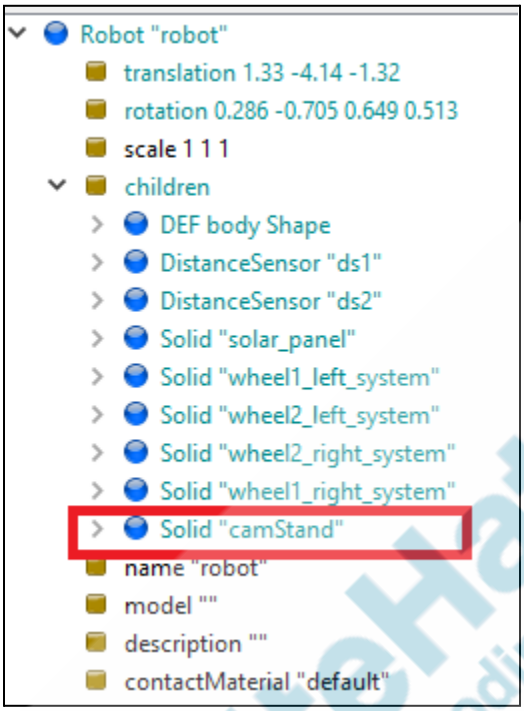
Topic	Planet Exploration Robot - 4	
Class Description	**Students will be introduced to the camera component. They will add a camera to the planet exploration robot and learn to move its position. They will also take and store pictures using the camera.**	
Class	**PRO C287**	
Class time	**45 mins**	
Goal	• Add a camera on a camera stand to the planet exploration rover. • Move the camera up and down using a slider joint and arrow keys. • Take pictures with the camera and store them in a folder.	

Resources Required	• Teacher Resources:
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen
	  ○ Smartphone
	• Student Resources:
	  ○ Laptop with internet connectivity
	  ○ Earphones with mic
	  ○ Notebook and pen	

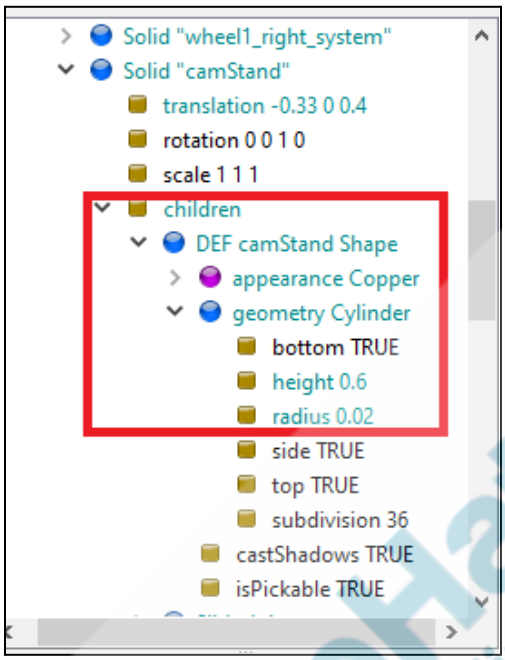
Class structure	**Warm-Up** **Teacher-Led Activity 1** **Student-Led Activity 1** **Wrap-Up**	**10 mins** **10 mins** **20 mins** **05 mins**
Credit & Permissions:	**This project uses Webots, an open-source mobile robot simulation software developed by Cyberbotics Ltd.** **License**	

WARM-UP SESSION - 10 mins	
Teacher Action	**Student Action**
Hey <student's name>. Hope you had a good day today. Are you excited to add more functions to the rover? **Following are the WARM-UP session deliverables:** • Greet the student. • Revision of previous class activities. • Quizzes.	**ESR**: Hi, varied **ESR:** Yes. Click on the slide show tab and present the slides
WARM-UP QUIZ Click on In-Class Quiz	
Activity Details **Following are the session deliverables:** • Appreciate the student. • Narrate the story by using hand gestures and voice modulation methods to bring in more interest in students.	
TEACHER-LED ACTIVITY - 10 mins	
Teacher Initiates Screen Share	
• **Adding camera to the planet exploration rover**	
Teacher Action	**Student Action**
Do you remember what we did in the last class? That is very well summarized. Very good.	**ESR:** We made the rover move automatically. We also made it detect obstacles and made it avoid them.

Today we will add a camera to the rover so that it can take pictures of the planet that it is exploring. Isn't it exciting?	**ESR:** Yes!
First we will add a camera stand in front of the rover.The camera will be mounted on top of this rover. *Teacher Teacher Activity 1 starts coding.* Let us add a Solid child node to the Robot. This will be the solid for the camera stand. Under this, as a child node, add a cylindrical Shape	
Robot> children > Add new - Solid. Set the following properties. **name : camStand** **boundingObject : USE - camStand** **Physics : phy1**	



Add a child node **Shape** for the camStand
Set the following properties for the **Shape**.
appearance : Copper
geometry : Cylinder
height : 0.6
radius 0.02

