IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 5, March 2025

Design and Implementation of Gesture- Controlled Robotics: Advancing Human- Machine Interaction

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Abstract: *This research integrates the Strandbeest mechanism by Theo Jansen with gesture control technology to design a responsive walking robot. The goal is to eliminate the bottlenecks that traditional gesture-controlled robots face, most of which are wheeled or stationary, and integrates a walking mechanism optimized for stability and efficiency. With similarities in the Strandbeest design, the four-legged linkage system is the core piece of these robots that brings about smooth motion and adaptability across diverse terrains.*

The ADXL335 accelerometer and NRF24L01+ RF module are used to facilitate gesture control, which provides intuitive real- time operation. The Arduino Nano microcontroller is used to process the gesture inputs and to control the walking mechanism by using an L298N motor driver. It is designed for effective working in confined and rugged environments with a compact chassis powered by DC motors. The accuracy of a system for gesture recognition, stability in locomotion, and consistency in communication is experimentally demonstrated through preliminary tests. The development of such systems has applications in all fields of agriculture, exploration, and assistive technologies, which require efficient adaptive robots. This work combines the sophistication of mechanisms with the intuitiveness of control in human-robot interaction. Keywords: Gesture-Controlled Robot, Theo Jansen Mechanism, Arduino Nano, ADXL335 Accelerometer, NRF24L01+ RF Module, Robotics, Human-Robot Interaction This paper introduces a responsive walking robot that integrates the Strandbeest mechanism by Theo Jansen with gesture control technology.

The project aims to overcome the limitation of traditional gesture-controlled robots, which are mostly wheeled or stationary, by introducing a walking mechanism optimized for stability and efficiency. This robot, inspired by the Strandbeest model, uses a four-legged linkage system which produces smooth walk and is durable enough to negotiate all kinds of surfaces. The use of an ADXL335 accelerometer and an NRF24L01+ RF module allows for intuitive real-time gesture control over this system. The system is processed and controlled by an Arduino Nano microcontroller, which processes gesture inputs and then controls the walking mechanism using an L298N motor driver.

It has been designed to use a compact chassis and DC motors to function suitably in the confined and rugged environment. The preliminary test reveals the capability of achieving gesture recognition accuracy, stable locomotion, and reliable communication for such a system. The innovation could introduce applications where efficiency and adaptivity in robots might be demanded and could find places in agriculture, exploration, or assistive technologies. This research contributes to progress in human-robot interaction by combining mechanical sophistication with intuitive control. Keywords: Gesture-Controlled Robot, Theo Jansen Mechanism, Arduino Nano, ADXL335 Accelerometer, NRF24L01+ RF Module, Robotics, Human-Robot Interaction.

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DOI: 10.48175/IJARSCT-24179
ISSN 2581-9429 IJARSCT