SMART AGRICULTURE MONITORING AND CONTROLLING SYSTEM FOR FARMING

PROJECT REPORT

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ABSTRACT

Utilizing information and communication technologies (ICT) to increase agricultural operations' production, efficiency, and sustainability is known as smart agriculture. In order to give farmers real-time information about the condition of their crops and livestock, smart agriculture monitoring and controlling systems (SAC systems) collect and analyze data from sensors in the field. SAC systems can be used to estimate crop yields and spot potential issues early on in addition to automating processes like irrigation, fertilization, and pest management. Increased agricultural yields and quality: By giving farmers up-to-the-minute updates on the condition of their crops, SAC systems can support farmers in maximizing crop production. Reduced use of water, fertilizer, and pesticides: By automating and improving these processes, SAC systems can assist farmers in reducing their usage of water, fertilizer, and pesticides. This can help farmers save money while also preserving the environment. Enhanced agricultural operations efficiency: SAC systems can assist farmers in enhancing their agricultural operations efficiency by automating chores like irrigation, fertilization, and insect management.

Farmers may have more time as a result, which will allow them to concentrate on other activities like marketing their crops. Enhanced sustainability of agricultural methods: By lowering a farmer's dependency on water, fertilizer, and pesticides, SAC systems can aid in enhancing the sustainability of agricultural activities.By doing so, you can assure future environmental protection and future generation haveto access the food.

Keywords—*smart agriculture monitoring and controlling system for farming, ESP32,temperature Sensors, Solar panels.,*

CHAPTER – I

INTRODUCTION

A type of agricultural technology known as smart agriculture monitoring and controlling systems (SAMCS) employs sensors, wireless connection, and data analyticsto assist farmers in monitoring and managing their crops and livestock. Data on a varietyof variables, such as soil moisture, temperature, humidity, nutrient levels, and pest anddisease activity, can be gathered using SAMCS. Then, this information can be utilized to automate processes like fertilization, pest management, and irrigation, as well as to assist farmers in making better choices regarding their farming methods.

There are numerous agricultural systems that can be monitored and managed using SAMCS, including:

- Crop fields.
- Livestock farm.
- Orchards and vineyards.
- Green house.
- Aquaculture operations.

Enhanced productivity and efficiency: SAMCS can assist farmers in automating jobs, saving time, and choosing better farming practices. Crop yields may increase as a result, increasing revenue.

Cost savings: SAMCS can assist farmers in saving money on water, fertilizer, and insecticides. This is so that farmers can avoid overusing inputs and apply the properquantity at the proper time with the aid of SAMCS.

Reduced environmental impact: SAMCS can assist farmers in minimizing their environmental impact by assisting them in more effective use of water, fertilizer, and insecticides. The early detection and treatment of pests and illnesses by farmers withthe use of SAMCS can help reduce the need for pesticides.

1.1 AIM:

A comprehensive system that uses sensors, data analytics, and automation to monitor and manage many elements of agricultural production is known as a smart agriculture monitoring and controlling system. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over the farm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes,including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically. Alternatively, the device can fertilize the crops automatically when the soil nutrient levels fall below a predetermined level.

1.2 OBJECTIVES:

By utilizing sensors, data analytics, and automation to track and manage environmental conditions, crop growth, and livestock health, a smart agriculture monitoring and controlling system for systems aims to increase the productivity and efficiency of agricultural operations. Sensors can be used by smart agriculture systems to gather information on environmental factors including temperature, humidity, soil moisture, and light levels. Using this information, one may spot future issues like pests or drought and take appropriate action. Systems for intelligent agriculture can also be used to regulate environmental factors like fertilizer and irrigation. In addition to helping to savemoney, this can guarantee that crops receive the right amount of nutrients and water. Sensors can be used in smart agriculture systems to track the growth and development of crops. With the help of this information, potential issues can be identified, such as illnesses or nutrient deficiencies, and solutions can be found. Crop growth can also be regulated using smart agriculture systems, for example by modifying irrigation and fertilization schedules. This may contribute to higher agricultural yields and better crop quality. Sensors can be used in smart agriculture systems to track the activity and healthof cattle. This information can be utilized to spot possible issues, such illnesses or injuries, and to take appropriate action. The health of animals can also be managed usingsmart agriculture systems, for example by giving medication or changing feed amounts.The production and health of animals may both benefit from this.

1.3 INTRODUCTION TO THE PROPOSED METHODOLOGY:

The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over the farm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically. Alternatively, the devicecan fertilize the crops automatically when the soil nutrient levels fall below a predetermined level. By utilizing sensors, data analytics, and automation to track and manage environmental conditions, crop growth, and livestock health, a smart agriculture monitoring and controlling system for systems aims to increase the productivity and efficiency of agricultural operations. Sensors can be used by smart agriculture systems to gather information on environmental factors including temperature, humidity, soil moisture, and light levels. Using this information, one may spot future issues like pestsor drought and take appropriate action. Systems for intelligent agriculture can also be used to regulate environmental factors like fertilizer and irrigation. In addition to helping to save money, this can guarantee that crops receive the right amount of nutrients and water. Sensors can be used in smart agriculture systems to track the growth and development of crops. With the help of this information, potential issues can be identified, such as illnesses or nutrient deficiencies, and solutions can be found. Crop growth can also be regulated using smart agriculture systems, for example by modifying irrigation and fertilization schedules. This may contribute to higher agricultural yields and better crop quality. Sensors can be used in smart agriculture systems to track the activity and health of cattle. This information can be utilized to spot possible issues, such illnesses or injuries, and to take appropriate action.

