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AI Driven IoT(AIIoT) for Smart Agriculture

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Abstract*: The agricultural industry is witnessing a significant shift due to the emergence of Artificial Intelligence driven Internet of Things (AIIoT), which is providing farmers with unparalleled automation capabilities and insights. The goal of this paper is to present a thorough review of AIIoT in smart agriculture, emphasising its uses, advantages, and consequences for decision-making. Smart agriculture decision-making is a game-changing technology that gives farmers the ability to maximise their operations and make well-informed judgements. Through the utilisation of advanced analytics, real-time data, and decision support systems, farmers may optimise crop yields, minimise expenses, and minimise risks. The agricultural industry will become more sustainable and productive as a result of farmers' increased ability to make decisions as the field of smart agriculture develops. The application of AI and IoT in smart agriculture is a game-changing technology that might completely alter how we grow and prepare food. Farmers can increase crop yields and quality, streamline operations, and contribute to a more effective and sustainable food supply chain by utilising AI and IoT. The advantages of AIIoT in smart agriculture are evident, despite the fact that there are still certain obstacles to be addressed, and its use is anticipated to increase in the years to come.*

Keywords: IoT, AIIoT, Smart Agriculture, KSK approach, KK approach

I. INTRODUCTION

In the ever-evolving landscape of technology, the agricultural sector has not been left behind. Smart Agriculture, a term that encompasses the integration of advanced technologies into farming practices, has been transforming the way we produce food. This review delves into the various aspects of Smart Agriculture, its benefits, and its potential to revolutionize the agricultural industry[1-10].

At the core of Smart Agriculture is the use of advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data. These technologies are used to collect, analyze, and interpret data from various sources, including soil sensors, weather stations, and satellite imagery. This data is then used to make informed decisions about crop management, irrigation, and pest control, among other things[11-22].

One of the most significant benefits of Smart Agriculture is its ability to increase crop yields. By using data-driven insights, farmers can optimize their crop management practices, leading to healthier plants and higher yields. This is particularly important in a world where the demand for food is rapidly increasing due to population growth[23-35].

Another advantage of Smart Agriculture is its potential to reduce the environmental impact of farming. By using precision agriculture techniques, farmers can minimize the use of water, fertilizers, and pesticides, thereby reducing the environmental footprint of their operations. This is crucial in an era where climate change and environmental degradation are pressing global concerns[36-48].

Smart Agriculture also has the potential to improve the livelihoods of farmers. By increasing crop yields and reducing input costs, farmers can increase their profits and improve their standard of living. Additionally, the use of technology can help to attract younger generations to the agricultural sector, which is facing a shortage of skilled labor[49-59].

However, the adoption of Smart Agriculture is not without its challenges. The initial investment in technology can be high, and there may be a learning curve for farmers who are not familiar with the use of advanced technologies. Additionally, there are concerns about data privacy and security, as well as the potential for job displacement due to automation.

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In assumption, Smart Agriculture represents a significant step forward in the agricultural industry. By leveraging advanced technologies, farmers can increase crop yields, reduce environmental impact, and improve their livelihoods. While there are challenges to overcome, the potential benefits of Smart Agriculture make it a worthwhile investment for the future of agriculture[60-64].

II. DECISION MAKING IN SMART AGRICULTURE

Smart agriculture is a rapidly growing field that utilizes advanced technologies to optimize agricultural practices and enhance crop productivity. Decision-making plays a crucial role in smart agriculture, enabling farmers to make informed decisions based on real-time data and predictive analytics. This review provides a comprehensive examination of decision-making in smart agriculture, exploring key concepts, methodologies, and applications.

- Data Collection and Integration- Effective decision-making in smart agriculture relies on the availability of accurate and timely data. Various sensors and IoT devices are deployed to collect data on soil conditions, crop health, weather, and other relevant parameters. Data integration platforms enable the seamless consolidation of data from multiple sources, ensuring a holistic view of the farming system.
- Data Analytics and Modeling-Once data is collected, it undergoes various analytics and modeling techniques to extract meaningful insights. Machine learning algorithms, statistical models, and predictive analytics are employed to identify patterns, predict crop yields, and optimize inputs. These models provide farmers with valuable information to guide decision-making.
- Decision Support Systems- Decision support systems (DSSs) are software applications that assist farmers in making informed decisions. DSSs integrate data analytics, modeling, and user interfaces to provide customized recommendations based on the farmer's specific context. They empower farmers to evaluate multiple scenarios, consider trade-offs, and make optimal decisions.

