Implementation of small solar robotic vehicle to explore land surface properties

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Introduction

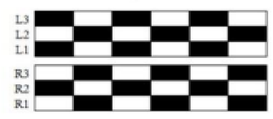
❖ Primary goal of this project is about to develop a machine, to operate on locations such as (plain flat soil , max 10% slope without any stones).

❖There are six legs of the machine to "walk" on the soil like ants. The movement of an ant will be imitated by robotic system with actuators. The system consists of solar panel, battery, electromechanical energy conversion devices and driver circuitry.

Specifications and Design Requirements

❖ The mechanical sub system of 50x50x50 cm size.

❖ There are 6 legs of the machine to walk like ants and they are activated three at a time like a tripod pattern.



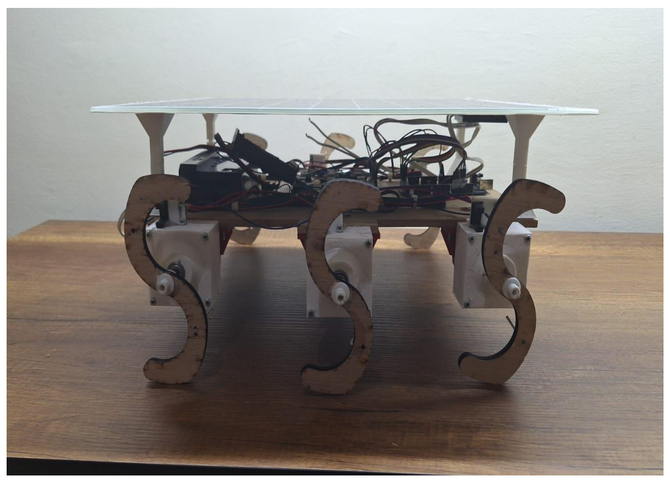
❖ System must have solar panel, batteries, electromechanical energy conversion devices and driver circuitry.

Solution Methodology (Hardware System)

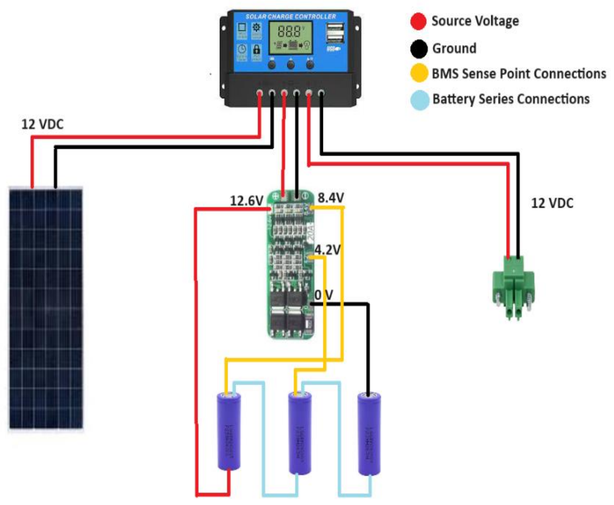
❖ ***Hardware System***
- ❖ ***Mechanical System***
- ❖ ***Solar Power Management System***
- ❖ ***Control System***

Mechanical System

The primary components of the vehicle encompass the main frame, legs, reducer for stepper motors, and spacers positioned between solar panel and the main frame. These components are constructed using materials such as plywood and PLA.



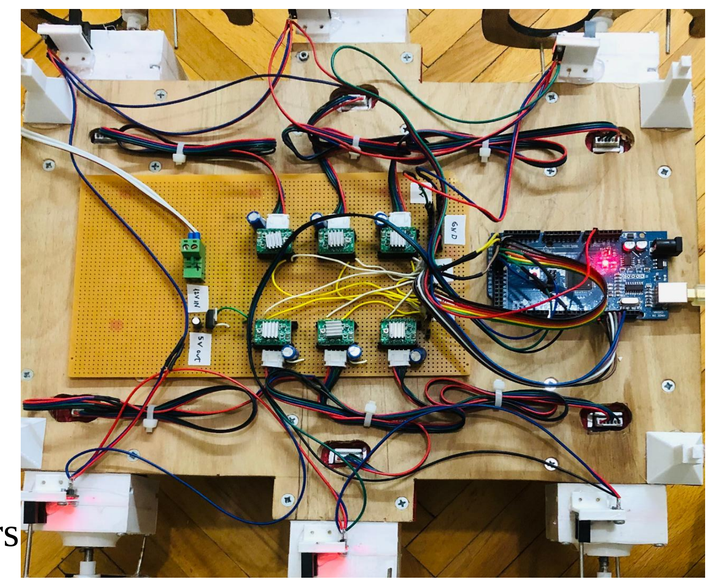
Solar Power Management System:
- 12 VDC, 1.15 A Solar Panel
- PWM Solar Charge Controller
- Series connected Li-ion Batteries for 12.8VDC
- 3S Battery Management System



Control System:

Key Features
- DC-DC Conversion
- Capacitive Protection
- Embedded 5V and GND connectors
- Ease of access to all components

Purpose
- Stepper Motor Control
- Power Distribution
- Microcontroller, sensors and other modules gathers in this system.



Solution Methodology (Software System)

❖ ***Software System***

❖ ***Motor Controller Software***
- ✓ Sensor Readings
- ✓ Stepper Motor Control
- ✓ Filter Commands
- ✓ Timeouts

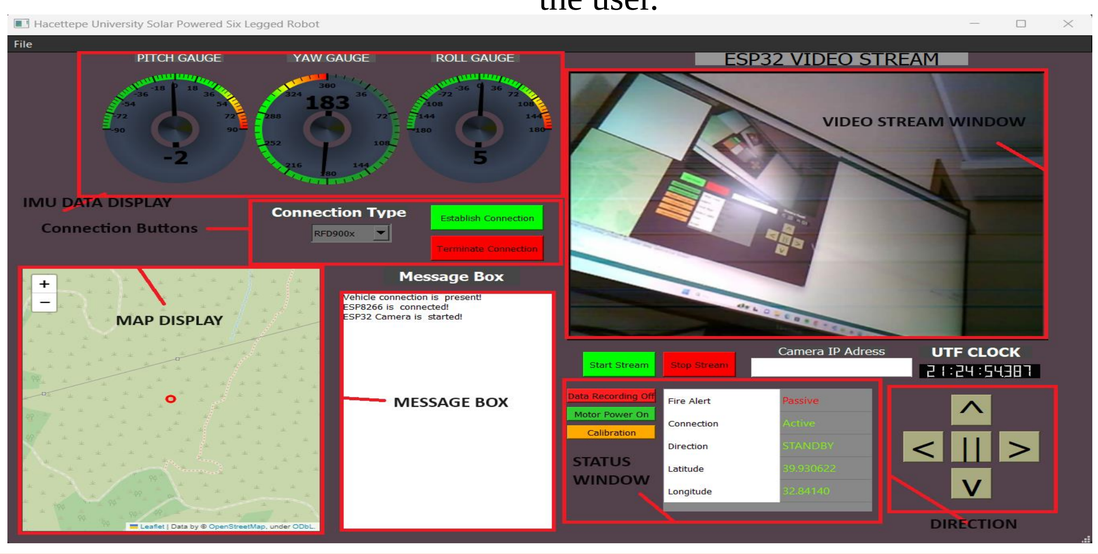
Drive motors simultaneously while reading IR sensors to move in synchronozation, it filters commands coming from wifi module for selecting direction and has timeout function in case connection is lost

❖ ***Wireless Communication Software***
- ✓TCP Server
- ✓Video Streaming
- ✓Receive/Transmit Data
- ✓Connection Validation

Establishes 2 TCP server one for communication and one for video streaming. They are waiting for GUI to connect for controlling robot remotely.

❖ ***Graphical User Interface***
- ✓Receive/Display Video Stream
- ✓TCP Client
- ✓User Controls
- ✓Receive/Transmit Data

It allows users to interact with robot remotely by connecting to the robot. Displays all necessary information to the user.



Results and Discussion

❖The project's objective is to develop a simple machine capable of walking like ants on flat soil. To achieve this goal, a mechanical subsystem was designed with specific specifications and requirements. Following this design phase, a prototype was constructed and subsequently tested. If deemed necessary, iterations were implemented to enhance the machine's performance and achieve better results. The decision to initiate the iteration process was based on key factors, including budget considerations and the imperative nature of the improvements.

❖With increased investments in both budget and time, this robot can be improved to move efficiently at any geographical location. The potential applications of such an improved robot extend to various areas, including fields, wastelands, and even sparsely covered forests. This enhanced mobility can prove invaluable for tasks such as reforestation initiatives or observations of natural ecosystems and wildlife. The broader functionality achieved through these investments opens up new possibilities for addressing environmental challenges and advancing research in diverse terrains.

References

- Kavlak, K. (2021). Bluetooth Controlled Hexapod Robot Design . Avrupa Bilim ve Teknoloji Dergisi , Ejosat Özel Sayı 2021 (HORA) , 421-424 . DOI: 10.31590/ejosat.960612