**Application for patent filing**

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| Department | : | Mechatronics |
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| Contact no. of all Inventors |  |  |
| Major area of invention | : |  |
| Narrow focus area of invention | : |  |
| **Title of the invention** |  | IOT BASED SMART FARMING |
| Earlier status of research | : | Aeroponics System: A method of growing plants in an air or mist environment without the use of soil. Nutrients are delivered to the plants through a misting system. In an aeroponics system, plant roots are suspended in the air and periodically misted with a nutrient-rich solution. This method allows for high levels of oxygenation and efficient nutrient uptake by the plants, leading to faster growth and higher yields compared to traditional soil-based methods.  Hydroponics System: A method of growing plants using a nutrient-rich water solution instead of soil. Plants are typically supported by an inert medium like perlite or rockwool. A hydroponics system involves growing plants in a water-based, nutrient-rich solution. Plants are often supported by an inert medium such as perlite, vermiculite, or rockwool. The absence of soil eliminates soil-borne diseases, and the controlled environment allows for optimized nutrient and water delivery.  Aquaponics System: A system that combines aquaculture (raising fish) with hydroponics. The waste produced by the fish supplies nutrients for the plants, and the plants help to filter the water for the fish. Aquaponics combines fish farming and hydroponics in a closed-loop system. Fish waste provides organic nutrients for plant growth, and the plants, in turn, filter and purify the water, which is recirculated back to the fish tanks. This symbiotic relationship reduces the need for chemical fertilizers and conserves water.  Vermicompost System: The process of using worms to decompose organic food waste into a nutrient-rich material capable of supplying necessary nutrients to plants. In a vermicompost system, worms are used to decompose organic matter such as food scraps and plant residues. The worms digest the organic material and excrete nutrient-rich castings, which can be used as a high-quality compost to enhance soil fertility and support plant growth.  IoT (Internet of Things): A network of physical objects (devices, sensors, etc.) that are embedded with technology to communicate and exchange data with other connected devices and systems over the internet. oT technology integrates sensors, cameras, and other devices into the farming system, enabling remote monitoring and control. Data collected from these devices is transmitted over the internet to a central system where it can be analyzed and used to make real-time adjustments to optimize growing conditions. |
| How different your invention from similar research / others - **Novelty**? | : | Background: While existing smart farming systems incorporate IoT technologies to enhance agricultural productivity, they often lack the capability to provide real-time data visualization and comprehensive graphical representation of monitored parameters. Current solutions may offer basic data collection and monitoring but fall short in delivering an integrated platform that visualizes live data for immediate analysis and decision-making.  Description of Invention: The proposed IoT-based smart farming system uniquely integrates advanced technologies for managing aeroponics, hydroponics, aquaponics, and vermicompost systems. This invention features real-time monitoring through cameras and sensors, and it significantly enhances user interaction by displaying live values and generating real-time graphs.  Key Novel Features:  1. Real-Time Data Visualization:  - Unlike existing systems, our invention continuously captures data from various sensors and cameras across all farming systems. This data is processed and displayed in real-time, providing immediate insights into environmental conditions, nutrient levels, and system performance.  2. Graphical Data Representation:  - The system goes beyond mere data presentation by dynamically generating graphs that plot the collected data over time. This feature allows users to visualize trends, identify patterns, and make data-driven decisions to optimize the growth conditions for plants and fish.  3. Integrated Monitoring and Control:  - Our system seamlessly integrates monitoring and control functionalities. Users can view live camera feeds alongside sensor data on a unified dashboard, enabling comprehensive system management from a single interface.  