Software Requirements Specification

CS684: Embedded Systems Project

µScribe

Group 10

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1 Introduction

To use Firebird V Hexapod for scribing letters and shapes. The motion required to scribe a letter or shape is preprogrammed into the Hexapod.

1.1 Definitions, Acronyms and Abbreviations

Firebird V: A robot indigenously designed at ERTS laboratory, IIT Bombay.

Hexpod: A robot with six legs

Firebird V Hexapod: A hexapod created by attaching six limbs to Firebird V, each with three degrees of freedom

Servo Motor: A type of motor which uses closed-loop feedback to provide position control

ATMEGA2560: The microcontroller used by Firebird V robot

AVR GCC: The platform-specific compiler which compiles C code to run on various AVR microcontrollers developed by Atmel

WinAVR: Open-source software which uses AVR GCC compiler

AVR Studio: Open-source software which uses AVR GCC compiler

ICC AVR: Proprietary software by ImageCraft Creations Inc. which uses AVR GCC provided by WinAVR

Motor Naming Convention: The six legs are numbered 1 to 6. Each leg has three servo motors labeled as A, B, and C. A single motor of the Hexapod is thus identified by a leg number and a motor label. For example, the three motors of first leg are named 1A, 1B, and 1C.

1.2 References

1. FIRE BIRD V ATMEGA2560 Robotic Research Platform Hardware Manual. IIT Bombay & NEX Robotics Pvt. Ltd.

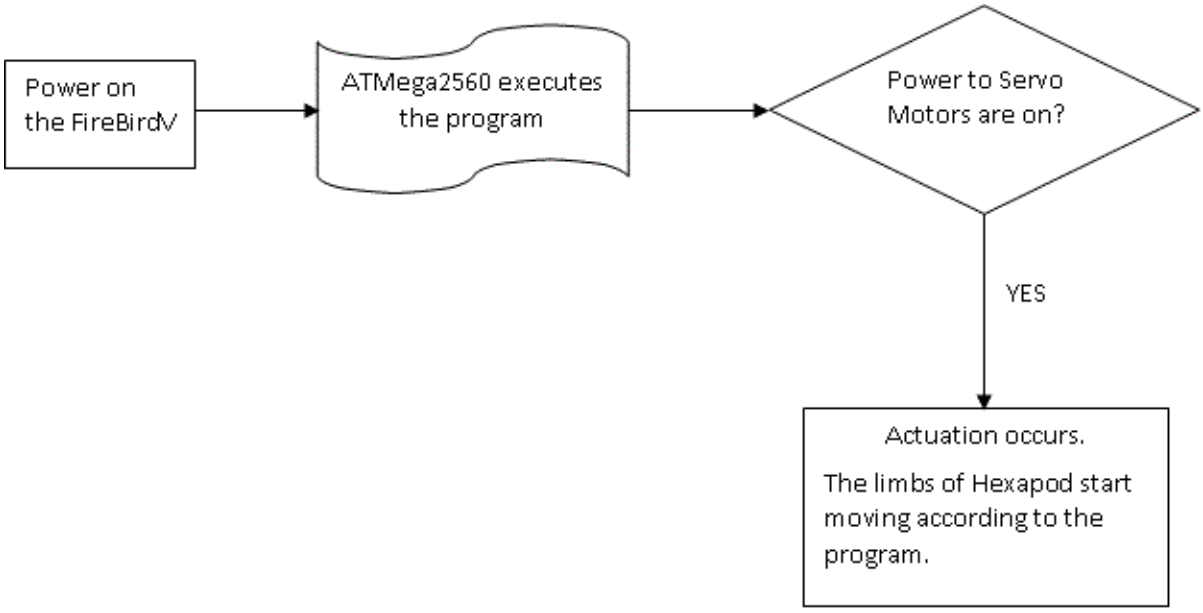
2. FIRE BIRD V ATMEGA2560 HEXAPOD Robotic Research Platform USER GUIDE. IIT Bombay & NEX Robotics Pvt. Ltd.

