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Quadrupod Spider Robot

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ABSTRACT: The main purpose of this project is to design a prototype of an autonomous Quadrupod robot. This project presents a robot with legs radially free distributing around the body, as compared with radial symmetric or rectangular symmetric robots, the legs of a radially free distribute Quadrupod can rotate around the body of it and redistribute their positions.

The spider robot is a device used in monitoring surroundings wirelessly. The aim of this project is to build a four-legged walking robot that is capable of basic mobility tasks such as walking forward, backward, rotating in place, and raising or lowering the body height. This robot can be used for surveillance of domestic pets at home. This robot will serve as a platform on to which additional sensory components could be added or which could be programmed to perform increasingly complex motions.

KEYWORDS: Rectangular symmetric robots, Quadrupod robot, Four-legged

I. INTRODUCTION

Using robots nowadays is very common, and people use them in many applications. Robotics is related to electronics, mechanics, and software. The aim of the project was to design a quadruped robot, which looks similar to the biological spider. Robot is useful for such environment, where humans dose not reach and robot consist of a real time web monitoring system using ESP32 CAM Wi-Fi module.

There are a few fundamental robot types: wheeled, tracked and legged robot. Wheeled robots are quick, however not reasonable for unpleasant regions. Tracked robots are more slow, however more reasonable to tough regions. Legged robots are slow, much hard to control however very strong in unpleasant region. Legged robots are equipped for crossing enormous openings and can work even subsequent to losing a leg.

Many investigate were acted in this field in the beyond couple of years, due to its huge potential. Legged skeleton is particularly great for space missions. There are likewise a few tasks in military examination. Legs have obvious focal points over wheels. The greatest benefit is in cross over capacity and capability. Legged robot has a unique ability to isolate their body from territory abnormalities. Legged robots are more energy efficient as compare other robot types.

II. LITERATURE REVIEW

The theories and pre-requisites regarding the motion and dynamics of the robot has been studied. The movements of different types of robots, its joints, were studied. The rotation, revolution, orthogonal twisting, linear joints, radial symmetry of different kinds of legged robots are studied. To build this project many designs of Quadra pod were studied like controlling of the Quadra pod using servo-controller and Arduino. Control method used significantly reduces the workload on MCU so it can communicate efficiently with the external devices. Also, hexapods with legs radially distributing around the body are studied for the efficient construction.

1. U. Saranli, M. Buehler, and D. E. Koditschek -A Simple and Highly Mobile Hexapod Robot

In this paper, the authors describe the design and control of RHex, a power autonomous, untethered, compliant-legged quadrupod robot. RHex has only six actuators—one motor located at each hip— achieving mechanical simplicity that promotes reliable and robust operation in real-world tasks. Empirically stable and highly maneuverable locomotion arises from a very simple clock-driven, open loop tripod gait. The legs



rotate full circle, thereby preventing the common problem of toe stubbing in the protraction (swing) phase. An extensive suite of experimental results documents the robot's significant "intrinsic mobility"—the traversal of rugged, broken, and obstacle-ridden ground without any terrain sensing or actively controlled adaptation. RHex achieves fast and robust forward locomotion traveling at speeds up to one body length per second and traversing height variations well exceeding its body clearance.

2. Kavlak, Koray. (2021). "Bluetooth Controlled Hexapod Robot Design

Multi legged robots are used in space studies, first aid, search and rescue activities in natural disasters, defense industry, detection and destruction of dangerous and explosive materials, mining, nuclear power stations and many other fields. A hexapod robot, which is in the classification of multi-legged robots, is defined as a robot with six legs to walk or move. There are so many possibilities for leg placement, leg designs and gait patterns in hexapod robots. It is preferred because it has the ability to move stable and flexible on any surface. In this paper, the hexapod robot was designed and manufactured with Bluetooth control, and the strength analyzes of the body and leg linkage were carried out in the Ansys program.

3. Santiago Noriega Alvarez, Maria Camila Rojas, Hemando Leon-Rodriguez, "Design and Development of Quadraped Spider Robot

The spiders, in comparison with the majority of others animals, it has the ability to access to that kind of environment where others animals or even the humans can't. Those attributes of the spiders are taken into this project in order to design and develop a quadraped spider robot in conditions to move in all kind of directions and perform such movement like ascend or descend. The paper is presented the dynamic and kinematics model with the purpose of understand how, mathematically, a quadraped animal and a spider walk. In this case we studied the movement of a real spider, so we can define a suitable bio-mimetic model for our robot. Similarly, the motion simulation was implemented and the results are shown.

