An IoT-Based Operator Aid System for Lygus Bug Vacuum

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Introduction

- Lygus bugs (*Lygus* spp.) are significant pests for California strawberries. They cause substantial reduction in the yield due to mishappen fruit.
- In California, bug vacuums are widely used to mechanically control Lygus bugs in the field.
- The efficacy of the vacuums to remove Lygus depends on operating parameters such as tractor speed, vacuum height, and the air speed of the vacuum's fan.
- This research introduced an IoT-based (Internet of Things) system that could automatically collect and save tractor/vacuum parameters on both a local memory storage and a remote cloud-based system.

Materials and Methods

- **Microcontrollers**: Arduino Nano 33 IoT, and Arduino UNO
- **IoT:** A Cellular Device
- **Sensors**: Garmin GPS, Draw-wire encoder, Hall-effect sensor
- **Data**: Time/Date, Location, Tractor speed, Vacuum height, and RPM of vacuum's fan
- **Data storage:** A SD card and ThingSpeak cloud system (real-time)
- **Height-Indicator device:** An indicator with three LEDs to show the status of vacuum height (low, recommended, and high)

Figure 1. Components of the IoT-based operator aid system

Figure 2. Left to right: Heatmaps of tractor speed, vacuum height, and air speed of vacuum's fan

Results and Discussion

Table 1. Summary statistics of the system's performance

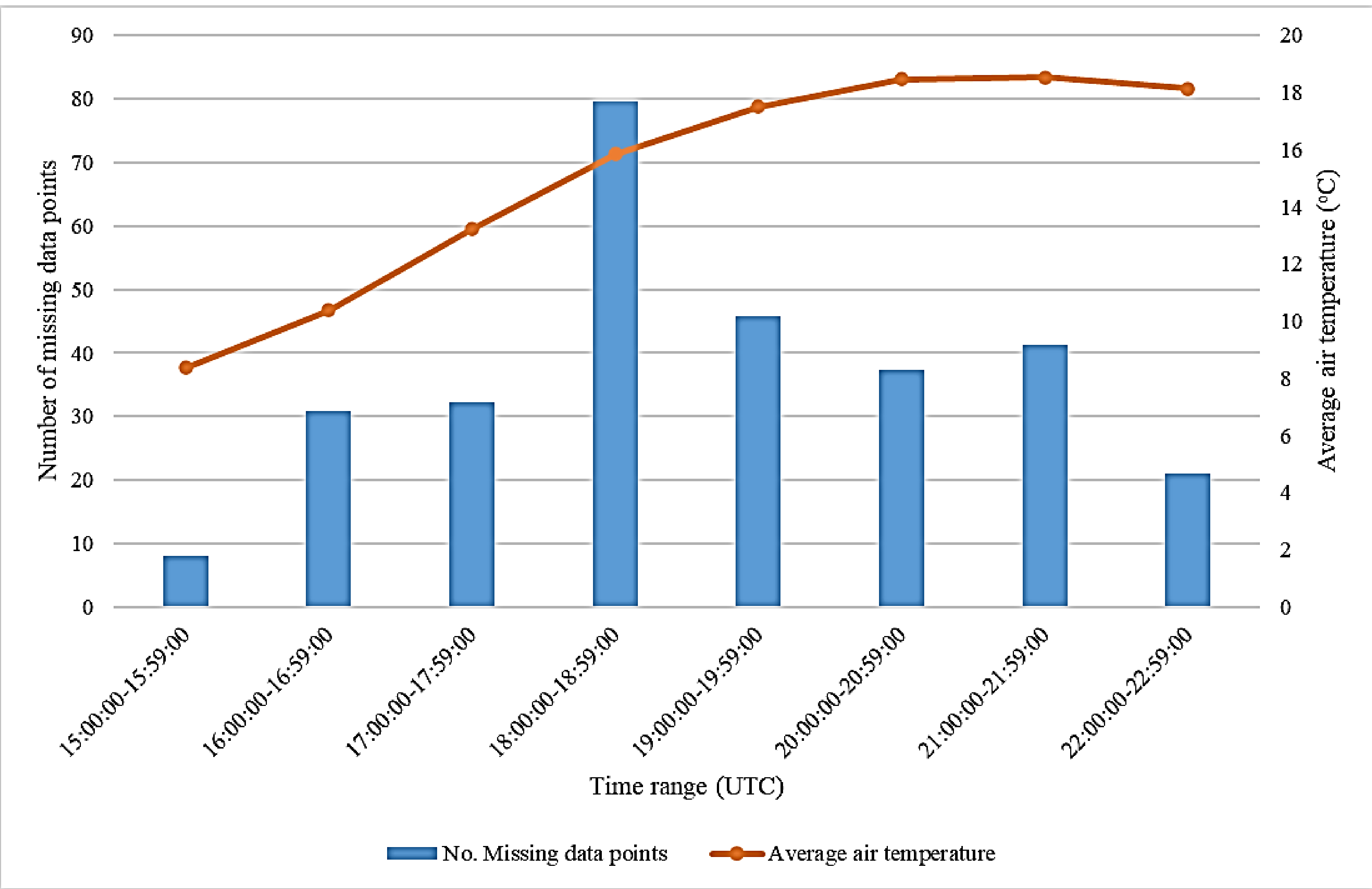| Statistics	Thingspeak cloud system
No. of days for data collection	19
Average hours for data collection/day (HH:MM)	6:30
Total hours for data collection (hr)	125
Total number of data points	24100
Total number of missing data points	228
Percentage of missing data points (%)	0.95

Figure 3. Temporal distribution of missing data points

Figure 4. Spatial distribution of missing data points

Conclusion

The experimental results showed that the proposed system successfully collected and saved data to monitor tractor/vacuum parameters and helped drivers to adjust the vacuum height.

Acknowledgments