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Designing of Hexapod Robot

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ABSTRACT: The objective of this paper is to build a six legged walking robot which can perform basic functions like crawling forward and backward. Hexapod robots are used where stability and flexibility are demanded.The legs will have three degrees of freedom each. This robot will serve as a platform for basic surveillance purpose in industries. As the robot has six limbs, the robot can be easily programmed to configure many types of gait such as tripod, quadrapod and wall climbing robot.The robotic locomotion and image acquisition is based on the algorithms fed to the controller**.**

KEYWORDS*:* surveillance,locomotion,image acquisition.

I. INTRODUCTION

Hexapod robot is one of the most statically stable and possess a great flexibility while standing or moving due to its movement using six legs that can sbe easily manipulated. This robot is biologically inspired from the behaviour of an insect with six legs.The design process involved in developing the body and arms of the robot has higher level of difficulty.As of now, the use of robots are commonly increasing in automobiles,process industries,aviation sectors and even for domestic purposes.The hexapod robot has, by definition, six legs and is inspired by insects such as ants and crickets. This gives it the ability to move flexibly across various terrain and does not require any balancing mechanisms to stand upright.These robots plays a vital role in arctic and antartic explorations, search and rescue operations and surveillance operations.However the robot's static stability margin is not optimum. For instance, a quadrapod has better stability and less designing complexity. Nevertheless, a hexapod configuration using alternating tripods has been chosen just to try to increase the machine's speed, slightly jeopardizing stability; heavy legs with powerful microservomotors are chosen over other types as they can withstand heavy loads. It contains the required subsystems such as PIC Microcontroller,batteries and 2D image acquisition camera.

The system designs of hexapod robots from each journal have their own differences. RHex developed by [4] is actuated by brushed DC motor. The motors used here are Maxon type motor with a 33:1 planetary gearhead powered by a 24V NiMH battery. The design of the leg is one degree of freedom. According to the author, the method is easy to build and maintain the robot and no sliding friction during spring displacement. Another hexapod robot, Bill-Ant-P robot done by [8] is made of 6061 aluminum and carbon fiber sheets. It uses MPI MX-450HP hobby motors for its reliability, high torque, and affordability movement. The motor have 8.37kg-cm of torque, can rotate about a 60 degree in 0.18sec, and has a small internal dc motor consumes 1125mW of power at stall torque.In our paper,the legs will have three degrees of freedom each.The microcontroller used here is aurdino uno based on atmega328.The Operating speed of the microservomotor is 0.1 s/60 degree.

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II. BLOCK DIAGRAM

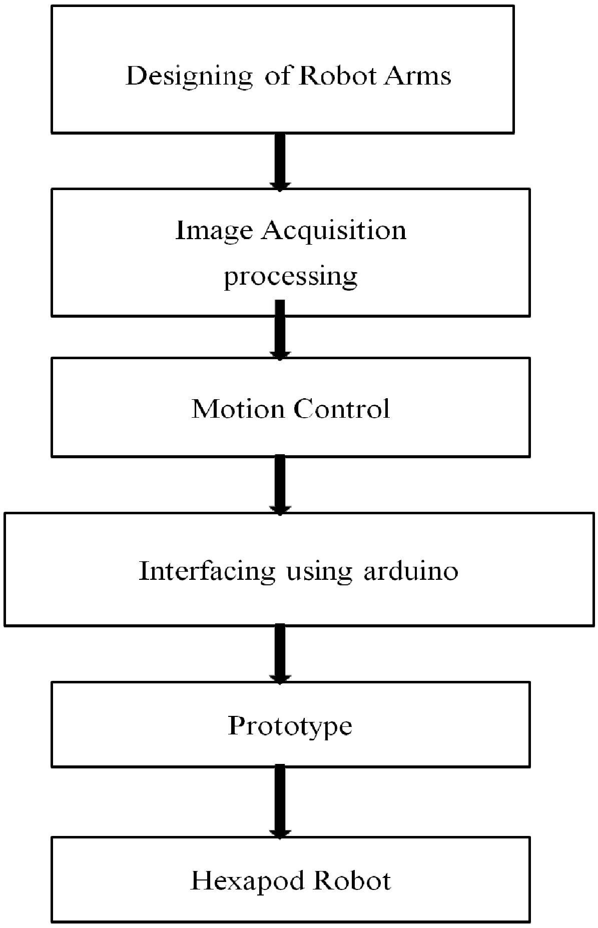

Fig. 1 Block diagram of hexapod designing

III. HARDWARE AND SOFTWARE

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

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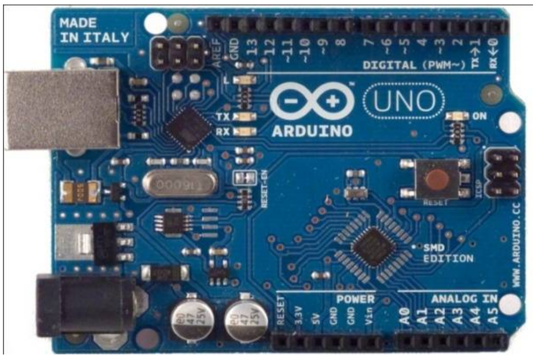

