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HEXAPOD ROBOT

Gautam Asopa(B17121),Dinbandhu Yadav(b17042) ,Dipesh Kumar Gupta(B17043),
Nakul Yadav(b17095), Hritik Dev(B17122),Jatin Garg(b17013)

b17121@students.iitmandi.ac.in,b17042@students.iitmandi.ac.in,b17043@students.iitmandi.ac.in
b17095@students.iitmandi.ac.in,b17042@students.iitmandi.ac.in,b17013@students.iitmandi.ac.in

Abstract— The main motive our project to design a hexapod



the robot which has 18 servo motors. Due to its flexibility in locomotion and style, it has its various application as it can move on any uneven surfaces, climb stairs and some inclined planes. Walk easily in the desert also. It has many advantages over wide the range of robots as it can balance well in a minimum of three legs.

I. APPARATUS REQUIRED

I wish you the best of success.

A. SERVO MOTORS



Fig. 1. Servo Motors

These are motors which can be precisely controlled by its angle of rotation, angular acceleration, and angular velocity. It has its own resistive potentiometer and IC to read their position encoder. Encoder inside it reads the signal from the microcontroller to fix the shaft angle. Eighteen such servo

motors have been used in our project in order to provide its every leg 3 axis rotation.

B. ARDUINO MEGA

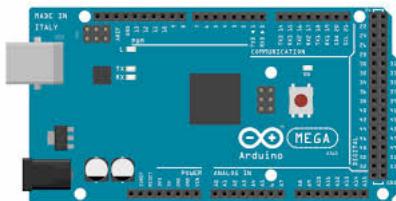


Fig. 2. Arduino Mega

Arduino Mega is a microcontroller board based on ATmega1280 . It was the major component used in our project to save algorithms and transmit the signal to servo motors. In our project, it is operated at 9600 baud rate.

C. 12 V/10 amp SMPS DC POWER SUPPLY



Fig. 3. 12 V/10 amp SMPS

It converts 220v volt AC to 12 V DC. It has step down transformer, capacitance, and high-frequency filtration mechanism. It can sustain current up to 10 amperes.

D. BUCK CONVERTERS

It is used to step down the voltage output of power supply to a specific range of operation of servo motors used. The buck converters used could sustain at most 3 amp current. Six such buck converters (one for three motors of each leg) were used in our project.

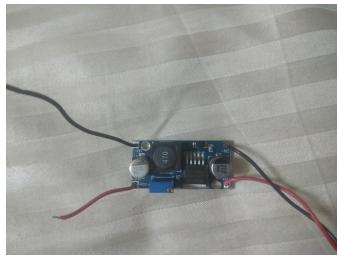


Fig. 4. Buck Converter

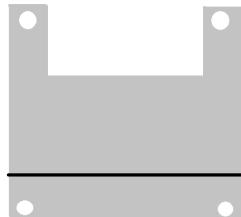


Fig. 7. Motor Cover*12



Fig. 8. Thigh Piece*12

II. CONSTRUCTION

The whole body of hexapod is made up of sheet metal. Different designs of pieces of sheet are used to make the different part of the hexapod. the designs used by us are shown below- Mechanical processes used while making the hexapod-

- Drilling -For making joints with servo motors screws were added , for that purpose drilling was used .
- Riveting It was in order to permanently fix some components such as gears.
- Grinding to remove sharp edges in bots ,cutting delicate parts of sheet metal.



Fig. 5. Joint Piece* 6

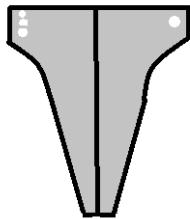


Fig. 6. Leg Piece*6

1. First of all 220 v AC power supply is converted to DC supply by SMPS to 12 v. 2. SMPS supplies 12 v to 6 buck converters in parallel passing through a switch which indeed supplies 6.5v as an output from each buck converter.
3. Each buck converter provides voltage/current to 3 motors of each leg.
4. jumper wires from slots of Arduino are connected to each

motor in order to provide signals to motors according to an algorithm.

5. all the ground are made common.

III. WALKING MECHANISMS

There are many types of walking mechanism to make the robot walk such as :-

A. THREE LEG MOVEMENT

In this algorithm robot first balances on three alternate legs up and other the down, the three legs up first moves forward by the motor directly attached to the body of a bot, and then the robot balances on other legs down and three legs which are up moves ahead by same mechanism above and hence this movement in a loop will be responsible for the forward movement of a robot.

B. CRAWLING MOVEMENT

This is the mechanism we presently are using to move our bot. this mechanism uses all six legs for movement, this mechanism is a quite stable mechanism.int this mechanism all the legs first pushes bot ahead by moving at their respective places and then get back to their same position with respect to the bot. As a result of above mechanism, the robot takes on step ahead. This mechanism is a slow mechanism, the distance covered by it in one step is small as compared to different algorithms of moving the hexapod.



