

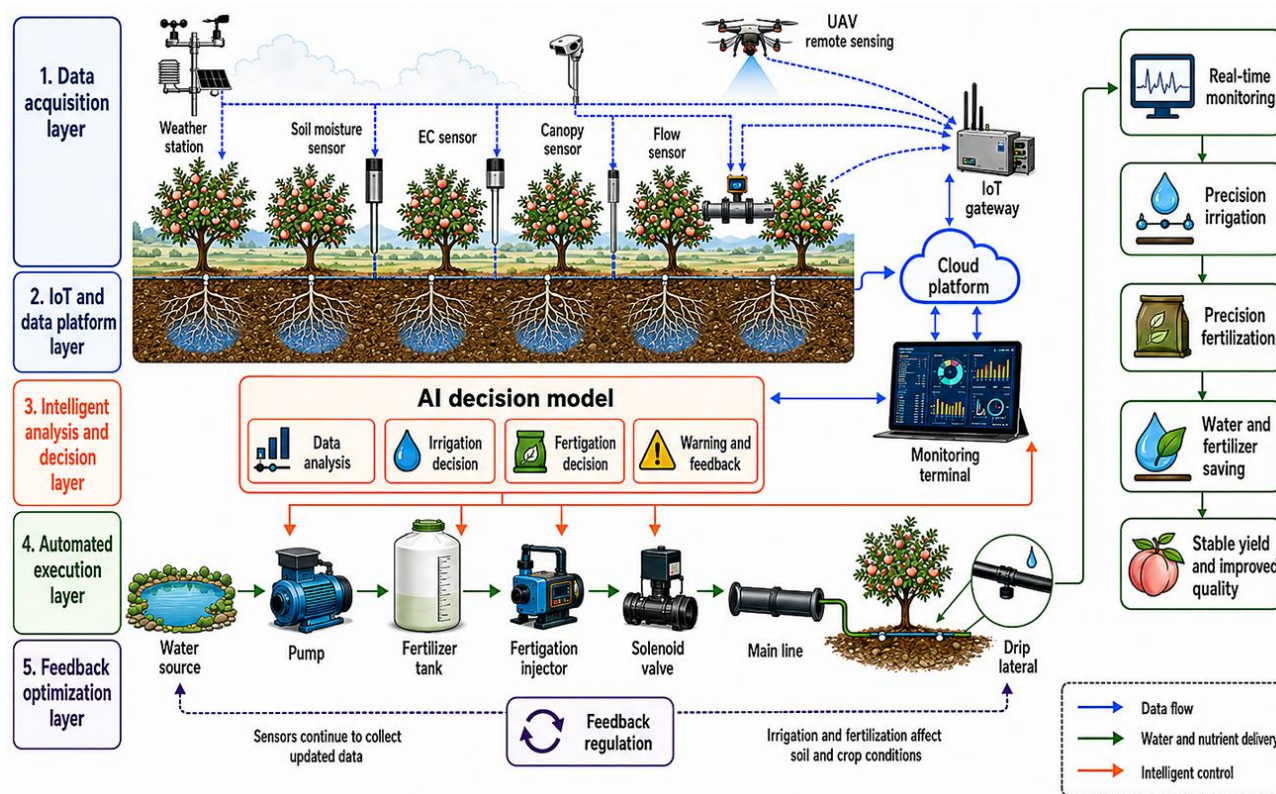


Figure 3 Smart orchard management system for precision irrigation and fertilization

Image caption: This system integrates sensors, UAV remote sensing, an IoT platform, and an AI decision model to achieve real-time monitoring, intelligent decision-making, automated execution, and feedback optimization of water and nutrient management in peach orchards, thereby improving resource use efficiency and promoting stable yield and improved fruit quality

8 Conclusions and Future Perspectives

Based on existing studies, high-yield and high-quality peach cultivation cannot be achieved simply by increasing fertilizer or irrigation inputs. Instead, it should be built on the coordinated regulation of water, nutrients, tree growth, and environmental conditions. Nitrogen, phosphorus, and potassium are key factors affecting peach yield and fruit quality, among which nitrogen regulation is particularly sensitive. Peach trees generally maintain better yield and fruit quality when leaf nitrogen content remains within an appropriate range and when phosphorus and potassium supplies are relatively balanced. If the interactions among nutrients are ignored, or if the influence of nutrient reserves from the previous year on current-year growth is not considered, fertilization decisions may become inaccurate, leading to nutrient imbalance, quality decline, or resource waste. Therefore, integrated water and fertilizer management in peach cultivation should shift from experience-based fertilization to precise regulation based on tree demand, soil nutrient supply, and target yield.

Under the background of climate change and water scarcity, irrigation optimization is of great significance for maintaining stable peach production. Proper water supply in young orchards is beneficial for canopy formation and later yield improvement. In mature orchards, techniques such as drip irrigation, regulated deficit irrigation, and partial root-zone drying can reduce water consumption while maintaining relatively stable yield. Integrated drip irrigation and fertilization can synchronously deliver water and nutrients to the active root zone, thereby improving water use efficiency and fertilizer uptake efficiency while reducing evaporation, deep percolation, and nutrient loss. This indicates that water management and nutrient management in peach cultivation should not be treated separately. Only through water-fertilizer coordination can resource use efficiency be improved.

In the future, peach water and fertilizer management will further develop toward intelligent and digitalized systems. Technologies such as thermal imaging, crop water stress index, stem water potential monitoring, satellite