IMPLEMENTATION OF OBSTACLE AVOIDER WALKING ROBOT

K. HEMALATHA[1], K. ARCHANA[2], L.Sunil[3]
Department of Mechanical Engineering [12,3]
St. Martin's Engineering College, Secunderabad.
Email: hemame@gmail.com

Abstract

The development of obstacle-avoiding walking robots represents a significant advancement in the field of robotics, blending elements of mobility, perception, and decision-making to navigate complex environments autonomously. This abstract outlines the key components and stages involved in the creation of such robots. The development process typically begins with the design of the robot's mechanical structure, which includes considerations such as leg configuration, joint types, and overall stability. This stage often involves iterative prototyping and testing to optimize performance and ensure robustness. Once the mechanical design is established, attention turns to the sensory systems necessary for obstacle detection and localization. This may include a combination of cameras, LiDAR, ultrasonic sensors, and inertial measurement units (IMUs) to provide comprehensive environmental awareness. With sensors in place, the next step is to implement algorithms for perception and decision making. These algorithms interpret sensor data to identify obstacles in the robot's path and generate trajectories to navigate around them safely. Machine learning techniques, such as neural networks, may be employed to improve the robot's ability to recognize and respond to different types of obstacles. Integration of hardware and software components follows, with a focus on real-time communication and control systems. This includes the development of motor controllers, feedback loops, and communication protocols to coordinate the robot's movements and ensure stable operation. Finally, extensive testing and validation are conducted to evaluate the robot's performance in simulated and real-world environments. This iterative process allows for refinement and optimization of both hardware and software components to achieve the desired level of autonomy and reliability.

Keywords: Arduino UNO, Servo Pin Board, Servo Motor Coding, Frame Chaises, Servo Motor

1. Introduction

A obstacle avoider walking robot is a type of robotic system designed to replicate the walking abilities of humans or animals, typically with two legs. These robots are a subset of humanoid robots and are engineered to achieve a wide range of tasks, from navigating challenging terrains to performing various activities in a human-like manner. The concept of bipedal locomotion in robots has gained significant attention in the field of robotics due to its potential applications in areas such as search and rescue, healthcare, manufacturing, and entertainment. Obstacle avoider walking robots are often inspired by human anatomy and biomechanics, with the goal of achieving balance and stability during walking. They rely on advanced sensor technologies, control algorithms, and mechanical components to emulate the complex coordination required for bipedal movement. Key components of a obstacle avoider walking robot include: Leg Mechanism: obstacle avoider robots typically have two articulated legs with joints that mimic human hip, knee, and ankle movements. These joints provide the necessary flexibility and range of motion for walking. Sensors: Sensors such as accelerometers, gyroscopes, and force sensors are integrated into the robot to measure its orientation, balance, and interaction with the environment.

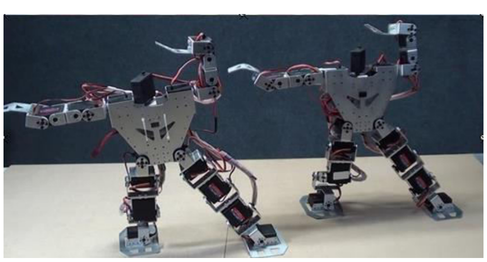


Fig.1 obstacle avoider Walking Robot

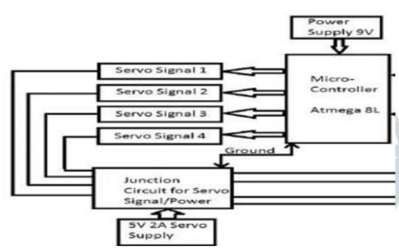


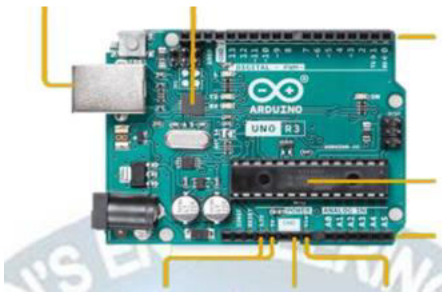
Fig. 2 Flowchart

2. FIELD AND BACKGROUND OF INVENTION:

The invention and development of obstacle avoider walking robots have a rich history that spans several decades. Bipedal locomotion is a challenging problem in robotics due to its complexity, requiring precise balance control and coordination of multiple degrees of freedom in the legs. The concept of obstacle avoider walking robots has evolved from early mechanical models to sophisticated, highly advanced systems. Here's a brief overview of the background and key milestones in the invention and development of obstacle avoider robots Early Concepts and Mechanical Models: The idea of creating robots that mimic human or animal movements can be traced back to ancient times, with early automata and mechanical devices. Leonardo da Vinci designed some early humanoid automata, and clockwork figures with bipedal locomotion were developed in the 18th and 19th centuries.

3. SUMMARY

A obstacle avoider walking robot is a specialized type of robot designed to emulate human or animal-like walking on two legs. These robots are engineered to achieve balance and coordination in their movements, with sophisticated control algorithms and sensor systems. Key components of biped walking robots include leg mechanisms with articulated joints, sensors for measuring balance and environmental interaction, and complex control algorithms for real-time adjustments.



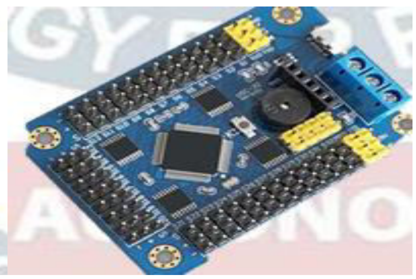


Fig. 3. Arduino UNO Fig. Fig.4 Servo Pin Board

4. COMPONENTS OF ROBOT

1. Servo motors
2. Arduino UNO
3. Power supply
4. Servo pin Board
5. Robot Frame

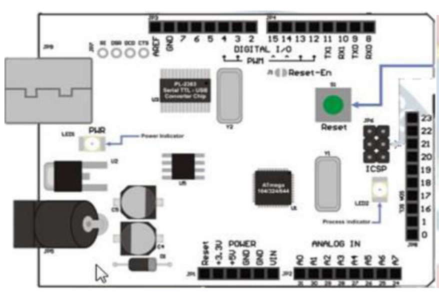


Fig.5 Servo Pin Board Fig.6 Robot

5. WORKING MECHANISM:

Mechanical Structure: A obstacle avoider walking robot typically has two legs, each equipped with multiple joints and links that mimic the structure of human legs. These joints provide mobility and flexibility for walking and other movements.

Sensors: A variety of sensors are employed to monitor the robot's state and its environment Inertial Measurement Units (IMUs) are used to measure the robot's acceleration and orientation, providing information about its body's position and orientation in space.

Control Algorithms: Control algorithms are responsible for coordinating the robot's movements to achieve stable and efficient walking. Key control algorithms include Stabilization Control: This algorithm calculates and controls the robot's centre of mass to keep it within the support polygon formed by the feet, adaptability to different ground surfaces.

Kinematics and Inverse Kinematics: Kinematics and inverse kinematics equations are used tocompute the joint angles and positions needed to achieve specific leg movements and body postures while maintaining balance.

OBJECTIVES:

1. Mimic Human Locomotion: robots are often designed to emulate human-like walking and other forms of locomotion. This objective includes replicating the natural movement of human legs and body. Stability and Balance
2. One of the primary objectives is to achieve stability and balance during walking. robots aim to maintain equilibrium to prevent falling, even in the presence of external disturbances or on uneven terrain. Energy Efficiency
3. Robots should be designed to move efficiently to conserve energy. Minimizing energy consumption is crucial for extending the robot's operational duration, especially in applications with limited power sources. Adaptability to Different Terrains
4. Many robots are designed to navigate a variety of terrains, including rough or uneven surfaces, stairs, and obstacles. The ability to adapt to different environments is essential for applications like search and rescue, disaster response, and outdoor exploration.

MARKET OPPORTUNITY:

Biped walking robots offer numerous market opportunities in a wide range of industries and applications. While the field of bipedal robotics is still evolving, it has the potential to address various needs and challenges. Here are some key market opportunities for biped walking robots Search and Rescue: Bipedal robots can navigate complex and disaster-stricken environments more effectively than wheeled or tracked robots. They can be used in search and rescue missions to locate survivors and deliver supplies. Healthcare and Rehabilitation: Bipedal robots can assist with patient mobility, providing support for individuals with mobility impairments. They can also be used in rehabilitation therapy to aid patients in regaining their walking abilities.

SOURCE CODE SAMPLE:

```
#include <Servo.h>
// Define servo pins #define LEFT_HIP_PIN 9
#define RIGHT_HIP_PIN 10
#define LEFT_KNEE_PIN 11
#define RIGHT_KNEE_PIN 12
// Create servo objects
Servo leftHip, rightHip, leftKnee, rightKnee;
// Function to move hip servo
void moveHip(Servo hip, int angle) { hip.write(angle);
delay(500); // Adjust delay for smoother movement
}
```

```
// Function to move knee servo
void moveKnee(Servo knee, int angle) { knee.write(angle);
delay(500); // Adjust delay for smoother movement
}
void setup() {
// Attach servos to pins leftHip.attach(LEFT_HIP_PIN); rightHip.attach(RIGHT_HIP_PIN);
leftKnee.attach(LEFT_KNEE_PIN); rightKnee.attach(RIGHT_KNEE_PIN);
}
void loop() {
// Move the left leg forward
moveKnee(leftKnee, 45);
delay(1000); // Delay to maintain position
// Move the left leg backward moveKnee(leftKnee, 90);
delay(500); // Delay to maintain position moveHip(leftHip, 45);
delay(1000); // Delay to maintain position
// Move the right leg forward
moveHip(rightHip, 90);
moveKnee(rightKnee, 45);
delay(1000); // Delay to maintain position
// Move the right leg backward
moveKnee(rightKnee, 90);
delay(500); // Delay to maintain position
moveHip(rightHip, 45);
delay(1000); // Delay to maintain position
}
```

CONCLUSION:

The intented to make a design of a obstacle avoider walking Robot. A better design is desired from this project so that the fabrication and development of the Robot is made easy. The design consists of a robot of 17 DOF (degree of freedom) which means 17 joints are present in the robot. Robot provides a easiness in day to day working/activities. The regular use of such robot will helps in understanding the working of robot in a more effective manner and also gives us an ideas of up gradation in various fields.

References.

1. Introduction to Autonomous Robots by Nikolaus Correll, Bradley Hayes
2. Principles of Robot Motion: Theory, Algorithms, and Implementations by Howie Choset, Kevin Lynch
3. Principles of Robot Motion: Theory, Algorithms, and Implementations by Howie Choset, Kevin Lynch
4. Humanoid Robotics and Neuroscience: Science, Engineering, and Society by Gordon Cheng, Philippe Gaussier
5. Walking: A Complex Tool for Human Evolution by François L. T. Müller and Thomas R. Kivell (Editors)
6. Legged Robots That Balance by Marc Raibert
7. Humanoid Robots: Modeling and Control by Shuuji Kajita, et al.
8. Legged Robots: Aggregation and Locomotion by Max Bernhard
9. Humanoid Robotics: A Reference edited by Ambarish Goswami,
10. Biped Locomotion: Dynamics, Stability, Control and Application by Grigore C. Burdea and Ali K. Ünsal