

# AUTONOMOUS ROBOT

The WAO KRANIUS is a robot that uses a "gear mechanism", a computer program and several sensors to navigate its way around the room. Let's let at these three structures a little more closely.

## MECHANISM STRUCTURE

**Q** The gear mechanism relays rotational power from the motor by way of gears to rotate the tires. The first function of a gear is to change rotational direction. If one side rotates clockwise, then when two gears are combined, the other side will rotate counterclockwise. Combining gears makes rotation convenient for the machine. The second function of gears is to change the rotational speed. When a gear with ten teeth and a gear with forty teeth are combined, even if the gear of ten teeth rotated on time, the gear of forty teeth carries out only  $\frac{1}{4}$  of a rotation. The rotation speed is reduced  $\frac{1}{4}$ . Because the thousands of rotations per minute created by the motor are too fast to use to move a tire, gears are used to reduce the rotations to a suitable speed.

The third function of the gear is rotational power (called torque). The motor used by WAO KRANIUS distributes only a few grams of power and by itself is not strong enough to move the tires. There is a deep relationship between rotational speed and torque. When you compare small gears, which have been combined to be fast, and large gears, which have been combined to be slow, you will find that when the motor speed is the same for each case you will see that speed and torque are inversely related. The higher the speed, the lower the torque; the lower the speed, the higher the torque.

## COMPUTER

Like most modern electronic appliances, the WAO KRANIUS contains a computer. Although computers are used for various things and have various functions, all computers have the same contents. There are three fundamental elements that constitute a computer. They are:

1. CPU - Central Processing Unit; performs operations and controls
2. Memory- Memorizes programs and data
3. I/O interface - Outputs result of calculation and checks the outside of the micro-controller



## SENSORS



Did you know that there are electronic sensors that can sense in ways similar to humans? For example there is the Ultrasonic Waves Sensor that can pick up sound vibrations. There are gas sensors, which are often used in the kitchen for a gas alarm. And there are even electronic "taste" sensors that can sense the difference between salt and sugar. There are three sensors used in the WAO KRANIUS. They are:




1. CdS sensor, which is used as a floor sensor
2. The infrared detector IC, which is used as Infrared sensor. The light from infrared light reflects off of any reflective obstacle.
3. The phototransistor, which is used as pulse sensor. Phototransistor converts light into current and distinguishes only light from dark.


# INSTRUCTIONS FOR PROGRAMMING THE WAO KRANIUS AUTONOMUS ROBOT


## EXPLANATION OF KEYBOARD


Demo Key WAO KRANIUS has three set demo programs.

Command Key These keys are for input of commands. They carry out the operation of the character or sign shown on the key. An explanation of each key follows.

 Runs forward. Normally it operates at middle speed. Then enter operation time from value keys.


 Runs at backward. Normally it operates at middle speed. Then enter operation time from value keys.


 Turns left (only right tire runs forward) Normally it operates at middle speed. Then enter operation time from value keys.

 Turns right (only left tires runs forward) normally it operates at middle speed. The enter operation time from value keys.

[Low] Runs at slow speed for each operation before pressing ""

[High] Runs at high speed for each operation before pressing ""

 Rotates to left on the spot (left tire runs backward, right tire runs forward) Then enter operation time from value keys.

 Rotates to right on the spot (left tire runs forward, right tire run backward) then enter operation time from value keys.

[Stop] Stops moving. If WAO KRANIUS has been operated, this command makes it stop.

[Buzzer] Makes a PiPo sound. WAO KRANIUS is able to make four sounds. After press BUZZER key, choose from 1 to 4 and press one of them. Then choose how many time WAO KRANIUS makes PiPo sounds from value keys. The kind of sounds and correspondence of each key is in the following table.

Value keys	Kind of Sound
"1"	"Pipi"
"2"	"Pipo"
"3"	"Popi"
"4"	"Pi-"

Value key This key is used for the input of operation time and number of repetitions.

Reset key the function of this key is to stop movement and cancel any inputted programs. Also, pushing this key initiates the program mode (the state where a program can be inputted from a keyboard.)

<u>Mode key</u>	Push the mode key followed by the corresponding value key when shifting into modes other than the program and demo mode.
<u>Program key</u>	It is used when programming a repetition command of operation, the condition judgment command of a sensor to an input state, etc.
<u>Power switch</u>	Turns ON/OFF WAO KRANIUS's power

## HOW TO PROGRAM

- 1) Program Mode      Press "RESET" to enter the program mode. Four red and green LEDs on the PC board will light up. This means it is possible to program.
  
- 2) Demo Mode        "Demo 1"  
Movement: After set amount of time passes, sound will start suddenly and WAO KRANIUS will start moving at random.  
Operation procedure: RESET- MODE- Demo 1- TIME (Enter by value key)  
How to use: Value keys '0' to '9' correspond to the time zero minute to nine minutes.  
  
"Demo 2"  
Movement: If the infrared sensor perceives an obstacle, it avoids the obstacle and moves forward continuously.  
Operation procedure: RESET- MODE- Demo 2 (to stop program press RESET)  
  
"Demo 3"  
Movement: Hold up your hand before WAO KRANIUS, the infrared ray sensor of WAO KRANIUS will react and it follows the obstacle.  
Operation procedure: REST- MODE- Demo 3 (to stop the program press RESET)

## PROGRAM 1

This program will cause WAO KRANIUS to move forward accelerating smoothly from LOW SPEED to MIDDLE SPEED to HIGH SPEED.

- Press RESET to set as program mode

1) LOW- ↑·3 - ENTER

2) ↓·3 - ENTER

3) HIGH - ↑·3 - ENTER

## PROGRAM 2

This program will cause WAO KRANIUS to move at Middle Speed in a square patten. Operation time is set at 2. 90-degree rotation is set at 4.

- Press RESET to set as program mode

1) ↑·2 - ENTER

2) STOP - 1- ENTER

3) ↓·4 ENTER

4) STOP-1 - ENTER

5) ↓·2 - ENTER

6) STOP - 1- ENTER

7) ↑·4 - ENTER

8) STOP - 1- ENTER

9) ↓·2 - ENTER

10) STOP - 1- ENTER

11) ↑·4 - ENTER

12) STOP - 1- ENTER

13) ↓·2 - ENTER

14) STOP - 1- ENTER

15) ↑·4 ENTER

16) STOP - 1- ENTER

### PROGRAM 3

For this program, using the tools and methods you have already learned, have WAO KRANIUS write out the first initial of your name. Depending on the letters used in your name this may take a several steps. Take time to think through the possibilities, draw out the steps to the right, then fill in the blanks below (you may not need all of the boxes below).

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

11)

12)

13)

14)

15)

## PROGRAM 4

For this program, combine different rotational movements, speed and sound to come up with your own unique motion for WAO KRANIUS to make. These combinations can make WAO KRANIUS "dance" in the style you choose.

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

11)

12)

13)

14)

15)

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)
- 13)
- 14)
- 15)
- 16)
- 17)
- 18)
- 19)
- 20)
- 21)
- 22)