IoT Sensor Network for Precision Agriculture

The global population is predicted to reach 10 billion in the 2050's. Population growth has created challenges for agriculture which have been met in the past by improved yields achieved through use of fertilizers, chemicals and mechanization. Demand for food continues to grow and must be satisfied, despite the environmental impact and threat of extreme weather and climate change. To meet demand, agriculture is exploring new technologies to reduce waste and enhance productivity.

In addition, humanity must look at how to alter food production to prevent the most catastrophic effects of global warming. The United Nations panel on climate change reports about 30% of human greenhouse gas emissions and more than 40% of methane results from agriculture, deforestation and other land use, such as harvesting peat and managing grasslands and wetlands.

The approach of using sensor and communication technologies to improve efficiency of food production is often referred to as precision agriculture or sometimes smart farming, and often uses internet of things or IoT devices. Precision agriculture can apply to monitoring crops or local environmental conditions, livestock, or equipment. It is also applied to greenhouse farming which allows a more controlled environment.

The objective of this project is to design an IoT sensor network for precision agriculture. While a basic greenhouse monitor is a common hobby project, the objective here is to design a scalable sensor network that can provide a map of environmental conditions throughout a commercial scale facility, while operating with low power and high reliability.

This will require:

1. Specifying the application.

   To design a system you need some understanding of the application. What parameters are important to measure? How can you control them? What sensors do you need, how far apart should they be, how often should they send data, how many network nodes will you have? How much local processing power and data storage capacity are required?

2. Designing in the network.

   You need to evaluate potential network protocols and select one based on network simulation results. Two possibilities you might be acquainted with are Zigbee, a common standard used in smart building solutions, and Bluetooth, which is usually used for wireless links between consumer computing devices and accessories.

3. Designing a sensor node.

   You need to further develop the specification and select sensors based on parameters such as cost, power dissipation, and interface. A microcontroller will need to be selected based on the specification including the sensor I/O and the wireless protocol. The most efficient implementation will require a custom PCB design.

4. Implementing the application.

   Firmware is required to collect the data and communicate to the network. Data needs to be logged and analyzed or displayed. This development can proceed in parallel with the sensor node design using an evaluation board, provided a microcontroller family is chosen early in the project.