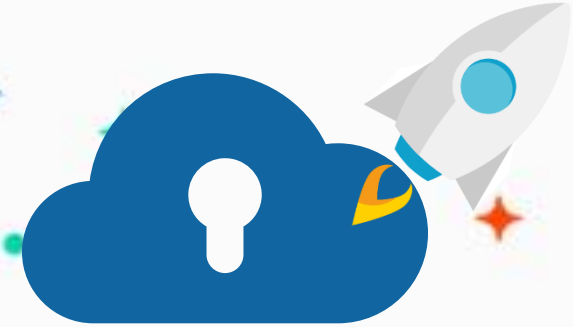

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Lesson 3. Cycle Sport

Lecturer:

Lesson Objective

Learning Objectives

1. Learn about cycling and build a bicycle robot.
2. Use a double-crank mechanism to imitate the movement of a bicycle while riding.
3. Use a medium motor to drive the bicycle to turn, and use a belt drive to drive the bicycle to move.

Possible Difficulties

1. Building of bicycle robot.
2. Understanding and analysis of dead center position.
3. Adjust the double-crank mechanism to avoid dead center position.



Background

Background Knowledge | Cycle Sport

Bicycles originated in Europe.

In 1868, the first bicycle race was held in France.

In 1896, in the first Olympic Games, cycling was included in the official events.

Background Knowledge | Cycle Sport



Track cycling is a bicycle racing sport usually held on specially built banked tracks or velodromes using purpose-designed track bicycles.

Background Knowledge | Cycle Sport



Mountain bike racing (shortened MTB or ATB racing) is the competitive cycle sport discipline of mountain biking held on off-road terrain.

Background Knowledge | Cycle Sport



Road racing bicycle is a sport that challenges speed and endurance.

The race is held on roads with various terrain changes.

Background Knowledge | Cycle Sport



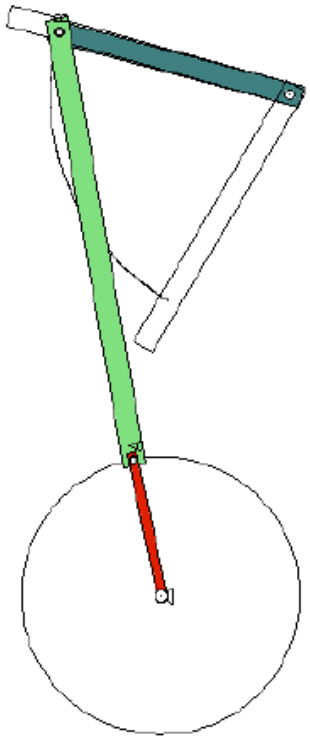
Bicycle Motocross (shortened BMX) is named after its thicker tires and the racing track is very similar to the track used by off-road motorcycles.

The BMX track consists of straights, curves, and multiple obstacles.



Introduction

Introduction | Crank-rocker Mechanism

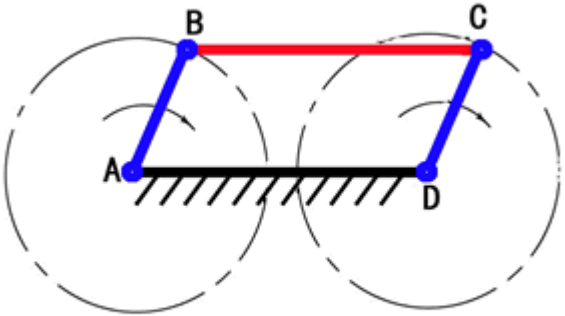


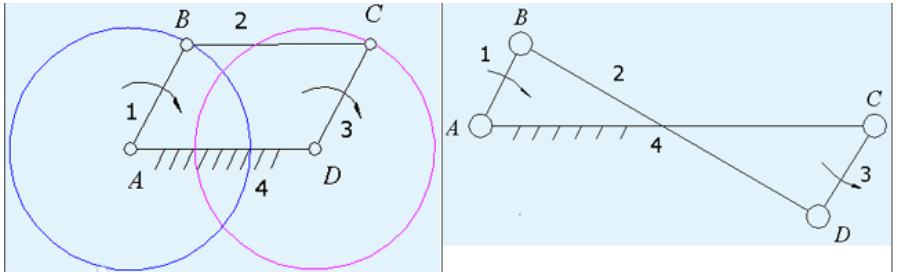
A **crank-rocker mechanism** refers to a hinged four-bar mechanism with a crank and a rocker.

