Lecture Notes in Networks and Systems 434

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Rising Threats in Expert Applications and Solutions

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of the encrypted password is impossible to crack. Thus, this experimental setup will boost security for multiple applications.

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A Survey on Water Usage Optimization Using Artificial Intelligence in Agricultural Sector

N. Bharathi and M. Hanumanthappa

Abstract Agriculture automation is a major source of concern and emerging subject across the world. Agriculture has a substantial contribution to the economy. The global population is quickly increasing, resulting in greater demand for food and labor. Traditional farming approaches were insufficient to achieve these goals. New automated procedures were created as a result. These new approaches met food demands while also creating employment opportunities for billions of people. The main purpose of this paper is to propose Artificial Intelligence (AI)-based water solutions in the agricultural sector. The goal is to highlight compelling new prospects for artificial intelligence (AI) interventions, to address the primary water management concerns that smallholder farmers confront. Water management may have a huge impact on their income and output, and it's ripe for technological innovation. By providing real-world examples, the topic of artificial intelligence and its applications in the water sector would be more accessible to a wider audience of readers. The examples shown here were chosen to exemplify how AI-based solutions may handle agricultural-related problems and deliver substantial advantages to the water industry.

Keywords Artificial intelligence · Irrigation · Water management

1 Introduction

1.1 Introduction About Agriculture

Agriculture consumes the most water globally; however, only a small portion of the water diverted for agriculture is actually utilized for agricultural development, with

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the remainder being drained, evaporated, or runoff. Water shortage is becoming more prevalent around the world as a result of climate change and depletion, posing new issues for food production, processing, and preparation, as well as energy, industry, and other economic sectors, as well as our ecosystem and general well-being. Agriculture is both the cause and the victim of water scarcity, accounting for 70% of worldwide water withdrawal, making it a critical component in tackling the water problem.

Smallholder farmers, who own less than 2 ha of land and account for 80% of all farms worldwide, are among the world's most disadvantaged people, living in extreme poverty with a daily average income of $3, and a poverty rate of more than 50%. Few technology breakthroughs aimed at addressing the issues encountered by smallholder farmers have had a significant influence on their livelihoods, with many losing steam in execution, delivery, and scale-up, or overlooking their most pressing needs as their communities and environs evolve. The market is flooded with technical solutions, but artificial intelligence (AI) has a huge untapped potential.

The main advantage of AI is its capacity to provide individualized services at scale and at lower rates, which is exactly what agriculture requires. Use of AI offers strong and feasible solutions that improve on many of the technology advancements, presently seen by analyzing the requirements of smallholder farmers, identifying the relevant levers in the system to address them, and measuring their potential routes to effect.

With this goal in mind, we identified water management as an area where we can make a significant difference in the lives of smallholder farmers. Water management can help smallholder farmers raise their income and yields, making it a major driver of enhanced profitability. Smallholder farmers, on the other hand, lack the knowledge and instruments necessary for effective water management at every stage of their trip, including water access, water consumption, and water replenishment. As a result, poor water management decisions are made, resulting in lesser income. The main aim of this paper is to bring to the forefront compelling new opportunities for AI interventions to address the major challenges smallholder farmers face in water management.

1.2 Introduction About Artificial Intelligence

Artificial intelligence (AI) is the simulation of human intelligence and will do the activities vision, speech recognition, decision-making, and language translation. Based on the data presented to them, AI systems seek to make intelligent suggestions or predictions. These inputs can take a variety of forms, including time-series data such as rainfall patterns, past yields from farmers, and photographs, among others. Similarly, the outputs can be recommendations or predictions in a variety of formats, such as rainfall forecasts for the following year, yield projections, or items recognized in an image.

2 Water Usage Optimization Techniques

We have prioritized two opportunities for AI in water management which ultimately helps farmers make better decisions that will improve their income and livelihoods:

1. Assess the water balance and improve crop planning using the Evapotranspiration method.
2. Optimize irrigation scheduling using smart Irrigation and dielectric methods.

2.1 Water Balance Using Evapotranspiration Method

To aid the irrigation manager in making irrigation decisions, the state of the soil water for an irrigated crop must be monitored on a regular basis. Irrigation scheduling is usually done in one of two ways. To directly monitor soil water, one technique is to utilise soil moisture sensors. The soilwater balance technique, on the other hand, accounts for soil water in the rooting depth using weather data. Irrigation scheduling or water balancing strategies depending on weather or Evapotranspiration (ETc) are frequent terminology for this method.

