Robotics/Electronics Lesson 1 V2.0

Overview

The first lesson is to setup the foundations for the course. We will introduce basic concepts of electricity, the arduino and code.

At the start of the class show the class a traffic light built using the arduino. The instructor will give the students the opportunity to guess what the arduino is doing (traffic light).

Big Concept #1: Electricity is the flow of charged particles (electrons)

To students: Can anyone give me examples of devices you can turn on and off?

Each student will participate by giving one example such as lamps, phones, computers, cars, video games, refrigerators. Instructor will write these examples on the board.

To students: What do they have in common?

Expected answer: All of these devices require power or electricity

To students: Electricity is the flow of charged particles (electrons). Lets examine what that means.

*We will abstract the details of electricity to only an electron.*

Activity 1: Hot potato

For this activity we will use a ball (hot potato) to represent an electron. The activity goes as follows:

1. Everyone will form a circle (standing up) and have a neutral face.

2. The ball is like a hot potato. When you get the ball students will get excited (smile) by jumping up and down.

3. When they get tired or after 5–10 jumps they have to pass it to the left and resume a neutral position.

4. When the last student has to pass the ball, he/she will throw it to the floor. This is where we introduce the concept of a **battery**. A battery creates electrons (balls). Explain that without a battery we do not have electricity.

5. An assistant will act as a battery will now pass 3 balls to the right (one at a one). At least 3 students will be jumping up and down now.

6. Next remove one of students/assistant. Demonstrate that now the balls can not pass it to the next student. This is called an **open circuit**. Put the student back and explain now that it is a **closed circuit**.

7. The final component to this activity is the light. Ask the students how do they feel when they jump up and down. Explain that when a paper gets hot it tends to glow like a fire. Have one of the assistant act as a light. When a ball is pass to the assistant/light he/she will hold a piece of paper that shows a light glowing… Likewise a light will not be glowing if no electrons are pass to the light.

8. Finally remove a student from the circuit the assistant/light should glow. Put the student back on the circuit, the assistant/light should not glow. This is a **switch**.

9. Add a couple more balls into the circle and explain when electrons move in the closed circuit this is called **electric current**.

Draw a circuit with a wire, a battery and a light bulb to bring all the concepts we learned together
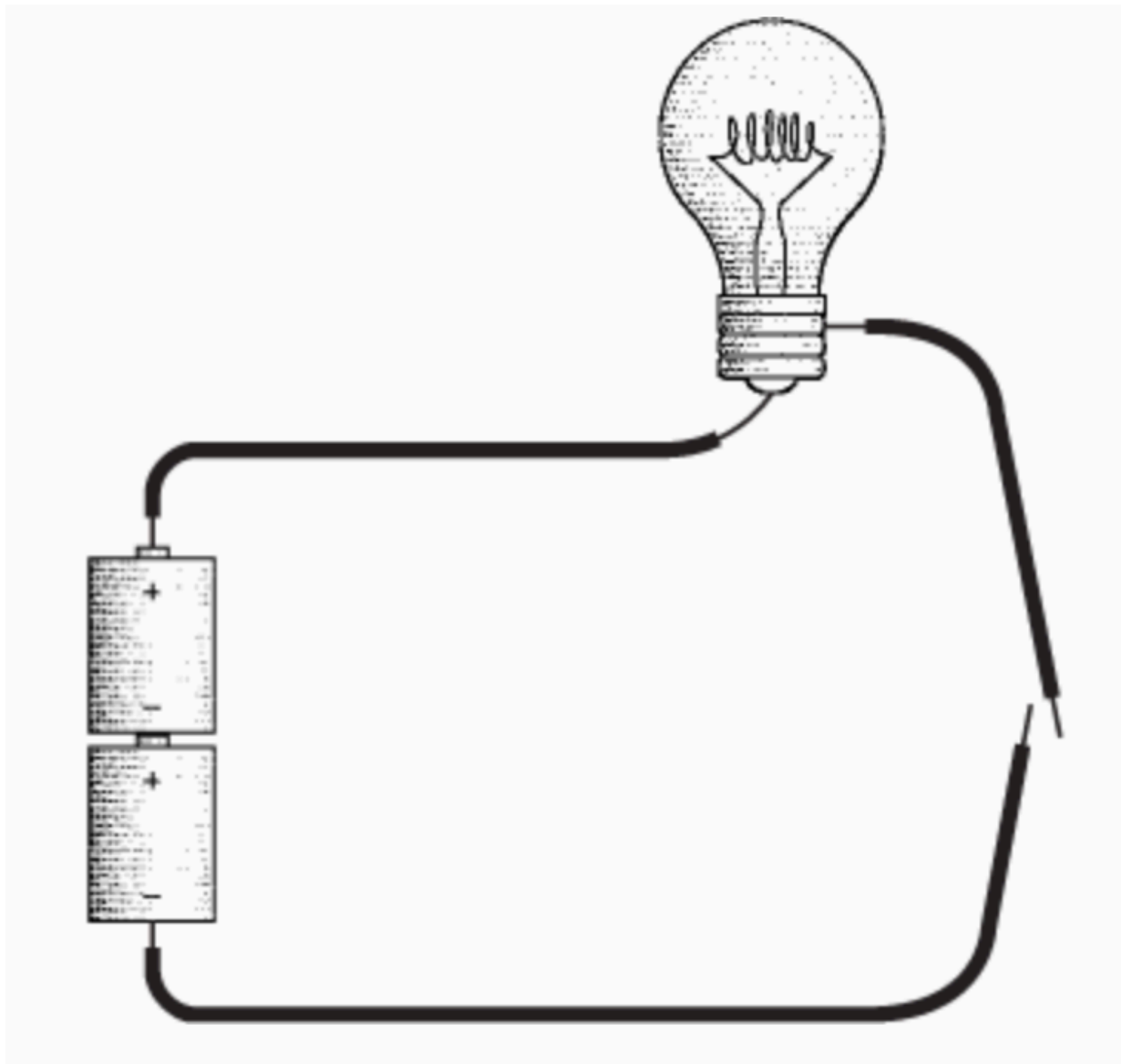
Big Concept #2: Arduino is just a mini computer

