Touch Screen Controlled Robot

(For Handicapped and Mentally Disabled)

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Abstract
The project is a Touch Screen controlled robot . It uses an Arduino Duemilanove Development Board especially designed for those having interest in electronics, embedded system, robotics and industrial-automation. The software used for programming is WinAVR. The programming language used is Embedded C. There also is an LCD used for displaying the direction of the Robot.

Keywords
Arduino Programming, RobotC Programming, AVR Micro-controller Programming

I. Introduction (About Arduino Duemilanove)

Arduino Duemilanove Development Board 129011 is especially designed for those having interest in electronics, embedded system, robotics and industrial-automation. This board is made in such a way that it becomes easier for anybody to learn about Arduino programming, RobotC programming & AVR microcontroller programming using any other software/IDE. This board can also be used in various applications and hobby projects.

A. Arduino Duemilanove Development Board 129011

- Includes Atmel's ATmega328P Microcontroller with 32kb flash memory working at 20MIPS
- On-board Motor Driver for connecting 2 DC motors or 1 Stepper motor
- PC interface for UART communication through virtual COM port by FT232RL IC
- On-board Reset switch
- 16 MHz external crystal
- Exposed all 20 normal usable I/O pins
- Exposed 6 channel I/O pins for ADC with 5v/1A power supply
- Exposed 14 I/O channels for sensors and other peripherals with 5V/1A power supply
- Separate power supply option for Motor & microcontroller
- Dual or single power supply option for microcontroller & motor
- Dual power supply option for microcontroller, through DC source (6V to 16V) or USB
- On-board 5V regulated power supply for microcontroller
- One test surface mounted LED (Digital13) for status and debugging purpose
- Two Rx & Tx surface mounted LEDs for UART receive & transmit indication
- Two supply indicator LEDs for microcontroller supply & motor supply
- Exposed 3.3V, 5V & Ground pins
- On board USB programming provision through FT232RL USB to Serial converter
- Exposed ISP & ICSP pins for programming
- Option for separate AREF (Analog Reference) voltage for ADC
- Standard Arduino Shield can be mounted easily
- Designed as per Arduino standard & compatibility

B. Parts Identification Microcontroller

It is a micro computer chip which stores the user program, executes them and takes necessary action. The chip used here is Atmel's popular AVR Atmega328P microcontroller but any AVR series microcontroller with pin compatibility can be used.

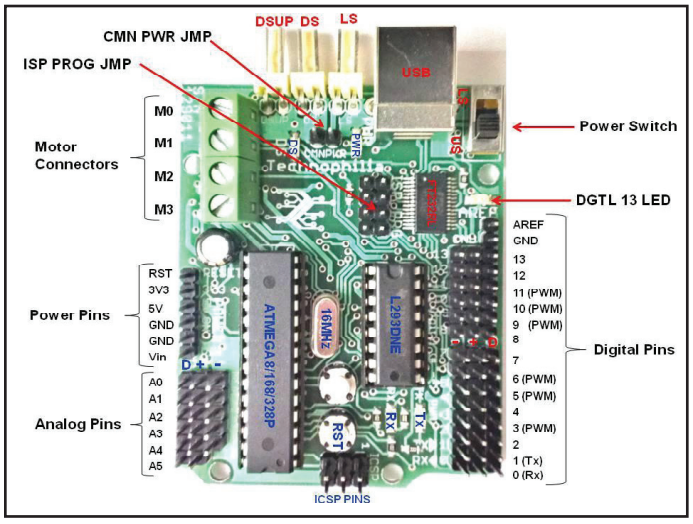


Fig. 1:

C. AMS-1117-5.0 Voltage Regulator

It is a three terminal 5V voltage regulator IC used to provide a constant voltage supply of 5V to the microcontroller and other peripherals (i.e. sensors etc) attached to the main board.

D. FT232RL USB to Serial Converter

The FT232R is a USB to serial converter IC. This IC creates a irtual COM port in the PC & takes care of protocol conversion needed for the communication between the PC's USB port and microcontroller. Optionally it performs voltage conversion and clock generation.

