysts to understand the process.

Larry Constantine first developed the DFD as a way of expressing system requirements in a graphical form, this led to the modular design.

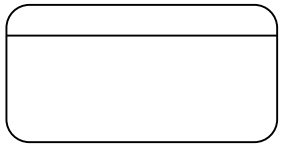
So, it is the starting point of the design to the lowest level of detail. A DFD consists of a series of bubbles joined by data flows in the system.



5.7 DFD SYMBOLS

In the DFD, there are four symbols

1. A square defines a source (originating) or destination of system data
2. An arrow identifies data flow. It is the pipeline through which the information flows
3. A circle or a bubble represents a process that transforms the incoming data flow into outgoing data flows.
4. An open rectangle is a data store, data at rest or a temporary repository of data



A process that transforms the data flow

Source or Destination of data

Data flow

Data Store

CONSTRUCTING A DFD:

Several rules of thumb are used in drawing DFD'S:

1. Process should be named and numbered for an easy reference. Each name should be representative of the process.
2. The direction of flow is from top to bottom and from left to right. Data traditionally flow from source to the destination although they may flow back to the source. One way to indicate this is to draw the long flow line back to a source. An alternative way is to repeat the source symbol as a destination. Since it is used more than once in the DFD it is marked with a short diagonal.
3. When a process is exploded into lower-level details, they are numbered.
4. The names of data stores and destinations are written in capital letters. Process and dataflow names have the first letter of each work capitalized

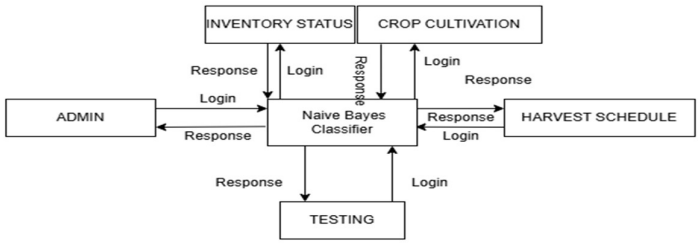
DATA FLOW

1) A Data Flow has only one direction of flow between symbols. It may flow in both directions between a process and a data store to show a read before an update. The latter is usually indicated, however by two separate arrows since these happen at different type.
2) A join in DFD means that exactly the same data comes from any of two or more different processes data store or sink to a common location.
3) A data flow cannot go directly back to the same process it leads. There must be at least one other process that handles the data flow produce some other data flow returns the original data in the beginning process.
4) A Data flow to a data store means update (delete or change).
5) A data Flow from a data store means retrieve or use.

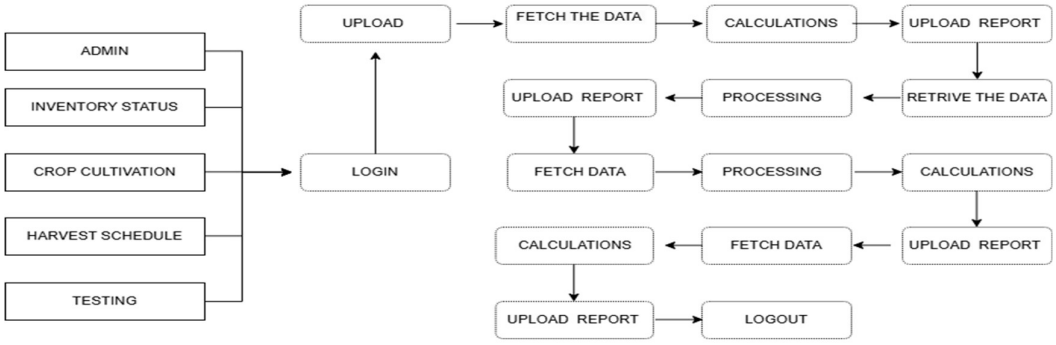
A data flow has a noun phrase label more than one data flow noun phrase can appear on a single arrow as long as all of the flows on the same arrow move together as one package.

5.8 ACTIVITY DIAGRAM

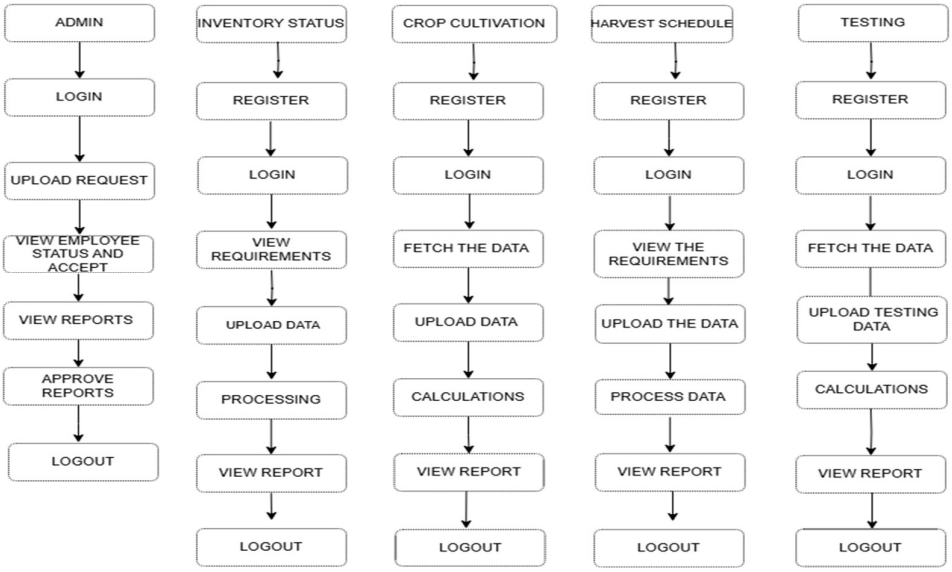
LEVEL 0



LEVEL 1

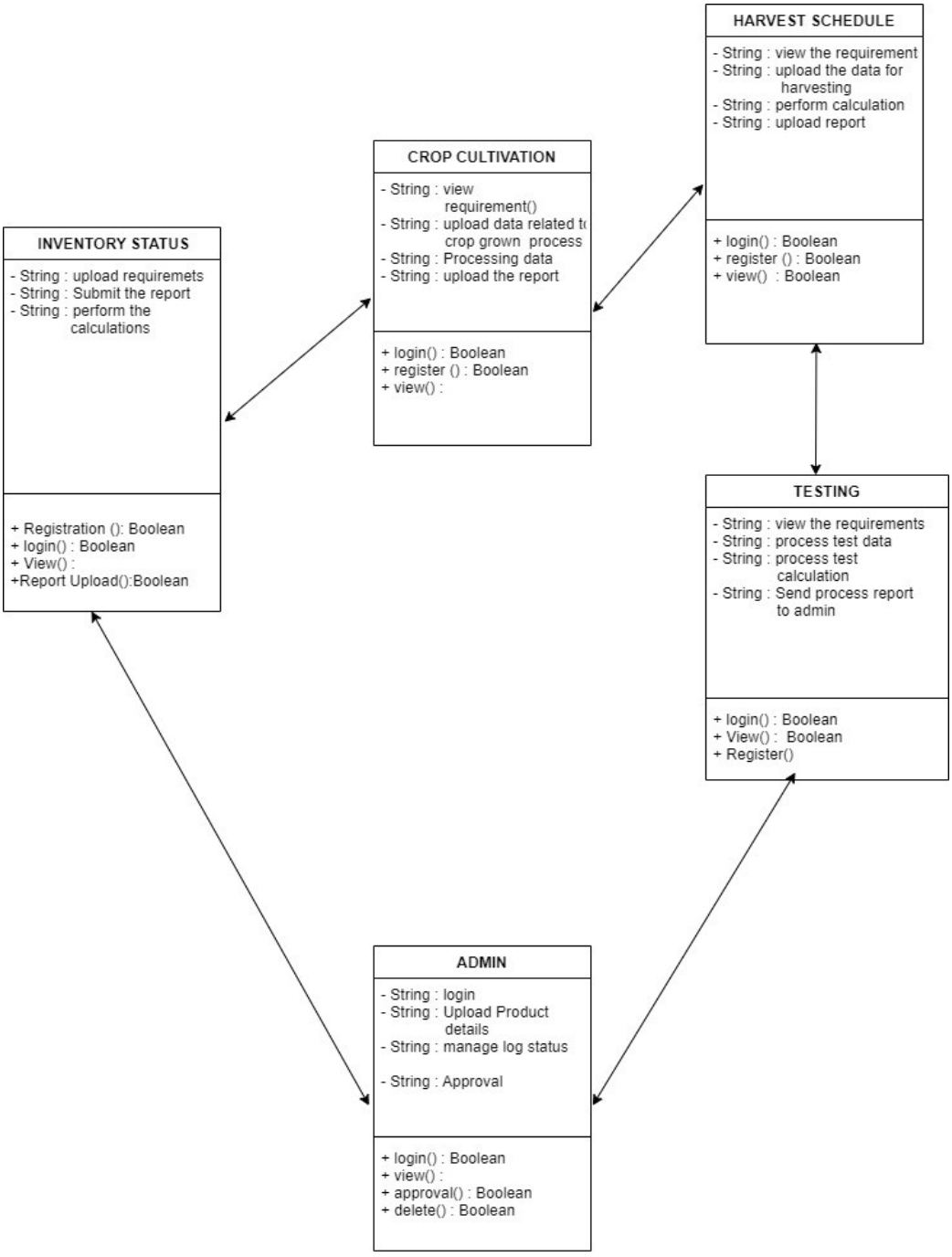


LEVEL 2



5.9 USE CASE DIAGRAM

5.10 CLASS DIAGRAM



SYSTEM TESTING AND IMPLEMENTATION

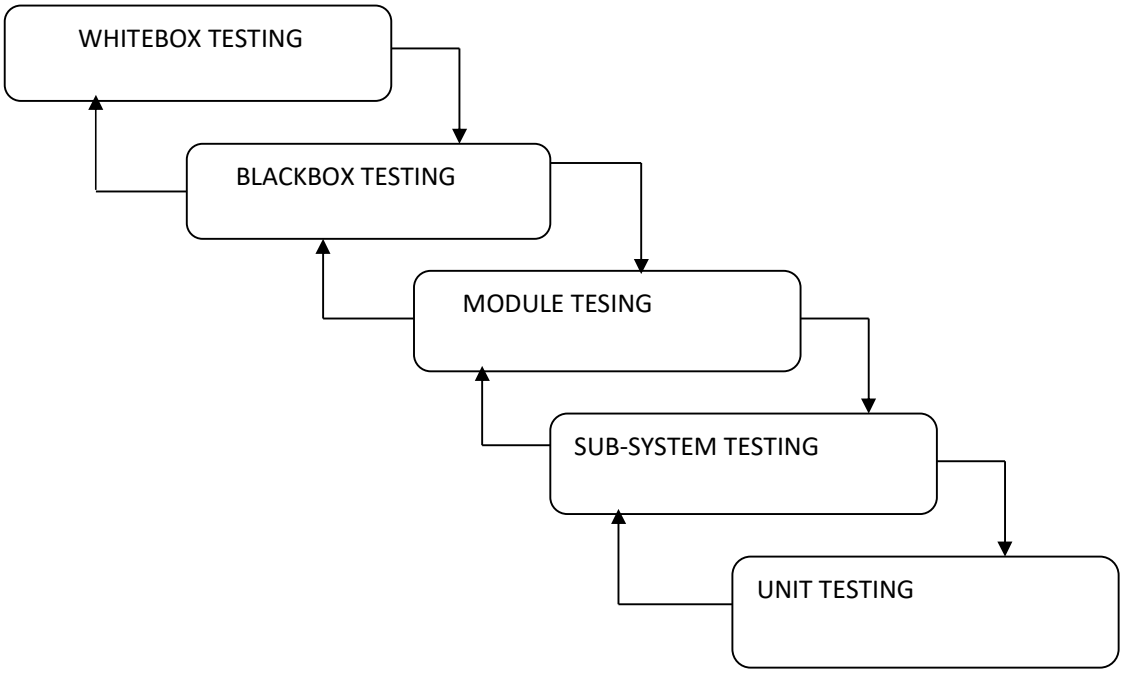
INTRODUCTION

Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. In fact, testing is the one step in the software engineering process that could be viewed as destructive rather than constructive.