Fig. 9. Hexapod Robot

IV. CODE FORMATION

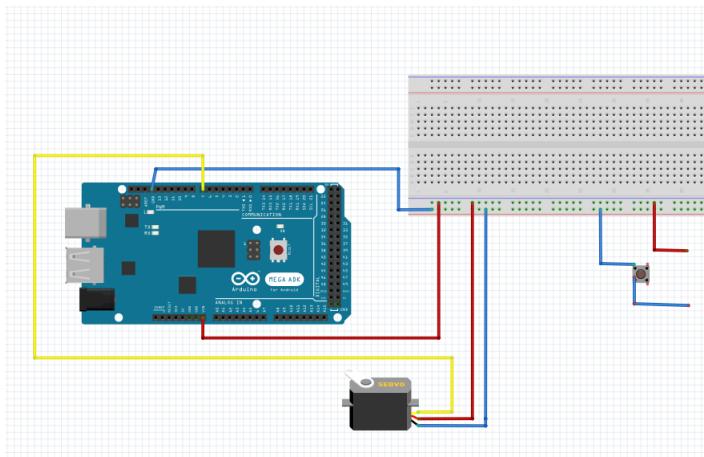


Fig. 10. Circuit Diagram for 1-motor

We are using a library developed in 2009 that is a servo.h library. It is an inbuilt library on the Arduino board or you install its clone and set up any other board like AVR boards that I've used and then integrate them. It really gives very strong control over any library. It gives very flexible functions to control the maximum of 48 servos on Arduino mega. Servos have gears and shaft and its small IC also. So by passing the signals, You can control its angular motion. Developing algorithm is very curious and exciting part of the whole projects. It has a direct physical significance of the movements of legs. For algorithm part, We've made the six function separately for the six legs and just giving an instruction like clockwise or anti-clockwise or up legs or down legs or up thigh or down thigh and the angle for them. You

can go through the code at GitHub site- Link for the same is https://github.com/dipeshkumar1998/Hexapod_rob

V. PSEUDO PARALLEL PROGRAMMING IN ARDUINO

As we know there are single cores present in microcontroller of Arduino so it can pass only one signal at a time but we needed a simultaneous movement of all 18 motors at many steps. So we used a pseudo-parallel programming algorithm in order to move more than one motors simultaneously.

Algo goes like the large simultaneous movement of motors are divided into small parts by a common no of moves/common factor and the small movements are accomplished alternatively and are made to go in the loop till both the task is fully accomplished.

VI. ADVANTAGES OVER OTHER ROBOTS

- This is more pronounced than a wheeled robot because wheeled robot moves faster only on flat surfaces but hexapod can walk over uneven surfaces and stairs as well as hilly terrain.
- This is better than octa and quadra legs robot as the bot can stand even on 3 legs as on 3 legs also it forms a tripod stability structure so we are left with 3 free legs for doing different tasks such as weight lifting etc.
- Hexapod is a very stable structure with flexible movement; it can even be stable if one or other legs are damaged.
- This bot is edge over drone also as drones have less battery backup but we can send this bot anywhere as we can increase the battery backup by increasing battery but this is a problem in route due to weight issues which are not here.

VII. APPLICATIONS

- Our Hexapod added with one or some features can make it specific for various fields.
- This bot can walk on uneven surfaces means it can really be helpful in hilly areas of Himachal Pradesh, where it can be used to carry objects from one place to another.
- It can sustain high temperatures when proper insulation is provided, so then it can provide services during fire emergencies.
- If we install a camera on Hexapod then it can be used as a robot for Patrolling services.
- This can also be used as a Spy camera by the army on borders to see activities of enemies.
- We can use Hexapod in deep forests for study of Animal Kingdom and due to its stability, it is robust and tough.
- Biologists use hexapod to study their hypotheses on insect locomotion by having knowledge of mechatronics.
- Wide use of hexapod is in Automobile industry, due to high precision and high flexibility, this can be used for screw, headlight and installation of other things.

- This can be used in natural calamity or by army for food parceling or message sending .
- Overall this is a All terrain vehicle used for different purposes as it provide us with multi axis accesses so the use of bot depends upon the user.

VIII. IMPROVEMENTS

- Due to lack of budget we were not able to use raspberry pi which can transmit multiple signals at a time ,if we would use it in our project hexapod's movements would be more accurate and simultaneous.
- the mechanical construction could be improved as this bot lacks in many regards like balancing on three legs, etc.

IX. THINGS WE LEARNT

- First of all as we can see the each parts of the bot is made by us so we became good at mechanical works like drilling,grinding cutting,riveting,etc..Also we have got good knowledge of joints
- we know that parallel programming can not be done in Arduino ,so we learnt a new technique of pseudo parallel programming.
- After project we have got a good knowledge of working of different electronic and electrical devices.

REFERENCES

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- [2] https://www.alibaba.com/product-detail/Feetech-FS5109M-high-torque-10kg-servo_60214530202.html
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