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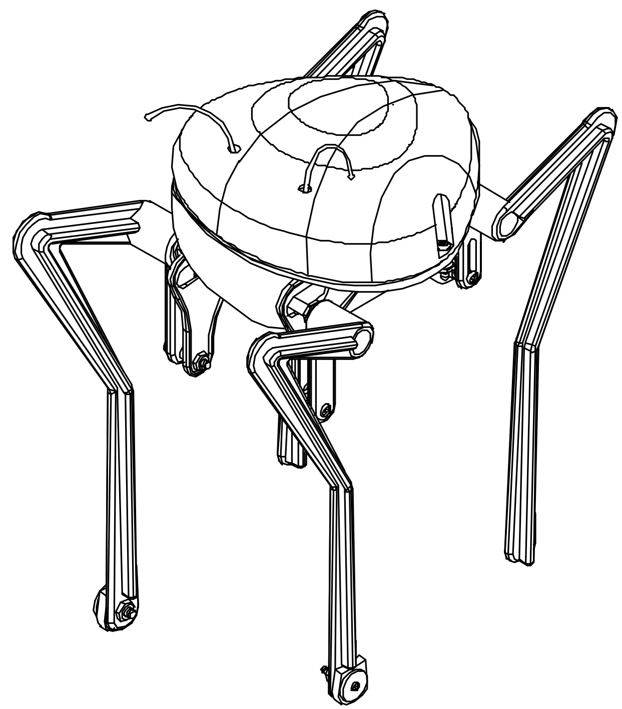
Hydrazoid

Build your own robot



Model No: MR-1004

Manufactured by iBOTZ Div of Instruments Direct Ltd.
The Open University is based at Milton Keynes, UK

PLEASE READ BEFORE PROCEEDING

Read this manual carefully before getting started on your robot. Ask someone to help you read the instructions. Keep this manual for future reference.

- Take care when using sharp tools such as pliers or screwdrivers.
- Keep the robotic parts away from small children. Don't assemble the robot where small children can reach it.
- Keep fingers out of the working parts such as the motors and gears.
- Do not force the robot to move/stop; this could cause the motors to overheat.
- The Specification and anything contained within this manual are subject to change without notice.
- When using batteries:

  -Use the batteries in the correct polarity (+ -)

  -Never short circuit, disassemble, heat, or dispose of batteries in a fire.

  -When the robot is not in use the batteries should be removed.

  -If the batteries or robot become wet, remove the batteries from the hold and dry the robot.

  -Do not mix old and new batteries. Do not mix alkaline, standard (carbon-zinc) or rechargeable (nickel-cadmium) batteries. We recommend the use of alkaline batteries for extended life.

Product Information

Hydrazoid

Model: MR-1004

About
This robot reacts to sound impulses and walks for a few seconds and then automatically stops.

Specification

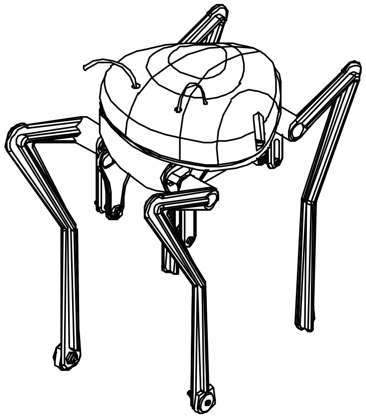
Power voltage : DC 3V (AA Battery x 2pcs)

Power consumption : minimum current : 5 mA (with motor on standby)
Maximum current : 120 mA (while operating motor)

Walking time : Approx. 12 seconds

Height 195 mm
Length 155 mm
Width 125 mm

Hydrazoid MR-1004 robot



This iBOTZ kit is an ideal introduction for someone wanting to investigate the fascinating world of robots and intelligent machines.

The kit introduces the fundamentals of sensor technology and shows how sensors, electronic circuit boards, and motors can be combined with carefully designed mechanical gears and shafts to produce a robot that walks for after hearing a sound, then stop.

Clap you hand and watch HYDRAZOID walk, then stop. How does it do that?

By reading this manual you will find out what the components in your iBOTZ HYDRAZOID do, and how they work together to generate its behavior. In the process you will be introduced to some basic electronics and aspects of engineering design.

We have iBOTZ robots in our laboratory at the Open University, and they are always a big hit with visitors. When you have built and experimented with yours, you will be ready to move on towards the more advanced robots that are used for research. Have fun!

Professor Jeffrey Johnson
Department of Design & Innovation
The Open University
http://technology.open.ac.uk

History of Robots

Definition of a Robot

According to The Robot Institute of America (1979) :
"A reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks." According to the Webster dictionary: "An automatic device that performs functions normally ascribed to humans or a machine in the form of a human (Webster, 1993)."

A brief review of robot development is important as it puts the current machines and interest in them into an historical perspective. The following list highlights the growth of automated machines that led to the development of the industrial robots currently available today.

250BC

One of the first robots was the clepsydra or water clock, which was made in 250 B.C. It was created by Ctesibius of Alexandria, a Greek physicist and inventor.

1801

Joseph Jacquard invents a textile machine that is operated by punch cards. The machine is called a programmable loom and goes into mass production.

1830

American Christopher Spencer designs a cam-operated lathe.

1892

In the United States, Seward Babbitt designs a motorised crane with gripper to remove ingots from a furnace.

1921

The first reference to the word robot appears in a play opening in London. The play, written by Czechoslovakian Karel Capek, introduces the word robot from the Czech robota, which means a serf or one in subservient labour. From this beginning the concept of a robot takes hold.

1938

Americans Willard Pollard and Harold Roselund design a programmable paint-spraying mechanism for the DeVilbiss Company.

1948

Norbert Wiener, a professor at M.I.T., publishes Cybernetics, a book which describes the concept of communications and control in electronic, mechanical, and biological systems.

1954

After the invention of the transistor in 1948, many robots were used in conjunction with the computer. The first patent for a computer controlled industrial robot was developed in 1954 by George Devol. Devol created a computerized memory and control system called "universal automation." Devol co-founded the Unimation industrial robot company, and "started the industrial robot revolution" by selling designs of powerful assembly line arms to General Motors.

1959

Planet Corporation markets the first commercially available robot.

1960

Unimation is purchased by Condec Corporation and development of Unimate Robot Systems begins. American Machine and Foundry, later known as AMF Corporation, markets a robot,

1962

General Motors installs the first industrial robot on a production line.

1968

Stanford Research Institute at Palo Alto, California (SRI) builds and tests a mobile robot with vision capability, called Shakey. It was a small unstable box on wheels that used memory and logical reasoning to solve problems and navigate in its environment. Besides moving between rooms and avoiding objects, Shakey II was able to stack wooden blocks according to spoken instructions. It looked to see if the blocks were properly aligned, and if not, it adjusted the stack. Shakey was once asked to push a box off a platform, but could not reach the box. The robot found a rasmp, pushed the ramp against the platform, rolled up the ramp, and then pushed the box onto the floor

1970

At Stanford University a robot arm is developed which becomes a standard for research projects. The arm is electrically powered and becomes known as the Stanford Arm.

1973

The first commercially available minicomputer-controlled industrial robot is developed by Richard Hohn for Cincinnati Milacron Corporation. The robot is called the T3, “The Tomorrow Tool”.

1974

Professor Scheinman, the developer of the Stanford Arm, forms Vicarm Inc. to market a version of the arm for industrial applications. The new arm is controlled by a minicomputer.

1976

Robot arms are used on Viking 1 and 2 space probes Vicarm Inc. incorporates a microcomputer into the Vicarm design.

1977

ASEA, a European robot company, offers two sizes of electric powered industrial robots. Both robots use a microcomputer controller for programming and operation. In the same year Unimation purchases Vicarm Inc.

1978

The Puma (Programmable Universal Machine for Assembly) robot is developed by Unimation from Vicarm techniques and with support from General Motors.

1980

The robot industry starts its rapid growth, with a new robot or company entering the market every month.

A brief overview

The parts of many modern robots can be generalized into four categories: the **base**, **object manipulator**, **primary control system**, and **sensory system**. The **base** is usually a metal or plastic frame that supports the robot's components. Most industrial robot bases are stationary, although the arms move about. Other bases move about by treads, wheels, or legs. Wheel driven bases have various configurations. Some have two big rear wheels, and a small front balancing wheel, while others have four equally sized wheels.

The second part of the modern robot is the **object manipulator**. Basic grasping and manipulation requires a large amount of memory, due to the requirements of smoothness and sensitivity during operation . The minimum number of fingers necessary to grasp an object, hold it securely, and manipulate it smoothly was found to be three.

The third part of the modern robot is the **control system**. Primary systems include the remote control, driver circuit, or computer. Quite often, the control system consists of a primary control and secondary, application-specific controls. The primary control executes the main program, calling individual functions or reading resultant data, while the secondary control systems determine how those functions are processed.

The final part of the modern robot is the **sensory system**. The sense of touch is used for object recognition or collision avoidance. For example, a robot hand, equipped with a rubber skin of microswitches, can recognize objects such as screws, pins, and washers.

When, in 1954 George C. Devol filed a U.S. patent for a programmable method for transferring articles between different parts of a factory, he wrote:

"The present invention makes available for the first time a more or less general purpose machine that has universal application to a vast diversity of applications where cyclic control is desired."

In 1956 Devol met Joseph F. Engelberger, a young engineer in the aerospace industry. With others, they set up the world's first robot company, Unimation, Inc., and built their first machine in 1958. Their initiative was a great deal ahead of its time; according to Engelberger, Unimation did not show a profit until 1975.

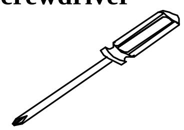
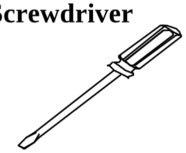
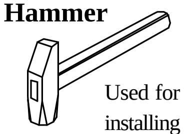
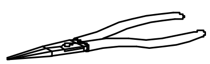
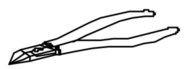
The first industrial robot saw service in 1962 in a car factory run by General Motors in Trenton, New Jersey. The robot lifted hot pieces of metal from a die-casting machine and stacked them.

Japan, by comparison, imported its first industrial robot from AMF in 1967, at which time the United States was a good 10 years ahead in robotics technology. By 1990, there were more than 40 Japanese companies that were producing commercial robots. By comparison, there were approximately one dozen U.S. firms, led by Cincinnati Milacron and Westinghouse's Unimation.

The Future of Robots

Robots and the robotics industry will continue to grow at a rapid rate. As technology advances so will the robots that rely so heavily upon these advances. Robots will become more technical until one day they will become as powerful as we are.

Tools needed for assembly

+ Screwdriver 	**- Screwdriver** 	**Hammer**  Used for installing gears
Long-nose pliers 	**Cutting pliers** 	

Helpful hints prior to assembly

In removing parts from plastic frame, simply twist the plastic parts away from the frame or use some cutting pliers, being careful not to snap any of the fragile parts.

Tapping screws

Tapping screws make threads like normal screws do so in wood. The best way to screw a tapping screw is to screw in a couple of turns and then unscrew half a turn, repeat this until the screw is in flush to the surface.

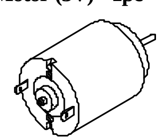
Tightening of nuts and screws

Make sure nuts are tightened securely to the bolts; if not they may work loose and cause the robot to malfunction. Also make sure the nuts are not too tight and cause the parts to function incorrectly.

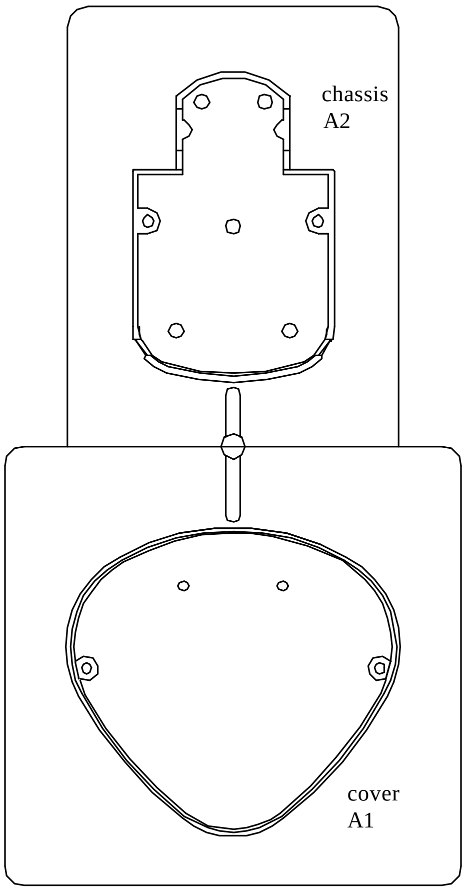
Screw sizing

The size of the screws is expressed by the thickness and length. A screw marked M3x10 is 3mm thick and 10mm long. Nuts are measured in a similar way corresponding to the size of the screw. A M3 nut is used on an M3bolt/screw.

Parts list

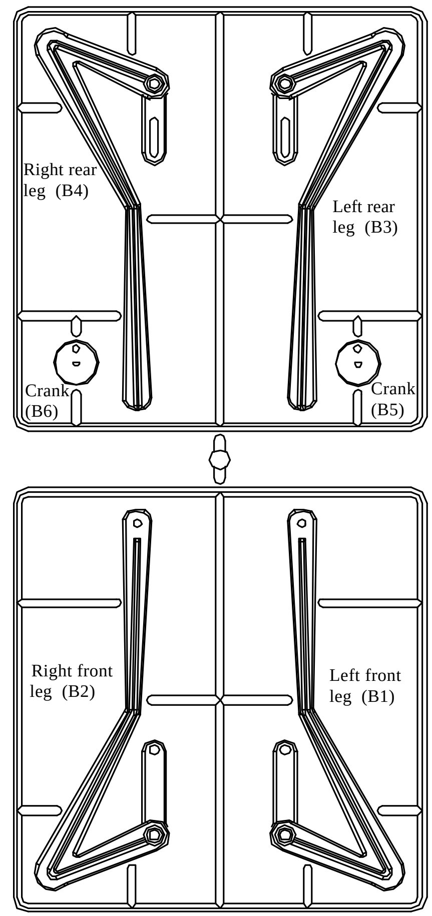
Screws **Screw A** M3x28 **4pcs** **Screw B** M3x20 **2pcs** **Screw C** M3x12 **6pcs** **Screw D** M2x5 **12pcs**	**Tapping Screws** **Screw E** Ø2.6x20PB **2pcs** **Screw F** Ø2.6x6 PB **3pcs** **Screw G** Ø2.3x5 PB **1pc**	**Washers** **Flat washer A 2pcs** 11.5mm Ø **Flat washer B 4pcs** 7.6mm Ø **Spring washer C 8pcs** 5.5mm Ø
Pipe Spacers **Pipe spacer A** Ø 3x12 **2pcs** **Pipe spacer B** Ø 3x5 **8pcs**	**Nuts** **Nut A** M3 **18pcs** **Nut B** M2 **4pcs**	**Gears** **Pinion gear (A) 1pc** **Crown gear (B) 1pc** C34T×12Z×Ø2.9 **Flat spur gear (C) 1pc** 40T×Ø2.9 **Flat spur with pinion gear (D) 1pc** 30T×10Z×Ø2.9 **Flat spur with pinion gear (E) 1pc** 32T×12Z×Ø2.9
L Bracket 4pcs	**Spanner 1pc**	
Rubber Bushing 2pcs	**Gear shaft 1pc**	
Motor (3V) 1pc 	**Motor base 1pc**	
	Sleeve 2pcs	Fibre-optic antenna 2pcs