6.1 STRATEGIC APPROACH TO SOFTWARE TESTING

The software engineering process can be viewed as a spiral. Initially system engineering defines the role of software and leads to software requirement analysis where the information domain, functions, behavior, performance, constraints and validation criteria for software are established. Moving inward along the spiral, we come to design and finally to coding. To develop computer software, we spiral in along streamlines that decrease the level of abstraction on each turn.

A strategy for software testing may also be viewed in the context of the spiral. Unit testing begins at the vertex of the spiral and concentrates on each unit of the software as implemented in source code. Testing progress is done by moving outward along the spiral to integration testing, where the focus is on the design and the construction of the software architecture. Talking another turn on outward on the spiral we encounter validation testing where requirements established as part of software requirements analysis are validated against the software that has been constructed. Finally, we arrive at system testing, where the software and other system elements are tested as a whole.



6.2 TESTING PROCEDURES

Unit testing focuses verification effort on the smallest unit of software design, the module. The unit testing we have is white box oriented and some modules the steps are conducted in parallel.

1. WHITE BOX TESTING

This type of testing ensures that

- All independent paths have been exercised at least once
- All logical decisions have been exercised on their true and false sides
- All loops are executed at their boundaries and within their operational bounds
- All internal data structures have been exercised to assure their validity.

To follow the concept of white box testing we have tested each form. We have created independently to verify that Data flow is correct, all conditions are exercised to check their validity, all loops are executed on their boundaries.

2. BLACK BOX TESTING

The established technique of flow graph with Cyclamate complexity was used to derive test cases for all the functions. The main steps in deriving test cases were:

Use the design of the code and draw correspondent flow graphs.

Determine the Cyclamate complexity of the resultant flow graph, using formula:

V (G) =E-N+2 or

V (G) =P+1 or

V (G) =Number of Regions

Where V (G) is Cyclomatic complexity,

E is the number of edges,

N is the number of flow graph nodes,

P is the number of predicate nodes.

Determine the basis of set of linearly independent paths.

3. MODULE TESTING

In this part of the testing each of the conditions were tested to both true and false aspects. And all the resulting paths were tested. So that each path that may be generated on particular condition is traced to uncover any possible errors.

4. SUB SYSTEM TESTING

This type of testing selects the path of the program, according to the location of the definition and use of variables. This kind of testing was used only when some local variables were declared. The definition-use chain method was used in this type of testing. These were particularly useful in nested statements.

5. UNIT TESTING

In this type of testing all the loops are tested to all the limits possible. The following exercise was adopted for all loops:

- All the loops were tested at their limits, just above them and just below them.
- All the loops were skipped at least once.
- For nested loop test the innermost loop first and then work outwards.
- For concatenated loops the values of dependent loops were set with the help of a connected loop.

CONCLUSION

7.1 CONCLUSION:

Vertical farming is an innovative approach to agriculture that allows the cultivation of various fruits and vegetables in a controlled, stacked environment, making it especially suitable for urban areas. This method maximizes space, conserves up to 95% more water compared to traditional farming, and eliminates the need for pesticides due to its controlled environment. Additionally, it enables year-round production, ensuring a steady supply of fresh produce, and reduces the carbon footprint by cutting down transportation needs. While crops like leafy greens, herbs, and some fruits such as strawberries and tomatoes thrive in vertical farms, larger crops still present economic challenges.

However, the initial high setup cost, energy consumption, and need for technical expertise can be barriers to widespread adoption. Despite these challenges, advancements in LED technology, automation, and renewable energy are making vertical farming more viable. With the right investment and innovation, it has the potential to contribute significantly to sustainable agriculture by bringing fresh, pesticide-free produce closer to urban consumers, creating job opportunities, and addressing food security issues.

7.2 FUTURE ENHANCEMENT

Vertical farming is a groundbreaking method of agriculture that allows for growing a variety of fruits and vegetables in a managed, layered setting, making it particularly well-suited for urban locations. This technique makes the most of limited space, uses up to 95% less water compared to traditional farming, and removes the necessity for pesticides because of its controlled environment. Furthermore, it allows for continuous production throughout the year, ensuring a consistent supply of fresh food, and lessens the carbon footprint by reducing the need for transportation. While crops like salad greens, herbs, and certain fruits such as strawberries and tomatoes flourish in vertical farms, growing larger crops still poses economic difficulties.

However, the initial high setup cost, energy consumption, and need for technical expertise can be barriers to widespread adoption. Despite these challenges, advancements in LED technology, automation, and renewable energy are making vertical farming more viable. With the right investment and innovation, it has the potential to contribute significantly to sustainable agriculture by bringing fresh, pesticide-free produce closer to urban consumers, creating job opportunities, and addressing food security issues. Vertical farming offers a hopeful way to address challenges related to reliable food access, environmental responsibility, and the increasing number of people living in cities. By making it possible to grow fresh, healthy food all year long within urban settings, and by greatly lowering water use and environmental harm, vertical farming has the potential to reshape conventional agriculture. Technological advancements in systems like hydroponics, aeroponics, and aquaponics have been crucial in developing efficient and environmentally sound vertical farming techniques.

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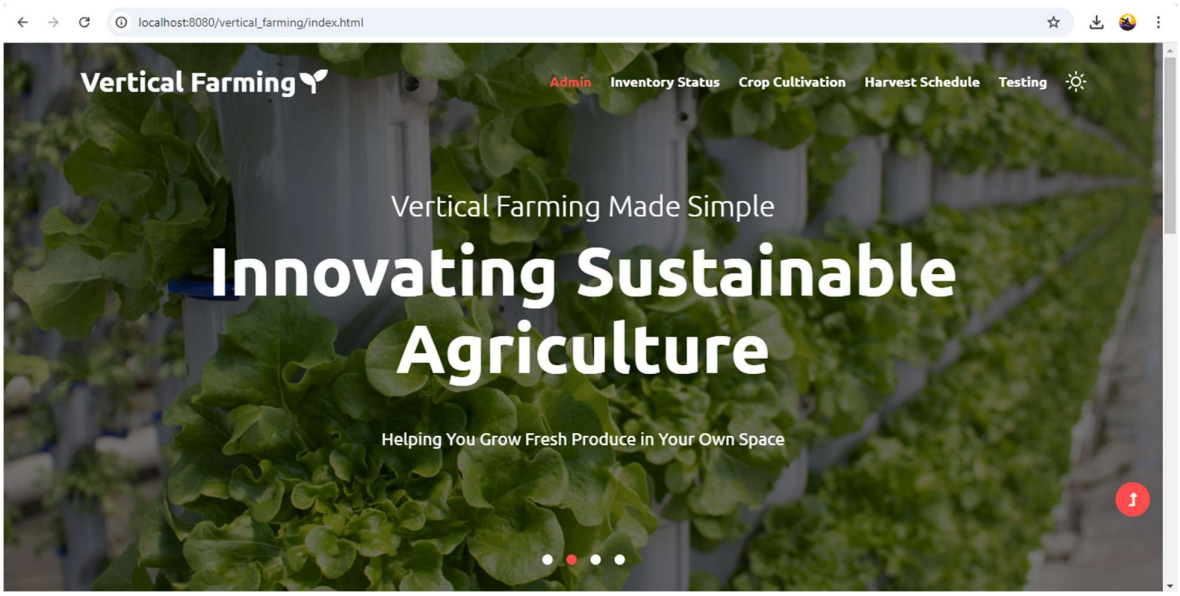
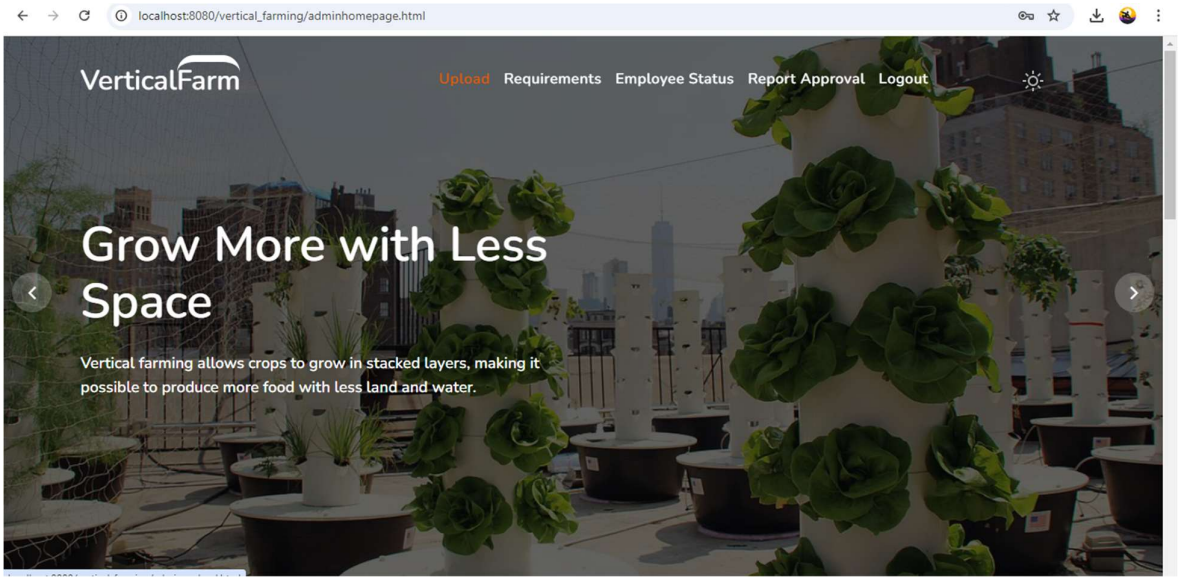
APPENDIX

