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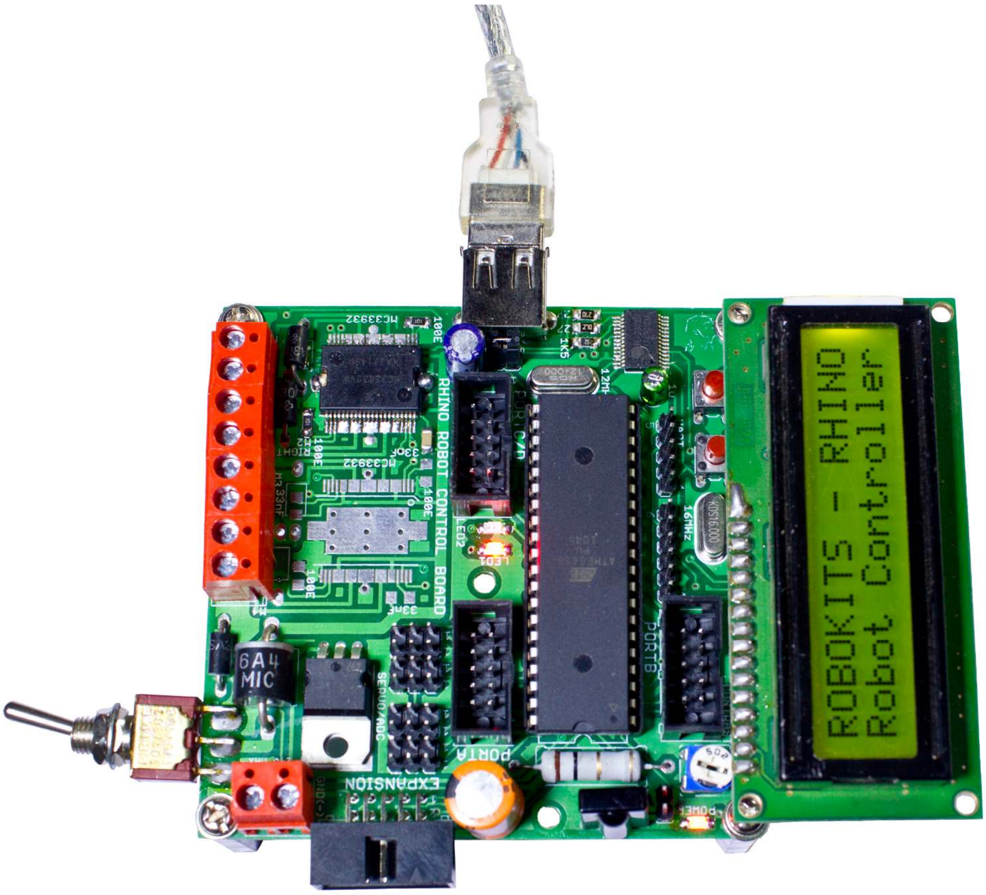
Rhino Robot Control Board

Basic tutorial



RAN1101 Basics: LEDs, Switches, LCD, Motor Drivers, UART

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Rhino Robot Control Board is our most powerful, versatile and most easy to use robot control board. In this first part of tutorials and application notes series you will learn about basic elements of Rhino Board and Quick C – IDE software which is a specially developed software for this board.

We also hereby assume that you have gone through Rhino Board Manual, Quick C IDE user manual and Quick C IDE library reference. Its not necessary for you to understand everything written in those documents but you should have an overview so that you can use them as reference for some part in this document.

This tutorial covers

- **Controlling LEDs and give outputs**
- **Taking Inputs from switches**
- **Display static and dynamic data on LCD**
- **Control motors**
- **Input and output data to UART (PC as other device)**

Required Items for this tutorial

- **Rhino Robot Controller Board or Rhino Robot Controller Board L293**
- **LCD Display**

1. LEDs

There are 2 LEDs on Rhino Board. LEDs are connected to PC6(IO 22) and PC7(IO 23) of Atmega16 MCU on board. There are functions in Quick C to directly control LEDs. We can also control pins of Atmega to control LEDs. First program is for simple blinking of LED1.

