Department of Computer and Mathematical Sciences

CS 1305
Intro to Computer Technology

8

Module 8: Introduction to LEGO MINDSTORMS

Objectives:
The main objective of this module is to become familiar with a LEGO MINDSTORMS kit and learn how to construct a robot using LEGO MINDSTORMS kit.

Introduction
LEGO MINDSTORMS kit comes with everything is needed to learn how to build a functional robot. The reverse side of the cover label has a chart of each piece that should be included in the set as well as the amount of each. Pieces are lost easily so every piece may not be accounted for or may have not been included in the set. Familiarize with the pieces listed on the chart as well as try and locate some of pieces in the set.

Specialty pieces:
Locate and familiarize with the special pieces that perform actions and will be used by a constructed robot. In Figure 1, it illustrates a LEGO MINDSTORMS microcomputer with accessories such as sensors and motors as follows:

1) LEGO MINDSTORMS microcomputer (**brick**)
2) Motors
3) Touch Sensor
4) Light Sensor
5) Ultrasonic Sensor
6) Sound Sensor
7) Wires

Figure 1: LEGO MINDSTORMS Microcomputer and Accessories

LEGO MINDSTORMS Microcomputer

Locate a LEGO MINDSTORMS microcomputer or **brick**, which is how it will be referenced from now on. The center part of the **brick** as shown in Figure 1 has:

- Four buttons:
    1. **Orange button**: On / Enter / Run
    2. **Light gray arrows**: Used for moving left and right in the NXT menu
    3. **Dark gray button**: Clear / Go back
- **Program Status** is a figure on the display that is still when nothing is happening or will appear to be running when the selected program is set to **Run**.
- **Program Name** is the current program that the brick is set to. The brick can store up to 5 programs.

- The numbers **1**, **2, 3**, and **4** refer to the four **input** slots above the respective numbers. This is where input devices will be plugged in.
- The letters **A**, **B**, and **C** refer to the three **output** slots below the respective letters. This is where output devices will be plugged in.

Servo Motors

The motors are high efficiency motors, with built in rotation sensors that run off the power of the **brick**.

Touch Sensor

Touch sensor is sensor that acts like a switch or a button switch. They inform **brick** if the switch is:

- Tapped
- Released
- Held down

Light Sensor

Light sensor is light sensitive sensor that can detect:

- Light and dark areas of a room
- Difference in some shades of color such as red, blue and yellow
- Infrared light

Ultrasonic Sensor

Sensor that gives robot sight and can detect:

- Distance 0 – 255 cm

Sound Sensor

Sensor that is capable of hearing, it can detect:

- Adjusted decibels: equivalent to the human ear
- Unadjusted decibels: sounds that a human ear cant hear

Wires

The wires that come with the set are cables used to connect the sensors and motors to the **brick**.

Task 1: Building a Robot

In this task, you will learn the basic building techniques used with LEGO. This robot will be used in all the labs with modifications to help it perform different task.

Activity 1.1: In this activity, we will build a robot called **Robot1**. Refer to the building instructions on page 8-21.

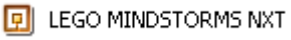
Task 2: LEGO Mindstorms NXT Software

In this task, you will learn how to use LEGO Mindstorms NXT Software to program your robot.

Activity 2.1: LEGO MINDSTORMS NXT software
Follow these steps to open **NXT** software:

1) From the **All Programs** command, click on **Start** button 

and then select **All Programs** command 

from the **Start** menu as shown in **Figure 2**.
2) Choose **Lego Mindsotrms NXT** and follow the arrow to 

as shown in **Figure 3**.
3) Title your program under the start new program as shown in **Figure 5**.
4) Click go.