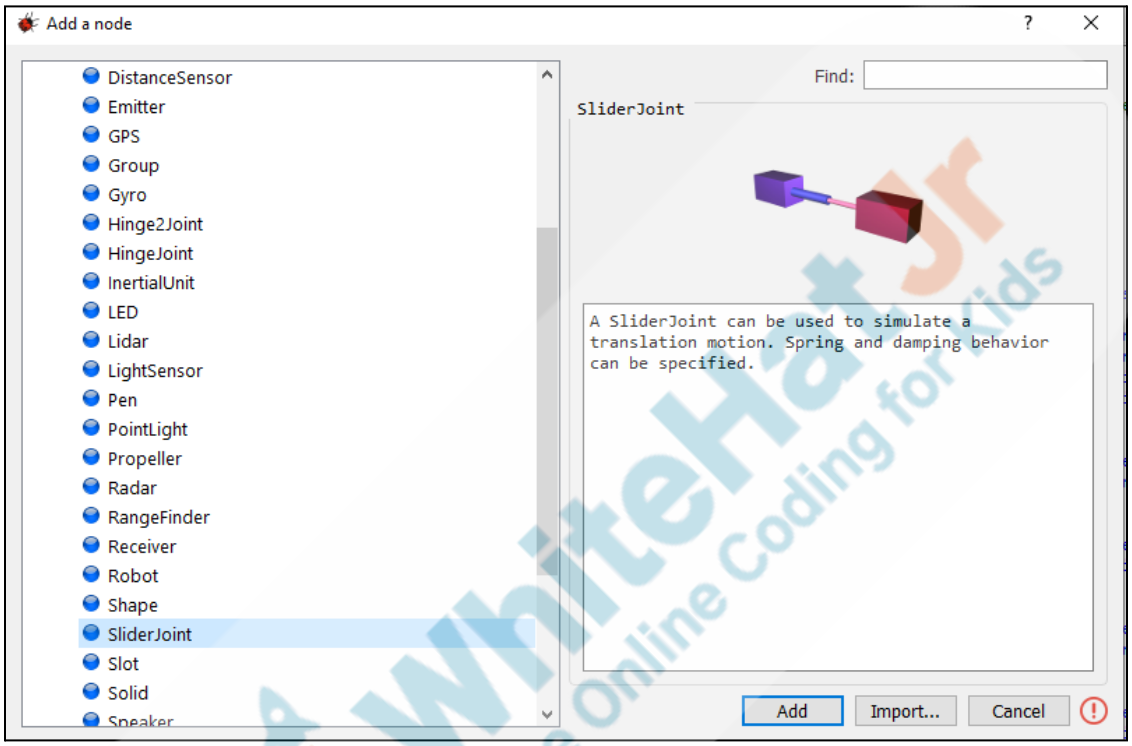


OUTPUT:

Now it's time to add a camera. The camera that we add can be moved up and down (slid up and down) using the arrow keys. So first we have to add a slider joint to the camera stand. A slider joint allows two objects to slide

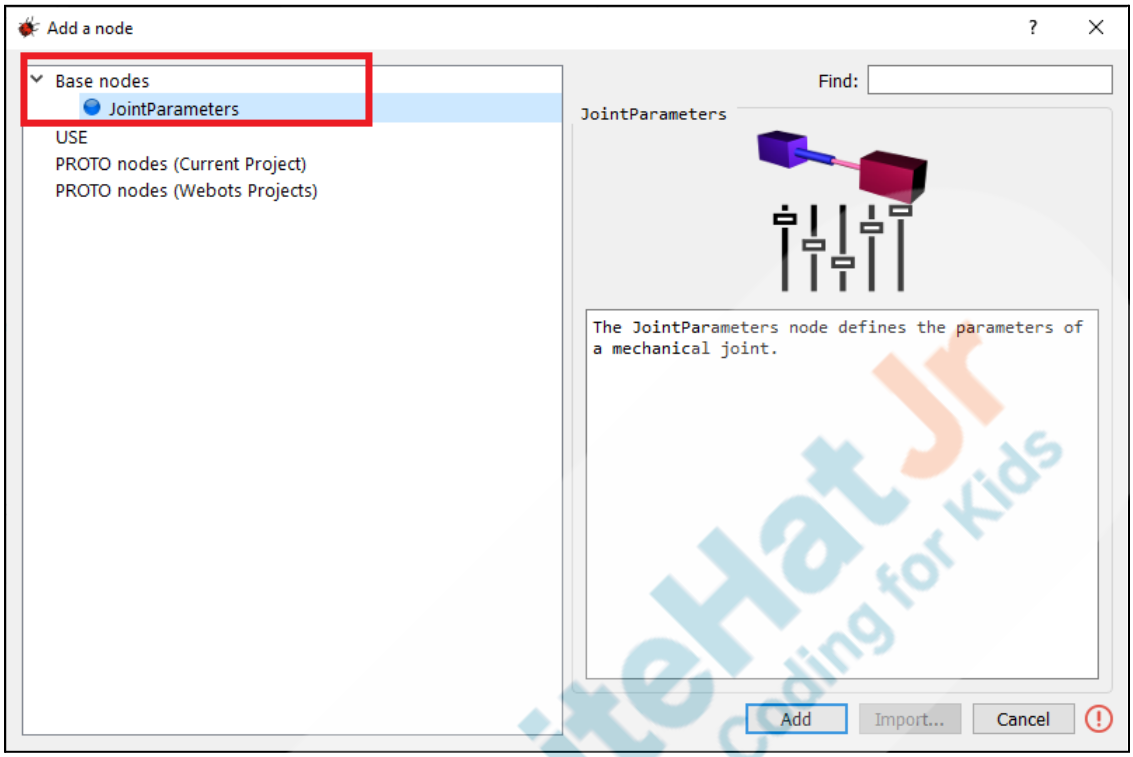
along the same axis without any rotation.	

