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Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Electronics Engineering (SENSE)

Robotics & Automation

FOUR-LEGGED WALKING ROBOT (QUADRUPED)

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FOUR-LEGGED WALKING ROBOT (QUADRUPED)

Introduction

The four-legged walking robot, commonly referred to as a quadruped robot, is a bio-inspired machine designed to mimic the walking patterns of animals such as dogs, cats, or horses. These robots excel in mobility and adaptability, making them suitable for a wide range of terrains and applications where traditional wheeled or tracked robots struggle.

Quadruped robots are characterized by their ability to achieve dynamic stability, which allows them to walk, trot, and even climb obstacles. Their design often incorporates advanced sensors, actuators, and control algorithms, enabling precise movement and flexibility. As robotics technology advances, quadrupeds are becoming increasingly capable, offering significant advantages in tasks requiring stability, robustness, and adaptability.

Quadruped robots are extensively studied in the fields of bio-inspired robotics, artificial intelligence, and mechanical engineering due to their complex yet versatile motion systems. The growing interest in quadruped robots highlights their potential to solve real-world challenges in environments where traditional robots fail.

CIRCUIT DIAGRAMS AND COMPONENTS

S.N	Components	No required	Specifications
1	Arduino uno	1	ATmega328P 16 MHz microcontroller Digital I/O Pins: 14 Analog input pins: 6 I/O Voltage: 5V Input voltage (nominal): 7-12V DC Current per I/O Pin: 20mA
2	Servo Motor	12	SG90 180° rotation Torque: 1.2 - 1.6 Kg.cm Input Voltage : 4.8 – 6 V
3	Bluetooth Module	1	HC-05 Frequency: 2.4 GHz Range: 10 m (in open air) Operating voltage: 3.3 – 5 V Operating current : 50 mA
4	7.4V Li ion Battery	1	18650 Li-ion cell 3.7 V per cell 2500 mAh

A. Arduino Uno Board

Arduino UNO is a microcontroller board based on the ATmega328P. 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 Arduino IDE is used to program the arduino boards.



B. Bluetooth Module

The Bluetooth module, is a board with integrated Bluetooth function, is mainly used for short-distance wireless communication, and has become the backbone of the development of the Internet of Things. A It employs Bluetooth technology to establish connections between the sender and receiver.



Bluetooth module

C. Servo Motor

The function of the servo motor is to convert the control signal of the controller into the rotational angular displacement or angular velocity of the motor output shaft. Servo motor is used to drive the joints.



D. Jumper Wires

A jump wire is an electrical cable or a group of wires that has a connector or a pin at each end (sometimes without them, just "tinned"). This wire is typically used to connect the components of a breadboard or other prototype or test circuit internally or with other equipment or components, without the need for soldering. It offers a convenient and easy way to interconnect the components of a circuit during testing and experimentation.