1.4 ADVANTAGES OF IoT-BASED AUTONOMOUS VEHICLE CONTROL:

Smart agriculture systems can assist farmers in increasing crop yields by giving them access to real-time data on crop health and environmental conditions, which can be usedto make more informed decisions about irrigation, fertilization, and pest control. Smartagriculture systems can also assist farmers in improving crop quality by giving them theability to more precisely control environmental conditions and crop growth, which canhelp to produce crops that are more nutritious. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over the farm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically. Alternatively, the device can fertilize the crops automatically when the soil nutrient levels fall below a predetermined level. By utilizing sensors, data analytics,and automation to track and manage environmental conditions, crop growth, and livestock health, a smart agriculture monitoring and controlling system for systems aimsto increase the productivity and efficiency of agricultural operations. Sensors can be used by smart agriculture systems to gather information on environmental factors including temperature, humidity, soil moisture, and light levels. Using this information, one may spot future issues like pests or drought and take appropriate action. Systems for intelligent agriculture can also be used to regulate environmental factors like fertilizer and irrigation. In addition to helping to save money, this can guarantee that crops receive the right amount of nutrients and water. Sensors can be used in smart agriculture systems to track the growth and development of crops. With the help of this information, potential issues can be identified, such as illnesses or nutrient deficiencies, and solutions can be found. Crop growth can also be regulated using smart agriculture systems, for example by modifying irrigation and fertilization schedules. This may contribute to higher agricultural yields and better crop quality. Sensors can be used in smart agriculture systems to track the activity and health of cattle. This information canbe utilized to spot possible issues, such illnesses or injuries, and to take appropriate action. system that uses sensors, data analytics, and automation to monitor and managemany elements of agricultural production is known as a smart agriculture monitoring and controlling system. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the systemcomprises of a network of sensors placed all over the farm. These sensors gather information on numerous environmental and crop health factors, including temperature,humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pestcontrol, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically.Alternatively, the device can fertilize the crops automatically when the soil nutrient levels fall below a predetermined level.

1.5 COMPARISON OF EXISTING AND PROPOSED:

Proposed Model	Existing Model
Level 3 autonomous, sensor-drivencontrol system	Data on environmental conditions, agricultural growth and livestock health can be gathered using a variety of sensors.
ESP32 microcontroller, ToF sensors,motor driver	Use a networked, cable, or wireless device to send data to a central server**.**

Utilizes ToF sensors for real-time obstacle detection and avoidance	Store data in database
No direct user control operates autonomously	Manual control by the user or limited automation
Limited to internal components, no external communication	Limited external connectivity, may lack IoT capabilities
High complexity due to autonomous navigation and sensor integration	Moderate complexity, simpler components
Autonomous transportation, surveillance, agriculture, industrial automation	Limited to basic tasks, remote controlapplications
Collects data from ToF sensors for navigation and decision-making	Limited data collection capabilities
Typically, higher costs due to advanced components and autonomous capabilities	Generally lower cost due to simplercomponents and manual control
Optimized for energy-efficient operation, efficient energy use	Energy consumption depends on user control and activity
Scalable for various applications requiring autonomous control	Limited scalability for more advanced applications
Adaptable to diverse environments and tasks	Limited adaptability, often designed for specific use cases
Advanced obstacle avoidance and navigation enhance safety	Safety relies on user decisions and control
Potential for energy-efficient transportation and reduced emissions	Limited environmental impact, often for entertainment

Table 2.1 Comparison between existing and proposed

1.6 SCOPE OF PROJECT:

The application of intelligent monitoring and control systems in agriculture is extensive and expanding. These systems can be utilized to enhance various facets of agricultural productivity, from aquaculture and forestry to crop and livestock production. Utilizing irrigation, fertilization, insect management, and crop growth monitoring and control are all possible with smart agriculture systems. Farmers may benefit from this by increasing agricultural yields, enhancing crop quality, cutting costs, and enhancing the sustainability of their business operations. Systems for smart agriculture can be used to monitor and manage the breeding, feeding, and health of cattle. This can assist farmers in lowering expenses, enhancing the sustainability of their business operations, and improving the health and productivity of their livestock.

Hardware Integration:

Hardware integration is the process of joining several hardware elements, such as sensors, actuators, and controllers, to create a comprehensive system for smart agriculture monitoring and controlling systems. Hardware integration aims to produce a dependable, scalable, and user-friendly system.The selection of the appropriate components for the task is one of the most crucial parts of hardware integration. Based on the particular environmental factors and agricultural parameters that need to be tracked, sensors should be chosen. Depending on the particular components that need tobe controlled, actuators should be chosen. Depending on the system complexity and desired level of automation, controllers should be chosen.

Software Development*:*

Popular open-source platform Arduino is used to create embedded electronics. A number of smart agriculture tools, including soil moisture sensors and irrigation controllers, can be created using Arduino. A number of different smart farm devices canbe created using the widely used and reasonably priced Raspberry Pi computer. A cloud-based platform called AWS IoT Core can be used to connect and control IoT devices. Using AWS IoT Core, smart agriculture systems that can scale to accommodate a largenumber of devices can be created.

Wireless Connectivity and IoT Communication*:*

The project will explore the integration of wireless connectivity, leveraging the ESP32's capabilities, to enable remote control and real-time data transmission. The IoT aspect involves establishing communication between the autonomous vehicle, other IoT devices, and centralized control systems. This connectivity allows the vehicle to receive updates on traffic conditions, road closures, and other critical information, enhancing its adaptability to dynamic scenarios.

Testing and Demonstration*:*

There are various methods for testing and demonstrating smart agriculture monitoring and controlling systems. Testing the system in a controlled setting, like a lab or greenhouse, is a typical strategy. This makes it possible to test the device in a variety ofsettings without running the risk of endangering livestock or crops.

A different strategy is to field test the system. This makes it possible to evaluate the system using actual crops or livestock and real-world settings. However, field testing can be more difficult and expensive, and it's crucial to take precautions to reduce the possibility of harm to livestock or crops.

Future Prospects*:*

The scope extends to exploring future possibilities and advancements in the field. This may involve the integration of advanced artificial intelligence (AI) algorithms for more intelligent decision-making, the exploration of advanced vehicular networking protocols, and enhancements in energy efficiency.

