



Adaptive Motion Control of FIREBIRD V Robot

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Abstract— *Fire Bird V supports ATMEGA2560 (AVR), P89V51RD2 (8051) and LPC2148 (ARM7) microcontroller adaptor boards. This modularity in changing the microcontroller adaptor boards makes Fire Bird V robots very versatile. User can also add his own custom designed microcontroller adaptor board. The Fire Bird V robot is the 5th in the Fire Bird series of robots. First two versions of the robots were designed for the Embedded Real-Time Systems All the Fire Bird V series robots share the same main board and other accessories. Different family of microcontrollers can be added by simply changing top microcontroller adaptor board. Atmel ATMEGA2560 is used as Master microcontroller (AVR architecture based Microcontroller) Atmel ATMEGA8 as Slave microcontroller. This paper presents an interactive adaptive module which moves the robot in various directions by loading a program through Atmel Studio 6 into AVR Boot loader and also by using the motor movement supported by L293D IC and setting different ports of IC in configuration with Robot. Atmel ATMEGA2560 is used as Master microcontroller and Atmel ATMEGA8 as Slave microcontroller. Students and engineers can go through each step involved in it for effective learning. The paper will also lay emphasis on basic learning of FIREBIRD V Robot, components of FIREBIRD V Robot, ATMEGA 2560 Microcontroller, Embedded C Programming Language and L293D IC*

Keywords— *FIREBIRD V Robot, ATMEGA 2560 Microcontroller, Embedded C Programming Language, Robot movement using L293D IC, Atmel Studio6/AVR Studio software, AVR Boot loader as program loader*

I. INTRODUCTION

The paper describes the movement of FireBird V Robot in different direction like left, right, forward, backward, soft-right ,soft-left, backward- right, backward-left, by direction control of DC Motor in clock-wise and Anti-clock wise direction using L293D IC with connecting four pins(PA0-PA3) for direction controls to Port A,PA0-Left Motor,PA1-Left Motor,PA2-Right Motor,PA3-Right Motor. Using two pins for enabling motor driver IC connected to Port L (PL3-PL4), PL3-Left Channel Enabling, PL4-Right Channel Enabling. Fire Bird V supports ATMEGA2560 (AVR), P89V51RD2 (8051) and LPC2148 (ARM7) microcontroller adaptor boards, L293D IC. The L293D is a Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. The motor used with FireBird V robot uses the concept of H-Bridge; it is a circuit which allows the voltage to be flown in either direction. Voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge changes the direction ideally for driving a DC motor. There are two enable pins on L293D. Pin 1 and pin 9, to drive the motor, for which pin 1 and 9 need to be high. For driving the motor with left H-bridge enable pin 1 to high, and for right H-Bridge make pin 9 to high. If either pin1 or pin9 goes low then the motor in the corresponding section will

suspend working. The adaptive motion of robot is controlled by movement of wheels which are configured by making following functions of motion sets defined in MAIN function using Embedded C Programming Language with delay of 1000ms before each movement and hard stop at (0x00) position.

Sr.No	Direction(Movement)	Motion Set
1	Forward	Both wheels forward
2	Backward	Both wheels backward
3	Left	Left wheel backward, Right wheel forward
4	Right	Left wheel forward, Right wheel backward
5	Soft_Left	Left wheel stationary, Right wheel forward
6	Soft_Right	Left wheel forward, Right wheel stationary

II. Hardware Methodology

A. FIREBIRD V Robot

FIREBIRD V robot has 6 modules: Sensor which senses the environment, Actuators for movement of robots, controller as brain of robot, intelligence as user written commands to perform action, power supply to make the system function and communication where a robot can talk to another robot or system.



Fig. 1 FIREBIRD V Robot

B. ATMEGA 2560

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller. It is connected to a computer with a USB cable or powers it with an AC-to-DC adapter or battery to get started.

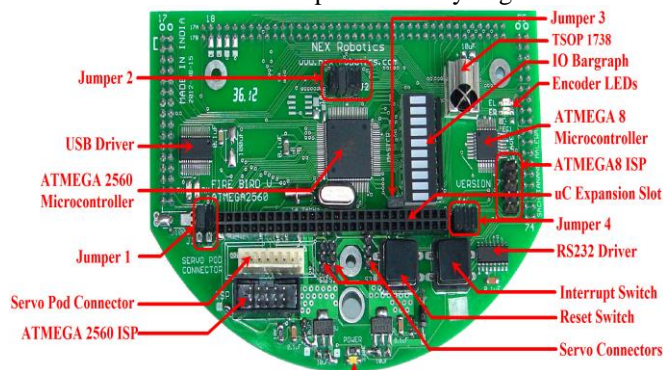


Fig. 2 ATMEGA2560 microcontroller adapter board

C. L293D IC

L293D is a Motor Driver IC that allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction.

