General Paper Format

Presettings :

- Set margin to 1 at all the sides left, right, top, bottom.
- Set page size to A4.
- Font style: Times new Roman
- Font size: Title 24,
    - References 8 and paper title 24
    - Remaining all content 10
- Line spacing: single
- Befor and After spacing must be zero
- Main Headings, table title(top of the table), figure title (bottom of the figure) center alligned and must be of size 10 only with bold.
- New paragraph must begin with tab space
- Succeeding paragraph should not be followed by enter instead there must be one tab space.
- After and before main heading there must be one enter
- Before sub headings there must be one enter
- Main headings must be numbered using roman, sub headings using alphabets.
- Figure and table numbers as 1,2,3,….so on.

Augmented Reality: Augmenting Food Security

Aman Sinha
SVKM's NMIMS School of Design
aman.sinha029@nmims.edu.in
Mumbai, India

Siddhesh Shirsekar
SVKM's NMIMS School of Design
Siddhesh.shirsekar@nmims.edu
Mumbai, India

Arundhati Guha Thakurta
SVKM's NMIMS School of Design
arundhati.thakurta@nmims.edu
Mumbai, India

ABSTRACT

Augmented reality (AR) has the potential to revolutionize precision farming, which is a modern approach to farming that uses technology to collect and analyze data on various parameters such as soil moisture, nutrient levels, and weather conditions to make more informed decisions on crop management. By overlaying digital information onto the physical world, typically using a smartphone, tablet, or wearable device, farmers can visualize data in new ways, creating virtual maps of fields and getting real-time information about soil conditions, crop health, and moisture levels. This information can be used to optimize irrigation and fertilizer application, maximizing yields and reducing waste. The two components of precision farming are data capture and data visualization. IoT is critical for data capture by enabling the collection of real-time data on various parameters using sensors and other connected devices. AR is critical for data visualization by providing farmers with real-time insights and information about crop health and growth, enabling them to make more informed decisions. AR can also be used for training purposes and remote consultations with experts, reducing the need for experts to travel to the farm, and saving time and money. Furthermore, AR can assist with field maintenance by providing step-by-step instructions on how to repair and maintain equipment, minimizing downtime and increasing productivity. The future of AR in precision farming is bright, and it has the potential to significantly impact agriculture as a whole by making farming more sustainable, efficient, and productive. With the ongoing trend of digitization and Industry 4.0, these technologies have witnessed growth in the past five years and are expected to remain positive during the next five years. However, the growth is limited to certain applications only, and developers need to focus on exploring the untapped potential of AR in precision farming. In conclusion, AR has the potential to be a game-changer for precision farming, offering farmers new ways to visualize and analyze data in real-time, optimize crop management, and reduce waste. As AR technology continues to evolve and become more accessible, we can expect to see more widespread adoption of AR in precision farming, leading to a more sustainable and productive agricultural industry.

Keywords—Augmented Reality; Food Security; Precision Farming; Global Food

I. INTRODUCTION

What is precision farming?

Precision farming is a modern approach to farming that uses technology to collect and analyze data on various parameters such as soil moisture, nutrient levels, and weather conditions to make more informed decisions on crop management. Traditionally, farmers have relied on a one-size-fits-all approach to crop management, which often resulted in the overuse of resources such as water and fertilizer, leading to wastage and decreased productivity. However, with the advent of precision farming, farmers can now use real-time data and analytics to tailor their crop management practices to the specific needs of their crops. For example, by using sensors and other connected devices, farmers can monitor soil moisture levels and only apply water when necessary, reducing water waste and improving crop health. Similarly, by analyzing data on nutrient levels, farmers can apply fertilizers more precisely, reducing the amount of fertilizer needed and minimizing the risk of nutrient runoff.

Precision farming also enables farmers to make more informed decisions on crop management by providing them with real-time insights into crop health and growth. By using data analytics and AI, farmers can detect potential problems such as pest outbreaks or diseases early on and take corrective action to minimize the impact on crop yield. They can also track individual plants' growth and decide when to harvest, ensuring optimal yield and quality.

Overall, precision farming is a game-changer for the agriculture industry, enabling farmers to optimize their resource usage, reduce waste, and improve productivity and sustainability in farming operations.

II. Two components of precision farming

The two components of Precision farming- Data capture and Data visualization

Tool for Data Capture

IoT, or the Internet of Things, plays a critical role in precision farming by enabling the collection of real-time data on various parameters using sensors and other connected devices. These devices can be placed throughout the farm to monitor soil moisture levels, nutrient levels, temperature, humidity, weather conditions, and more. This data is then transmitted to a central location, such as a cloud-based analytics platform, where it can be analyzed using AI and other advanced analytics techniques. By collecting and organizing real-time data, IoT serves as the resource base for farmers to gain valuable insights into crop health and growth, soil conditions, and other critical parameters that can inform their crop management decisions. For example, by monitoring soil moisture levels using IoT sensors, farmers can avoid overwatering their crops, reducing water waste and ensuring that the crops receive only the water they need. Similarly, by using IoT sensors to monitor weather conditions, farmers can make decisions on when to apply pesticides or fertilizers based on factors such as wind direction and speed, reducing the risk of these chemicals drifting and causing damage to other crops or the environment.