CHAPTER 2

LITERATURE REVIEW:

The development of IoT-based autonomous vehicles represents an infusion of technologies, as evidenced by the literature. This section provides an overview of relevant studies that contribute to the understanding and implementation of autonomousvehicles using components such as ESP32, ToF sensors, Bluetooth controllers, and IoT connectivity. Carducci et al. (2019) outline the role of ESP32 in enabling IoT applications in building automation systems, underscoring the adaptability of ESP32 in diverse scenarios [1]. Similarly, Schraven et al. (2019) contributes by designing a development board for research on IoT applications within building automation systems, emphasizing the practical implications of ESP32 integration [2]. The ESP32's capabilities are thoroughly explored in the overview by Espressif Systems (Shanghai) Co., Ltd., providing insights into its features and applications [3].

The significance of open protocols in building automation systems is highlightedby Schneider Electric's guide, emphasizing seamless integration in automated environments [4]. Studies by Maier et al. (2017) and Ghosh et al. (2018) showcase practical implementations of ESP32 in IoT contexts, validating its potential beyond conventional vehicle applications [5] [6]. Rai and Rehman (2019) delve into theapplication of ESP32 in a smart surveillance system, further showcasing its versatility [7]. Bluetooth controllers play a important role in vehicle control interfaces. Pahuja andKumar (2014) present an Android mobile phone-controlled Bluetooth robot using a microcontroller, emphasizing remote control mechanisms [8]. Similarly, Singh et al. (2011) offer insights into Bluetooth wireless technology, a foundational component of communication for autonomous vehicles [9]. Chinmayi et al. (2018) contributes to the field with an obstacle detection and avoidance robot, showcasing the application of advanced sensor systems [10].

Additional studies, such as those by Arvind Kumar Saini et al. (2015) and Singh et al. (2017), further explore Bluetooth-controlled robots, highlighting the feasibility of remote-controlled mechanisms [11] [12]. Hossain et al. (2017) present an IoT-based autonomous vehicle design aided by computer vision, underscoring the potential of sensor fusion for enhanced perception [13]. Advances in autonomous vehicles' modelingand self-defense mechanisms are explored in the works of Bairy (2022) and Mazri and Tibari (2022) [14] [15].

The importance of Explainable Artificial Intelligence (XAI) in autonomous vehicles is discussed by Madhav and Tyagi (2023), bridging the gap between AI decisions and human trust [16]. Li et al. (2023) delves into understanding driver preferences in highly autonomous vehicles, aligning with the human-centered approach [17]. ToF sensors are integral to perceiving the vehicle's environment. The study by Kolb et al. (2008) highlights the impact of ToF sensors on realism and interactivity [18]. Other studies, such as those by Jain et al. (2012), Espinosa (Northwestern University), and Ansari et al. (2015), further emphasize the role of sensors and communication in robotics [19] [20] [21].

In conclusion, the reviewed literature underscores the multidimensional nature ofIoT-based autonomous vehicles, blending ESP32, ToF sensors, Bluetooth controllers, and advanced algorithms. These insights contribute to the development of vehicles thatredefine transportation, safety, and connectivity.

CHAPTER – 3

OBJECTIVE AND METHODOLOGY

. Smart agriculture systems can also assist farmers in improving crop quality by giving them the ability to more precisely control environmental conditions and crop growth, which can help to produce crops that are more nutritious. The technique can beused to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all overthe farm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity.The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically.

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To ensure user-friendly interaction and control, the development of a responsive UI is a key objective. Our goal is to design a UI that empowers users to dictate the vehicle's direction through intuitive commands. This UI will serve as a communicationchannel between the user and the vehicle, offering real-time feedback and simplifying the testing of various vehicle features. Methodologically, we adopt a phased development process. We start with the selection and evaluation of hardware components, ensuring the ESP32 microcontroller, ToF sensors, motor driver, andnecessary sensors are carefully chosen for the project. The next phase focuses on the design and circuit connections, where we refer to datasheets and documentation to connect the components securely and ensure proper power supply and communication lines.

Programming the ESP32 using Arduino IDE is a crucial step in our methodology. We develop logic for sensor data processing, motor control, obstacle detection, and user interface interaction. Libraries and APIs are incorporated for seamless integration, and sensor calibration is performed to fine-tune parameters for optimal functionality. The implementation of advanced algorithms for autonomous movement is a key aspect of our methodology. These algorithms utilize ToF sensor data for obstacle detection and collision avoidance, ensuring safe navigation. The development of the UI using appropriate software tools is another critical step, emphasizing a user-friendly app or web interface for remote control and real-time feedback. Leveraging the ESP32's Wi-Fi capabilities for remote control and data transmission is integrated into our methodology.We configure the ESP32 to connect to a Wi-Fi network, enabling users to interact with the vehicle through the UI from anywhere. The final phases involve the integration of all components, thorough testing in controlled environments, and the demonstration of the fully functional autonomous vehicle. We gather user feedback during the demonstration to improve the user experience.