Robot> children > camStand > SliderJoint

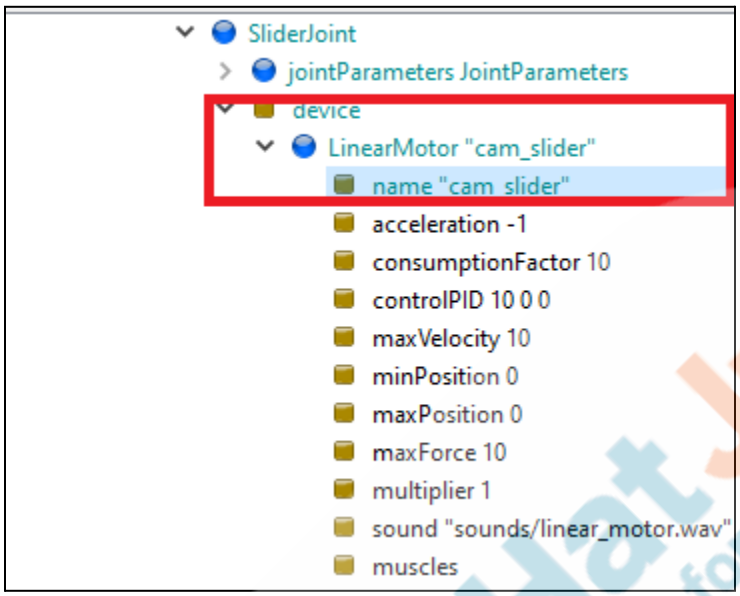


Set jointParameters

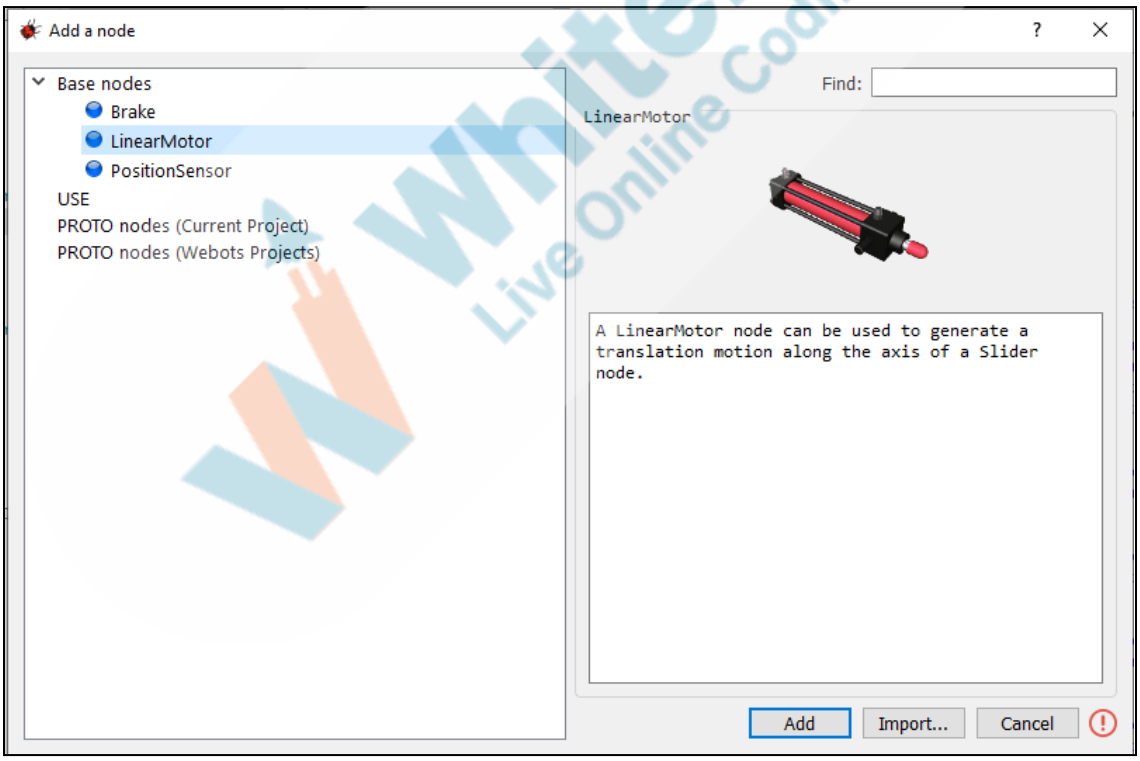
jointParameters : JointParameters



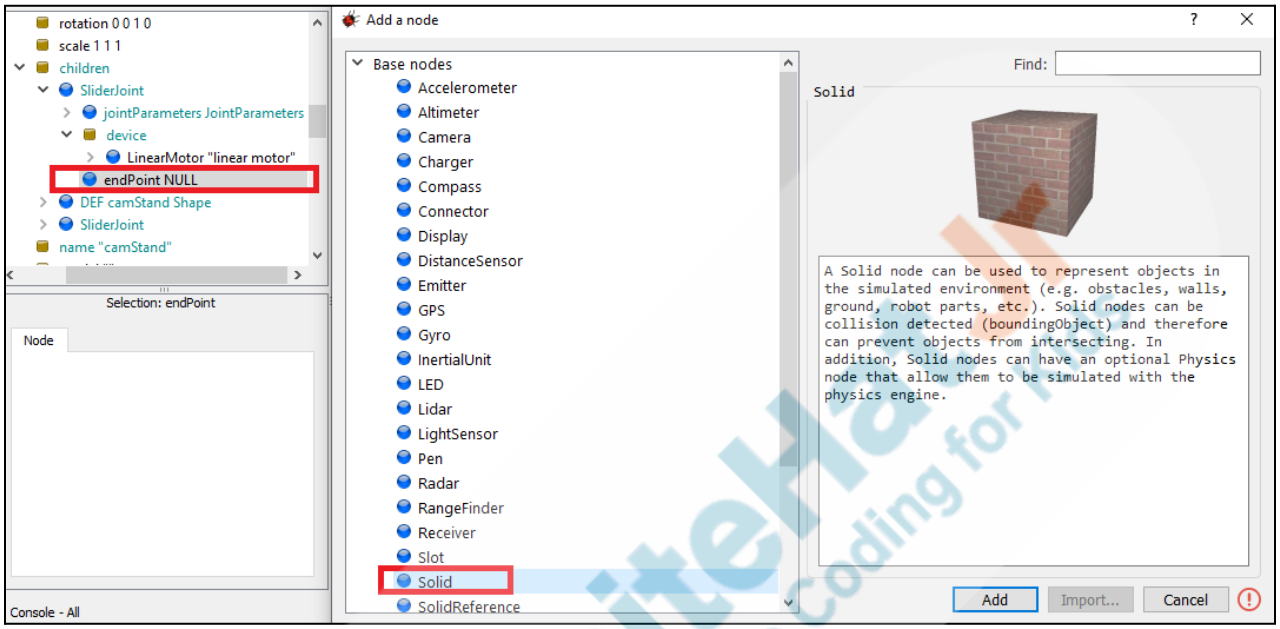
Add a linear motor under the **device** of the **SliderJoint**
device :LinearMotor
