RESEARCH ARTICLE OPEN ACCESS

Smart Agro Devices Using Iot

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ABSTRACT
Agriculture had been concerned with the production of basic food crops for many decades. In India, the majority of the people are involved in agricultural activities but still, most of the Indian farmers do not have sufficient technology to address major problems like monitoring of fields which includes irrigation control, soil moisture and weed removal. The traditional challenges of weed management in agriculture can be mitigated by IoT-based solutions. Employing sophisticated sensors, these solutions discern between crops and weeds, initiating precision interventions. IoT has revolutionized irrigation practices by harnessing real-time data collection. Smart irrigation systems utilize sensors to monitor soil moisture levels, climatic conditions, and plant water demands. Balancing nutrient application with crop requirements is central to sustainable farming practices. IoT-equipped sensors scrutinize soil nutrient levels. IoT-enabled devices gather vital environmental data, humidity, and light exposure. Real-time communication is vital for timely decision-making in agriculture. IoT-driven SMS and alert systems provide farmers with instantaneous updates about changing conditions. This proactive information equips farmers to respond promptly and efficiently to evolving situations. IoT driven smart agro devices redefine agriculture through their role in crop weed removal, smart irrigation, crop prediction, fertilizer prediction, and SMS alert systems for farmers. These interconnected innovations exemplify the potential of IoT technology to revolutionize farming practices, enhancing resource efficiency, productivity, and sustainability while bolstering the livelihoods.

I. INTRODUCTION

The Smart Agro Devices by the Internet of Things (IoT) has revolutionized modern agriculture by integrating cutting-edge technology into traditional farming practices. These devices, employing sophisticated sensors, AI-driven algorithms, and real-time data analytics, address pivotal agricultural challenges. They encompass functionalities such as precise crop weed removal, leveraging computer vision and robotics to discern and eliminate weeds while preserving crops and reducing herbicide dependency. IoT-enabled irrigation control systems monitor soil moisture, weather conditions, and crop needs, optimizing water distribution and usage for increased productivity. Additionally, predictive analytics in Smart Agro Devices forecast crop growth stages and fertilizer requirements, aiding farmers in sustainable practices and informed decision-making. Complemented by a robust SMS and alert system, these devices offer timely notifications about pest infestations, adverse weather, or equipment issues, empowering farmers to proactively mitigate risks and optimize farm management practices. Ultimately, the integration of IoT in agriculture through Smart Agro Devices signifies a transformative shift, enhancing efficiency, sustainability, and productivity in farming practices. Conventional farming practices often rely heavily on chemical inputs, leading to environmental degradation and resource depletion. Smart Agro Devices offer solutions such as precise irrigation control, weed removal without excessive herbicides, and optimized fertilizer usage, promoting sustainable farming practices and reducing environmental impact.

II. OBJECTIVE

The objective of smart agro devices using IoT is to enable Precision farming, resource Optimisation and sustainable agriculture practices by providing real time monitoring predictive insights and automated system for crop weed removal, irrigation control crop and fertilizer prediction, SMS and alert notification.

III. LITERATURE REVIEW

[1]2021 7th International Conference on Advanced Computing & Communication Systems (ICACCS) on “Weed Detection in Agricultural fields using Deep Learning Process” by C. Thirumarai Selvi, R.S. Sankara Subramanian [1]

Weed detection is a crucial task in the agricultural productivity. This requires improved computational methods to provide a faster response. Thus, the proposed method has higher accuracy compared to the existing methods. The experiment is carried out for sesame crop with multiple weeds. The result shows 95% accuracy in classification using convolutional neural network and max pooling layers supported by reduced rate of misclassification of weed and crop. This work suggests a deep learning with image processing-based framework to classify, various crops and weeds. A deep convolutional neural network (CNN) architecture is developed to implement this classification with improved accuracy by increasing the deep layers as compared to the existing CNN.

[2] 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE) on “Smart Irrigation system using Internet of Things” by A. Anitha, Nithya Sampath, M. Asha Jerlin [2].

The sand and the water level are the critical parameter for the development of smart irrigation system. Generally, the soil moisture is affected by a sundry parameter such as air temperature, soil temperature, air humidity, ultra violet rays, and much more. This paper proposed an IoT based smart irrigation system utilizing sensors to record the data and store it in the cloud storage. The future work can be prediction of soil moisture using the recorded data and it may provide cost effective. The auto mode makes it a smart system and it can be further customized for application categorical scenarios.

[3] S. Qazi, B. A. Khawaja and Q. U. Farooq, "IoT-Equipped and AI-Enabled Next Generation Smart Agriculture: A Critical Review, Current Challenges and Future Trends," [3]

The evolution of agriculture, stressing the shift to smart agriculture (Agriculture 4.0) to tackle challenges like population growth and resource shortages. It underscores the vital role of wireless tech (ZigBee, LoRa, Wi-Fi, Bluetooth) in areas like smart irrigation and pest detection. The key contribution is introducing and discussing emerging 6G technologies, addressing their characteristics, advantages, and potential applications in agriculture, bridging a gap in literature focused on specific technologies rather than a holistic 6G overview in agriculture.

[4] Smart Farming Becomes Even Smarter with Deep Learning—A Bibliographical Analysis [4]

UAV-aided IoT networks have enormous potential for application in agriculture. Given their high manoeuvrability, high mobility, and their low maintenance cost, they were used in studies related to almost all topics. Therefore, UAV-aided studies were not analysed as an independent topic and UAV can be considered as an integral part of smart farming. With the integration of UAVs into smart farming, equipped with sensors and cameras, the articles tended towards artificial intelligence applications that produce faster results working with real-time data. In addition to datasets collected with sensors and cameras, in deep learning studies there are also other data sources like satellite data, open-access databases, and synthetic datasets. The focus of this study was to identify where deep learning has been used for improving various agricultural practices, to rank the topics in order to help new researchers in this area, and to emphasize practices that could direct future research. This survey should motivate more researchers to focus on deep learning topics, related to data analysis, image analysis and computer vision, applying it for classification or prediction in smarter farming.

[5] Multispectral Crop Yield Prediction Using 3D-Convolutional Neural Networks and Attention Convolutional LSTM Approaches [5]

In this paper two novel methods have been proposed, which are the combination of the 2D CNN and LSTM attention as the first model, and the usage of 3D-CNN and ConvLSTM instated of 2D-CNN and single LSTM as the second model for county-level crop yield prediction. As the first step, multi-2D-CNNs are used with help of the skip connection to extract features. After that, the outputs of the previous step are used for attention LSTM and Mult cascaded CNN parallelly. Attention mechanism was used to focus on main features and disqualify the unimportant ones. Finally, a single dense layer has been applied to make pre dictions. Although the second model has the same architectures the first model, 3D-CNN and ConvLSTM have been used instated of the 2D-CNN and LSTM. 3D-CNNs can extract both spectral and spatial simultaneously, and ConvLSTM is bale to temporal and spatial spectral together.

[6] Et-Taibi Bouali, Mohamed Riduan Abid," Renewable Energy Integration into Cloud & loT-Based Smart Agriculture"[6]

Integrating renewable energy into smart farms paves the path towards adopting solution in off-grid sites. Adopting fuzzy logic into smart drip irrigation, our system reduces water consumption by up to 71.8%. Collecting rainwater: by collecting rainwater, water table resources are saved, and energy use is reduced. Improving water quality: when water is kept in basins, it becomes more oxygenated, thus becoming more beneficial for the plants. The user can predict the yield of the crop in which year he or she wants to. The paper uses advanced regression techniques like Kernel Ridge, Lasso and ENet algorithms to predict the yield and uses the concept of Stacking Regression for enhancing the algorithms to give a better prediction.

[7] A. Nigam, S. Garg, A. Agrawal and P. Agrawal, "Crop Yield Prediction Using Machine Learning Algorithms," 2019 Fifth International Conference on Image Information Processing (ICIIP) [7]

Agriculture is one of the major and the least paid occupation in India. Machine learning can bring a boom in the agriculture field by changing the income scenario through growing the optimum crop. This paper focuses on predicting the yield of the crop by applying various machine learning techniques. The outcome of these techniques is compared on the basis of mean absolute error. The prediction made by machine learning algorithms will help the farmers to decide which crop to grow to get the maximum yield by considering factors like temperature, rainfall, area, etc.

[8] P. S. Nishant, P. Sai Venkat, B. L. Avinash and B. Jabber, "Crop Yield Prediction based on Indian Agriculture using Machine Learning," 2020 International Conference for Emerging Technology (INCET)[8]

The research conducted by Nishant et al. at the 2020 INCET conference focuses on enhancing crop yield prediction in India. By utilizing straightforward parameters such as state, district, season, area, and year, alongside advanced regression techniques like Kernel Ridge, Lasso, and Elastic Net, the study aims to improve predictive accuracy. Notably, the application of Stacking Regression yields significant enhancements in prediction compared to using individual regression models. This combination of basic parameters with sophisticated algorithms offers a novel approach to addressing the critical issue of crop yield forecasting in India, with potential implications for agricultural planning and food security. The plan is to develop a user-friendly mobile application specifically tailored for farmers, with an emphasis on accessibility by converting the entire system into regional languages. This proactive approach toward practical implementation ensures that the research not only contributes to academic discourse but also directly benefits stakeholders in the agricultural sector, potentially leading to more informed decision-making and resource allocation.

