Tecnológico de Monterrey

Institute of Advanced Materials for Sustainable Manufacturing

Enhancing Agricultural Efficiency with AtmosTrace

Omar Mata[1], Antonio Rivera[1], Pedro Ponce[1]

[1]Tecnologico de Monterrey, Institute of Advanced Materials for Sustainable Manufacturing

INTRODUCTION

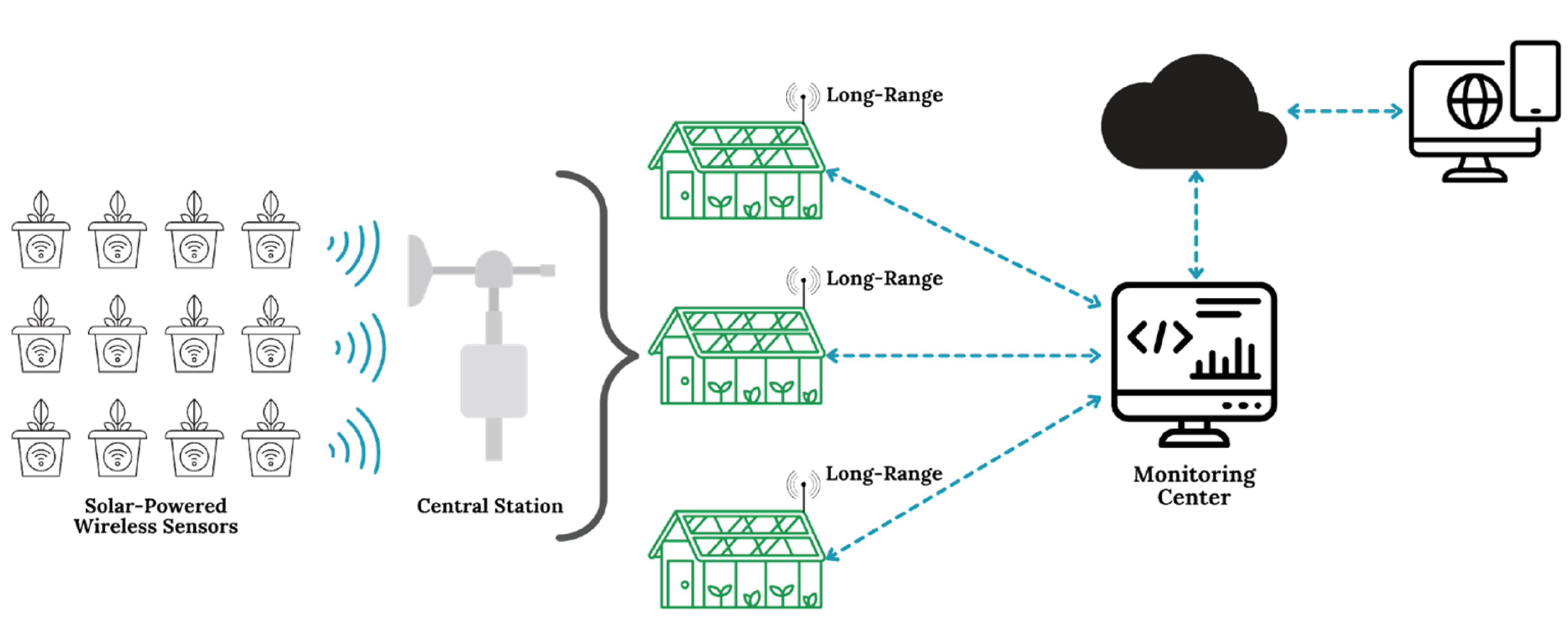
In the context of increasing demands for sustainable food production, precision agriculture is becoming more essential.

Traditional greenhouse monitoring systems often suffer from **limited range, accuracy, and real-time capabilities**, leading to inefficient resource management and lower crop yields.

To address these challenges, this research introduces AtmosTrace, an advanced environmental monitoring system designed for optimizing greenhouse agriculture.

AtmosTrace consolidates real-time environmental data such as air **temperature**, **humidity, soil moisture, CO2 levels, and particulate matter**, enabling precise, data-driven agricultural management.

MATERIALS AND METHOD



AtmosTrace consists of two primary components: a Central Station (Hub) and a Wireless Modular Sensor Network. The hub is capable of monitoring critical environmental parameters including air temperature, humidity, atmospheric pressure, CO2 levels, particulate matter, wind speed, and solar irradiance. Solar-powered wireless sensors are distributed throughout the greenhouse, measuring soil and air conditions. These sensors are modular, allowing for easy expansion of the system's capabilities as needed.

The data gathered is transmitted using long-range communication protocols, ensuring scalability for larger or multiple greenhouses. Data storage options include both local (via SD card) and remote cloud storage, where it is further processed using models like ARIMA for short-term forecasting

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RESULTS AND DISCUSSION

AtmosTrace was tested in various greenhouse environments, demonstrating significant improvements in crop yield and resource efficiency.
Real-time soil and air data enabled precise control of irrigation and climate systems, leading to a 15% reduction in water usage.
The use of solar-powered sensors further enhanced system sustainability by eliminating the need for external power sources.
The accuracy of predictions for variables such as temperature and humidity reached a high precision with an error margin of only **0.67%**.

As a result of this research, a utility model was registered **MX/u/2024/000203**, and **Hummsky Agrosolutions** was established to commercialize the solution

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CONCLUSIONS

AtmosTrace offers a scalable and sustainable solution for precision agriculture. It provides real-time environmental data and integrates with predictive analytics to optimize resource usage and enhance crop yields.
Ongoing developments aim to further improve its predictive capabilities through advanced **AI integration**, offering even more robust decision-making support for farmers.

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