cover set



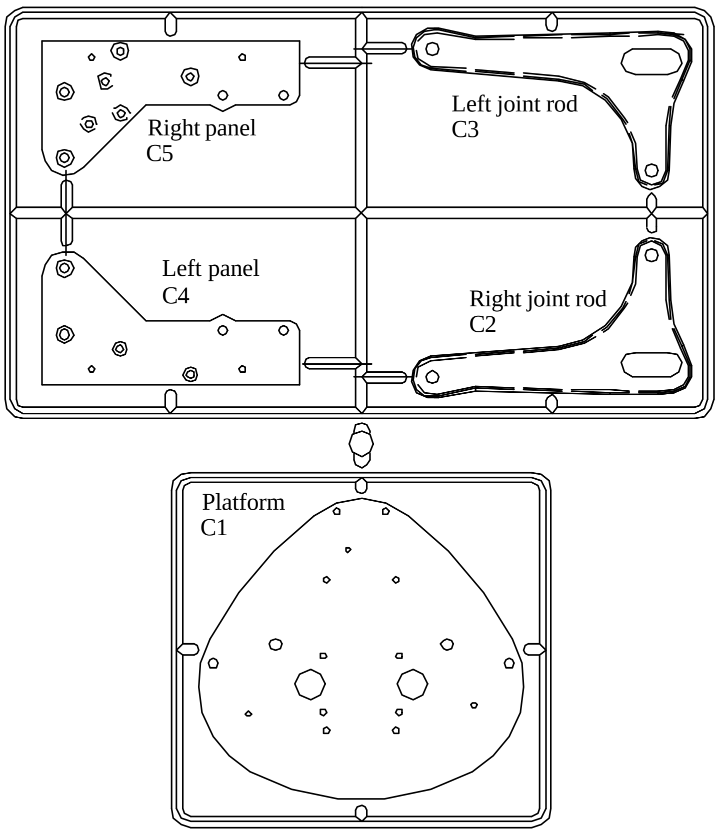
Plastic Parts List

Legs set

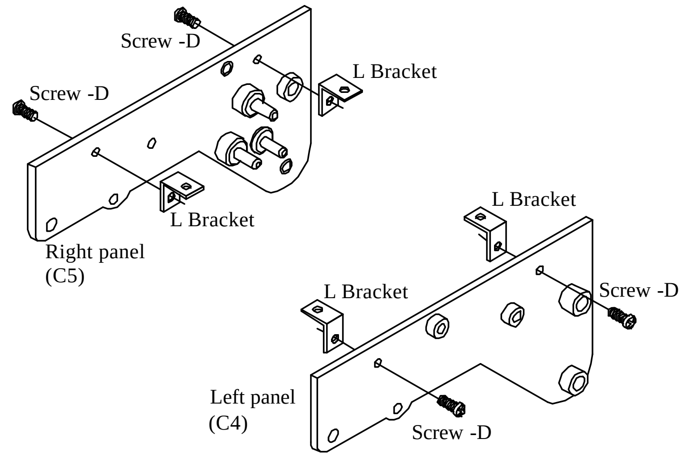


Plastic Parts List

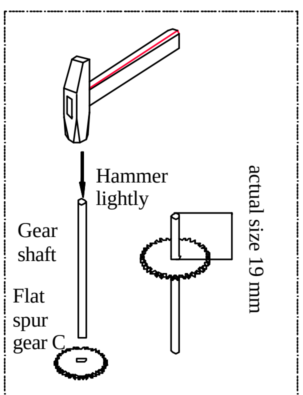
Platform set

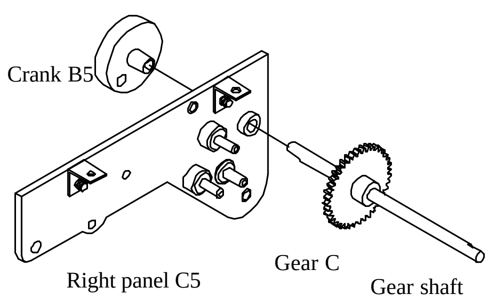


1. Assembling the L brackets and panel (right and left)

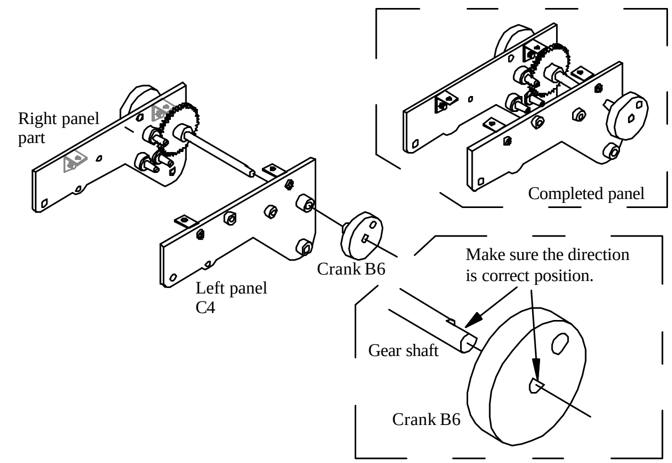


2. Installing right panel, crank and gear shaft

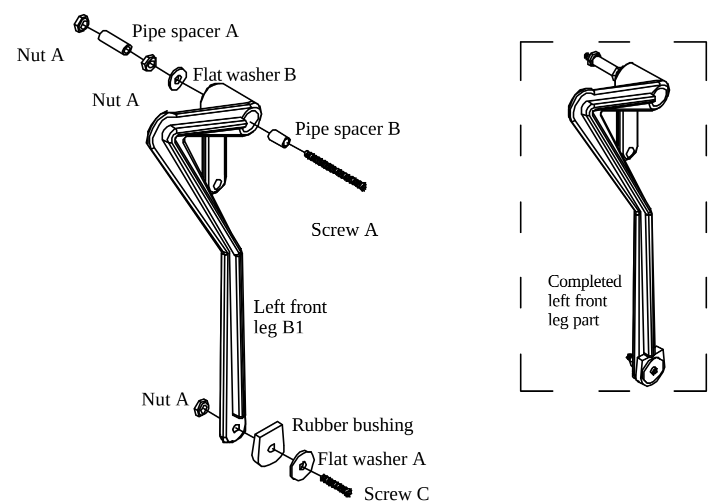




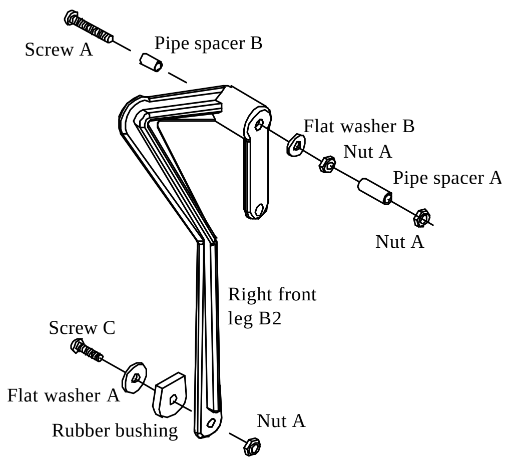
3. Assembling of motor and pinion

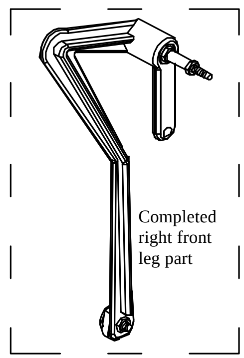


4. Assembling left front leg

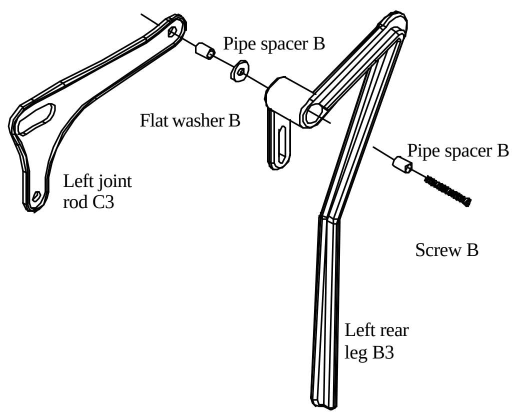


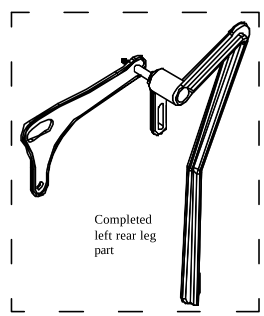
5. Assembling right front leg



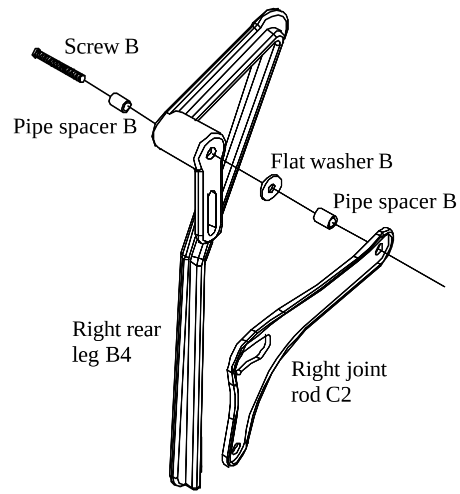


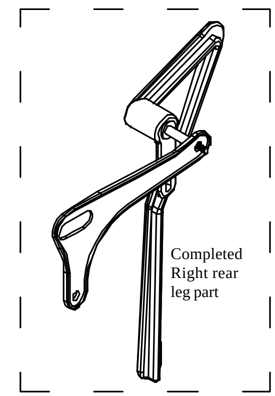
6. Assembling left rear leg



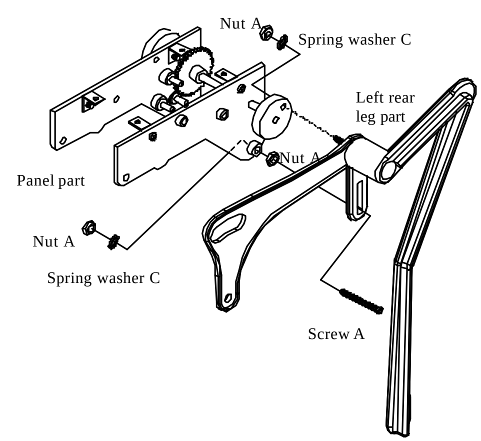


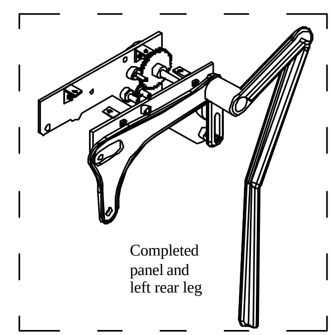
7. Assembling right rear leg



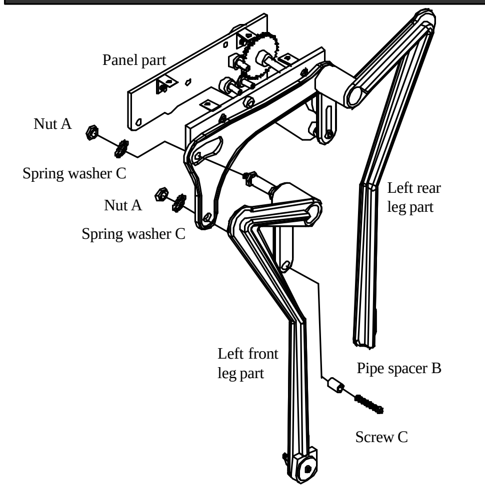


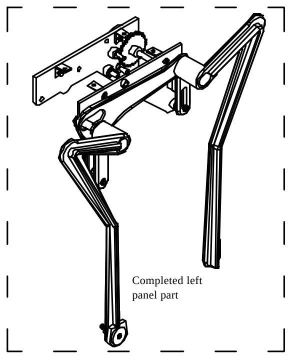
8. Assembling left panel part and left rear leg part





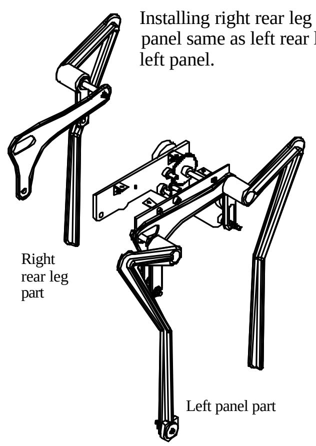
9. Assembling left panel part and left front leg part

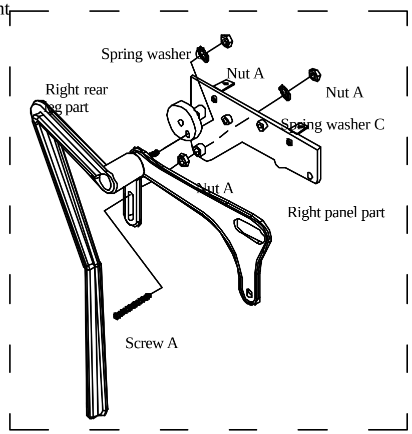




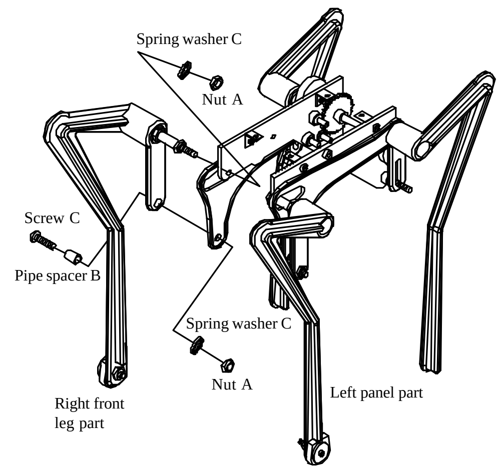
10. Assembling right panel part and right rear leg part

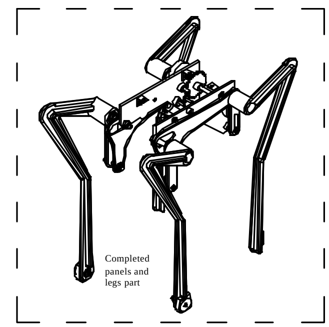
Installing right rear leg and right panel same as left rear leg and left panel.



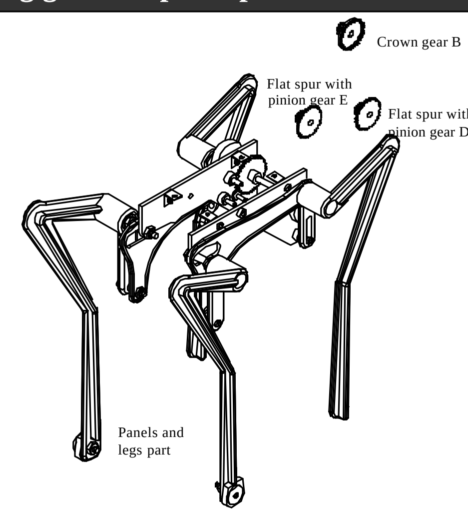


11. Assembling right panel part and right front leg part

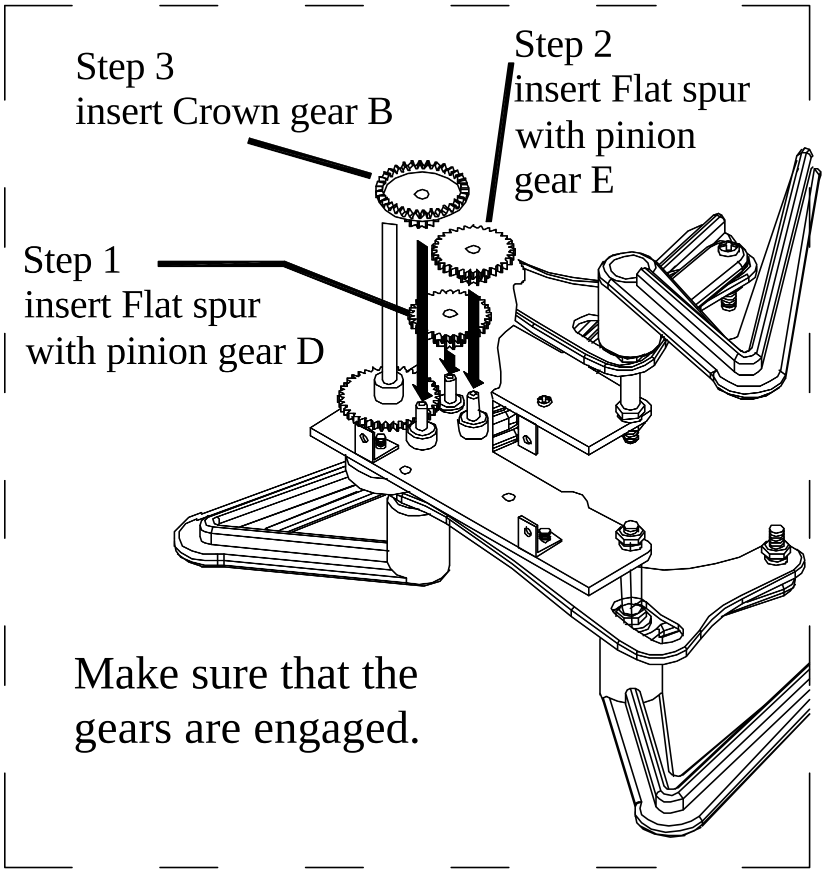




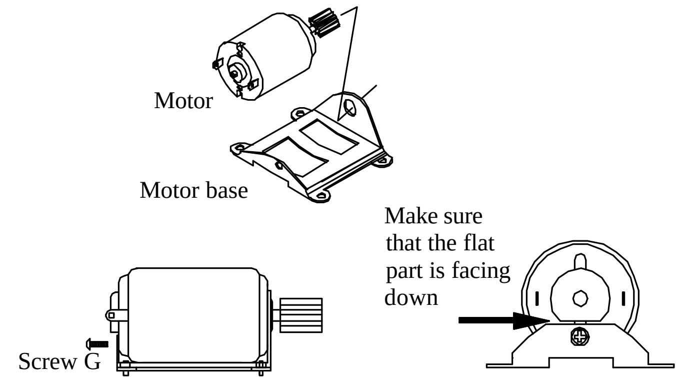
12. Installing gears on panel part

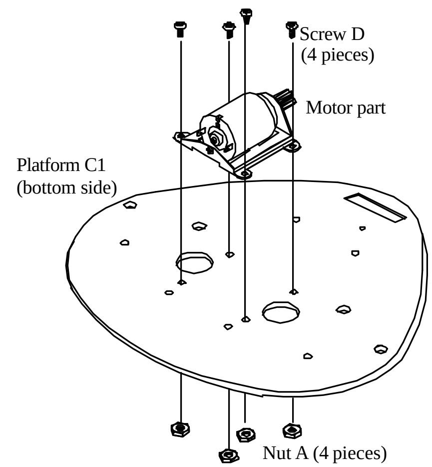


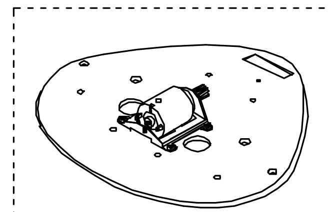
Continuation of step 12



13. Installing the motor on the platform

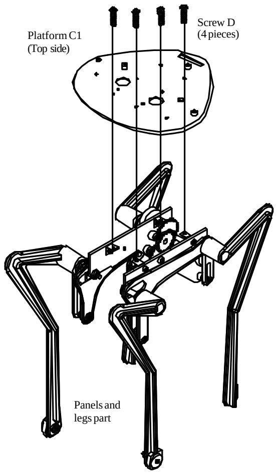


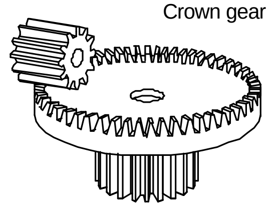




Completed platform and motor

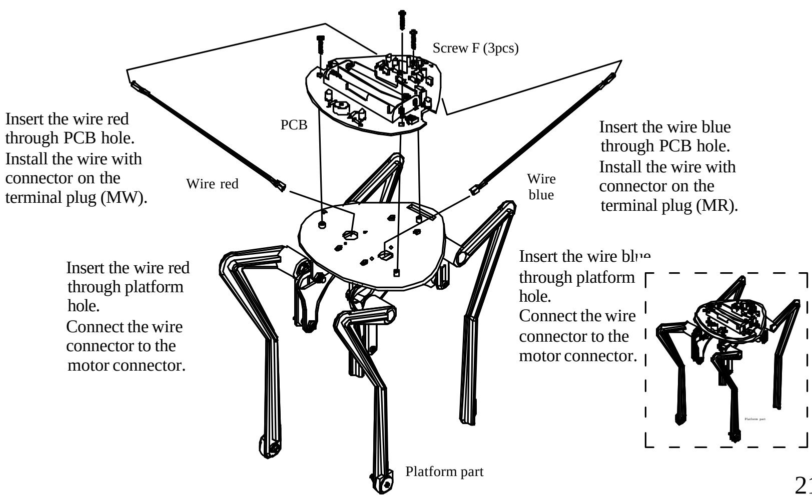
14. Assembling platform and panel/leg part





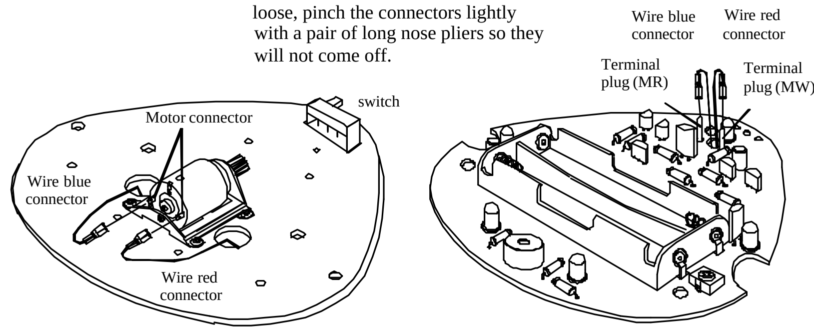
Make sure the pinion gear of motor and the crown gear engaged correctly with each other as illustrated.

15. Installing PCB on the platform part

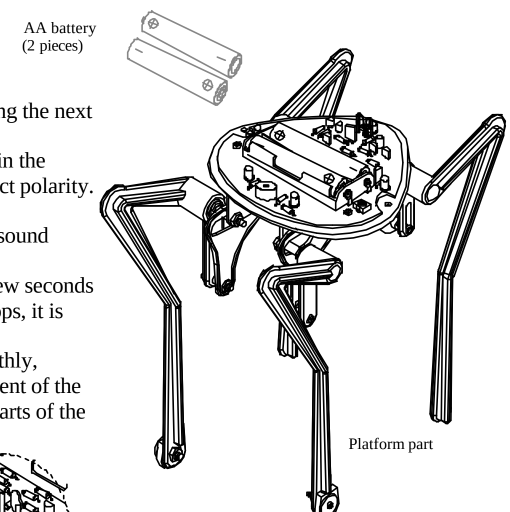


16. Connecting the wires connectors to the terminal pins

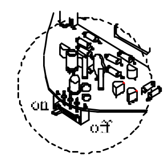
If the connectors of the wires are too loose, pinch the connectors lightly with a pair of long nose pliers so they will not come off.



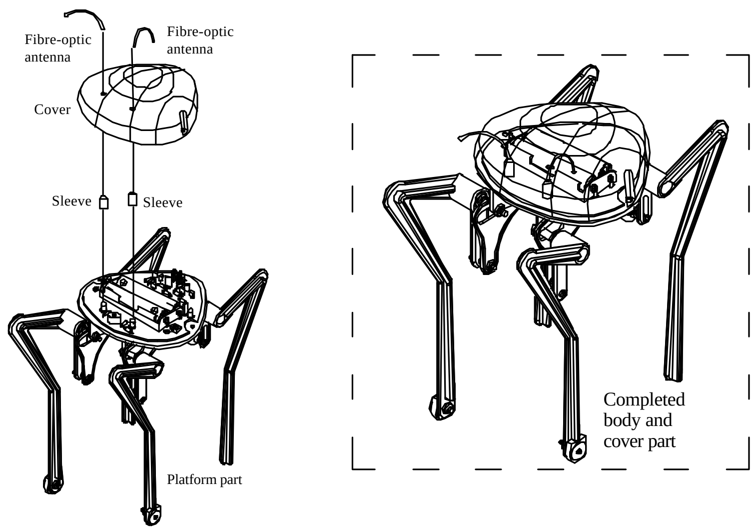
17. Insert the AA battery and check it



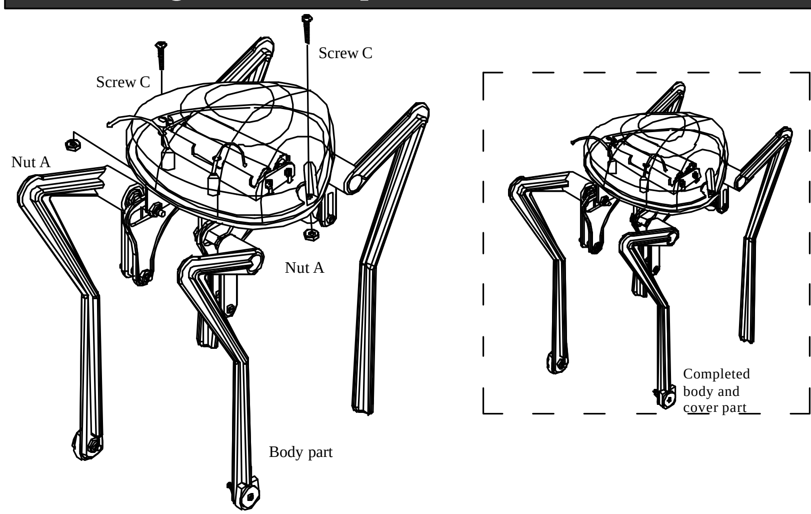
Please check before starting the next assembly.
Place two "AA" batteries in the battery holder in the correct polarity.
Turn the switch on.
Clap your hands near the sound sensor.
If hydrazoid walks for a few seconds and then automatically stops, it is functioning correctly.
If they do not move smoothly, please check the engagement of the gears and the assembled parts of the legs.



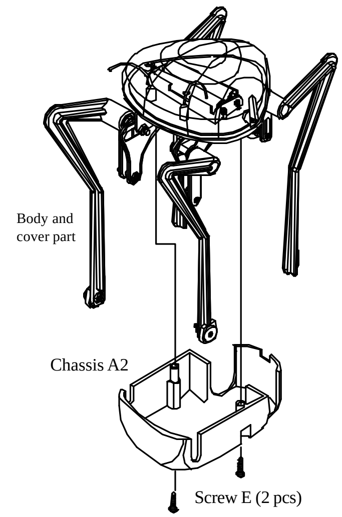
18. Assembling cover, tube and platform parts



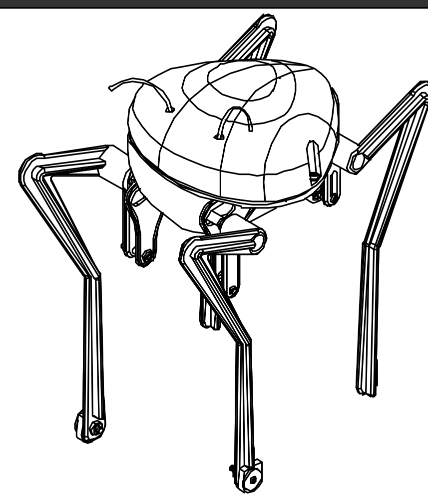
19. Installing the cover on platform with screws



20. Assembling chassis and body part

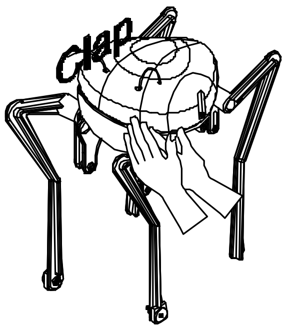


21. Completed sketch



How to operate your Hydrazoid

- Install both the “AA” batteries in the battery holder.
- Check that the motor runs when the robot is switched on.
- Clap your hands near the sound sensor (condenser microphone).
- If Hydrazoid walks for a few seconds and then automatically stops, it is functioning correctly.

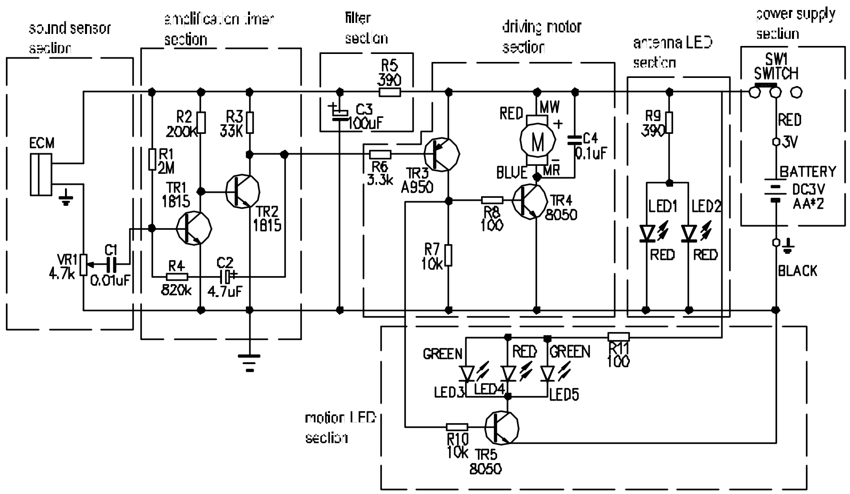


Use this chart to diagnose any problems:

Problem	Solution
The motor is not spinning.	~ Check that the wiring is correct. ~ Check the polarity of the batteries. ~ Insert new batteries.
The legs don’t move even though motor is running.	~ Check the engagement of the gears. ~ Check the assembling of the legs.
Hydrazoid easily topples while walking.	~ Check the wiring of the motor. ~ Check the both cranks are correct. ~ Check the assembling of both front and rear legs.

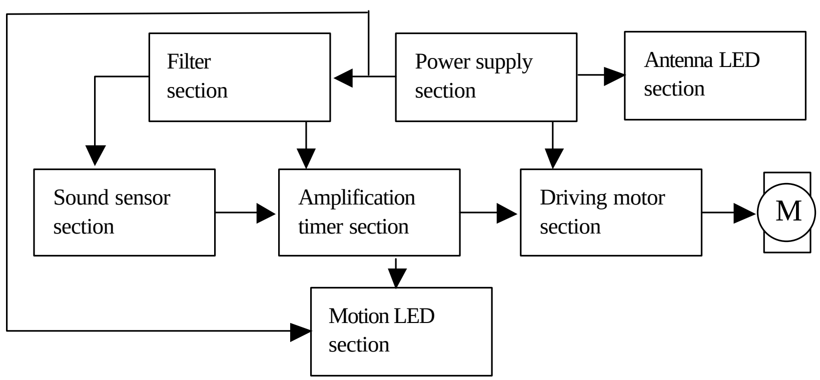
Schematic of electronic circuit

The schematic of electronic circuit is a kind of diagram showing how the parts such as resistors and capacitors are connected to each other by simplified markings.



Block diagram

The block diagram is a simplified figure that shows each function of the electric circuit.



Explanation of circuit

1. Sound sensor section

A condenser microphone is used as a sound sensor picking up a sound such as a handclap. It converts this acoustic signal into an electric signal.

2. Amplification timer section

When there is no signal from the microphone (ECM) transistors TR1 –TR4 are all turned off, that is, little or no current flows between each Collector and Emitter. The motor therefore is not running. When a sound is detected all these transistors turn on and the motor runs. TR1 and TR2 amplify the small signal voltage from the microphone. The signal from the Collector of TR2 is fed back to the Base of TR1 (through C2 and R4). When the sound stops, this feedback prevents the voltage on the Collector of TR2 rising immediately. Hence the motor continues to run after the sound stops for an interval set by the values of C2 and R4.

3. Driving motor section

This section is for driving the motor. TR4 acts as a switch, turning the motor on and off. It handles the relatively large current drawn by the motor when it runs. When TR2 is on, it turns on TR3 and TR4 and the motor turns. When TR2 is off, TR3 and TR4 are also turned off and the motor stops.

