Spring 5-14-2019

Module: Robot Senses

Mohammad Azhar
CUNY Borough of Manhattan Community College

Module:Robot Senses

Learning Objectives:
Students will be able to:

- Describe the basics of Sensors
- Learn how to program the LEGO Robot to make decision using touch sensors

INFORMATION *Assigned Readings*	• Sensors, by Labautopedia. Jun 2009.
DIALOGUE *Class Discussion*	In Class Discussion (20 minutes): • Describe the basics of Sensors • Introduce how to program the LEGO Robot to make decision using touch sensor
PRACTICE *Lab Exercises*	In Class Lab Project Activity: 1. Hands-on Lab Activity (30 Minutes): a. Introduce Sensors b. Introduce how to program the LEGO Robot to make decision using touch sensor 2. Challenge (40 Minutes): a mini hackathon challenge "Obstacle Avoidance" where they will apply the knowledge from the hands-on lab activity
FEEDBACK *Lab*	The feedback will be given during: • Demonstration of exercises in the hands-on lab activity. • Demonstration of Mini Hackathon Challenge.
EVIDENCE	• Completion of Lab and Mini Hackathon Challenge

Class Discussion	Lab Activity	Mini Hackathon Challenge

Questions/comments? Dr. Mohammad Q. Azhar

Module: Robot Senses

CLASS DISCUSSION

Vocabulary

Sensor	Touch Sensor	Wait Block	Decision Making

Sensor

A **sensor** is hardware component which obtains information from the environment (or internal state). Robots receive information from sensors as **input**. The robot then takes the sensor information and **decides** what **action** to take.

Human Sensors	**Robot Sensors**	**LEGO EV3 Sensors**
Eyes	Color Sensor: capable of detecting colors	
Ears	Sound Sensor	
Nose	Smell Sensor	
Tastebuds	Taste Sensor	
Nerve cells	Touch sensor: detects when its front button is pressed or released and is able to count single and multiple presses.	

Collecting Data using Sensors to Make Decision

- Animals (e.g., bats) receive stimuli (e.g., sound) as **inputs** from their environments. Some of these signals are **processed** by the brain which **determines** whether to **take action** and **what action** to take. [stimuli **(as input)** → **action or no action (as output)**]
- A human's eyes **(i.e., sensor)** can **detect** *visible light* (i.e., stimuli) which the **brain** then **processes** as things the human may recognize in their environment. The human attaches meaning to these things and then decides what to do.

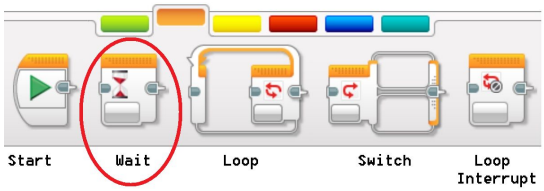
Gamma ray	X-ray	ultraviolet	**visible**	infrared	microwave	radio

- Engineers take inspiration from biological organisms (e.g., humans and bats) for creating sensors for robots. For example, **sensors** may **mimic** some of the capabilities of eyes and ears. This may be a camera that **detects** *visible light* to form a **digital image** of colored pixels and shapes.
- The robot has to be **programmed** (written based on algorithms) and provided **artificial sensors** (e.g., camera) to **process** these images in order to **'recognize'** objects.

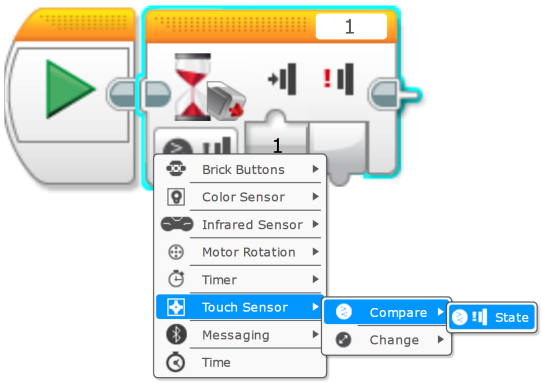
Module: Robot Senses

LAB ACTIVITY

Programming the Wait Block with the Touch Sensor



The image above shows an active orange tab in which the WAIT block can be found.

