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AR-Based Organic Farming

[1]Shreyas G(4MC22CS146) CSE & Malnad college of Engineering (Hassan).
[2]Shravya H K(4MC22CS142) CSE & Malnad college of Engineering (Hassan).
[3]Veerendra G Adoor(4MC22CS179) CSE & Malnad college of Engineering (Hassan).
[4]Sinchana P(4MC22CS152) CSE & Malnad college of Engineering (Hassan).
[5]Mrs. Shruthi K.R. Assistant Professor, Malnad college of Engineering (Hassan).

Abstract - With an increase in world food production and fewer resources to use, more people are paying attention to solutions like precision agriculture. This literature review investigates how Augmented Reality (AR) influences organic farming, especially when used with the IoT, AI and image processing. While AR is widely used in factories, farmers are now checking plant health, spotting pests and learning from the technology. Trials suggest that using AR with CNNs and sensors helps identify pests early on in their lifecycle, an important factor for achieving both better yields and using fewer pesticides. AR apps make it possible to observe plant growth and suggest means of handling different climates. When SLAM, GPS and remote sensing are joined, AR becomes more accurate. The many examples provided in the survey include different ways that robotics is used in farms for livestock and crops, tackling issues like portable robots and correct data. By joining other tools, AR becomes fundamental for building smart farming systems that are both environmentally friendly and accountable.

Key Words: Augmented Reality (AR), Precision Agriculture, Organic Farming, Internet of Things (IoT), Artificial Intelligence (AI), Pest Detection, Smart Farming Systems.

1.INTRODUCTION

Development across the world depends on agriculture supplying food and supporting financial stability. Still, the main environmental issues from farming in the past include too much water use, greenhouse gas emissions and damage to farmland. Amid increasing numbers of people and more serious climate change, farms must move towards becoming more sustainable. AR has been described as a strong technology that is not used very much in engineering. With AR helping place digital details over real life, farmers can check information and follow directions as they plant or harvest. Plants are examined in recent studies using photography, to find pests and offer simple tips for their control. Thanks to AR integration, these technologies can assist farmers right on the field and help them need less equipment and expert assistance. With AR, farms can manage difficult aspects of farming and receive real-time guidance that improves production and helps keep the environment safe.

Examples like Vuforia and AR.js let developers use affordable SDKs to make AR technology in places with few resources. Thanks to AR, farmers can track the progress of their plants and easily locate any pests to help with managing their farms. In most cases, adding AR to farming makes farmers stronger, uses less chemicals and helps the environment. The survey studies recent examples of AR in organic farming, noting the new trends and hinting at what future innovations might be.

2. Literature Survey

The use of Augmented Reality (AR) on organic farms is seen as a vital solution for solving food security, climate problems and efficient use of resources everywhere. More and more research demonstrate that AR can help speed up, perfect and guide the processes used in farming. Research from applied studies and developments is summarized here to show which findings and technologies can benefit AR-based organic farms.

1. Introduction to AR in Agriculture

AR is a technology that quickly adds digital information to the real environment to enrich the user's experience. AR allows agricultural workers to see soil condition, check plant health and spot pest infestations right in their fields. It is especially helpful for organic farmers who try to keep chemicals out of their systems and protect natural balances. Because of AR, data from sensors, drones and weather stations can be instantly viewed, giving farmers early notices, useful advice on plant health and more accurate guidance when doing tasks. As a result, manual checks are used less, resources are managed well and ecological farming methods are supported.

2. AR in Precision and Organic Farming

According to Hurst et al. (2021), AR is becoming more popular in both smart manufacturing and precision farming. When combined with GPS, IoT sensors and AI, AR provides live updates for farmers to base their decisions on. For crops, AR helps grow plants, anticipate health concerns and analyze the environment and for livestock, it helps in checking animal well-being. AR helps protect the environment by giving farmers greater transparency to manage crops and get prompt advice on organic methods which in turn reduces the use of many fertilizers and pesticides.

3. Intelligent Pest Management using AR and CNN

Articles like the IEEE paper on intelligent pest management have shown ways AR is being used in organic farming. Image processing and CNNs help the system identify pests and identify the stage of development for insects and in plants. Through mobile apps, farmers can take pictures of leaves or pests and receive practical, instant, AR-enhanced tips and grow them organically. Thanks to data on pests and plant diseases, AR apps can detect an infestation in early stages, with the least possible damage and need for chemicals. It matters for organic certifications, since using chemicals is not allowed.

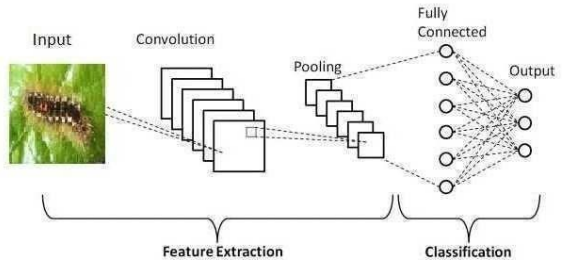

Fig -1: CNN model architecture used for pest detection

When AR is combined with CNNs, quick observation and a prompt response can stop widespread crop damage from occurring. By integrating, farmers are able to handle possible problems quickly, without always having to hire a professional to come inspect the field.

4. AR Hardware and Deployment Frameworks

People can engage with AR using their phones, smart glasses and other wearables. Hurst et al. state that AR projects can be monitor-based, video see-through or optical see-through systems. Farmers value MAR in agriculture since it allows them to access AR on their smartphones or tablets easily and affordably, displaying AR in real life settings. With smart glasses, you can check data and monitor animals in real time without taking your hands off your work. QR codes are used as visual markers in marker-based AR, whereas marker-less AR depends on computer vision and GPS for agricultural apps.

5. Impact on Sustainable Agriculture

UN Sustainable Development Goal 2: Zero Hunger will be promoted significantly by the use of AR. With their help, farmers notice pests faster, water more wisely and check their crops in real time, so yields are higher and the environment suffers less harm. Study results demonstrate how AR technology can help farmers see greenhouse effect models, helping them respond to climate changes.

Farmers can use these systems which connect to environmental stations and weather reports, to receive warnings and learn how to react to hazards. AR provides online guidelines to farmers in rural areas that explain the best methods of sustainable agriculture, so farmers can learn on their own.

6. Summary of Coupled Technologies

- AR Application
- Coupled Technologies
- Domain
- Crop Disease Detection
- Image Processing, CNN, Mobile AR
- Livestock Health Monitoring
- QR, IoT Sensors, Smart Glasses
- Livestock
- Autonomous Machine Supervision
- GPS, Machine Learning, Visual Overlay
- Climate Modeling and Growth Visualization
- Digital Twins, AR Simulation
- Organic Pest Control Guidance
- CNN, Organic Databases, Real- time AR Feedback
- Fig-1: CNN model architecture used for pest detection

7. Future Direction and Research Opportunities

There is still much to learn about using AR in organic precision farming. In the future, improvements might be made in pest detection systems, plant disease databases in AR and the development of lightweight AR systems for use in areas where connectivity is poor. Thanks to combining AR with blockchain, consumers can have greater confidence in organic produce, since the origins can be easily confirmed. When AR becomes readily available, it could promote agriculture for all types of people and businesses.

3. Observations and Insights from the Literature

As we looked into what's been written on AR and AI for farming, we recognized some findings and noticed key issues in the existing research which prompted us to explore AR for organic farming. These appear here:

1. Problems Found in Current Systems

- Lack of Regional Lists of Farming Pests: Practically all papers examined only general databases such as IP102 and did not address pests or the pattern of damage found in organic farming in South Asia or tropical areas.

- There are Few AR Lifecycle Visualizations: Even though a number of the studies used deep learning for pest stage recognition, just a few made 3D AR representations of those stages that farmers could use during their daily tasks.

- Most of the AR applications reviewed used only English or technical language, so they couldn't be used by many local users, those farmers with little or no knowledge about reading or digital technology.

- Though smart glasses are remarkable, they are difficult to use on farms because they are not practical and can only work outdoors in good weather. It appears that mobile AR is more useful when you're working outdoors.

2. Concepts and Innovations to Be Implemented

The following key points have emerged from the literature as foundational for conceptualizing an AR solution:

- A mobile application of AR built with Unity AR Core is used so farmers can find pests on their crops right in front of them. We plan to illustrate the lifecycle (egg → larva → pupa → adult) of each pest class using 3D models, which helps farmers know when to control the pests.

- Guided by Voice in Local. Instead of text, the app will provide voice directions in local languages (such as Hindi and Kannada) showing the farmer how to use organic treatments.

- The software will collect and store all pest images, along with guidance from sound clips so users can use them offline, ways to give farmers access to treatment methods when there's no internet connection. Organic treatment adjustments are supported by an AR overlay.

- Depending on the pest and what life stage it's at, the AR app will suggest suitable organic remedies that include neem oil, garlic spray or biological control agents—and add the images or objects into the video as AR content on the screen.

3. Vision and Relevance

With this method, objective focuses on:

- Close the divide in how rural farmers and AI/AR technology use technology.

- Encourage techniques for pest management that are approved by organic farmers.

- Take part in improving SDG Target 2a by developing agricultural technology that everyone can use.

When the technology is finally put in place, it will be built for simplicity, match local traditions and work for farming, so it does not stress users.

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