



## Education & Setup Booklet

- 4 Unplugged STEM Activities
- 4 Computing STEM Activities



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# SolarX

SolarX is an educational maker kit that you can set up and program yourself, and learn about electronic programming as well as solar technologies and energy resources.

## What is Solar Panel?

The **solar panel** absorbs the sunlight with the help of the cells on it and converts it into solar energy by absorbing it.

### Information Box:

Solar panels work by converting sunlight to electricity. If there is dust/dirt on the surface of the solar panel, the efficiency may decrease as the amount of light absorbed by the solar panel is reduced.

### Do You Know This?

Do you know that solar panels need sunlight, not the heat spreaded by the Sun?



**Solar energy** is one of the renewable energy sources because it is obtained from natural sources. Renewable energy sources are energy that can be obtained continuously from the energy flow that exists in natural processes. For example, since sunlight will continue as long as our world exists, solar energy obtained from sunlight is a renewable energy source. Some energy sources obtained from natural resources are as follows;



#### Information Box:

Now that, we have learned about renewable energy sources, let's examine what nonrenewable energy sources are and how they are determined.

Nonrenewable energy sources are energy sources that are non-sustainable, that is, they can be exhausted as they are used. For example, petrol is a nonrenewable energy source because it is exhaustible.

## ) How Do Solar Panels Absorb? (

There are photovoltaic (PV) cells on the solar panels that absorb sunlight. These cells absorb sunlight (photons) and convert it into electrical energy. When sunlight reaches the panels, it starts to power photovoltaic (PV) cells by generating direct current (DC) electricity. These cells transmit direct current electricity to the solar inverter with the help of some cables.



## What is Robotistan SolarX?

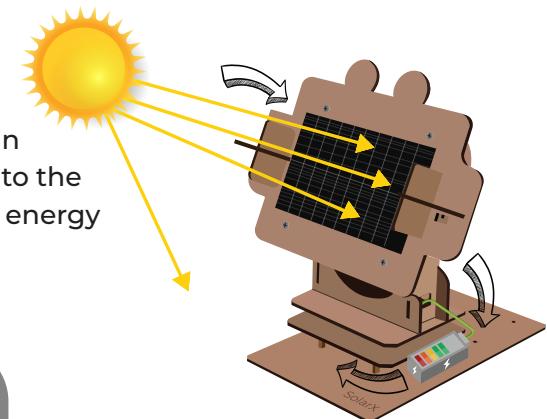
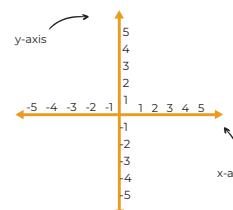
SolarX is an electronic development kit that includes 2 LDR modules(totally 4 LDR sensors), 2 servo motors, a solar panel and wooden parts. In addition, SolarX has a development board that uses the Robotistan Nano Microcontroller board compatible with Arduino. Thanks to this board, SolarX's circuit connections can be done easily.

## How Does Robotistan SolarX Work?

Under favour of LDR sensors and servo motors, SolarX can move in 2 different (**horizontal-vertical**) axes according to the amount of light it detects. With these movements, it aims to obtain maximum energy by bringing the position of the solar panel on it to the position where the sunlight is the maximum. SolarX can store this energy and provide to be used it later.

### Information Box:

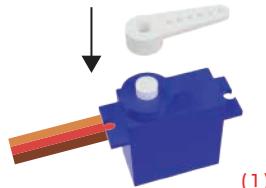
The vertical movements of Solar X are on the Y-axis, and the horizontal movements are on the X-axis.





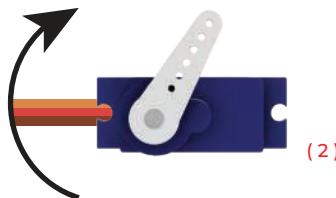
# Attention: Servo Motor Calibration

Before starting the assembly, you have to manually calibrate the angles of the servo motors. Otherwise, Servo Motors won't be working properly.



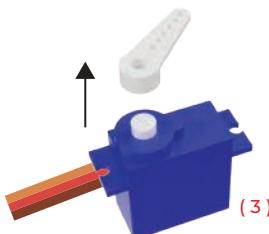
(1)

Attach the servo horn to the servo motor (1)



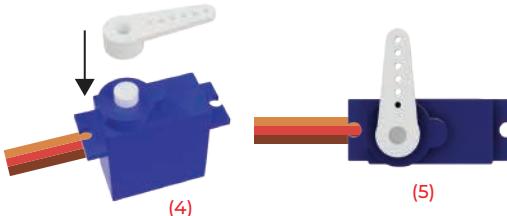
(2)

Then slowly turn the servo horn clockwise until it stops. It is not a problem if the servo horn is not the same as the angle shown in the image above. The important thing here is that you have hit the last angle of the servo.  
(2)



(3)

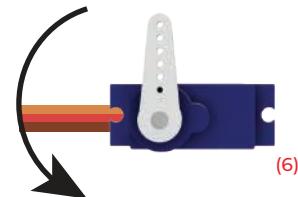
Remove the servo horn from the servo motor (3)



(4)

(5)

Reattach (4) and reposition the servo horn perpendicular to the servo motor as shown. (5)



(6)

Slowly turn the servo horn counterclockwise (6) until it is parallel with the servo motor, as seen in the image.(7)



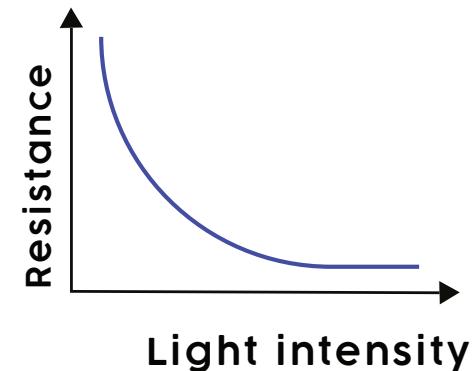
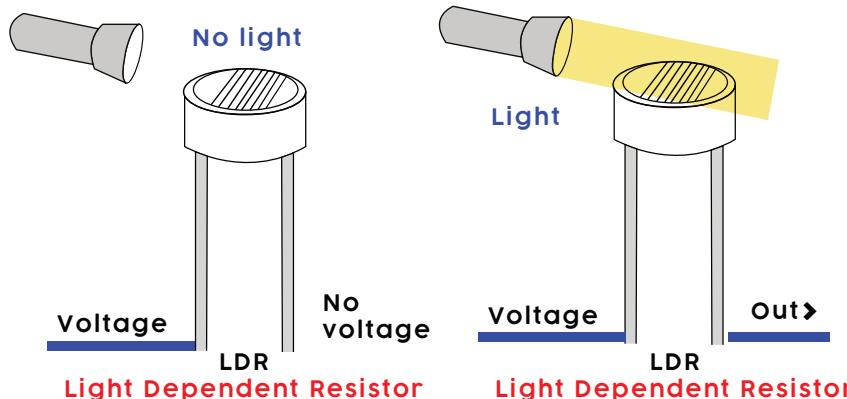
(7)

When this step is finished, it means that the servo motor is in the center position. It is important that you apply this process to other servo motors in the set. After processing the other motors, remove the servo horn and set aside for assembly.



# How Does LDR Sensor Work?

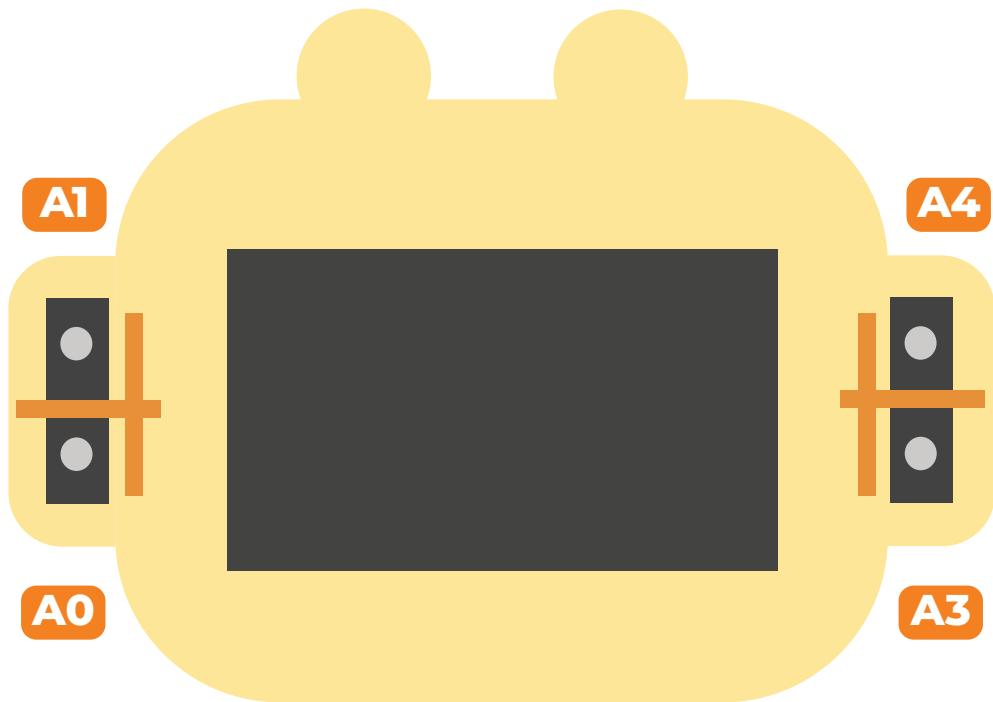
LDR (Light Dependent Resistor) is a circuit element that allows us to detect the amount of light in the environment by changing the amount of resistance. As the intensity of the light falling on the LDR sensor increases, the resistance value decreases. As the light intensity decreases, the resistance value increases.





