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GREEN-EDU Learning Activity

Title: Frictional force

Author(s):

Summary: 'F.5.3.2. The aim of this lesson plan is to experience the friction force on different floors will be different by using the specific stages of coding based on the learning outcome that is "application of friction force on slippery and rough floors, the applications of friction force in daily life

Lesson plan summary	
Subject	Green Engineering and Robotics
Topic	*Applications of friction force on slippery and rough floors*
Age of students	*Secondary 10-11*
Preparation time	*15 Minutes*
Teaching time	*2*40 Minutes*
Online teaching material (links for online material)	
Offline teaching material	

Aim of the lesson

By the end of this lesson students will:

· realize that the friction force varies depending on the floor.

.   experience that the friction force causes a decrease in the energy of motion.

.   be aware of the place and importance of friction force in our daily life.

.   reveal their own ideas about friction force and thus gain creative and innovative thinking skills.

Trends

STE(A)M Learning /expository learning / discovery learning / question and answering method

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Activities

Describe here in detail all the activities during the lesson and the time they require. Remember, that your lesson plan needs to revolve around the topic of green engineering and robotics.

Name of activity	Procedure	Time
Engage-1	The teacher greets the students and asks how are they. Then the students are divided into groups. A remarkable story about friction force and energy is distributed to each group. (Activity 1 Aylin's Snow Adventure) Aylin and her family were on their way to Erzurum where their grandfather lived, for the semester holiday. As it got closer to Erzurum, the air cooled down and snow was covered everywhere. When Aylin looked out the window of the car, she saw that some cars stopped and some cars slid and crashed. Realizing the situation, his father, Ahmet thought that he had to put a chain on the tires and went out of the car and headed to the baggage. But he saw that there was no chain. Concerning this, as Ahmet hurried to find a chain from the environment, slipped and fell on the ground. Ahmet complained that "I wish I had worn my snow shoes instead of flat shoes.". Fortunately, the people around them brought chain for their car and they continued the journey by putting the chain on the tires. Aylin watched all these things with curiosity and thought about them along the way. What do you think about why Ahmet fell on the ground? What do you think about why Ahmet put the chain on the tires? Making the Activity: A student is asked to read this story aloud. At the end of the story, answers are received from each group for questions. Students are asked what examples they can give on this topic from their daily lives.	5 min
Explore-1	An activity is given to students to observe that the friction force varies depending on the type of friction floor and causes a decrease in their speed. Topic: Friction Force Experiment Name: Why did the speed decrease? Purpose: Tools and Equipment: - Cardboard - Toy car -Different types of floors (sandpaper, aluminum foil)	X min

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-Various books
-Ruler

How shall we try?

1. Students are asked to create an inclined plane.
2. Students are put on a hypothesis about which floors the car will go further by putting different floors under the inclined plane.

Hypothesis………………………………….

3.Students release cars from the top of the inclined plane and write their observations.
4. They measure how long the car travels on different floors with a ruler and record the measurements in the table.

Set up	Type of floor	Taken road (cm)
1. Set up		
2. Set up		

What conclusion have we reached?

1. On which ground did the car go further?
Since the energy would not get lost, wouldn't cars have to go on forever? What is the force that stops cars?
3. What is the reason why the car moving on the aluminum foiled floor goes further than the car moving on the sandpaper floor?

Hypothesis, measurement results and answers to the questions are taken from each group. Students' answers are discussed and brainstorming is created.

Explain-1

At this stage, it is aimed to make the students integrate the activity with coding.
Effect of Floor on Friction

Material List to be used:
1. Arduino Robotic Coding Board
2.2 Pieces 3V-6V DC Motor
3. 1 Push Button
4.2 Pieces HC-SR04 Ultrasonic Distance Sensor
5. 2 Wooden Blocks
6. 1 Piece of Marble Floor
7. 1 Sanding Floor
8. 2 pieces of 1meter rope
9. Jumper Cable
10. 1 Piece 10k Resistor
11. Mblock IDE Program

x min

1. Arduino Uno   2. 3V-6V DCMotor   3. Push button

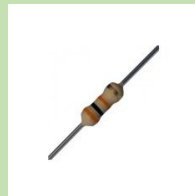4. HC-SR04   5. Wooden block   6. 1 Piece of
Marble

