Adventures of Young Innovators

Volume 5: From idea to innovation

Sara

Can't wake up early for school, what did he innovate to solve his problem?

Khalid

Innovate to help the blind man
EBot Microcontroller & Software

EBot is an ecosystem developed by Creative Bits Solutions-Kuwait, it focuses on teaching programming and prototyping through a very easy process. It consists of two main parts a Microcontroller unit which is a small compact digital computer, and an educational software that uses drag and drop method to make programs without writing long codes.

Smart devices

Computers

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Alarm ..

& late wakeup!

Learning Objectives

1. To know light and shadow formation.
2. To know how light reacts with different types of materials.
3. To be introduced to LDR sensor, and how to program it.
4. To use acquired knowledge to build a light-controlled alarm.

New way of learning

Innovative Thinking  Problem Solving  Time Management  Taking Responsibility  Decision Making  Programming

After long school day...

I will make a sunrise alarm system.

The next morning...

Brush my teeth.

Beep!

Eat my breakfast.

I am ready for school.

Good morning friends.

Good morning Khalid!

Wait for me pleaseeease!

HAA HA HAAA

SCHOOL BUS!!

OKAY OKAY!

ZZZZ

Beep! Beep!

Beep!

Beep!
What is light & shadow?

Hamad was on a wild trip with his family enjoying the fresh air, other families were seated nearby too. After lunch, Hamad noticed an elderly man holding a short stick. The old man planted the stick into the sand and then sat waiting beside it.

Hamad approached the man and asked him, “Why did you plant the stick in the sand, sir?”

The man replied, “Look, my son, at the shadow of the stick on the sand. Its length changes with the movement of the sun, and we can know the time depending on the position on the shadow, it was of the first clock devices used on Earth!

<table>
<thead>
<tr>
<th>Scientific Term</th>
<th>Scientific Concept</th>
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</thead>
<tbody>
<tr>
<td>1 Light</td>
<td>a form of energy that can be seen</td>
</tr>
<tr>
<td>2 Shadow</td>
<td>Dark area formed by the fall of light on a darkened object</td>
</tr>
<tr>
<td>3 Light rays</td>
<td>Light waves getting out of light source (natural or industrial)</td>
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</table>

What is the light and how does the shadow form?

Light is a form of energy that can be seen, where other forms such as electric energy and thermal energy, cannot be recognized by the human eyes. The natural source of light is the sun, and industrial sources include light bulbs and candles etc.

Light travels in the form of straight lines called light rays, these rays fall on objects and reflect back to the eye, which causes vision (discovered by Alhazen, an Arabic scientist). Shadow is the dark area formed by the fall of light on a darkened object.

Materials are divided according to their ability to access light as follows:

- **Transparent materials** that are clearly visible such as glass.
- **Semi-transparent materials**, the visibility of which is not clear such as paper tissue.
- **Dark material** that does not allow passage of the light and have a distinct shadow such as a piece of cardboard.
In this project, students will learn the importance of time and the efficiency, then make a sun based alarm system.
Assembly Instructions
1. In the Ebot Blockly software, click on Input Reading from the right menu.
2. Select the type of sensor and the pin that is used to connect to it, and then click Debug. Make a note of the values.
Questions:

1. Define light?
2. How does a shadow form?
3. Is there a relationship between a shadow and the moon?

Further discussion:

1. Try using Light Sensor (LDR) in other projects.
2. Can you develop this project?

Did you Know!

The moon is a big hunk of rocks, its surface reflects light from the sun, and when the moon is between the sun and earth, a total or partial solar eclipse occurs according to our location on the globe.

Taking Notes will help you develop your projects in the future, and it will prevent you from repeating same mistakes.
Center of Mass and its relation to balance!

Learning Objectives

1. To know the concept of center of mass
2. To know center of gravity concept
3. To know Fosbury flop and its inventor
4. To use acquired knowledge to build a self-balancing robot

New way of learning

Innovative Thinking  Analyzing
Inventing  Planning
Problem Solving  Focus and attention

Khalid & Sara teaching E to ride a bike.