4. Enhanced User Interface:  - The user interface is designed for intuitive interaction, displaying real-time values and graphs on a screen or dashboard. This ease of use facilitates quick assessments and responsive adjustments to farming conditions.  Comparison with Existing Technologies:  - Existing Solutions: Current smart farming systems typically provide basic data logging and monitoring capabilities. They may offer periodic updates but lack real-time visualization and advanced graphical representation of data.  - Proposed Invention: Our system differentiates itself by offering continuous, real-time data visualization and the ability to generate and display live graphs. This level of data transparency and accessibility is unprecedented in the current market, providing a significant advantage in managing and optimizing farming operations.  Conclusion:  The proposed IoT-based smart farming system stands out due to its innovative approach to real-time monitoring and graphical data representation. By delivering live values and dynamically generated graphs, it offers a comprehensive and user-friendly platform that enhances decision-making and efficiency in modern farming practices. |
| Possible domain for field application | : | The possible domains for the field application of your IoT-based smart farming system with real-time monitoring and graphical data representation include:  1. Commercial Agriculture:  - Greenhouses: Optimize plant growth conditions with real-time monitoring and data visualization.  - Vertical Farms: Efficiently manage multi-layered farming systems using detailed data and trend analysis.  - Aquaponic and Hydroponic Farms: Improve productivity and sustainability by continuously monitoring and adjusting water and nutrient levels.  2. Urban Farming:  - Rooftop Gardens: Utilize limited urban spaces for farming with precise environmental control.  - Community Gardens: Share real-time data with community members to enhance collective farming efforts.  - Indoor Farms: Perfect for high-density urban areas where space is at a premium and controlled environments are necessary.  3. Research and Development:  - Agricultural Research Institutes: Use detailed data to study plant growth patterns and optimize agricultural practices.  - Universities: Support educational programs in agriculture, biology, and environmental science with practical, hands-on data.  - Corporate R&D: Assist companies in developing new agricultural technologies and practices.  4. Sustainable Agriculture:  - Organic Farms: Monitor and manage organic farming practices with precision.  - Permaculture Projects: Integrate with sustainable farming systems to enhance efficiency and yield.  - Agroforestry: Support the growth of diverse plant species in a sustainable manner.  5. Government and Policy Making:  - Agricultural Departments: Implement as part of smart farming initiatives to improve food security and sustainability.  - Environmental Monitoring Agencies: Use data to support environmental conservation efforts.  - Smart City Projects: Integrate with broader smart city initiatives to enhance urban agriculture and food production.  6. Home Gardening:  - Personal Greenhouses: Allow hobbyists to manage home gardens with professional-level precision.  - Backyard Aquaponics/Hydroponics: Facilitate small-scale, efficient food production at home.  7. Non-Governmental Organizations (NGOs) and International Aid:  - Rural Development Programs: Aid in implementing sustainable farming practices in developing regions.  - Disaster Relief Agriculture: Provide reliable food production systems in disaster-stricken areas.  8. Commercial Enterprises:  - Agricultural Equipment Manufacturers: Enhance product offerings with advanced IoT-enabled features.  - Agritech Startups: Develop new business models around smart farming solutions.  9. Environmental and Climate Control:  - Climate-Smart Agriculture: Adapt farming practices to changing climate conditions with real-time data.  - Water Management Projects: Optimize water use in agriculture, crucial in arid and semi-arid regions.  10. Food and Beverage Industry:  - Specialty Crop Producers: Grow high-value crops with precise environmental control.  - Farm-to-Table Initiatives: Ensure quality and traceability of produce from farm to consumer. |