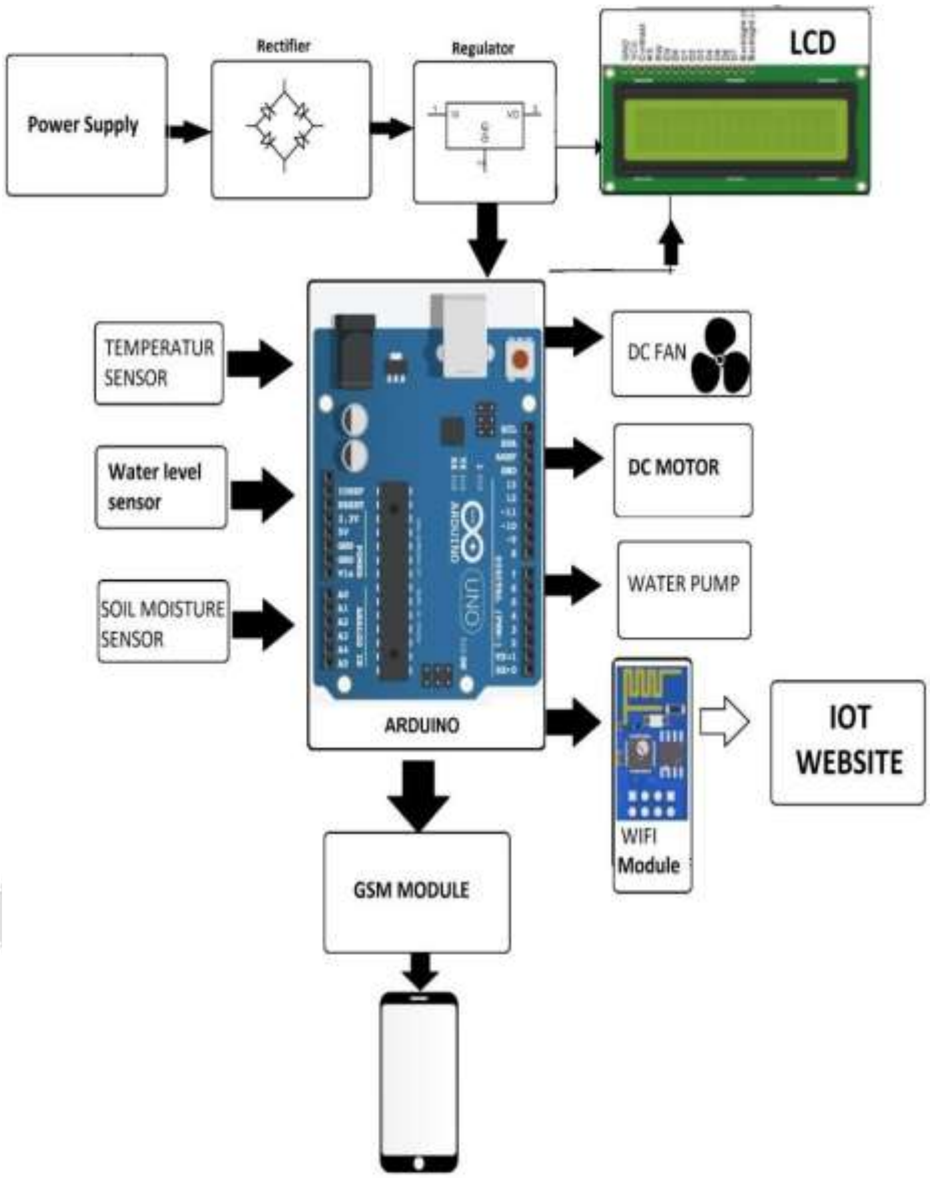

Figure 3.1 Flow diagram

3.1 SELECTION OF COMPONENTS

3.1.1 Selection of Microcontroller

- ESP32 serves as the central processing unit, providing robust performance fordata processing and decision-making.
- Acts as the intelligence hub, processing sensor data and executing controlalgorithms for autonomous vehicle operations.
- Known for its versatility and user-friendly nature, ESP32 is Foremost importantin developing functional prototypes for obstacle avoidance and navigation.
- Enables seamless communication between the vehicle, other IoT devices, andcentralized control systems for real-time updates.
- Integrates with ToF sensors, motor drivers, and UI, showcasing its adaptability increating a comprehensive IoT-based autonomous vehicle.

Figure 3.1.1 ESP32

3.1.2 **Selection of Sensor**

- Measure the temperature of the water, soil, or air with a temperaturesensor.Measure the amount of water vapor in the air using humidity sensors.
- Measure the amount of water in the soil using soil moisture sensors.
- pH sensors: Determine the soil's acidity or alkalinity.Sensors that measure light intensity: Calculate light intensity.Measure the amount of carbon dioxide in the air using carbon dioxide sensors.
- Sensors for nutrients: Check the amount of nutrients in the water or soil.Sensorsfor pests and illnesses: Find out whether crops have pests or diseases.Estimate crop yield using yield sensors.
- sensors that track animal health: Keep tabs on livestock.Track the whereabouts of cattle with animal location sensors.

Figure 3.1.2 TEMPERATURE SENSOR

3.1.2 **Selection of Ph sensor**

- In smart agriculture, pH sensors are an essential component of monitoring andmanagement systems for farming. For crops to grow and develop, pH, a measurement of a substance's acidity or alkalinity, is essential. The ideal pH range for the majority of crops is 6.0 to 7.5.
- Crop yields can be increased by using pH sensors to keep the soil's pH within adesirable range.
- Cost savings: By maximizing fertilizer application rates and minimizing theneed to use lime needlessly, pH sensors can assist farmers in saving money.
- Savings: pH sensors can help farmers save money by maximizing fertilizerapplication rates and reducing the need to use lime unnecessarily.

Figure 3.1.3 Ph SENSOR

3.2 SOFTWARE USED

3.2.1 Arduino Ide

Arduino IDE serves as the coding environment for our autonomous vehicle project, offering a user-friendly platform for programming the ESP32 microcontroller. This IDE streamlines code development with its intuitive interface, making it accessible for both beginners and experienced developers. The compatibility between Arduino IDE and ESP32 is crucial, ensuring a seamless integration process. Within Arduino IDE, we harness the power of libraries and APIs to enhance functionality, incorporating pre-built code snippets and tools. This not only accelerates development but also ensures a robust and well-supported programming environment.

3.2.2 Blynk Iot

Blynk is an Internet of Things (IoT) platform that facilitates the development of connected devices and applications. It provides a user-friendly environment for creating IoT projects without the need for extensive coding or hardware expertise. Blynk provides a drag-and-drop interface that allows users to easily design their control panels or dashboards for IoT projects. This can include buttons, sliders, displays, and other widgets. Blynk supports a variety of popular hardware platforms, including Arduino, Raspberry Pi, ESP8266, ESP32, and more. This makes it versatile and adaptable to different project requirements. it offers a range of widgets (UI components) that users can add to their projects, such as buttons, sliders, graphs, and displays. It also supports features like push notifications and data logging. In this project, we Utilized Blynk's user-friendly interface to create a mobile app for controlling the autonomous vehicle. Leverage Blynk's compatibility with ESP32 to establish a robust connection, enabling real-time communication. Enhancing user interaction by integrating Blynk's features, allows users to remotely control the vehicle's direction, speed, and functionalities.

