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Mars Rover: Autonomous Terrain Exploration and Soil Moisture Analysis

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Abstract: *The exploration of Mars has long intrigued scientists due to its potential for past or present life, diverse geology, and similarities to Earth's early environment. This project introduces a multifunctional Mars Rover designed for autonomous terrain exploration and real-time soil moisture analysis. Built around an ESP32 microcontroller, the rover integrates various components including an OV2640 camera, ultrasonic sensors, and a robotic arm with a soil moisture sensor. It is programmed to navigate independently using obstacle detection and path-planning algorithms, while simultaneously collecting environmental data and streaming it via a local web interface.*

This rover serves as a scaled-down, cost-effective prototype capable of simulating the conditions and functionalities needed in real Martian missions. The goal is to bridge the gap between conceptual planetary rovers and hands-on educational or research tools. The system is built to perform self-guided movement, collect soil data, and provide visual feedback, making it ideal for educational demonstrations, remote sensing, and research in environmental monitoring. The project showcases the integration of Internet of Things (IoT) concepts with robotics and embedded systems to support the future of autonomous planetary exploration, while also offering insights into terrestrial applications like precision agriculture and disaster area monitoring.

Keywords: Mars

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