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How Artificial Intelligence is Revolutionizing Crop Yield Prediction

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ABSTRACT

As the world's population grows, producing enough food is essential. New technology is helping farmers make this happen. I am focusing on using computers to predict how much crops will grow. I am working with images of pea plants when they are still young and use them to figure out how much food will be harvested in the future from the field. One way to do this is to have the computer look at how green the crops are in each image, which shows how healthy they are. Other visual clues our model can look at are how many flowers or how many pods the plants have, or the size of their leaves. The computer learns from these clues and compares what it has learned. This tool can help farmers to make decisions on how to grow their food better and plan for the future which leads to better use of their resources and higher crop production.

KEYWORDS: prediction, artificial intelligence, RGB images, yield, Explainable AI (XAI)

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Imagine a camera placed on a tractor, just watching the plants grow quietly and taking a picture every week. The camera can tell farmers, "Your field is doing great here, but that other part needs some extra care!" That's Artificial Intelligence (AI) helping farmers predict how much crops will yield before harvest season even comes. Having exact crop yields every year helps farmers make smarter choices like choosing the best variety and this offers more food for everyone.

How Farmers Predict Yield Today

Traditionally, farmers predict crop yields by intermittently surveying their fields, counting plants, or simply guessing based on previous years' methods. This is tiring, and occasionally inaccurate. If they're unsure, they can hire specialists or use expensive satellite images to have a better sense of things, but this is costly and time-consuming.

The problem is that traditional methods might miss subtle clues, and predictions may vary vastly from farmer to farmer. One

Credit: The Spruce / K. Dave

missed sign translates into fewer harvests in the crop, leading to food shortages and financial losses.

How AI Sees More Clearly

AI is trained by looking at thousands of pictures taken throughout the growing season. It start with simple photos called RGB images (like the photos on your phone). These photos are transformed into a vegetation index called Green Leaf Index (GLI). Think of GLI as a filter that makes healthy green plants stand out so they are easily seen, and the AI can very easily pick them out.

A branch of AI, called deep learning, is used in this research; imagine a smart detective that has all it has learned from previous photographs. By looking at photographs taken every week, the AI model learns how plants develop and predicts whether they will yield a high or low harvest when picked. It reminds the plant's growth week by week, just like we remember stories chapter by chapter.

But how does it remember week to week? The model uses a process called time-series analysis. It's a type of timeline for growth in plants, where the AI looks at photos in sequence, and it learns how each plant grows and changes over time. As it watches the plant closely for several weeks, the AI can spot patterns that humans may miss.

The Magic of AI Prediction

Deep-learning algorithms are made up of layers that examine each bit of information in each image. Imagine building with a puzzle: each layer of the AI decides different bits of the puzzle, including color, shape, and texture. By the final layer, it combines all these hints and makes a prediction.

Tracking Growth Stages with AI

This AI does not take random shots. Instead, it follows the most important stages of plant growth from the moment vulnerable seedlings poke their head out of the soil until they are mature.

Each stage indicates something interesting about how healthy they are and how much they will yield. This AI closely monitors during vulnerable growth stages, when signs of probable future crop prosperity are evident.

There is something called Explainable AI (XAI), which tells what the AI model was searching for when it was making this prediction, so it can tell what stage of growth is affecting the prediction, and precisely at what moment a test can be carried out to know how much yield can be gotten from the crop.

Why AI Matters

A farmer spends days looking over crops, yet this AI model can examine fields in minutes. With precise yield prediction, farmers will be able to maximize their resources, save water, fertilizers, and labor. Yet another exciting benefit is that AI helps farmers with planning. Knowing an estimate of the future yield, the farmer can arrange for storage, transport, and selling ahead of time. This can also reduce loss and put fresh food on people's plates.

AI gives farmers an incredible advantage in being able to know exactly what their crops will do. It's like granting farmers superpowers so that they can look into the future of their crops. With AI, we can end food shortages, stop climate change, and build a better, safer future for farming. We can be part of the AI revolution and transform farming for generations to come!