

Analysis of Quadruped Robot Locomotion Using LEGO Mindstorms Kit

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1. INTRODUCTION

My interest in robotics and the Boston Dynamics Spot robot dog inspired me to create my programmable robot. The LEGO system at my disposal provided an ideal foundation for the project, as it allows for easy modelling and enables the creation of highly versatile solutions.

2. AIMS

The aim of my research was to create a four-legged LEGO robot capable of stable walking and to program it using Python. By specializing the legs, my goal was to optimize the movement and implement both remote control and voice control to make the most of the tools available to me.

3. METHODS AND MATERIALS

During the project, I utilized the LEGO Mindstorms EV3 platform, with its mechanical components controlled by two high-performance motors and two medium motors. An infrared sensor was used to detect the environment. The design and movement of the legs were tested on various surfaces to achieve stable walking. The control system was based on ev3dev, a Debian Linux distribution running on the Intelligent Brick, which provided full SSH access, enabling remote control of the robot and configuration of the Linux system. For programming, I used Python 3 and the ev3dev-lang library, while the development environment was Visual Studio Code with the ev3dev browser extension.

4. RESULTS

The robot's stable walking was successfully achieved on flat terrain and gentle slopes using only two motors for propulsion. Due to its fixed-centered body structure, the robot cannot perform lateral weight shifting typical of animals. Therefore, complex legs equipped with shock absorbers were designed to stabilize its movement. The hip and head movement mechanisms, along with the developed control programs, enable autonomous obstacle avoidance and manual remote control, allowing the testing and optimization of different operating modes [Fig. 2].

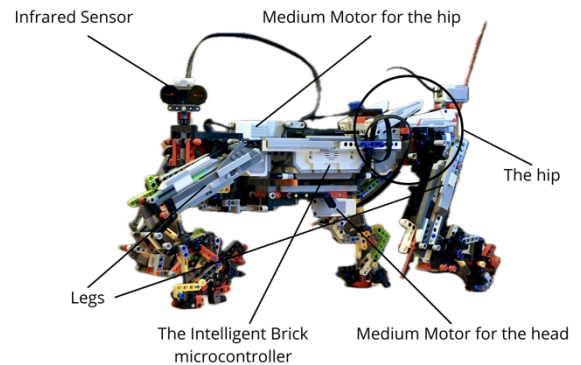


Figure 2. The Final Model

5. DISCUSSION

The developed robot model demonstrated the feasibility of implementing a quadrupedal walking mechanism on the LEGO platform, providing a foundation for further advancements toward more stable and efficient structures. The results open up new possibilities in application areas such as autonomous exploration in rubble environments, where cost-effective, agile robots can enable fast and safe data collection.

6. CONCLUSIONS

The research results indicate that the limited port capacity of the LEGO platform prevents the creation of a more complex and stable robot. For further developments, I will use Raspberry Pi and Arduino-based control systems, as well as custom 3D-printed components.

7. ACKNOWLEDGEMENT

I would like to thank my friend Bazsi for helping me setup the robot's software, developing the program, and conducting the testing process.

8. REFERENCES

- <https://www.ev3dev.org/>
- <https://github.com/ev3dev/ev3dev-lang-python>
- <https://www.youtube.com/@Bricks.Master.Builders>