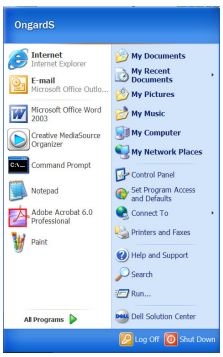


Figure 2: Menu from Start button

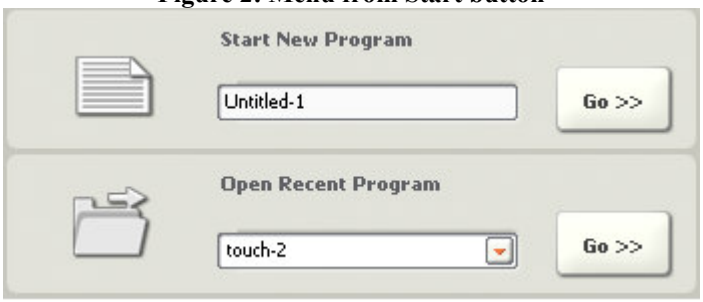


Figure 4: : Robolab Menu

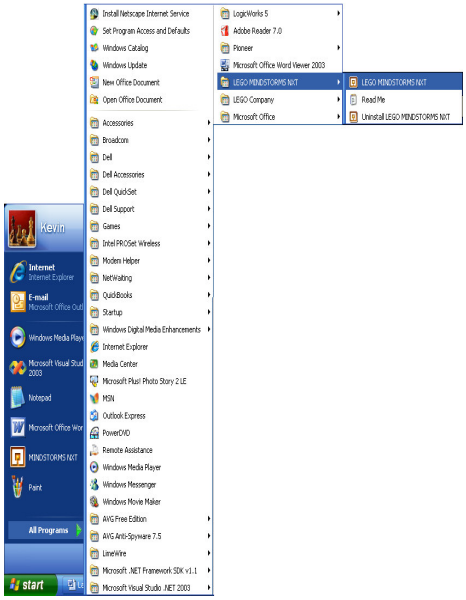


Figure 3: Selecting Mindstorms NXT

You should now have a blank workspace similar to **Figure 4** and are ready to program.

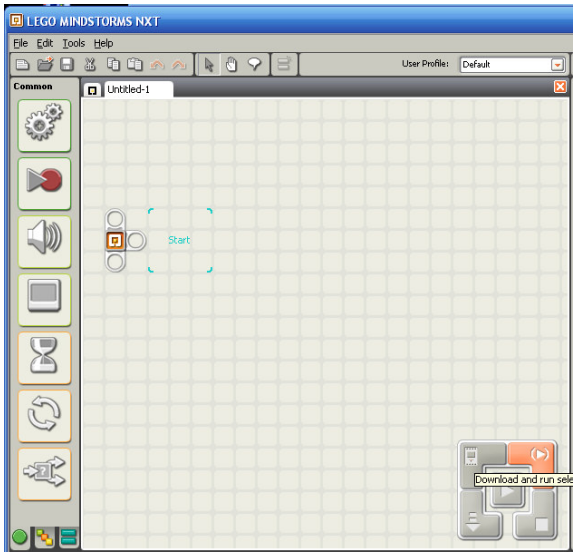


Figure 5: Blank Workspace with Functions Window

Task 3: The First Program
In this task you will learn how to write your first inventor program. You will be using **Robot1** from **Task 1.**

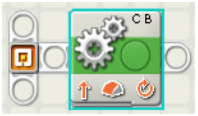
Figure 6: Function Menu

Activity 3.1: The Function Menu
The column on the left of the work space with the title **Common** will be referred as the tool pallet as shown in **Figure 6.**

Activity 3.2: Creating a Connection and a 3 second robot

On your workspace you will see the following icon 

which shows the start of the program. Robot1 has two motors that are connected to the brick at port A and C. Your program has to activate this motor. In order to do that, you need to select the **Move** icon  from the **Function menu** and drag it to the block labeled start on your workspace.

You should now have a completed connection between the beginning of your program and move command that looks something like this. 

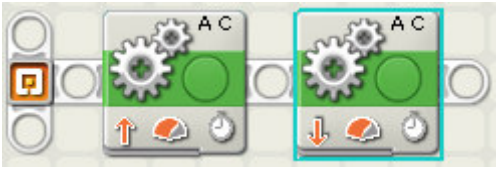
At the bottom of the workspace you should see the following options:

Now you must program the command by making the following selections:

- Ports – A and C.
- Direction – up arrow (represents forward).
- Steering – leave even.
- Power – leave at 75.
- Duration – click on the drop down arrow and select seconds.
    - In the box to the left of seconds type in 3.
- Next Action – Brake.

It should now look like this:

Activity 3.3: Try it yourself
There are two directions under the move command. You have just done forward so now connect another move command and make it go backwards for 3 seconds. Your complete program should look like this.



Task 4: Downloading Your Program
In this task, you will learn how to send a program to your brick and run it.

Activity 4.1: Follow the steps below to send your first program to your brick.

1. Connect the USB cable to the robot and your computer.
2. Turn on your brick by pressing the orange button.

   Locate and click on the **Download and Run** button  which is in the lower right corner of your workspace.

The NXT software will then connect to the brick and will display a new window that shows the progress of the send. When the send is complete your brick will play a tune.

Activity 4.2: Run your program
Make sure you place your robot on a flat surface where it will not fall. To run your program, navigate through the menus by going in the following order:

1. Turn on the robot.
2. Click on My Files
3. Click on Software Files
4. Find what you named the program and click on it.
5. Click run.

The robot should immediately begin to turn its wheels and move forward. To stop your robot, press the dark gray button. You have now successfully programmed your first robot.

Print the program from Activity 3.3 and turn it in.