Lesson 7
(Defining the Problem)

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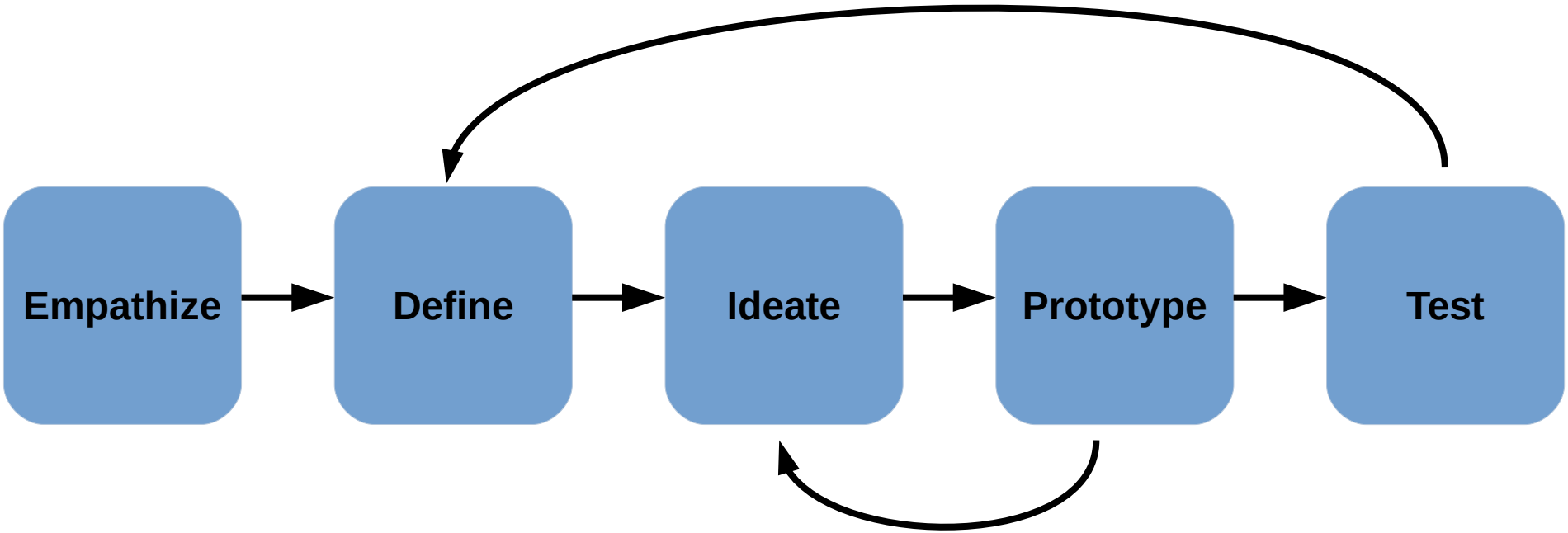
Target for Today!

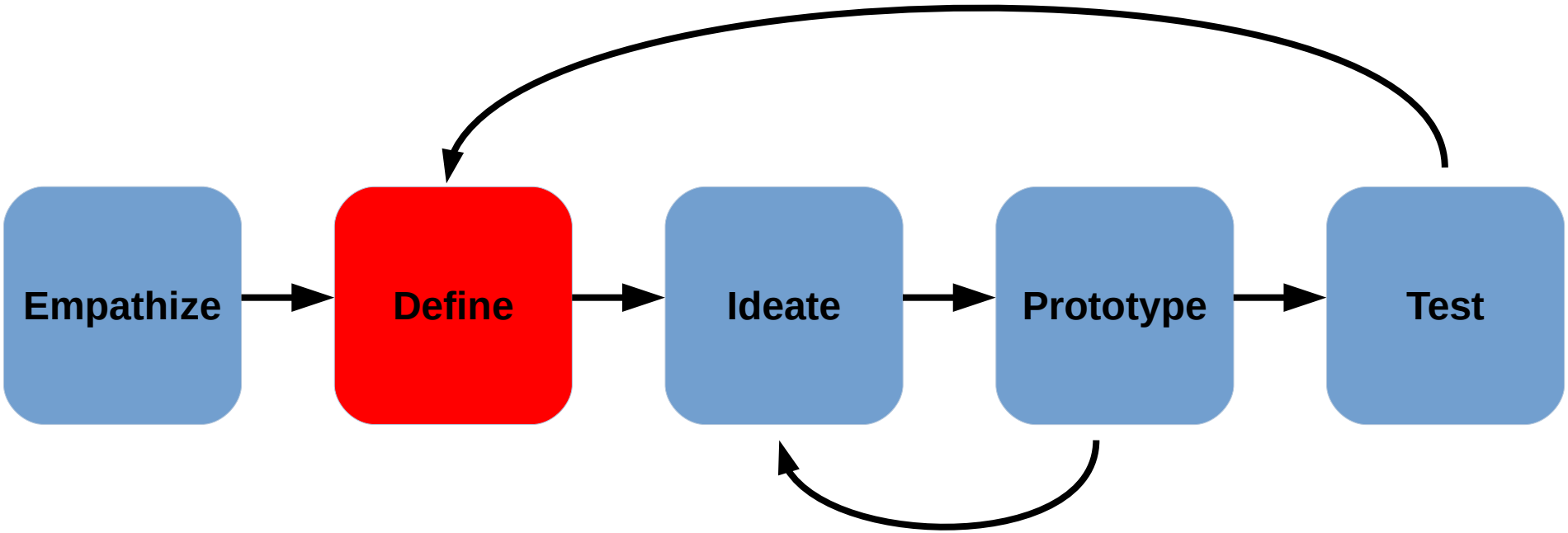
- Design Thinking: Define the Problem
- Learn how to use Tilt Sensor
- Learn how to use Passive Infrared Sensor