To students: Ok we looked at a light bulb but can anyone tell me what makes a phone or a computer different then that drawing above

The expected response is that it is not much different. All electronics take inputs and outputs something. A light has an on and off switch which is an input and it outputs the light brightening up. A iPhone is the same thing, if you press the home button the screen lights up. If you press the photo button, the camera snaps a picture. The only thing different is what is processing the input that results in the output. An

*iPhone has a mini computer that processes input and returns output. The **arduino** in front of you does exactly that.*
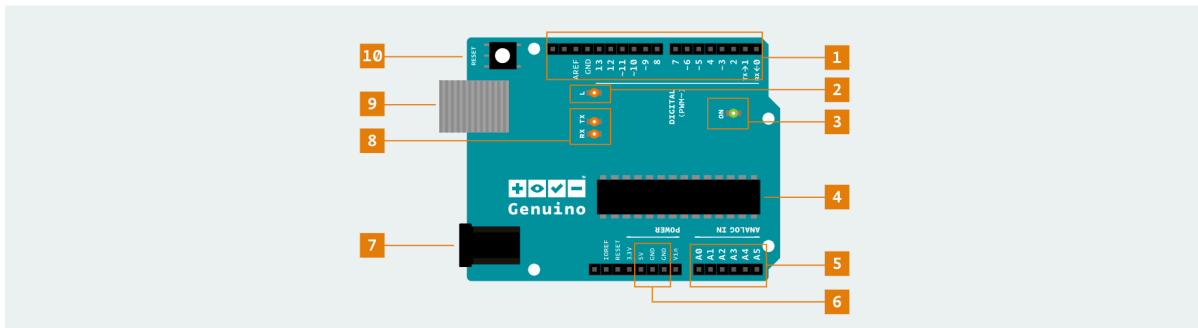
To students: Can anyone give me more examples that take inputs and returns outputs in real life

The some expected responses are a toy machine, car meter, ac, music player…

To students: Now we will explore some of the components of the arduino board

Instructor will explain only components needed in this session: 2, 3 ,7 and 9

Arduino/Genuino Uno.