floor

7. 1 Sanding Floor   8. Two pieces of one meter rope 9. Jumper
cable

10. 10k Resistor   11. Mblock IDE

The Data Obtained:
With the above materials, two mechanisms will be installed in one
environment with a marble floor and in another environment with a
sanding floor. In different friction environments, the timing of the
wooden blocks to reach the distance sensor will be measured.
Ultrasonic distance sensor and Arduino Uno board timer code will be
used to measure arrival times. The data to be collected as a result of
the experiment will be time.
Expectation:
The friction coefficients on different floor types will be different.
Rough floors have higher friction than flat floors. The movement of
objects will be slower as the friction resistance increases. Since the
friction is less on the marble floor, the wooden block in this
environment is expected to complete the track more quickly. The
wooden block will stop when it comes in front of the distance sensor
and the time to this point will be measured with Arduino.

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Measuring the Effect of Friction Force of floor on the Motion of Objects

Goal:
This experiment is designed to examine and measure the effect of different floors on the friction force of objects. For this purpose, the effect of the friction forces of different floors on the object will be examined by pulling two identical objects with equal force on different floors that have different friction coefficients.

Design of Experiment Setup:
Two experimental setups will be prepared for this experiment.

1. setup: 1 meter long flat marble will be placed on horizontal ground. A distance sensor will be placed at one end of this marble. This test environment will be a marble friction test environment for us.

2. setup: 1 meter long flat sandpaper will be placed on horizontal ground. A distance sensor will be placed at one end of this sander. This test environment will be a sanding friction test environment for us.

Elaborate-1	Two identical wooden blocks are required for the experiment and two 1-meter ropes are required to pull these blocks by the DC motor. DC motors will be placed on one end of the floor and wooden blocks on the other. One end of this one-meter rope will be attached to the wooden block in the marble floor and the other end to the pin of the DC motor in the marble floor. One end of another 1 meter rope will be attached to the wood block in the sanding floor and the other end to the pin of the DC motor in the sanding environment. HC-SR04 distance sensors must be placed in front of DC motors, in a position to detect wooden blocks from a distance of 3cm. Finally, a button that will start the DC motors and start the timer counter will be used to start the experiment. **The setting of the Experiment:** In the experiment setup, DC motors will be operated at the same time by pressing the button and it will be ensured that they pull the wooden blocks. At the same time, pressing the button will start the counting process on the Arduino Robotic card. 1. There will be a DC motor at one end of the marble test environment and a wooden block attached to this DC motor at the other end. The HC-SR04 Distance sensor will be located in front of the DC motor. When the start button is pressed, the counter will start counting. At the same time, the engine on the marble floor will start pulling the wooden block on the marble floor with a voltage of 2 V. The DC motor will continue to pull until the distance between the wooden block and the distance sensor remains 3 cm. When the	X min

distance of 3 cm remains, the distance sensor will warn and stop the motors.
At the same time, the timer will calculate the time so that the timing of the wooden block on the marble floor will be determined.

2. There will be a DC motor at one end of the sanding test environment and a wooden block attached to this DC motor at the other end. The HC-SR04 Distance sensor will be located in front of the DC motor.
When the start button is pressed, the counter will start counting.
At the same time, the engine on the sanding floor will start pulling the wooden block on the sanding floor with a voltage of 2 V.
The DC motor will continue to pull until the distance between the wooden block and the distance sensor remains 3 cm. When the distance of 3 cm remains, the distance sensor will warn and stop the motors.
At the same time, the timer will also count the time so that the timing of the wooden block on the sanding floor will be determined.

Our aim in the design of this experiment; to show that the effect of the friction force on different floors will be different and the motion of the moving object will be affected. Our expectation here is that the wood block moving on the marble will be drawn faster since the friction force of the sanding floor will be higher.

Necessary materials:
1 x Arduino Uno Robotic Coding Board
1 x Breadboard
2 x 5V DC Motor
2 x HC-SR04 Distance Sensor
1 x Push Button
2 x 1meter rope
1 x 10k resistor
2 x Wooden Block

Introduction of DC Motor and Pin Connections:

DC motors are worm gear systems. They have the speed depending on the rate of voltage given to their pins and rotate as long as the voltage is applied. There are 2 pin outputs, these are Vcc, GND. They have the same speed with the voltage value given from the Vcc pin. Voltage from 0 to 5 V can be applied to the DC motor by giving 0-255 value from Arduino's PWM generating pins. To define the functions of pin outputs:
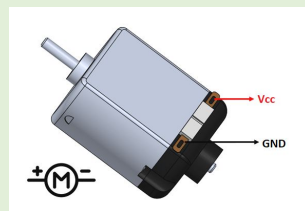
Vcc: Required for the operation of the device pin to which the voltage is given
GND: pin required for the completing the electrical circuit
The connection must be reversed to reverse the motor

