FOOTWEAR FOR TERRAIN RECOGNITION

IITM Technology Available for Licensing

Problem Statement

- **Camera-based sensors** require proper illumination and can produce **erroneous results in shadows**.
- Existing techniques predominantly capture only the surface details, **missing critical sub-surface information.**
- Current methods like the **Wenner 4-Point Test** and **Rod Driven Method** for measuring ground impedance are **impractical for use with humans or robots.**
- The need for more accurate and **reliable terrain recognition methods** to **ensure safe and effective navigation**, especially for applications **like robotics and mobility aids.**
- A method to obtain **both surface and sub-surface terrain data** to improve overall terrain recognition accuracy.
- **Developing practical, non-intrusive, and wearable devices (e.g., footwear)** that can measure ground impedance and **provide real-time terrain recognition feedback.**

Technology Category/ Market

Category – Assistive, Test Equipment, and Design Manufacturing, Robotics & Automation, Electronics and Circuits

Applications -Agri-based, Automotive, Biomedical engineering, Electronic System & Design Manufacturing

Industry - Robotics and Automation, Healthcare and Medical Devices

Market - Global assistive technology market size was valued at US$ 22.98 Bn in 2023 and is estimated to reach US$ 32.25 Bn by 2030, exhibiting a compounded annual growth rate (CAGR) of 4.7%

Intellectual Property

- **IITM IDF Ref. 2363**
- **IN 531158 (Patent Granted)**

TRL (Technology Readiness Level)

TRL-4, Technology validated in Lab.

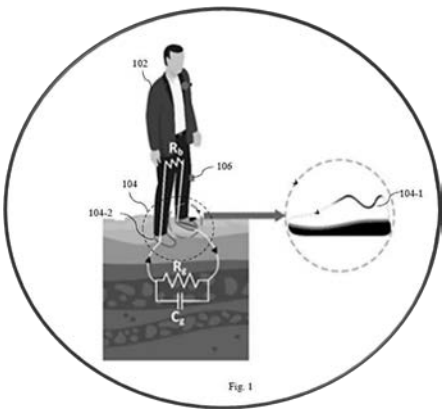

Fig. 1: User wearing the terrain recognition footwear.

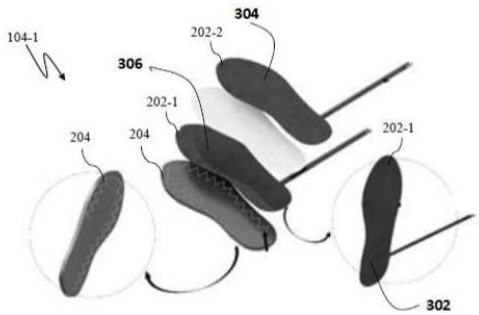

Fig. 2: Exploded view of the first footwear showing internal components.

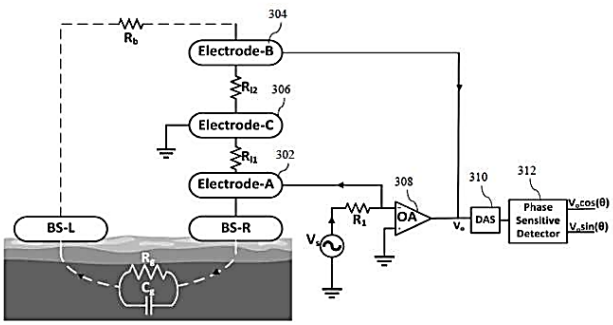

Fig. 3: Equivalent circuit diagram for measuring ground impedance.

Research Lab

Prof. Boby George
Dept. of Electrical Engineering

CONTACT US
Dr. Dara Ajay, Head TTO
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

Technology

Electrode Integration in Footwear:

- The footwear includes a first electrode for transmitting an electrical current to the ground and a second electrode for receiving the electrical current through the user's body. This setup is designed to measure the ground impedance.

Conductive Sole Design:

- The second footwear of the pair features a conductive bottom sole that collects the electrical current passed through the ground from the first electrode and couples it to the body, facilitating accurate impedance measurement.

Processing Element for Impedance Measurement:

- The footwear's processing element measures ground impedance by comparing transmitted and received electrical current strengths, using an operational amplifier to determine output voltage and impedance.

Impedance-based Terrain Identification:

- Measured impedance determines terrain type, enhancing recognition accuracy and correcting outputs from methods like image processing.

Non-intrusive, Wearable Technology:

- The wearable, non-intrusive design is practical for continuous use and suitable for integration into robotic systems, overcoming the limitations of traditional impedance measurement methods.

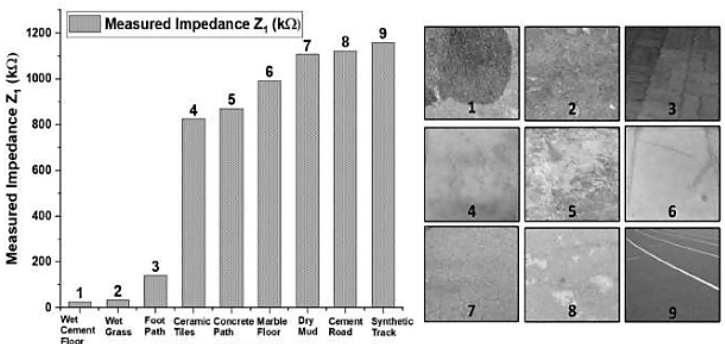

Fig. 4: Ground impedance values with corresponding terrain photographs.

Key Features / Value Proposition

Accurate Terrain Recognition:
- Uses electrodes and a conductive sole to precisely identify terrain types, including stairs, ramps, and slopes.

Enhanced Safety and Mobility:
- Provides real-time feedback for improved safety and stability for visually impaired individuals and amputees with advanced prosthetics.

Non-intrusive, Wearable Design:
- Comfortable everyday footwear, making advanced terrain recognition practical and accessible.

Integration with Existing Systems:
- Combines impedance measurements with image processing for enhanced accuracy and reliability.

Broad Applicability:
- Suitable for personal mobility aids, robotic navigation, and assistive devices across various fields.

Image

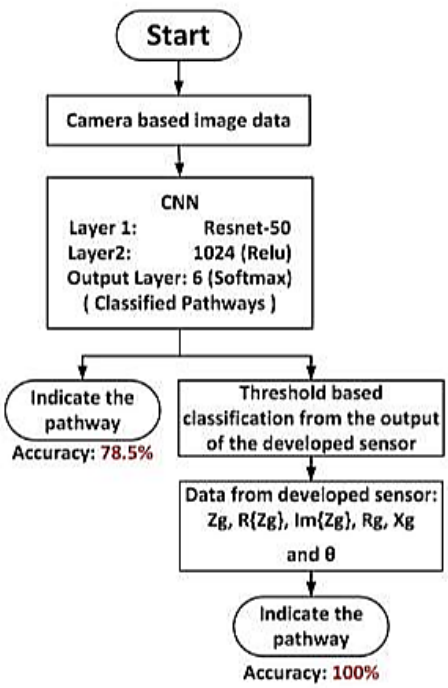

Fig. 5: Results showing ground resistance and reactance values.

CONTACT US

Dr. Dara Ajay, Head TTO
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in

Phone: +91-44-2257 9756/ 9719