# Minimouse

## Introduction:

Minimouse is simply an advanced version of a Line Follower Robot. It consists of two major components:

(1) Hardware ( includes the sensors and driving mechanisms )
(2) Software ( path following and grid solving algorithm )

## The Hardware of Minimouse:

The hardware of a minimouse plays a vital role in functionality of the robot. It should be capable of providing accurate information to the "brain" of the minimouse and should be efficient in executing the decisions made by it. The hardware includes:

(a) An array of Sensors
(b) Motors for driving the mouse
(c) The Brain of the mouse
(d) Power Supply to the entire system

## Sensors:

Sensors are used in a minimouse for the purpose of line (grid) following and to determine the obstructions (red cubes) in the course. This can either done using Light Dependent Resistors (LDR) or Infrared Sensors (IR Sensors).

The LDR when connected series in a circuit varies its resistance depending upon the intensity of visible light available. So when an LDR coupled with a visible light source (usually a LED) shows better low resistance on a white surface (high amount of reflection) and much higher resistance on a black surface (less amount of reflection). The LDR and LED couple is mounted such a way that one is beside another both facing the surface. Any number of sensors can be used to increase the efficiency but depending upon the processing speed of the brain – "Microcontroller" of your mouse. A minimum of three sensors are required to get accurate results out of the grid.

An IR sensor uses the same principle but uses Infrared LEDs instead of ordinary LEDs. Both IR and LDRs can be used for line following, but it would be better to use an IR sensor for determining the obstruction ahead. A touch sensor can even be used for this. For more details on sensors please do check the following web links:

http://www.technologystudent.com/elec1/ldr1.htm (LDR)
http://www.kpsec.freeuk.com/components/other.htm (LDR)

http://www.robotroom.com/Infrared555.html (IR Sensors)
http://www.students.uwosh.edu/~piehld88/laser.htm (IR Sensors)
http://www.wanyrobotics.com/distance.html # (IR Sensors)

An LED – LDR Couple

## Motors:

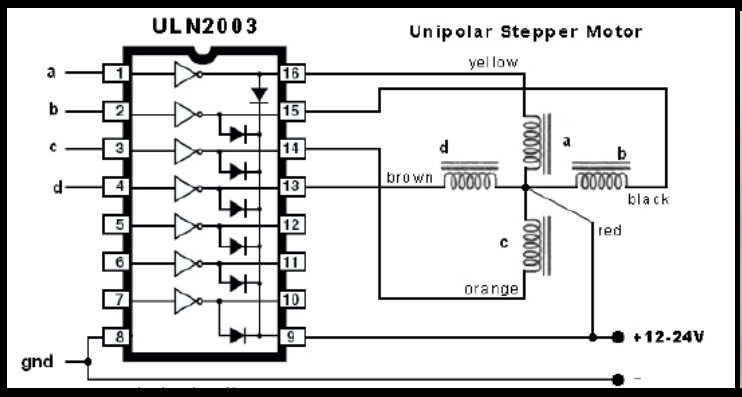
Any geared motor can be used to drive a minimouse. But one should be ensure that the motor is not too fast that the sensors don't get sufficient time to sense the grid. Direct connection of motor with the microcontroller is not possible. So for ordinary geared motors a motor driving IC L293D (an H bridge) must be used. It has got many other functions such as enabling differential drive (mobility in all direction) and pulse width modulation for controlling the speed of motor.

http://www.robotroom.com/Jet.html (motors)

http://www.me.umn.edu/education/courses/me2011/robot/technotes/L293/L293.html (L293D)

http://www.4qdtec.com/bridge.html (H Bridge)

Stepper motors can be used for maneuvering the minimouse which provides better accuracy. A stepper motor has more number of coils than an ordinary geared motor and energizing each coil turns the rotor to a specified angle thereby enabling better control on the movement of the mouse. For driving a unipolar stepper (bipolar steppers are also there) you need to connect an IC ULN2003 to the microcontroller.




The sequence to apply (a,b,c,d) – (1,0,0,0), (0,1,0,0),(0,0,1,0),(0,0,0,1), the motor rotates in one direction if we apply (1,0,0,0),(0,0,0,1) then motor will rotate in other direction. A good parallel port circuit diagram is in the link. (The input a, b, c, d data outputs from the microcontroller)

http://electronics-diy.com/stepper_motors.php

More useful links in stepper motor are:

http://www.imagesco.com/articles/picstepper/02.html
http://www.cs.uiowa.edu/~jones/step/types.html
http://www.doc.ic.ac.uk/~ih/doc/stepper/

## The Brain – Micro Controllers:

Micro controllers are programmable ICs in which you can store a program in machine code and execute it. There are many micro controllers but use of either ATmega 16 or ATmega 32 will be sufficient for solving the minimouse. Besides the have the advantage that they don't need a special programmer circuit to write the machine codes in it. ATmega 16 and ATmega 32 are basically same in pin diagram and function except the fact that ATmega 32 has more programmable memory.

ATmega 16 has 4 ports and each port having eight pins. A port is place where you can give your input (sensors) and tap outputs (motors) depending upon the way they are defined in the program (code) you load into the micro controller. (Ref the sample codes given)

You can use the WinAVR 2008 for compiling your program (converting your C program to machine code). You can download WinAVR 2008 from:

winavr.sourceforge.net

The WinAVR also include a "programmer's notepad" where you can write and compile your C program for your mouse. It also includes an "mfile generator" which actually configures your compiler for the particular micro controller you are using. For further details in AVR programming and development please do go through the eBook written Bibin John:

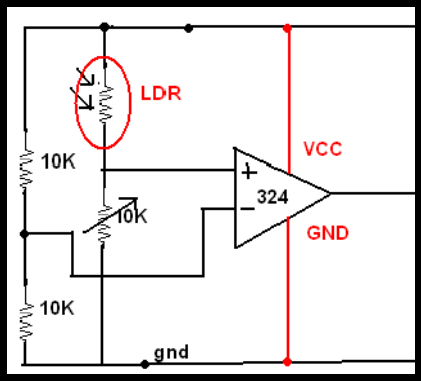
My Experience in Programming AVR Microcontroller Using WinAVR/AVRgcc

You can burn the codes to your micro controller using parallel port, serial port or usb port. If you are using a parallel port programmer you can use the WinAVR itself for burning the codes. But if you going for serial port programming you should download software called Pony Prog:

www.lancos.com/prog.html

You can get the detailed pin diagram of ATmega 16 from its data sheet. The sensors can be directly connected to the micro controllers using its in build ADC (Analog to Digital Conversion) ports which should be initialized in the code (check sample code) or you can use a comparator IC LM339 so that you can use the ADC ports for interfacing an LCD. If you are using the inbuilt ADC of the micro

controller the sensitivity of the sensor can be adjusted by adjusting the threshold value in the program (check sample code). Otherwise in case of a comparator it can be done by adjusting the preset connected to the sensor.



Sensor connected to the comparator using a preset.

You can even equip your minimouse with a LCD to determine the output of various sensors, direction of the mouse, etc. To get a better idea on the hardware of the minimouse please do go through the EBook written by Bibin John:

My Experience in Autonomous Robotics

Indian forums for robotics and electronics:

www.roboticsindia.net

www.migindia.com

www.hamradioindia.org

www.machinegrid.com

## Power Supply:

There should be sufficient power to drive both the circuit and the motors. Ordinary AAA cells would be sufficient. In case of using IR LEDs, a large power drop may occur. So it would be better I you use separate power supplies for the circuit and motors.

## The Software of Minimouse:

The mouse starting from the rightmost corner (starting point) can either go straight or turn left depending how you program it. Them it goes to the next node a checks whether any obstruction is present over there. If an obstruction is present it takes the alternative path and if not it bypasses that node and repeats the same procedure.

The flood fill algorithm which is used to solve the Micromouse can be used to solve the minimouse too. You can get the flood fill algorithm at any Micromouse forums.

Another algorithm which can be used in the solution of minimouse is considering a 5X5 matrix and taking each element as a node (junction) of minimouse arena. When the minimouse gets obstructed,

i.e. it can't go anywhere from that node, the program closes that possibility by sending a particular value to the specified element representing that node. Similarly for the correct path also it sends another value. In the end the minimouse has the set of nodes through which it should go so as to reach the end point. The algorithm can be made more efficient if you can pass the direction, left right or straight, the mouse should move at each node so that it can move much faster. This can also achieved by passing predetermined values to elements of the matrix.

This tutorial is aimed at beginners to the field of autonomous robots. You can browse through the internet for more information. The links provided in this tutorial will definitely provide some help to you. Thank you for patiently reading this tutorial for any doubts or queries do contact:

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