9.1 OUTPUT SCREENSHOTS

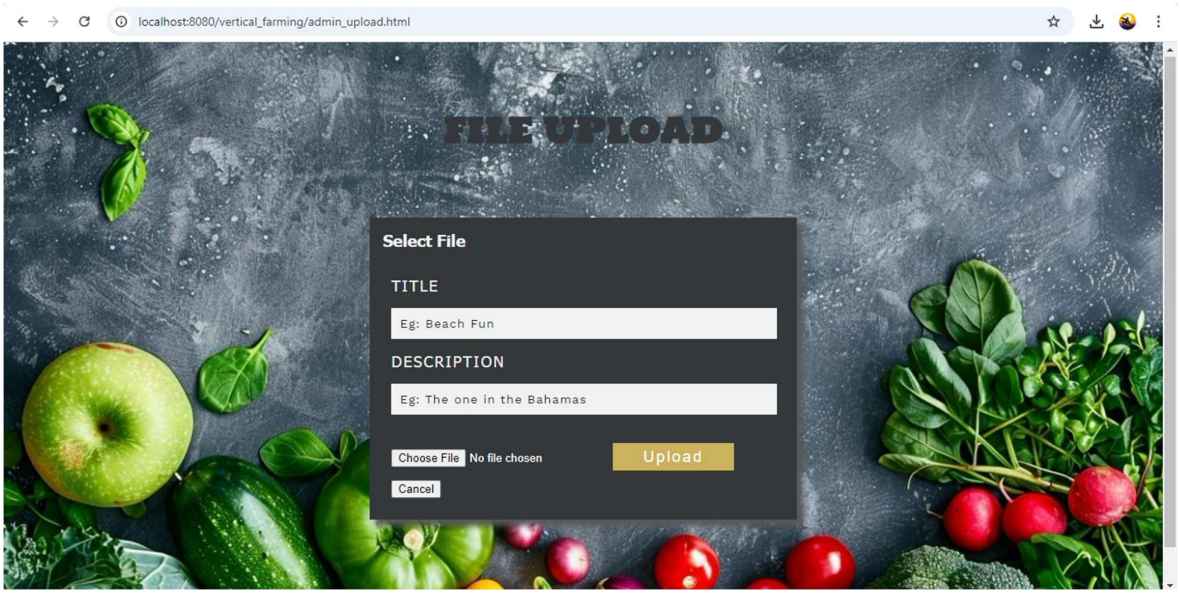
1.HOME PAGE



2.ADMIN PAGE

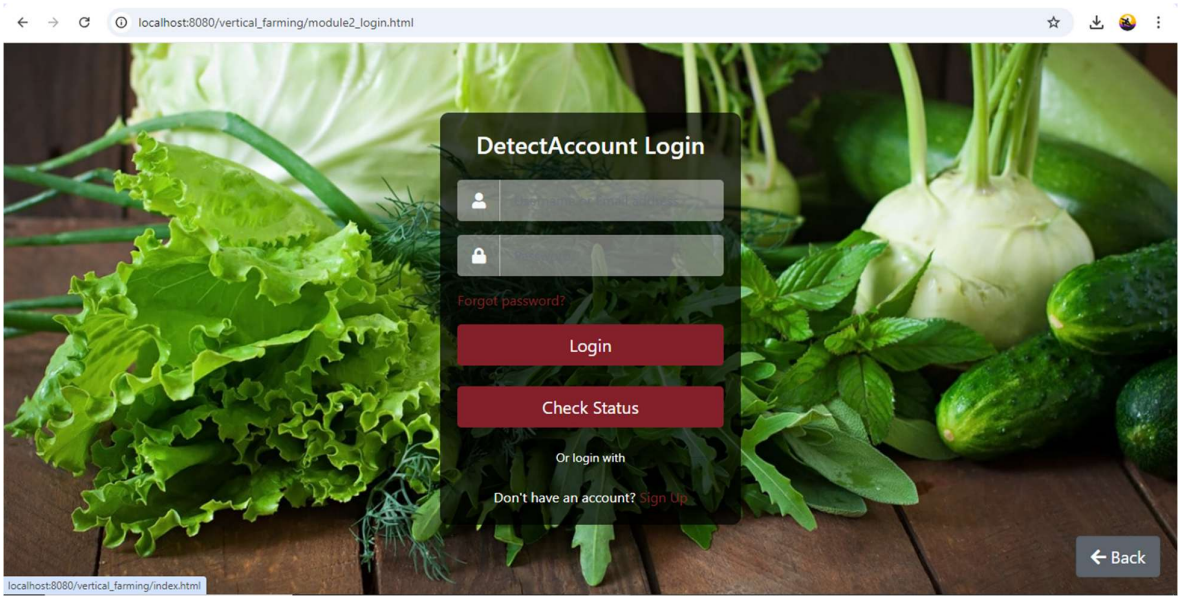


3.EXIST FILE UPLOAD

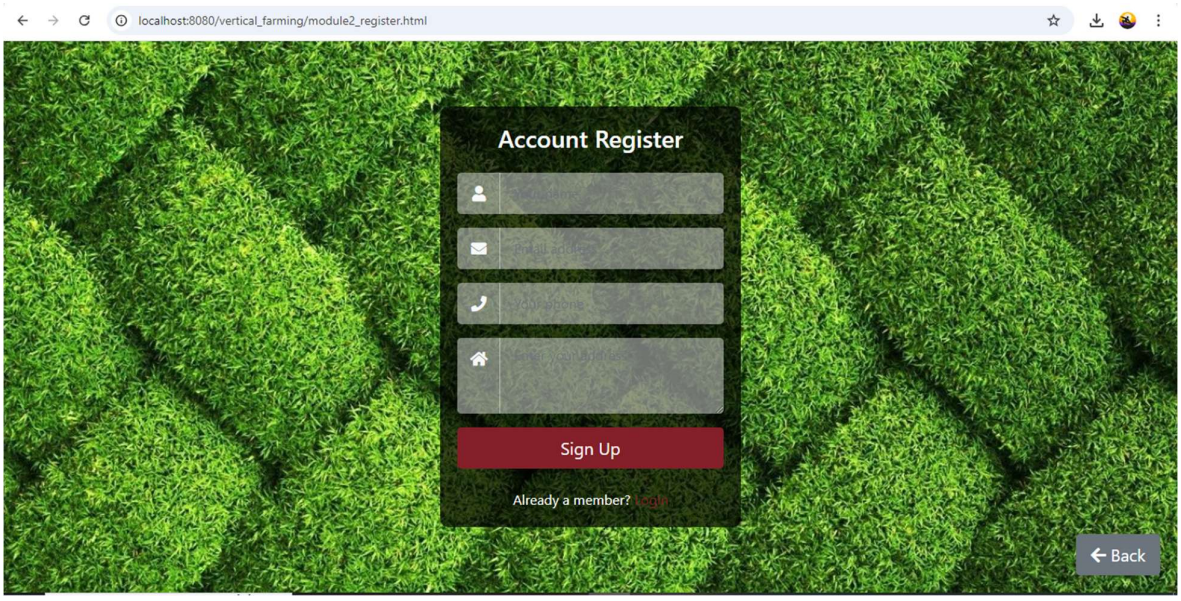


4.UPLOADED FILE

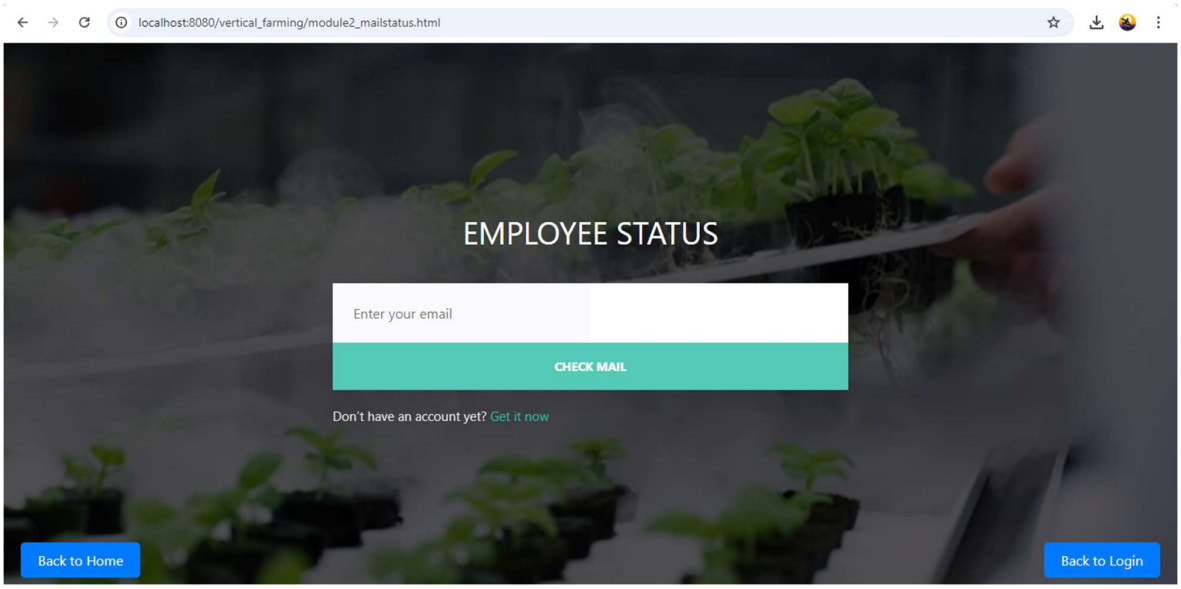
5.LOGIN PAGE(USER)



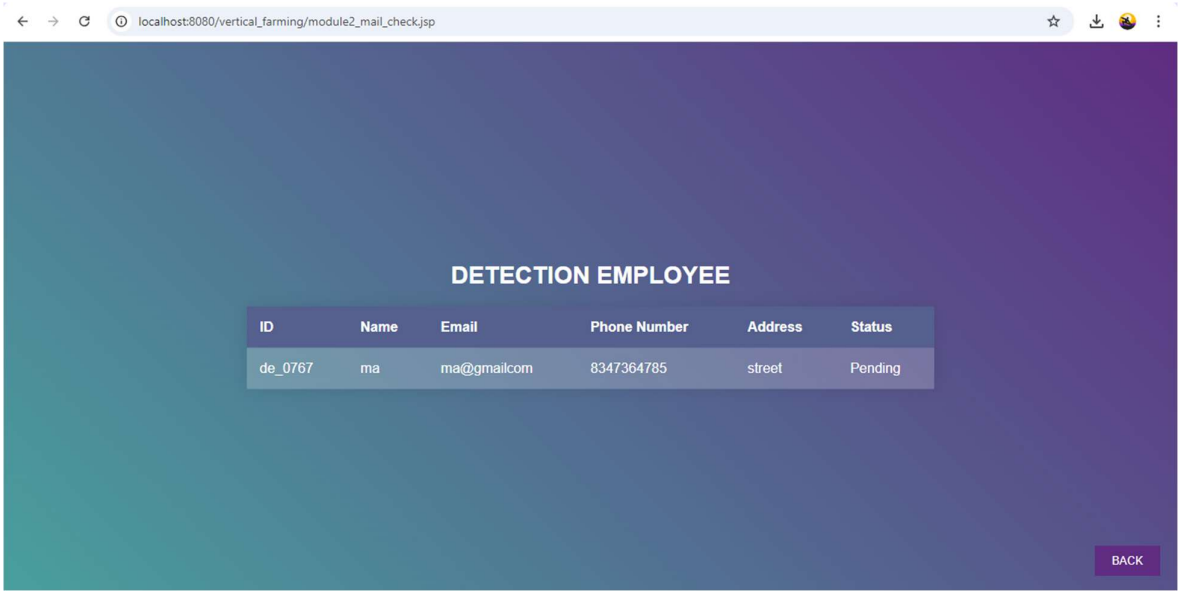
6.REGISTER PAGE(USER)