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Introduction of Buttons and Pin Connections:

Buttons are used to open or close a circuit in electrical and electronic systems. They are connected in series to a system. Energy flow is provided by pressing the button, so energy goes into the system and the system starts working. The electrical circuit cannot be completed when the button is not pressed, so no energy flow can be provided, so it doesn't work because there isn't energy to the system. The purpose of use here is to transmit the energy connected to one pin to the other pin when pressed. It will not be able to transmit when it is not pressed.


HC-SR04 Distance Sensor and Pin Connections Introduction

The HC-SR04 Distance sensor is a sonar-style distance measuring device. It has a system that measures the distance of the opposite object by taking the sound waves it sends from one eye to the opposite object and taking it from the other eye. It can measure distances between 2cm and 400cm.

To define the functions of pin outputs:

Vcc: Required for the operation of the device pin to which the voltage is given

GND: pin required for the completing the electrical circuit

Trig: Sensor Triggered Pin

Echo: Pin which takes the data from the sensor

Making Circuit Connections:
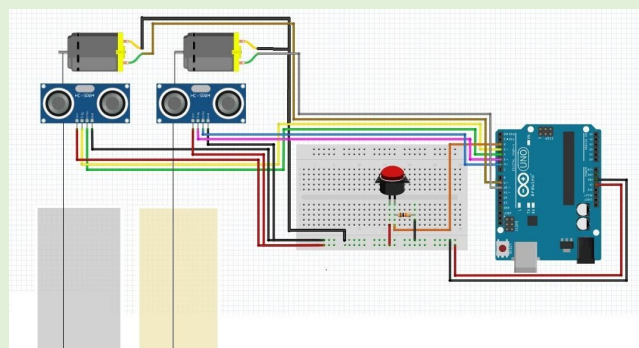
Firstly, as mentioned above, two experiment set-ups, one is from marble and the other is from sandpaper, will be prepared. After making the preparations for setting the above experiment:

1. The Vcc pin of the DC motor in the set-up prepared for the sanding floor will be connected to the number 9 pin of Arduino and the GND pin of the DC motor to the GND Pin of Arduino.
2. The Vcc pin of the DC motor in the set-up prepared for the marble floor will be connected to the number 10 pin of Arduino and the GND pin of the DC motor will be connected to the GND Pin of Arduino.
3. Connections of HC-SR04 Distance sensor prepared for the sanding floor will be made as given below.

HC-SR04 Pins	Arduino Pins
Vcc	Vcc
GND	GND
Trig	D3
Echo	D4

4. Connections of HC-SR04 Distance sensor prepared for marble floor will be made as given below.

HC-SR04 Pins	Arduino Pins
Vcc	Vcc
GND	GND
Trig	D5
Echo	D6

5. A button will be used to operate this circuit. When this button is pressed, DC motors will start and draw wooden blocks. Also, pressing the button will start counting from 0. One end of the button will be connected to the Vcc pin and the other end to the digital pin 2 of Arduino. Here, a 10-kohm pull-down resistor is used to prevent instability. One end of the pull-down resistor will be connected to the end of the button that goes to Arduino and the other end to the GND pin of Arduino.

Coding:

The application we will use for coding is the Mblock program. This application is a tool that allows us to do robotic coding by dragging and dropping blocks without the need for programming language knowledge. Coding block is on the side.

If we explain the application steps one by one:

Two variables will be created which we have to use in this project before moving to coding blocks. "Data1" and "data2" variables will be created by coming to the Variables menu of the Mblock IDE and clicking on the "Create a Variable" tab.

Digital Pin Reading () block:
Indicates that data from the given Digital pin of Arduino () in parentheses are read. Data from digital pins can only be 0 or 1. In this project, data from digital pin 2 is read.
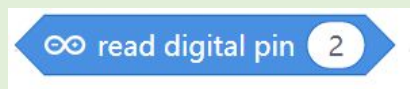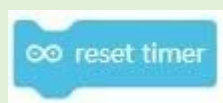

If () then block:

If the expression that comes in parentheses with this block of code is logically "True", all blocks placed in the block work. If it is logically "False", this and the code blocks in it are passed without running.

Timer Reset block:
It is stated that with this code block, a time counter starting from 0 is started in Arduino.

Set PWM () output () block:
This code block is used to output PWM signals to the digital pins that can output PWM of the arduino. In this project, a voltage of 100 PWM, that is 2 V voltage, was applied to the DC motor connected to pin 9 of Arduino and to the DC motor connected to pin 10 again.

Create data1 () block:

Allows the value in parenthesis to be assigned to the data1 variable we created earlier. Here, 1 is assigned to the variable data1.

set data1 ▾ to 1

Create data2 () block:
Allows the value in parenthesis to be assigned to the data2 variable we created earlier. Here, 1 is assigned to the variable data2.

set data2 ▾ to 1

( ) with ( ) comparison block:
This block compares two values given in parentheses. Returns "True" or 1 if it is the same, or "False" or 0 if it is not the same. Here, our data1 value and 1 value were compared.

data1 = 1

Here, our data2 value and 1 value were compared.

data2 = 1

() <() comparison block:

This block compares the magnitude of the two values given in parentheses. Returns "True" or 1"False" if the value in the first parenthesis is greater than the second. Returns "false" or 0 if the value in the first paranthesis is not greater than the second one.

< 50

ın this project, it is compared whether the distance taken from the sanding floor is less than 3.

∞ read ultrasonic sensor trig pin 3 echo pin 4 < 3

ın this project, it is compared whether the distance taken from the marble floor is less than 3.

∞ read ultrasonic sensor trig pin 5 echo pin 6 < 3

Distance Sensor () Trigger Pin () Reading Pin block:
This code block represents data reading from the HC-SR04 Distance sensor. In the distance sensor, the pin number of the Trig pin connected to Arduino will be entered in the Trigger pin parenthesis, and the pin number of the Echo pin connected to Arduino will be entered in the Reading pin parenthesis.

In this project, 3 Trigger Pins and 4 Reading Pins are used for the Distance sensor prepared for the sanding medium.

read ultrasonic sensor trig pin 3 echo pin 4

In this project, 5 Trigger Pins and 6 Reading Pins are used for the Distance sensor prepared for the marble environment.

read ultrasonic sensor trig pin 5 echo pin 6
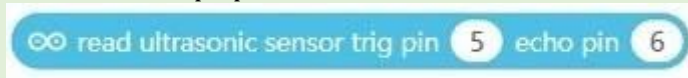
( ) and ( ) block:
In this block, two values in parentheses are compared with the AND logical operator.

and

The results are obtained according to the logical state of the two values.

INPUT		OUTPUT
X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

In our project,the condition is provided if the distance value taken from the distance sensor connected to the digital pin 3 and 4 of Arduino for the sanding medium is less than 3 AND the content of the data1 variable is 1.

read ultrasonic sensor trig pin 5 echo pin 6 < 3 and ver2 = 1

In our project, the condition is provided if the distance value taken from the distance sensor connected to the digital pin 5 and 6 of Arduino is less than 3 AND the content of the data2 variable is 1.
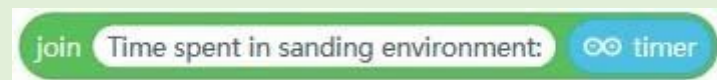
In our project, if the value read from the digital pin 4 of Arduino is 1 and the content of the data1 variable is 1, then the condition is provided.
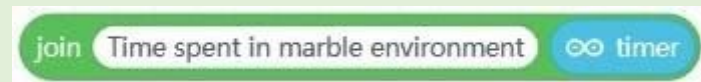

( ) with ( ) jointing block:
This block combines two values in parentheses. Here, the time from the timer will combine with the "time spent in the sanding environment".
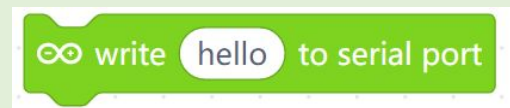

Here, the time from the timer will combine with the "time spent in a marble environment".
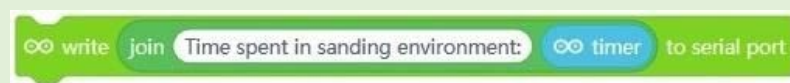

Write ( ) to serial port block:

Allows the serial port of the variable that comes in parentheses is sent to the computer via USB cables.

Combine () with () and Write to Serial Port block:
It combines what is written in parentheses and sends this value to the Serial port, to the computer. Here, in parenthesis, it will combine the "Time in Sanding environment" with the value from the timer and write to the serial port that sends it to the computer.
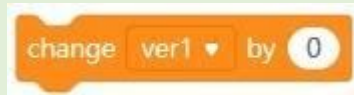

Here, in parenthesis, it will combine the "Time in marble environment" with the value from the timer and write to the serial port that sends it to the computer.

Change "ver" by ( ) block:

It means that the content of the variable defined by us is replaced with the value written in parentheses. In the project here, the content of the data1 variable is replaced with 0
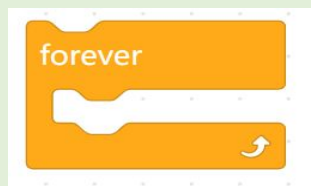

In the project here, the content of the data2 variable has been replaced with 0.

forever block:
As long as Arduino is open, it provides continuous repetition of the blocks placed in it. This process will be done continuously unless Arduino is closed.

The block when Arduino Uno starts:
This block represents energizing the Arduino Robotic Coding device. It means that code blocks added as a chain will be executed when energized and started to run.

- Since the "if () block" is added as a chain to the "When Arduino Uno starts" block, the condition inside the if block is queried first.
- The condition here is that the value of "Digital Pin reading (2)" is 1. This means that the button connected to the digital pin number 2 of Arduino is pressed.
- After pressing the button connected to pin 2, the code block chains under it start working. The first block of code is "Reset Timer". This code block enables Arduino to start a timer in it.
- The next code chain is "PWM set (9) output (100)". This code block shows that the value of 100 is sent as PWM to the DC motor connected to Arduino's digital pin 9. The next block of code is "Set PWM (10) output (100)". This code block shows that the value of 100 is sent as PWM to the DC motor connected to the digital pin 10 of Arduino.
- The PWM value ranges from 0 to 255. PWM 0 indicates 0 volts and 255 indicates 5 volts. In this way, the values of PWM can be calculated by making the direct proportion. The 100 PWM value we send represents approximately 2 Volts.
- With the PWM voltages given to DC motors, the motors will start attracting wooden blocks in different environments.

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	- Data1 and data2 variables that we need are defined and 1 is assigned to their values. - Then, "repeat continuously" is entered into our repeat block and the blocks in here are repeated continuously. - the if () the block () is in the continuous repetition occurs if the distance measured by the distance sensor placed on the ground is less than 3 and the value of the data1 variable should be 1 When this condition is met, the codes inside the code block will work. If not, it continues from the code below the block of code. - When the reading of the distance sensor is less than 3, that is, the distance of the wooden block to the distance sensor is less than 3 cm, the codes inside will work. These codes mean the time to complete the distance of the environment whichever block is entered. - Then the PWM value of the DC motor in that environment is set to 0, wherever the distance sensor showed the distance under 3 cm. - The content of the latest data variable is set to 0. - Thus, the time for taking the distance of the wooden block for both environments will be found. - With a simple calculation, Speed (V) = Path (X) / Time (t) and average speed are found. when Arduino Uno starts up After the activities, detailed information about the subject is conveyed to the students by the teacher. With force, we move, accelerate or slow objects. In some cases, force prevents or complicates movement of objects. This force results from the property of the object itself or the property of the surface it touches. The rough surface makes it difficult for objects to move, while the less rough surfaces facilitate the movement. For example; While it is easy to slide on an icy ground (less rough), it is much more difficult to slip on an earthy ground (rough). The force that occurs between objects and the surface they touch, which makes or hinders the movement of the object and acts in the opposite direction to the movement direction of the object, is called friction force. Objects moving on rough surfaces stop after a while. The reason for this is the friction force between the object and the surface. It is a result of the friction force that a ball moving on the football field slows down after a while and the swinging swing slows down after a while.	
5. Evaluation	Diagnostic Branched Tree is distributed for the purpose of evaluation. In this activity, students are asked to find the appropriate output.	x min

WYŻSZA SZKOŁA
Biznesu i Nauk o Zdrowiu w Łodzi
UNIVERSITY OF WESTERN MACEDONIA
UNIVERSITÀ DEGLI STUDI DI PALERMO
Anatolia College | STEM
Școala Gimnazială Nr. 16 „Take Ionescu"
Timisoara, Str. București Nr.11
Tel: 0256/292889
e-mail: eco_scoala_16tm@yahoo.com

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		X min

Assessment

Describe here the assessment method of the lesson, if any. For example, if you plan on assessing your students with a quiz, include here questions and answer options with color-coding the correct answers.