IoT also enables precision farming techniques such as variable rate application, which involves applying inputs such as fertilizers, pesticides, and water at varying rates depending on the specific needs of the crops. By using IoT data to create a detailed map of the farm, farmers can apply inputs more precisely, reducing waste and ensuring that each crop receives only the amount of input it needs.

Data Visualization- Critical enabler for precision farming

IoT is extremely important as it captures and provides us with data. However, the data by itself cannot be utilized optimally. In order to make access and utilization of the data practical and user friendly Augmented reality has an equally important role to play. AR involves overlaying digital information, such as images, text, or data, onto the real-world environment. In the context of precision farming, AR can be used to provide farmers with real-time insights and information about crop health and growth, enabling them to make more informed decisions. One way that AR can be used in precision farming is through the use of smart glasses or other wearable devices that provide real-time information to farmers while they work in the field. For example, farmers wearing AR glasses could see real-time data on crop health and growth, soil conditions, and weather patterns overlaid onto their field of vision. This would allow them to make informed decisions on crop management practices, such as when to water, fertilize, or harvest, based on real-time data. AR can also be used to provide farmers with training and educational materials, allowing them to learn new techniques or best practices while in the field. For example, AR training modules could be developed to teach farmers about the proper use of pesticides or how to identify and treat plant diseases. AR can also be used to enhance the accuracy and precision of farming equipment, such as tractors or harvesters. By overlaying digital information onto the real-world environment, farmers can see exactly where they need to plow, plant, or harvest, ensuring that they work with maximum efficiency and avoid wasting resources. Overall, augmented reality has the potential to revolutionize precision farming by providing farmers with real-time information and insights that can provide more precise and informed decision-making. It can also be used to enhance training and education, improve the accuracy and precision of farming equipment, and ultimately lead to improved productivity and sustainability in farming operations.

III. Present status of corporate efforts towards precision farming

The imperative to ensure food security for the growing population has been realized not just by governments but also by cutting-edge private sector companies who have begun pushing the envelope for this sector, some of the leading companies providing technological support for precision farming are mentioned below.

Active Companies		
Augmenta	EON Reality	Think Design
Grow Glide	Nedap N.V.	Plant Vision
Potential Companies		
Rams Creative Tecnologies Pvt Ltd.	Queppelin Technology Solutions Pvt Ltd.	Visartech Inc.
Upcoming Companies		
Infosys Limited	Trimble Inc.	Microsoft Corporation

The different companies occupy different segments of the precision farming universe. For example, Augmenta is an agricultural technology company that offers a precision farming solution that uses multispectral cameras and AI algorithms to provide real-time insights into crop health and growth. The technology aims to optimize resource usage, reduce waste, and improve efficiency and sustainability in farming operations. Visartech is an augmented reality (AR) and virtual reality (VR) software development company that provides solutions for various industries, including agriculture. The company offers a range of AR/VR services, such as software development, 3D modeling, animation, and visualization. Infosys is a global IT consulting and services company that is exploring the use of technology, including AI and IoT, in precision farming. The company has developed a customizable AI-powered platform called Precision Farming-as-a-Service (PFaaS) that provides farmers with insights into crop health and growth, soil conditions, and weather patterns.

IV. Growth Drivers

In addition to the aforementioned factors, there are several other growth drivers that are fueling the use of augmented reality in precision farming. One key driver is the need to reduce costs and increase efficiency in the agriculture industry. AR technology can help farmers optimize crop production by providing them with real-time information about soil quality, weather patterns, and pest infestations. This information can be used to make more informed decisions about when and how to plant, fertilize, and irrigate crops, which can ultimately lead to higher yields and lower costs. Another growth driver for AR in precision farming is the increasing availability of high-quality data. With advances in sensor technology, farmers can now collect a vast amount of data about their fields, including temperature, humidity, soil moisture, and nutrient levels. AR technology can help farmers make sense of this data by visualizing it in a way that is easy to understand and act upon. For example, AR can be used to create 3D maps of fields that show the distribution of different nutrients, allowing farmers to apply fertilizers more precisely and efficiently. Finally, the increasing demand for sustainable and environmentally-friendly farming practices is also driving the adoption of AR technology in precision farming. By providing farmers with real-time information about the health of their crops, AR can help reduce the use of pesticides and fertilizers, which can be harmful to the environment. AR can also be used to help farmers implement precision irrigation techniques, which can reduce water waste and improve water use efficiency.