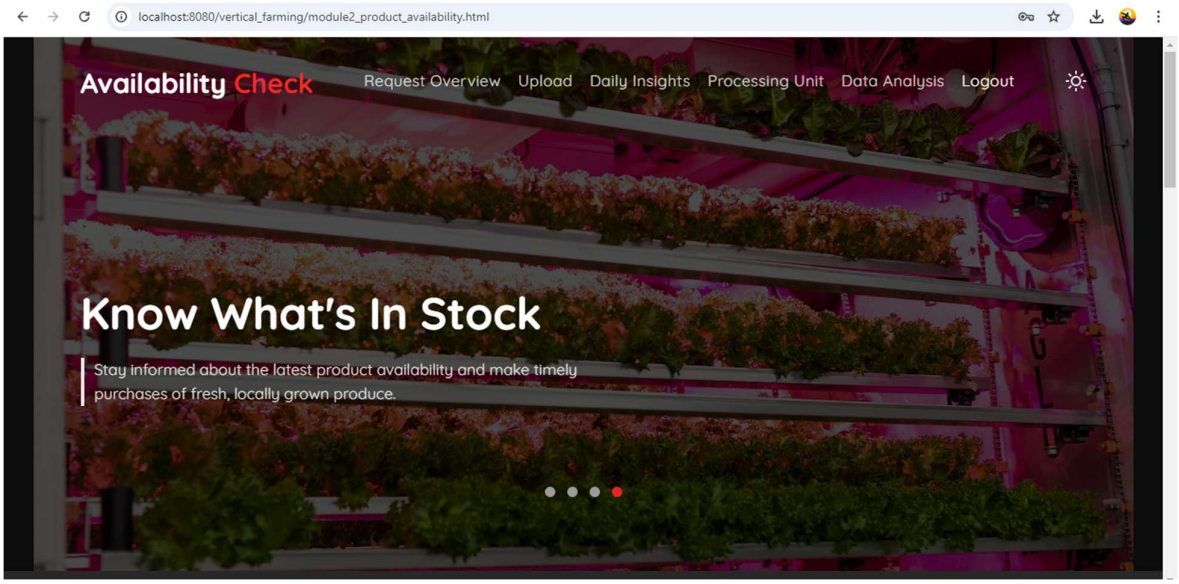
7.EMPLOYEE STATUS



8.EMPLOYEE ACTIVIES



9.HOME PAGE OF AVAILABILITY CHECK



10.CLIENT REQUEST

CLIENT ID	NO	FRUIT/VEGETABLE	VARIETY	NO OF TONS NEEDED	TIME PERIOD (MONTHS)	REQUEST DATE	CLIENT NOTES	REQUESTED BY	REQUEST STATUS	DELIVERY DATE
cl_7655	1	Tomato	Roma	25	3	2024-10-01	Need for restaurant	John Doe	Pending	2024-12-01
cl_7655	2	Lettuce	Butterhead	15	2	2024-10-02	For salad preparation	Jane Smith	Pending	2024-11-01
cl_7655	3	Spinach	Bloomsdale	10	2	2024-10-03	Fresh use in meals	Alex Johnson	Pending	2024-11-02
cl_7655	4	Cucumber	European	20	3	2024-10-04	For salads	Emily Brown	Pending	2024-12-05
cl_7655	5	Bell Pepper	Red	12	3	2024-10-05	For various dishes	Michael White	Pending	2024-12-10
			Black			2024-10-	Needed for	Jessica		2024-12-

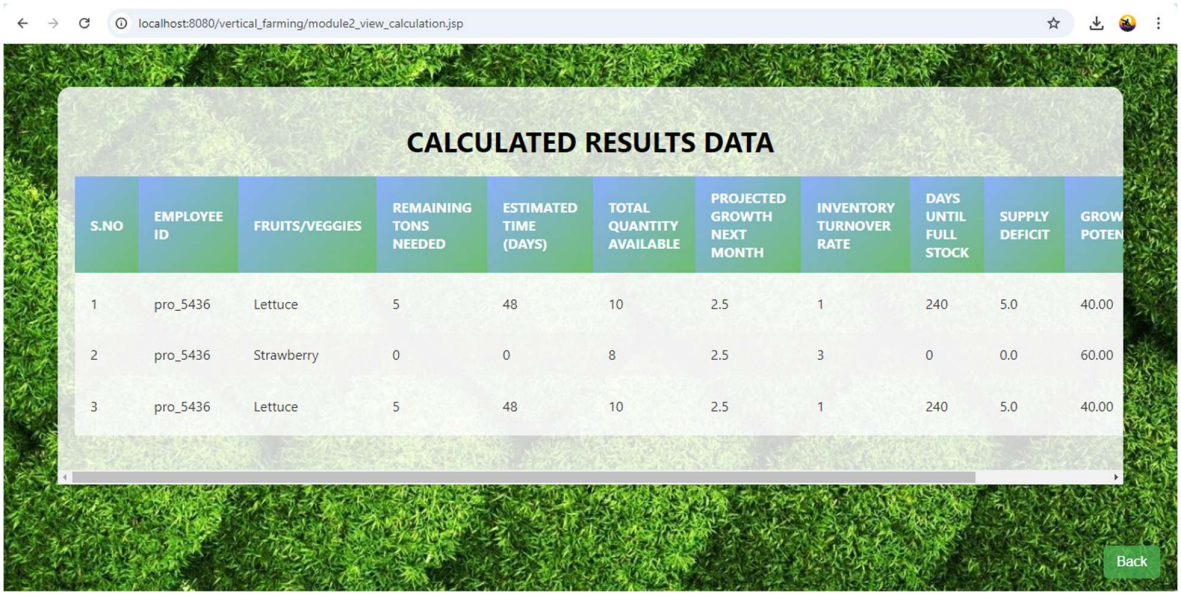
11.CLIENT REQUEST DETAILS

Crop Name	Total Quantity	Quantity Available	Growing Status	Number of Growing	Number of Fully Grown	Growing Quantity	Fully Grown Quantity	Estimated Days to Maturity	Notes
Tomato	30	15	Fully Grown	0	15	0	15	0	Sweet and juicy variety.
Lettuce	25	10	Growing	10	5	10	5	48	Needs regular watering.
Spinach	20	5	Fully Grown	0	5	0	5	0	Harvested last week.
Cucumber	15	10	Growing	10	0	10	0	60	Fast-growing variety.
Bell Pepper	12	6	Fully Grown	0	6	0	6	0	Colorful and crunchy.
Eggplant	10	4	Growing	4	0	4	0	78	Watch for pests.
Carrot	50	30	Fully Grown	0	30	0	30	0	Good for salads.
Strawberry	25	15	Fully Grown	0	15	0	15	0	Very sweet.
Broccoli	18	8	Fully Grown	0	8	0	8	0	High in vitamins.

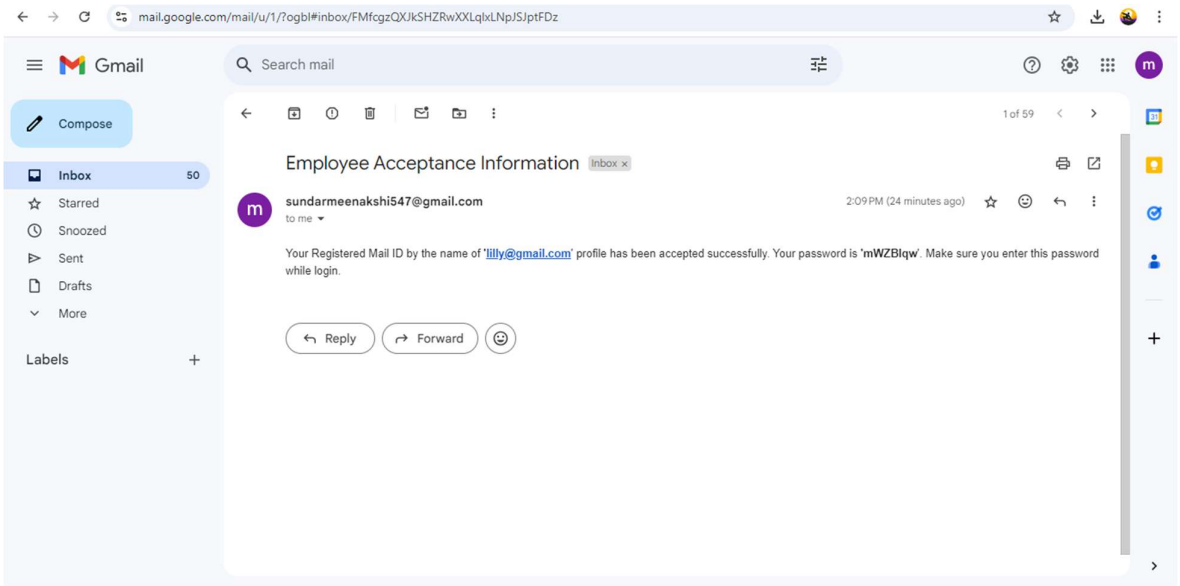
12.CALCULATION OF CLIENT

O	FRUIT/VEGETABLE	VARIETY	NO OF TONS NEEDED	TIME PERIOD (MONTHS)	REQUEST DATE	CLIENT NOTES	REQUESTED BY	REQUEST STATUS	DELIVERY DATE	ACTION
	Tomato	Roma	25	3	2024-10-01	Need for restaurant	John Doe	Pending	2024-12-01	Calculate
	Lettuce	Butterhead	15	2	2024-10-02	For salad preparation	Jane Smith	Pending	2024-11-01	Calculate
	Spinach	Bloomsdale	10	2	2024-10-03	Fresh use in meals	Alex Johnson	Pending	2024-11-02	Calculate
	Cucumber	European	20	3	2024-10-04	For salads	Emily Brown	Pending	2024-12-05	Calculate
	Bell Pepper	Red	12	3	2024-10-05	For various dishes	Michael White	Pending	2024-12-10	Calculate

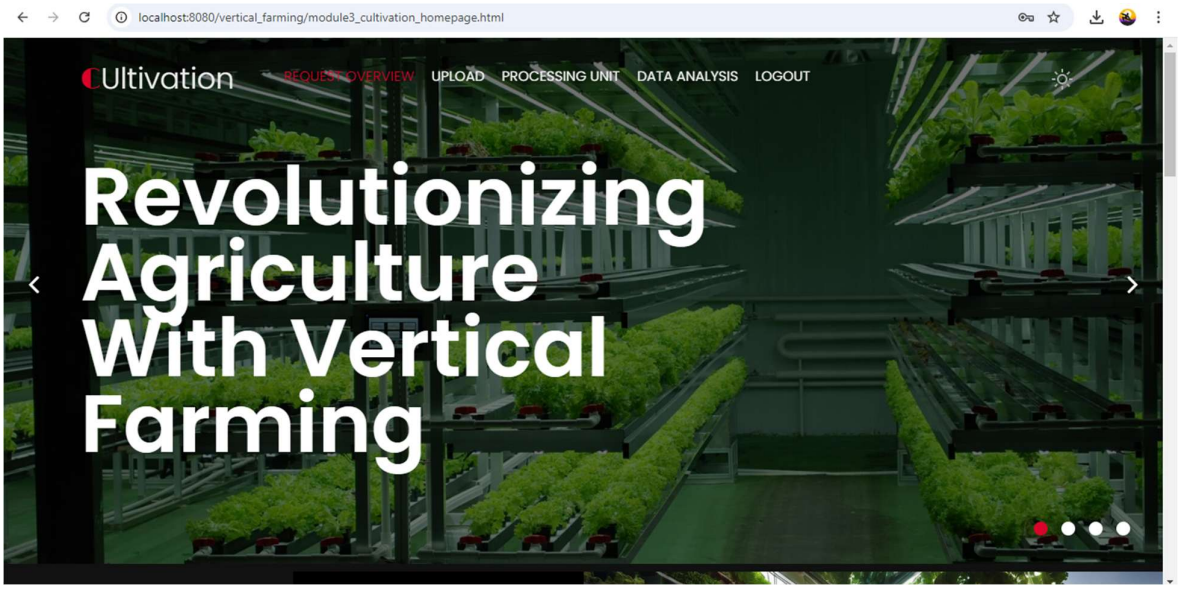
13. CALCULATION RESULT



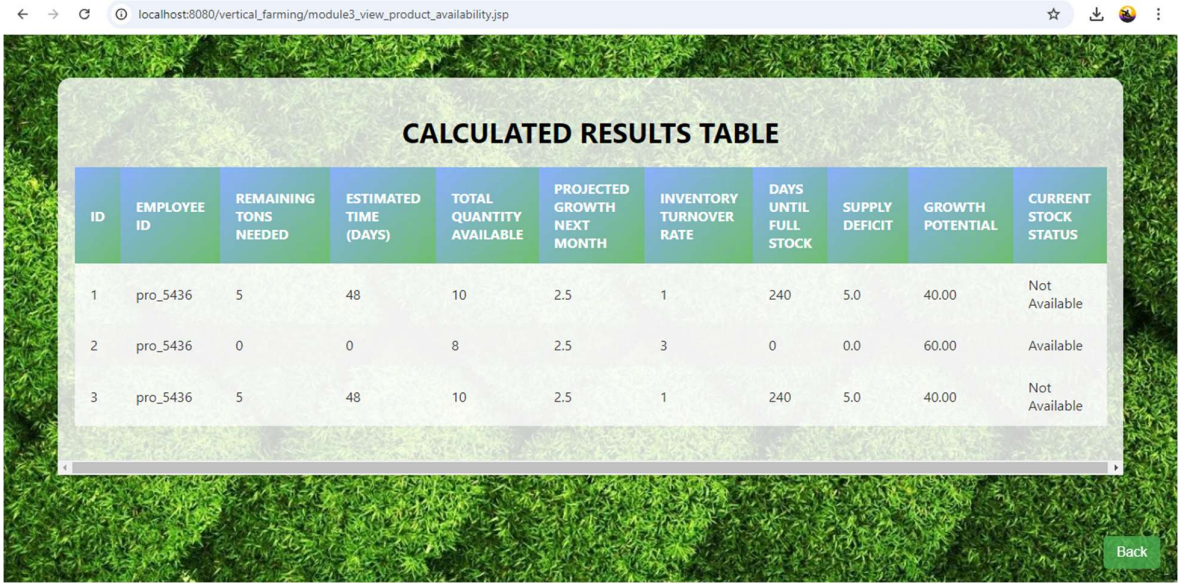
14. EMPLOYEE ACCEPTANCE MAIL



15. CULTIVATION HOME PAGE



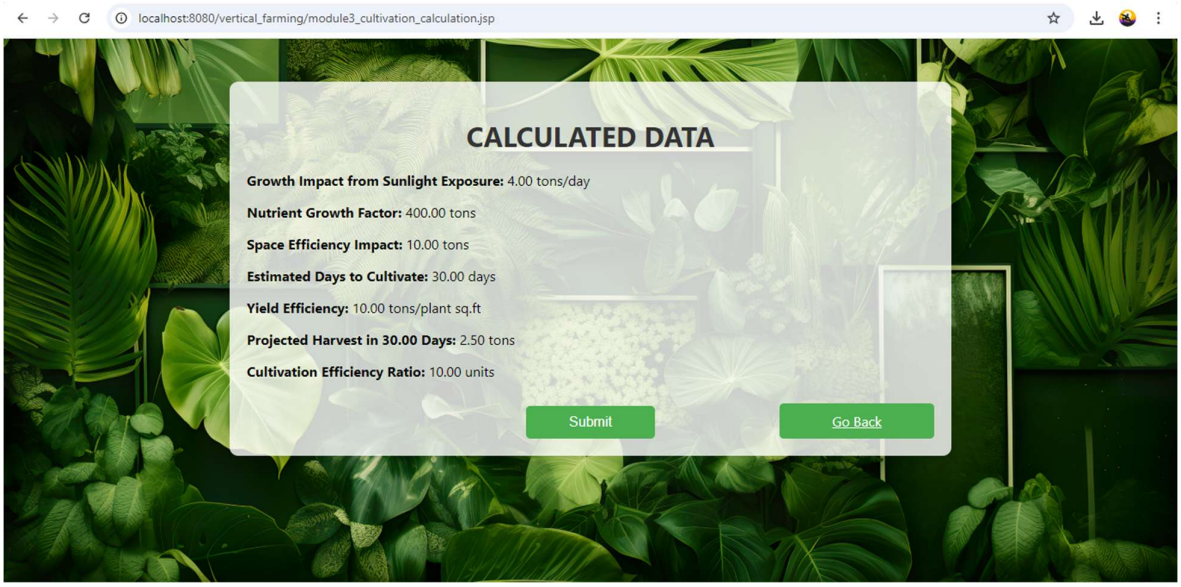
16. CULTIVATION AVAILABILITY



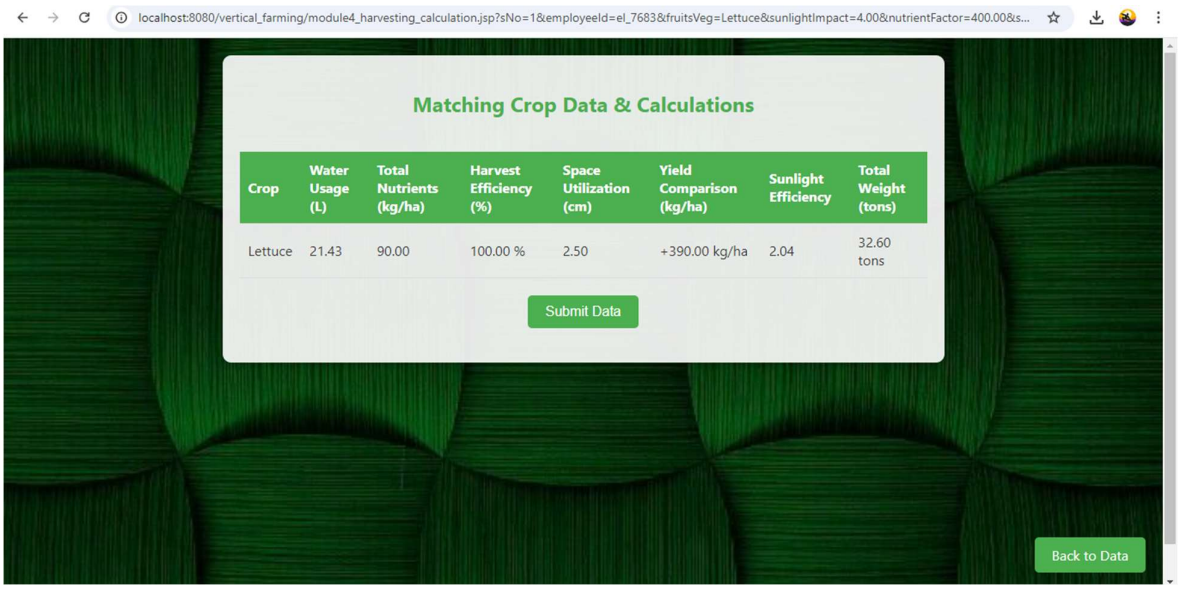
ID	EMPLOYEE ID	REMAINING TONS NEEDED	ESTIMATED TIME (DAYS)	TOTAL QUANTITY AVAILABLE	PROJECTED GROWTH NEXT MONTH	INVENTORY TURNOVER RATE	DAYS UNTIL FULL STOCK	SUPPLY DEFICIT	GROWTH POTENTIAL	CURRENT STOCK STATUS
1	pro_5436	5	48	10	2.5	1	240	5.0	40.00	Not Available
2	pro_5436	0	0	8	2.5	3	0	0.0	60.00	Available
3	pro_5436	5	48	10	2.5	1	240	5.0	40.00	Not Available