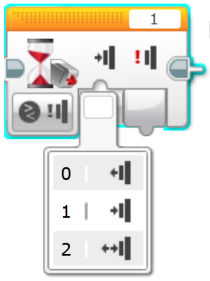


The WAIT block

The Wait block makes your program wait for a specified condition before continuing to the next block in the program.

The condition can be based on the input from the **TOUCH sensor**.

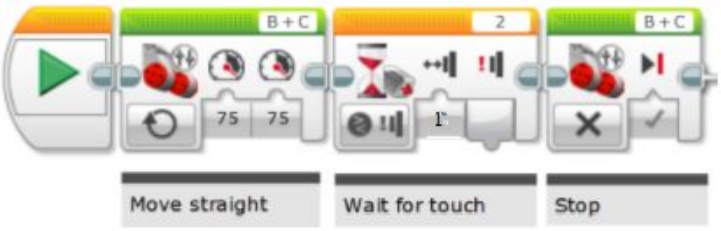
Under the **Compare mode**, data from the TOUCH sensor will be continuously read data until it detects a program-specified **state**.



The possible **states** and corresponding numeric parameter values in this mode are:

Numeric value	State
0	Released (Not pressed)
1	Pressed
2	Bumped (Pressed then released)

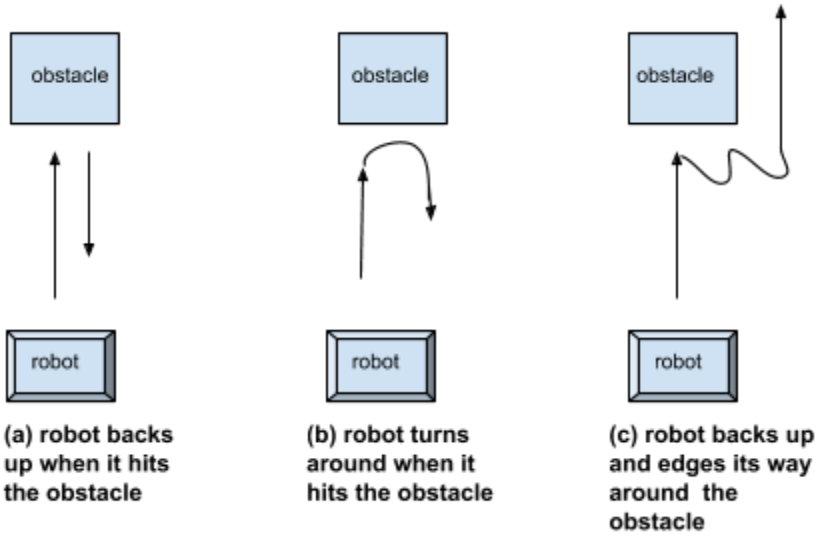
Example: Program your robot to move straight until you tap the sensor.



Module: Robot Senses

MINI HACKATHON CHALLENGE: Obstacle Avoidance Challenge

A classic task that mobile robots perform is known as **obstacle avoidance**. This behavior entails robots trying to avoid bumping into objects that obstruct or hinder their path. One way that robots achieve this is by bumping into obstacles to discover they exist, and then backing up and/or turning around to avoid them. Some examples are shown below:



(a) robot backs up when it hits the obstacle

(b) robot turns around when it hits the obstacle

(c) robot backs up and edges its way around the obstacle

Challenge 1: Write down your algorithm for robot to back up when it hits the obstacle as shown in Figure (a).

Module: Robot Senses

Challenge 1: Program your robot to back up when it hits the obstacle as shown in Figure (a)

Challenge 2: Write down your algorithm for your robot to turn around when it hits the obstacle as shown in Figure (b)

Module: Robot Senses

Challenge 2: Program your robot to turn around when it hits the obstacle as shown in Figure (b)

Challenge 3: Write down your algorithm for your robot to back up and edge its way around the obstacle as shown in Figure (c)

Module: Robot Senses

Challenge 3: Program your robot to back up and edge its way around the obstacle as shown in Figure (C)

Reflection: Write down the challenges that you experienced and how you solved them.