- 1. **Digital pins** Use these pins with digitalRead(), digitalWrite(), and analogWrite(). analogWrite() works only on the pins with the PWM symbol.
- 2. **Pin 13 LED** The only actuator built-in to your board. Besides being a handy target for your first blink sketch, this LED is very useful for debugging.
- 3. **Power LED** Indicates that your Genuino is receiving power. Useful for debugging.
- 4. **ATmega microcontroller** The heart of your board.
- 5. **Analog in** Use these pins with analogRead().
- 6. **GND and 5V pins** Use these pins to provide +5V power and ground to your circuits.
- 7. **Power connector** This is how you power your Genuino when it's not plugged into a USB port for power. Can accept voltages between 7-12V.
- 8. **TX and RX LEDs** These LEDs indicate communication between your Genuino and your computer. Expect them to flicker rapidly during sketch upload as well as during serial communication. Useful for debugging.
- 9. **USB port** Used for powering your Genuino Uno, uploading your sketches to your Genuino, and for communicating with your Genuino sketch (via Serial. println() etc.).
- 10. **Reset button** Resets the ATmega microcontroller.

Big Concept #3: Code is just a set of instructions

The instructor will write code on board together as a class

To students: In order for a computer to do what you want it to do, you have to tell it what you want it to do also known as programming

Explain to students code is a set of instructions like when your mom tells you clean your room. Another example: it's like telling a baby how to walk: left foot first then right food. It requires step by step instructions, that computer will not know magically to do what you want it to do. For example if I tell my sister I want bubble tea, she needs to know how to get to the store, how much does it cost, where am I and so on…

Activity 2: Variables

In this activity we will introduce the concepts of variables. In essence variables store information/stuff

The activity goes as follows:

1. Cups will be labelled with names [x, y, z]

2. Posit notes or balls will be labelled with numbers [1, 2, 3]

3. Instructors will write several variables on the board and the students will be required to place the posit notes in the correct cup

4. Do step 4 a couple times

```
int x=1; int y=2; int z=3
```
```
int x; int y=2; int z=3
```
```
int x=1; int y=2; int z
```
```
int x=2; int y=2; int z=2
```

Activity 3: Methods

Methods are just a set of instructions grouped together.

The activity goes as follows:

1. The instructor will write a set of instructions on the board

2. Pick cup x up. Pick cup y up. Count to 1 and put cup x and cup y down.

3. Repeat step 2 with other instructions.

Activity 4: Setup Method

To students: The setup() method is ran once at the just after the Arduino is powered up

```
void setup() { }
```

1. Stack all the cups together.

2. Instructor will tell the students to setup the cups by placing them in a straight line.

Activity 5: Loop Method

The students: The loop() method is ran continuously afterwards.

```
void loop() { }
```

1. Instructor will write one instruction on the board. Pick up cup then put down cup.

2. Instructor will count 1, 2, 3… Students are expected to repeat the instruction.

The students: Led Pin 13 is the led on the board

Instructor will point to place on the board. A variable stores information in this case the number 13.

```
int ledPin = 13; void setup() { } void loop() { }
```

To students: The pinMode describes whether the pin is an input or an output

pinMode is a method and it takes inputs returns an output. It stores to a set of instructions to act on the input ```void setup() { pinMode(ledPin, OUTPUT); }``` 1. Explain **input** is like putting a quarter into a machine and it **outputs** a toy.

To students: The digitalWrite() describes the state of the led pin 13

Instructor will explain LOW means low power and HIGH means high power. Do if I

give it low power that means no electrical current are going to the led and high power means electrical current are going to the led. Explain that HIGH and LOW is like removing a student from the circle. Have students give examples of devices with swtiches

```
void loop() { digitalWrite(ledPin, HIGH); }
```

To students: We have already installed the program please plug in your arduino into your battery. Assistants will be there to help out the students.
Students should see led pin 13 light on on the board

Big Concept #4: The Blinking Led

If time permits we will learn how to make the led blink.

To students: When you cross a side walk and there is almost no time left. What is the red hand signal doing?
It is blinking!

To students: Given that we learned about HIGH and LOW, does anyone have idea how to make the led blink?
Let students to discuss several solutions among the group. Give clues like a pause time if needed. Afterwards instructor will go over the code and have assistants install the program on all the ardunios and have them turn it on. Students should see led pin 13 blinking.

```
void loop() {
digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
delay(1000); // wait for a second
digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
delay(1000); // wait for a second }
```