17. CULTIVATION RESULT

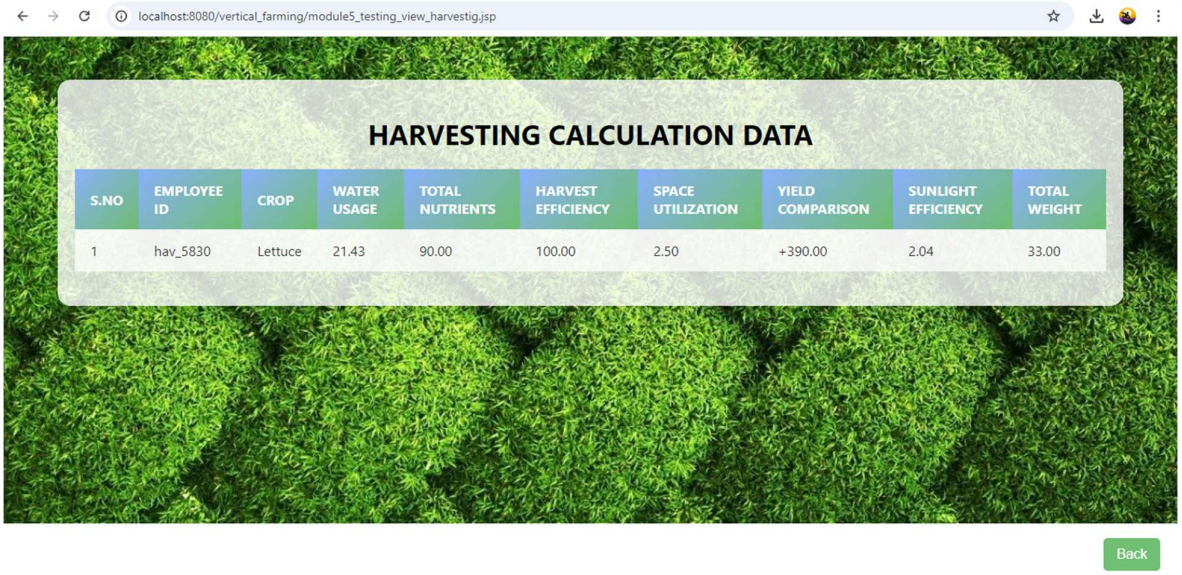
18.PURTICULAR PROPERTY DATA



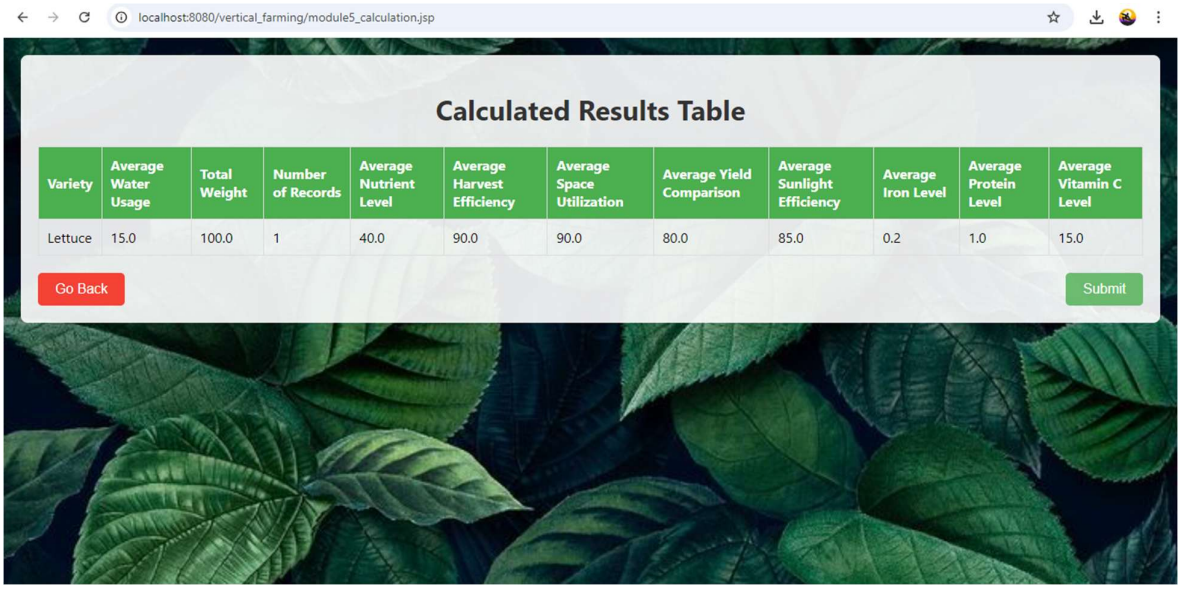
19. HARVESTING CROPS



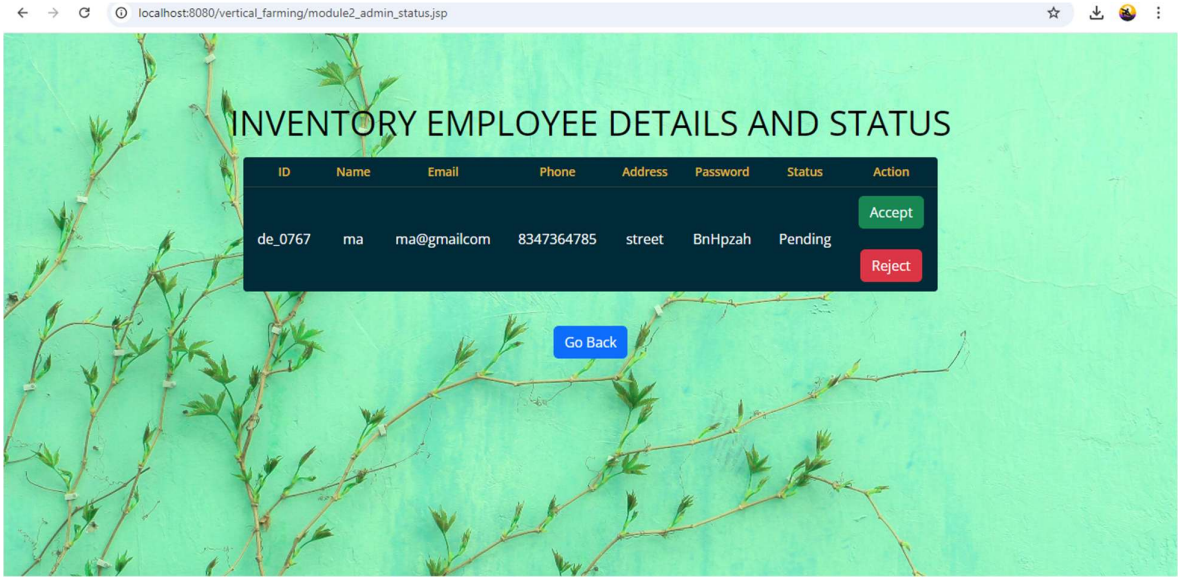
20. HARVESTING DATA



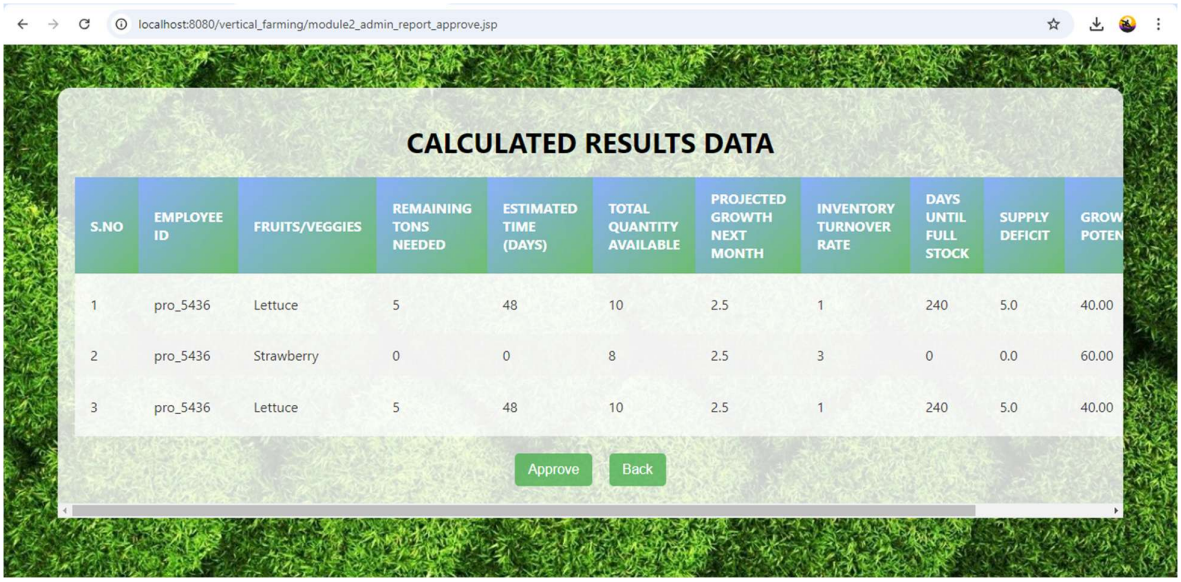
21. HARVESTING RESULTS



22. EMPLOYEE ACCOUNT REQUEST



23. EMPLOYEE DATA



9.2 SOURCE CODE

HOME PAGE: index.html

```
<!--
Author: W3layouts
Author URL: http://w3layouts.com
-->
<!doctype html>
<html lang="en">
<head>
   <!-- Required meta tags -->
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width, initial-scale=1">
   <title>Cooking - Restaurants Category Bootstrap Responsive Website Template - Home : W3Layouts</title>
   <!-- Google fonts -->
   <link href="//fonts.googleapis.com/css2?family=Ubuntu:wght@300;400;500;700&display=swap" rel="stylesheet">
   <!-- Template CSS Style link -->
   <link rel="stylesheet" href="index/css/style-starter.css">
</head>

<body>
   <!-- header -->
```

```
<header id="site-header" class="fixed-top">
    <div class="container">
        <nav class="navbar navbar-expand-lg navbar-light">
            <a class="navbar-brand" href="index.html">
                Vertical Farming<i class="fas fa-seedling ms-1"></i>
            </a>
            <button class="navbar-toggler collapsed" type="button" data-bs-toggle="collapse"
                data-bs-target="#navbarScroll" aria-controls="navbarScroll" aria-
expanded="false"
                aria-label="Toggle navigation">
                <span class="navbar-toggler-icon fa icon-expand fa-bars"></span>
                <span class="navbar-toggler-icon fa icon-close fa-times"></span>
            </button>
            <div class="collapse navbar-collapse" id="navbarScroll">
                <ul class="navbar-nav ms-auto my-2 my-lg-0 navbar-nav-scroll">
                    <li class="nav-item">
                        <a class="nav-link active" aria-current="page"
href="adminlogin.html">Admin</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link" href="module2_login.html">Inventory Status</a>
                    </li>
                    <li class="nav-item">
                        <a class="nav-link" href="module3_login.html">Crop Cultivation</a>
                    </li>
```

```
            <li class="nav-item">
                <a class="nav-link" href="module4_login.html">Harvest Schedule</a>
            </li>
            <li class="nav-item">
                <a class="nav-link" href="module5_login.html">Testing</a>
            </li>
        </ul>
    </div>
    <!-- toggle switch for light and dark theme -->
    <div class="cont-ser-position">
        <nav class="navigation">
            <div class="theme-switch-wrapper">
                <label class="theme-switch" for="checkbox">
                    <input type="checkbox" id="checkbox">
                    <div class="mode-container">
                        <i class="gg-sun"></i>
                        <i class="gg-moon"></i>
                    </div>
                </label>
            </div>
        </nav>
    </div>
    <!-- //toggle switch for light and dark theme -->
</nav>
```

```
        </div>
    </header>
    <!-- //header -->
    <!-- banner section -->
    <section class="w3l-main-slider" id="home">
        <div class="banner-content">
            <div id="demo-1"
                data-zs-src='["index/images/banner1.jpg",
"index/images/banner2.jpg","index/images/banner3.jpg", "index/images/banner4.jpg"]'
                data-zs-overlay="dots">
                <div class="demo-inner-content text-center">
                    <div class="container">
                        <div class="banner-info">
                            <h5>Vertical Farming Made Simple</h5>
                            <h3 class="mt-2 mb-5">Innovating Sustainable Agriculture</h3>
                            <p>Helping You Grow Fresh Produce in Your Own Space</p>
                        </div>
                    </div>
                </div>
            </div>
        </div>
    </section>
    <!-- //banner section -->
    <!-- about section -->
    <section class="w3l-aboutblock py-5">
```

```
<div class="container py-lg-5 py-md-4 py-2">
    <div class="row align-items-center">
        <div class="col-lg-5">
            <h3 class="title-style">Learn How to Start Vertical Farming at Home</h3>
            <p class="mt-3">Vertical farming is an innovative way to grow crops in urban environments using minimal space. Discover how you can grow fresh produce from the comfort of your home.</p>
            <div class="row mt-lg-5 mt-4">
                <div class="col-sm-6 grids_info">
                    <i class="fas fa-seedling"></i>
                    <div class="detail mt-sm-4 mt-3">
                        <h4>Beginner's Guide</h4>
                        <p>Easy steps to set up your vertical farm at home.</p>
                    </div>
                </div>
                <div class="col-sm-6 grids_info mt-sm-0 mt-4">
                    <i class="fas fa-leaf"></i>
                    <div class="detail mt-sm-4 mt-3">
                        <h4> Sustainable and Efficient</h4>
                        <p>Grow more using less space and fewer resources.</p>
                    </div>
                </div>
            </div>
        </div>
        <div class="col-lg-7 ps-lg-5 mt-lg-0 mt-5">
```

```
                <div class="row align-items-center">
                    <div class="col">
                        <img src="index/images/vertical-farm1.jpg" alt="" class="img-fluid radius-image">
                    </div>
                    <div class="col">
                        <img src="index/images/vertical-farm2.jpg" alt="" class="img-fluid radius-image">
                    </div>
                </div>
            </div>
        </div>
    </section>



    <!-- //team section -->
    <!-- content block1 -->
    <section class="w3l-content-block1 py-5">
        <div class="container py-md-5 py-4">
            <div class="row">
                <div class="col-lg-6 col-md-8 title-content py-md-5">
                    <h3 class="title-style text-white">Join Our Vertical Farming Workshop, Grow Your Own Food</h3>
```

```
                <p class="mt-3 text-light">Learn the art of vertical farming and transform your home into a sustainable food source. Vertical farming allows you to grow fresh produce in small spaces with minimal resources.</p>
            </div>
        </div>
    </div>
</section>
<!-- //content block1 -->
<!-- blog section -->
<!-- //blog section -->
<!-- instagram-feeds -->
<!-- //instagram-feeds -->
<!-- footer -->


<!-- //footer -->
<!-- Js scripts -->
<!-- move top -->
<button onclick="topFunction()" id="movetop" title="Go to top">
    <span class="fas fa-level-up-alt" aria-hidden="true"></span>
</button>
<script>
    // When the user scrolls down 20px from the top of the document, show the button
    window.onscroll = function () {
        scrollFunction()
    };
```

```
    function scrollFunction() {
        if (document.body.scrollTop > 20 || document.documentElement.scrollTop > 20) {
            document.getElementById("movetop").style.display = "block";
        } else {
            document.getElementById("movetop").style.display = "none";
        } }
    // When the user clicks on the button, scroll to the top of the document