E. L293DNE Motor Driver

This is basically a motor driver IC which takes input from microcontroller and is able to drive the DC and stepper motors by using separate power supply.

F. Switches

1. RST (Reset Switch)

The Reset switch is basically used to reset a running program right to the beginning. It is same as the reset switch of a PC.

2. PWR (Power on Switch)

It is basically a toggle switch used to provide power supply to the main board. The power can be supplied to the microcontroller either by a battery connected at LS (Logic Supply, 2pin white connector) or an USB cable connected between the board & a PC/ Laptop. Thus, the POWER switch can be made to toggle between LS (Logic Supply) or US (USB Supply).

G. Power Supply

1. LS (Logic Supply)

It is a 2pin berg strip consists of two pins one is +ve and another is –ve. A battery or an AC adaptor can be connected here to provide power supply to the mother board. It provides regulated power supply to all the peripherals present in the mother board and also to the external peripherals connected with the motherboard through a 5V voltage regulator IC. The DC voltage provided to this terminal should lie in between 6 to 16V, 1Amp. To use the supply connected at LS pin the power switch should be toggled towards "LS" (Logic Supply).

2. DS (Driving Supply)

It is a 2pin berg strip consists of two pins one is +ve and another is –ve. It is basically used to provide a separate high current/voltage power supply to the Motors. For operating DC motors you may connect here a Power supply of 5 to 25V, 1Amp.

H. CMNPWR (Jumper)

It is a simple 2pin jumper which can be used to use a single power supply for DS and LS. If you put a jumper here & connect a single battery only at DS or LS, the microcontroller as well as the motor will get supply from that battery.

I. USB Socket

It is basically used for USB communication with the PC. It also provides necessary logic supply to the motherboard. In order to use the USB supply the PWR switch should be toggled towards US (USB Supply). When using the USB power some precautions should be taken such as any heavy load should not be connected to the board directly and don't use the CMNPWR (Jumper)

J. LED's

1. Active High

- Orange LED - Digital13 - PORTB5 – Status indicator used for debugging
- Red LED - PWR - Power ON indicator
- GREEN LED - DS - Driving Supply Power ON indicator for motor
- Red LED - Tx - UART Transmit indicator
- Green LED - Rx - UART Receive indicator

K. ISP PRG (In-System Programming) Interface

It is the In-System Programming interface of the main board which can be used to download/burn/dump the user programs (.hex files) in to the microcontroller. To do ISP programming you have to put 4 jumpers there, the pins used are given below:
FT232 Pins Microcontroller Pins
RI RST
DCD MOSI
DSR SCK
CTS MISO

L. ICSP (In-Circuit Serial Programming) Interface

In Circuit Serial Programming (ICSP) is a method of directly programming AVR microcontrollers using different types of separate hardware programmer. It has been designed as per the Arduino standard so that you can connect a separate hardware programmer & download/burn/dump your programs (.hex files) in to the microcontroller. The pins used are given below:
MISO SCK RST
+5V MOSI/SDIN GND

M. Digital 0-13

These are the general purpose I/O port pins. It consists of 14 pins that can be used for digital input and or digital output. These pins are in the form of DATA-VCCGROUND (denoted as D + - respectively on the board). The pins near to the edge of the board are the Data pins. The VCC and Ground pins are provided with a 5V/1A power supply. The 14 pin details are:
Digital 0 PORTD0 UART Rx Digital 9 PORTB1 PWM#
Digital 1 PORTD1 UART Tx Digital 10 PORTB2 PWM# + M0
Digital 2 PORTD2 Digital 11 PORTB3 PWM# + M1
Digital 3 PORTD3 PWM# Digital 12 PORTB4 M2
Digital 4 PORTD4 Digital 13 PORTB5 Dgtl13 LED + M3
Digital 5 PORTD5 PWM#
Digital 6 PORTD6 PWM#
Digital 7 PORTD7
Digital 8 PORTB0