## Information Box:

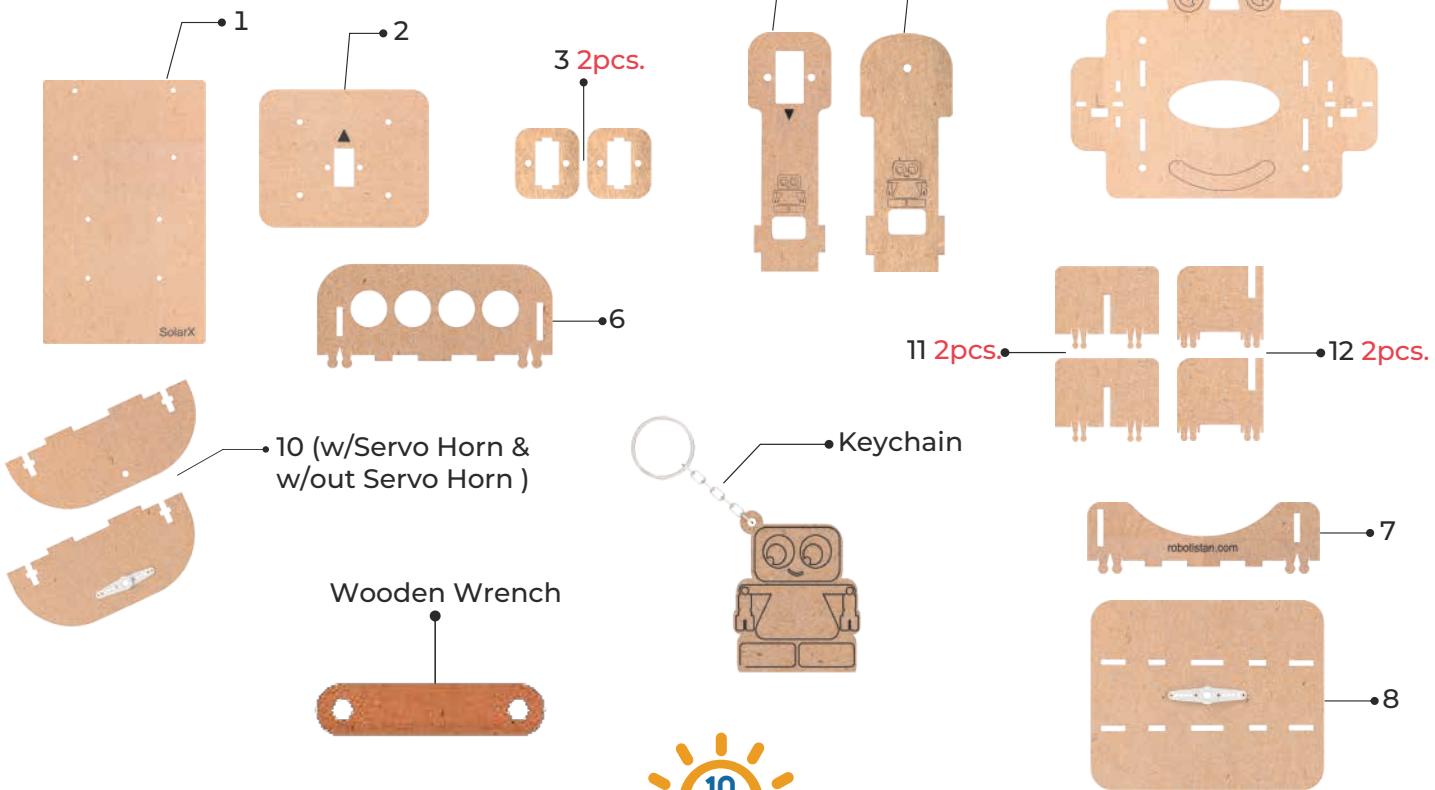
Take a look at this helpful diagram to see the pin numbers for the Robotistan Nano that correspond to the Solar X light sensors.





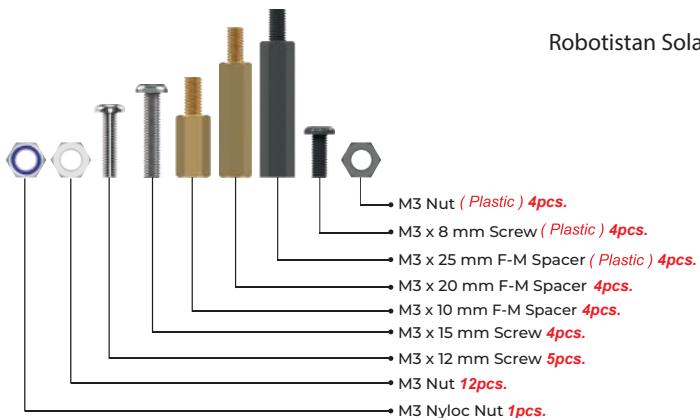
# Let's Get To Know The Set Content

## Wooden and Metal Parts





# Electronic Circuit Elements



Robotistan SolarX MainBoard



Connecting Cables 2pcs.



LDR Module 2pcs.



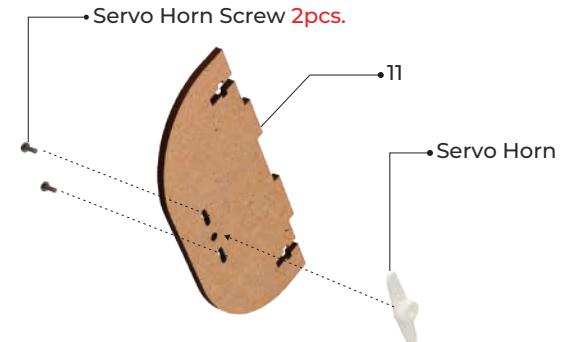
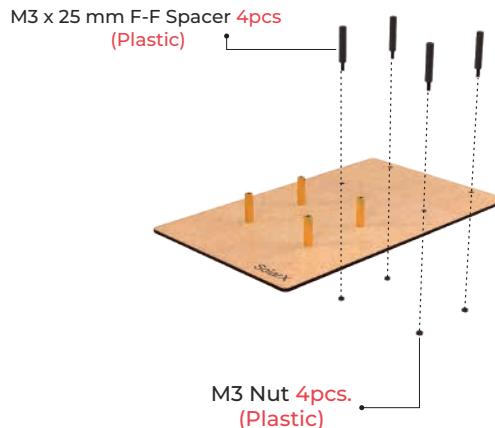
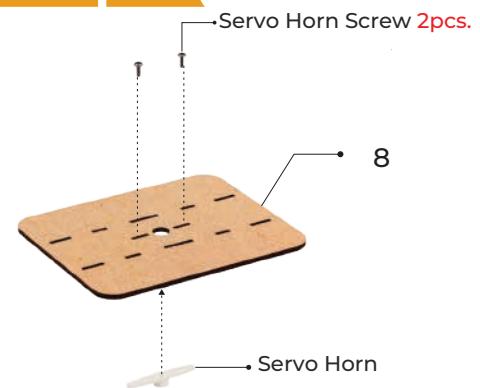
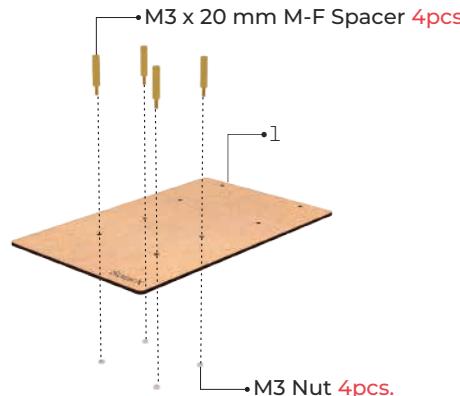
Servo Motor 2pcs.