Goo E, go!

Umm... I can't!

Bam

Hahaha

Ouch

At eventide ...

I have to find a way to balance myself

When the wheel tilts, the electronic control
will then open the balance automatically

After a while ...

I have developed a solution to return my balance, and protect me from falling

The back wheel with support ...

When the wheel tilts, the electronic control
will then open the balance automatically

Next day...

Let’s continue with E

OK!

Amazing! You’ve made it

WOW!

That wasn’t hard at all
Majid was watching sports games on television with his father when the high jump competition began. Athletes started to jump higher above the bar and the sports commentator was talking about the famous Fosbury Flop. Majid asked his father about this famous jump and how could a man jump high distances like this?

The father replied, “Each body has its own center of mass. This center is determined according to the shape of the body and according to its density.” For example, the center of mass for a rectangle is in the center at the intersection of the two axils. The center of mass of the circle is in the middle. This principle applies to regular objects, when the body mass is distributed regularly throughout the body and homogeneous. But in irregular objects the center of the gravity is located at the intersection point of the axes arising from the points of the perimeter of the body so that the object is balanced if suspended from one of these points.

The center of mass in a homogeneous body is determined in the same way. Majid asked, “What would help us determine the center of mass of an object?” His father said that the car manufacturers took advantage of the idea of the center of mass in automobile design so that the center is in the middle of the car. The car parts and components are distributed so that the car remains balanced if suspended from its center of the mass and thus keeps the car balanced during movement. The athletes we observe jumping understand the idea of center of mass and apply it to the execution of their high jumps. Majid asked, “How can they benefit from the center of mass principle in their jumps?” His father said that the human body is like any other body that has a center of mass. The center of mass, when a human is standing upright, is in the middle of the stomach. When a human raises their hands, the center of mass rises slightly. In addition, if a human bends their body the center of mass can be outside the body. The athlete discovered that in order to execute his high jump over the bar, the center of his mass should be under his body, specifically under the crossbar. The athlete needs to bend his body to one side and make his back bend towards the crossbar in a certain way and move his feet away from the crossbar to carry the jump. Majid said, “Now I know the secret of this jump and its relation to the center of mass of the body.” The father said, “But you have to pay attention, there is another term called the center of gravity where weight is the same as the center of mass of the body if it is subjected to gravity. But if there a change in or lack of gravity, as in outer space, the center of gravity is not the same as the center of mass. There will be a slight difference.

The center of gravity is responsible for the movement of whole body points to the same acceleration when the center of gravity of this body is exposed to a certain strength under the influence of gravity.
In this project, students will learn about the balance and how to use the motors to move the mass toward the equilibrium.
A device that converts electrical energy into mechanical energy in a rotational manner.

Infrared Sensor

is a sensor that sends waves of electromagnetic energy which are transferred through light. It consists of two components, an emitter and a receiver.

DC Motor

Input Reading is a feature used to read the values of a sensor based on its surrounding environment. It is used to identify the values of the sensors in the current environment to ensure the best functionality.

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Live Control

Live control is a feature that allows the user to connect directly to the outputs and control them, without the need to download the code to the Ebot:

1. Click on Live Control from the right menu.
2. Select the type of output to be measured by marking (✓) in front of the pin, then choose the sensor type from the drop-down menu and select its properties below.
3. Press the Start button at the bottom of the screen to see the changes, now you can change the values and see changes directly in your project.
Did you Know!

Dick Fosbury, an American native, was a university student in the United States of America when he invented his famous flop, which he named after himself!

Questions:

1. Where is the center of gravity of the human body?
2. Is the center of gravity of a ball the same as the center of gravity of a rock?
3. What is the relationship between the center of gravity of the body and its movement?

Further discussion:

1. Try finding your body’s center of mass while doing different poses
2. What improvements can you add to this project?

Take Notes

Taking Notes will help you develop your projects in the future, and it will prevent you from repeating same mistakes.

Art Work

Programming
Construction
Connection
General Notes
The scale.. which will solve the problem

Learning Objectives

1. To know the reason behind scale studies
2. To be introduced to some of weight measuring devices
3. To discover how to build new inventions
4. To use acquired knowledge to electronic scale

New way of learning

Innovative Thinking  Problem Solving  Creative Thinking  Social Skills  Focus and attention  Programming

Finally, I am on the Farmer’s Market!

Oh! people are exploiting this blind man to take more!

I found it! I will make a two-pan scale with a buzzer to ALERT him..

Simply, when the pans are imbalanced the scale would beep.

The lighter Pan

0.005 Kg

The heavier Pan

Then, she took the scale to the market..

Thanks Sara for this GREAT gift, it will help me A LOT!
What is weight? How can it be measured? What are its measuring units?

Weight is the attraction force of the earth to an object. It equals the object’s mass multiplied by the gravitational acceleration constant. Weight measuring tools have evolved with the progression of the human life, some of famous weight measuring tools are:

- **Balanced scales**: a device that shows the variance between the weight of two different objects where the heavier one is being attracted to the earth.
- **Automatic scales**: They have arms that reduce the force of the heavier weight to a lower force and are equipped with a sensitive indicator to measure the weight.
- **Steelyard Scales**: has a beam with irregular arms. The long arm has a weight suspended from it, which is moved until equilibrium is obtained. The load is suspended from the short arm of the beam, and there are indicators on the arm to determine the weight. Many doctors use this type of scales to measure the weights of patients.
- **Weighbridge**: It is a bridge-like scale, used to measure the weight of vehicles and their loads. It consists of a metallic platform across the road (the specified area in front of the building) and has a screen that records the weight electronically.
- **Electronic scales**: It is the latest and fastest scale types and gives a more accurate weight measure than other scales.

What is the importance of scale?

Ali and Ahmad are friends at the school; they’re neighbors in the same neighborhood too. Both have a house with a garden inside where there are apple and orange trees. During their vacation, Ali collected some apples and offered Ahmad to exchange them with an equivalent weight of oranges, but Ahmed refused, believing that the oranges were heavier than the apples, until Ali persuaded him to weigh both of them using a small set of scales in his house to weight the fruits and exchange same weight. How can anyone specify the weight of fruit or food accurately?

As life began to develop and the man started to expand his relations with neighboring districts, especially in commercial exchanges, people needed a way of evaluating and measuring their stuff, so both exchanging parties found it acceptable. First, they used stones, then replaced them with weights and used balanced scales, that’s how the tools of measuring weight have been developed over the ages and studying and learning of Metrology have become an important matter. So, what is weight? How can it be measured? What are its measuring units?

**Weight** is the attraction force of the earth to an object. It equals the object’s mass multiplied by the gravitational acceleration constant. Weight measuring tools have evolved with the progression of the human life, some of famous weight measuring tools are:

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### Scientific Terms and Concepts

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<td>Weight</td>
<td>A natural phenomenon happened as a result of vibrations in the earth’s crust,</td>
</tr>
<tr>
<td>Gravity</td>
<td>The force that attracts a body towards the centre of the earth</td>
</tr>
<tr>
<td>Mass</td>
<td>a large body of matter with no definite shape.</td>
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</tbody>
</table>
In this project, students will learn about balance and measurement to make an electronic scale program it.
Assembly Instructions

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8.
Infrared Sensor is a sensor that sends waves of electromagnetic energy which are transferred through light. It consists of two components, an emitter and a receiver.

Buzzer is a mechanical output device that converts electrical energy to sound energy, and uses different frequencies to make different sounds.

Input Reading is a feature used to read the values of a sensor based on its surrounding environment. It is used to identify the values of the sensors in the current environment to ensure the best functionality.

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The Ebot system allows for four additions to the IF statement. These show when the button is clicked:

- **AND**: All conditions must be met.
- **OR**: One or more of the conditions must be met.
- **ELSE IF**: Checked if the original IF is false.
- **ELSE**: Executed if none of the IF / ELSE IF statements’ conditions are met.

Input Reading IF Statement

How to Mute buzzer

Double click on the sound icon till it converts to this.
Questions:
1. What is weight?
2. What are the known types of scales?
3. Why did man need to measure weights?

Further discussion:
1. Can you use different melodies to signify difference in weight?
2. What improvements can you add to this project?

Did you Know!
That an ant can carry objects weighing up to twice its size? The elephant weighs up to 5 tons, while it can run at 40 kilometers.

Take Notes
Taking Notes will help you develop your projects in the future, and it will prevent you from repeating same mistakes.
Learning Objectives

1. To know simple machines
2. To recognize simple machines types
3. To innovate solutions for daily problems
4. To use acquired knowledge to build a crane

A Crane ..

to lift heavy packages!

New way of learning

Programming Decision Making Creative Thinking Inventing Problem Solving Sharing
What are simple machines?

Khalid went with his father on a holiday to the farm, and while helping his father to water the trees and uproot the weeds from the ground, he found a large rock that prevented the water from passing and it was surrounded by weeds.

Khalid tried to push the rock with all his strength, but he could not move it. He then tried to lift the rock but could not. He called his father, who brought a long stick and put it under a small stone and then was able to lift the big stone. Surprisingly asked Khalid: how could you lift the rock in this simple way! “It’s the crane, son” Father replied, “it is one of the simple machines that man has benefited from since ancient times!

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<tr>
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<tr>
<td>Simple machine</td>
<td>A tool that helps make work easier to perform, by using less force</td>
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<tr>
<td>Crane</td>
<td>A long arm that moves around a fixed point</td>
</tr>
<tr>
<td>Pulley</td>
<td>A grooved wheel with a rope or cable running along the groove</td>
</tr>
<tr>
<td>Inclined plane</td>
<td>A flat surface set at an angle or incline with no moving parts</td>
</tr>
<tr>
<td>Wheel &amp; axle</td>
<td>A large curricular device that is rigidly secured to a smaller wheel or shaft called an axle</td>
</tr>
<tr>
<td>Wedge</td>
<td>A triangular shaped tool used to push two objects apart</td>
</tr>
<tr>
<td>Sickle</td>
<td>A traditional agricultural tool</td>
</tr>
</tbody>
</table>

A simple machine is a tool that helps make work easier to perform, by using less force. These machines are used to perform different tasks and uses force at a specific point called potential to overcome another power called load. There are six basic types:

- **Crane**: is a long arm that moves around a fixed point called the *Fulcrum*, and used to lift heavy objects. Crane types include the lever, scissors, and forceps.
- **Pulley**: is a grooved wheel with a rope or cable running along the groove, used transform movement; examples include fixed and movable pulleys.
- **Inclined plane**: is a flat surface set at an angle or incline with no moving parts, it requires less force to move objects through an inclined plane than lift them vertically.
- **Wheel & Axle**: is a large curricular device that is rigidly secured to a smaller wheel or shaft called an axle. Wheels decrease the amount of friction between the object and surface, resulting in smoother and easier movement.
- **Sickle**: is one of the agricultural traditional tools, it was used for harvesting before the introduction of modern technology, such as a harvester.
- **Wedge**: a triangular shaped tool used to push two objects apart, it consists of two inclined planes meet and form a sharp edge.
In this project, students will learn to make large constructions by making a wirelessly controlled crane to transfer things.
**Servo motor**

A motor which has the ability to move to any angle between -90 and +90 degrees, 180 degrees in total.

**DC Motor**

A device that converts electrical energy into mechanical energy in a rotational manner.
Questions:
1. What is a simple machine?
2. What are the types of simple machines?

Further discussion:
1. Try lifting a box with your hands, then use a simple machine, what do you notice?
2. Can you think of other machines that will help you solve your everyday problems?

Did you Know!
The first to use the wheel were the ancient Egyptians to transfer obelisks and large stones to build the pyramids!
Scientific innovation stories ..

A series of stories about young adventurers facing problems in life and inventing solutions using Ebot. Each book contains four different scientific technology projects for children that develop programming, electronics connections, and mechanical skills.

The series include the following books

Skills gained:

- Problem Solving
- Projects Programming
- Electrical Projects
- Mechanical Projects