COMPONENTS	PARAMETERS	VALUE
Arduino	Clock speed	Up to 240MHz
	Operating voltage	3.3v
	Analog input pins	18
	DC per i/o pin	12ma

Ph sensor	Measuring range	0.10-15.0m
	Measuring accuracy	+/-0.01 pH
	Power supply	3.7-5.2V
	Weight	7.7g
ESP32	Operating Voltage	4.5-4.6V
	Single channel current	2A
	H-bridge	Bipolar Transistor H-bridge

Table 3.1.4 List of Components

CHAPTER 4

PROPOSED WORK AND MODULES

4.1 INTRODUCTION:

A type of agricultural technology known as smart agriculture monitoring and controlling systems (SAMCS) employs sensors, wireless connection, and data analytics to assist farmers in monitoring and managing their crops and livestock. Data on a variety of variables, such as soil moisture, temperature, humidity, nutrient levels, and pest and disease activity, can be gathered using SAMCS. Then, this information can be utilized to automate processes like fertilization, pest management, and irrigation, as well as to assist farmers in making better choices regarding their farming methods. . Smart agriculture systems can also assist farmers in improving crop quality by giving them the ability to more precisely control environmental conditions and crop growth, which can help to produce crops that are more nutritious. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over the farm. These sensors gather information on numerousenvironmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically.

4.2 PROPOSED WORK:

The application of intelligent monitoring and control systems in agriculture is extensive and expanding. These systems can be utilized to enhance various facets of agricultural productivity, from aquaculture and forestry to crop and livestock production. Utilizing irrigation, fertilization, insect management, and crop growth monitoring and control areall possible with smart agriculture systems. Farmers may benefit from this by increasingagricultural yields, enhancing crop quality, cutting costs, and enhancing the sustainability of their business operations. Systems for smart agriculture can be used tomonitor and manage the breeding, feeding, and health of cattle. This can assist farmersin lowering expenses, enhancing the sustainability of their business operations, and improving the health and productivity of their livestock. Then, this information can be utilized to automate processes like fertilization, pest management, and irrigation, as wellas to assist farmers in making better choices regarding their farming methods. . Smart agriculture systems can also assist farmers in improving crop quality by giving them the ability to more precisely control environmental conditions and crop growth, which canhelp to produce crops that are more nutritious. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over the farm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity. The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. This may contribute to higher agricultural yields and bettercrop quality. Sensors can be used in smart agriculture systems to track the activity and health of cattle. This information can be utilized to spot possible issues, such illnesses or injuries, and to take appropriate action. system that uses sensors, data analytics, and automation to monitor and manage many elements of agricultural production is known as a smart agriculture monitoring and controlling system. The technique can be used to increase crop yields, lower expenses, and have a minimal negative impact on the environment. Usually, the system comprises of a network of sensors placed all over thefarm. These sensors gather information on numerous environmental and crop health factors, including temperature, humidity, soil moisture, nutrient levels, and pest activity.The data is then sent to a central server, where it is examined and put to use to produce conclusions and suggestions. The system can be used to automate a number of processes, including pest control, fertilization, and irrigation. When the amount of soil moisture falls below a predetermined level, the irrigation system, for instance, can be turned on automatically.

4.3 METHODOLOGY:

The methods of cultivation with regard to groundnut and banana fields are discussed in this section. Experiments are conducted on fields such as paddy, groundnut,banana, and sugarcane. In India, groundnut output ranks second highest, and there are primarily two types of groundnut cultivation:

Physical layer: A layer of automation for managing the smart agriculture system is thephysical layer. A control monitoring system and sensors are included in the automationprocess controller. Its functions include managing and controlling the sensors and performing system device monitoring. Soil moisture sensors, temperature sensors, motion detection sensors, water level sensors, and photosynthesis sensors are all used inthe automation process. This sensor is a component of the IoT Layer's IoT Devices category. These sensors are designed to monitor soil moisture levels, crop waterrequirements, plant temperature, environmental conditions, and animal motion. The automation field was observed using CCTV cameras, infrared cameras, water systems,and weather monitoring systems.

Automation process controller: The sensors and monitoring tools of the physical layerprovide input to the IoT devices.

The in-house server makes use of the Internet of Things data manager, which gets real-time data from the system controller. It briefly stores data on a local server. The cloud receives data from the gateway and analyzes it before starting the appropriate service. Through a clearly defined security channel, the Com-Op layer gets real-time data fromthe IoT layer. Depending on the data received, a specific service is then selected.

IoT layer: The IoT layer is where data from the physical field is gathered andtransferred to the Comp-op layer for additional processing. A system controller is present in the IoT layer, and the IoT devices are connected to it. For instance, a physicallocal system collects data from the devices and uses this system controller to move it from the local server to the main cloud server. The IoT devices feed data to the controllerand issue alerts every second, notifying the controller of any changes. Digital cameras, embedded electronics, and wireless sensors are the core components of the automationsystem. As a regional server, the in-house servers are employed.

Sensor Integration and Calibration: Integrate the ToF sensors with the ESP32 to enable accurate distance measurements and obstacle detection. Develop and implementalgorithms for sensor data processing, ensuring precise calibration for optimal performance. Verify the reliability of sensor data through systematic testing.

Motor Control Logic: The energy management and monitoring system is used to regulate the energy and power resources utilized in the automation process in order to conserve and minimize power and increase the efficiency of automation.

UI Development and Integration: Design a user-friendly interface using platforms likeBlynk for remote control and real-time feedback. Collaborate on creating UI elements that allow users to interact with the autonomous vehicle. Integrate the UI with the ESP32code to establish bidirectional communication.

Wi-Fi Connectivity: Leverage the ESP32's Wi-Fi capabilities for remote control and data transmission. Configure the ESP32 to connect to a Wi-Fi network, enabling users to interact with the vehicle through the UI from any location. Test the robustness of Wi-Fi connectivity.

Integration Testing: Assemble all hardware and software components for comprehensive integration testing. Validate the interaction between sensors, motor control, and the UI. Identify and resolve any issues that may arise during the integrationprocess.

Demonstration and User Experience: Demonstrate the fully functional autonomous vehicle to showcase its capabilities. Allow users to interact with the UI, control the vehicle's movement, and receive real-time feedback. Gather user feedback to improve the user experience.