    function topFunction() {
        document.body.scrollTop = 0;
        document.documentElement.scrollTop = 0;
    }
</script>
<!-- //move top -->
<!-- common jquery plugin -->
<script src="assets/js/jquery-3.3.1.min.js"></script>
<!-- //common jquery plugin -->
<!-- slider-js -->
<script src="index/js/jquery.min.js"></script>
<script src="index/js/modernizr-2.6.2.min.js"></script>
<script src="index/js/jquery.zoomslider.min.js"></script>
<!-- //slider-js -->
<!-- theme switch js (light and dark)-->
<script src="index/js/theme-change.js"></script>
<!-- //theme switch js (light and dark)-->
```

```
<!-- MENU-JS -->
<script>
    $(window).on("scroll", function () {
        var scroll = $(window).scrollTop();
        if (scroll >= 80) {
            $("#site-header").addClass("nav-fixed");
        } else {
            $("#site-header").removeClass("nav-fixed");
        }
    });

    //Main navigation Active Class Add Remove
    $(".navbar-toggler").on("click", function () {
        $("header").toggleClass("active");
    });
    $(document).on("ready", function () {
        if ($(window).width() > 991) {
            $("header").removeClass("active");
        }
        $(window).on("resize", function () {
            if ($(window).width() > 991) {
                $("header").removeClass("active");
            }
        });
```

```
        });
    </script>
    <!-- //MENU-JS -->

    <!-- disable body scroll which navbar is in active -->
    <script>
        $(function () {
            $('.navbar-toggler').click(function () {
                $('body').toggleClass('noscroll');
            })
        });
    </script>
    <!-- //disable body scroll which navbar is in active -->

    <!-- bootstrap -->
    <script src="index/js/bootstrap.min.js"></script>
    <!-- //bootstrap -->
    <!-- //Js scripts -->
</body>
</html>
```

PUBLICATION DETAILS

10.1 PAPER PUBLICATION DETAILS

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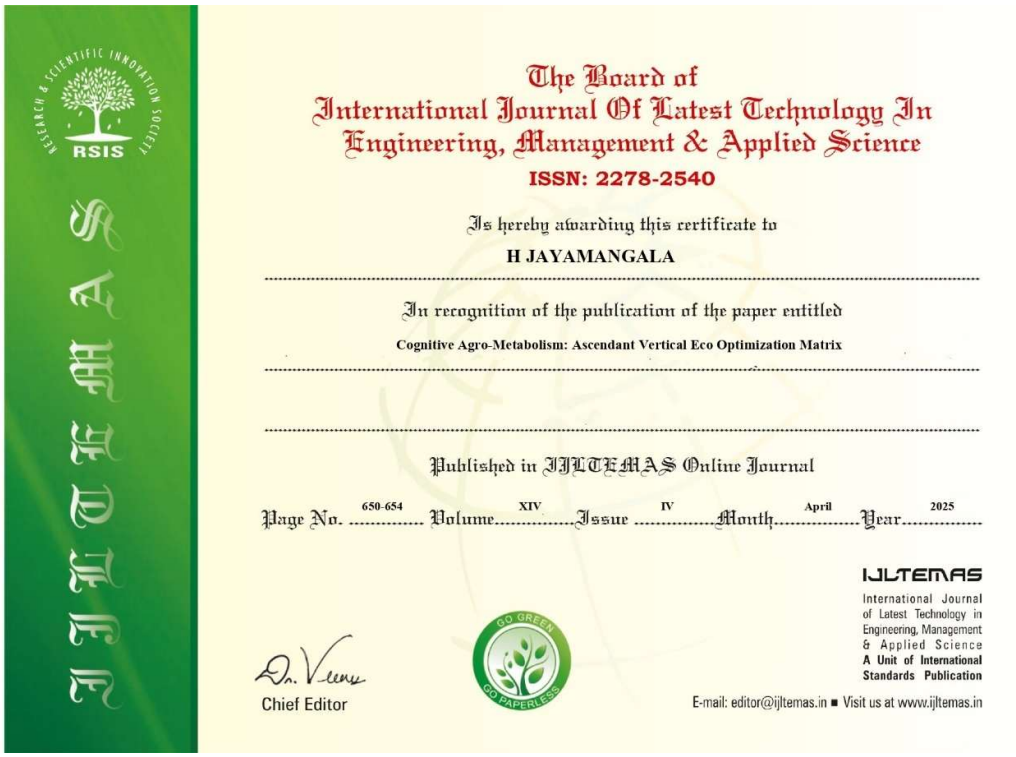

The Board of
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In recognition of the publication of the paper entitled

Cognitive Agro-Metabolism: Ascendant Vertical Eco Optimization Matrix

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10.3 FULL PAPER PUBLICATION COPY

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Cognitive Agro-Metabolism: Ascendant Vertical Eco Optimization Matrix

Elavarasan S, H Jayamangala

Department of Computer Applications – PG, VISTAS

DOI: https://doi.org/10.51583/IJLTEMAS.2025.140400073

Abstract: Vertical farming presents a hopeful approach for tackling issues related to reliable food access, environmental responsibility, and the growth of cities. This innovative agricultural method involves growing crops in vertically stacked layers within controlled environments, optimizing space and resource use while enhancing yields. Recent advancements in automation have significantly improved the efficiency and sustainability of vertical farming. By minimizing water and pesticide use, and shortening supply chains through proximity to urban centres, vertical farming reduces transportation costs and carbon emissions. Economic benefits include year-round production and premium pricing for pesticide-free produce. However, challenges remain, including high initial investments and energy demands. From an environmental perspective, vertical farming uses less land and water than conventional agriculture. This review highlights vertical farming's potential to improve global food security and support sustainable urban development. It also emphasizes the need for further research and collaboration to overcome barriers, with continued innovation and supportive policies essential for its widespread success.

Keywords: Growing food in stacked layers within cities, utilizing automated systems for efficient resource use, offers a sustainable approach to enhance crop production and ensure reliable food access.

I. Introduction

Increasing populations, expanding cities, shrinking water resources, and a changing climate are causing a reduction in available farmland for each individual. As the world's population is projected to hit 9.7 billion by 2050, governments must figure out how to produce food responsibly for everyone. Urban vertical farming offers a potential solution, utilizing technology and automation to optimize land use in high-rise buildings. This approach promises to boost productivity while minimizing environmental impact, offering benefits such as biosecurity, protection from pests and droughts, and reduced transportation and fossil fuel use. These indoor, climate-controlled farms are seen as a clean and sustainable food source. However, the strategy also presents challenges, including economic feasibility and scalability. This article explores the advantages and disadvantages of vertical farming, highlighting key issues for policymakers to consider to evaluate further its potential and guide future economic analysis [1].

Agriculture is crucial in India's economy, employing over 70% of the population and contributing about one-third of the GDP. Nevertheless, difficulties in agriculture impede the country's advancement, and adopting environmentally sound farming methods provides the answer.

Making agriculture more intelligent involves updating conventional practices with automation and Internet of Things (IoT) technologies. This research intends to offer information for informed choices that will boost output, agricultural development, and environmental responsibility, guaranteeing the production of high-quality food and secure food supplies. Data spanning from January 2015 to December 2019 was examined using R programming and R Studio. The study emphasizes the importance of incorporating new technologies into farming, pinpointing crucial elements for farmers to embrace these advancements to increase productivity. It also suggests enhancing infrastructure, increasing internet availability in rural regions, and creating shared platforms to encourage the innovation and exchange of agricultural technology knowledge, ultimately improving the sector's efficiency and long-term viability [2].

Increasing heat and more common severe weather events seriously endanger agricultural output, jeopardizing the food supply for millions. To overcome these issues, there's a rising demand for different, environmentally friendly farming methods that can flourish despite a changing climate. A particularly promising approach is indoor vertical farming, especially plant factories with artificial lighting (PFALs). Progress in this area centres on refining the application of technology to enhance the environmental sustainability of agriculture.

The agriculture sector is not exempt from this shift; it has embraced digital technologies, improving operational efficiency. Agricultural machinery now includes electronic controls, advancing performance, and technologies like sensors and drones are utilized for data collection. These innovations track critical factors such as weather, spatial data, and the behavior of crops and livestock, enhancing the overall farm life cycle. Agri-Food 4.0 represents the integration of these technologies to optimize agricultural processes and address evolving demands [3].