The new approach is designed by Dr Kutubuddin S Kazi for decision making. This approach is called as KSK approach. This approach is best suited for any kind of decision making system. Also, to secure IoT structure, they also proposed a method called as KK approach for IoT security.

Decision-making in smart agriculture has a wide range of applications, including:

- Crop Management: Optimizing irrigation schedules, fertilization strategies, and pest control measures to maximize crop yields.
- Resource Allocation: Efficiently allocating resources such as water, fertilizer, and labor based on real-time data.
- Risk Management: Identifying potential risks and developing mitigation strategies to reduce financial losses.
- Supply Chain Management: Enhancing coordination and collaboration within the agricultural supply chain to improve efficiency and market responsiveness.

Despite the advancements in decision-making in smart agriculture, several challenges remain:

- Data Quality and Reliability: Ensuring the accuracy and reliability of data collected from sensors and IoT devices is crucial for effective decision-making.
- Model Development and Validation: Developing and validating accurate and robust models for predictive analytics and decision-making is an ongoing challenge.
- User Adoption and Training: Empowering farmers with the knowledge and skills to use decision support systems effectively is essential for widespread adoption.

Decision-making in smart agriculture is a transformative tool that empowers farmers to make informed decisions and optimize their operations. By harnessing real-time data, employing advanced analytics, and utilizing decision support systems, farmers can increase crop yields, reduce costs, and mitigate risks. As the field of smart agriculture continues to evolve, the decision-making capabilities of farmers will further enhance, leading to a more sustainable and productive agricultural sector.

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III. PROPOSED METHODOLOGY

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) in the agricultural sector, commonly referred to as AIIoT, has been a game-changer in the field of smart agriculture. This innovative technology has transformed the way farmers manage their crops, livestock, and overall farm operations, leading to increased efficiency, productivity, and sustainability. Figure 1 shows the proposed AI driven IoT based Smart Agriculture system.

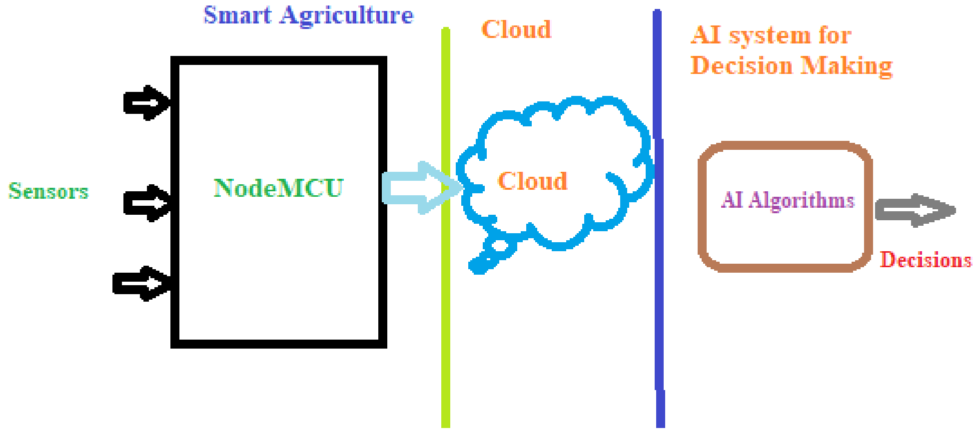

Figure 1- AI driven IoT based Smart Agriculture system(Proposed)

AIIoT in smart agriculture is a comprehensive system that utilizes sensors, drones, and other IoT devices to collect real-time data on various aspects of farming, such as soil moisture, temperature, humidity, and crop health. This data is then analyzed by AI algorithms, which provide valuable insights and recommendations to farmers, enabling them to make informed decisions and optimize their operations.

One of the most significant benefits of AIIoT in smart agriculture is its ability to improve crop yield and quality. By monitoring soil conditions and weather patterns, farmers can adjust their irrigation and fertilization practices accordingly, ensuring that their crops receive the optimal amount of water and nutrients. This not only leads to higher yields but also reduces the environmental impact of farming, as it minimizes water waste and prevents over-fertilization.