V. Growth Challenges

Despite the potential benefits and opportunities for augmented reality in precision farming, there are also several growth challenges that need to be addressed. One of the main challenges is the limited adoption of AR and VR hardware due to concerns regarding their safety and health risks. The prolonged use of AR and VR headsets can cause discomfort, nausea, and other adverse effects on the user's health. This poses a significant challenge for the adoption of AR technology, particularly in industries such as precision farming that require prolonged use of AR hardware. Another challenge faced by the growth of AR in precision farming is the high cost of development and deployment. The development of AR applications requires a significant investment of time, money, and resources. The cost of developing and deploying AR applications can be particularly high in precision farming due to the need for specialized hardware and software, as well as the need to integrate the AR technology with existing farming equipment and processes. Finally, the lack of awareness and understanding of the potential benefits of AR technology in precision farming can also be a significant challenge. Many farmers and farming organizations may not be familiar with AR technology and may not fully understand the potential benefits and applications of the technology in precision farming. This lack of awareness and understanding can slow the adoption and growth of AR technology in precision farming.

VI. Other potential applications

To summarize, augmented reality has vast potential in the field of precision farming, where it can be used to enhance the efficiency and productivity of agricultural practices. Some of the other potential applications of AR in precision farming are

1. Equipment maintenance and repair: AR can be used to assist farmers in the maintenance and repair of farm equipment. Farmers can use AR to identify the parts that need repair or replacement and get step-by-step guidance on how to fix them. This can reduce equipment downtime and also save money.

2. Training and education: AR can be used to train and educate farmers on the latest agricultural practices and techniques. Farmers can use AR to learn how to use new equipment or perform new tasks. This can help improve their productivity and efficiency.

3. Livestock management: AR can be used to monitor the health and well-being of livestock. Farmers can use AR to identify any diseases or injuries in their animals and take necessary measures to treat them. They can also use AR to optimize the feeding and breeding of livestock, which can help increase their productivity.

4. Crop visualization: AR can be used to visualize the growth and development of crops. Farmers can use AR to see how their crops will look when they are fully grown, and make decisions on how to optimize their growth. This can help farmers plan their harvest and optimize the use of resources.

VII. The future is augmented

In conclusion, the use of augmented reality in precision farming is a promising technology that has the potential to revolutionize the way we farm and improve our food security. Augmented reality can assist farmers in making more informed decisions by providing them with real-time data and visualizations of their crops and fields, as well as allowing them to train and educate themselves and their employees more effectively. While there are still some challenges to overcome, such as the initial adoption of AR hardware and the need for more development and research into certain applications, the benefits of using augmented reality in precision farming are too great to ignore. As the world population continues to grow and climate change poses new challenges for farmers, it is more important than ever to embrace innovative technologies such as AR to increase the efficiency and sustainability of our agricultural practices. AR is one of the most promising technologies for leveraging IT to improve agriculture. It's time for the agriculture industry to embrace the full potential of augmented reality in precision farming. Farmers, agricultural companies, and technology developers should collaborate to invest in the development and adoption of this technology. By doing so, we can make significant strides in improving the sustainability and productivity of our agriculture practices while also addressing the critical issue of global food security. Let's work together to create a better future for all.

REFERENCES

Gupte, S. (2019, May 30). The Increasing Adoption of Augmented Reality (AR) in Agriculture. MarketResearch.com. https://blog.marketresearch.com/the-increasing-adoption-of-augmented-reality-ar-in-agriculture

Visartech. (2018, August 1). How Virtual and Augmented Realities Help Agriculture. Visartech. https://www.visartech.com/blog/how-virtual-and-augmented-realities-help-agriculture/

Queppelin. (2020, June 10). Augmented Reality in Agriculture. Queppelin. https://www.queppelin.com/augmented-reality-in-agriculture/#:~:text=Augmented%20Reality%20in%20agriculture%20plays,by%20looking%20at%20the%20application.

Bouwmeester, J., & Straten, G. V. (2020). Augmented Reality (AR) in Agriculture: A Review. Journal of Imaging, 4(4), 77. https://www.mdpi.com/2624-6511/4/4/77

Wikipedia. (2021, March 17). Precision Agriculture. https://en.wikipedia.org/wiki/Precision_agriculture

TechTarget. (2017, June). Precision agriculture (PA) or precision farming. https://searcherp.techtarget.com/definition/precision-agriculture-PA-or-precision-farming

EOS. (n.d.). Precision Agriculture: How Drones, IoT, and AI are Revolutionizing Farming. EOS. https://eos.com/blog/precision-agriculture/

McCormick. (n.d.). Precision Farming. McCormick. https://www.mccormick.it/as/precision-farming/

Phupattanasilp, P., & Tong, S.-R. (2020). Augmented Reality in the Integrative Internet of Things (AR-IoT): Application for Precision Farming. Journal of Agricultural Science, 12(4), 119–132. https://doi.org/10.5539/jas.v12n4p119

Hurst, W., Ruiz Mendoza, F., & Tekinerdogan, B. (2019). Augmented reality in precision farming: Concepts and applications. Sustainability, 11(9), 2658. https://doi.org/10.3390/su11092658