II. Methodology: Technological Advances in Vertical Farming

This methodology examines the key technological advancements driving the development of vertical farming, focusing on innovations that enhance crop production, sustainability, and efficiency in controlled environments. The following areas are explored:

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Hydroponics

Hydroponics describes cultivating plants in water mixed with nutrients, rather than in soil. In vertical farming, hydroponic systems are widely adopted because they optimize space, conserve water, and allow for precise management of nutrients [4]. Several hydroponic methods, including the nutrient film technique (NFT), deep water culture (DWC), and drip irrigation, have been modified for use in vertical farming.

Aeroponics

Aeroponics, another method of growing without soil, involves suspending plant roots in the air and misting them with a nutrient-rich solution. Compared to hydroponics, aeroponics typically uses even less water and allows roots to access more oxygen, which benefits their growth [5]. However, aeroponic systems are more complex and require precise control over the delivery of nutrients and environmental conditions.

Aquaponics

Aquaponics is an integrated farming approach that links growing plants without soil (hydroponics) and raising fish (aquaculture), creating a mutually advantageous cycle. In this setup, the waste produced by fish provides nourishment for the plants, and simultaneously, the plants cleanse the water, making it suitable for the fish [6]. Aquaponics can be incorporated into vertical farming structures to create a self-sufficient, closed-circuit system for producing food.

Opportunities and Advantages of Vertical Farming

Continuous Crop Cultivation

A significant advantage of vertical farming lies in its capacity for uninterrupted crop growth throughout the year, independent of external climate. By precisely controlling indoor environmental elements like temperature, moisture levels, and illumination, vertical farms can establish optimal growing environments for a variety of plants, enabling multiple harvests within a single year [7]. This not only increases the amount of food produced but also ensures a consistent availability of fresh agricultural products in all seasons.

Lower Water Consumption

Vertical farming techniques, particularly hydroponics and aeroponics, can significantly decrease the amount of water used in comparison to traditional agricultural practices. By recirculating water and meticulously regulating nutrient delivery, vertical farms can achieve water-saving levels as high as 95% [8]. This is particularly important in areas experiencing water scarcity or extended periods of drought.

Table 1. Comparison of hydroponic techniques used in vertical farming

Technique	Description	Advantages	Disadvantages
Nutrient Film Technique (NFT)	Plants grow in narrow troughs with a thin layer of nutrient-rich water constantly moving over their roots.	- Space-efficient - Easy to maintain - Suitable for leafy greens	- Limited to small plants - Requires precise nutrient management
Deep Water Culture (DWC)	In this method, plants are held above a deep tank of nutrient-filled water, allowing their roots to grow down into the solution.	- Simple setup - Low maintenance - Suitable for larger plants	- Requires more space - Higher risk of root rot
Drip Irrigation	Nutrient solution is delivered directly to the root zone through a network of drippers	- Precise nutrient delivery - Water efficient - Suitable for a wide range of crops	- Complex setup - Requires regular maintenance

Less Need for Pesticides and Weed Killers

The regulated setting within vertical farms leads to a decreased need for pesticides and herbicides. By shielding plants from external pests and illnesses, these farms can maintain plant health through integrated pest management strategies, such as using natural predators and physical barriers [9]. This reduced use of chemicals not only makes food safer but also lessens the environmental harm from farming.

Smaller Carbon Impact

Vertical farming can contribute to a smaller carbon footprint for food production by reducing the distance food travels and supporting local food networks. By cultivating crops close to cities, vertical farms can decrease the energy consumed and emissions produced by long-haul food transportation [10]. Furthermore, using renewable energy sources like solar and wind power can further minimize the carbon impact of vertical farming activities.

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Challenges and Restrictions

Significant Start-Up Expenses

A key obstacle for vertical farming is the considerable initial investment required to build and operate these systems. Putting in place the necessary infrastructure, equipment, and technology for vertical farms can be costly, especially for large-scale operations [11]. This financial hurdle can limit the widespread adoption of vertical farming, particularly in developing countries or areas with scarce financial resources.

Energy Consumption Needs

Vertical farms depend on artificial lighting and regulated climates to ensure ideal plant development. However, these systems can use a large amount of energy, leading to high operating expenses and increasing environmental worries [12]. While renewable energy sources can help lessen these effects, the energy demands of vertical farming remain a significant challenge.

Need for Specialized Skills

Operating a vertical farm necessitates a range of specialized proficiencies, including knowledge of plant science, engineering, and computer systems. A lack of skilled personnel can hinder the expansion and success of vertical farming endeavors [13].

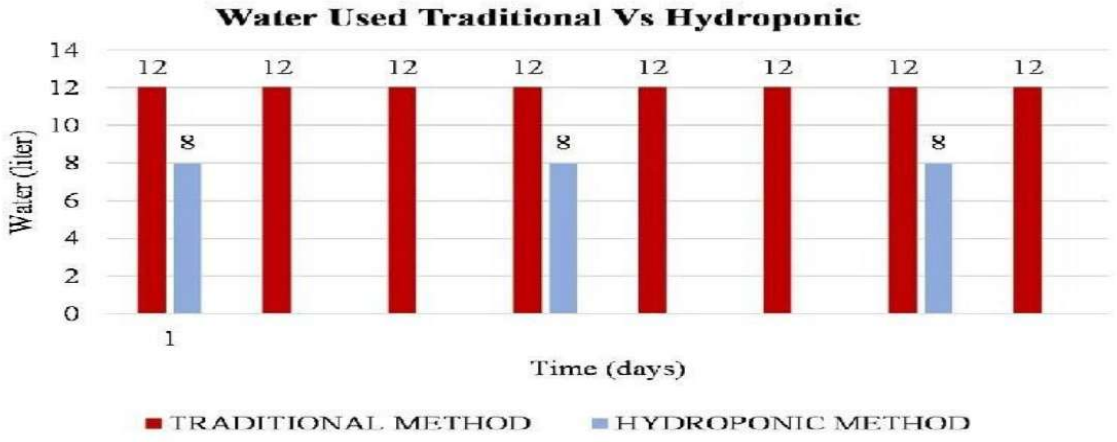

Fig. 1. Water usage comparison between vertical farming and traditional farming

Creating educational programs and training schemes designed for the unique demands of vertical farming can help address this issue and ensure a consistent pool of qualified professionals.

SOILLESS CULTIVATION TECHNOLOGIES FOR EFFICIENT USE OF WATER AND NUTRIENTS

Soilless cropping systems facilitate the precise delivery of essential mineral elements to plants via nutrient solutions. This methodology enables optimum crop performance coupled with high water-use efficiency, ensuring continuous production capabilities. A major benefit is the enhanced control over the rhizosphere environment, allowing for the optimization of root function through regulated parameters such as available nutrients, pH, water potential, oxygenation, and temperature, ultimately leading to high nutrient content and yields. Furthermore, these systems provide a sterile growing medium, free from residues, which permits superior plant development. Key soil-free growing methods encompass the Nutrient Film Technique (NFT), flood and drain systems, and aeroponics. Aquaponics is another commonly used system in vertical farming where plant roots are grown directly in an oxygen-rich nutrient solution.

real crops in vertical farming

In vertical farming, crops are commonly cultivated in controlled environments, similar to standard greenhouses. Businesses frequently opt to grow produce that is highly sought after locally, especially by grocery stores, eateries, and direct-to-consumer services like delivery or subscription models.

In vertical farming, microgreens represent a cultivation method characterized by a very short production cycle. These are young vegetable seedlings typically harvested between 10 and 14 days after planting. Their height ranges from 3 to 8 centimeters and usually includes a central stem, a pair of cotyledon leaves, and sometimes a pair of true leaves. In countries with higher income levels, microgreens are popular in the culinary world due to their vibrant color, distinctive flavor, and pleasant aroma, which enhance the appeal of gourmet dishes. They are also regarded as functional foods because they contain higher levels of vitamins,

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Fig.2 Example of Eco-Friendly Innovation: Vertical Farming

minerals, and antioxidants. Research has shown that microgreens can contain 2 to 10 times more phytochemicals than their mature counterparts [14].

III. Result and Discussion

The "Cognitive Agro-Metabolism: Ascendant Vertical Eco-Optimization Matrix" initiative seeks to transform conventional farming through the implementation of vertical farming methods. It employs hydroponics, aeroponics, and aquaponics to maximize the growth of produce, especially in city environments. This vertical farming setup is structured into five essential components, each designed with particular roles in overseeing the cultivation process.

Admin module acts as the central control, processing client requests, employee performance data, and reports from other modules. It outputs approvals/rejections, employee evaluations, notifications, comprehensive summaries, and final result approvals, ensuring oversight and coordination.

Inventory Status manages resources, handling user registrations and inventory requests. It uses daily production reports and inventory data to output approvals/rejections, login credentials, client request overviews, availability calculations, and database uploads, maintaining stock control.

Crop Cultivation focuses on the growing process, receiving user registrations and cultivation requests, and data on required crops. It outputs approvals/rejections, login credentials, inventory status, growth analysis, and system uploads, optimizing crop development.

Harvest Schedule plans the harvesting process, taking user registrations and harvesting requests, along with crop status and yield information. It outputs approvals/rejections, login credentials, growth data overviews, harvesting analysis, and database uploads, ensuring timely collection.

Testing evaluates the harvested produce, processing user registrations and testing requests, and data on harvest outcomes. It outputs approvals/rejections, login credentials, harvest performance overviews, testing result analysis, and database uploads, guaranteeing quality assurance.

Hardware and Software Requirements

For setting up the development environment, you'll need: Eclipse as your coding tool, a computer with a processor speed of 2.6GHz or greater, 2GB of RAM, and at least 20 GB of storage space.

The database requirements include: MySQL version 5.0, running on an Intel Pentium processor with a speed of 2.6GHz or higher.

The software prerequisites are: for the user interface (core Java, CSS, JavaScript, servlet technologies), for the web application (J2EE Frameworks, Hibernate), and for the data management system (MySQL version 5.1).

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IV. Conclusion

Vertical farming offers a hopeful way to address challenges related to reliable food access, environmental responsibility, and the increasing number of people living in cities. By making it possible to grow fresh, healthy food all year long within urban settings, and by greatly lowering water use and environmental harm, vertical farming has the potential to reshape conventional agriculture. Technological advancements in systems like hydroponics, aeroponics, and aquaponics have been crucial in developing efficient and environmentally sound vertical farming techniques.

Vertical farming is a groundbreaking method of agriculture that allows for growing a variety of fruits and vegetables in a managed, layered setting, making it particularly well-suited for urban locations. This technique makes the most of limited space, uses up to 95% less water compared to traditional farming, and removes the necessity for pesticides because of its controlled environment. Furthermore, it allows for continuous production throughout the year, ensuring a consistent supply of fresh food, and lessens the carbon footprint by reducing the need for transportation. While crops like salad greens, herbs, and certain fruits such as strawberries and tomatoes flourish in vertical farms, growing larger crops still poses economic difficulties.

However, the initial high setup cost, energy consumption, and need for technical expertise can be barriers to widespread adoption. Despite these challenges, advancements in LED technology, automation, and renewable energy are making vertical farming more viable. With the right investment and innovation, it has the potential to contribute significantly to sustainable agriculture by bringing fresh, pesticide-free produce closer to urban consumers, creating job opportunities, and addressing food security issues.

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