In addition to crop management, AIIoT also plays a crucial role in livestock farming. By using IoT devices such as GPS trackers and health monitors, farmers can keep track of their animals' location, health, and well-being. This allows them to detect and address any potential health issues early on, reducing the risk of disease outbreaks and improving overall animal welfare.

Moreover, AIIoT in smart agriculture has the potential to revolutionize the way farmers manage their resources. By analyzing data on crop yields, weather patterns, and market trends, AI algorithms can provide farmers with valuable insights on when to plant, harvest, and sell their crops. This not only helps farmers optimize their operations but also contributes to a more stable and efficient food supply chain.

However, despite the numerous benefits of AIIoT in smart agriculture, there are still some challenges that need to be addressed. One of the main concerns is the cost and complexity of implementing these technologies, particularly for small-scale farmers. Additionally, there are concerns about data privacy and security, as the collection and analysis of sensitive farming data could potentially be misused.

In conclusion, AIIoT in smart agriculture is a transformative technology that has the potential to revolutionize the way we produce and consume food. By leveraging the power of AI and IoT, farmers can optimize their operations, improve crop yields and quality, and contribute to a more sustainable and efficient food supply chain. While there are still some challenges to overcome, the benefits of AIIoT in smart agriculture are undeniable, and its adoption is likely to continue growing in the years to come.

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Components Required for Smart Agriculture system:-

- NodeMcu-2
- PCB
- 4 channel ADC
- Moisture sensor
- DHT11

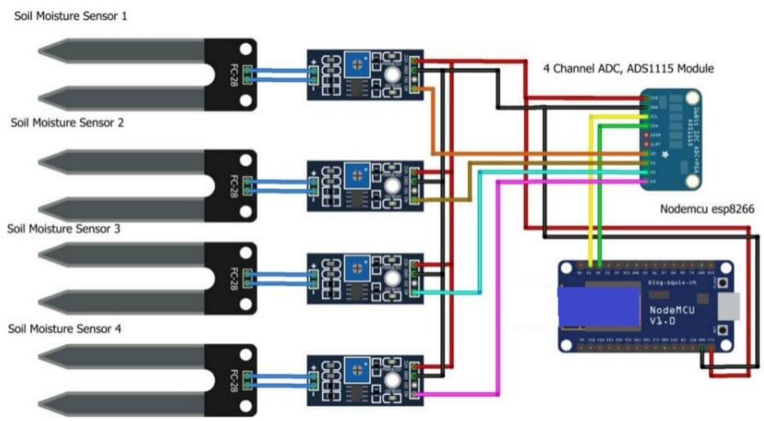

Figure 2- Soil Moisture sensor connection

Steps of Connection and experimentation –

- Must upload the code after creating all of the connections.
- Attach the NodemcuVin to every Soil Moisture Sensor Vcc.
- Attach the Nodemcu Vin to the Multiplexer Vcc;
- Attach the ADC multiplexer's GND to the Nodemcuo GND and all of the soil moisture sensor's ground to the Nodemcuo GND.
- As shown in the above Figure 2, the multiplexer is connected to the output of the soil moisture sensor.
- Connect other sensors like temperature and humidity to Nodemcuo as shown in figure 3.
- Attach Nodemcu d3's DHT 11 output pin to it.
- The output of the soil moisture sensor is connected to the A0;
- Attach NodemcuVin to the DHT 11 Vcc.
- Link Nodemcu GND to the DHT 11 Gnd;