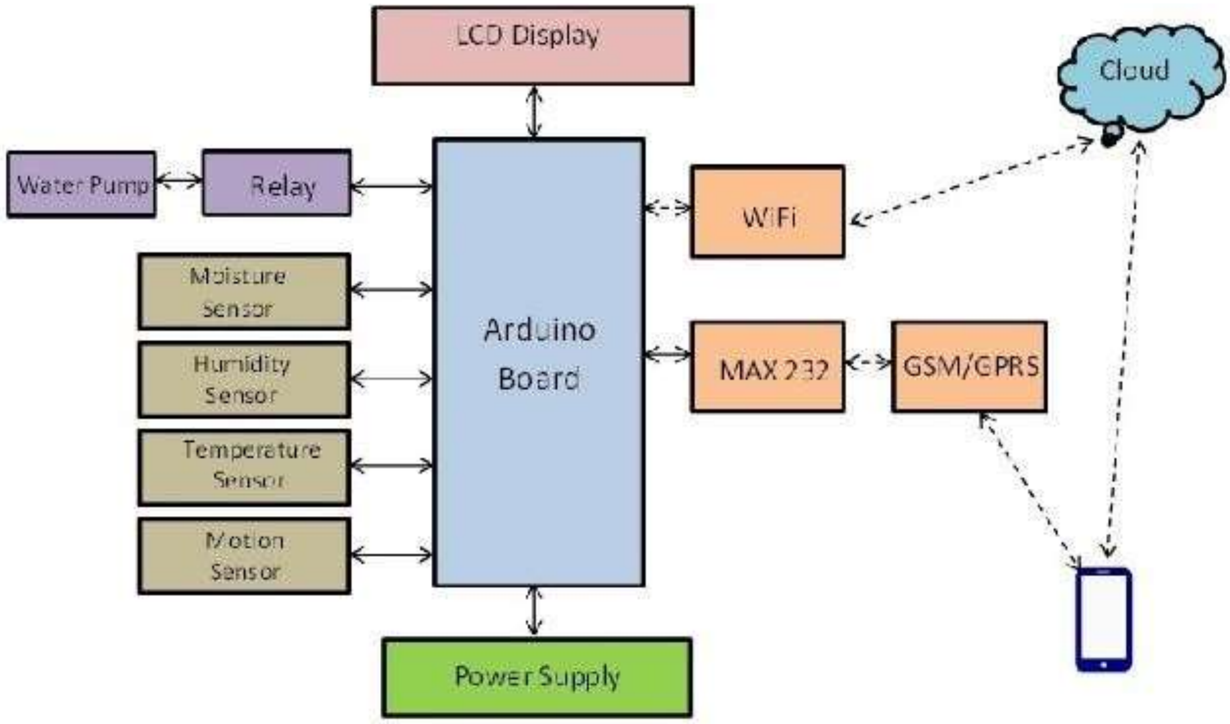

Figure 4.3.1 Block Diagram

4.4 CALIBRATION AND TESTING:

Calibration and testing play a vital role in ensuring the precision and reliability of an IoT-based autonomous vehicle's control system. In the context of our project utilizing ESP32, ToF sensors, LM298D motor driver, and a user interface (UI) developed with the Blynk IoT platform, the calibration process focuses on fine-tuning sensor parametersand validating system functionality.

Sensor Calibration:

The Time-of-Flight (ToF) sensors are critical components for accurate distance measurements and obstacle detection. During calibration, meticulous adjustments are made to sensor settings to achieve optimal performance. This involves configuring parameters such as measuring range, accuracy, and power supply to ensure the sensors provide reliable and consistent data. The calibration process is iterative, involving testing the sensors in controlled environments to verify their responsiveness and accuracy in different scenarios. Fine-tuning these parameters ensures the ToF sensors deliver precise distance measurements, forming the foundation for reliable obstacle detection and collision avoidance.

Testing:

The testing phase encompasses comprehensive evaluations of each system component, validating their functionalities and interactions within the integrated system.

- **Sensor Testing:** Verify the accuracy of ToF sensors by placing obstacles at varying distances. Ensure the sensors can detect and measure these distances accurately. This phase ensures that the obstacle detection mechanism is robust and dependable.
- **Motor Control Testing:** Evaluate the LM298D motor driver's ability to translatecontrol signals from the ESP32 into precise movements. Test acceleration, deceleration, and steering mechanisms to ensure smooth and controlled vehicle motion.
- **UI Testing:** Validate the UI's responsiveness and bidirectional communication with the ESP32. Test remote control features through the UI, ensuring that commands are accurately interpreted and executed by the vehicle.
- **Integration Testing:** Assess the harmonious collaboration of all components. Conduct tests where the vehicle receives commands from the UI processes information from ToF sensors, and executes motor control decisions seamlessly.Integration testing ensures that the system performs reliably as a whole.
- **Real-world Scenarios:** Simulate real-world scenarios to validate the vehicle's autonomous capabilities. Test its navigation in diverse environments, obstacle avoidance in dynamic settings, and responsiveness to remote commands throughthe UI.

CHAPTER 5

RESULTS AND DISCUSSION

The final result of our project is detailed in this chapter. Upon discussion with ourguide and assessors, we finished by considering all the corner cases and the existing problems.

5.1 RESULT

The development of an IoT system for agriculture could address numerous immediate problems by

Farmers can access a large number of outcomes from real-time data from the crop field thanks to quality and production management. The cloud connects three layers in the architecture, The devices are all connected, and all data is uploaded, processed, and retrieved by API libraries. A process flow outlining how to cultivate crops from seedingthrough harvest is presented. The experimentation is done on groundnut and banana crops, and the signals from various sensors are gathered and put in the cloud to combinewith IoT for automation and effective decision-making. The system is operating successfully and efficiently. The architecture suggested in this study might serve as a foundation for the creation of an IoT-based smart agriculture system.

