Robotic Sensing

Now that you’ve had some experience with building basic circuits, it’s time to take things up a notch. You built a circuit that could react to the press of a button. While this is a good start, it’s not much if you want to build robots that are good at doing things.

# Recognizing environmental cues

The best robots tend to be ones that are good at responding to their environment. To be able to do this, they have to be able to recognize stimuli (cues) from their environment. To do this, they use sensors. Sensors come in many forms and allow a robot to pick up on a variety of changes in their surroundings. This can include:

* Temperature
* Humidity
* Sound, including ultrasound
* Magnetic fields
* Orientation relative to surroundings
* Light, including visible wavelengths, infrared, and light intensity
* Touch
* Speed/Acceleration
* Flexing
* Moisture

More complex sensors and components can greatly enhance a robot’s abilities to gather data. For instance, I own special components that can allow robots to do some of the following tasks:

* Detect a heartbeat
* Allow a user to draw by using a touchscreen and stylus
* Control a robot’s movement with a joystick
* Echolocate objects and track their distances from the robot
* Balance on two wheels and navigate in specific directions
* Follow a path marked by a line

Without many of these sensors, Arduinos simply wouldn’t be so versatile. How would they react to their environment if they had no way of understanding it in the first place?

# Interpreting the environment

Naturally, none of these sensors are helpful unless a robot can make sense of the data it receives and figure out how to react. This is where software comes in- the Arduino can process data and execute commands, meaning that it can process information from sensors and decide how to act based on this information.

# Robotic Reaction

An Arduino is essentially a computer on a small scale. Computers by definition are able to receive input, process data, and produce an output. Therefore, to be a computer, an Arduino has to be able to produce outputs. This is also accomplished through different components. Once again, the immense variety of components allows Arduinos to be versatile; different forms of output allow Arduinos to react in different ways. Note that Arduinos don’t just display information as their outputs- they can react in other ways, too. Here are some common examples:

* Motors, actuators, and other similar devices allow robots to move things- including themselves.
* Lights and screens allow robots to produce visual responses. These don’t have to be responses that humans can understand. For instance, the Wi-Fi-enabled ESP8266 microcontroller can allow a robot to communicate with a Wi-Fi network.
* Speakers produce sounds.
* Microcontrollers and many other components communicate by producing electrical signals.
* Timers allow robots to do things only when they’re supposed to.

As you can see, Arduinos are versatile because they are able to interpret, process, and react to lots of data in many ways. This allows them to be more autonomous and generally useful.

# Project 2

For this project you’ll be working with two different sensors: A photoresistor and a tilt switch. First start by building the following circuit:

A circuit board with wires

Description automatically generated

Note that this circuit works best in a well-illuminated area, such as outside or in a bright room. Try waving your hand above the photoresistor. How does the LED respond?

A photoresistor is a special kind of resistor. Its name comes from the fact that its resistance changes as the amount of light hitting it varies. This makes the LED brighter or dimmer accordingly.

Next try building this circuit:

A blue circuit board with wires

Description automatically generated

The green component shown in the diagram is a tilt switch. Your tilt switch will probably look different, but the effect should be the same as long as you’re still able to build it.

Once your circuit is built, try carefully picking up the breadboard and tilting it in different directions. You should see the LED turn on or off depending on how the breadboard is oriented.

A ball tilt switch is essentially a tube with a contact at one end and a conductive ball that can roll around. When you tilt it too far, the ball rolls to the other end and completes a circuit.

# The takeaway

These circuits are both meant to show you examples of how a circuit can use sensors to react to its environment. Both of these sensors measure something about the environment (light or orientation) and produce an effect (producing a change in the LED).