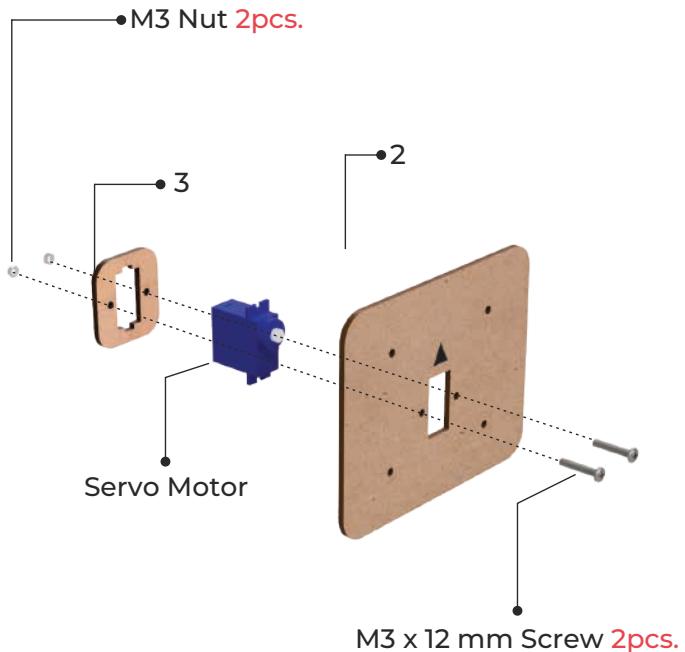
Solar Panel



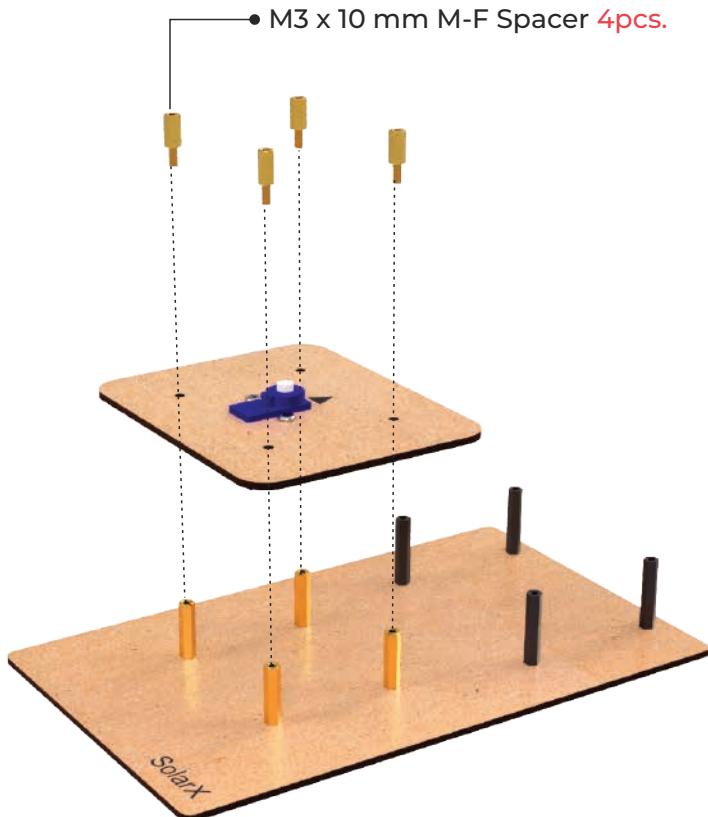
# The Installation Steps

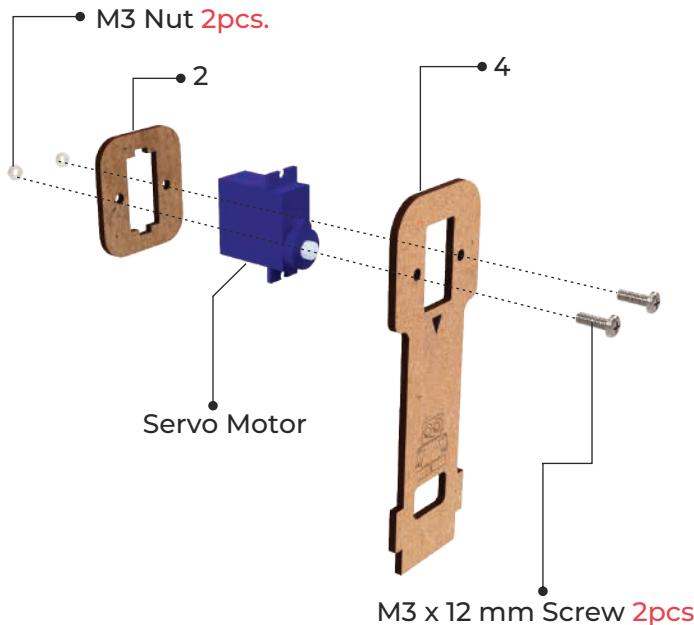


Servo Horn and Servo Horn Screws can be found inside the Servo Motor's package.

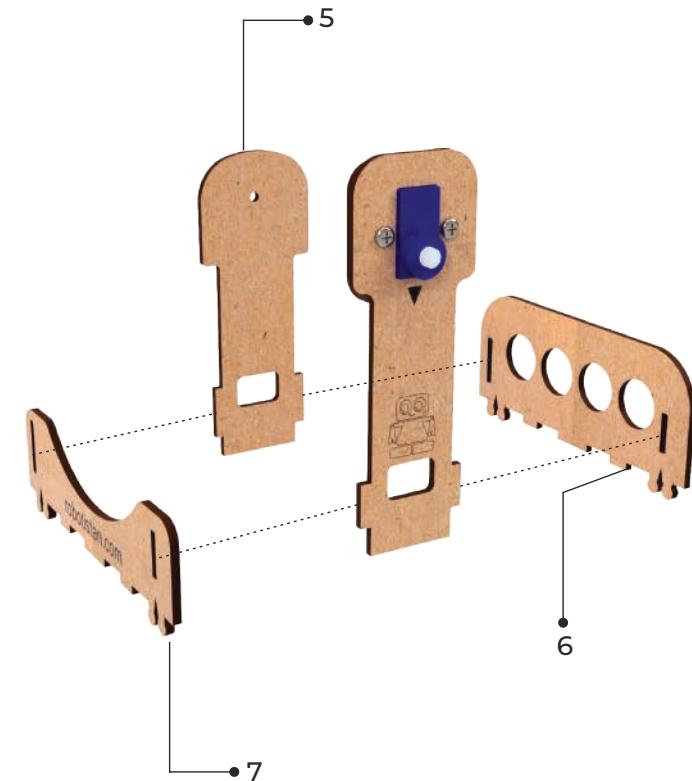


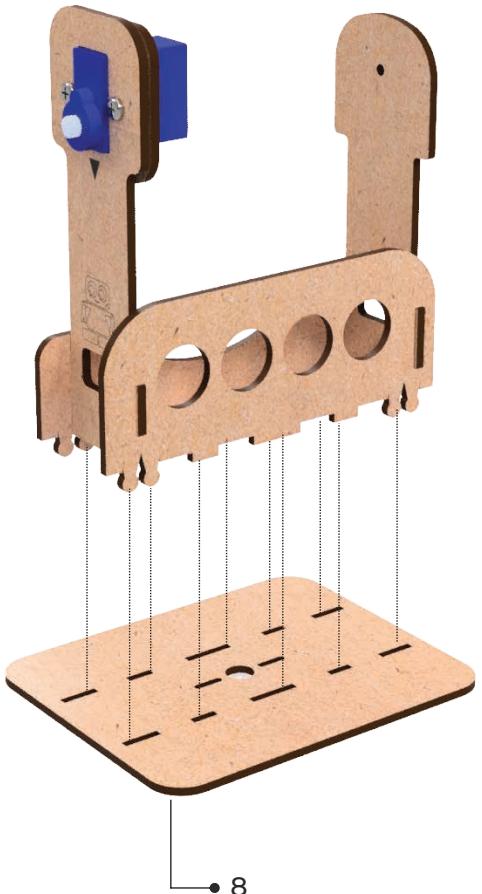
Make sure Servo Motor  
is facing right direction  
as seen in the image.



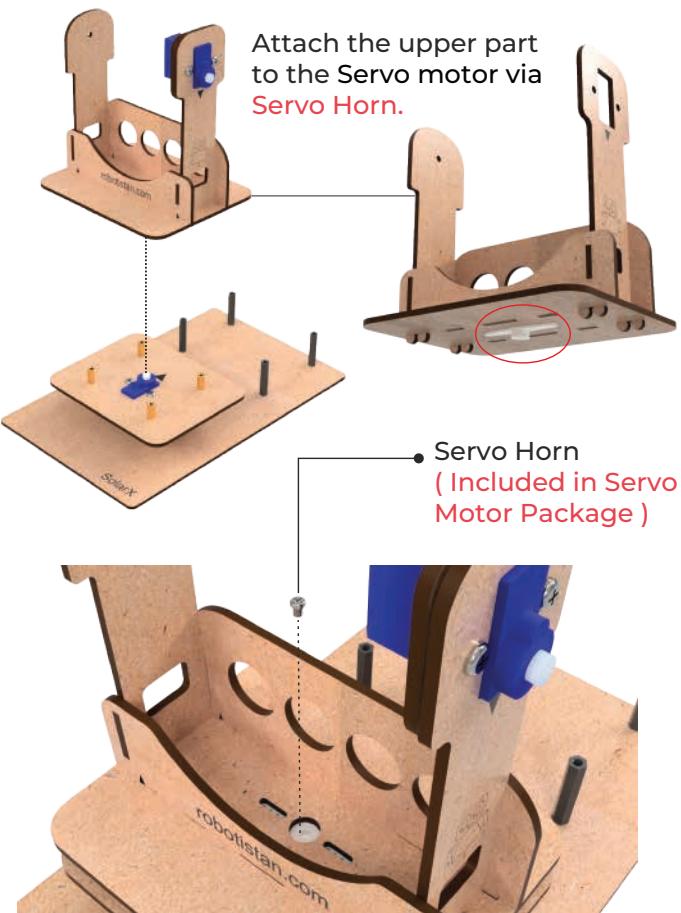


Make sure Servo Motor is facing right direction as seen in the image.