The layers used in this architecture are intended to store, manage, and monitor crop growth information as well as to provide effective decision-making for the use of fertilizers, water supply, and crop planting based on information gathered from sensors connected to the field's ground. The planned work has been examined in live agriculturalfields to determine its process.

milliseconds	Moisturizersensor reading
1	673
2	675
3	656
4	634
5	643
6	678
7	687
8	663
9	661
10	679
11	656
12	645

Figure 5.1.1 smart agriculture monitoring and controlling system

	Proposed IoT Autonomous Vehicle	**Existing**
Accuracy (%)	92%	75%
Autonomy Level	High	Low
Connectivity Range (m)	100	30
Obstacle Detection Range(m	10	5
Energy Consumption (W)	15	20
Safety Rating	9/10	6/10
Adaptability	High	Low
User Interface	Smart Phone	Remote Control
Cost	7000	5000

Table 5.1.3 Results

5.2 SIGNIFICANCE

The significance of IoT-based autonomous vehicle control lies at the forefront of a transformative era in transportation technology, reshaping the way we perceive, interact with, and manage vehicular systems. This approach amalgamates the Internet of Things(IoT) with autonomous vehicles, presenting a myriad of benefits that extend beyond traditional modes of transportation. One of the primary significances is the substantial enhancement in safety and efficiency. Autonomous vehicles, equipped with IoT technologies, can navigate through complex environments with a heightened level of precision and awareness.

The integration of sensors, such as Time-of-Flight (ToF) sensors, enables these vehicles to perceive their surroundings in real-time, accurately detecting obstacles, pedestrians, and other vehicles. This comprehensive awareness translates into advanced collision avoidance mechanisms, making roads safer for both passengers and pedestrians. The fusion of IoT facilitates seamless communication between autonomous vehicles, traffic infrastructure, and centralized control systems, ensuring real-time updates on traffic conditions, road closures, and critical information for adaptive decision-making. Moreover, the IoT-based autonomous vehicle control contributes to the optimization of overall transportation efficiency. These vehicles can intelligently navigate through traffic, adapt to changing road conditions, and optimize routes based on real-time data. This not only reduces travel time but also minimizes congestion and fuel consumption, contributing to a more sustainable and eco-friendly transportation ecosystem.

5.3 LIMITATIONS OF PROPOSED WORK

IoT-based autonomous vehicle control, while offering numerous advantages, faces significant limitations that must be addressed for successful deployment. One primary concern is the vulnerability of interconnected IoT devices to cyber threats, introducing risks such as unauthorized access and data breaches. Ensuring robust cybersecurity measures is crucial to safeguard the vehicle's control systems against malicious manipulation. Additionally, the reliability of communication networks poses a challenge, as disruptions or latency issues may compromise real-time decision-making capabilities, impacting the safety of autonomous vehicles. The high cost associated with implementing and maintaining IoT infrastructure, environmental factors affecting sensor accuracy, evolving regulatory frameworks, and concerns about public trust further contribute to the limitations that require thoughtful consideration and resolution. Addressing these challenges through advancements in cybersecurity, network reliability, cost reduction measures, environmental adaptability, regulatory clarity, and public awareness is essential to unlock the full potential of IoT-based autonomous vehicle control.

5.4 COAT BENEFIT ANALYSIS

The cost-benefit analysis for an IoT-based autonomous vehicle control system involves evaluating the expenditures against the potential advantages and long-term gains. In the case of this project, utilizing components such as ESP32, Time-of-Flight (ToF) sensors, LM298D motor driver, and a user interface (UI) via Blynk IoT, the analysis is crucial for decision-making and resource allocation.

LIST OF PRODUCTS	**OST(Rs)**
ESP8266 NodeMCU CP2102 Board	299
DF Robot Fermion VL6180X ToF Distance Ranging Sensor(Breakout)	636
TowerPro MG9OS Mini Digital Servo Motor (180 Rotation)	235
L298N 2A Based Motor Driver Module	119
ESP32-WROOM-32DIoT Development Board Module for Arduino	505
OTHER COMPONENTS	1000
TOTAL	**2794**

Table 5.4.1 Cost Analysis

CHAPTER 6

CONCLUSION

6.1 CONCLUSION FOR PROPOSED SOLUTION:

IoT will improve intelligent farming. The technology can monitor and manage the irrigation system by forecasting the humidity and soil moisture levels. IoT helps improve time management, water management, crop monitoring, soil management, andpesticide and insecticide control in several areas of farming. Additionally, this approachreduces the amount of labor required by humans, streamlines farming practices, and promotes smart farming. In addition to the benefits this system offers, smart farming can, with only a single touch and no work, aid in expanding the farmer market.

ACKNO.The motor driver's role in controlling the vehicle's movement is fundamental,enabling precise control over speed and direction. This aspect has greatly contributed tothe vehicle's capacity for autonomous navigation and effective maneuvering. TheESP32's versatility has been evident, acting as the central hub for processing sensor data,executing commands, and making real-time decisions.As a result, Researchers are focusing on creating additional features and functionality for smart agriculture systems in addition to addressing the aforementioned restrictions.Researchers are striving to create systems that can employ artificial intelligence to forecast agricultural growth and cattle health, for instance. They are also working on creating systems that can control numerous things at once.

6.2 SUGGESTION FOR FUTURE WORK:

The experimentation is done on groundnut and banana crops, and the signals from various sensors are gathered and put in the cloud to combine with IoT for automation and effective decision-making. The system is operating successfully and efficiently. Thearchitecture suggested in this study might serve as a foundation for the creation of an IoT-based smart agriculture system.

The layers used in this architecture are intended to store, manage, and monitor crop growth information as well as to provide effective decision-making for the use of fertilizers, water supply, and crop planting based on information gathered from sensorsconnected to the field's ground. The planned work has been examined in live agricultural fields to determine its Investigating alternative power sources and optimizing energy consumption can contribute to the sustainability of autonomous vehicles. Implementingeco-friendly solutions aligns with the broader goal of creating environmentally conscious transportation systems. Furthermore, enhancing the cybersecurity measures of IoT-based autonomous vehicles is crucial for ensuring their resilience against potential cyber threats. Future work should focus on developing robust security protocols to safeguard communication channels, prevent unauthorized access, and protect the integrity of data exchanged between vehicles and the infrastructure. The integration of sensor fusion techniques, beyond the currently employed Time-of-Flightsensors, could significantly improve perception capabilities.