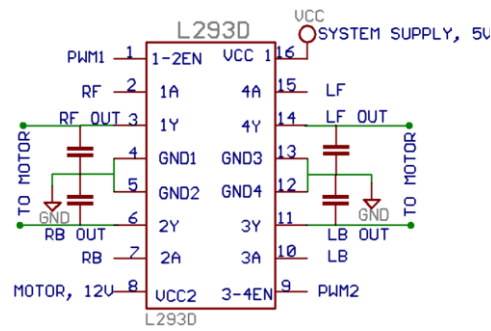


Fig. 3 L293D IC

D. Motion Control

Fire Bird V robot has two 75 RPM DC geared motors in differential drive configuration along with the third caster wheel for the support. The robot can turn with zero turning radius by rotating one wheel in clockwise direction and other in counterclockwise direction. Position encoders are mounted on both the motor's axles to give a position feedback to the microcontroller. Motors are controlled by L293D dual motor driver which can provide up to 600mA of current to each motor. To change the direction of the motor, appropriate logic levels (High/Low) are applied to L293D's direction control pins.

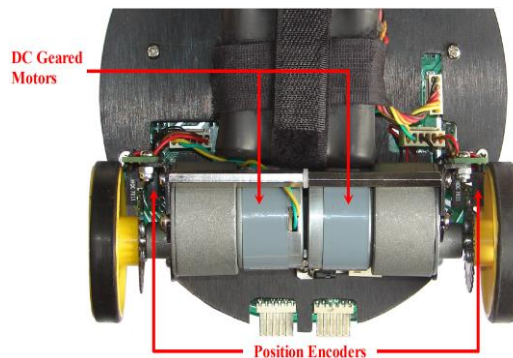


Fig.4 DC Geared Motors

III. Software Methodology

A. Atmel Studio 6/AVR Studio

Atmel Studio 6 is an Integrated Development Environment (IDE) for writing and debugging AVR/ARM applications in Windows XP/Windows VISTA/Windows 7 environments. Atmel Studio provides a project management tool, source file editor, simulator, assembler and front-end for C/C++, programming and on-chip debugging.

B. AVR Bootloader

A bootloader is a program that runs in the microcontroller to be programmed. It receives new program information externally via some communication means and writes that information to the program memory of the processor. A bootloader has to be written to the flash memory just once using a conventional programmer. The bootloader is programmed such that when the bootloader start condition is satisfied it receives data via a predetermined interface (eg, UART) and writes these into the program memory at predetermined locations.

IV. Proposed Algorithm

- i. Set Directions of PortA pins from PA3 to PA0 as output pins.
- ii. Set initial value of PA3 to PA0 pins to logic 0.
- iii. Set PL3 and PL4 pins as output.
- iv. Determine the functions for motor movements.

- v. Read original value of Port A
- vi. Forward Logic motion set----Stop
- vii. Backward Logic motion set----Stop
- viii. Left Logic motion set ----Stop
- ix. Right Logic motion set----Stop
- x. Soft-Left Logic motion set----Stop
- xi. Soft-Right Logic motion set----Stop

Directions	PA0 Left Backward	PA1 Left Forward	PA2 Right Forward	PA3 Right Backward
Forward	0	1	1	0
Backward	1	0	0	1
Left	1	0	1	0
Right	0	1	0	1
Soft_Left	0	0	1	0
Soft_Right	0	1	0	0
Forward	0	0	0	0

Fig 5.Logic Table

V. Result

On Execution of above algorithm the output is displayed on the screen as shown:

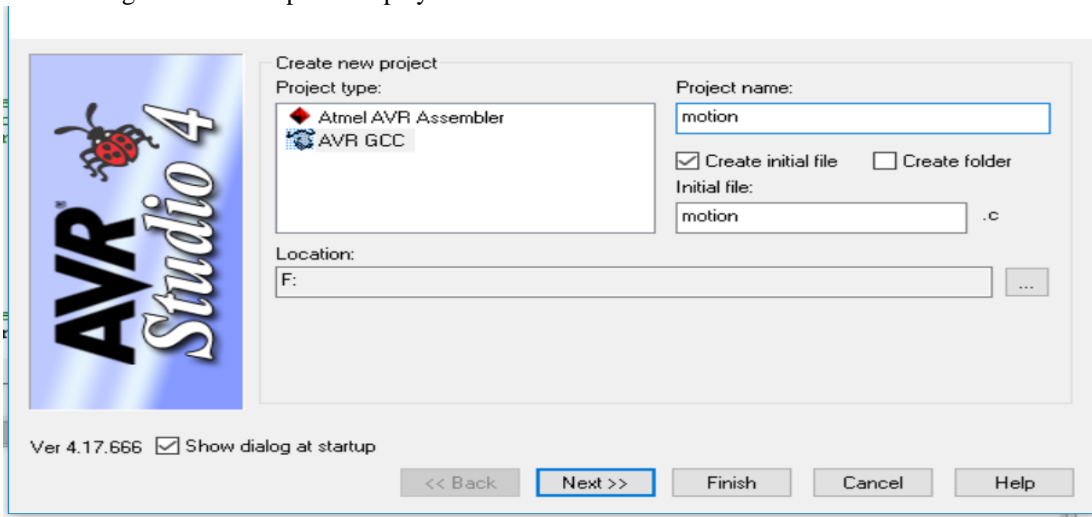


Fig 6: Create a Project and specify Project Name

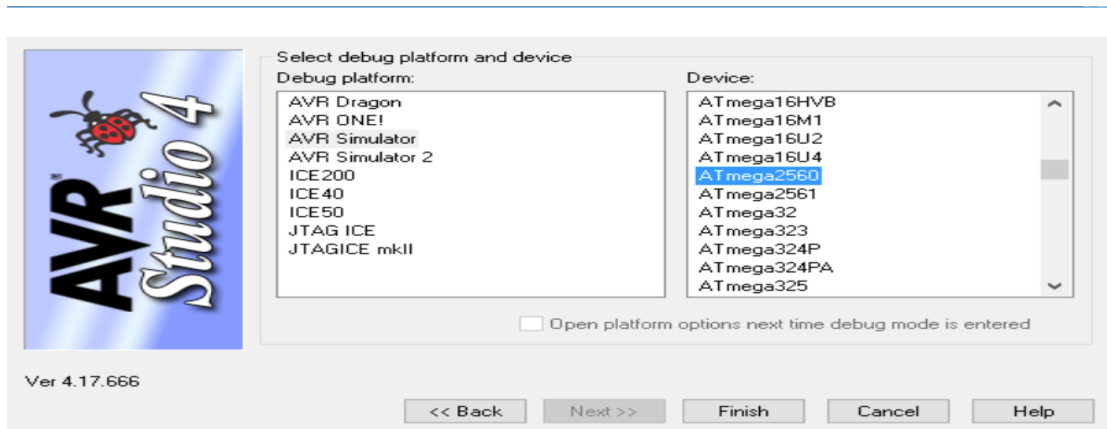


Fig 7. Select Debug Platform

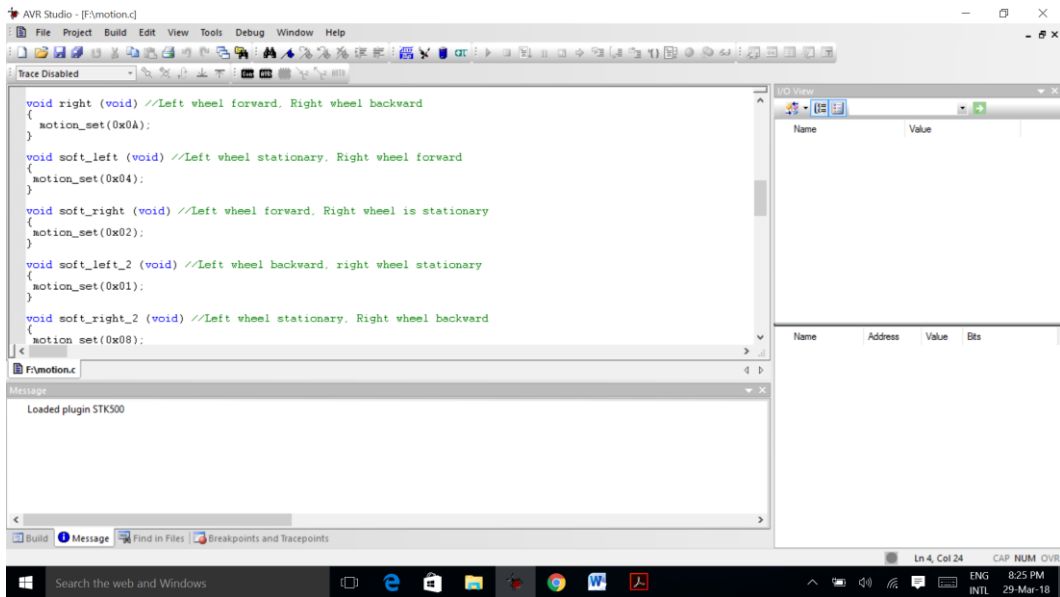


Fig 8 Programming using Embedded C Language

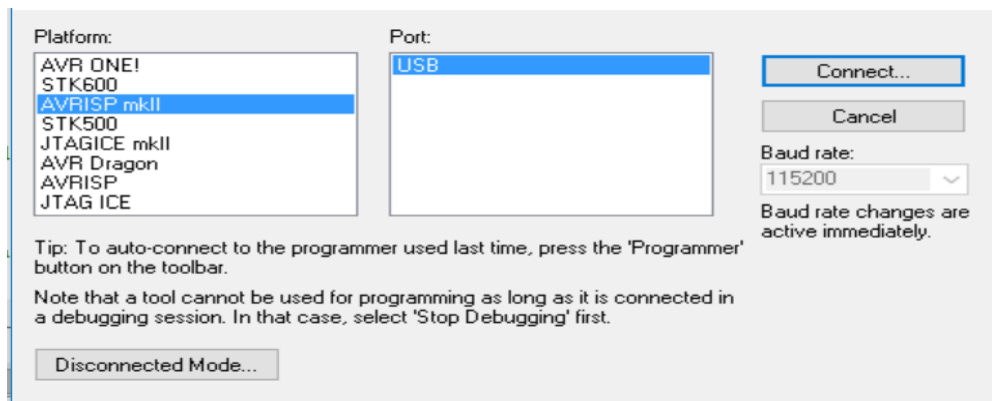


Fig 9: Connection to Robot using USB cable

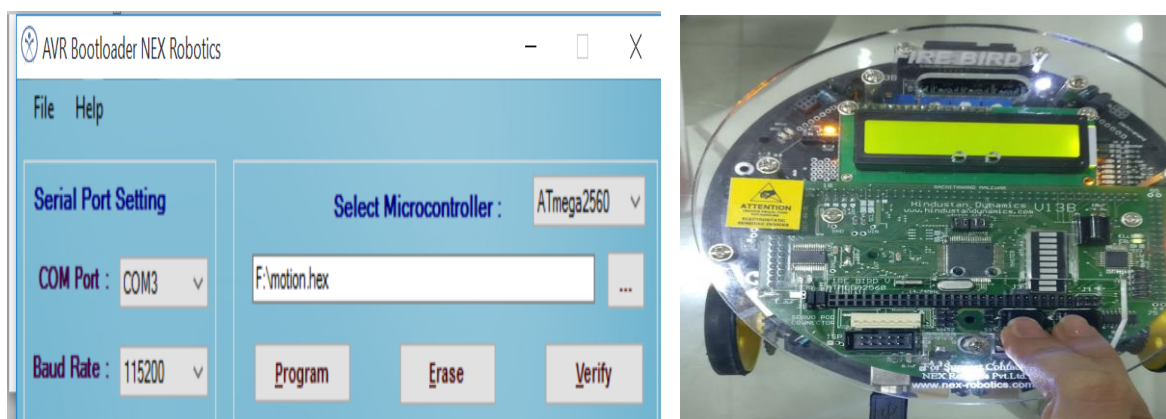


Fig 10: Open AVR Bootloader and load .hex file by selecting COM port as COM3 and click on Program button to load program by setting microcontroller to Atmega 2560 and observe the movement of Robot.

VI. Conclusion

The paper concludes that the motor can be moved in various directions using L293D motor. It can be further improvised by operating through mobile phones by developing GUI interface.

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