name: cam_slider (the name given is important since this will be used in the controller code)



Linear Motor



Add a **Solid** as the **endPoint** of the **SliderJoint**



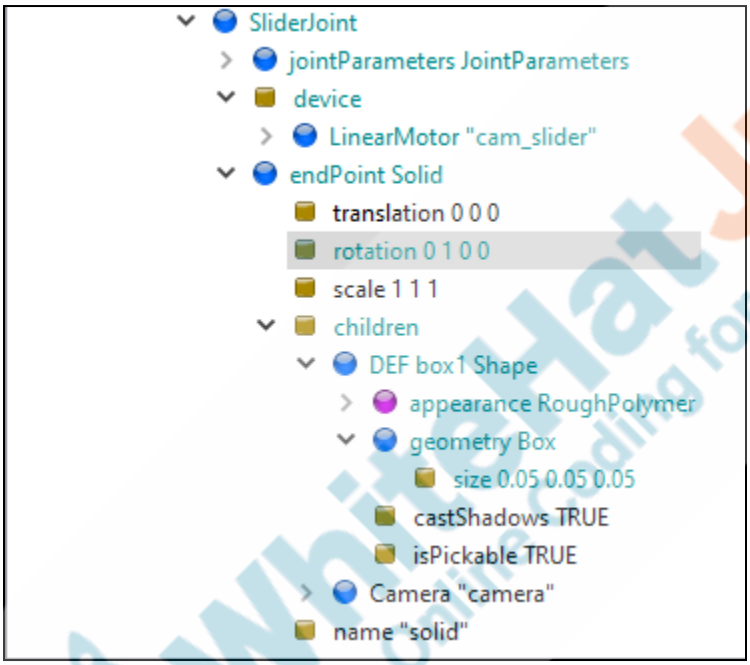
Now we are ready to add the camera as a child node of the **endPoint SOLID**. We will add two child nodes,