IV. METHODOLOGY

A. CROP PREDICTION AND IRRIGATION CONTROL SYSTEM

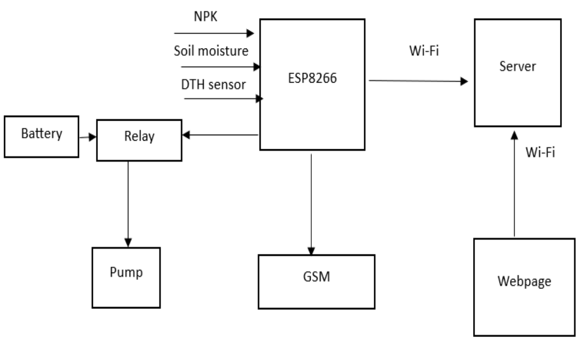

Fig.1 Design of Crop Prediction and Irrigation Control System

NPK AND SOIL MOISTURE SENSORS

- NPK (Nitrogen, Phosphorus, and Potassium) sensors measure the levels of these essential nutrients in the soil
- Soil moisture sensors measure the moisture content of the soil
- DTH11 Sensor used for measuring temperature and humidity

Functionality: These sensors provide real-time data about the soil conditions for suggesting suitable crop and whether any fertilizers are needed

ESP8266

- ESP8266 is a microcontroller with Wi-Fi capability

Functionality: Collects data from the sensors and sends it to the server via Wi-Fi

SERVER

- The server is a computer that hosts the web application and receives data from the ESP8266

Functionality: It receives sensor data, processes it, stores it in a database, and provides a web interface for users to access the data remotely

GSM MODULE

- GSM (Global System for Mobile Communications) module allows communication via cellular networks.

Functionality: It provides an alternative communication channel in case Wi-Fi connectivity is not available.

WEBPAGE

- The webpage provides a user interface for accessing the data collected from the sensors.

Functionality: Users can view real-time and historical data, such as temperature, humidity and NPK concentrations, through tables.

RELAY AND PUMP:

- A relay is a switch that is controlled by the ESP8266
- The pump is connected to the relay and is used for irrigation purposes

Functionality: Based on the soil conditions monitored by the sensors and the commands received from the server ESP8266 controls the relay to turn the pump on or off and ensures efficient water usage and plant health

B. CROP AND WEED DETECTION AND REMOVAL

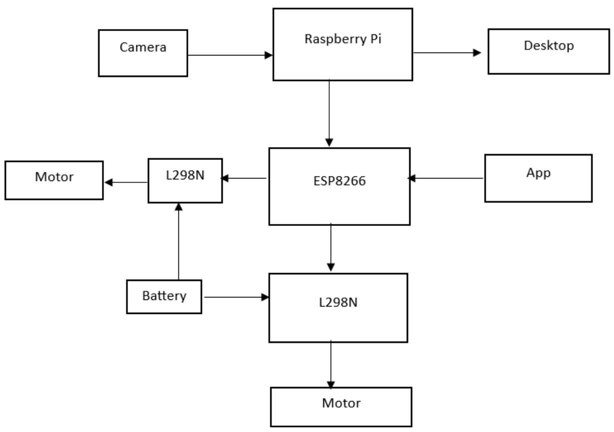

Fig. 1 Design of Crop and Weed Detection and Removal

CAMERA:

Functionality: The camera captures images of crops and weeds

RASPBERRY PI:

- The Raspberry Pi serves as a microcomputer capable of running crop and weed detection

Functionality: Receives images from the camera, processes them

DESKTOP

- Virtual display for Raspberry Pi

Functionality: It may perform more intensive processing tasks on the images received from the Raspberry Pi

ESP8266 MODULE:

- ESP8266 is a microcontroller with Wi-Fi capabilities.

Functionality: It receives data from the mobile app which is used for controlling rover

L298N MOTOR DRIVER MODULES:

- The L298N motor driver modules provide a way to control the speed and direction of DC motors.

Functionality: Each L298N module controls a motor. ESP8266 sends signals to the L298N modules to control the movement (speed and direction) of the motors connected to them. These motors might be used for such as driving rovers

BATTERY:

- The battery supplies power to the L298N motor driver modules.

Functionality: It provides the necessary electrical energy to drive the motors connected to the L298N modules, enabling movement or other mechanical actions based on the commands received from the ESP8266 module.

V. CONCLUSIONS

Agriculture has the potential to be revolutionized by the development and application of IoT and sensor technologies, enabling more sustainable and effective food production. The need for food will rise as the world's population expands, and the agriculture industry must come up with novel solutions to fulfil this demand while preserving sustainability. IoT and sensors, which provide real-time monitoring and management of crops, soil, and environment, present a possible answer to these problems. In order to increase agricultural output and efficiency, smart farming employing IoT and soil moisture and humidity sensors has emerged as a promising alternative. Farmers may gather real-time data on soil moisture, humidity, and temperature using these sensors, which can then be evaluated to help them decide when to water, fertilise, or use pesticides. Using IoT technology in agriculture offers the potential to boost agricultural yields, lower labour costs, and use less water. Farmers can save time and concentrate on other crucial facets of their business by automating some operations. In conclusion, IoT-based smart farming using humidity and soil moisture sensors has the potential to completely change how we raise food. It is a promising approach that can assist farmers in increasing output, lowering expenses, and having a less environmental impact. Introduction of sensors to monitor and track the status of crops and irrigation also helped farmers for increasing the crop production and better output. Proper messaging and alert systems are also introduced for the purpose of convenient and sufficient water pumping may results in plant growth and the increment of food production. In short, introducing IoT solves many challenges and helps to diminish many disadvantages of traditional farming. However, the development of sustainable and effective agricultural techniques that can fulfil the requirements of a rising population while protecting the environment for future generations, as well as the successful integration of IoT and sensor technologies, are key to the future of smart agriculture.

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