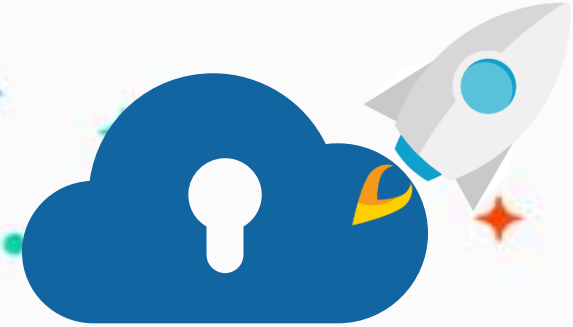

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Lesson 4. Obstacle Avoidance In Snow

Lecturer:

Lesson Objective

Learning Objectives

1. Understand skiing and build a ski robot.
2. Build a robot that imitates human skiing posture and program the robot to move.
3. Use an ultrasonic sensor to control ski steering and avoid obstacles.

Possible Difficulties

1. Understand the crank slider and its variant crank rocker mechanism.
2. Application of crank rocker mechanism.
3. Use an ultrasonic sensor to control robots to avoid obstacles.



Background

Background Knowledge | Ski Sports



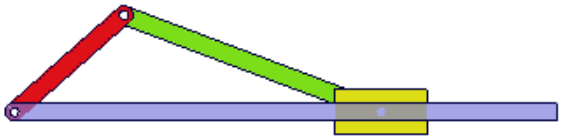
Skiing is a competitive sport in which athletes install skis on the soles of their boots and perform speed, jumping downhill on the snow.

Modern skiing can be roughly divided into three categories: Alpine Skiing, Nordic Skiing and Freestyle.



Introduction

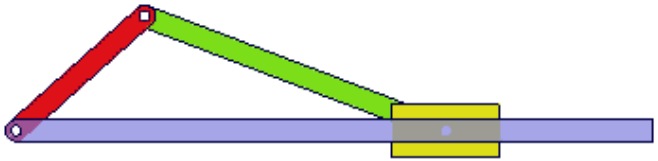
Introduction | Slider-crank Mechanism



The slider-crank mechanism uses a crank and a slider to achieve mutual conversion between rotation and movement.

The mechanism can convert a whole-turn rotation into a reciprocating movement, or a reciprocating movement can be converted into a whole-turn rotation.

Introduction | Slider-crank Mechanism



When in the slider-crank mechanism, the slider can only swing in a fixed position, but the linkage mechanism driven by the crank can slide, it becomes a crank-rocker mechanism.