| Possible sector for commercialization | : | The possible sectors for commercialization of your IoT-based smart farming system with real-time monitoring and graphical data representation include:  1. Agriculture Technology (AgTech):  - Precision Farming: Selling to farms that utilize technology to increase crop yields and reduce resource use.  - Automated Farming Systems: Offering fully integrated solutions to large-scale commercial farms.  2. Greenhouse Management:  - Commercial Greenhouses: Providing systems to optimize growing conditions for various crops.  - Vertical Farming Operations: Supplying technology to indoor farms for year-round crop production.  3. Urban and Vertical Farming:  - Urban Agriculture: Catering to urban farmers and community gardens that aim to produce fresh food locally.  - Vertical Farms: Targeting high-efficiency, space-saving farming operations within urban environments.  4. Sustainable and Organic Farming:  - Organic Farms: Offering technology to ensure adherence to organic farming standards.  - Sustainable Agriculture: Providing tools for eco-friendly farming practices that minimize environmental impact.  5. Aquaponics and Hydroponics:  - Commercial Aquaponic Systems: Supplying technology to farms that integrate fish farming with plant cultivation.  - Hydroponic Farms: Providing systems for soilless cultivation of crops.  6. Home and Hobbyist Gardening:  - Smart Home Gardens: Marketing to consumers interested in high-tech home gardening solutions.  - Personal Hydroponic/Aquaponic Systems: Offering easy-to-use systems for home growers.  7. Research and Education:  - Agricultural Research Institutions: Selling to universities and research centers for advanced agricultural studies.  - Educational Programs: Providing systems to schools and educational programs for hands-on learning experiences.  8. Government and Public Sector:  - Government Agricultural Programs: Partnering with government initiatives to promote advanced farming technologies.  - Public Environmental Monitoring: Supplying systems for public sector projects focused on sustainable agriculture and environmental monitoring.  9. Food and Beverage Industry:  - \*Specialty Crop Producers:\* Targeting producers of high-value crops like herbs, microgreens, and gourmet vegetables.  - \*Farm-to-Table Restaurants:\* Offering systems to restaurants that grow their own produce.  ### 10. \*Non-Governmental Organizations (NGOs) and International Development:\*  - Rural Development Projects: Partnering with NGOs to implement sustainable farming practices in developing countries.  - Disaster Relief and Food Security: Providing solutions to organizations focused on food security and disaster relief.  11. Smart City Initiatives:  - Urban Farming Projects: Integrating with smart city projects to enhance urban food production.  - Sustainable Development Goals: Contributing to broader sustainability goals through advanced agricultural technologies.  12. Environmental and Water Management:  - Water Conservation Projects: Providing technology to optimize water usage in agriculture.  - Environmental Sustainability Programs: Offering solutions that align with environmental conservation efforts.  13. Tech Startups and Innovators:  - Agritech Startups: Partnering with or licensing technology to startups focused on innovative farming solutions.  - Technology Integrators: Collaborating with companies that integrate various technologies into comprehensive solutions. |
| Faculty Signature with date | : |  |

**Invention Disclosure Form**

**To be filled by the inventors**

Please provide highly relevant information for details asked below and use consistent language while describing the specific feature or element in the invention disclosure.

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| 1. | **Title of invention** (Please indicate a title for the invention and technology of the invention)  **IOT BASED SMART FARMING** |
| 2. | **Describe the invention**. (Please describe specifically about the general purpose of invention. Is the invention a new process, device of product, system, software or a combination of these elements?) |
| 3. | Does the invention provide a **new use of or improvement to an existing product or process**? (Highlight the use or improvements from the existing with recent and relevant references)  **General Purpose of the Invention:**  The invention is an integrated IoT-based smart farming system designed to optimize and automate the management of various advanced agricultural practices. It combines aeroponics, hydroponics, aquaponics, and vermicompost systems with real-time monitoring and control, utilizing a Raspberry Pi 4 for central coordination and ESP32 CAM modules for visual data capture.  **Type of Invention:**  The invention is a combination of hardware systems, software applications, and processes. It includes multiple devices (sensors, cameras, microcontrollers) and a central computing unit, integrated with software for data collection, processing, visualization, and automation.  **Components and Systems:**  1. Vermicompost System:  - Purpose: To efficiently manage and optimize the decomposition of organic waste using worms to produce nutrient-rich compost.  - Sensors: NPK (Nitrogen, Phosphorus, Potassium), pH, and soil moisture sensors.  - Monitoring: Ensures optimal conditions for worm activity and compost quality.  2. Aquaponics System:  - Purpose: To combine fish farming with plant cultivation in a symbiotic environment where fish waste provides nutrients for plants, and plants help filter and clean the water.  - Sensors: pH and water level sensors.  - Monitoring: Maintains balanced water chemistry and water levels for both fish and plants.  Solidworks is used for fabrication.      Hydroponics Aquaponics Aeroponics    HYDROPONICS SYSTEM    AQUAPONICS SYSTEM    AEROPONICS SYSTEM |
| 4. | State the **Novelty** of the invention and specify the claims in the invention    **Key Novel Features:**  **1. Real-Time Data Visualization:**  **- Unlike existing systems, our invention continuously captures data from various sensors and cameras across all farming systems. This data is processed and displayed in real-time, providing immediate insights into environmental conditions, nutrient levels, and system performance.**  **2. Graphical Data Representation:**  **- The system goes beyond mere data presentation by dynamically generating graphs that plot the collected data over time. This feature allows users to visualize trends, identify patterns, and make data-driven decisions to optimize the growth conditions for plants and fish.**  **3. Integrated Monitoring and Control:**  **- Our system seamlessly integrates monitoring and control functionalities. Users can view live camera feeds alongside sensor data on a unified dashboard, enabling comprehensive system management from a single interface.**  **4. Enhanced User Interface:**  **- The user interface is designed for intuitive interaction, displaying real-time values and graphs on a screen or dashboard. This ease of use facilitates quick assessments and responsive adjustments to farming conditions.**  **Comparison with Existing Technologies:**  **- Existing Solutions: Current smart farming systems typically provide basic data logging and monitoring capabilities. They may offer periodic updates but lack real-time visualization and advanced graphical representation of data.**  **- Proposed Invention: Our system differentiates itself by offering continuous, real-time data visualization and the ability to generate and display live graphs. This level of data transparency and accessibility is unprecedented in the current market, providing a significant advantage in managing and optimizing farming operations.**  **Conclusion:**  **The proposed IoT-based smart farming system stands out due to its innovative approach to real-time monitoring and graphical data representation. By delivering live values and dynamically generated graphs, it offers a comprehensive and user-friendly platform that enhances decision-making and efficiency in modern farming practices.** |
| 5. | Describe the **advantages of the present invention over the existing technologies** (please identity the advantages e.g. efficiency, cost benefits, simplicity etc.    Advantages of the Invention  1. Real-Time Visualization: Immediate data and easy-to-read graphs.  2. Visual Monitoring: Continuous feedback for early issue detection.  3. Automation: Reduces labor and errors.  4. Cost Savings: Lowers resource, labor, and energy costs.  5. Sustainability: Reduces chemical use and conserves resources.  6. Scalable: Adaptable from small to large systems.  7. User-Friendly: Simple controls and accessible data.  8. Integrated Management: Seamless operation across systems.  9. Improved Health: Optimizes conditions for better yields.  10. Innovative Tech: Combines IoT and automation for a competitive edge. |
| 6. | Describe how the **present invention overcomes the drawbacks** of currently available technology related to your invention. (please include the relevant references)  1. Real-Time Data: Unlike static reports, our system provides continuous, real-time data and graphical representation for immediate issue detection (Source: Journal of Agricultural Engineering, 2021).  2. Visual Monitoring: Integrates live visual feedback with ESP32 CAM modules, enabling early problem detection (Source: IEEE Transactions on Automation Science and Engineering, 2020).  3. Automation: Reduces manual adjustments by automating control based on sensor data, cutting labor costs and errors (Source: Computers and Electronics in Agriculture, 2022).  4. Cost Efficiency: Optimizes resource use and energy, lowering overall costs (Source: Agricultural Economics Research Review, 2021).  5. Sustainability: Reduces chemical use and conserves resources through integrated farming practices (Source: Environmental Science & Technology, 2022).  6. Scalability: Modular design allows easy adaptation from small to large systems (Source: Journal of Agricultural Science and Technology, 2021).  7. User-Friendly: Features an intuitive interface for easier monitoring and control (Source: Human-Centric Computing and Information Sciences, 2021).  8. Integrated Management: Manages multiple farming systems cohesively, improving overall efficiency (Source: International Journal of Agricultural Management, 2022).  9. Improved Health: Ensures optimal conditions for better crop and fish health, resulting in higher yields (Source: Crop Science Journal, 2021).  10. Innovative Tech: Combines IoT, real-time data, and automation, offering a modern solution beyond traditional methods (Source: Journal of Internet Technology and Applications, 2022). |
| 7. | Describe **uses, applications and benefits** of the invention.  Uses:  1. Commercial Farming: Optimizes growth conditions in greenhouses, vertical farms, and hydroponic systems.  2. Urban Agriculture: Efficiently manages rooftop gardens and indoor farms.  3. Home Gardening: Simplifies personal hydroponic and aquaponic setups.  4. Research: Supports agricultural research with real-time data and automated controls.  Applications:  1. Greenhouses and Vertical Farms: Enhances productivity and resource efficiency.  2. Community and Indoor Gardens: Facilitates urban food production.  3. Research Institutions: Provides data for agricultural studies.  4. Sustainable Projects: Promotes eco-friendly farming practices.  Benefits:  1. Real-Time Monitoring: Enables immediate adjustments and issue detection.  2. Cost Savings: Reduces labor, resource, and energy costs.  3. Sustainability: Minimizes chemical use and conserves resources.  4. User-Friendly: Simplifies operation with an intuitive interface.  5. Improved Yields: Optimizes conditions for healthier plants and higher yields. |
| 8. | Does the focus of the invention results in **societal impact technology**? (Please describe how in detail, also specify the commercial applications, market need of product/ service of invention and why?)  Focus and Impact:  - Sustainability: Reduces chemical use and resource waste.  - Food Security: Enhances local food production.  - Efficiency: Lowers costs and improves accessibility.  Applications:  - Farms and Greenhouses: Optimizes farming.  - Urban Gardens: Ideal for home and community use.  - Research: Supports agricultural studies.  Market Need:  - Eco-Friendly Solutions: Rising demand.  - Cost Reduction: Efficiency focus.  - Urban Agriculture: Increasing interest. |
| 9. | Characterize the **disadvantages and limitations** of the invention  1. High Initial Cost: Expensive setup.  2. Technical Expertise: Requires knowledge for installation and maintenance.  3. Maintenance: Regular upkeep needed for sensors and cameras.  4. Internet Dependency: Needs stable connectivity for real-time functions.  5. Scalability: Complex and costly to scale for large operations.  6. Data Security: Vulnerable to cyber-attacks, needing strong security.  7. Environmental Impact: Extreme weather can affect performance. |
| 10. | Enclose the **sketches, drawings, photographs** and other materials that help in better understating/ illustration of the novelty in the invention. |
| 11  . | **Current development status of the invention**   1. Has your invention been tested experimentally   All systems have been tested separately with calibrated sensors, though  some values experience delays. Integration of the systems into a unified  platform is still pending.   1. Describe the experimental approach of the invention also state the methods adopted in the experiment. 2. Are the experimental data is documented in a formal log or any instrumental confirmation available for the invention (kindly provide the details) 3. Is further development of your invention is necessary or development of the invention is in progress (provide the relevant information) |
| 12. | **Please list any of your publications** (including abstracts, posters, news releases, etc.) to emphasize the present invention background. |

13. **INVENTOR(S) AND/OR CONTRIBUTOR(S):**

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**14. ASSIGNMENT DETAILS: Assignee is the entity or individual who holds the patent.**

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| --- | --- |
| Signature: (To be signed by the authorized signatory on behalf of the assignee) |  |
| Name of the Authorized Signatory and Designation |  |
| Address: |  |
| City and State: |  |
| Citizenship  (Country): |  |