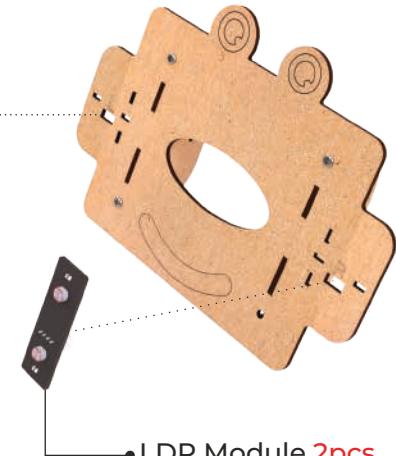
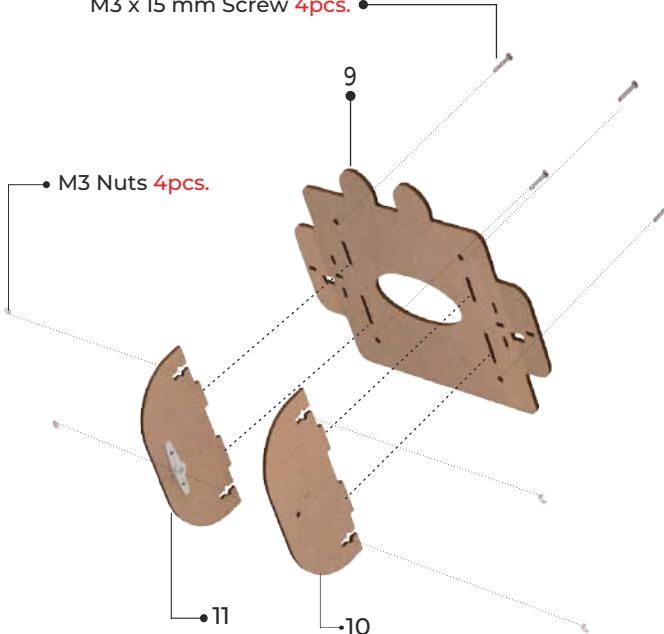


Attach the upper part  
to the Servo motor via  
**Servo Horn.**





M3 x 15 mm Screw 4pcs.



• LDR Module 2pcs.

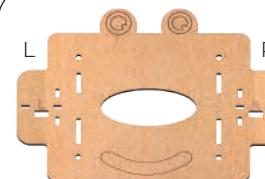
1



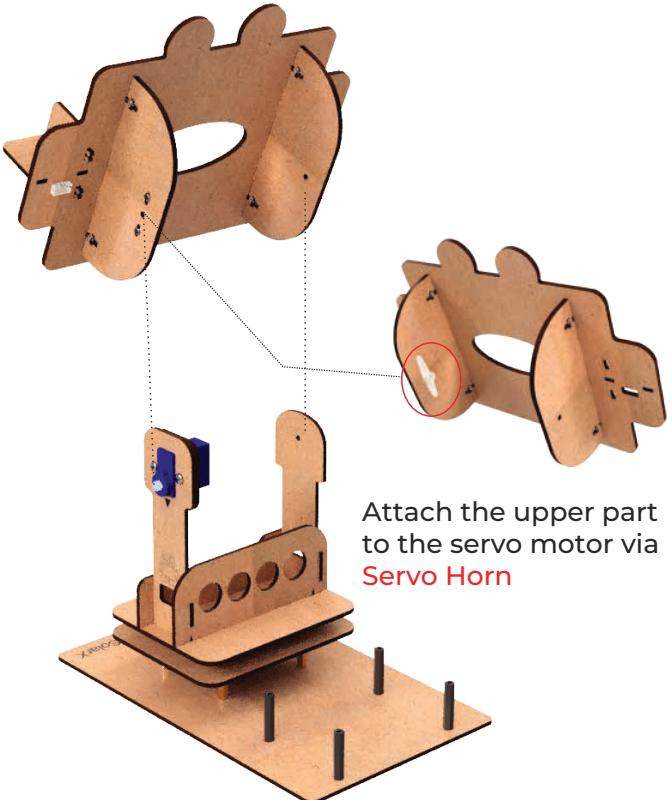
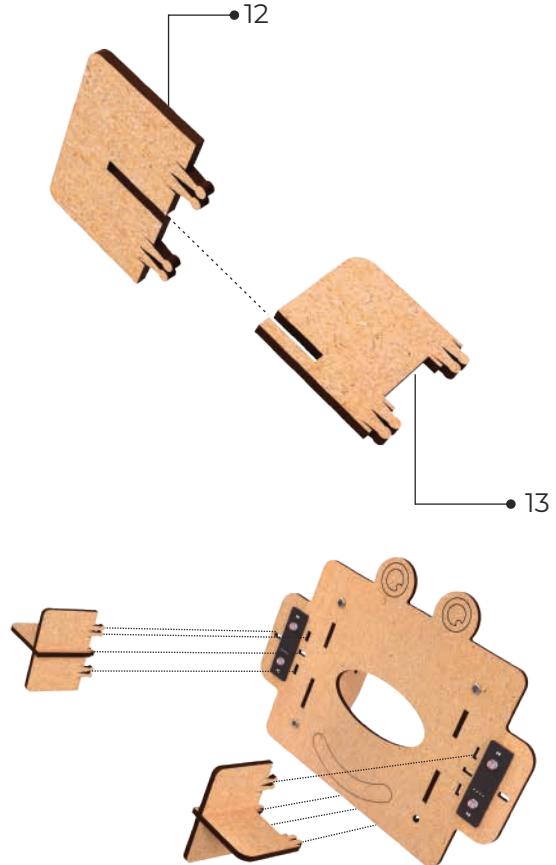
2



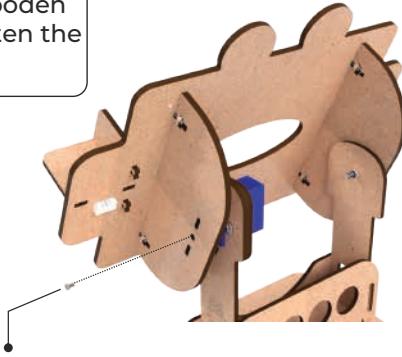
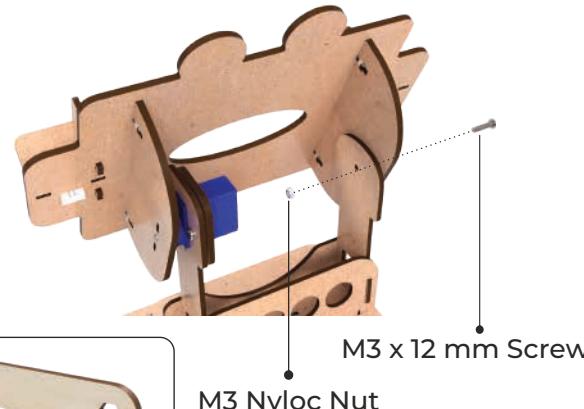
**T-Joints:** For the T-Joint first place M3 Nut to the slot then, use M3 x 15 mm Screw to tighten the joint.



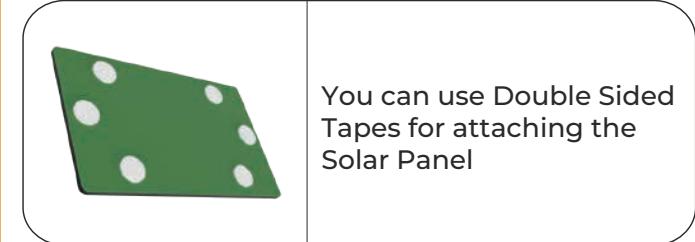
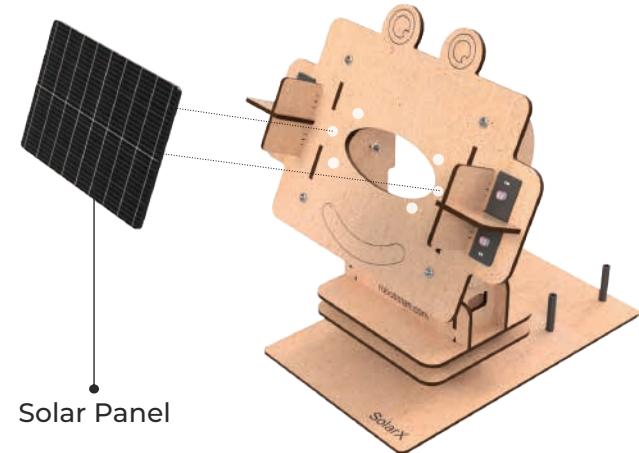
You can use Left and Right sign to tag the LDR modules It is essential for solar tracking to work properly.



Attach the upper part  
to the servo motor via  
**Servo Horn**

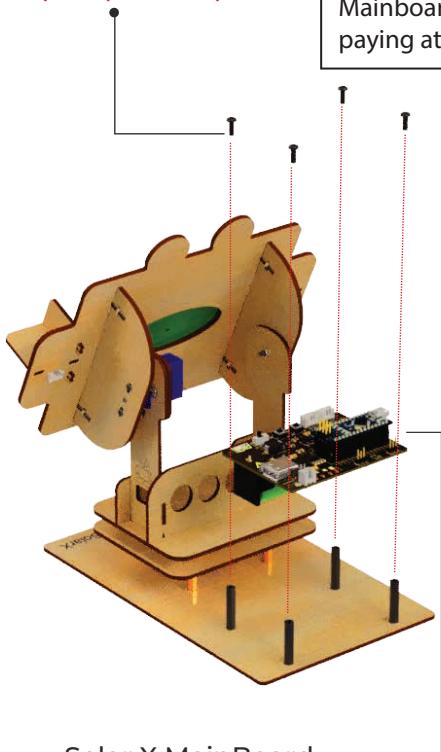


( Included in Servo Motor Package )

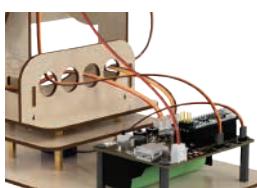
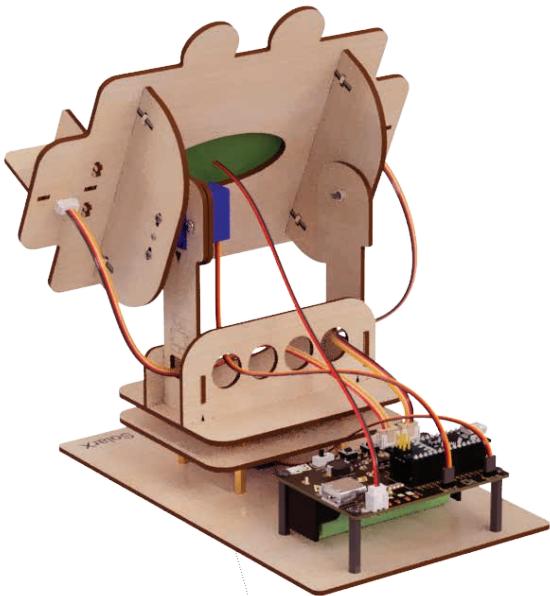




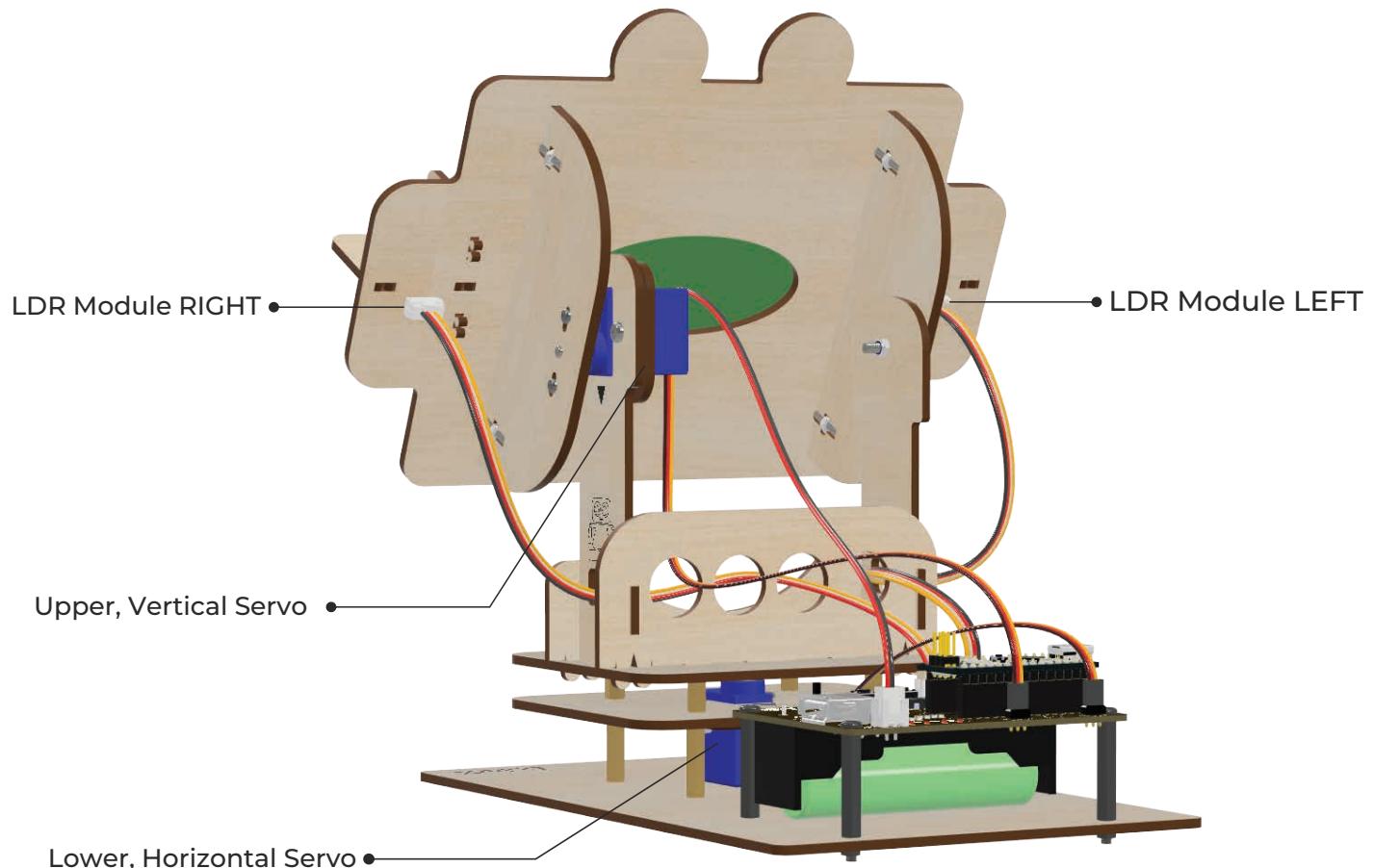
M3 x 8 mm Screw  
4pcs. ( Plastic )



After turning off the SolarX Mainboard, insert the battery by paying attention to polarity.

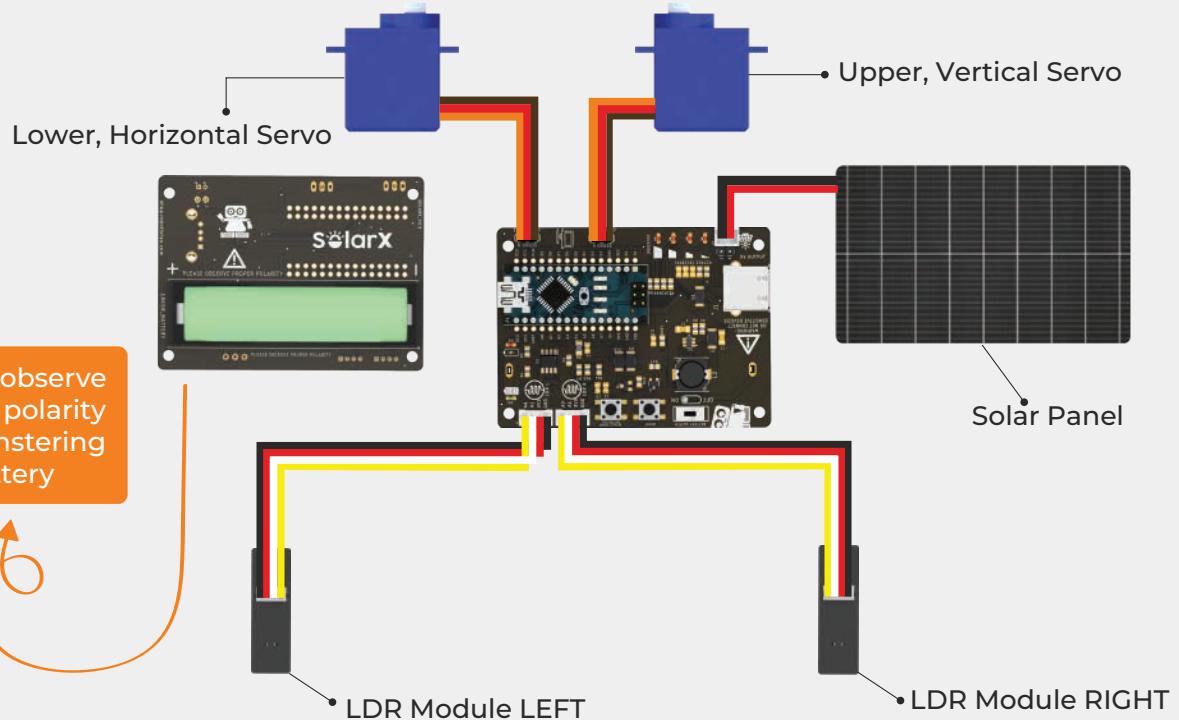


You can organise the cables as seen in the image.  
*(Except Solar Panel's Cable)*