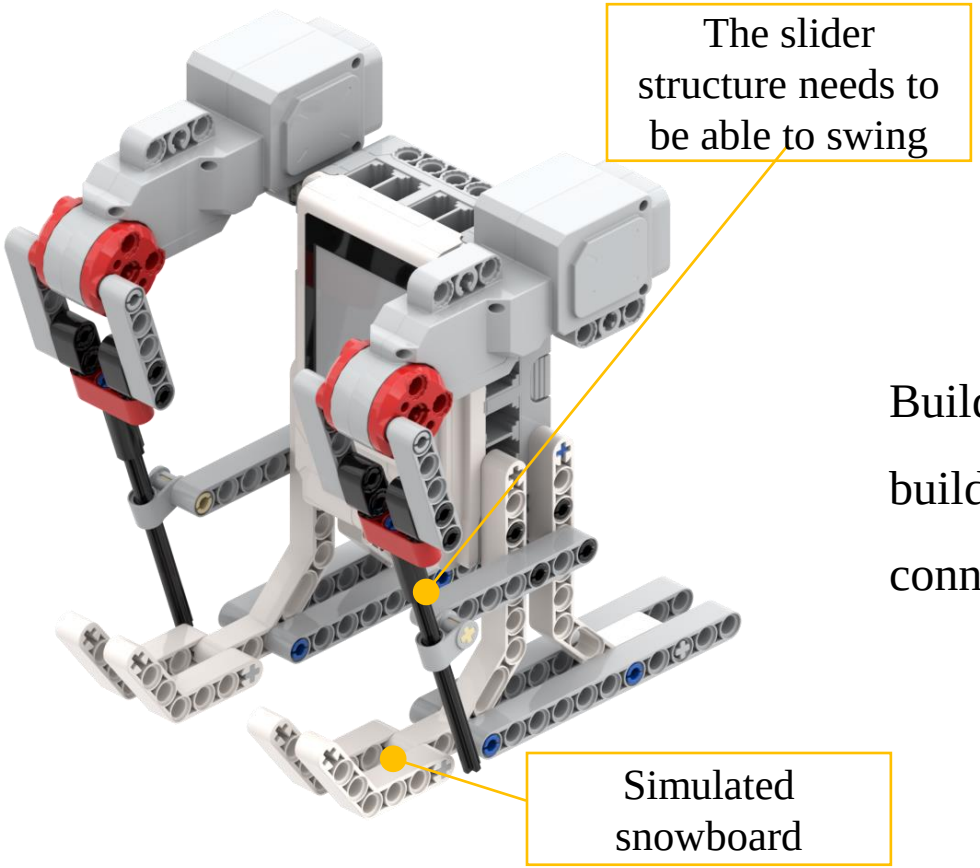


Practice





Practice | Robot Building



Build the ski robot according to the building manual and choose the port to connect to.

Practice | Programming



Let your ski robot start two motors at the same time.

Can your robot move forward?



Exploration



Exploration | Discussion

Please tell me what problems you found while building the robot and programming.

Can't move forward?

Moving slowly on the ground?

Can’t the robot be carried by ski poles?

How to avoid obstacles?

Exploration | Discussion

So, how to solve these problems and make improvements?

Exploration | Ultrasonic Sensor



The ultrasonic sensor is a device used for distance measurement. Its working principle is to emit ultrasonic waves and calculate the time difference of the echoes reflected by the object, thereby calculating the distance between it and the object.

We can use ultrasonic sensors to control when a ski robot turns.

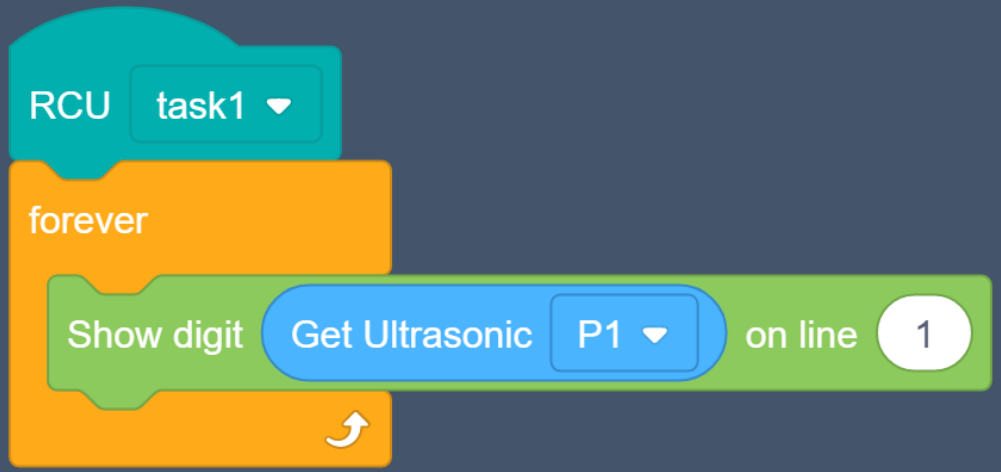
Exploration | Ultrasonic Sensor



This module is used to read and detect the distance of objects. The unit of the read value is centimeter (cm.) The effective range is between 7 to 180cm.

Exploration | Ultrasonic Sensor





Please write a program to display the value of the ultrasonic sensor on the controller screen to test whether the sensor is working properly.



Optimization

Optimization | Analysis



Test, observe, and think :