Researchers are also focusing on building user-friendly interfaces and tools for smart agriculture systems. This would make the systems easier to use and maintain for farmerswho are not familiar with the technology.

CHAPTER 7

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APPENDICES

I. BILLING:

LIST OF PRODUCTS	**OST(Rs)**
ESP8266 NodeMCU CP2102 Board	299
DF Robot Fermion VL6180X ToF Distance Ranging Sensor(Breakout)	636
TowerPro MG9OS Mini Digital Servo Motor (180 Rotation)	235
L298N 2A Based Motor Driver Module	119
ESP32-WROOM-32DIoT Development Board Module for Ardunio	505
OTHER COMPONENTS	1000
TOTAL	**2794**

I. CODING:

```
#define BLYNK_TEMPLATE_ID "TMPL3ioi0p-BR"
#define BLYNK_TEMPLATE_NAME "IOT Controlled Robotic Vehicle" #define BLYNK_AUTH_TOKEN
"qciU0pxVJpAaZZPPdNHZ_O-ZNiqQHI2c"

#define BLYNK_PRINT Serial

//#include <ESP8266WiFi.h>
//#include <BlynkSimpleEsp8266.h>

#include <WiFi.h> #include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
char auth[] = BLYNK_AUTH_TOKEN;char ssid[] = "Elite Sytems";
char pass[] = "Elite2022";

    #define ENA        13// Enable/speed motors Right        GPIO14(D5)
    #define ENB        12// Enable/speed motors Left         GPIO12(D6)
    #define IN_1   14    // L298N in1 motors Rightx          GPIO15(D8)
    #define IN_2   27    // L298N in2 motors Right           GPIO13(D7)
    #define IN_3   26    // L298N in3 motors Left            GPIO2(D4)
    #define IN_4   25    // L298N in4 motors Left            GPIO0(D3)
```

```
int speedCar = 100;#include <Wire.h>
#include "Adafruit_VL6180X.h" Adafruit_VL6180X vl = Adafruit_VL6180X();

void goAhead(){

digitalWrite(IN_1, LOW); digitalWrite(IN_2, HIGH); analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW); digitalWrite(IN_4, HIGH); analogWrite(ENB, speedCar);
}

void goBack(){

digitalWrite(IN_1, HIGH); digitalWrite(IN_2, LOW); analogWrite(ENA, speedCar);

digitalWrite(IN_3, HIGH); digitalWrite(IN_4, LOW); analogWrite(ENB, speedCar);
}

void goRight(){

digitalWrite(IN_1, HIGH); digitalWrite(IN_2, LOW); analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW); digitalWrite(IN_4, HIGH); analogWrite(ENB, speedCar);
}

void goLeft(){

digitalWrite(IN_1, LOW); digitalWrite(IN_2, HIGH); analogWrite(ENA, speedCar);

digitalWrite(IN_3, HIGH); digitalWrite(IN_4, LOW); analogWrite(ENB, speedCar);
}

void stopRobot(){

digitalWrite(IN_1, LOW);digitalWrite(IN_2, LOW);

analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW); digitalWrite(IN_4, LOW); analogWrite(ENB, speedCar);
}


BLYNK_WRITE(V0)
{
int button = param.asInt(); // read buttonif (button == 1) { Serial.println("Moving forward"); goAhead();
}
else { Serial.println("Stop"); stopRobot();
}
}

BLYNK_WRITE(V1)
{
int button = param.asInt(); // read buttonif (button == 1) { Serial.println("Moving backward"); goBack();
```

```
  }
else { Serial.println("Stop");stopRobot();
  }
  }

  BLYNK_WRITE(V2)
  {

  int button = param.asInt(); // read buttonif (button == 1) { Serial.println("Moving Right"); goRight();
  }
else { Serial.println("Stop");stopRobot();
  }
  }

  BLYNK_WRITE(V3)
  {
  int button = param.asInt(); // read buttonif (button == 1) { Serial.println("Moving Left");
  goLeft();
  }
else { Serial.println("Stop");stopRobot();
  }
  }

  void setup()
  {
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);pinMode(ENB, OUTPUT);
  pinMode(ENA, OUTPUT); pinMode(IN_1, OUTPUT); pinMode(IN_2, OUTPUT); pinMode(IN_3, OUTPUT);
  pinMode(IN_4, OUTPUT);stopRobot();
  Serial.println("Adafruit VL6180x test!");


  if (! vl.begin()) { Serial.println("Failed to find sensor");while (1);
  }
  Serial.println("Sensor found!");
  }

  void loop()
  {
  Blynk.run();
  uint8_t range = vl.readRange(); uint8_t status = vl.readRangeStatus();

  if (status == VL6180X_ERROR_NONE) {
  Serial.print("Range: "); Serial.println(range);Blynk.virtualWrite(V4,range);
  }

  float lux = vl.readLux(VL6180X_ALS_GAIN_5);Serial.print("Lux: "); Serial.println(lux);
  Blynk.virtualWrite(V5,lux);



  delay(1000);
  }
```

II. WORK CONTRIBUTION:

STUDENT NUMBER 1:

Project Title: **SMART AGRICULTURE MONITORING ANDCONTROLLING SYSTREMS FOR FARMING**

Student Name: **AKSHYA SRI S**
Register Number:**201EC110**

Hardware:

- Physical devices like greenhouse vents, fertilizer injectors, and irrigation pumpsare all controlled by actuators.
- Solenoid, relay, and motor actuators are a few of the often-utilized devices insmart agriculture.
- The system may send and receive data to and from the cloud as well as to otherdevices thanks to the communication module.
- Wi-Fi, Bluetooth, and cellular modems are a few popular communicationmodules used in smart agriculture.

Software:

- The software gathers information from sensors placed all over the property.
- Numerous environmental variables, including temperature, humidity, soil moisture, and nutrient levels, may be measured by these sensors.
- The data is processed by the software to find patterns and trends.
- Then, using this information, irrigation systems may be automated, fertilizer application rates can be changed, and early pest and disease detection can be accomplished