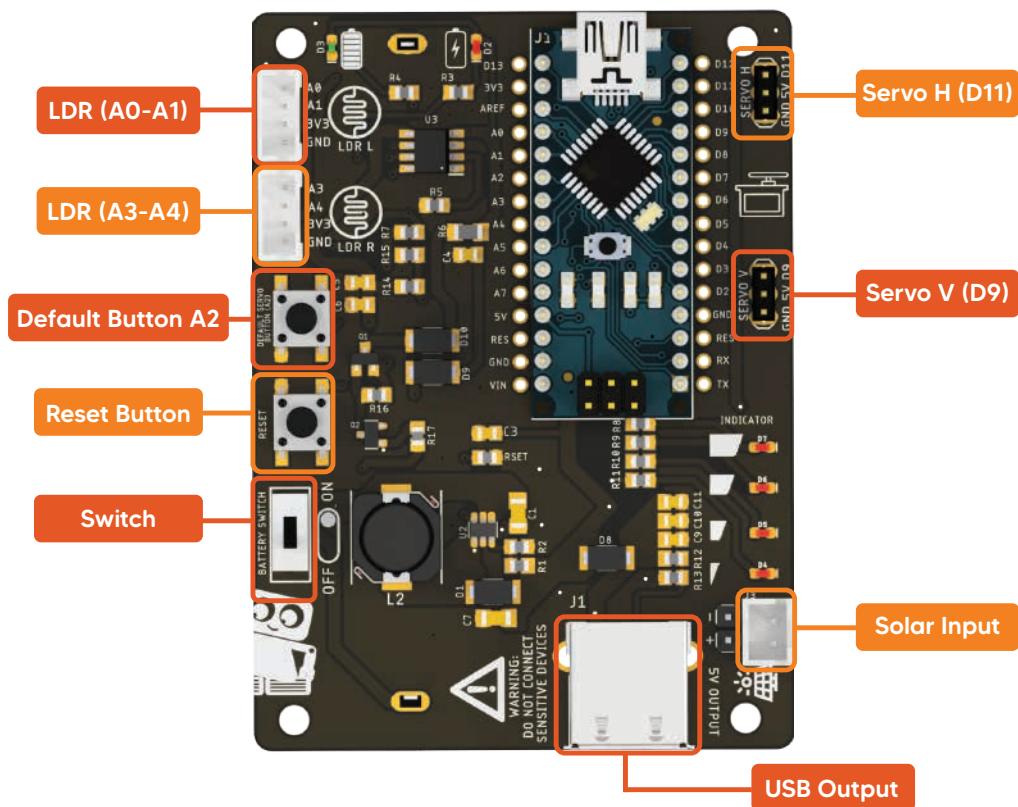


# Circuit Setup





# Robotistan Nano Microcontroller Board



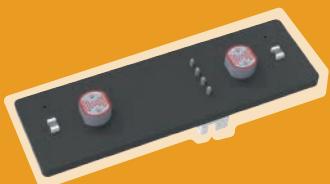


## SolarX Main Board:



SolarX Main Board is a development board that uses the Robotistan Nano microcontroller. Thanks to this card, electronic circuit elements in Robotistan SolarX are easily connected to the connector on the card with the help of a single cable. In this way, the circuit setup becomes very easy.

## LDR (Light Sensor):



The light sensor or light dependent resistor is an electronic component that measures the amount of light in the environment. It changes the resistance value inversely to the amount of light falling on it. For example, as the amount of light increases, the resistance value decreases.



## Solar Panel:



Solar panels, also called photovoltaics, absorb energy from the Sun and convert it into electricity.

## Servo Motor:



Servo motors are motors that provide angular movement (0-180). Servo motors can move according to the given angle value and stay fixed at that angle value.

Arduino IDE

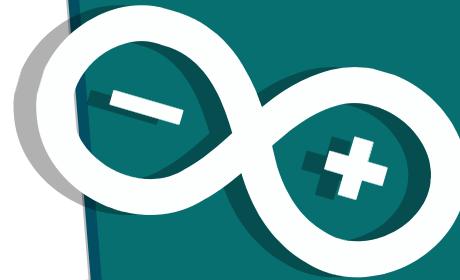
File Edit Sketch Tools Help

Arduino Nano

```
1 void setup() {  
2 // put your setup code here, to run once:  
3  
4  
5 }  
6  
7 void loop() {  
8 // put your main code here, to run repeatedly:  
9  
10  
11 }  
12  
13  
14
```

read digital pin 9

forever



# Coding with Robotistan SolarX and Installing Steps

read analog pin (A) 0

The SolarX code comes preloaded to the Arduino Nano, which is included in the kit. SolarX will run automatically when you complete the kit installation and power up the circuit.

set digital pin 9 output as high



# Arduino Installing Steps

The SolarX STEM kit is a customizable kit. After making the necessary Arduino IDE connections, you can add some different features for SolarX by making some changes in the code or writing a new code.

You can develop the code of the SolarX STEM kit after making the following Arduino connections.



## Coding with Arduino

### What is Arduino?

The Integrated Development Environment (IDE) for Arduino is a cross-platform application written in C and C++ languages (for Linux, macOS, Windows). It is used to write and upload programs to Arduino compatible boards, but can also be used in 3rd party cores and vendor development boards.



## How to Use Arduino IDE?

A

Let's open <https://www.arduino.cc/en/software> in the browser.

The screenshot shows a web browser window with the URL <https://www.arduino.cc/en/software>. The page displays download options for the Arduino IDE 2.0.2. A callout bubble labeled "Download the Arduino IDE program by selecting your system" points to the "Windows MSI installer" link. The download section includes links for Windows (Win 10 and newer, 64 bits), Windows ZIP file, Linux (ApplImage 64 bits (X86-64), ZIP file 64 bits (X86-64)), and macOS (10.14: "Mojave" or newer, 64 bits). To the left, there is a logo for the Arduino IDE 2.0.2 and a brief description of the software.

B

The screenshot shows the Arduino IDE 2.0.2 interface. The top menu bar has "File", "Edit", "Sketch", "Tools" (which is highlighted), and "Help". The "Tools" menu is expanded, showing options like "Auto Refresh" (marked with 1), "Archive Sketch", "Manage Libraries...", "Serial Monitor", and "Serial Plotter". Below this is the "Board" section, which is also expanded. It shows "Get Board Info" (marked with 2) and "WIF101 / WIFININA Firmware Updater". Under "Board", there is a "Boards Manager" option (marked with 3). A dropdown menu for "Boards Manager" lists several boards: "Arduino Yun", "Arduino Uno", "Arduino Uno", "Arduino Diemilanove or Diecimila", "Arduino Nano" (which is checked and marked with 4), and "Arduino Mega or Mega 2560".



# Arduino Sample Code for Robotistan SolarX

[rbt.ist/solarxv2arduino](http://rbt.ist/solarxv2arduino)

solarx | Arduino IDE 2.1.1  
File Edit Sketch Tools Help  
Arduino Nano

```

1 #include <Servo.h>
2
3 #define STEP_DELAY 15
4 //Pin Definitions of LEDs
5 #define led1 4
6 #define led2 5
7 #define led3 6
8 #define led4 7
9
10 int BUTTON_PIN = A2;
11 int buttonState = 0;
12 int solar_mode = 1;
13
14 int TOLERANCE = 15;
15
16 Servo servohori;
17 int servoh = 0;
18 int servohLimitHigh = 170; //Maximum Limit Of Horizontal Servo
19 int servohLimitLow = 20; //Minimum Limit Of Horizontal Servo
20
21 Servo servoverti;
22 int servov = 0;
23 int servovLimitHigh = 170; //Maximum Limit Of Vertical Servo
24 int servovLimitLow = 30; //Minimum Limit Of Vertical Servo
25
26 //Pin Definitions of LDRs
27 int ldrtopr = A4; //Top R LDR
28 int ldrbotr = A3; //Bottom R LDR
29 int ldrtopl = A1; //Top L LDR
30 int ldrbotl = A0; //Bottom L LDR
31
32 void setup() {
33   pinMode(led1, OUTPUT);
34   pinMode(led2, OUTPUT);
35   pinMode(led3, OUTPUT);
36   pinMode(led4, OUTPUT);
37
38   servohori.attach(11);
39   servohori.write(90);
40   delay(1500);
41   servoverti.attach(9);
42   servoverti.write(90);
43   Serial.begin(9600);
44
45   pinMode(BUTTON_PIN, INPUT_PULLUP);
46 }

```

```

48 void loop() {
49   delay(20);
50   buttonState = digitalRead(BUTTON_PIN);
51   if (buttonState == LOW) {
52     digitalWrite(led1, LOW);
53     digitalWrite(led2, LOW);
54     digitalWrite(led3, LOW);
55     digitalWrite(led4, LOW);
56     delay(50);
57     if (solar_mode == 1) { //Start Position
58       for (int i = 0; i < 3; i++) {
59         digitalWrite(led1, HIGH);
60         delay(300);
61         digitalWrite(led1, LOW);
62         delay(300);
63       }
64     servohori.attach(11);
65     servohori.write(90);
66     delay(1500);
67     servoverti.attach(9);
68     servoverti.write(90);
69     solar_mode++;
70   } else if (solar_mode == 2) { //Sunlight Position
71     TOLERANCE = 3;
72     for (int i = 0; i < 3; i++) {
73       digitalWrite(led1, HIGH);
74       digitalWrite(led2, HIGH);
75       delay(300);
76       digitalWrite(led1, LOW);
77       digitalWrite(led2, LOW);
78       delay(300);
79     }
80     solar_mode++;
81   } else if (solar_mode == 3) { //Flashlight Position
82     TOLERANCE = 20;
83     for (int i = 0; i < 3; i++) {
84       digitalWrite(led1, HIGH);
85       digitalWrite(led2, HIGH);
86       digitalWrite(led3, HIGH);
87       delay(300);
88       digitalWrite(led1, LOW);
89       digitalWrite(led2, LOW);
90       digitalWrite(led3, LOW);
91       delay(300);
92     }
93     solar_mode = 1;
94   }
95 }

```



Scan the QR code to go to the whole code and the necessary libraries.



```
97 int solarvalue = analogRead(A6);
98 int batvalue = analogRead(A7);
99 float voltage = batvalue * (10 / 1024.0);
100
101 //Capturing Analog Values Of Each LDR
102 int top1 = analogRead(ldrtop1);
103 int top2 = analogRead(ldrtop2);
104 int bot1 = analogRead(ldrbot1);
105 int bot2 = analogRead(ldrbot2);
106
107 //Calculating average of LDR
108 int avgtop = (top1 + top2) / 2;    //average of top LDRs
109 int avgbot = (bot1 + bot2) / 2;    //average of bottom LDRs
110 int avgleft = (top1 + bot1) / 2;   //average of left LDRs
111 int avgright = (top2 + bot2) / 2;  //average of right LDRs
112
113
114 //Power Measure
115 if (voltage <= 3.3) { //%%0 - %20
116     digitalWrite(led1, LOW);
117     digitalWrite(led2, LOW);
118     digitalWrite(led3, LOW);
119     digitalWrite(led4, HIGH);
120     delay(500);
121     digitalWrite(led4, LOW);
122     delay(500);
123 } else if (voltage > 3.3 && voltage <= 3.5) { //%%20 - %40
124     digitalWrite(led1, LOW);
125     digitalWrite(led2, LOW);
126     digitalWrite(led3, LOW);
127     digitalWrite(led4, HIGH);
128 } else if (voltage > 3.5 && voltage <= 3.75) { //%%40 - %60
129     digitalWrite(led1, LOW);
130     digitalWrite(led2, LOW);
131     digitalWrite(led3, HIGH);
132     digitalWrite(led4, HIGH);
133 } else if (voltage > 3.75 && voltage <= 4) { //%%60 - %80
134     digitalWrite(led1, LOW);
135     digitalWrite(led2, HIGH);
136     digitalWrite(led3, HIGH);
137     digitalWrite(led4, HIGH);
138 } else if (voltage > 4) { //%%80 - %100
139     digitalWrite(led1, HIGH);
140     digitalWrite(led2, HIGH);
141     digitalWrite(led3, HIGH);
142     digitalWrite(led4, HIGH);
143 }
```

```
145 //MOVE - TOP & BOTTOM
146 servov = servoverti.read();
147
148 if (avgbot - avgtop > TOLERANCE) {
149     if (servov <= servovLimitLow) {
150         servov = servovLimitLow;
151     } else
152         servoverti.write(servov - 1);
153
154
155 } else if (avgtop - avgbot > TOLERANCE) {
156     if (servov >= servovLimitHigh) {
157         servov = servovLimitHigh;
158     } else
159         servoverti.write(servov + 1);
160 }
161 else {
162     delay(5);
163 }
164 delay(STEP_DELAY);
165
166 //MOVE - RIGHT & LEFT
167 servoh = servohori.read();
168
169 if (avgleft - avgright > TOLERANCE) {
170     if (servoh >= servohLimitHigh) {
171         servoh = servohLimitHigh;
172     } else
173         servohori.write(servoh + 1);
174 } else if (avgright - avgleft > TOLERANCE) {
175     if (servoh <= servohLimitLow) {
176         servoh = servohLimitLow;
177     } else
178         servohori.write(servoh - 1);
179 }
180 else {
181     delay(5);
182 }
183 delay(STEP_DELAY);
184 }
```



## Block Based Sample Code for Robotistan SolarX

### What is Block Based Coding?

Block coding turns programming into a drag-and-drop process by converting text based code into visual blocks. Each block contains real code and when they're combined together, they create animations and games. No matter which block-based programming language you're using, they all have a variety of different blocks that perform different key coding functions.

Solar X can be programmed using block programming editors like mBlock.

### What is mBlock?

mBlock is designed for the Science, Technology, Engineering, Arts and Mathematics (STEAM) education. Inspired by Scratch 3.0, it supports both graphical and textual programming languages. Currently, more than 10 million people are using it to learn programming, create their own projects, and share their creations. With mBlock, you can design engaging stories, games, and animations, and program devices such as Makeblock robots and microbit. On mBlock, you can switch to the Python mode simply with one-click. In addition, mBlock integrates cutting-edge technologies including Artificial Intelligence (AI) and Internet of Things (IoT).

mBlock provides two editors, namely the block-based editor and Python editor.  
The block-based editor is the default editor of mBlock .



# How to Use mBlock?

## Information Box:

Scan the QR code to Download the Offline Editor.



<https://www.mblock.cc/en/download/>



1

Code with robots

Code with blocks

play : hi until done

play : hi

start recording

stop recording

play recording until done

play recording

play note 60 for 0.25 beat

play snare for 0.25 beat

increase audio speed by 10 %

4

Arduino Nano

Arduino Nano (old)

Arduino Nano

Arduino Nano

Become a developer of mBlock to unlock more potential.

Cancel OK



set digital pin 9 output as high

read digital pin 9

# SolarX mBlock Code



set digital pin 9 output as high



```

when Arduino starts up
  set servoY ▾ to 90
  set servoX ▾ to 0
  ○○ set servo pin 11 angle as servoX
  ○○ set servo pin 9 angle as servoY

forever
  set solarValue ▾ to round ○○ read analog pin (A) 6
  set batValue ▾ to round ○○ read analog pin (A) 7
  set voltage ▾ to batValue * 10 / 1024.0
  set topLeft ▾ to ○○ read analog pin (A) 1
  set topRight ▾ to ○○ read analog pin (A) 4
  set bottomLeft ▾ to ○○ read analog pin (A) 0
  set bottomRight ▾ to ○○ read analog pin (A) 3
  set avgTop ▾ to topLeft + topRight / 2
  set avgBottom ▾ to bottomRight + bottomLeft / 2
  set avgLeft ▾ to topLeft + bottomLeft / 2
  set avgRight ▾ to topRight + bottomRight / 2
  ○○ set servo pin 9 angle as servoY
  ○○ set servo pin 11 angle as servoX

ServoControlled
SolaXvoltage

```

```

define: SolaXvoltage
if < voltage > 3.3 then
  ○○ set digital pin 4 output as low ▾
  ○○ set digital pin 5 output as low ▾
  ○○ set digital pin 6 output as low ▾
  ○○ set digital pin 7 output as high ▾
  wait 0.2 seconds
  ○○ set digital pin 7 output as low ▾
  wait 0.2 seconds

if < voltage = 3.3 and voltage = 3.5 then
  ○○ set digital pin 4 output as low ▾
  ○○ set digital pin 5 output as low ▾
  ○○ set digital pin 6 output as low ▾
  ○○ set digital pin 7 output as high ▾

if < voltage = 3.5 and voltage = 3.75 then
  ○○ set digital pin 4 output as low ▾
  ○○ set digital pin 5 output as low ▾
  ○○ set digital pin 6 output as high ▾
  ○○ set digital pin 7 output as high ▾

if < voltage = 3.75 and voltage < 4 then
  ○○ set digital pin 4 output as low ▾
  ○○ set digital pin 5 output as high ▾
  ○○ set digital pin 6 output as high ▾
  ○○ set digital pin 7 output as high ▾

if < voltage > 4 then
  ○○ set digital pin 4 output as high ▾
  ○○ set digital pin 5 output as high ▾
  ○○ set digital pin 6 output as high ▾
  ○○ set digital pin 7 output as high ▾

```

```

define: ServoControlled
if < avgTop > avgBottom and servoY < 170 then
  change servoY ▾ by 1
if < avgBottom > avgTop and 0 < servoY then
  change servoY ▾ by -1
if < avgLeft > avgRight and servoX < 170 then
  change servoX ▾ by 1
if < avgRight > avgLeft and 0 < servoX then
  change servoX ▾ by -1
if < servoY = 0 then
  change servoY ▾ by 1
if < servoY = 170 then
  change servoY ▾ by -1
if < servoX = 0 then
  change servoX ▾ by 1
if < servoX = 170 then
  change servoX ▾ by -1

```



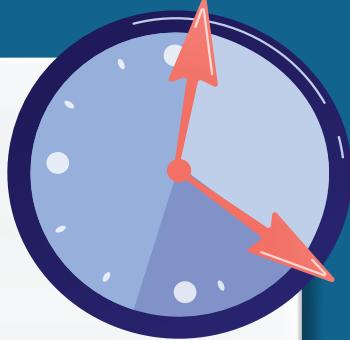


The screenshot shows the mBlock IDE interface. On the left, there's a sidebar with 'Devices', 'Sprites', and 'Background'. Below it, a message says 'Connect your device - How to connect?' with a link 'Read more'. Under 'Blocks', there are sections for Pins, Data, Sensors, Events, Control, Operators, Variables, and My Blocks. A red arrow labeled '1' points to the 'My Blocks' section. At the bottom, there are buttons for 'Mode Sketch', 'Upload', 'Run', and 'Disconnect'.

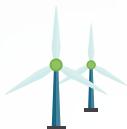
This screenshot shows a 'USB' configuration dialog. It features a diagram of a computer monitor connected to a robot head via a USB cable. Below the diagram is a checkbox 'Show all connectable devices'. A dropdown menu lists 'COM19' (selected), 'COM19', and 'COM24'. A red arrow labeled '2' points to the dropdown menu.

The screenshot shows the mBlock IDE workspace. It includes a robot sprite, a background image, and a message 'Device connected - How to use device?'. Below the workspace is a 'Mode Sketch' button and a 'Disconnect' button. The code palette on the right contains several orange blocks under the 'Control' category, specifically 'repeat [ ] forever' loops. A red box highlights the 'repeat [ ] forever' block.

CONNECTION TEST CODE



# Unplugged STEM Activities





# Unplugged STEM Activity 1

- Match energy sources with the right type of energy.

Natural Gas - Geothermal Energy - Oil - Coal - Solar Energy - Wave Energy - Biomass Energy  
Wind Energy

**RENEWABLE**

**NON-RENEWABLE**



# Unplugged STEM Activity 2

- Match the sensors with their descriptions.

It is the sensor that allows us to detect the amount of light in the environment.



Solar Panel

It is the microcontroller board used in SolarX.



LDR  
(Light Sensor)

It is a circuit element that provides angular movement.



Servo Motor

It is a board designed to easily communicate with SolarX circuit elements.



Robotistan  
SolarX Main  
Board

It is a circuit element that converts solar energy into electrical energy.



Battery

It stores the generated electrical energy.



Robotistan  
Nano



# Unplugged STEM Activity 3

Renewable / AC / Inverter / Heat / Servo Motor / 2 / Electrical / LDR (Light sensor) /  
non-renewable energy / INPUT

- Solar energy is used for the generation of electricity and \_\_\_\_\_ generation.
  - SolarX only generates \_\_\_\_\_ energy.
  - SolarX moves on \_\_\_\_\_ different axes.
  - The circuit element that provides the movement in SolarX is the \_\_\_\_\_ .
  - \_\_\_\_\_ detects the amount of light in the environment.
  - Solar energy is one of the \_\_\_\_\_ sources.
  - In order to use the energy obtained from solar panels in our home, we need to convert DC current to \_\_\_\_\_ current.
  - The light sensor (LDR) is an \_\_\_\_\_ circuit element.
  - \_\_\_\_\_ , is the type of energy obtained from natural resources that can be depleted with use.
  - Energy from solar panels is stored in \_\_\_\_\_ .
- 
- Explain the difference between renewable and non-renewable energy sources?



# Unplugged STEM Activity 3

## ■ True (T) or False (F)

- Oil is a renewable energy source. (\_\_\_\_)
- Energy obtained from sustainable natural sources is called renewable energy. (\_\_\_\_)
- The relationship between the light sensor and the applied resistance is inversely proportional. (\_\_\_\_)
- Servo motors can move 360 degrees. (\_\_\_\_)
- The solar panel absorbs the sun's rays thanks to the photovoltaic cells on it. (\_\_\_\_)

## ■ Give 4 examples of places where solar energy is used.

---

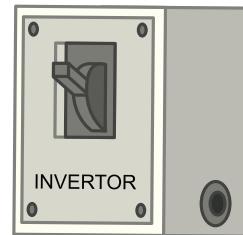
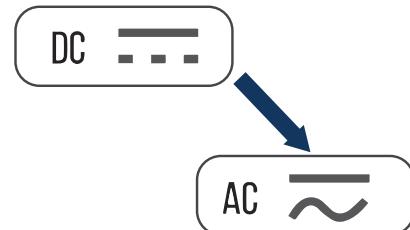
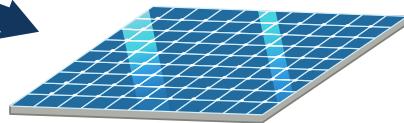
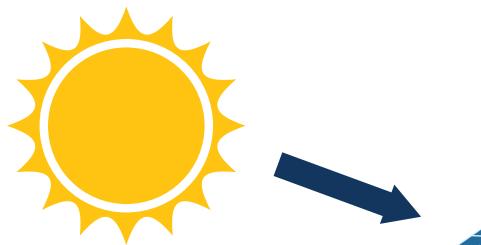
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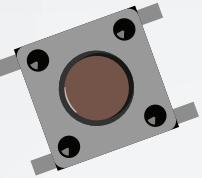
---



## Unplugged STEM Activity 4

- Explain the diagram that explains the working principle of Solar Panels with the help of arrows as given in the example.





# Computing STEM Activities





## Computing STEM Activity 1: Solar X LED Salutation

```
when green flag clicked
    [set digital pin 7 output as low]
    [set digital pin 4 output as high]
    [set digital pin 5 output as high]
    [set digital pin 4 output as low]
    [set digital pin 6 output as high]
    [set digital pin 5 output as low]
    [set digital pin 7 output as high]
    [set digital pin 6 output as low]
```



## Computing STEM Activity 2: Solar X Servo Salutation

```
when green flag clicked
  forever
    set servo pin 9 angle to 90
    wait for 0.3 seconds
    set servo pin 9 angle to 0
    wait for 0.3 seconds
    set servo pin 11 angle to 90
    wait for 0.3 seconds
    set servo pin 11 angle to 0
    wait for 0.3 seconds
```



## Computing STEM Activity 3: X Axis Control

- Watch the movement of the servos by varying the amount of light in the environment.

The Scratch script starts with a `when green flag clicked` hat. It initializes `servoY` to 90 and sets servo pin 9 to angle `servoY`. A `forever` loop begins with four `set [variable v] to [value]` blocks: `topLeft` to `read analog pin (A) 1`, `topRight` to `read analog pin (A) 4`, `bottomLeft` to `read analog pin (A) 0`, and `bottomRight` to `read analog pin (A) 3`. It then calculates averages: `avgTop` as `topLeft + topRight / 2` and `avgBottom` as `bottomRight + bottomLeft / 2`. The script then sets servo pin 9 to angle `servoY`. It contains three nested `if` blocks: 1) `if avgTop > avgBottom and servoY < 170 then change servoY by 1`; 2) `if avgBottom > avgTop and 0 < servoY then change servoY by -1`; 3) `if servoY = 0 or servoY = 170 then set servoY to 90`.



## Computing STEM Activity 4: Y Axis Control

- Watch the movement of the servos by varying the amount of light in the environment.

The Scratch script starts with a "when green flag clicked" hat block. It sets the servoX variable to 90 and initializes three variables: topLeft, topRight, bottomLeft, bottomRight, avgLeft, and avgRight. The script then enters a "forever" loop. Inside the loop, it reads analog pins A1, A4, A0, and A3 to determine the average light levels for the left and right sides. It then checks if the average left light level is greater than the average right light level and if the servoX value is less than 170. If both conditions are true, it changes the servoX value by 1. It also checks if the average right light level is greater than the average left light level and if the servoX value is greater than 0. If both conditions are true, it changes the servoX value by -1. Finally, it checks if the servoX value is equal to 0 or 170, and if so, it sets the servoX value to 90.

```
when green flag clicked
set servoX v. to 90
set servo pin 11 angle as servoX
forever
  set topLeft v. to (read analog pin (A) 1)
  set topRight v. to (read analog pin (A) 4)
  set bottomLeft v. to (read analog pin (A) 0)
  set bottomRight v. to (read analog pin (A) 3)
  set avgLeft v. to (topLeft + bottomLeft) / 2
  set avgRight v. to (avgRight + bottomRight) / 2
  set servo pin 11 angle as servoX
  if (avgLeft > avgRight) and (servoX < 170) then
    change servoX v. by 1
  end
  if (avgRight > avgLeft) and (0 < servoX) then
    change servoX v. by -1
  end
  if (servoX = 0) or (servoX = 170) then
    set servoX v. to 90
  end
end
```



## Sample Questions

- What is the relationship between the amount of light detected by LDR sensor and the resistance value?
- How does going solar help the environment?
- Will solar panels generate electricity on cloudy or rainy days?
- Do solar panels need cleaning?
- Does the angle of the solar panel matter? If it is important, why is it important?



## Educational Achievements

SolarX is a STEM activity kit developed for using in STEM activities. The teachers can develop STEM projects by using this kit in their lessons. SolarX and its education booklet include the following achievements. The student,

- can set up SolarX by using the user manual,
- can write some project code by using Arduino IDE programming environment,
- can generate own code in the Arduino IDE,
- can write some project code by using mBlock IDE programming environment,
- can generate own code in the mblock IDE,
- understands the working logic of light sensor (LDR),
- understands the working logic of servo motor,
- can write C code with light sensor(LDR) and servo motor,  
and have some knowledge about renewable energy sources.
- Understands the working logic of Solar Panels.





# Answer Key

## Unplugged STEM Activity 1

### RENEWABLE

- Geothermal Energy
- Solar Energy
- Wave Energy
- Biomass Energy
- Wind Energy

### NON-RENEWABLE

- Natural Gas
- Oil
- Coal



## Unplugged STEM Activity 2

- Solar Panel: It is a circuit element that converts solar energy into electrical energy.
- LDR (Light Sensor) : It is the sensor that allows us to detect the amount of light in the environment
- Servo Motor: It is a circuit element that provides angular movement.
- Main Board: It is a board designed to easily communicate with SolarX circuit elements.
- Battery:It stores the generated electrical energy.
- Arduino Nano: It is the microcontroller board used in SolarX.



# Answer Key

## Unplugged STEM Activity 3

- 1- Heat
- 2- Electric
- 3- Servo
- 4- 2
- 5- LDR (Light Sensor)
- 6- Renewable
- 7- AC
- 8- INPUT
- 9- non-renewable-energy
- 10-Inverter

### True (T) or False (F)

- False
- True
- True
- False
- True

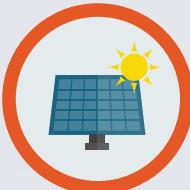


- Explain the difference between renewable and non-renewable energy sources?  
\_\_\_\_\_

- Give 4 examples of places where solar energy is used.  
\_\_\_\_\_

# SolarX

Solar Tracking System



 GitHub



 Shop Robotistan



This product may contain small parts and could be hazardous for children aged 0-7. Children should use this product under adult supervision.