Design Thinking Process



5 Phases of Design Thinking

Design Thinking Process



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Define

- **Write the Problem Statement**
- One of the hardest part of the process
- **Empathize** helps us gain insights
- **Define** helps us make sense of it
- Why is it important to **Define** the problem?

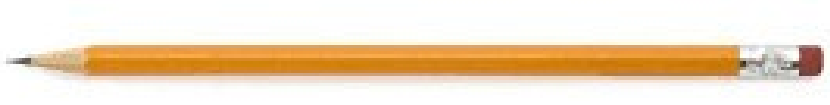
Importance of Defining Problem

- In the 60s, NASA realized that normal pens do not work in space
- Problem Statement:
  - **Ink won't flow without gravity**
- Solution:
  - High tech pressurized pen that don't require gravity

USD $ 1,000,000 to develop

Importance of Defining Problem

- The Russian space agency encountered the same problem
- Problem Statement:
  - **Pen won't work in space**
- Solution:
  - Use a pencil



$ 0.10 each

Good Problem Statement

- Human-centered
- Broad enough for creative freedom
- Narrow enough to be manageable

Techniques for “Defining”

- **5 “Why”**
  - Repeatedly ask “Why”
  - Developed by Toyota
  - Must understand the user first
  - If you cannot answer “Why”, go back to to the “Empathize” stage, **don’t make assumptions!**

Techniques for “Defining”

Example

Working adults are often unhealthy.

1) Why are they unhealthy?
   Because they didn’t exercise enough

2) Why don’t they exercise enough?
   Because they are too busy.

3) Why are they too busy?
   Because they have work and family time.

4) Why are they not exercising during family time?
   Because their kids couldn’t join them.

5) Why couldn’t their kids join in the exercise?
   Because the exercise facilities isn’t suitable for kids.

Empathize

Worksheet

Discuss and fill in your worksheet (20 mins)...

5 “Why”
Apply the 5 Why technique.

Re-Empathize
Note down any further interview questions or observations that you need to understand the problem better.

Define
Complete your problem statement

ALP Project

Keep what you have written!

You'll need to include it into your ALP Project write-up.

PIR and Tilt Sensors

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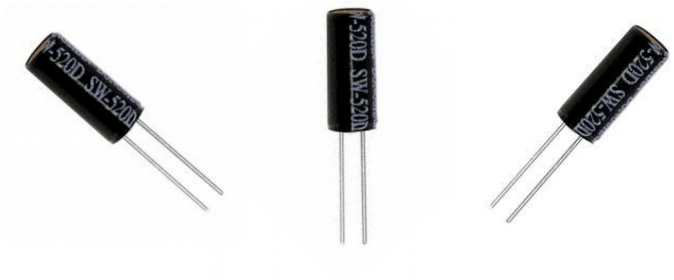
Tilt Switch

- Works just like a push button switch
  - Need pull-up / pull-down resistor!
- Turns on when tilted upwards
- Turns off when tilted downwards