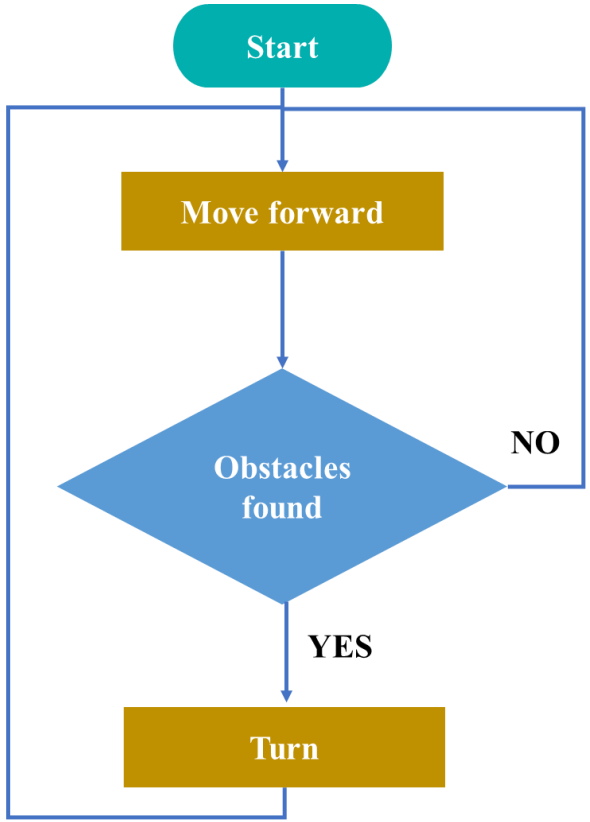
1. How to make the ski robot move forward easier?

2. How to increase the friction of ski poles?

3. What impact does the position of the slider crank structure have on the progress of the robot?

Please improve your robot, make the model richer, and play freely based on this.

Optimization | Analysis



Test, observe and think

1. How to use the ultrasonic sensor to determine the location of obstacles in front of the robot?

2. How should the robot move more appropriately when moving forward and turning?

Please optimize and complete the programming of the ski robot, and then play freely on this basis.

Optimization | Analysis

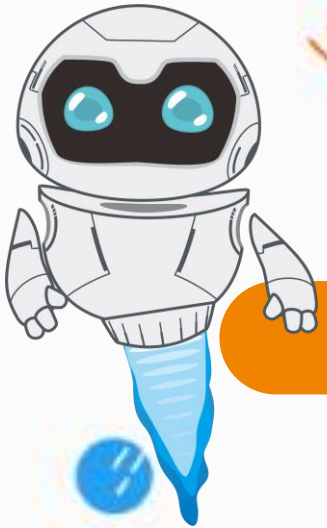


Test, observe and think

1. How to use the ultrasonic sensor to determine the location of obstacles in front of the robot?

2. How should the robot move more appropriately when moving forward and turning?

Please optimize and complete the programming of the ski robot, and then play freely on this basis.



Result



Result | Robot Games

Let’s have a obstacle avoidance race for robot skiers!

Result | Display Your Robots

Please introduce your robots.

- Start with an interesting, powerful, and informative introduction to yourself
- Describe the building steps and program implementation process (problems encountered and solutions)
- Run the program to display your robot
- Explain the highlights of the work (add explanations for creative effects)

Further Reading: Why can we land safely from high places when skiing?

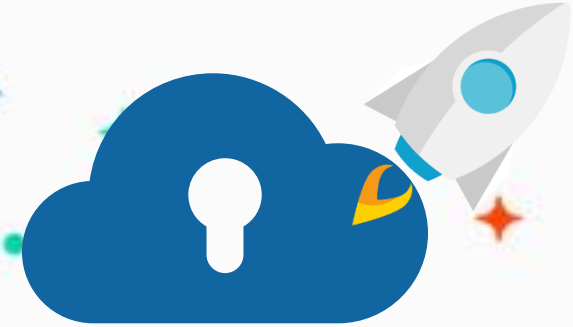


Alpine skiing is the most spectacular and exciting event in the Winter Olympics. Athletes use special skis to accelerate down the inclined platform, then rise into the air, flying for a few seconds before landing. The athlete's starting speed can reach more than 100 kilometers per hour, and the flight distance is often about 100 meters. So why can they land safely after jumping from a high platform?

Further Reading: Why can we land safely from high places when skiing?



Although the platform is high, the relative height between the athlete's body and the slide is always only a few meters. The curvature of the slope is roughly parallel to the parabolic trajectory of the athlete running in the air. When athletes land, they scrape the ground forward, which is very similar to the landing of an airplane. Their vertical impact on the ground is much smaller than in track and field events such as the triple jump. At the same time, there is a thick layer of snow that acts as a buffer, so athletes can always land safely.



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Thanks!

LECTURER: