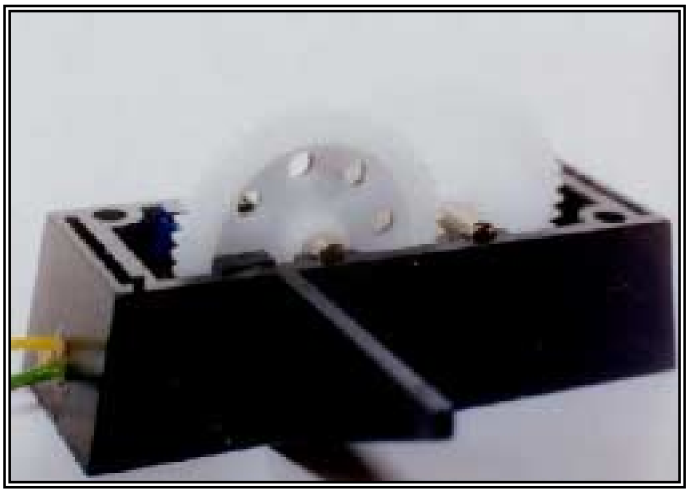
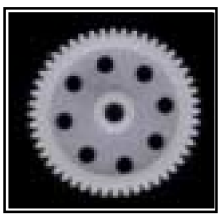
Odometry for Cybot

Cybot has a major weakness with its sensing ability: it can't tell how far it has travelled, in what direction and how fast. It needs some Odometry: a means of measuring distance travelled.



The milometer in a car is also known as an odometer. On wheeled robots like Cybot the usual method is to attach a disk with radial slots cut in it to a wheel axle. A light source is arranged to shine through the slots to a detector on the other side of the disk. As the axle turns the beam of light is cut as the slots move past, providing electrical pulses at the output of the detector. If you count these pulses you get a measure of how much the wheel has revolved and how far the robot has moved. Take an old computer 'mouse' apart: the type with a ball underneath. You will find two slotted disks arranged at right-angles providing distance-travelled information in two dimensions to the computer. It is possible to adapt these parts for use on a robot, but for Cybot all you need to do is drill some holes in one of the gear wheels in each gearbox to give us our 'slotted disk'. Then all that is needed is a light source (or emitter) and a detector. The big problem is what to do with our detector output signal. This would normally go into a spare input on the microprocessor chip, but as we don't know what form the processor will take as yet, we will have to wait a while before making use of the new sensor. In the mean time......

Step 1. The Tachometer wheel



I used the gear driven by the motor pinion as my disk wheel. Each of the large gears in the box has 48 teeth, and each is meshed with a 12- toothed pinion dropping the motor speed by a factor of 4 in three stages. This means that the road wheel rotates 4 x 4 x 4 = 64 times more slowly than the motor shaft. The gear I have used rotates 4 times more slowly than the motor, but 16 times *faster* than the road wheel. In other words, for every revolution of the road wheel, my 'slotted disk' will rotate 16 times. This means that if I have 8 slots or holes in my disk, there will be 16 x 8 = 128 pulses at the detector output for every revolution of the road wheel.

The wheels are 55 mm in diameter so their circumference is πD = 3.142 x 55 = 172.8 mm. We have 128 pulses per revolution so each pulse corresponds to a distance travelled of 1.35 mm. By counting pulses we measure distance. By counting pulses for a known time period we get a value for speed.

Now each wheel has its own sensor, so if one wheel has travelled further than the other, then we know the robot has been turning and directional information can be deduced.

Marking out the hole positions is easy because 48 is divisible by 8, giving us one hole every 6 teeth. Use a black felt pen to mark every 6^{th} tooth and then using a sharp point, make a firm dint in the gear 3 mm down from the outer rim for the centre of each hole. The eight holes can then be made with a sharp 2.5 mm drill.

Step 2. The Sensor

This is based on an Infra-Red diode/phototransistor matched pair: the Vishay TCZT8012 available from Farnell, although anything similar will do. These are

'side-looking' devices in a convenient square package easily stuck to the sides of the gearbox with impact adhesive. Looking at the picture of the assembled gearbox you can just see the tops of the LED and phototransistor fixed either side so as to 'look through' the holes in the gear as they go past. The circuit is quite simple and only requires two resistors in addition to the detector pair. I went to the trouble of soldering all the components together and fitting them inside the box (well clear of the gears). The three wires are brought out through a hole drilled in one end. If you don't feel up to this then the two resistors can be mounted on a small piece of board fixed outside the box.

Step 3. Interfacing

As I said before the signal we have produced can be routed straight into a spare ‘port’ input on the controlling microprocessor chip, but as we don’t know what this is yet, little further progress can be made unless you make up your own processor board of course. This is however the first stage in turning Cybot from a toy into a ‘real’ robot!