Code 1 : Simple blink

Open 001 – LED1 blink program in sample codes folder.

Library used : Delay

The code is simple. **LED1ON()** turns on LED1 and **LED1OFF()** turns off LED1. **DELAYMS(100)** provides delay for 100 milliseconds.

Code 2 : Simple blink with TOGGLELED function

Open 002 – LED Toggle program in sample codes folder.

Library used : Delay

The **TOGGLELED1()** turns on LED1 if its OFF, but if its On it will switch it off. This program creates same effect as code 1.

Code 3 : Control LEDs with PORT IO function

Open 003 – LED control with PORT IO program in sample codes folder.

Library used : Delay, IO Notations

This code uses **PINMODE(23,1)** and **DIGITALWRITE(23,1)** which are Arduino like pin access functions for Rhino Board. You can see Library reference file for all IO pins. LED1 is connected on PORTC-7.

The **PINMODE(23,1)** function sets PORTC.6 pin as output pin. **DIGITALWRITE(23,1)** Turns LED1 on As LED is connected to this pin it turns on and **DIGITALWRITE(23,0)** tunrs off as per pin status. Any other pin on board can be set high or low with this function.

This concludes the LED sections. It also shows how to set output on any pin of Rhino Board.

2. Switches

There is one general purpose switch on rhino board which is connected to PD.6 (IO 30). More switches may be connected to extra IOs and can be used by PORT IO functions. You may also use 8 switch Keypad or 4x4 Keypad with this board to get more switches. Second switch on Rhino is a reset switch which resets microcontroller.

Code 1 : Simple Input

Open 004 – Simple Switch Input program in sample codes folder.

Library used : Delay

Here to take input we need to use a conditional statement like 'if'. Here if(SWITCH1ON()) returns true(1) if switch is pressed and false(0) if switch is not pressed. The if – else condition creates logic to turn on and off the LED as per switch input.

This program will also work without DELAYUS(100) statement but its always advisable to keep delay in infinite loop to avoid microcontroller to use its all resources.

Code 2 : Input with PORT IO functions

Open 005 – Switch Input with PORT IO program in sample codes folder.

Library used : Delay, IO Notations

This code uses PINMODE(30,0) and DIGITALREAD(30) which are Arduino like pin access functions for Rhino Board. You can see Library reference file for all IO pins. Switch is connected on PORTD-6.

The PINMODE(30,0) function sets PORTD.6 pin as input pin. if(DIGITALREAD(30)) returns true(1) if switch is not pressed and false(0) if switch is pressed. This program runs same as previous one but using this functions you can connect switches externally to any of IOs and take input.

This concludes the Switch Input section. It also shows how to take digital input from any IO pin of Rhino Board.

3. LCD & ADC

Rhino Board is capable of driving a Character LCD display with parallel interface. Display size can be 16X2, 16X4, 20X2, 20X4 and other compatible displays. For other types of LCDs like graphic LCD readymade functions and pinouts are not available, however it can be done easily like its done on any other AVR board.

Connection is very simple, Rhino board haves a 16 Pin Male header on one of the edges. Here an LCD display with 16 female header can be plugged in. There is a potentiometer for contrast adjustment.

Code 1 : LCD Modes Demo

Open 006 – LCD Basic Demo program in sample codes folder.

Library used : LCD, Delay

This code shows simple text printing on LCD. It also shows all the modes that LCD supports. When printing on LCD it can display cursor with or without blinking or no cursor at all. Various functions used in this program are self explanatory.

Code 2 : Advanced LCD functions and displaying variables on LCD

Open 007 – LCD Advance program in sample codes folder.

Library used : LCD, Delay

LCD is often used as debug tool while making programs. This may be to verify that whether ADC(Analog to digital convertor) is taking correct values from sensors or to verify formulas for calculations. This code prints tables of 1 to 99 on LCD screen line by line. This code also demonstrates the use of for loop and nested loops. **LCD_PRINT** function can’t display values directly on LCD so first we need to convert any value to string and then pass through function. In this code **itoa** function is used to covert integer values to string.