- Box Shape
- Camera

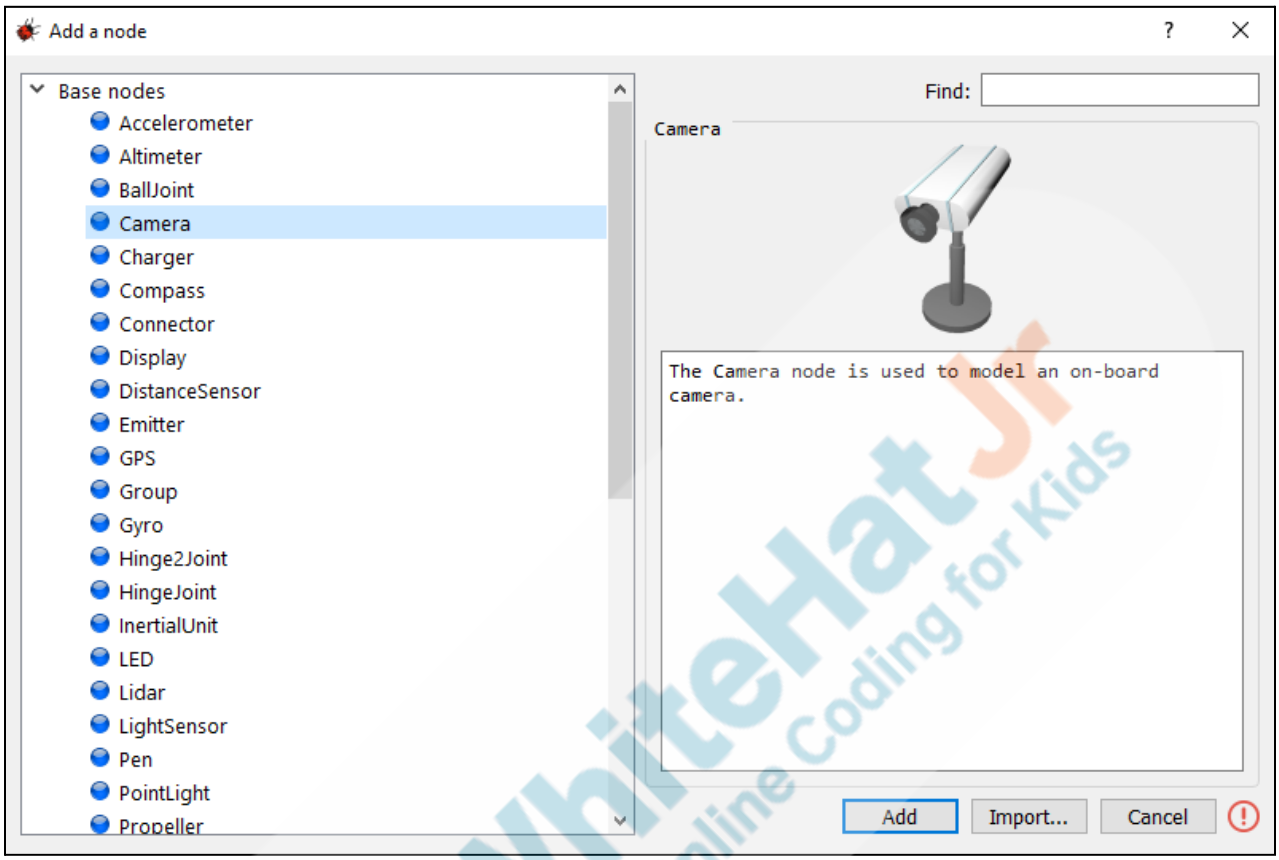
Note: Students can add any shape to hold the camera.

Once the camera is added, we can view the camera preview at the top left corner of the output window. Rotate the Robot in manual mode and you can observe that the camera preview also changes.

Robot> children > camStand > SliderJoint > endPoint Solid > children > Shape
Set the following properties for the Shape
appearance : RoughPolymer
geometry : Box
size x : 0.5, y : 0.5 z : 0.5

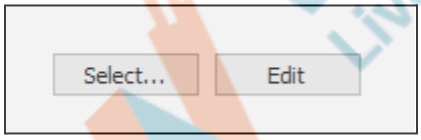


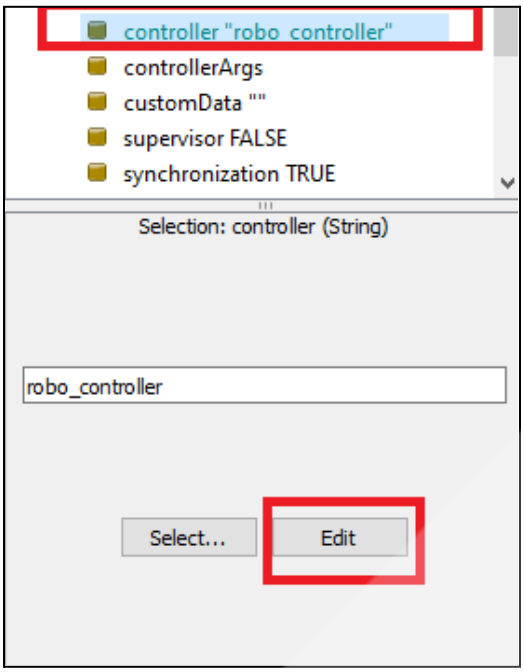
Robot > children > camStand > children > SliderJoint > endPoint Solid > Camera
Set the following properties :
name : camera (the name given is important since this will be used in the controller code)

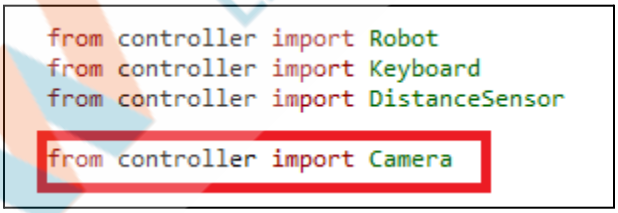


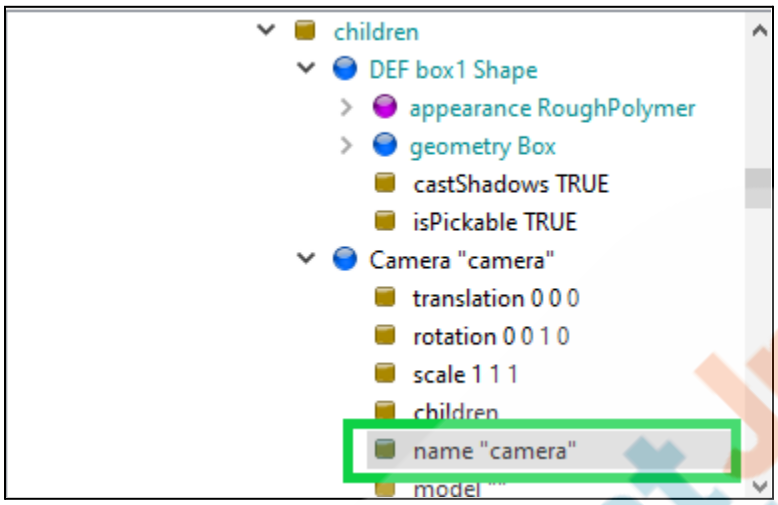
OUTPUT:

Now that the camera is ready, let's start coding !	
Teacher Stops Screen Share	
So now it's your turn to create. Please share your screen with me.	
Can you write the code to move the camera up and down on the slider when the arrow keys are pressed? We will also make the camera take pictures and save them in the home drive.	**ESR:** Yes!

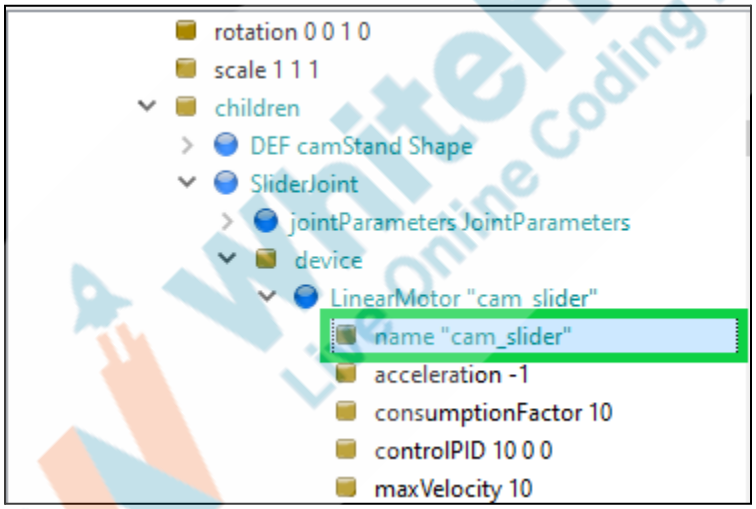
Let's try. I will guide you through it.	
STUDENT-LED ACTIVITY - 20 mins	
• **Ask the student to press the ESC key to come back to the panel.** • **Guide the student to start Screen Share.** • **The teacher gets into Full Screen.**	
Student Initiates Screen Share	
ACTIVITY • **Move the camera up and down with the arrow keys** • **Take pictures using the camera and store them.**	
Teacher Action	**Student Action**
Teacher helps the student to download boilerplate. *Guide the student to open the .wbt file inside the **worlds** folder. Click on **Robot>controller > Edit button.** The controller file will open on the right side.* 	*Student downloads **Student Activity 1** in **Webots***

<table>
<tr><td> 
</td><td></td></tr>
<tr><td>The first step is to import the Camera library into the controller. Can you help me with the syntax?

Thank you, we will import the library by writing
from controller import Camera</td><td>ESR: from controller import Camera</td></tr>
<tr><td> 
</td><td></td></tr>
<tr><td>To move the camera up and down, we have to first get the slider device using getDevice().
Remember to give the same name that was given during the construction.</td><td></td></tr>
<tr><td colspan="2">NOTE : Guide the students to use the same name in the code and in the construction.</td></tr>
</table>

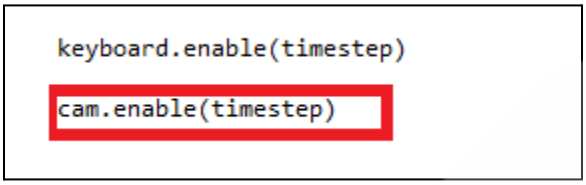
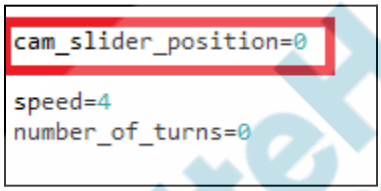


NOTE : Guide the students to use the same name in the code and in the construction.



CODE:

```
robot=Robot()
keyboard = Keyboard()
timestep=64

autoMode= False

cam_slider=robot.getDevice("cam_slider")
cam= robot.getDevice("camera")
```

Now enable the camera using the **enable()** function.	
	
Let us write the code to move the camera along the slider joint. Let us set the initial camera position as zero.	
	
When the UP arrow key is pressed, we will increase the value of current position by 0.01 points.Using the **setPosition()** function, we will change the position of the camera slider to the updated value. Can you tell me what we should do when the DOWN arrow key is pressed? That is correct. Let us write an **if condition** to check whether the UP arrow key was pressed. Inside the if block we will increase the value of **cam_slider_position** and pass it as a parameter to **cam_slider.setPosition()**. Similarly, write an **if condition** to check whether the DOWN arrow key was pressed. Inside the if block we will	**ESR:** Decrease the value of the current position and set it to the camera slider.

decrease the value of **cam_slider_position** and pass it as a parameter to **cam_slider.setPosition()**.	

