Agricultural Cyberbiosecurity

Sensors

Sensors IRL (In real life!)

Sensors are all around us. You use a sensor when you log into your phone with your fingerprint. Your computer might use its camera to scan your face to know its really you. Or, you might have "clap-on" lights that turn on and off when they hear you clap. Sensors actively detect something that is happening around us. In farming, sensors can help measure things like how much water is in the soil, or how much food animals are eating. Lots of different places use sensors because they help us get important information quickly.

As our world gets busier, sensors are becoming more and more important. Think about a smartwatch. Smartwatches can record all kinds of information about the person wearing them. These can include the number of steps you take, or how fast your heart is beating. if you wear a smartwatch, you might use the measurements to plan your workouts. Sensors on a farm allow farmers to plan in a similar way. Farmers need to make decisions about the animals they have, the plants they grow, and how they run their businesses. Sensors give them more information to make those decisions.

Reasons why sensors are important for precision ag

1. Are relatively affordable.
2. Can take a lot of measurements.
3. Can take the measurements quickly.

Key terms

- **Biometric**: Involving the automated recognition of individuals by means of unique physical characteristics, typically for the purposes of security.
- **Bioterrorism:** intentional release or dissemination of biological agents, typically to cause fear or violence, for political intentions.
- **Data Literacy**: The ability to read, understand, and communicate data
- **Precision Agriculture**: Technology that maximizes the efficiency of a farm**,** but it is not critical to farm operations
- **Resistive force**: A physics term used to describe a force that is in the opposite direction of motion. Gravity making a thrown ball fall back down and the friction of sliding a box are two examples of resistive force.

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Types of Sensors

People use different sensors to measure different things. A sensor might be a camera to record a picture. A sensor might be the **GPS** in a car to know where we are going. We use a different sensor depending on what we want to know. Here are some examples of sensors, what they measure, and how they help make decisions. This is not a complete list, but it can help you understand the types of sensors used.

Electrochemical

These sensors record chemical properties, but what is a chemical property? One important example is **acidity**. The level of acid in the soil is important. Plants need acidity, but different plants prefer different amounts. So, a farmer may use an electrochemical sensor to plan their field.

Location

These sensors record location through **GPS.** They can help guide self-driving cars, tractors, and drones. They can also tell us how far we walk and give us directions.

Figure 1: A tractor's GPS readout and controls

"GPS Steers the tractor" by cogdogblog is marked with CC0 1.0.

Optical

These sensors record light. This sounds really fancy, but we all have optical sensors. Our eyes take in light to help us understand what's around us. An optical sensor does the same thing. They are used to look for specific types of light to help us understand characteristics we cannot see on our own.

Weather

When we think about the weather, we might think about rain, wind, sunshine, and temperature. Weather stations measure all of these and more. To do that, they can be a combination of different types of sensors. Collecting this information together can tell us a lot. We can learn how rain affects crop growth. We can also learn how rain plus temperature might be different.

Mechanical

These sensors record force. You may have heard from your teacher that force is a push or pull on an object. A push or pull on an object can tell us a lot about the thing being pushed or pulled. For example, a mechanical sensor might tell us that it takes a lot of force to push something into the ground. Knowing that we can decide how well a plant might grow out of the soil!

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Sensors as a System

Sensors can only record information. If we want something to happen, we need someone or something to use the information. The problem is getting that information to the right place. A person could just read the information. If we want a machine to use it, we need a different plan. A person could read the information and then take it to the machine. But that's not very fast. To speed things up, we could use the internet. The internet is a great way to send a lot of information in a short amount of time. What if we don't have internet access? We could rely on wireless connections like Bluetooth. Both the internet and Bluetooth can be described as connectivity. **Connectivity** allows for information to be shared without a person involved and from a distance. We can use this to link sensors and equipment together. Doing so creates systems that perform specific tasks.

Figure 2: An agricultural technician checking weather data.

Connection to Cyberbiosecurity

Connecting sensors through **Bluetooth** and the internet allow us to do amazing things. We can make machines that react to sensors without us knowing. However, **connectivity** also makes data vulnerable. Sometimes, the information that sensors collect are personal and private. This includes information on where we've been and who we talk to on our phone. This information is mostly used for good things. But some people want to use them for bad things. People called hackers can use the sensors to steal information and use it however they want.

This is also true for farmers. Farmers have the important job of making the food that you and I eat. To do this, farmers use sensors to keep track of their plants and animals' health. If that data were to be stolen by hackers, they can use the information however they want. It might mean that our food isn't safe. A farmer protecting their sensors means that they are keeping our food safe as well.

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Career connections

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Healthcare

Food Science

Agriculture

Automotive

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CAIA Scientist Spotlight

Dr. Robin White has a Ph.D. in animal sciences. She conducts research that brings together animal agriculture, sustainable food production, technology, and data analytics. In her work, she uses sensors and animal monitoring technologies to improve efficiency and sustainability of animals-source food production. She mentors students conducting research in these areas as part of her role as a faculty member. Robin is the Associate Director of CAIA.

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David Smilnak, *Ph.D. Student, Department of Agricultural, Leadership, and Community Education*
Robin White, *Assistant Professor, Department of Animal and Poultry Science*
Jaylan Day, *Undergraduate Student, Department of Chemistry*
Madison Powell, *Undergraduate Student, Department of Agricultural, Leadership, and Community Education*
Emily Mullins, *Undergraduate Student, Department of Agricultural, Leadership, and Community Education*
Hannah Scherer, *Associate Professor and Extension Specialist Teaching and Learning, Department of Agricultural, Leadership, and Community Education*

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