4. Filter section

When the motor spins, electrical noise (changes in power supply voltage) will be generated. Since this noise may affect the sensor and the amplification timer sections, leading to a malfunction, a filter consisting of R5 and C3 is incorporated in the power supply rail.

5. Power supply section

Two AA size batteries provide a 3 volt power supply. The batteries provide energy to operate the electronic circuit and spin the motor.

6. Antenna LED section

Light Emitting Diodes LED1 and LED2 are lit up all the time the robot is switched on.

7. Motion LED section

LED3, LED4 and LED5 only light up while the motor is running and TR5 is conducting.

So what is electronics?

We all know that atoms are made up of protons, neutrons and electrons. The electrons are tiny particles that orbit about the nucleus (made up of protons and neutrons) and have a special electrical property of **charge**. The protons in the nucleus have a positive (+) charge whilst those interesting electrons have a negative (-) one. This charge is what electronics is all about. When electrons move together in a similar way we say there is a **current** flowing. The electrons are actually moving all the time in materials like metals but they moving in all sorts of directions; it is only when they all get together and move in the same direction we say that we have a current flowing. However, electrons can't flow through every material. Materials that allow a current to flow easily are called **conductors**. Materials that don't allow a current to flow are called **non-conductors** or **insulators**. Metals are the most common conductors, whilst plastics are typical insulators.

In order to get electrons to flow in a certain way they need to have an “energy” given to them. Batteries are designed in such a way as to give that “energy” for electrons to flow between a negative and a positive side (or electrode). This creates something like a pressure or force and this is called the **voltage**. The bigger the voltage, the greater the pressure or force available to the electrons. This force is sometimes called **potential difference**. A typical battery will give a flow (or **voltage**) of 9 volts (**9v**). Before an electric current can go anywhere it needs to be given a road or path to follow. This is what you see on our printed circuit board and it is called a **circuit**. Therefore by connecting a battery to a circuit we can get a current to move and perform the function we want. The battery will eventually run out of energy as it pushes the electrons out from one side and collects them at the other. This will eventually result in the battery running down.

Current & Amps

So how do we measure current? Currents are measured in **amps**, and voltages are measured in **volts** (after the scientists Ampère and Volta). Voltages are sometimes called **potential differences**, or **electromotive forces**. Current flows into a component and the same amount of current always flows out of the component. As current flows through a component it will cause a reaction of some kind, for example a bulb getting brighter.

Resistors & Resistance

Any material that hinders the movement of electrons is called a resistor. Electrons move more easily through some materials than others when a voltage is applied. We measure how much opposition there is to an electric current as **resistance**. Components that cause a resistance are hence called **resistors**. The higher the resistance value, the more it restricts the flow. The resistor will give the circuit a stable current thus giving protection to sensitive elements within a circuit from damage

Resistance is measured in **ohms** after the discoverer of a law relating voltage to current. Ohms are represented by the Greek letter omega. (Ù).

The main function of resistors in a circuit is to control the flow of current to other components. Take an LED (light emitting diode) for example. If too much current flows through an LED it is destroyed. So a resistor is used to limit the current.

What is Ohms Law?

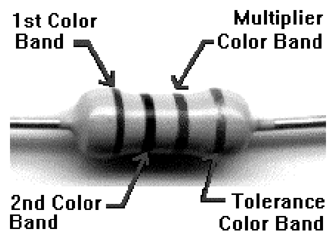
The Law basically brings together the relationship between Voltage (**V**), Resistance (**R**) and Current (**I**) as follows:

$$\textbf{Resistance(R) (ohm W)} = \frac{\textbf{Potential Difference (V) in volts}}{\textbf{Current (I) in amperes}}$$

Ohm discovered that if you double the voltage across the resistor then the current through it also doubles. If you halve the voltage then the current is halved. This means that the current is **proportional** to the voltage. Not surprisingly the opposite to this also happens! He also found that if you double the value of the resistor then the current through it is halved. If the value of the resistor is halved the current is doubled. Thus the current is **inversely proportional** to the resistance.

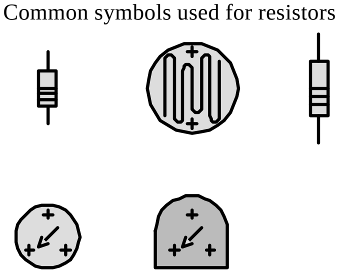
If all this is a little hard to take in, here’s a handy way to remember Ohm’s Law

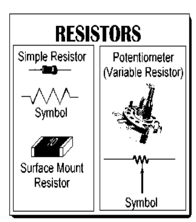
How do you determine the resistance of a resistor?



Resistors are colour coded for easy reading. To determine the value of a given resistor look for the gold or silver tolerance band and rotate the resistor as in the photo above. (Tolerance band to the right). Look at the 1st colour band and determine its colour. This maybe difficult on small or oddly coloured resistors. Now look at the chart and match the "1st & 2nd colour band" colour to the "Digit it represents". Write this number down. Now look at the 2nd colour band and match that colour to the same chart. Write this number next to the 1st Digit. The last colour band is the number you will multiply the result by. Match the 3rd colour band with the chart under multiplier. This is the number you will multiple the other 2 numbers by. Write it next to the other 2 numbers with a multiplication sign before it. Example: 2 2 x 1,000.To pull it all together now, simply multiply the first 2 numbers (1st number in the tens column and 2nd in the ones column) by the Multiplier

Common symbols used for resistors





Learn all about the electronic parts used in robots

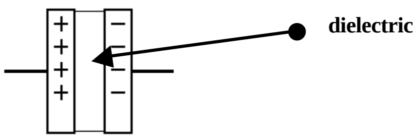
Resistor Colour Code Chart

1st. & 2nd Colour Band	Digit it Represents	-----Multiplier-----
BLACK	0	×1
BROWN	1	×10
RED	2	×100
ORANGE	3	×1000 or 1K
YELLOW	4	×10000 or 10K
GREEN	5	×100000 or 100K
BLUE	6	×1000000 or 1M
VIOLET	7	Silver is divide by 100
GREY	8	Gold is divide by 10
WHITE	9	▪ Tolerances ▪ Gold = 5% ▪ Silver = 10% ▪ None = 20%

Capacitors & Capacitance

Capacitors are like tiny batteries in a circuit storing charge. Like tiny batteries they can cause a current to flow in a circuit. But they can only do this for a short time - they cannot deliver a sustained current. They can be charged up with energy from a battery, then return that energy back later. The **capacitance** of a capacitor is a measure of how much energy or charge it can hold.

Essentially capacitors consist of two metal plates separated by a small gap. The plates will have different electric charges (just like a battery). You can increase the capacitance by putting a non-conducting material between the plates. This is called a **dielectric**.



When a capacitor charges up the protons and electrons in the dielectric separate out and move to the plates thereby giving more charge than usual. Dielectrics are made of various materials, ceramic being the more common. When a capacitor is connected to a battery it begins to charge. The current flows rapidly at first. Charge builds up on the two plates, negative charge on one plate and the same amount of positive charge on the other. The positive charge results from electrons leaving one of the plates and leaving positively-charged protons behind. But as the capacitor fills with charge it starts to oppose the current flowing in the circuit. It is as if another battery were working against the first. The current decreases and the capacitor charges more slowly.

Capacitance is measured in **Farads**.. A unit of Farad is represented by **µ.** , but most capacitors have much smaller capacitances, and the microfarad (a millionth of a farad) is the commonly used practical unit. One farad is a capacitance of one coulomb per volt. For practical purposes the microfarad (one millionth of a farad, symbol mF) is more commonly used. The **farad** is named after English scientist Michael Faraday.

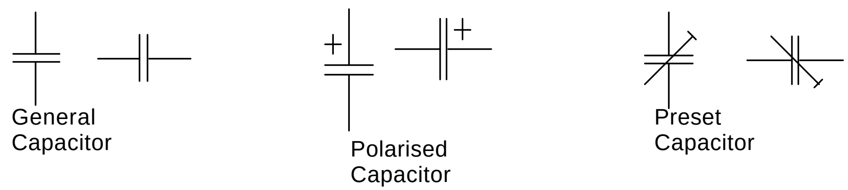
Capacitors come in two types, **electrolytic** and **non-electrolytic**. Electrolytic capacitors use a special liquid or paste, which is formed into a very thin dielectric in the factory. Non-electrolytic capacitors have ordinary dielectrics.

Electrolytic capacitors can store more charge than non-electrolytic capacitors but there are a couple of problems. They must be connected the right way around in a circuit or they won't work They also slowly leak their charge, and they have quite large tolerances.

We've seen that when a capacitor is fully charged the current stops. In other words a continuous current cannot flow forever through a capacitor. A continuous current is called a **direct current** or d.c. An **alternating current** (a.c.) however can flow through a capacitor. An alternating current is one which is continually changing its direction. Mains is a.c. and changes its direction 50 times a second. An alternating current continually charges and discharges a capacitor and hence is able to keep flowing. Electrolytic and Mylar capacitors are used in this electronics kit. We use a combination of resistors and capacitors to suppress voltage fluctuations in the power supply and set the time period on the timer. Capacitors can also be used to remove any alternating current components within a circuit.

Mylar capacitors have an insulator, which is a flexible mylar film, so a large area can be rolled up into a compact package. They do not have a polarity. Capacitors with large values are usually **electrolytic.** They have a **polarity** (or direction) and are sensitive to levels of voltage.

Typical symbols for capacitors in circuits are:



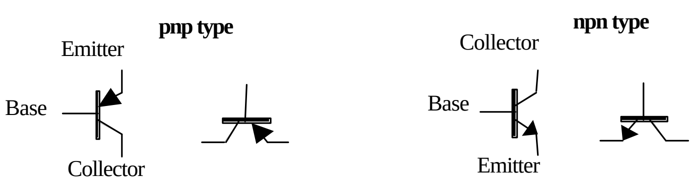
Transistor

The discovery of semiconductors was the most revolutionary change in electronics in the last century . Without this discovery we wouldn't have televisions, computers, space rockets or transistor radios. Transistors underpin the whole of modern electronics. They are very useful in computers, cars, washing machines and just about everywhere. In fact you see a lot of them in the **iBOTZ** robots!

It is easier to consider the transistor as a switch – **simply switching currents on and off**. They can also work as **amplifiers**, where they **increase** the current. Transistors are made of three slices of semiconductor material, two of one type and one of another. Therefore it is not surprising that it should be 2 x n-types plus one p-type or the other way around. This “sandwich” gives two junctions. If the thin slice is n-type the transistor is called a p-n-p transistor, and if the thin slice is p-type it is called a n-p-n transistor. The middle layer is always called the **base**, and the outer two layers are called the **collector** and the **emitter**.

It is important to remember that a transistor is a semi-conductor with the ability to amplify current. The "tiny sandwich" mentioned above is usually germanium or silicon, alternate layers having different electrical properties because they are impregnated with minute amounts of different impurities. A crystal of pure germanium or silicon would act as an insulator (non-conductor). By introducing impurities in the form of atoms of other materials (for example, boron, arsenic, or indium) in minute amounts, the layers may be made either n-type, having an excess of electrons, or p-type, having a deficiency of electrons. This enables electrons to flow from one layer to another in one direction only.

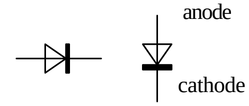
As mentioned above each transistor has three terminals called the Emitter, the Base and the Collector. When current flows into the base the emitter or the collector changes the current to a higher level.



We use the transistors in our other robots (such as Antoid) to turn on the **LED** (Light emitting diode) into a pulse form. We also use them to control the rotating directon of the motors. The transistorsamplify the signal from the sensor to rotate the motor and could also be used to cause the LED to flash.

Learn all about the electronic parts used in robots

Diode

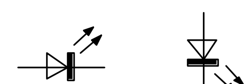


The diodes used in this circuit allow the flow of electrons one way only. This flow is from the anode to the cathode. Therefore, diodes are basically a one-way valve for electrical current. They let it flow in one direction (from positive to negative) and not in the other direction. Most diodes are similar in appearance to a resistor and will have a painted line on one end showing the direction or flow (white side is negative). If the negative side is on the negative end of the circuit, current will flow. If the negative is on the positive side of the circuit no current will flow.

LED

LED stands for Light Emitting Diode and it emits a light such as green or red. LEDs are simply *diodes* that emit light of one form or another. They are used as indicator devices. Example: LED lit equals machine on. They come in several sizes and colors. Some even emit Infrared Light that cannot be seen by the human eye.

IC Integrated Circuit

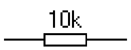
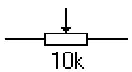
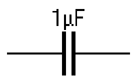
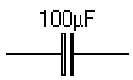
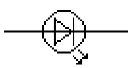
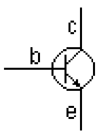
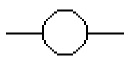
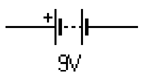


IC Integrated Circuit

Integrated Circuits, or ICs, are complex circuits inside one simple package. Silicon and metals are used to simulate resistors, capacitors, transistors, etc. It is a space saving miracle. These components come in a wide variety of packages and sizes. You can tell them by their "monolithic shape" that has a ton of "pins" coming out of them. Their applications are as varied as their packages. It can be a simple timer, to a complex logic circuit, or even a microcontroller (microprocessor with a few added functions) with erasable memory built inside. The IC's used in this robot amplifies the output voltage from the sensor and these signals to the circuit controlling the left motor. Basically it is amplifying the weak signals from the light sensor or phototransistor, and sends them to the motors for controlling the robots movements.

Know your symbols

The different types of components we have encountered each have a symbol to represent them in a **circuit diagram**. Please see the actual circuit diagram of Hydrazoid to see where the symbols are located

 Resistor	 Preset Resistor	 Non-electrolytic capacitor	 Electrolytic capacitor
 LED - the arrow shows the direction that conventional current can flow	 Transistor - the arrow shows the direction that conventional current flows	 Sound sensor	 Battery

Learn all about the electronic parts used in robots

We certainly enjoyed developing Hydrazoid and we hope equally that you enjoyed building it. We would be delighted to hear from you about this product and the resource material we provide and if you found it in any way beneficial.

We will be developing more and more exciting and innovative robots to add to the iBOTZ range for you to build and program. If you experience any difficulty building this robot you can go to our web site and see additional assembly photographs and frequently asked questions on **www.iBOTZ.com**.

Also if any components are missing or have been lost by you, don't worry! We will send them to you for free! All we ask is that you tear off the form across the page and send it to us together with a stamped self-addressed envelope.

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Part No.	Description	Qty
Plastic parts		
1004-001	Cover (A1)	
1004-002	Chassis (A2)	
1004-003	Left front leg (B1)	
1004-004	Right front leg (B2)	
1004-005	Left rear leg (B3)	
1004-006	Right rear leg (B4)	
1004-007	Crank (B5)	
1004-008	Crank (B6)	
1004-009	Platform (C1)	
1004-010	Left joint rod (C2)	
1004-011	Right joint rod (C3)	
1004-012	Left panel (C4)	
1004-013	Right panel (C5)	
1004-014	Screw -A	
1004-015	Screw -B	
1004-016	Screw -C	
1004-017	Screw -D	
1004-018	Screw -E	
1004-019	Screw -F	
1004-020	Screw -G	

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978-568-0484 (USA)

Part No.	Description	Qty
1004-021	Flat washer-A	
1004-022	Flat washer-B	
1004-023	Spring washer-C	
1004-024	Pipe spare-A	
1004-025	Pipe spare-B	
1004-026	Nut-A	
1004-027	Nut-B	
1004-028	L Bracket	
1004-029	Rubber bushing	
1004-030	Motor (3V)	
1004-031	Spanner	
1004-032	Gear shaft	
1004-033	Motor base	
1004-034	Gear-A	
1004-035	Gear-B	
1004-036	Gear-C	
1004-037	Gear-D	
1004-038	Gear-E	
1004-039	Sleeve	
1004-040	Fibre-optic antenna	
Electric parts		
1004-041	PCB	
Sets		
1004-042	Cover set	
1004-043	Leg set	
1004-044	Plat form set	
1004-045	Wire set	