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A Survey on Farmer-to-Consumer Website with Embedded Sensors.

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Abstract: The proposed website will serve as an online marketplace where farmers can showcase and sell their produce to consumers. To enhance efficiency, various electronic systems will be employed throughout the supply chain. RFID (Radio-Frequency Identification) tags will be utilized to track and trace products, ensuring transparency and authenticity from farm to table. This technology will enable consumers to access detailed information about the origin and journey of the products they purchase, fostering trust and accountability.

Additionally, sensors will be embedded in farms to monitor temperature, humidity, and other environmental factors. These sensors will provide real-time data to farmers and distributors, ensuring optimal storage conditions and minimizing product spoilage. Furthermore, incorporating automated inventory management systems will facilitate better stock control and reduce wastage.

***IndexTerms*–Sensors, Farmer to Consumer F2C, Precision Farming,IOT, Data Analytics.**

I. INTRODUCTION

This project focuses on the development of an innovative Farmer-to-Consumer (F2C) website platform fortified with cutting-edge electronic systems. The primary goal is to create a seamless digital interface that connects farmers directly with consumers while employing advanced electronic solutions to optimize the agricultural supply chain.
The proposed platform will serve as an online marketplace where farmers can exhibit and vend their produce directly to consumers. A core aspect involves the utilization of RFID (Radio-Frequency Identification) technology to establish a robust product tracking mechanism. This system will enable consumers to access comprehensive product information, including origin, cultivation practices, and transit details, ensuring transparency and authenticity.

To bolster efficiency and reduce spoilage, sensors will be implemented within storage facilities. These sensors will continuously monitor environmental variables like temperature and humidity, transmitting real-time data to stakeholders to maintain optimal storage conditions and prevent product degradation.

Additionally, the project aims to incorporate automated inventory management systems utilizing electronic components. These systems will enable real-time inventory updates, minimizing discrepancies and enhancing supply chain visibility for both farmers and consumers.

The platform will feature secure electronic payment gateways to facilitate seamless and secure transactions, prioritizing user convenience while ensuring fair compensation for farmers.

Furthermore, the project will emphasize the educational aspect by integrating electronic interfaces to disseminate agricultural knowledge and best practices. Online forums and resources will promote sustainable farming methods and technological advancements, empowering farmers with crucial insights for improved productivity.

In summary, this final-year electronics project endeavors to create an integrated F2C website platform fortified with sophisticated electronic components. The project's objectives revolve around enhancing transparency, efficiency, and trust within the agricultural supply chain, contributing to a more resilient and technologically advanced agricultural ecosystem.

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II. LITERATURE SURVEY

The increasing demand for food, both in order to ensure quality and quantities, has accelerated the need for industrial growth and intensive methods of production in agriculture. At the forefront of the new agricultural era, there is an emerging Internet of Things (IoT) market that is suggesting several creative solutions. Research organizations and scientific associations are seeking to increase their scope and speed by connecting with IoT and contributing technologies and goods to a range of different agriculture markets. The IoT idea gained prominence in the year 2000, with the development of the Auto-ID at MIT and the subsequent market research reports. In IoT, these systems communicate, perceive, and connect with internal & external state-embedded technologies [1].

ICT(Information and Communication Technologies) being integrated into conventional agricultural activities is helping to spark a fourth farming revolution. An important facet of technologies such as machine learning, UAVs (Unmanned Aerial Vehicles), Remote Sensing, Big Data Analytics, etc. is having the capability to boost farming activities to new heights. A broad variety of agricultural parameters, such as environmental factors, production status, soil condition, irrigation water, herbicides and pesticides, weed control, and greenhouse output climate, may be tracked in smart agriculture to increase crop yields, minimize costs, and maintain process inputs. Smart agriculture and the use of reduced pesticides and fertilizers in crops will help to mitigate leaching issues and pollution, as well as the effects of climate change, in precision agriculture [2].

Burgeoning IoT technology offers many new solutions and further growth opportunities, particularly for novel ideas in the agricultural sector. We also benefited greatly from recent developments in communication systems and protocols, primarily on the lower layers, which are the physical, network, and link layers. Besides that, the protocols in the topmost layers of the network are critical for effective data exchange and gathering. There are many applications, procedures, and designs that can be used in the agricultural sector as a whole. Several ongoing developments in IoT agriculture research involve network engineering and applications, device design, and security challenges. Furthermore, in several nations and institutions around the world, various IoT guidelines and policies have been adopted in agriculture. However, an impressive amount of research has been done on IoT and there is still a great need for further research on the topic in the agricultural field. This survey paper examines numerous challenges and trends related to smart agriculture [3].

A major challenge in greenhouses is determining the exact amount of water required. To prevent unnecessary water use, smart sensors are installed and operated using a variety of IoT techniques. Water storage in greenhouses is achieved by the use of automated drip irrigation, which is regulated by a soil moisture threshold. Water management may be handled effectively via IoT technology by avoiding water waste through the use of various kinds of sensors. The sensors are used to monitor the amount of water in the tank, and data is saved on the cloud through a mobile application [4].
Farmers may monitor the water level using their cell phones. The motor will operate automatically as a result of this technology. If the water level drops, the motor automatically turns on, and if the water level is high, the motor will shut down. Up to 50% of this water is lost in conventional irrigation systems owing to over-watering due to inadequacies in traditional irrigation techniques and systems [5].

It is in charge of anticipating the design, improvement, operation and management of irrigation systems. Tracking water requirements of crops based on gathered data and actuating the water flow in accordance with the anticipated needs without the participation of human operators is one of the objective of irrigation systems. It uses dispersed sensors to monitor different soil, water body, plant, and micro-climate factors. The irrigation technique (e.g., spray, drip, flooding and nebulizer) has an influence on how to properly monitor the water body as well as the actuation mechanism. Weather is one of the most significant variables in calculating agricultural water needs. The IoT will help to upgrade the new irrigation infrastructure in a more fascinating way. By tracking weather and soil conditions, a farmer can refine his irrigation system in a variety of ways. Weather prediction data, manage and track the whole farm from almost anywhere, Ethernet, and WIFI are all exemplars of how IoT technology tracks irrigation systems [6].

Soil management entails determining various soil parameters such as pH, moisture content, and so on. These parameters can be conveniently calculated using IoT sensors. Farmers will then take measures such as fertilization, drainage, irrigation, and so on. Soil management assists in the discovery of the right plant breed. It also assists in the identification of fertilizer needs in the soil. It necessitates a low-latency network for urgent intervention. For both enterprises and farmers, soil monitoring has been among the most challenging activities in agriculture. There are several environmental concerns in soil testing that have an impacts on crop productivity. If these types of problems are correctly defined, farming patterns and procedures can be readily understood. Soil Humidity, Precipitation, Fertilization, and Temperature are among the factors being monitored. The moisture content of soil is monitored using moisture and humidity sensors. The findings of a soil testing research survey improve crop production and propose fertilization options to farmers [7].

Many relevant factors are combined to preserve and establish an optimal ambience for plants while staying under strict limits, such as airflow, temperature, CO2, and O2 levels. This can be achieved by deploying an IoT-enabled ecosystem, in which smart sensors and devices exchange data for improved decision making. Weather have the greatest impact on crop production. Farmers can decide the best time for planting, irrigation, and harvesting using an IoT-enabled weather forecasting system. Probabilistic weather analyses were done using sensors in IoT applications. Farmers can learn about environmental conditions such as soil moisture, humidity, and air temperature by embedding remote sensors in the fields. Farmers should prepare accordingly and adjust the harvesting and irrigation period to boost the crop based on historical results. Farmers should take proactive measures to ensure a safe crop harvest by arranging and reviewing collected data [8].

The Internet of Things (IoT) proposes a waste disposal solution. IoT sensors may be used to create intelligent trash cans. This could be used to read, store, and transfer waste-related data through a network. Governance of waste can be accomplished with the aid of certain intelligent and streamlined algorithms [9].

The growth of agricultural production to provide adequate food for the world's population is becoming a growing worldwide issue. As a result, the significance of livestock management in farmland is essential for survival. Farmers, on the other hand, are trying to maintain their cattle in the context of rising worry over land and water supplies. Apart from that, farmers continue to focus on reducing waste and lowering total expenses. New technological advances are critical in helping to enhance the quality and quantity of agricultural output. The Internet of Things (IoT) enters the scene at this point. It allows farmers to improve the health of their livestock via remote access and data-driven decisions. Cattle Watch is a system for monitoring livestock. This cloud-based technology is often used to remotely track the well-being of livestock and aids in the identification of livestock locations using communication and energy sensors [10].

Farm management systems centralize, administer, and optimize a farm's output and operations. IoT-based farm management system automates the collection and storage of farm data, manages business expenditure, and agricultural budgets, and monitors and analyses farm operations and consumption. Smart farming raises production while lowering environmental effects, but this smart farming approach is only feasible with the help of FMS. For smart farming, FMS is an important component for production, planning, and decision-making [11].

Crop management involves assessing and recording the well-being of a crop. Plant and crop diseases can be detected using IoT sensors and RFID chips. These details can be gleaned from RFID tags and shared across the internet by the reader. This data is processed remotely by the farmer, and necessary steps are taken. This will keep pests away from the crops. In the agricultural sector, production tracking and prediction have played an important role in delivering benefits to users to produce valuable output while minimizing losses [12].

IoT has expanded steadily in last few years and a variety of IoTbased frameworks have been formulated in a variety of domains, most notably in agriculture. This review article discussed the prevailing state of the IoT in agriculture by reviewing key works of literature, analyzing current IoT research trends, and investigating common IoT sensors, devices, agriculture APPs, benefits & challenges, and analytics in IoT-based agricultural production. Despite of many challenges, IoT is an innovative breakthrough with a predicted exponential rate of growth of 27.1 billion connected components by 2021, it links diverse gadgets, devices, and individuals. The upcoming studies, inventions, and initiatives mostly in field of IoT-based smart agriculture would improve the quality of living for farmers and result in significant improvements in the agricultural sector. However, a variety of questions remain unresolved in order to make things sustainable for small and medium-scale growers. Security and expense are critical considerations. As competitiveness in agriculture intensifies and beneficial policies are adopted, it is projected that the increasing adoption of IoT for framing a smart agricultural environment will increase proportionately [13].

III. BLOCK DIAGRAM

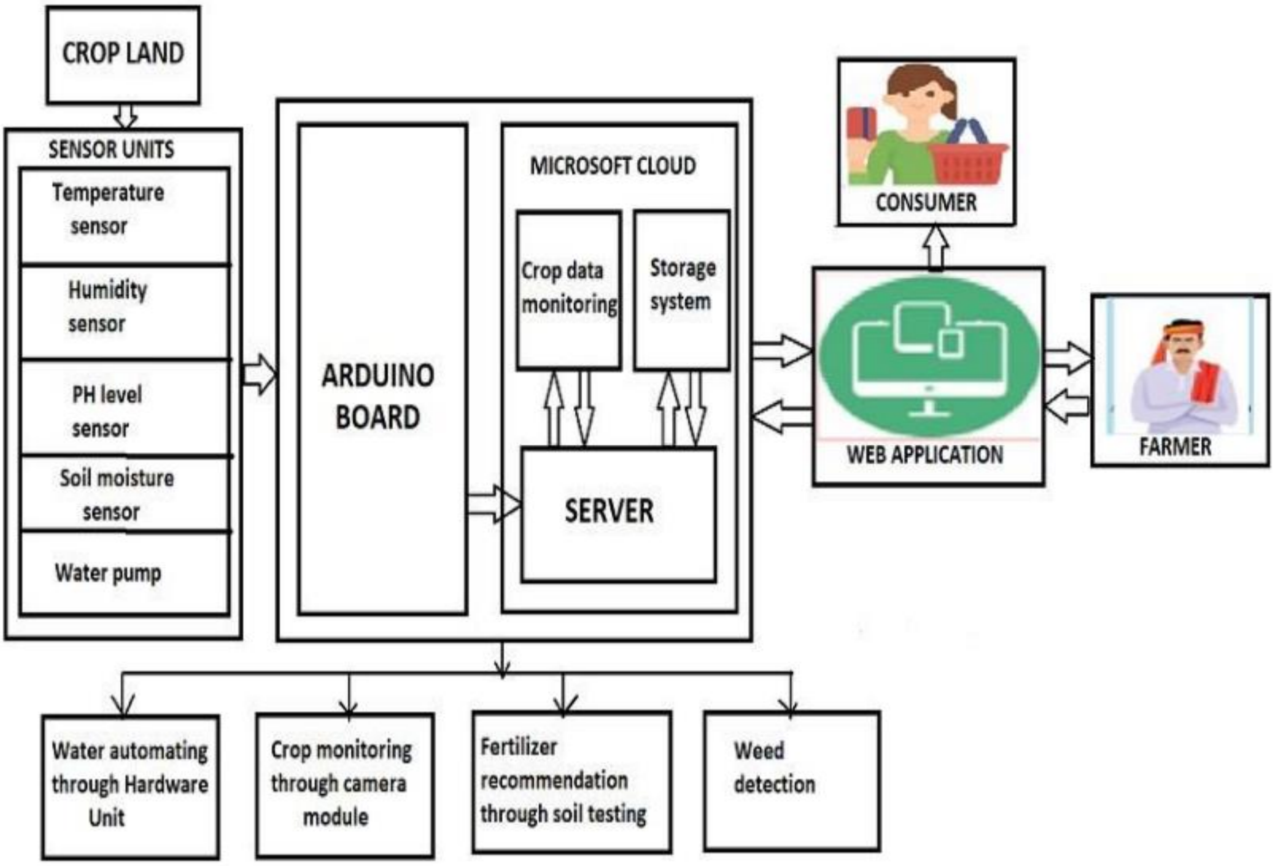

Fig 1.1 Infrastructure of Hardware Environment for Smart Farming

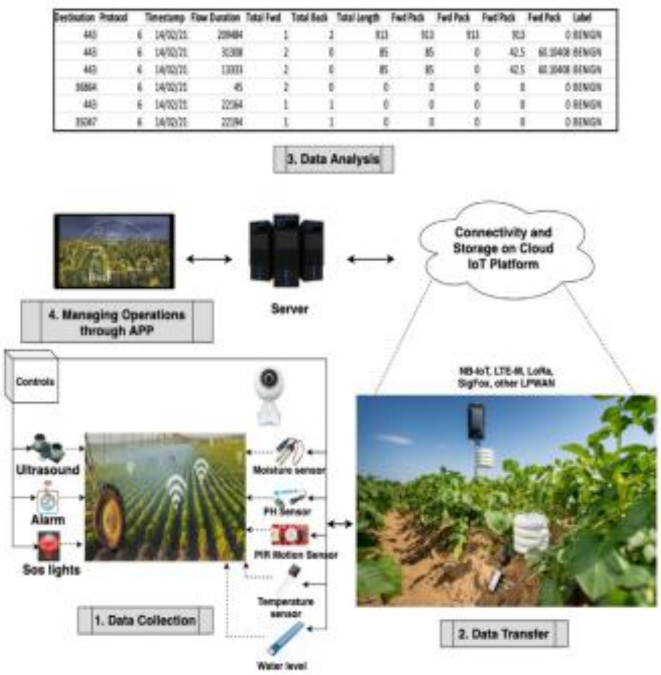

Fig. 1.2 Data Analytics Model for Crop Prediction

IV. SURVEY OUTCOME

The study clearly illustrated changes in consumer marketing practices and focused on online purchasing by farmers. The company has gained too much popularity due to the best services in providing high-quality fruits and vegetables. Farmeeco's marketing website helps consumers buy fresh fruits and vegetables and get them at the best price. The company has also utilized advanced software and hardware tools to manage the entire process with ease. They monitor the entire process from the beginning and use high-quality biofertilizers and pesticides to care for their plants. The main objective of this study was to create a profitable business model for selling vegetables and fruits online and help modern people improve the way they sell vegetables and fruits. Online selling of vegetables is the right way for modern people.

V. WEBSITE DESIGN

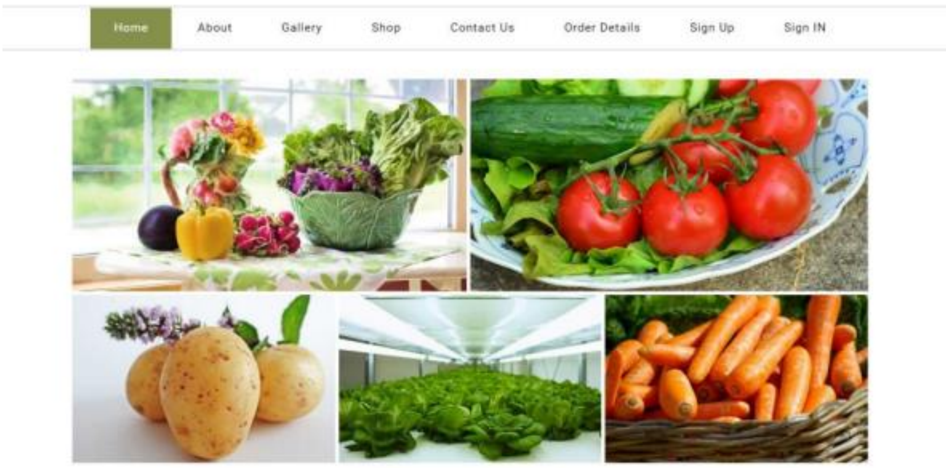

Fig 1.3 Web Page Design

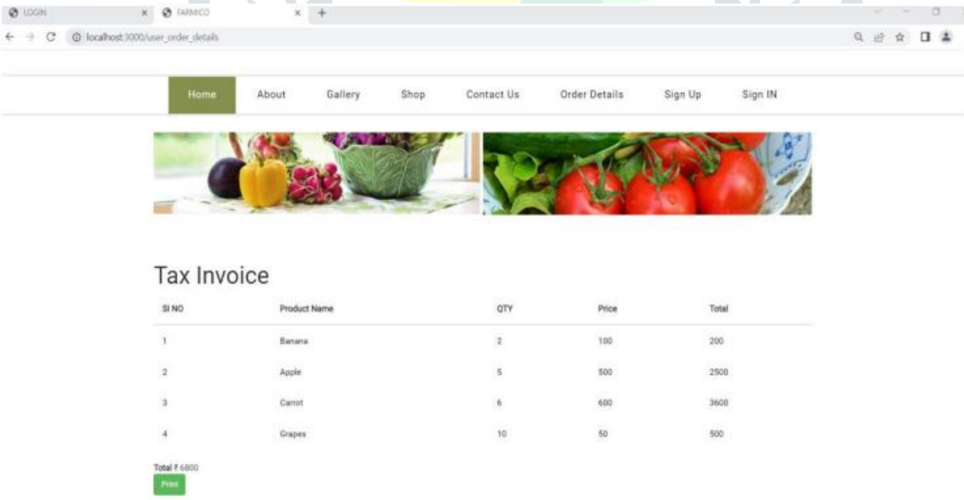

Fig 1.4 Payment Slip

VI. SYSTEM DESIGN

Select Suitable Sensor Technology:
Research and choose appropriate sensors based on accuracy, compatibility with web integration, cost-effectiveness, and scalability.

Develop the Website Infrastructure:
Engage web developers and designers to create the website interface. Ensure it's user-friendly for both farmers and consumers, incorporating sections for sensor data display, product listings, and user interaction.

Integrate Sensor Data Acquisition:
Establish protocols for collecting data from sensors (APIs, IoT platforms, etc.).
Implement connectivity solutions to gather data from sensors and transfer it to the website's backend.

Database Setup and Management:
Set up a robust database system capable of storing and managing large volumes of sensor data securely.
Design data structures and schemas to efficiently organize and retrieve sensor information.

Data Processing and Analytics:
Implement algorithms or analytics tools to process raw sensor data into meaningful insights (predictive analytics, trend analysis, etc.).
Generate reports or visualizations that farmers and consumers can easily understand.

User Interface Development:
Create user interfaces for farmers to access and interpret sensor data, manage their inventory, and update product listings.
Design consumer-facing interfaces that showcase product information, sensor-derived quality metrics, and purchasing options.

Security and Privacy Measures:
Implement robust security protocols to safeguard sensitive sensor data and user information.
Ensure compliance with data privacy regulations and best practices.

Testing and Validation:
Conduct thorough testing to validate the functionality, accuracy, and reliability of sensor data integration.
Gather feedback from farmers and consumers to refine the user experience and functionalities.

Deployment and Maintenance:
Deploy the integrated system and provide necessary training and support to farmers and consumers for using the platform.
Establish a maintenance plan to regularly update and improve the website, fix issues, and upgrade sensor technologies as needed.

Continuous Improvement and Innovation:
Continuously gather feedback and iterate on the platform based on user experiences and technological advancements. Explore new sensor technologies and data analytics techniques to enhance the system's capabilities over time.

VII. SURVEY TABLE

CROP	TEMPERATURE In degree (Celsius)	HUMIDITY	pH LEVEL	TYPE OF SOIL	DURATION
CORN/ MAIZE	18 – 27	55 – 65%	6 – 6.5	SANDY	95 DAYS
RICE	21-27	60 – 80%	6	SANDY	18 - 22 DAYS
TOMATO	21 - 24	60 – 85%	5 - 7	SANDY	50 DAYS
MARIGOLD	16 - 25	70 – 80%	7 -7.5	SANDY	110-120 YS

VIII. CONCLUSION

This adoption of smart and sustainable agriculture is useful for farmers for getting real-time soil parameters at their fingertips, without waiting for soil testing lab results. The farmer is monitoring the field at regular intervals of time. Weed is identified without a farmer in the field. A successful disease detection model is being built where a farmer uploads a pic (disease-affected part) is being processed. The main task in agriculture is irrigation now becomes automatic, and a crop successfully gets sufficient water through automatic irrigation at intervals. Farmers can able to cultivate their crops with greater yield. And this information can be uploaded to the developed website which includes the farmer and consumer menu. Consumers can choose the required crop and quantity and place the order via the website. So, there is direct communication between the farmer and the consumer to eliminate the middleman.

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