N. Analog A0-A5

These are the Analog to Digital Conversion pins. It consists of 6 pins that can be used for ADC as well as digital input and or digital output. These pins are in the form of DATA-VCC-GROUND (denoted as D + - respectively on the board)*. The pins near to the edge of the board are the Data pins. The VCC and Ground pins are provided with a 5V/1A power supply. The 6 pin details are:
A0 PORTC0
A1 PORTC1
A2 PORTC2
A3 PORTC3
A4 PORTC4
A5 PORTC5

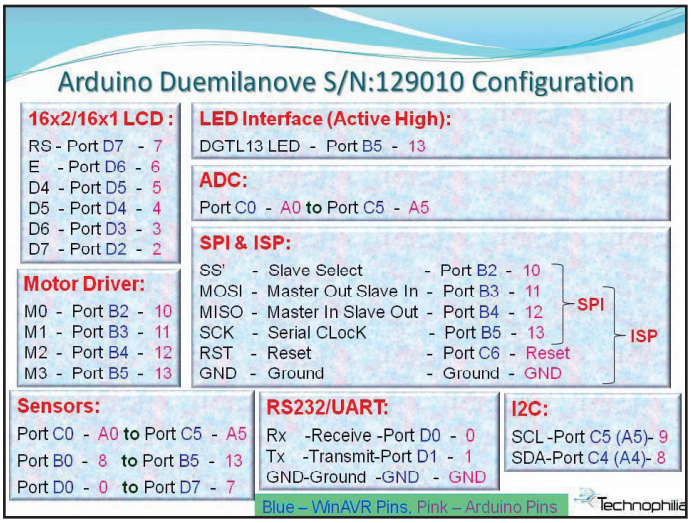
O. Power

These pins are provided to give the supply to the Arduino shield if connected from the board. The pin details are:
RESET Connected to the Reset pin of the microcontroller
3v3 3.3v out pin from the FT232 IC, don't connect any heavy load here
5V 5V out pin from the voltage regulator
GND, GND Ground pins
Vin Input voltage from external source goes to the voltage regulator input

P. Motor Driver Connections

The motor driver is used to run the DC motors or stepper motor that may be connected to the board according to the data from the microcontroller. The motor IC used here is L293DNE & the driver's link with microcontroller pins are:
M0 - Digital 10 PORTB2
M1 - Digital 11 PORTB3
M2 - Digital 12 PORTB4
M3 - Digital 13 PORTB5

Q. I/O Configurations/Connections:-

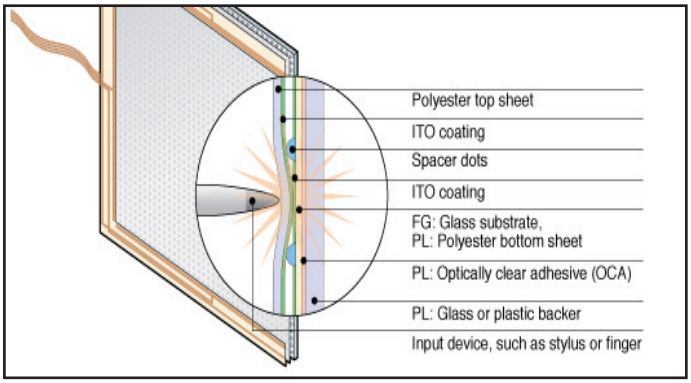


R. The AVR Microcontrollers

The AVR is a Modified Harvard architecture 8-bit RISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use onchip flash memory for program storage, as opposed to One-Time Programmable ROM, EPROM, or EEPROM used by other microcontrollers at that time. Atmel's low power, high performance AVR microcontrollers handle demanding 8 and 16-bit applications. With a single cycle instruction RISC CPU, innovative Pico Power® technology, and a rich feature set, the AVR architecture ensures fast code execution combined with the lowest possible power consumption. Whether you program in C or assembly, the tuned AVR instructions decrease program size and development time. The well-defined I/O structure limits the need for external components and reduces development cost. A variety of internal oscillators, timers, UARTs, SPIs, Pulse Width Modulation, pull-up resistors, ADCs, Analog Comparators and Watch-Dog Timers are some of the features available for creative engineers. The AVR microcontrollers are divided into 4 families tiny AVR, mega AVR, XMEGA and Application specific AVR. Among these 4 families of AVR here we are going to use a microcontroller of mega AVR family "ATmega328P".