When we ride a bicycle, which part is the crank and which part is the rocker?

Tip: When riding a bicycle, your thighs are the rockers.

Introduction | Double-crank Mechanism

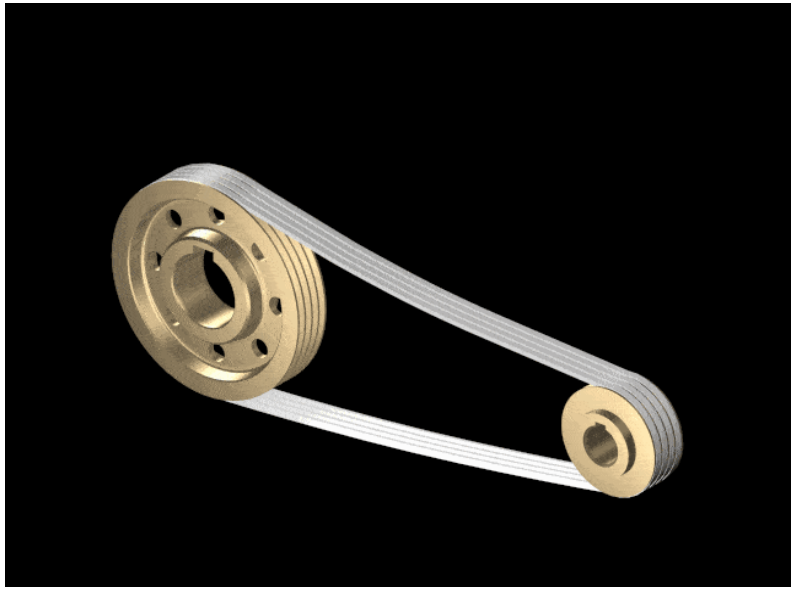




In a four-bar linkage hinge, if both links are cranks, the four-bar linkage is called a double-crank mechanism.

Among double-crank mechanisms, two common mechanisms are parallelogram and anti-parallelogram.

Introduction | Belt Drive



A **belt drive** is a mechanical transmission that uses a flexible belt tensioned on a pulley to transmit movement or power.

Using the friction of rubber bands, a friction belt transmission structure can be built.

