AI for Food Security and Sustainable Agriculture

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Abstract - Agriculture automation is the primary issue and emrging problem for every nation. The global population is growing very quickly, and as a result, there is a sharp rise in the need for food. Farmers must deteriorate the soil by applying more toxic pesticides because their traditional ways aren't enough to meet the growing demand. This has a significant impact on agricultural practices, and ultimately, the land remains unproductive and desolate. In the modern world, automation isessential, and the idea of the Internet of Things (IoT) and Artificial Intelligence are developing quickly aswell, there is a method for turning manual systems into automated systems. Sensors are used to monitorhumidity, nitrogen, phosphorous and potassium level present in soil.Crop diseases, poor storage management, pesticide control, weed management, inadequate irrigation, and water management are some of the issues affecting the agriculture sector. These issues can all be resolved using the many approaches described above. Deciphering concerns like the use of harmful pesticides, controlled irrigation, pollution management, and environmental repercussions in agricultural operations is urgently needed today. It has been demonstrated that automating farming operations increases soil yield and improves soil fertility.

Keywords Crop diseases, pesticide control, Agriculture automation, Artificial Intelligence, IoT.

INTRODUCTION

One way to guarantee global food security is through precision agriculture. Precision agriculture, sometimes known as digital agriculture, is a data-driven, sustainable farm management system powered by technology. Basically, it's the use of software tools, smart embedded devices, and contemporary information technology to help agricultural decision-making.With the advent of technology in this digital world, we humans have pushed our limit of the thinking process and are trying to coalesce nor- mal brain with an artificial one.Artificial intelligence is a whole new field that resulted from this ongoing research. It is the method by which a person can create a machine with intelligence. Al falls within the category of computer science, which has the ability to recognize its environment and should prosper in order to increase success rates. Al ought to be competent in his task based on prior knowledge. Certain domains, such deep learning, CNN, ANN, open CV, and AI, improve machine performance and aid in the development of more advanced technologies.[6]

Impact of AI in agriculture

Precision farming aims to boost farm profitability by cutting production costs and environmental impact. Precision agriculture heavily relies on digital technologies like blockchain, cloud computing, AI, data analytics, and IoT [4]. IoT-based smart sensors are used in precision farming to gather information about crop growth analysis, water requirements, fertilizer requirements, and soil nutrients. Using computer vision techniques, autonomous and semi-autonomous equipment, such as robots and unmanned aerial vehicles (UAVs), are used to recognize weed and disease in plants. Precision agriculture also makes use of satellite imagery to monitor fields and detect disease outbreaks.AI algorithms are utilized to collect and evaluate the data gathered from the deployed sensors in order to enhance the control and optimization of farming practices [7].

A. Needfor AI based agriculture

Management of Agricultural Production: The supply chain for agricultural production is extremely intricate. Al is changing the production, distribution, and consumption of our food. AI-powered technologies are being used by researchers to provide information and advice on a variety of agriculture-related topics throughout the food supply chain, including crop rotation planning, planting schedules, water and nutrient management, pest control, disease prevention, ideal harvesting, food marketing, product distribution, and food safety [7]. Crop Monitoring: Traditional techniques for keeping an eye on crop health require a lot of work and time. An effective method of keeping an eye on potential problems with crop health or soil nutrient deficits is to use artificial intelligence (AI). Applications to analyze plant health patterns in agriculture are being developed using deep learning support. Applications powered by AI like these are crucial for improving knowledge of plant diseases, pests, and soil health [7]. Disease Identification: Plant diseases pose a serious risk to the

economy, environment, and food security. For crop disease to be effectively managed, early detection is crucial. With a high degree of accuracy, AI- based picture recognition systems may be able to identify particular plant diseases, opening the door for agricultural disease identification in the field utilizing mobile devices like smartphones [7]. Internet of Things-Based Monitoring System Design. With the Internet of Things (IoT), specific objects can transfer data over a network without requiring human intervention. A humidity, nitrogen, phosphorous and potassium monitoring system in agriculture farm is one example of an Internet of Things application.

Internet of Things

The Internet of Things (IoT) is a system in which individuals and in animate items are given unique identities and the capacity to transfer data over a network without the need for source-to-destinationor human-to- computer communication.With the help of intelligent sensors and networked gadgets that communicate with one another through the internet,the Internet of Things (IoT) promises to improve life. There are now many common place devices with sophisticated sensors that can be operated online. Using clever sensors, analog data is transformed into digital data and immediately supplied to the microcontroller.

B.EXISTING SYSTEM

Agricultural robots are unique in the development of digital agriculture and offer several benefits to farming productivity. Robots have drawn the interest of industry and science since the 1950s, when the first industrial robots were created. Agricultural robots have evolved quickly as a result of recent breakthroughs in computer science, sensing, and control techniques. They now depend on a variety of cutting-edge technology for a range of application scenarios. In fact, by combining observation, decision- making, control, and execution strategies, notable improvements have been made. Nevertheless, due to their lack of artificial intelligence integration, the majority of agricultural robots are still in need of intelligence solutions, which restricts their applicability to small-scale applications without mass manufacturing. Therefore, in this study, we refer to over 100 pieces of literature categorized by the type of agricultural robots under discussion in order to assist researchers and engineers in understanding the current state of agricultural robot research. We explore the advantages and difficulties of developing more applications while bringing together a variety of agricultural robot research statuses and applications. Lastly, some recommendations are made about the current directions of agricultural robot development.

C. PROPOSED SYSTEM

Sensor deployment is the initial stage of the design cycle, during which intelligent sensors are placed to collect data on temperature, humidity, pesticides, fertilizers, water level, and soil moisture. Smart sensing and monitoring of the agricultural field constitute the second part of the working cycle. Plant health assessment, irrigation needs, planting, spraying, and soil field analysis are all taken care of in this phase. Smart analysis and planning, including soil and water management and automated irrigation, are carried out in the third phase. The fourth stage is smart control, which involves encouraging the use of self-driven vehicles for effective plant seeding and smart irrigation monitoring and control systems to improve water use efficiency.The smart supply chain phase, which concludes the cycle, involves the intelligent supply of mature plants to the industry [6].

Smart crop sensors:

To ascertain whether irrigation, insecticides, or fertilizers are necessary, these sensors will gather information on the moisture content of the soil, the absence of nutrients, or the presence of pests [6].

Smart irrigation system:

According to the suggested model, the irrigation system will activate when the robot receives a signal to turn on the motor and irrigate the plants when the soil moisture content drops.

ESP32 CAM:

The field or the mapped area will be flown over by the ESP32 CAM. Additionally, this ESP32 CAM will gather data regarding the health of the crops.

Cloud storage:

Everything required to know about the website's moisture and nutrient levels will be available via the cloud storage [6].

Robot:

The robot may be operated by the Google assistant, and it can perform tasks in the field such as turning on and off the motor [6].

D.BLOCK DIAGRAM

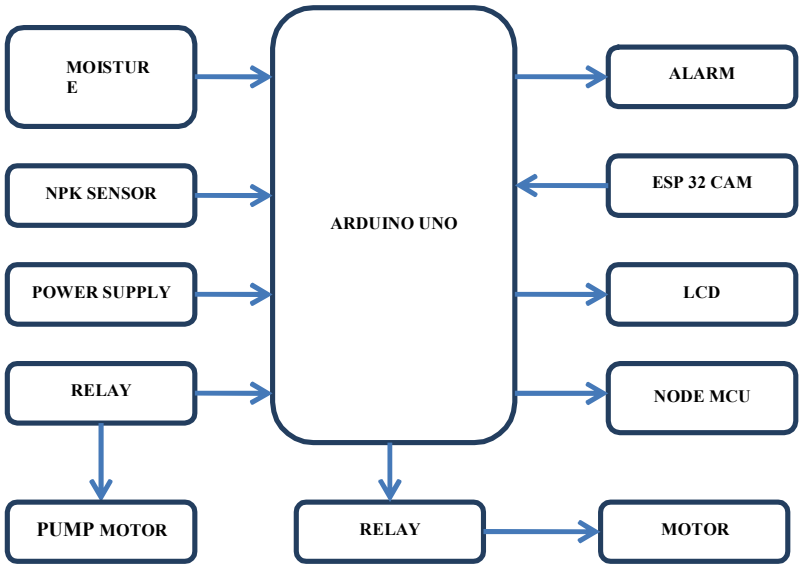

FIG. AI for food security and sustainable agriculture

CONCLUSION

In conclusion, ESP32 Cam is used to identify healthy and unhealthy plants using AI, and plants that are found to be unwell will be treated with pesticides. With its revolutionary approach to farming, the agriculture robot control system gives farmers unmatched control and field-level insights.Decision-making is aided by the integration of this and the display of real-time data in the Thingspeak cloud.In addition to lowering physical labor, automated features like pesticide and water sprays also support sustainable farming and resource optimization.The goal of the suggested PF strategy is to save farmers time and money. By automating data collecting, analysis, and decision-making processes with the use of Al, ML, and IoT technologies, farmers can improve overall productivity and streamline operations. Although the foundation of PF is the collection and organization of data, its true power lies in the application of various technologies to transform the gathered data into effective management strategies. The PF model that has been suggested aims to maximize the usage of fertilizers and pesticides in order to reduce the cost and environmental impact of agricultural practices. By applying data-driven insights and precise application tactics, farmers can use fewer pesticides, decrease pollution, and increase sustainability overall. PF incurs upfront costs, but in the long run, the benefits outweigh the drawbacks.providing a stable and expandable role.

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