3. FIRE BIRD V ATMEGA2560 Robotic Research Platform Software Manual. IIT Bombay & NEX Robotics Pvt. Ltd.

2 Overall Description

The application is being developed to work on Fire Bird V Hexapod. A pen is either attached to an arm of the Hexapod or attached vertical to the center of the Hexapod. Using the pen the Hexapod should scribe alphanumeric characters and regular shapes such as rectangle, circles etc. for this the Hexapod may need to move in a stable fashion keeping its chassis at a particular height.

2.1 Product Perspective



2.2 Product Functions

Hexapods can be used for scribing

- Letters
- Numbers
- Shapes

2.3 User Characteristics

The FireBird V Hexapod is autonomous and the user interaction is limited to terning on the power and servo motors of the Hexapod. The user should take care to sufficiently charge the batteries of the Hexapod for the duration of the program operation and to disconnect the charger when programming the Hexapod. In order to prevent any accidental damage to the servo motors the Hexapod chassis must be mounted on a sufficiently high platform while testing the programs.

2.4 Constraints

- A white plane surface is provided to the Hexapod to write.
- The servo motor speed is constant due to its self feedback mechanism.
- Due to inherent Hexapod design we might not be able to utilize each motor's possible range of motion.

2.5 Assumptions and Dependencies

- The ATMEGA2560 can execute HEX files.
- The motions for particular shapes are already hard coded in the form of series of strokes in the program.

2.6 Requirements Subsets

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3 Details

3.1 Functionality

- Should be able to perform simple natural movements like rotation by any given angle,movement in any given directions.
- Should be able to perform simple in-place movements such as jerking, swaying.

- The FireBird V Hexapod should be able to scribe out letters, number and shapes with reasonable fidelity and legibility.

3.2 Supportability

The platform specific code will be included in firebirdv_hexapod.h. The platform independent scribing logic will be included in hexapod.h. The actual scribing program will be in main.c. So main.h will include hexapod.h and hexapod.h will include firebirdv_hexapod.h. So if tomorrow FireBird VI is built then we only need to replace firebirdv_hexapod.h with firebirdvi_hexapod.h and include it in hexapod.h

3.3 Design Constraints

- Finding the exact motor velocity parameters for the Hexapod motion that will scribe the letter or shape.

- Translation of the shapes to a series of stokes and curves that can be sequentially scribed by Hexapod.

3.4 On-line User Documentation and Help System Requirements

Documentation of basic functions that are used in the motion of the Hexapod. For example,

1. void rotate_clockwise (unsigned char clock_angle);

2. void rotate_anticlockwise (unsigned char anticlock_angle);

3. void rotate (unsigned char angle);

4. void forward (unsigned int distance);

5. void backward (unsigned int distance);

6. void leftside (unsigned int distance);

7. void rightside (unsigned int distance);

8. void move (unsigned char angle, unsigned int distance);

9. void stroke (unsigned char angle, unsigned int distance);

10. void curve (unsigned char tangent_angle, unsigned char segment_angle, unsigned int distance);

3.5 Interfaces

3.5.1 User Interfaces

There are no special user interfaces except for switching on the Hexapod and Servo motors. The shapes to be drawn, alphabets to be scribed, etc. will be primarily hard-coded into the program itself.

3.5.2 Hardware Interfaces

ATMega2560: Master Microcontroller in Firebird V

ATMega8: Slave Microcontroller in Firebird V

RAM and Flash Memory: Already available as a part of the microcontroller.

18 NRS-995 Servo Motor: used for chassis of the Hexapod.

Power Supply: External 7.4V, 1800mAh Lithium Polymer Battery.

3.5.3 Software Interfaces

Compiler: AVR GCC(Specific to Atmel AVR processors)

Development Tools and IDEs: WinAVR, AVR Studio 4.0. ICC AVR7

Programming Languages: C, Esterel

Drivers: AVR MK II USB Connector Driver.

3.5.4 Communications Interfaces

In System Programming (ISP): AVR MK II USB Connector to Hexapod.