III. OBJECTIVE

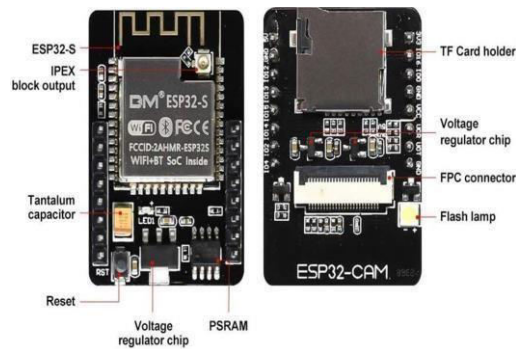
1. The main objective of our project is to reduce the human efforts required
2. To study the movement and dynamics of the Quadra-pod robot.
3. To design the Quadra-pod based on the market needs and making it available for selling in the market.
4. Analysis and simulation of the Quadra-pod.

IV. SYSTEM REQUIREMENTS

• Hardware Components

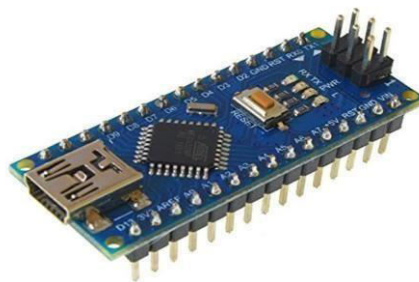
1 ESP32 Module:

In this project ESP32- CAM Module is used as a main vision of robot. The ESP32 CAM WiFi Module Bluetooth with OV2640 Camera Module 2MP for live data transmission has a very competitive small-size camera module that can operate independently with a minimum footprint of only 40 x 27 mm; a deep sleep current of up to 6 mA and is widely used in various IoT applications. It is also suitable for wireless monitoring as well as for smart devices applications, industrial wireless control, and other IoT applications.



2. Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. Arduino Nano is used to provide final output to the servo motors (i.e. Robot Legs). ESP32 module takes input from the web by Wi-Fi connection and gives output to the Arduino Nano. After taking input from the ESP32, Arduino Nano gives suitable output to the servo motors.



3. Servo motor

Servo motors are used to drive the Robot. A servo motor is a small and very energy efficient motor excellent for small as well as large project that require positioning of the shaft. Inside a micro servo motor, there is a small DC motor, potentiometer and a control circuit. The servo motor has three terminals: Position signal (PWM Pulses), VCC (From Power Supply), Ground. The servo motor angular position is controlled by applying PWM pulses of specific width. The duration of pulse varies from about 0.1 ms for 0 degree rotation to 2 ms for 180 degree rotation. The pulses need to be given at frequencies of about 50Hz to 60Hz.



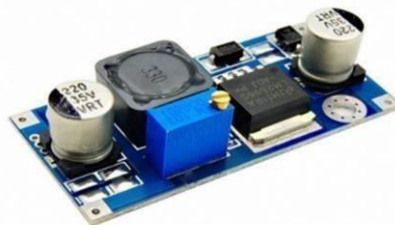
Lithium-ion Battery

Lithium-ion batteries are the fastestgrowing type of rechargeables; there are probably lithium-ion batteries in yourcellphone,MP3 player,and laptopcomputer.What's so good about lithium? It's a lightweight metal that easily forms ions, so it's excellent for making batteries. The latest lithium-ion batteries can store about twice as much energy as traditional NiCd rechargeables, work at higher voltages, and are more environmentally friendly, but don't last as long.

DC-DC Buck Converte

The buck converter is a very simple type of DC-DC converter that produces an output voltage that is less than its input. The buck converter is so named because the inductor always “bucks” or acts against the input voltage. The output voltage of an ideal buck converter is equal to the product of the switching duty cycle and the supply voltage.

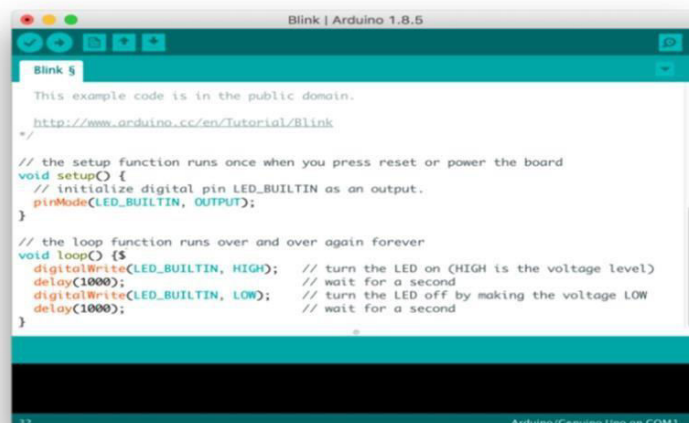
Like many power supply topologies, the buck converter operates on the principle of storing energy in an inductor. The voltage drop across an inductor is proportional to changes in electric current flowing through the device.



•Software Specifications

1 Arduino IDE Software:

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino as well as other development boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. It connects to the Arduino and other hardware to upload programs and communicate with them. The below figure is the screenshot of Arduino IDE software screen.