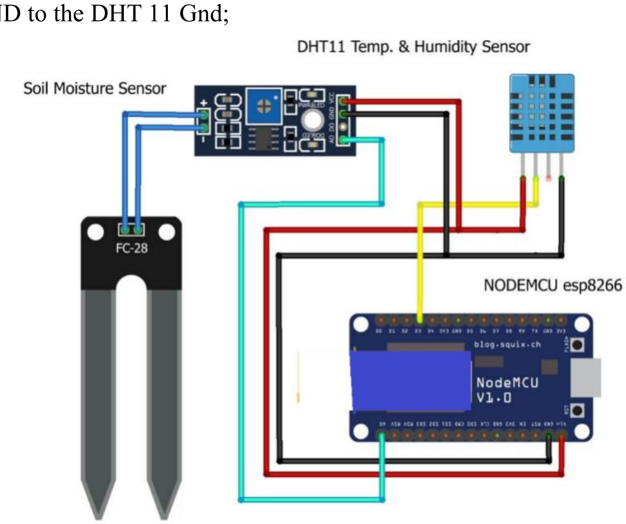

Figure 3- Sensors connections with NODEMCU

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IV. RESULTS AND DISCUSSION

Once finished connections as shown in Figure 2 and Figure3, the link Transfer the specified code (Figure 4) to the Nodemcu

```
#include <ESP8266WiFi.h>
#include <ESP8266HTTPClient.h>
#include <Adafruit_ADS1015.h>
WiFiClient client;
String thingSpeakAddress= "http://api.thingspeak.com/update?";
String writeAPIKey;
String tsfield1Name;
String request_string;
HTTPClient http;
 Adafruit_ADS1115 ads;
void setup()
{
 Serial.begin(115200);
 delay(3000);
 WiFi.disconnect();
 Serial.println("START");
 WiFi.begin("DESKTOP","asdfghjkl");   // Wifi ("ID","Password")
 while ((!(WiFi.status() == WL_CONNECTED))){
 delay(300);
 Serial.println("...");
```

Figure 4- Code for Nodemcu

Initially create the ThingSpeak Channel for Smart Agricultureing system using IoT. The Sensors output is displayed on the created channel as shown in Figure 5.

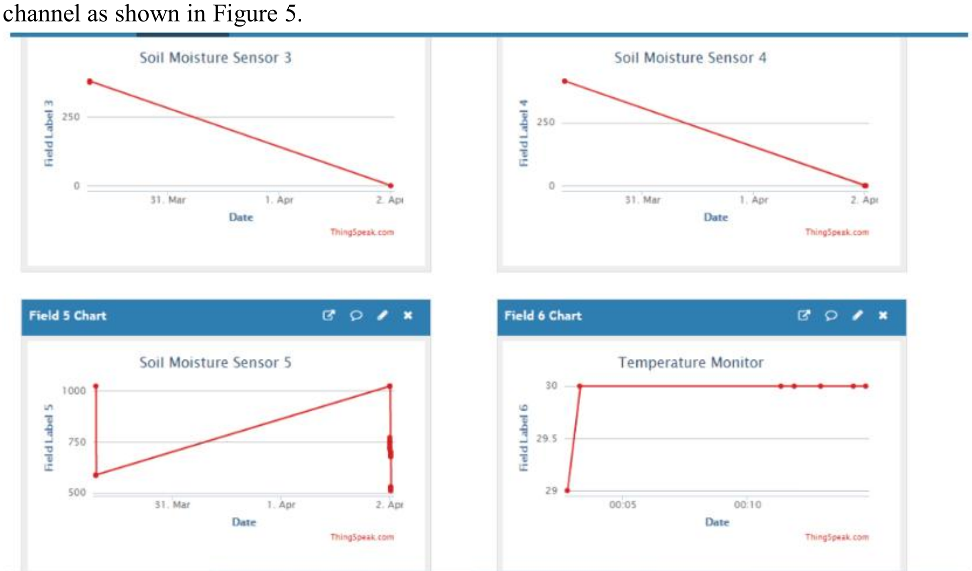

Figure 5- Output of System

Depends on the information received from IoT based smart agriculture system is connected to AI system for make proposer decisions. The decisions are either watering, fertilization, etc.

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V. CONCLUSION

In the agriculture sector, artificial intelligence of things, or AIoT, has become a disruptive force, giving farmers access to previously unheard-of insights and automation capabilities. With an emphasis on its uses, advantages, and effects on decision-making, this paper seeks to give a thorough review of AIoT in smart agriculture. Smart agriculture uses decision-making as a transformative tool to enable farmers to make well-informed decisions and maximise their operations. Farmers may boost crop yields, cut expenses, and lower risks by leveraging real-time data, applying advanced analytics, and putting decision support systems to work. Farmers will become more adept at making decisions as the field of smart agriculture develops, which will result in a more productive and sustainable agricultural industry. AIIoT in smart agriculture is a game-changing technology that could completely change how humans grow and prepare food. Farmers may streamline their processes, raise crop yields and quality, and add to a more effective and sustainable food supply chain by utilising AI and IoT. The benefits of AIIoT in smart agriculture are indisputable, and its acceptance is certain to continue expanding in the years to come, even though there are still some obstacles to be solved.

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