CODE:

```
# 315 is "up_arrow" key
if(key_pressed== 315):
    cam_slider_position=cam_slider_position+0.01
    cam_slider.setPosition(cam_slider_position)

# 317 is "down_arrow" key
if(key_pressed== 317):
    cam_slider_position=cam_slider_position-0.01
    cam_slider.setPosition(cam_slider_position)
```

OUTPUT:

Wonderful, you have written the code well. Now let us click a picture when the "**p**" key is pressed. The camera library has a function called getImage() that returns an integer array that contains the image.	

The **saveImage()** function lets you save the image in **jpg** format or **png** format.

- The first parameter is the name and format of the image file. eg: **img.jpg**. Everytime "**p**" is pressed, a new image is taken and saved, so to avoid overwriting the img.jpg file, we have to generate new names eg: img1.jpg, img2.jpg etc This can be done by appending a variable **img_num** to the end of "img" and incrementing **img_num** every time a new photo is taken.
- The second parameter is the quality of the **jpg** image. The value ranges from 1 to 100. A low quality image would quire less disk space. The quality parameter is ignored in case of **png** format.

The image will be stored inside the controllers folder in your computer. Notice that the file names are in sequential order just like we wrote in the code, **"Img1.png", "img2.png", "img3.png"** etc

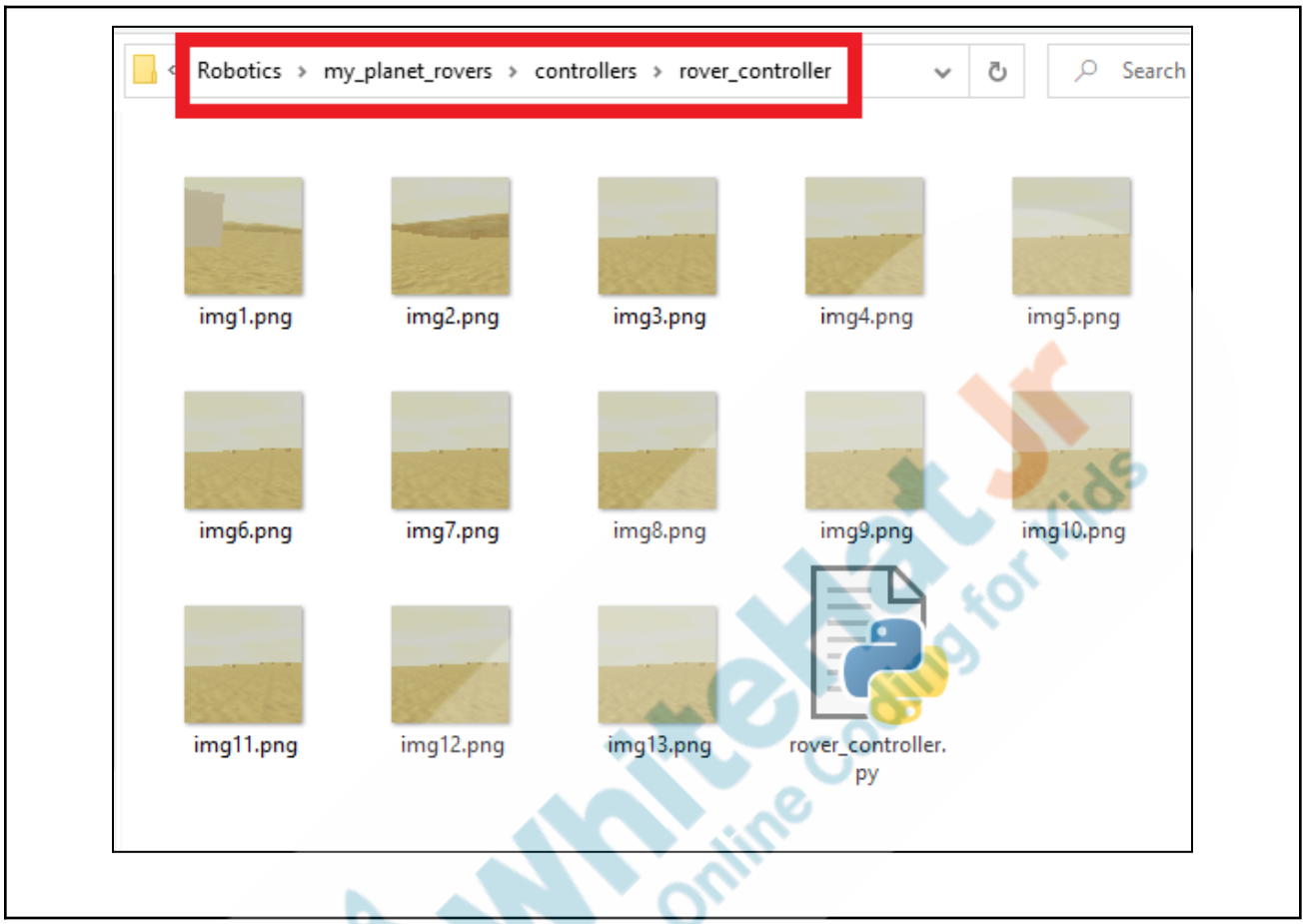
CODE:

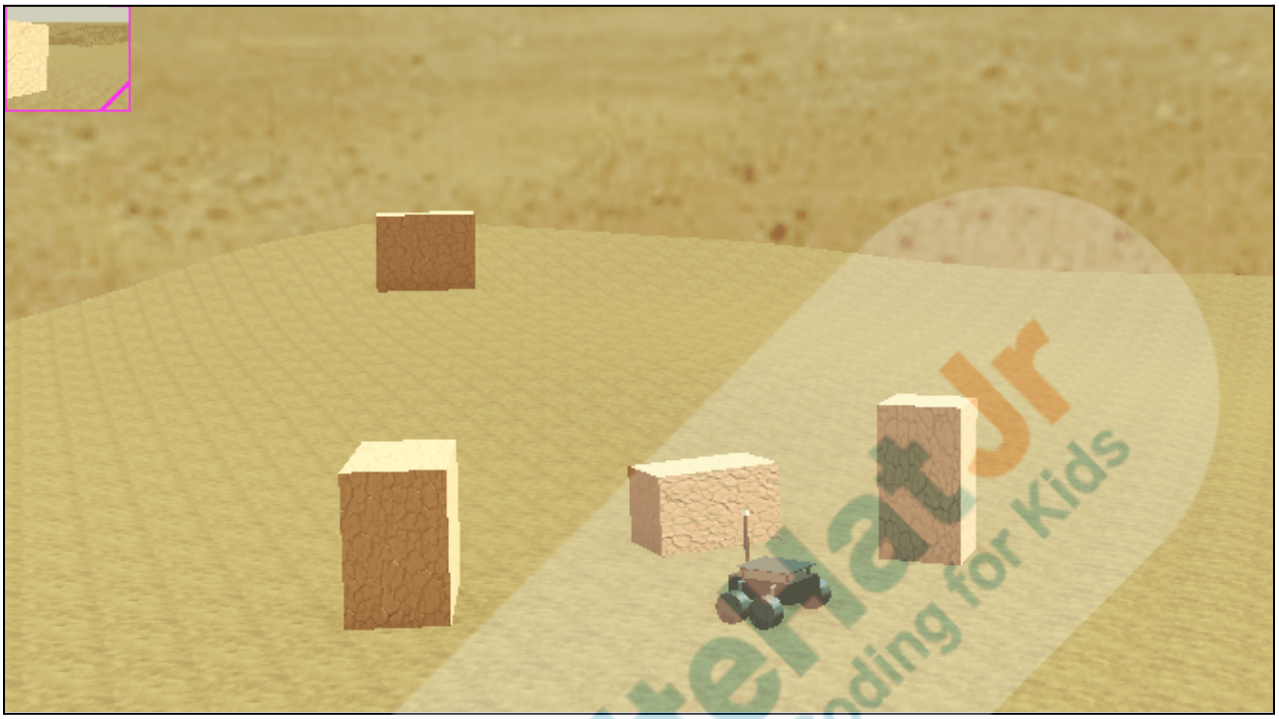
```
speed=4
number_of_turns=0

img_num=1

prev_key = 0
key_pressed = -1
```

```
# 315 is "up_arrow" key
if(key_pressed== 315):
    cam_slider_position=cam_slider_position+0.01
    cam_slider.setPosition(cam_slider_position)

# 317 is "down_arrow" key
if(key_pressed== 317):
    cam_slider_position=cam_slider_position-0.01
    cam_slider.setPosition(cam_slider_position)

 # p key takes pictures
if(prev_key == -1  and  key_pressed==80):
    cam.getImage()
    img_name= "img"+str(img_num)+".png"
    cam.saveImage(img_name,50)
    img_num=img_num+1
```

OUTPUT:

Images folder:





Click here to view the output video.

Wonderful, you have done a great job. How do you feel after creating a planet exploration rover ?	**ESR:** Varied

Teacher Guides Student to Stop Screen Share

WRAP-UP SESSION - 05 mins

Activity details

Following are the WRAP-UP session deliverables:

- Appreciate the student.
- Revise the current class activities.
- Discuss the quizzes.

WRAP-UP QUIZ

Click on In-Class Quiz

Activity Details

Following are the session deliverables:

- Explain the facts and trivia
- Next class challenge
- Project for the day
- Additional Activity (Optional)

FEEDBACK

- **Appreciate and compliment the student for trying to learn a difficult concept.**
- **Get to know how they are feeling after the session.**
- **Review and check their understanding.**

Teacher Action	Student Action
You get “hats-off” for your excellent work! In the next class, learn to create a one arm robot.	*Make sure you have given at least 2 hats-off during the class for:* 

PROJECT OVERVIEW DISCUSSION

Refer the document below in Activity Links Sections

Teacher Clicks ✖ End Class

ACTIVITY LINKS		
Activity Name	**Description**	**Links**
Teacher Activity 1	Boilerplate code	https://github.com/procodingclass/PRO-C287-Teacher-Boilerplate
Teacher Reference 1	Reference Code	https://github.com/procodingclass/PRO-C287-Reference-Code
Teacher Reference 3	Project	https://s3-whjr-curriculum-uploads.whjr.online/0d99a34a-014d-48b4-8ca2-3398ec131904.pdf
Teacher Reference 4	Project Solution	https://github.com/procodingclass/PRO-C287-Project-Solution
Teacher Reference 5	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/b31f182b-0a11-4f5e-bf1a-ae6f59936269.pdf
Student Activity 1	Boilerplate Code	https://github.com/procodingclass/PRO-C287-Student-Boilerplate