Fig. 2 Arduino uno board

SPECIFICATIONS:

Microcontroller	: Atmega 328
Operating Voltage	: 5V
Input Voltage (recommended)	: 7-12V
Input Voltage (limits)	: 6-20V
Digital I/O Pins	: 14 (of which 6 provide PWM output)
Analog Input Pins	: 6
DC Current per I/O Pin	: 40 mA
DC Current for 3.3V Pin	: 50 mA
Flash Memory	: 32 KB (Atmega 328) of which 0.5 KB used by bootloader
SRAM	: 2 KB (Atmega328)
EEPROM	: 1 KB (Atmega 328)
Clock Speed	: 16 MHz

POWER:

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

The power pins are as follows:

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- **VIN**. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V**.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- **3V3**. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**. Ground pins.

MICROSERVOMOTOR:

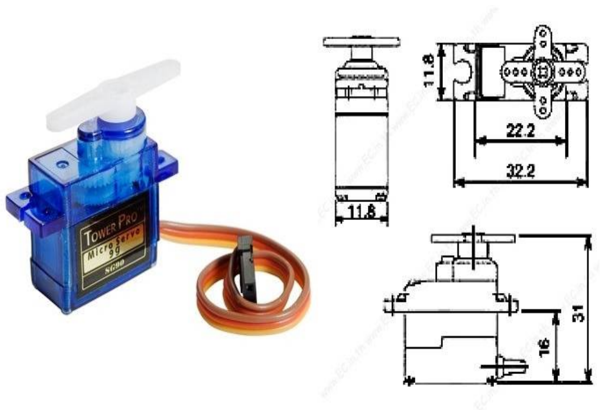

Fig. 3 microservomotor

SPECIFICATION:

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 µs
- Temperature range: 0 ºC – 55 ºC

Tiny and lightweight with high output power,this tiny servo is perfect for RC airplane,helicopter,quadcopter or robot.This servo has metal gears for added strength and durability.Servo can rotate approximately 180 degrees(90 in each direction) and works just like the standard kinds but smaller.It comes with 3 horns(arms) and hardware.

DESIGNING OF ROBOTIC LEGS:

Of the six legs, each legs will contain two servomotors s that are connected by two leg linkages . Each leg section will be machined from 1/4” or 1/2” aluminium plate. The inner and outer leg sections will come in a left and right handed variety while the middle leg section will be the same on both sides. The leg sections will be bolted to the microservomotors using small bolts at the servo mounting flanges and at the servos mounting disk .

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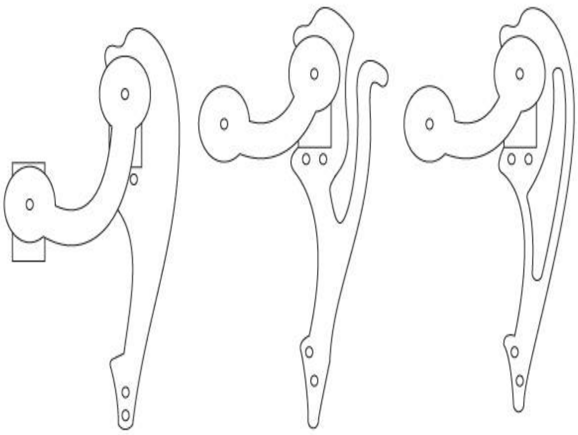

Fig. 4 Leg design

EMBEDDED C:

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, datatype declaration, conditional statements (if, switch, case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

IV. RESULT & CONCLUSION

Every parts of hexapod robot has to be analyzed to find out either it is strong enough to hold some force or pressure before the overall parts are assembled. Simulation software is a way to reduce time and cost before the prototype is being fabricated. A body of hexapod moves independently of its ground contact points. The programmed speed and flexibility of these controllers make them ideal for this project and future research. The robot is constructed using 8 servomotors . This project can also be implemented using PIC16F877A and programmed with MikroC software.

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