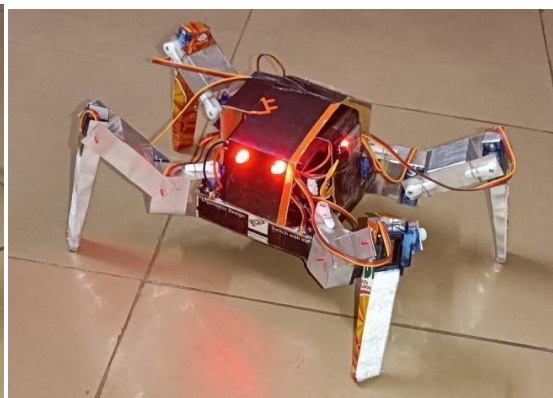
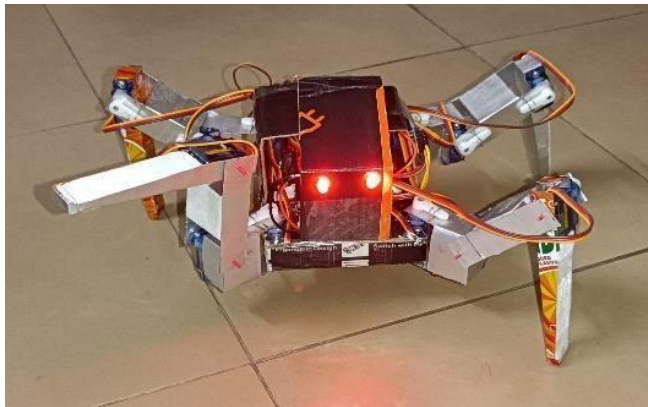
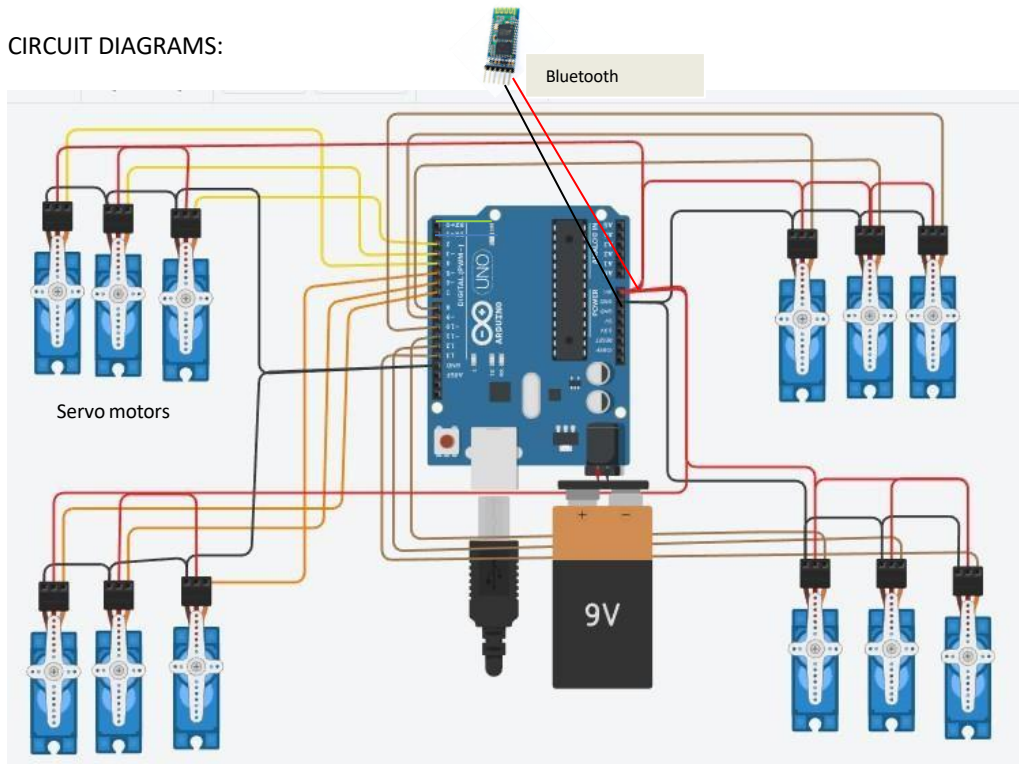
E. Power Source

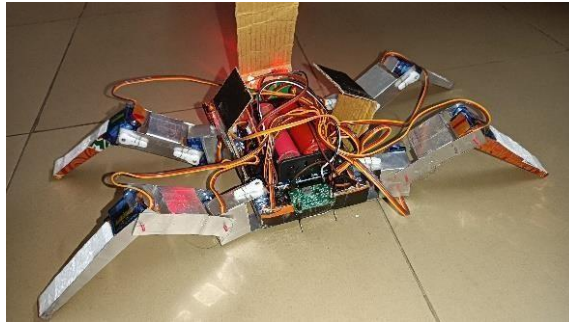
7.4 volts two cells lithium-ion battery is used to provide power to the Arduino board and servo motors.



Battery

CIRCUIT DIAGRAMS:





Applications

The versatility of quadruped robots enables their use in a variety of industries and scenarios. Below are the primary applications:

1. Search and Rescue

- Quadrupeds can navigate through rubble, uneven terrain, and debris to locate survivors during natural disasters such as earthquakes or floods.
- Equipped with cameras and sensors, they can provide live feedback to rescuers, reducing human risk in dangerous zones.

2. Military and Defense

- These robots are utilized for reconnaissance missions in areas that are hazardous for human soldiers.
- They can carry equipment, ammunition, or supplies over rough terrains where wheeled vehicles are impractical.

3. Exploration

- Quadruped robots play a critical role in planetary exploration (e.g., Mars missions) and deep-sea exploration, where stability and adaptability are essential.
- They can operate in low-gravity or high-pressure environments, gathering data and samples.

4. Agriculture

- Used for tasks such as field surveys, crop monitoring, and carrying tools or produce in terrains where conventional vehicles may damage the fields.
- They can work in extreme weather conditions, making them highly reliable.

5. Healthcare and Personal Assistance

- These robots are being developed to assist individuals with disabilities by helping them carry loads or performing other household tasks.
- Future designs aim to integrate these robots as mobility aids.

Conclusion

Quadruped robots represent a significant step forward in robotics, offering exceptional versatility and adaptability across diverse applications. With advancements in hardware and software, their performance continues to improve, making them an invaluable tool in areas such as disaster recovery, defense, and industrial maintenance. As technology evolves, these robots are expected to become even more intelligent, autonomous, and capable of tackling complex real-world challenges.