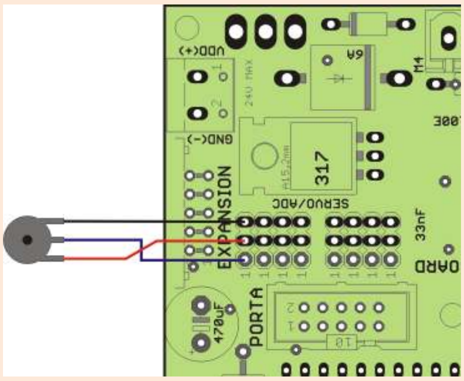
Code 3 : Use Analog to digital convertor to take analog input and show input on LCD

Open 008 – ADC on LCD program in sample codes folder.

Library used : LCD, Delay, ADC

Here we will use a potentiometer to give variable voltage output from 0-5V and take that input, covert it to a digital value and show on LCD

Connection : Connect a potentiometer with 3 wires. Center pin is output and 2 pins around is +5V and GND. Female headers or jumper wires can be used to make connections.



You can also test this code without potentiometer, however it will show some random values. If you short the ACD pin to +5V or GND it will show 1024 and 0 values.

When above connection is done potentiometer will output 0-5V as shaft is rotated. This output goes to ADC0 Pin(see diagram). `num=GETADC(7);` takes the ADC input and stores to num variable. Next statements show it on LCD. This is infinite loop as `while(1)` is used.

In place of potentiometer any sensor or equipment which gives analog output in 0-5V range can be connected to this board.

This concludes the LCD and ADC sections.

4. Motor drivers

Rhino Board includes motor drivers either L293 or MC33932. L293 provides 1A per motor while MC33932 provides 5A per motor. However coding remains same for both boards, so program written for one board will work on other too.

Motor drivers consume variable resources according to requirements and number of motors attached. If you need speed control for motors a timer and PWM pins will be consumed.

For driving motors you will also need external power supply. All above sample codes will work without extra power supply on USB power, but motors will need external power.

Code 1 : Driving DC motor with direction and speed control

Open 009 – DC Motor Demo program in sample codes folder.

Library used : LCD, Delay, Motor – M1 & M2 Motors Active with PWM

This code controls DC motor with speed and direction control. Motor is connected to M1 Connector. **LMF(i)** drives motor forward at speed of i and also LCD statements show current speed on LCD.

When program is running motor will start moving at speed of 30 and go till 99, once reached at speed 99 it will stay there for 2 seconds and then it will start reducing speed till 30, after speed 30 is achived motor will stop by **LMS()** command. After this it will repeate the process but in backward direction.

Code 2 : Driving Stepper motor with direction and speed control

Open 010 – Stepper Motor Demo program in sample codes folder.

Library used : LCD, Delay, Steppr – 1 Stepper Motor

Connection : Coil 1 of stepper is connected to M1, Coil 2 is connected to M2. Motor is used in bipolar mode so only 4 wires are used.

This code controls Stepper motor with speed and direction control. Works just like previous code.

There are many more functions for motor control which are described in Library reference document.

5. UART

UART is most simple and most used communication protocol for microcontrollers. Rhino uses the same to communicate with PC. Also other devices can be connected on UART lines. UART lines are already connected to onboard USB-Serial convertor IC PL2303 through which Board connects to a USB port of PC. Not only this, UART protocol also allows PC to program Rhino Board.

Code 1 : UART – Input and Output data

Open 011 – UART Demo program in sample codes folder.

Library used : Delay, UART

The code uses inbuilt UART functions to communicate with serial devices. On PC you can use a terminal software and connect it to virtual com port generated by Rhino Board. Once connected pressing reset switch will show a 2 line message on screen. After that sending any character on port will echoed back by board.

Check the first line where there is a definition for baud rate. This is the baud rate for communication. Make sure that this is same as the other device's baud rate.

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