

Robotics and Small Farming - a road map

Nowadays there is great emphasis on increasing agricultural yields to meet the challenges of feeding an ever growing global population. One of the answers is for farmers to endorse the concepts and practices of **Precision Agriculture**. Precision Agriculture optimizes crop yields by leveraging real-time data from the field and allowing farmers to make informed detailed decisions to increase their farms' productivity.

BigAgra (Big Commercial Agriculture) has been leveraging technology and machinery for years to achieve higher yields and bigger profits. However, they use expensive technology and a level of mechanization which is out of reach for the small farmer. Fortunately the cost of farming technology has been dropping significantly to make it accessible by the small farmer on a small budget.

The key to applying the appropriate technology is to look at farm data with the appropriate perspective. Traditionally, small farmers spend a lot of time in their fields and are intimately acquainted with their crops and livestock. Yes they keep records such as planting schedules, notes of crop inspections and related actions, watering and fertilizing schedules, livestock records, and crop yields. However, if database technology and data analysis systems are used to organize and work with this data, the process can become much more efficient and reactive. With this data, the precision agriculture approach can give significant improvements in the farming process and crop yields.

So here is the road map.

1. Learn to understand the concepts and practices of precision agriculture and what the data looks like.
2. Install appropriate technology and sensors at the farm and tie it together in a network to gather critical farming data.
3. Install and learn to use a farm operating system to take the real-time input from the sensors, monitors and the farmer and manager to store the data in a database in meaningful and practical ways.
4. Learn how to use the analysis components of the farm operating system to make more precise and timeous actionable farming decisions to improve the crop and yields and soil health.

What does the data look like?

- Aerial surveys using drones mapping weeds, plant health, yield and soil variation. With GPS/RTK satellite positioning, accuracies down to 2 cm are possible for precision data.
- Data gathered from farming machines - for example from a harvester with digital sensors to gather harvest data.
- Measurement of moisture and wind speed at strategic locations in the fields integrated into the farm wireless network.
- Measurement of nitrogen and acidity levels in the soil using robotic sampling machines.

- Precision GPS controlled optimized route planning of smart tractors and robot farm implements to reduce erosion and save fuel and accurately work the fields and crops
- Sensors monitoring animal health and the wellbeing of livestock, which can send messages - for example when a cow goes into labor or develops an infection, send a text message to the farmer's cell phone or computer.

Appropriate technology and sensors

For small farmers, there are many low cost sensors and related software and electronics available; many with wifi interfaces to connect to the farm wide wifi data network.

- Wind speed sensors
- Moisture sensors
- PH sensors
- UV and IR sensors
- Satellite positioning sensors accurate to 2 cm.
- Soil density sensors
- Rainfall sensors
- Programmable wheeled farmbot machines to act as platforms for tools and sensors in the fields – ie weeding, seeding, feeding, scanning, and inoculating.
- Wireless networking routers and access points to establish a wireless farm wide data network to capture the real-time data from the sensors and relay instructions to the farmbots and smart tractors
- Inexpensive wireless interfaces to the sensors, many of which are solar powered.

Farm Operating System software.

Software is usually the more expensive component in a data management and control system. However, for small farmers, there are several free offerings of open source software for farmers. They provide the brain of the data gathering process, organize and store the data in meaningful ways to provide farm managers with practical information on which to react to quickly.

So, the first step for the small farmer is to understand the precision data he has available on his farm and to understand and endorse precision agriculture principles and practices. Then he can design his system to gather the appropriate real-time data and install the sensors, monitors, and technology infrastructure. Lastly is to learn to use the Farm Operating System to gather the data, to organize it, and to analyze it to achieve a quality precision agriculture process/crop. Increased yields, healthier crops, improved soil, and decreased labor will result.