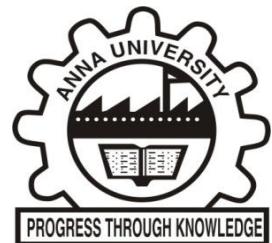




SMART FOOTWEAR



BY

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23GN03C - INTELLECTUAL PROPERTY RIGHTS STUDY REPORT

BACHELOR OF ENGINEERING IN

COMPUTER SCIENCE

ANNA UNIVERSITY, CHENNAI

**NATIONAL ENGINEERING COLLEGE, KOVILPATTI
(An Autonomous Institution)**

NOV 2025

**NATIONAL ENGINEERING COLLEGE, KOVILPATTI
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Date

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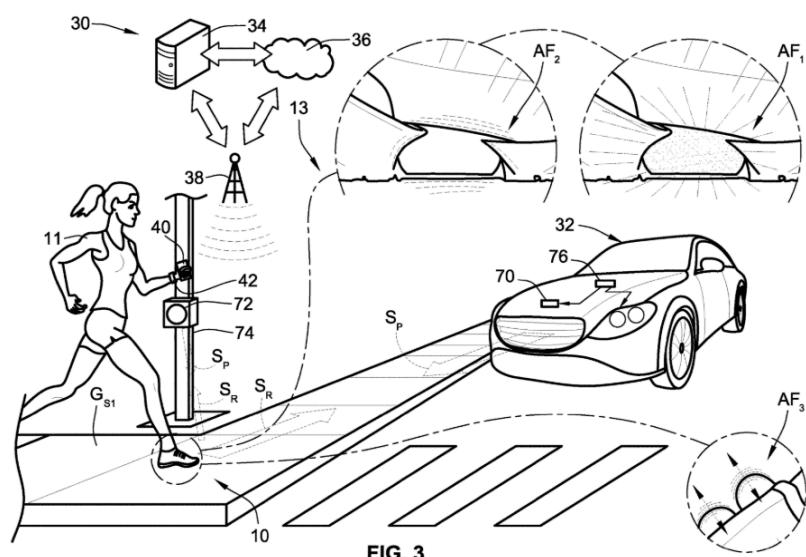
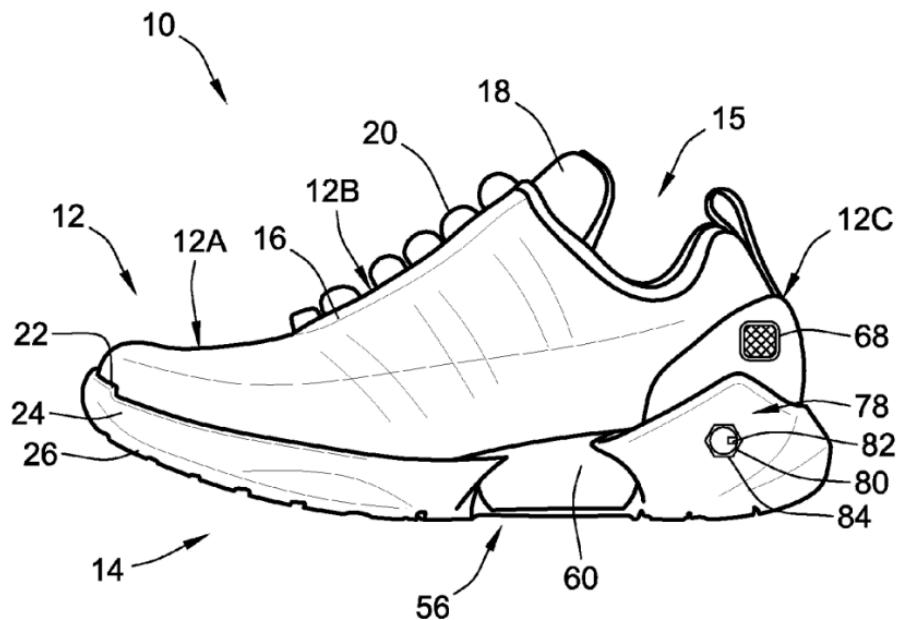
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SI NO:1

Title of the Patent	Smart Navigation System Using Smart Navigation Shoes
Patent number	KR101856999B1
Inventor (s)	Sun Yoel Jeon, Yeo-Baek Lee
Country	Korean
Date of grant	May 14, 2018

Abstract:

This Patent deals with the Smart Shoe that is equipped with Navigation module to guide pedestrians safely and accurately to their destination places without looking at a smartphone. This System includes four key components such as Smart Navigation Shoe,a Smartphone,a Navigation server,a Beacon Device at the destination. In addition with these,there is a vibration module and motion sensors for directional guidance and for detecting user movement to ensure path correction.

Unique features:

- Use of Beacon Signal and Motion sensors give more accurate signals than satellite GPS
- Guide the users by giving Directional Vibrations .
- Confirms if the user has reached the correct destination using Dual Code Matching system.
- Auto correction via vibrations when route mismatched
- Server can pick the best Beacon signal

Limitations:

- Expensive than other footwears
- Beacon signal can weaken or get blocked by walls,which affects accuracy
- Devices need regular charging.(Battery Dependency)
- Passively Beacons broadcast signals to all nearby devices,leads to user confusion and privacy concerns.
- Requires constant internet facility else crashes occurs

SI NO:2

Title of the Patent	Smart Shoes System Integrated with Intelligent Transportation System(ITS)
Patent number	JP71323360B2
Inventor (s)	Christopher Andon
Country	Japan
Date of grant	September 2,2021

Abstract:

This Patent is about an Intelligent Electronic Shoe (IES) System , a robust wearable safety solution designed for real time Pedestrian safety and smart Navigation in integration with Intelligent Transportation Systems(ITS). These Shoes contains RF transponders that respond to trigger signals from external transmitters. This System contains data from GPS modules,Motion sensors and wireless modules to determine the precise location, speed and direction of the pedestrian.Additionally , the System can trigger dynamic traffic light phase changes to prevent collisions.

Unique features:

- This System exchanges data with Public transport or Road systems using F2I and F2V technologies
- This System ensures Personalized and customizable alerts
- It gives Real time alerts if user is entering into dangerous zones by built in sensors.
- It allows Multiple user with biometric identification to use the same pair securely.

Limitations:

- High Battery Dependency,may limit long term use.
- High cost of production due to complex sensors and modules
- It is Beacon dependent.limits effectiveness and range
- GPS is not accurate inside buildings or tunnels.

SI NO:3

Title of the Patent	Custom Shoe Ordering and Delivery System Using 3D Foot Modeling via Smart Device
Patent number	KR20220170407A
Inventor (s)	Jo Yeon-hee, Choi Sang-mook, Han Gyu-hyung
Country	South Korea
Date of grant	December 30, 2022

Abstract:

This patent talks about a new and easy way to buy shoes without going to the store. You just use your smartphone to scan your foot in 3D using a special app. Then, you can see how different shoes look on your foot on the screen, like trying them on virtually. After that, you can choose the one you like and order it. The company will make the shoes perfectly to match your foot size and shape. This is very helpful because you can do everything from home, and the shoes will fit you better than normal ones. .

Unique features:

- Scans your foot in 3D using just a phone.
- Lets you try on shoes virtually with AR
- Suggests shoes based on your foot and style
- Uses smart data to make sure the shoe fits well.

Limitations:

- The scan might not be accurate if the phone camera is not good.
- People with special foot shapes may not get the best fit.
- Some users may find it hard to follow the scanning steps properly.
- AR try-on may not work the same on all phones.

SI NO:4

Title of the Patent	Smart Footwear with Wireless Charging
Patent number	US 11,382,383 B2
Inventor (s)	Jeffrey William Guard, Michael Jon Bower, William Fleming, Andrew Keener
Country	United States
Date of grant	July 12, 2022

Abstract:

This patent describes smart footwear equipped with sensors that detect pressure, motion, and temperature from the user's feet. It includes a wireless charging system to power the electronics without cables. The data collected can be used for health tracking or to control avatars in virtual reality environments. The system enhances user experience by combining comfort, mobility, and intelligent feedback.

Unique features:

- Built-in sensors to track pressure, motion and temperature.
- Wireless charging system for convenience.
- Connects to VR systems to control avatars.
- Stores and analyzes user movement data for health or gaming.

Limitations:

- May not work well without proper calibration.
- Wireless charging might be limited by the battery size.
- Sensor accuracy can vary with shoe fit and movement.
- VR integration may require compatible systems.

SI NO:5

Title of the Patent	System for Improving Blood Circulation
Patent number	JP7309229B2
Inventor (s)	Christopher Harding Moller, Tushara Subreen, Jussi Ville Mikkonen
Country	Japan
Date of grant	July 18, 2023

Abstract:

This patent introduces smart footwear that actively improves blood circulation. By sensing pressure points on your feet and delivering personalized massage through tiny motors, it helps relieve stress and boost comfort. It's like having a wearable therapist-designed for daily use, health monitoring, and even remote care via a mobile app.

Unique features:

- Embedded sensors detect high-stress foot zones for targeted massage.
- Flexible smart fabric with conductive threads and integrated electronics.
- Bluetooth-enabled mobile app for control and data visualization.
- Customizable fit using 3D printing for personalized comfort.

Limitations:

- Requires battery power or external charging for operation
- May not suit all foot anatomies without customization.
- Electronic components could be vulnerable to moisture or wear.
- High production cost due to embedded smart materials.

SI NO:6

Title of the Patent	Intelligent Electronic Footwear and Control Logic for Automated Infrastructure -Based Pedestrian Tracking
Patent number	US 10,334,906 B1
Inventors	Christopher Andon, Jordan M. Rice
Country	United States
Date of grant	July 2,2019

Abstract:

This patent that communicates wirelessly with intelligent transportation systems (ITS). Equipped with sensors and transponders, the footwear helps detect pedestrian location and motion, and interfaces with traffic signals to improve pedestrian safety. It enables real-time threat assessments, alters traffic light states, and issues alerts to prevent collisions using audio, tactile, or visual cues

Unique features:

- Warns users of nearby vehicles using lights, sounds, or vibrations.
- Communicates with vehicles and infrastructure wirelessly.
- Identifies users via sensors or gait recognition.
- Predicts collisions using combined user and environment data

Limitations:

- Depends on smart systems like poles and vehicles.
- It will function only while powered.
- Collects sensitive user location and movement data.
- Less effective if not widely used.

SI NO:7

Title of the Patent	Intelligent Electronic Footwear and Control Logic for Automated Pedestrian Collision Avoidance
Patent number	US 2019/0365014 A1
Inventors	Christopher Andon
Country	United States
Date of grant	December 5,2019

Abstract:

This patent describes smart footwear that helps protect pedestrians from accidents. The shoes can talk to nearby vehicles and traffic systems using wireless signals. If a car is coming too close, the shoes warn the user through lights, sounds, or vibrations. It also tracks the person's movement and surroundings to predict danger before it happens. This system helps people stay safe on roads, even when vehicles can't see them directly.

Unique features:

- Collision alerts via lights, sound, or vibration.
- Wireless communication with vehicles/infrastructure.
- User authentication through gait or sensors.
- Predictive collision detection using data fusion.

Limitations:

- Needs smart infrastructure to function.
- Battery limits due to continuous usage.
- Tracks personal and behavioral data.
- Less effective without wide adoption.

SI NO:8

Title of the Patent	Intelligent Electronic Footwear and Logic For Navigation Assistance by Automated Tactile, Audio and Visual Feedback
Patent number	US 11,122,852, B2
Inventor (s)	Christopher Andon, Hien Tommy Pham
Country	United States
Date of grant	September 21, 2021

Abstract:

This patent introduces intelligent electronic footwear that aids navigation using tactile, audio, and visual feedback. It uses GPS, sensors, and wireless connectivity to guide users to a destination. The shoes interact with infrastructure and other devices for enhanced safety, such as collision warnings. It also supports location-based gaming and AR experiences, making footwear not only functional but interactive and adaptive to real-world environments.

Unique features:

- Real-time navigation via tactile, audio, and visual cues.
- It enables communication with vehicles and users.
- AR/VR gaming with virtual object hunting using geolocation.
- Predicts collisions using real-time and crowd sourced data.

Limitations:

- Limited in areas with weak Bluetooth, GPS or cellular signals.
- Requires frequent charging due to sensor and motor power demands.
- Collects sensitive user data needing strong protection.
- Needs integration with city systems and third-party platforms

SI NO:9

Title of the Patent	System and Methods for Detecting Gait Disorders in Users
Patent number	KR20200140879A
Inventors	Karim Omnia
Country	Korea
Date of grant	December 16, 2020

Abstract:

This invention describes a smart insole system designed to monitor and analyze a user's walking pattern in real time. Each insole contains an electronic box equipped with sensors, processors, memory, and communication modules. These components work together to collect biomechanical data, compare it with reference values, and detect abnormalities in gait. The system can identify early signs of disorders like Parkinson's or muscular dystrophy and alert users or healthcare providers. It operates autonomously and is compact enough to fit inside regular footwear, making it suitable for everyday use without medical supervision.

Unique features:

- It monitors walking patterns instantly without needing external devices.
- It fits inside regular shoes without affecting comfort.
- It detects potential issues and alerts users before symptoms worsen.
- It uses AI models to adapt to each user's walking style and detect anomalies.

Limitations:

- It can't replace medical diagnosis—only suggests when to seek help.
- Needs regular charging, which may be inconvenient for some users.
- Transmits sensitive health data to external devices or servers.
- It may miss certain gait issues that require more advanced medical imaging.

Title of the Patent	Intelligent Electronic Footwear and Control Logic for Executing Automated Footwear Configurations
Patent number	JP 7124127 B2
Inventors	Christopher Andon, Nike Innovate C.V.
Country	Japan
Date of grant	August 23, 2022

Abstract:

This patent describes “intelligent electronic footwear” (smart shoes) that can sense, adapt, and communicate with external systems. The shoes are equipped with pressure sensors, wireless communication modules, and controllers that detect when a person is wearing them and where they are located. Based on these signals, the shoes can automatically tighten laces, adjust fit, and trigger visual, audio, or haptic alerts. They can also connect with remote devices like smartphones, cars, or home automation systems to enhance user convenience and safety. Essentially, these smart shoes blend wearable technology with IoT to make footwear interactive and adaptive.

Unique features:

- Auto-adjusting fit with smart laces and pressure sensors for comfort.
- Provides visual, sound, and vibration alerts to the user.
- Wireless connectivity with smartphones, cars, and smart homes.
- Location awareness & geofencing for safety and personalization.

Limitations:

- Needs battery power, frequent charging may be required.
- Expensive compared to normal footwear.
- Risk of damage from water, dust, or heavy use.
- Raises privacy and data security concerns due to tracking.

Title of the Patent	Smart Shoes, Method of Providing Sensor Information to Smart Shoes, Smart Device, and Method of Providing Guidance Program via Smart Device
Patent number	US 10,473,483 B2
Inventor (s)	Ji-Yong Lee, Do-Hoon Kim
Country	United States
Date of grant	November 12, 2019

Abstract:

This patent is about smart shoes that can collect sensor data like pressure and movement. The shoe sends this data to a smartphone. The phone runs a special program that gives feedback and guidance to the user. This helps improve walking, running, or exercise. It works in real-time and is useful for both fitness and health.

Unique features:

- Smart shoes collect foot pressure and movement data.
- Sends data wirelessly to a connected smart device.
- Smart device gives voice or visual guidance to the user.
- Useful for exercise, posture correction, or rehabilitation

Limitations:

- Sensors need power – may require regular charging.
- Needs continuous connection with mobile device to work.
- Guidance depends on the app's quality and accuracy.
- Not suitable for users who don't use smartphones.

Title of the Patent	Smart Performance Footwear and System
Patent number	US 11,052,286 B2
Inventor (s)	Aswin Reddy , El Segundo , CA (US)
Country	United States
Date of grant	Dec. 14 , 2017

Abstract:

This patent describes a smart performance footwear system with pressure sensors in the toe, forefoot, arch, and heel regions of both shoes, plus motion and distance sensors. The shoes wirelessly send data like foot pressure and movement to a mobile app. The system can vibrate or play sounds to notify the user. It helps monitor workout performance and suggests correct movements, making training safer and more effective.

Unique features:

- Multiple pressure sensors placed in heel and forefoot areas.
- Motion and distance sensors present in each shoe.
- Notifications via vibration or sound alerts.
- Wireless communication with a smartphone app for real-time monitoring.

Limitations:

- Requires on-board power for sensors and wireless modules.
- Needs a companion mobile app or device to view and act on feedback.
- Effectiveness depends on app designs and user interface.
- Accuracy may vary with shoe fit, sensor placement, or user movement style.

Title of the Patent	Smart Shoe System for calculating Energy Expenditure
Patent number	US 11,98,298,079 B2
Inventor (s)	Robert G. Street, Eric T. Weisenburger, Paul J. Costello
Country	United States
Date of grant	May 3,2022

Abstract:

This patent is about a smart shoe that helps track how many calories a person burns while walking or running. The shoe has small sensors inside that measure steps, movement, and speed. It uses this information to calculate energy used. The data is sent to a mobile phone through wireless connection. This helps people easily check their activity levels and improve their fitness. The shoe looks and feels normal, so it is comfortable to wear every day.

Unique Features:

- Calculates calories burned using motion sensors inside the shoe.
- Sends real-time data to your phone or smart device.
- Feels like a normal shoe but has smart features inside.
- Uses smart technology to analyze your walking or running pattern.

Limitations:

- Needs charging or battery replacement for the sensors.
- Requires a phone or device for tracking and viewing data.
- Accuracy may vary depending on walking style or speed.
- Only useful for walking or running—not other activities.

Title of the Patent	Smart Shoes
Patent number	KR102759477B1
Inventor (s)	Joo-Jin Song, Chang-Sung Kwon
Country	South Korea
Date of grant	2025-01-20

Abstract:

This patent covers smart shoes with an insole that measures foot pressure and movement using small pressure sensors and a 3D gyro sensor. The data is sent wirelessly via Bluetooth to a smartphone, smartwatch, or tablet for analysis. A portable wireless charger placed inside the shoe recharges the battery without cables. The system can compare left and right balance, track walking or running patterns, and support sports, health monitoring, or rehabilitation, making it easy for anyone to use.

Unique Features:

- Smart sole with built-in pressure sensors and gyro sensors to track movement and balance.
- Wireless data transmission (Bluetooth) to phones, smartwatches, or tablets.
- Portable wireless charger fits inside the shoe for easy charging without cables.
- Can compare left and right foot pressure and movement to check balance.

Limitations:

- Needs a compatible device (phone/watch/tablet) to view and analyze data.
- Battery still needs charging (though easier than wired charging).
- Wireless charging efficiency may be affected if coil alignment is poor.
- Pressure sensors and electronics may wear out over time with heavy use.

SI NO:15

Title of the Patent	Smart Shoe Insole with Health Monitoring and GPS Tracking
Patent number	JP2019-30618A
Inventor (s)	Tetsuvo Kikuchi, Akira ShimIzi
Country	Japan
Date of grant	February 28, 2019

Abstract:

This patent is for a shoe insole that can measure body information and track location, made especially for elderly people who may wander or have trouble knowing day from night. The insole has a sealed soft urethane sensor mat with many small square cells, each containing pressure sensors to measure foot pressure distribution, a temperature sensor, and a GPS module. The mat is covered with a soft sheet that touches the foot. The system can detect body pressure, temperature, location, and even health signs like heartbeat or fetal movement. The shoe's shape is also designed to prevent tripping by slightly raising the toes.

Unique Features:

- Insole with many small cells, each having a pressure sensor, temperature sensor, and GPS.
- Soft material design for comfort and tripping prevention.
- Can detect multiple health signs along with location.
- Designed for easy use by elderly or disabled people.

Limitations:

- Needs GPS signal, which may be weak indoors.
- Electronics may wear out due to foot pressure over time.
- Battery needs regular charging.
- Not as useful for people without mobility issues

SI NO:16

Title of the Patent	Foot Presence Sensing Using Magnets in Footwear
Patent number	US 11,044,967 B2
Inventor (s)	Steven H. Walker, Phillip Meneau
Country	United States
Date of grant	June 29, 2021

Abstract:

An article of footwear can include a ferromagnetic body and a magnetometer. The magnetic field changes based on the movement of the ferromagnetic body, which is influenced by the foot's position in the shoe. For example, the ferromagnetic body might be inside a compressible insole and move when the insole is compressed or relaxed. The magnetometer is placed in a relatively stationary part (like the sole) to detect these changes. The data about the rate of change in the magnetic field can control footwear functions (e.g., lacing) or give information about foot strike and step rate.

Unique Features:

- Magnet and magnetometer combination to detect foot presence and motion.
- Compression-sensitive insole design that moves the magnetic body with foot pressure.
- Non-contact sensing through changes in the magnetic field.
- Ability to trigger footwear functions and collect step rate/foot strike data.

Limitations:

- Susceptible to magnetic interference from external sources.
- Requires battery power for operation.
- Mechanical wear on the insole may affect sensor alignment.
- Needs precise calibration for accurate readings.

Title of the Patent	Safety Accident Prevention and Navigation Shoes for the Visually Impaired
Patent number	KR101864308B1
Inventor (s)	Jeong Jae-hong, Park Eun-bi, Kim Hye-jin, Kang Yu-jin
Country	South Korea
Date of grant	May 29, 2018

Abstract:

This patent describes smart shoes specially designed for visually impaired users. They use infrared sensors to detect obstacles, a light sensor to detect low-light conditions, and LEDs that automatically turn on when it's dark. GPS information is received from a smartphone and delivered to the wearer using voice and vibration alerts. The system has two separate vibration modules—one for obstacle alerts and one for navigation directions, so users can distinguish between them. A built-in weight sensor detects if the shoes are removed, triggering an anti-loss function that can alert the user and help locate the shoes.

Unique Features:

- Infrared sensor for obstacle detection.
- Light sensor that activates LEDs in low light.
- GPS navigation with voice and vibration guidance.
- Vibration intensity/frequency changes based on obstacle distance.

Limitations:

- Needs smartphone connection for GPS and anti-loss features..
- Battery life may limit operation time of sensors and LEDs.
- Voice guidance may be difficult to hear in noisy places.
- Requires calibration for accurate vibration pattern recognition

Title of the Patent	Fitness Training System with Energy Consumption Calculation
Patent number	JP6318215B2
Inventor (s)	Tesa Aragones, Adriana Guerrero, Steve Holmes
Country	Japan
Date of grant	September 24, 2019

Abstract:

This patent introduces a fitness training system that accurately measures and calculates a user's energy consumption during various physical activities. Using multiple integrated sensors — including motion, pressure, and biometric types — the system gathers detailed movement data such as step count, distance, pace, and exertion level. This data is processed in real time to estimate calorie burn with high precision. Designed for both casual and professional use, the system connects wirelessly to a smart device, allowing instant feedback and long-term health tracking.

Unique features:

- Combination of multiple sensor types for enhanced accuracy in energy calculation
- Real-time feedback via smartphone or smart device for immediate activity adjustment
- Supports a wide range of activities from walking and jogging to sports training
- Can integrate with health and fitness apps for continuous progress monitoring

Limitations:

- Requires battery power and regular charging for sensors
- Accuracy can be influenced by sensor placement or shoe fit
- Dependent on paired smart device for full functionality
- Advanced sensor components may lead to higher manufacturing costs

Title of the Patent	Smart shoe
Patent number	WO 2017084458A1
Inventor (s)	Cheng Chi, Zhao Ying, Hao Lixing, Sun Xiaoya, Fu Xiaoyue
Country	WIPO
Date of grant	26 May 2017.

Abstract:

This patent introduces a smart shoe that generates its own power using friction while walking. It includes sensors that detect steps, a small circuit that counts those steps, and an alert system (like lights or signals) that notifies the user when a step goal is reached. Instead of using a battery, the system produces electricity through mechanical friction inside the shoe. It's designed to help users track their movement without needing any external power source or devices.

Unique Features

- Battery-free operation through friction-generated electricity
- Step count alerts using built-in signals when movement goals are reached
- Support for multiple tracking stages to give progressive feedback
- Fully integrated system inside the shoe for a lightweight, portable design

Limitations

- Limited power output may restrict advanced features
- Fixed step count thresholds without user customization
- No support for syncing with mobile apps or smart devices
- Friction components may wear out over time with regular use

Title of the Patent	System and Method for Detecting Fatigue and Providing Coaching via Footwear
Patent number	US20210093915A1
Inventor (s)	Robert Rene Poindexter, Justin Underwood, Brian T. Fisher, Brian M. Ott, Ethan A. Allen
Country	United States
Date of grant	April 1, 2021

Abstract:

This patent describes a wearable footwear system capable of detecting fatigue in a user and providing real-time coaching feedback. The footwear includes embedded sensors such as accelerometers, gyroscopes, and pressure sensors to monitor user movement and gait patterns. Data from these sensors is processed to identify fatigue indicators (e.g., slowing pace, irregular stride, reduced force) and trigger corresponding coaching responses. The coaching feedback can be delivered through audio cues, haptic signals, or visual displays, helping the user maintain proper form and performance. The system may also sync with a mobile device for enhanced data analysis and personalized training programs.

Unique Features:

- Integrated motion and pressure sensors for real-time activity tracking.
- Fatigue detection based on gait and movement pattern changes.
- Personalized coaching feedback via audio, vibration, or visual signals.
- Wireless connectivity to smartphones for extended analysis.

Limitations:

- Continuous sensor operation may reduce battery life.
- Requires accurate calibration for reliable fatigue detection.
- Effectiveness may be reduced in extreme weather conditions.
- Dependent on user wearing the footwear properly for optimal data accuracy.

RESEARCH GAP ANALYSIS

- Lack of truly self-powered footwear: limited integration of kinetic/piezo/thermo harvesters with smart power management to reduce reliance on frequent charging or bulky batteries.
- Unified multi-sensor fusion is immature: pressure, IMU, GPS, PPG/SpO₂, temperature, and magnet sensors are rarely combined into one on-shoe model for robust context awareness (terrain, fatigue, risk).
- On-device edge AI is underused: most designs offload to phones/cloud; few demonstrate real-time, offline inference for navigation, fall prediction, or collision avoidance under tight power budgets.
- Adaptive personalization is shallow: systems seldom learn a user's baseline gait, pathology, footwear fit, and terrain preferences to auto-tune haptics, stiffness, cushioning, or feedback modalities.
- Standards for V2X/ITS interoperability are missing: no common, secure protocol for shoes to talk to traffic signals, AVs, beacons, or indoor RTLS across vendors and cities.
- Predictive health analytics are limited: current solutions detect events post-hoc; gaps remain in early warnings for neuropathy, Parkinsonian changes, ulcer risk, or recovery anomalies using longitudinal trends.
- Ergonomics and form factor trade-offs persist: electronics add weight/rigidity; there's little work on flexible, washable, sweat-resistant, and repairable modules that preserve comfort and durability.
- Privacy, security, and safety are under-specified: scarce use of on-shoe encryption, differential privacy, secure pairing, fail-safe behaviors, and regulatory pathways for medical-grade features.
- Accessibility and inclusivity need depth: fragmented support for visually impaired, elderly, or rehab users; limited multimodal feedback customization (haptic/audio/visual) and culturally neutral UI cues.
- Manufacturing scalability & lifecycle gaps: few designs show costed BOMs, modular upgrades, calibration at scale, recyclability/e-waste plans, or QA for sensor drift over months of real use.

OPPORTUNITIES FOR NEW INNOVATION OR IMPROVEMENTS

- Shoes that charge themselves using walking energy (no need for frequent charging).
- Combine all important sensors (pressure, GPS, temperature, health monitors) into one shoe.
- Use AI inside the shoe (not only on phones) for faster and offline guidance.
- Make shoes lighter, flexible, and washable while still keeping the smart tech inside.
- Add better privacy and safety features so personal data stays secure.

FUTURE DIRECTIONS & RECOMMENDATIONS

- Design eco-friendly smart shoes with recyclable parts to reduce e-waste.
- Create affordable models so everyone, not just athletes, can use them.
- Add multi-language voice guidance to support people from different cultures.
- Focus on health-focused shoes that can warn early about problems like diabetes or fatigue.
- Build shoes that can talk to smart cities (traffic signals, cars, hospitals) for safer walking.