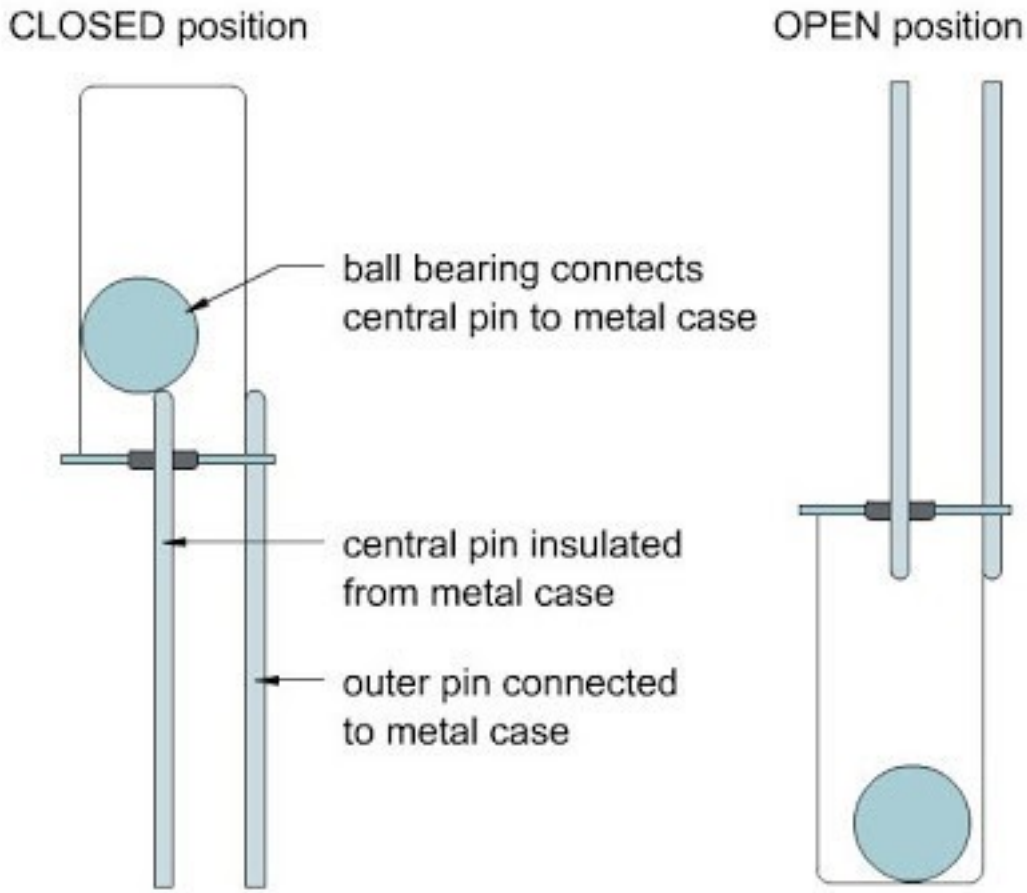
On Position



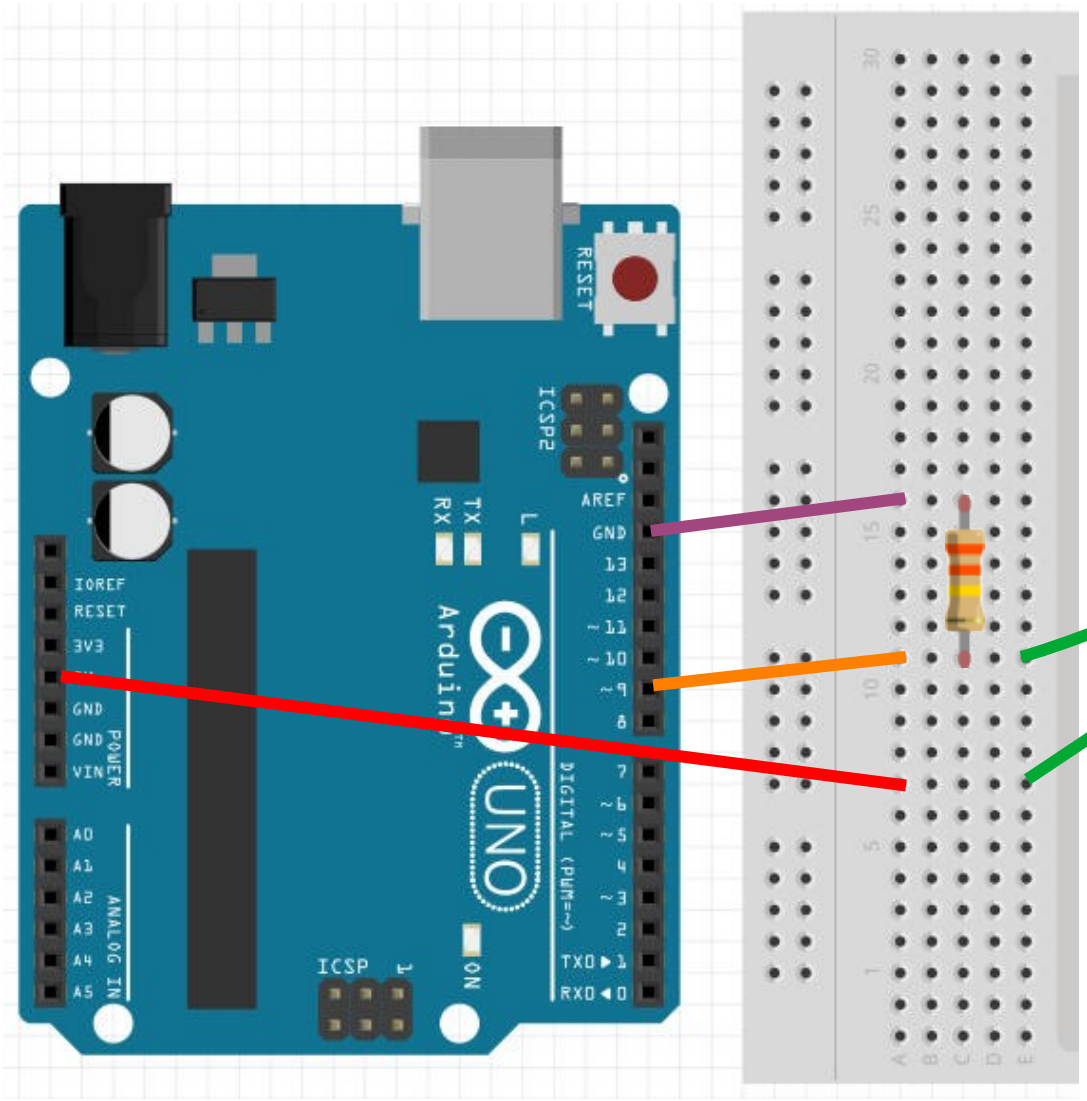
Off Position

Tilt Switch

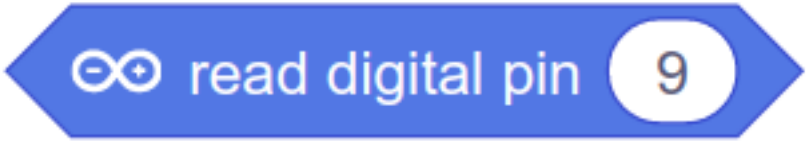
- Metal ball complete connection when switch pointed upwards



Tilt Switch



Read using “read digital pin”



Start up mBlock

- Don’t forget **mLink**
- Then go to **https://ide.mblock.cc**
- File → New

Get rid of this guy

Add this one instead

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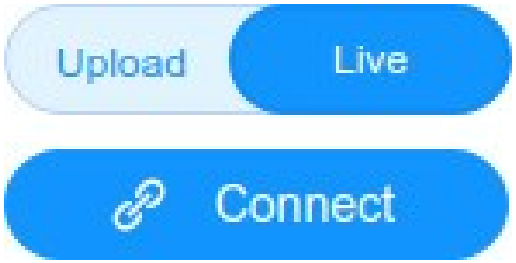
Connect with Arduino

- Switch to **“Live” mode** and **click “Connect”**



- **Select a COM port**
  You may need to [x] “Show all connectable devices”

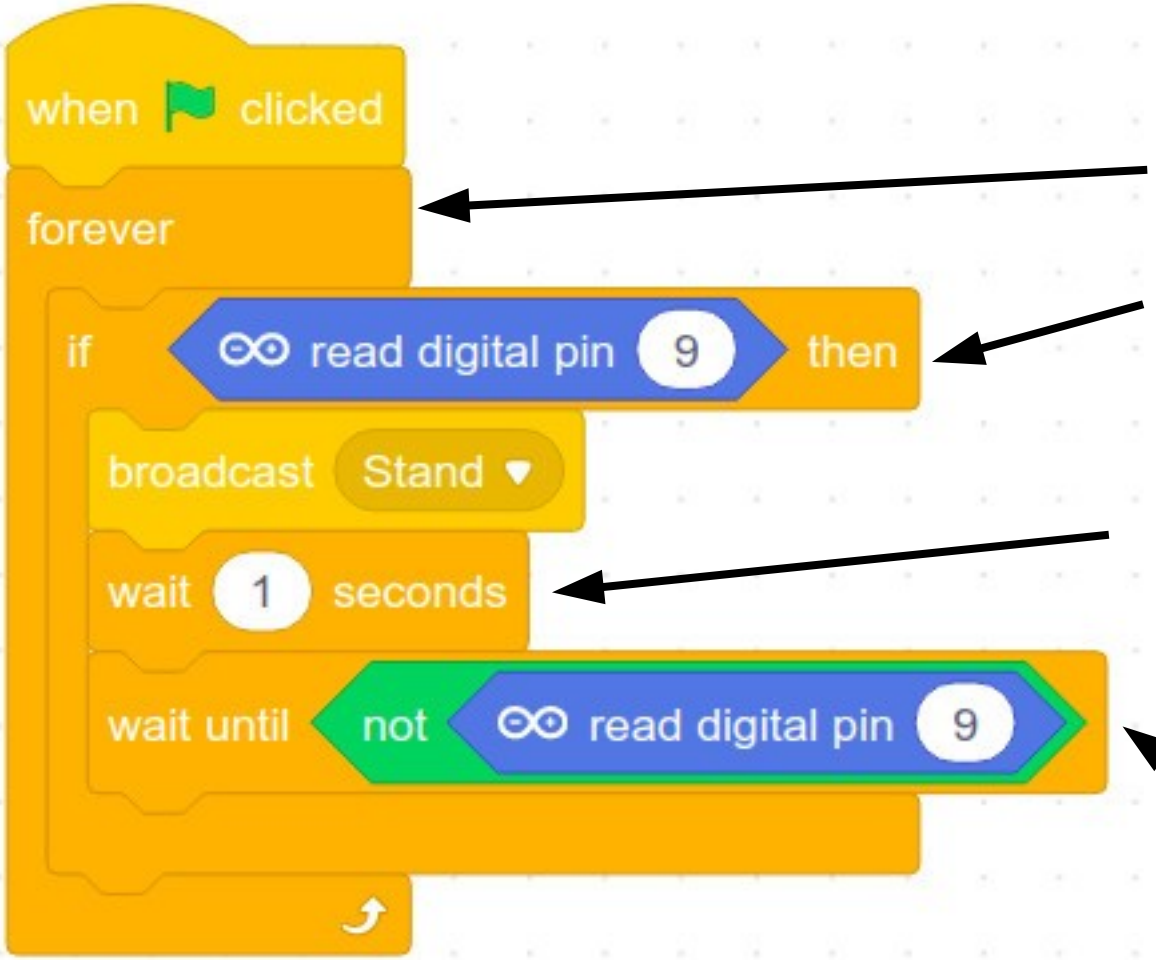
- **Click “Connect”**

Sit to Stand

- Helps the user count 3 sets of 3 repetitions
- Attach the tilt sensor to the leg with a elastic strap

Sit to Stand

Arduino Device



Repeats forever

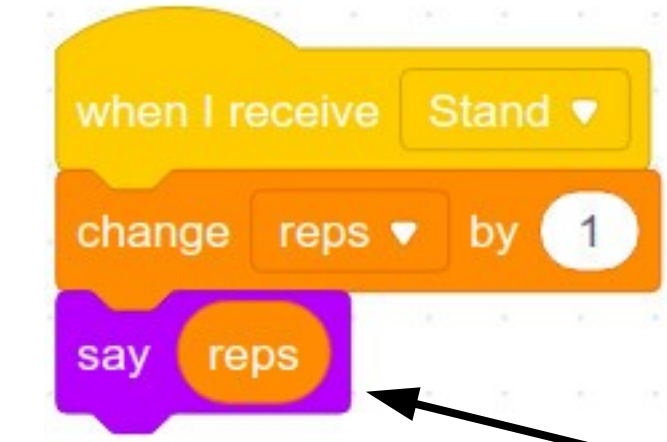
Send a message if switch is closed

Switch may “bounce”, this wait 1 second prevents multiple readings

Wait until switch is open, so we only broadcast once each time the user stands

Sit to Stand

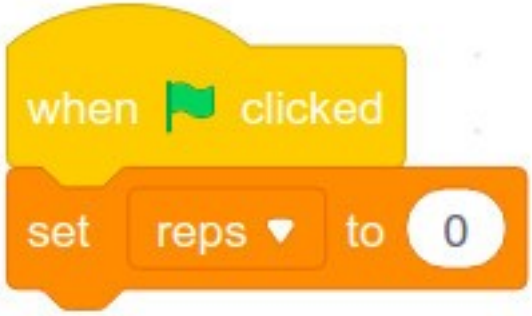
Sprite



Receives message from Arduino

Increment rep counter. Remember to create the “reps” variable first!

Read out the number of reps



Set reps variable to zero at start

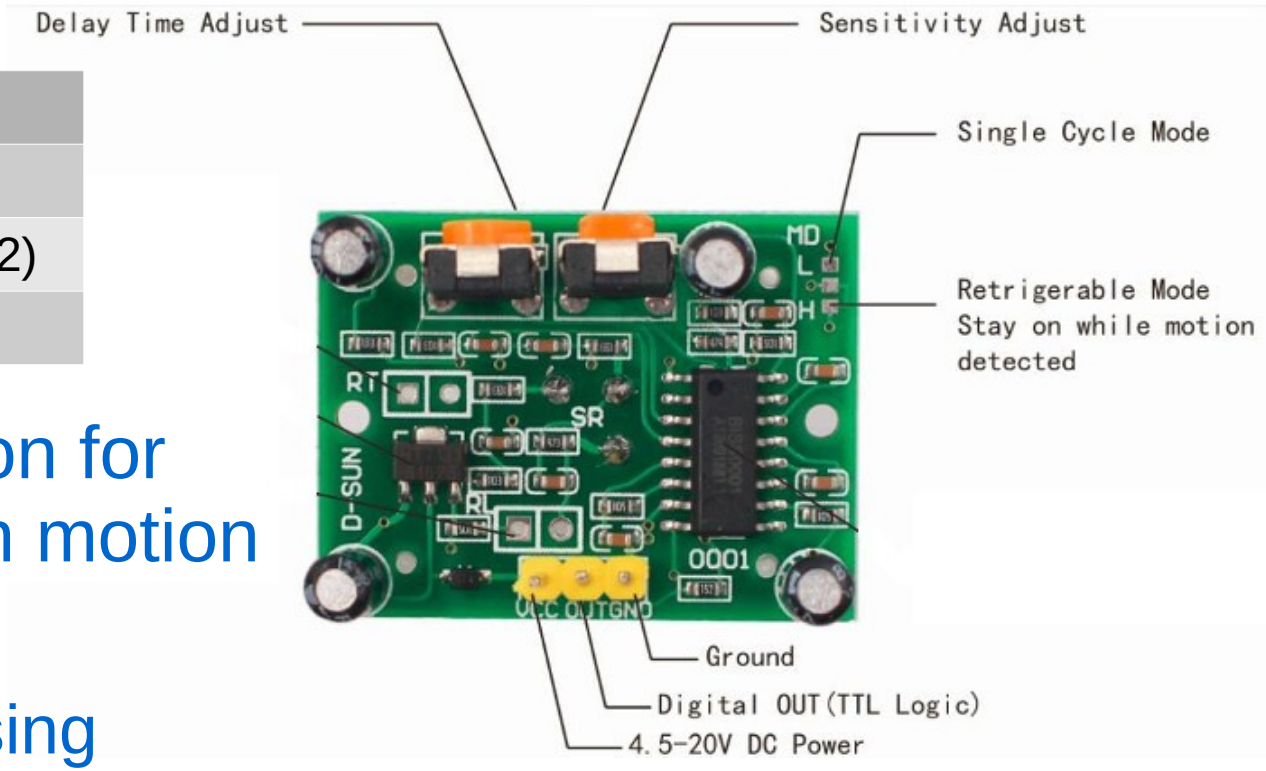
PIR Sensor

- Passive Infrared Sensor
- Detects far infrared produced by warm objects (eg. human body)
- Can only detect motion, not stationary objects

PIR Sensor

Pins Connections

Sensor	Arduino
Vcc / Power	5V
Out	Any I/O (Pin 2 to 12)
Gnd	Gnd



- Turns on and stay on for short duration when motion detected
  - Adjust duration using “Delay Time Adjust”

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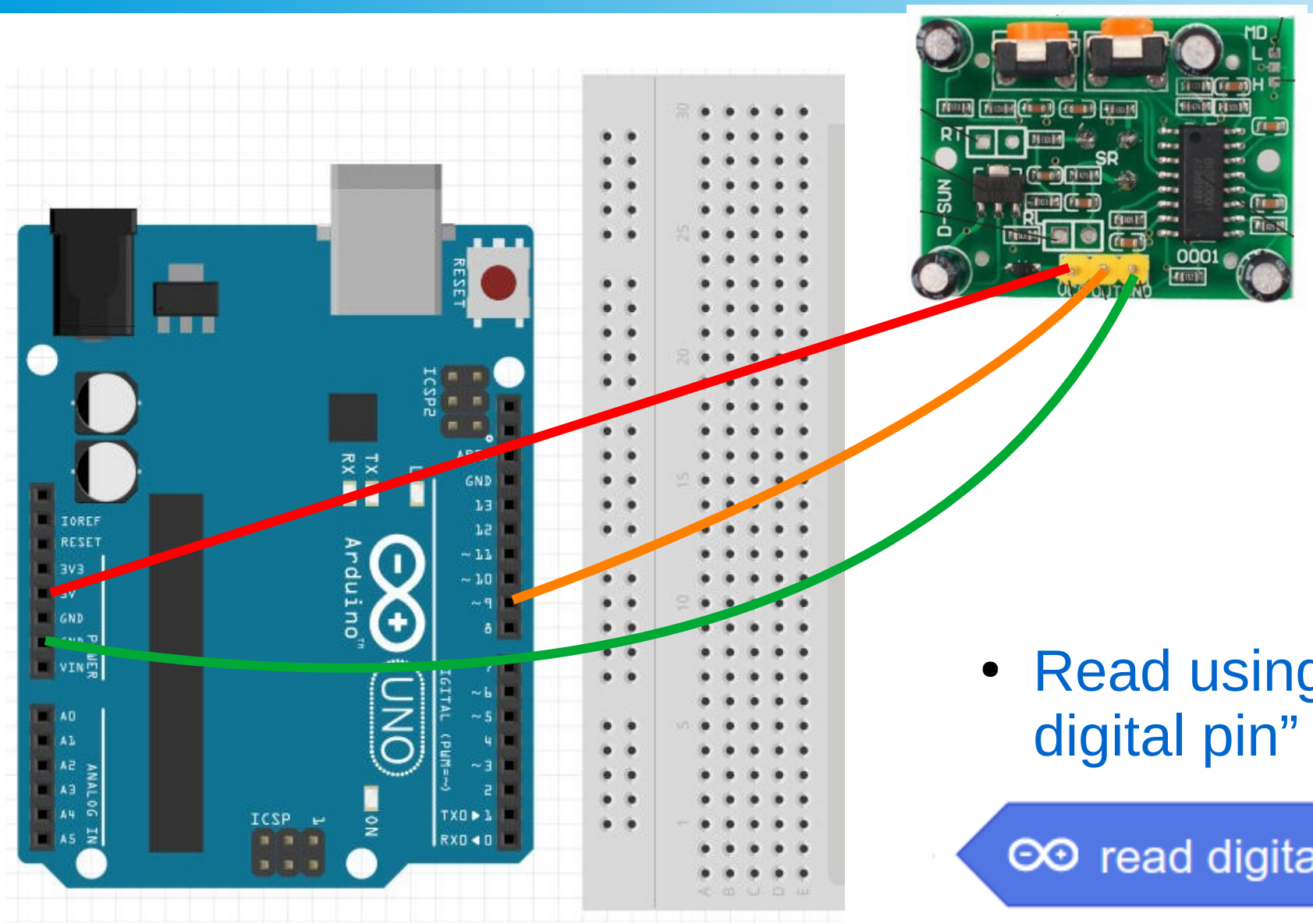
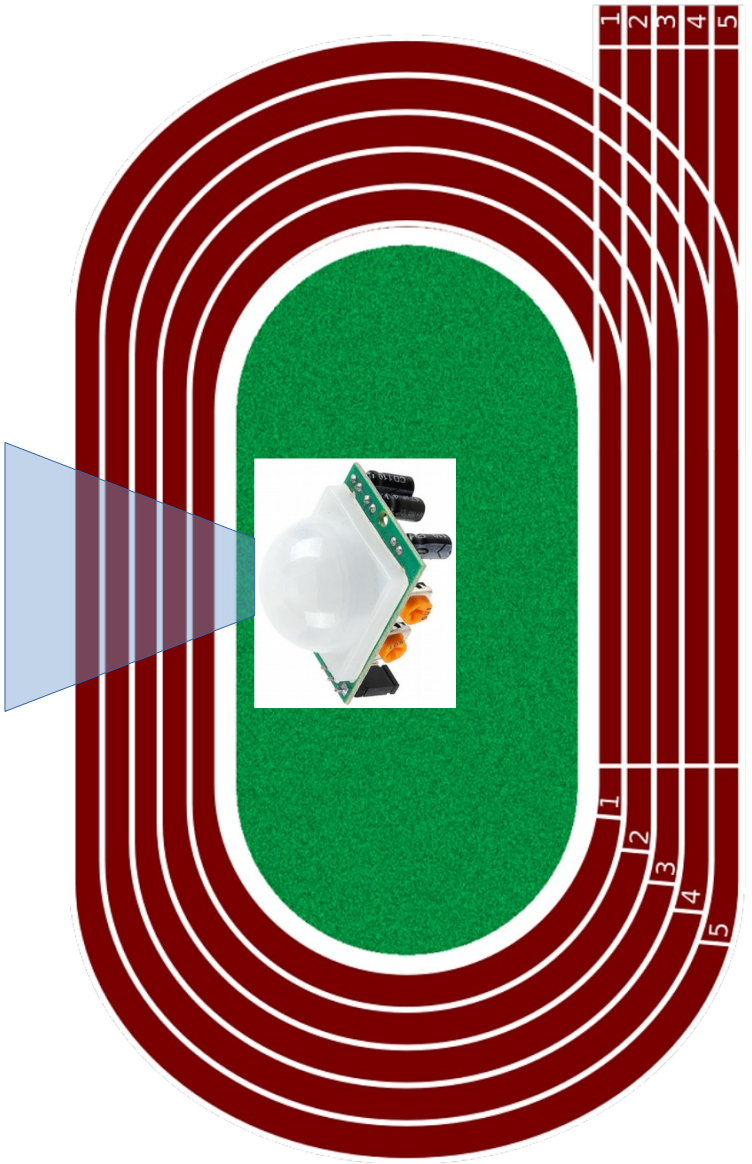
PIR Sensor



- Read using “read digital pin”

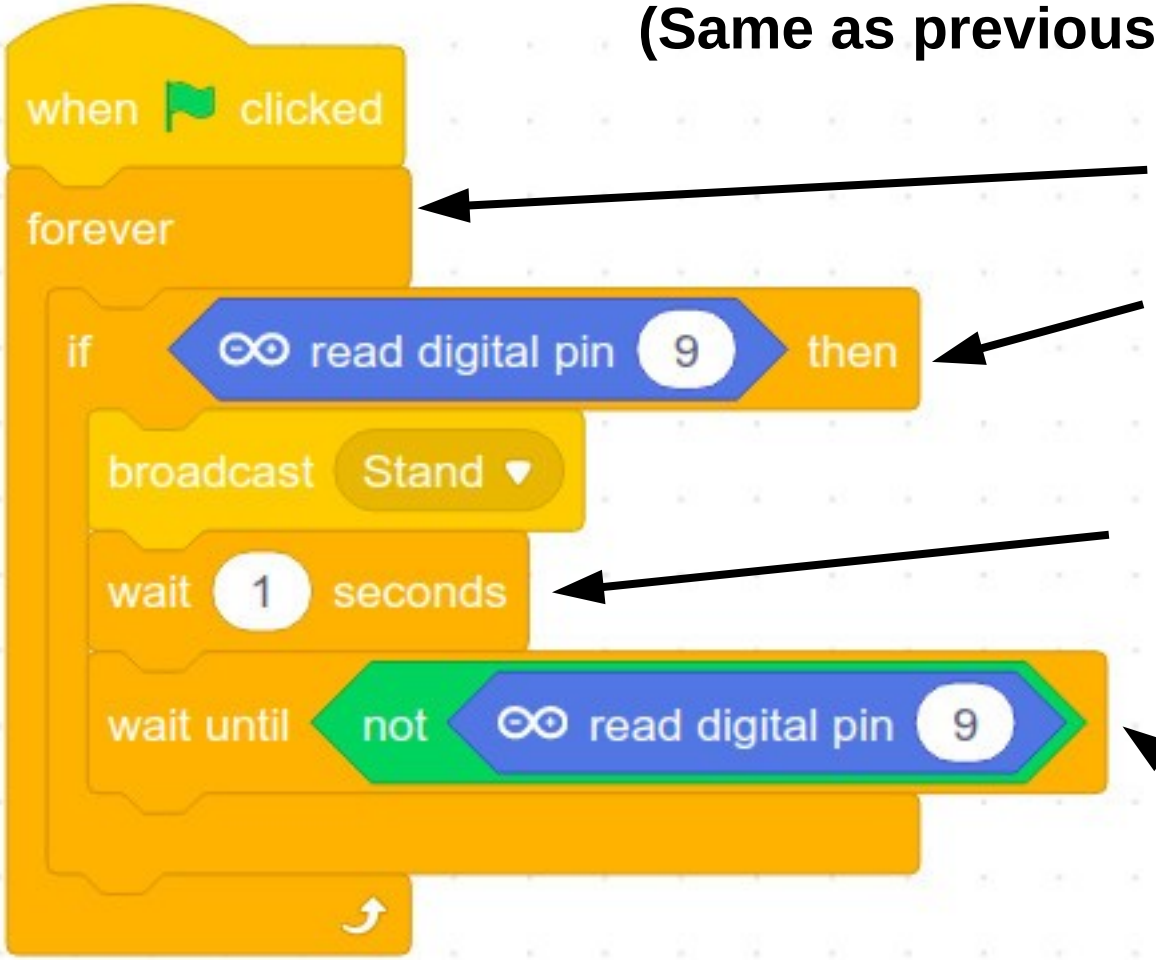
Lap Counter

- Detects when someone run pass the PIR sensor
- Counts the number of laps
- Display lap time



Lap Counter

Arduino Device
(Same as previous)



Repeats forever

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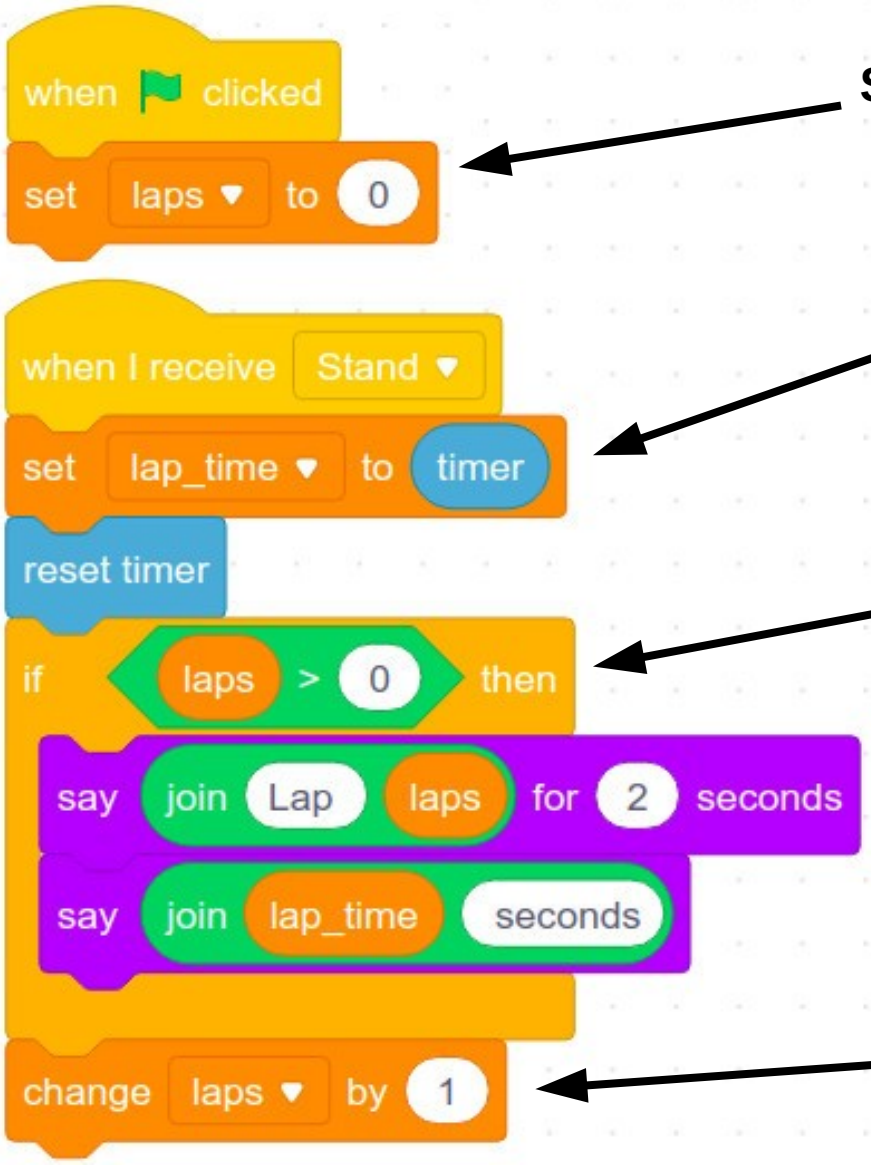
Lap Counter



Start count at zero

Save lap time then reset timer

If we have at least 1 lap, display lap count and lap time

Increment lap count by 1

Enhancement Ideas

- Sit to Stand
  - Provide guidance on exercise (See demo)
- Lap counter
  - Use sprites to provide large number display
  - Inform user if they are running below their target lap time

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