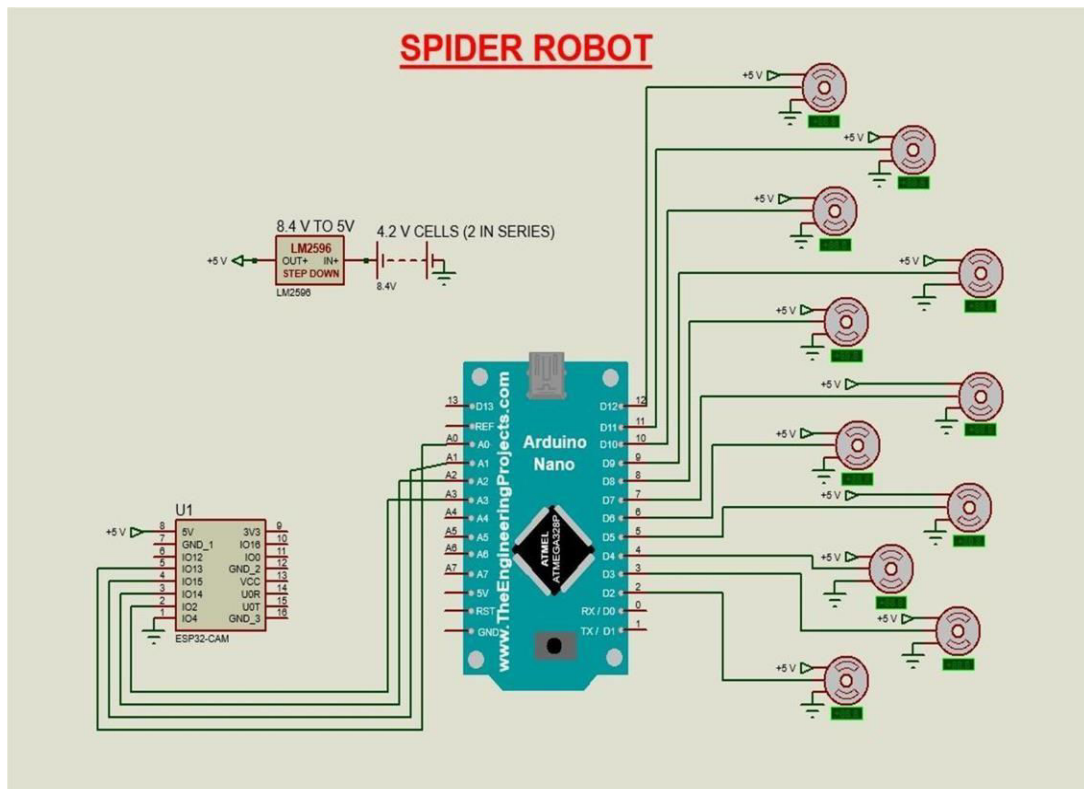
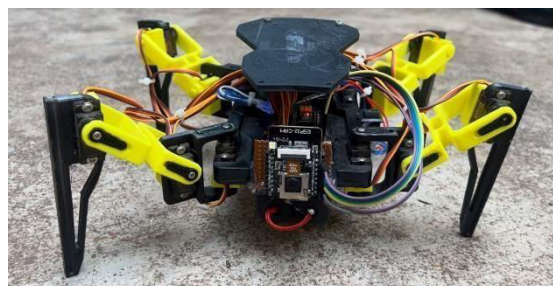
Figure

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors.

The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Circuit Diagram

The figure shows circuit diagram of the system. In above figure, ESP32 gives output in single format to the Arduino Nano. Arduino Nano then gives output to all 12 servo motors (i.e. robot legs). Arduino Nano gives output to the servo motors in the form of PWM (Pulse Width Modulation) signals. The duration of pulse varies from about 0.1ms for 0 degree rotation to 2 ms for 180 degree rotation. The pulses need to be given at frequencies of about 50Hz to 60Hz

**7.Final model.****Figure 7: (Front View)**



V. CONCLUSION

The main theme of this project is to build a quadruped spider robot, which can be used for real time detection purpose. This designed architecture suitable for smooth as well as for rigid surfaces. A quadruped robot can take an advantage of multiple legs to walk easily. The control of robot can be wirelessly done by means of ESP-32 CAM Wi-Fi module. The project **"QUADRAPOD SPIDER ROBOT"** has designed and tested. Integrating features of all the hardware components and have developed it. Presence of every module has been reasoned and placed carefully. Secondly, used advanced hardware and with the help of innovating technology the project has been successfully implemented.

VI. FUTURE SCOPE

The robot can be made more adaptable by involving different connection lengths for front and back legs. Intelligence can be improved by introducing different types of sensors and vision to improve the effectiveness of this robot in future Scope of movement and minutes accessible at each joint are the best worry as it is significant for accomplishing position and bug strolling. The robot can also be optimized in its movement. This could be done by extensive testing and coding.

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