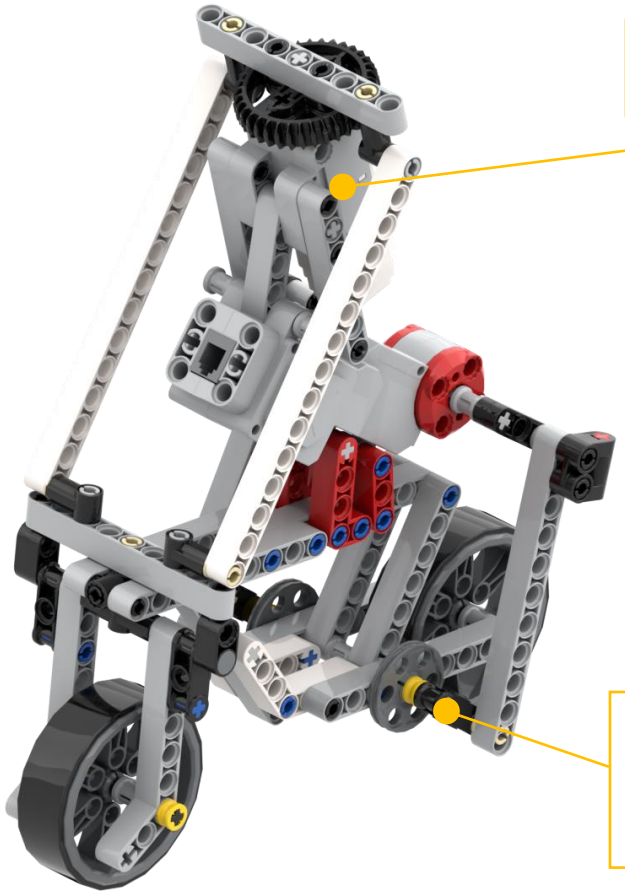


Practice





Practice | Robot Building

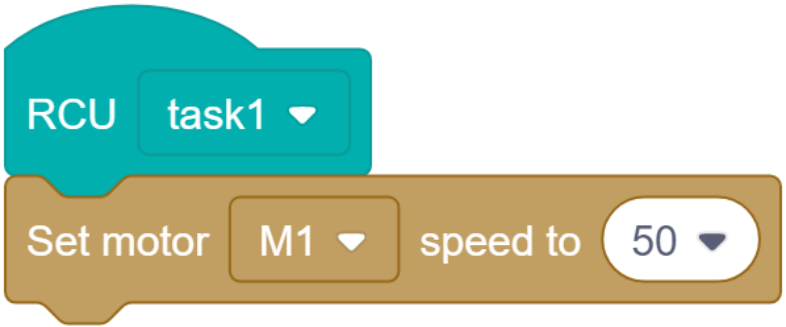


Medium-sized motor drives front wheel steering

Use a rubber band to connect the pulley to the rear wheel bushing

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

Practice | Programming



Please set up the program by yourself to drive the rear wheel to rotate when the robot rides a bicycle, and observe whether the riding posture of your robot is smooth.



Exploration



Exploration | Discussion

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

Is the double crank structure unable to drive?

The rear wheels can't rotate?

Is the robot's riding posture not smooth?

Fall easily?

Exploration | Discussion

So, how to solve these problems and make improvements?

Exploration | Dead Center Position

The dead center is any position of a crank where the applied force is straight along its axis, meaning no turning force can be applied.

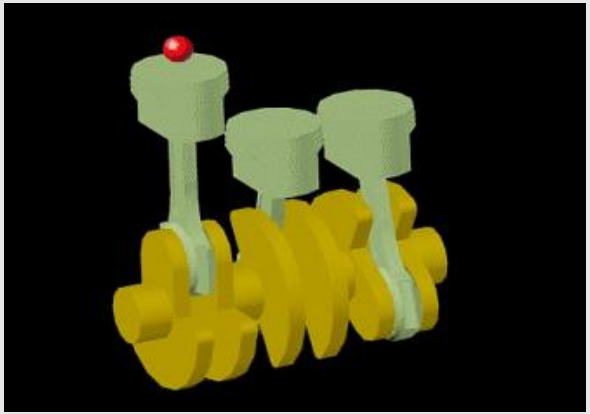
When the active part is at the dead center, it cannot drive the driven part to move.

Exploration | Dead Center Position

If the dead center position brings adverse effects to the movement of the force transmission mechanism, in order to smoothly pass the dead center and continue operation, the following two methods are usually used:



(1) Install the flywheel on the crankshaft



(2) Dislocation of multiple groups of mechanisms



Optimization

Optimization | Analysis

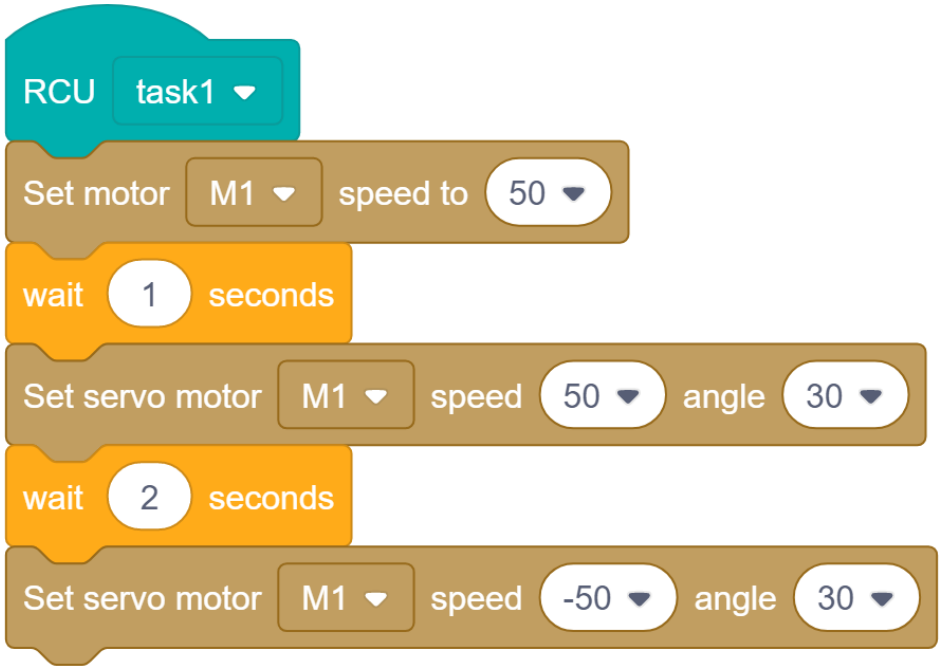


Test, observe, and think：

1. How should the position of the crank mechanism be modified?
2. Can the controller be used as a trailer and be used to maintain balance?
3. How to program the robot to complete the turn?

Please improve your robot to complete the function of controlling the movement and turning of the robot, and play freely on this basis.

Optimization | Analysis



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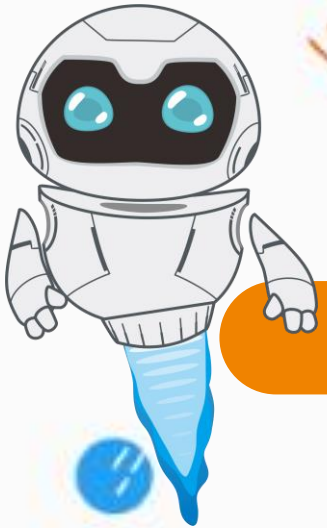


Result



Result | Robot Games

Let’s have a robot bike race!

Result | Display Your Robots

Please introduce your robots.

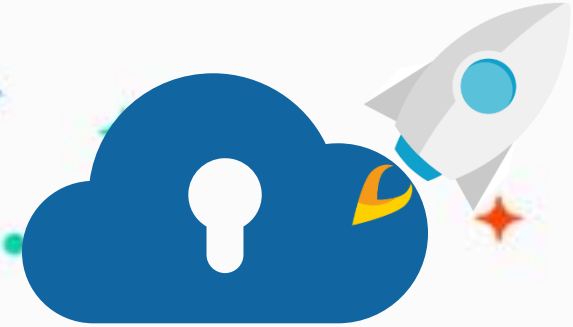
- Start with an interesting, powerful, and informative introduction to yourself
- Describe the building steps and program implementation process (problems encountered and solutions)
- Run the program to display your robot
- Explain the highlights of the work (add explanations for creative effects)

Result | Further Reading: why the bicycle does not fall over?

Although everyone is familiar with bicycles, it is not necessarily clear why such an unstable structure as a bicycle can keep from falling over.

The first reason is the adjustment of the center of gravity. When a bicycle starts to lean to one side, the center of gravity deviates. When the person riding the bicycle feels the deviation, they turn the handlebars. What he is doing at this time is to adjust the center of gravity, that is, to keep the center of gravity on the line connecting the support points of the front wheel and the rear wheel. This can correct the tilted state and play a balancing role. This is why when the bicycle tilts to one side, the handlebars rotate to the same side.

The second reason is the trail of the front wheels. The centrifugal effect created by the front wheel's wake keeps the bike from falling over. When the bicycle tilts while driving forward, the front wheel of the bicycle will deflect to the same side as the tilt and produce a deflection angle. Viewed from the trajectory of the front wheel on the ground, it happens to be a circular arc, so The centrifugal force formed by the deflection angle will correct the tilt state of the bicycle.



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Thanks!

LECTURER: