TACTILE PAVING NAVIGATION

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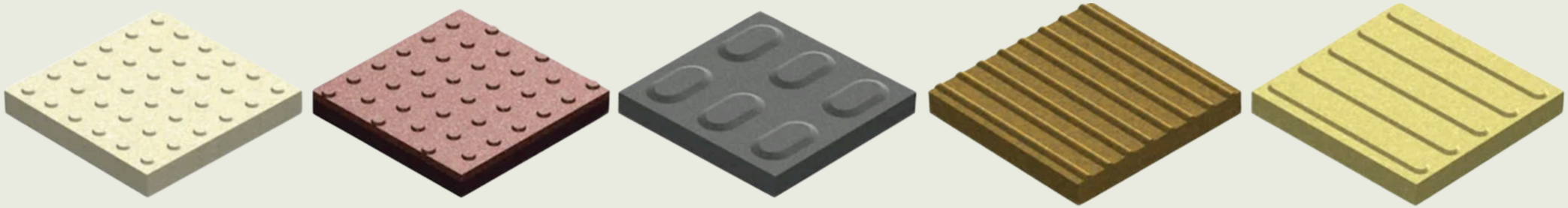
INTRODUCING TENJI BLOCKS

These are Tenji blocks, a.k.a. tactile paving. Tenji blocks are a crucial form of accessibility designed to help guide visually impaired individuals. The straight lines (directional blocks) indicate a clear path to follow, while the raised dots (warning blocks) signify an upcoming change in the surface or a potential hazard ahead, prompting caution.

VARIATIONS OF TACTILE PAVEMENT

- Blister surface for pedestrian crossing points
- Corduroy hazard warning surface
- Platform edge (on-street) warning surface (lozenge)
- Segregated shared cycle track/ footway surface and central Delineator strip (ladder & tramline)
- Guidance path surface
- Platform edge (off street) warning surface



Blister | Offset Blister | Lozenge | Hazard | Directional

Can the robot explore a terrain based on the texture, vibrations and pressure under it's wheels?

REAL-WORLD APPLICATION

Compact Street Sweepers (Vehicles we see cleaning city streets each morning)

- Currently operated manually for daily street cleaning
- Future autonomous versions could benefit from tactile paving navigation

Other applications include automated wheelchair and pedestrian robots

ROBOT MODEL

Looking through the various robot platforms available through the University, the Jaguar-4x4-wheel Mobile Robotic Platform seems like an excellent fit. It is designed for both indoors and outdoor use, other features include:

- Weather and water-resistant enclosure
- Capable of climbing steep slopes (Tenji blocks: signify changes in ground level or the presence of curbs, ramps, or stairs)
- Compatible with ROS (COM2009 - 3009 experience)

▲ *Jaguar-4x4-wheel Mobile Robotic Platform*

IMPLEMENTATION STRATEGIES

STRATEGY	
Microphone	Capture the distinct sounds generated by the wheel-surface interaction. Rolling on asphalt sounds different from rolling on grass, gravel, or wood. Audio analysis (e.g., spectrograms) can reveal unique acoustic fingerprints for various textures. Further, the Jaguar-4x4-wheel Mobile Robotic Platform can be mounted with a microphone or camera.
Machine Learning Classification	The robot would be driven over various known textures (e.g., concrete, asphalt, grass, gravel, carpet, sand, wood, tile), and the sensor data would be collected and labeled. The ML model would then output a probability distribution over the set of predefined texture classes.
Wheel Odometry/Encoders	Correlating sensor readings (robot motion data such as acceleration, angular velocity) with specific points on the surface to differentiate vibrations (and calculate bumps and patterns) caused by the terrain

BIBLIOGRAPHY

https://www.sheffield.ac.uk/sheffieldrobotics/sheffield-robotics-facilities/jaguar-4x4-wheel-mobile-robotic-platform

http://jaguar.drrobot.com/specification_4x4w.asp

https://www.youtube.com/watch?v=cdPymLgfXSY&t=2s

https://www.mdpi.com/2075-5309/13/10/2504

Images:
https://theweek.com/100250/google-doodle-what-are-tenji-blocks
https://www.hydac.com/en/mobile-applications/municipal-machines/