2.1.1 Creating Optimal Irrigation Scheduling and Distribution

Farmers want to develop an irrigation strategy for their crops that maximizes output and quality while minimizing costs. Evapotranspiration has long been an important parameter for designing an irrigation system that is specific to a plant's demands. It is the product of evaporation from the land surface and transpiration from plants. Farmers can enhance their estimation of Evapotranspiration by using modern satellite images and weather predictions. Breakthroughs in the internet of things (IoT) sensor technology, on the other hand, can help inform far more precise irrigation decisions by detecting plant behavior instead of (or in addition to) soil and weather (Figs. 1 and 2).

2.2 Smart Irrigation

Smart irrigation technology is being developed to increase production without the use of a large number of humans by sensing water levels, soil temperature, nutrient content, and weather predictions. Hinnell et al. [1] proposed an irrigation system based on Neural Networks (Neuro-Drip). On the other hand, Goap et al. [2], Nawandar and Satpute [3] have presented an IoT-based smart irrigation management system. In collaboration with the Internet of Things, AI has made a substantial contribution in this field (IoT).

Fig. 1 Process of calculating water balance

Fig. 2 **a** Components of the soil water balance model for evapotranspiration, **b** flowchart for evapotranspiration, **c** FAO Penman–Monteith method

Smart irrigation necessitates gathering data on the amount of moisture in the soil, the water content of plants, the humidity in the atmosphere, temperature, and other elements. This data can be collected using soil moisture sensors, temperature sensors, humidity monitoring sensors, and other sensors.

A project called SWAMP written by Carlos Kamienski [4], which had explained the concept SWAMP, is used to develop IoT based methods and approaches for smart water management in irrigation system. By evaluating sensor data and other pertinent information, the SWAMP platform evaluates the water demands of individual farms, develops irrigation prescription maps, and provides them to the farmers, who then carry out the irrigation according to their preferences. The estimated water needs for each farm are then sent into a component that optimizes water distribution management by delivering commands to actuators in devices that control water flow through canals until farmers may use them.

Shekhar et al. [5] In 2017, they created a robotic model that could detect the moisture content and temperature of Arduino and Raspberry Pi3 boards. The information is gathered on a regular basis and transferred to the Arduino microcontroller, which converts the analogue input to digital. The signal is transferred to the Raspberry Pi 3 (which includes the KNN algorithm), which then sends it to Arduino, which activates the irrigation system. Water will be provided based on demand, and sensor data will be updated and stored. Jha et al. [6] also used Arduino technology to create an automated irrigation system to save people and time in this field.

Another automatic watering approach was described by Varatharajalu and Ramprabu [7]. In this paper, they had discussed about soil moisture sensor, temperatures sensors etc., which helps in improving crop development.

One more method, subsurface drip irrigation it reduced water loss due to evaporation and runoff. Later, researchers built raindrop sensors that were operated via a wireless broadband network powered by solar panels in order to determine the demand for water supply to the fields. Using the GSM module, the raindrop sensor and soil moisture sensor transmit SMS to the farmer's phone, notifying them of the soil moisture content. As a result, the farmer can control the water flow by sending an SMS. As a result, we can expect this technology to identify sections of the field that require more water and prevent the farmer from watering when it rains.

3 Conclusion

We see tremendous potential for AI-based solutions to help tackle the underlying data difficulties and give more targeted, personalized, and relevant insights and recommendations to improve farmers' lives for each of the water management opportunities we've discussed. However, in order for any AI breakthrough to come to life and have a large-scale impact, we'll need an ecosystem that sets the ideal conditions for success, and we'll need to invest in and support a variety of initiatives and efforts to get there. A number of common enablers will make it easier for the AI approaches we've mentioned having the impact we want.

There are complementary areas of AI and irrigation exploration that lend further weight to this opportunity. Smartphone-based spectrometry for soil texture and nutrients, for example, is a new sector with a lot of potential. Fertigation, or the addition of fertilizer and mineral inputs to irrigation systems, is another developing subject in the irrigation industry, and one where AI has already proven its worth.

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