S. Touch Screen

1. Working



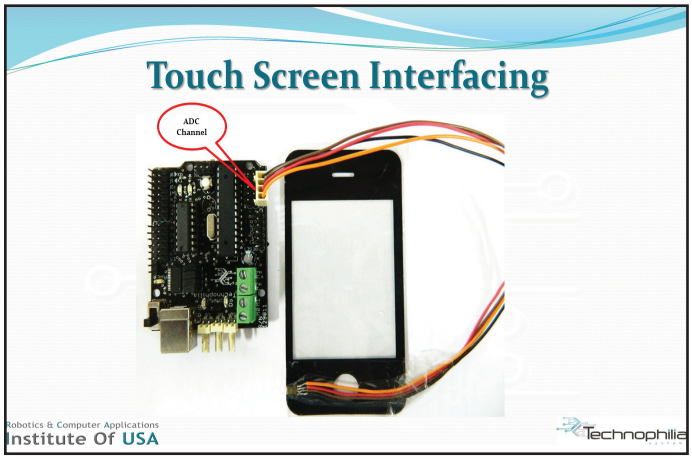
TOUCH SCREEN BASICS

The 4-wire Resistive Touch Screen consists of a conductive bottom layer of either glass or film and a conductive top film layer, separated by extremely small, transparent spacer dots. A voltage is applied across the conductive surface. Any type of probe, including fingers, gloved fingers, credit cards, pens, etc., that can be used to apply pressure against the top film will activate the screen. When ample touch pressure is applied to the top layer, the film flexes inward and makes contact with the bottom layer resulting in a voltage drop. This change in voltage is detected by the controller. By alternating the voltage signal between the top and bottom layer, the X and Y coordinates of the user's touch are computed. In a Film on Glass (FG) construction, the bottom layer is an ITO coated glass. In a Polyester Laminated (PL) or film-film-glass construction the bottom conductive layer is polyester. An additional layer of Optically Clear Adhesive (OCA) bonds the bottom polyester layer to a backer typically made of glass or poly material.

The touch screen is an input device that allows users to operate a device simply by touching the display screen. A basic touch screen has three main components: touch screen sensor, controller and software driver.

Touch Screen Sensor Typically a glass panel with a touch-responsive surface.	**Controller** A printed circuit board (PCB) that is the interface between the sensor and the display. The controller takes information from the touch screen and translates it into information a computer can understand, such as cursor control, right and left clicks, etc.	**Software Driver** A computer program that allows the computer operating system and the controller to communicate and helps the controller recognize input.

T. Connection of Touch Screen



U. LCD

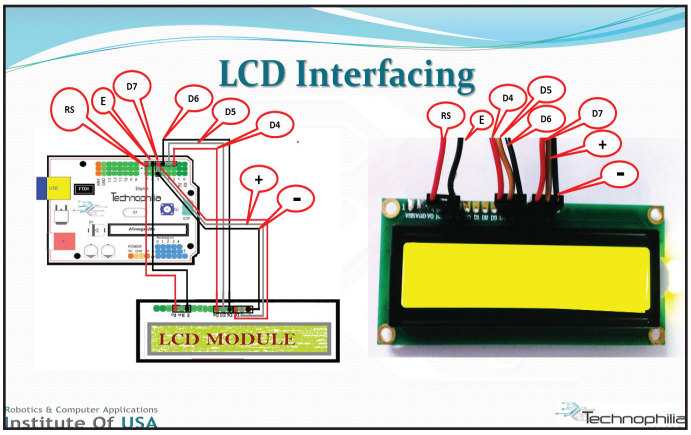
1. Working of LCD

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

(i). Pin Description

Pin No	Function	
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/ write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

(ii). Connection of LCD



Advantages

- Is very easy and comfortable to use
- Can also be used by handicapped and mentally disabled people

References

[1] "Arduino Duemilanove"[Online] Available: https://www.arduino.cc/en/Main/ArduinoBoardDuemilanove