Intelligent Wearable IoT Device for Road Safety with Advanced Gesture Detection via Machine Learning

Background:

With the increasing popularity of wearable technology and the Internet of Things (IoT), there is a growing need for innovative solutions that enhance road user safety. Traditional methods of ensuring road safety, such as traffic rules and signage, often rely solely on visual cues and may not always be effective in preventing accidents.

This invention discloses a wearable IoT device that utilizes machine learning-based gesture recognition technology to improve road user safety by providing an additional layer of communication and awareness between road users.

Field of the Invention:

The present invention relates generally to wearable technology, IoT devices, machine learning, and road user safety systems.

Summary:

A wearable IoT device for road user safety is disclosed. The device comprises a set of sensors, including but not limited to, accelerometers, gyroscopes, and proximity sensors, which are configured to capture motion and gesture data of a road user. The device also includes a processing unit with machine learning capabilities, enabling real-time analysis and recognition of specific gestures performed by the road user.

The invention offers the following key features:

1. Gesture Recognition: The device employs machine learning algorithms to recognize a set of predefined gestures associated with common road user actions, such as signaling a turn, stopping, or indicating an emergency. This allows the device to interpret the user's intentions and communicate them to other road users or a central traffic management system.

2. Visual and Audible Alerts: Equipped with visual and audible indicators, the device can provide alerts to the wearer and surrounding road users. For example, when a cyclist wearing the device extends their arm to signal a turn, the device can activate a flashing light pattern or emit an audible signal to draw attention to the maneuver.

3. Proximity Detection: Utilizing proximity sensors, the device can detect the presence of nearby vehicles or obstacles. This enables the device to provide warnings to the wearer, reducing the risk of collisions, especially in low-visibility conditions or blind spots.

4. Data Logging and Analytics: The device records and stores motion and gesture data, allowing for detailed analysis of road user behavior. This data can be used to identify high-risk areas, improve traffic management, and enhance road safety measures.

5. Integration with Traffic Management Systems: The device can communicate with a central traffic management system, providing real-time updates on road user movements and intentions. This enables dynamic adjustments to traffic signals, speed limits, or other traffic control measures to optimize safety and efficiency.

Description of the Invention:

The wearable IoT device for road user safety comprises the following components:

1. Sensors:
    - Accelerometers to measure acceleration and detect changes in velocity.
    - Gyroscopes to sense angular velocity and orientation.
    - Proximity sensors to detect nearby objects or vehicles.
    - Optional additional sensors such as heart rate monitors or environmental sensors.
2. Processing Unit:
    - A microprocessor with machine learning capabilities to process sensor data and recognize gestures.
    - Memory to store machine learning models, algorithms, and recorded data.
3. Visual Indicators:
    - LEDs or other light sources to provide visual alerts or signals to surrounding road users.
4. Audible Indicators:
    - Speakers or buzzers to emit audible alerts or notifications.
5. Communication Module:
    - Wireless communication capabilities (e.g., Bluetooth, Wi-Fi, or cellular) to transmit data to a central system or receive updates.
6. Power Source:

- Rechargeable battery to power the device.

7. Mounting Mechanism:
    - Flexible and adjustable strap or clip to securely attach the device to the wearer's body or clothing.

The device can be worn on various parts of the body, such as the wrist, arm, or waist, depending on user preference and the specific use case.

The machine learning-based gesture recognition system is trained using a dataset of labeled sensor data corresponding to specific gestures. The processing unit analyzes the captured sensor data in real-time, comparing it to the trained models to identify and classify gestures with high accuracy.

Upon recognizing a gesture, the device activates the appropriate visual and/or audible indicators to communicate the intention of the road user to their surroundings. Additionally, the device can transmit this information to a central traffic management system, enabling a more comprehensive understanding of road user behavior and improving overall safety.

The device's data logging capability allows for the collection and analysis of road user behavior patterns, which can be used by transportation authorities to optimize infrastructure design, implement safety measures, and enhance traffic management strategies.

The wearable IoT device for road user safety with machine learning-based gesture recognition offers a novel approach to enhancing road safety by providing an intuitive and effective communication channel between road users and their environment. By recognizing and interpreting road user intentions, the device improves overall awareness, reduces the risk of accidents, and enables smarter traffic management systems. This invention showcases the potential of wearable technology and IoT in creating safer and more efficient transportation ecosystems.

Design System:

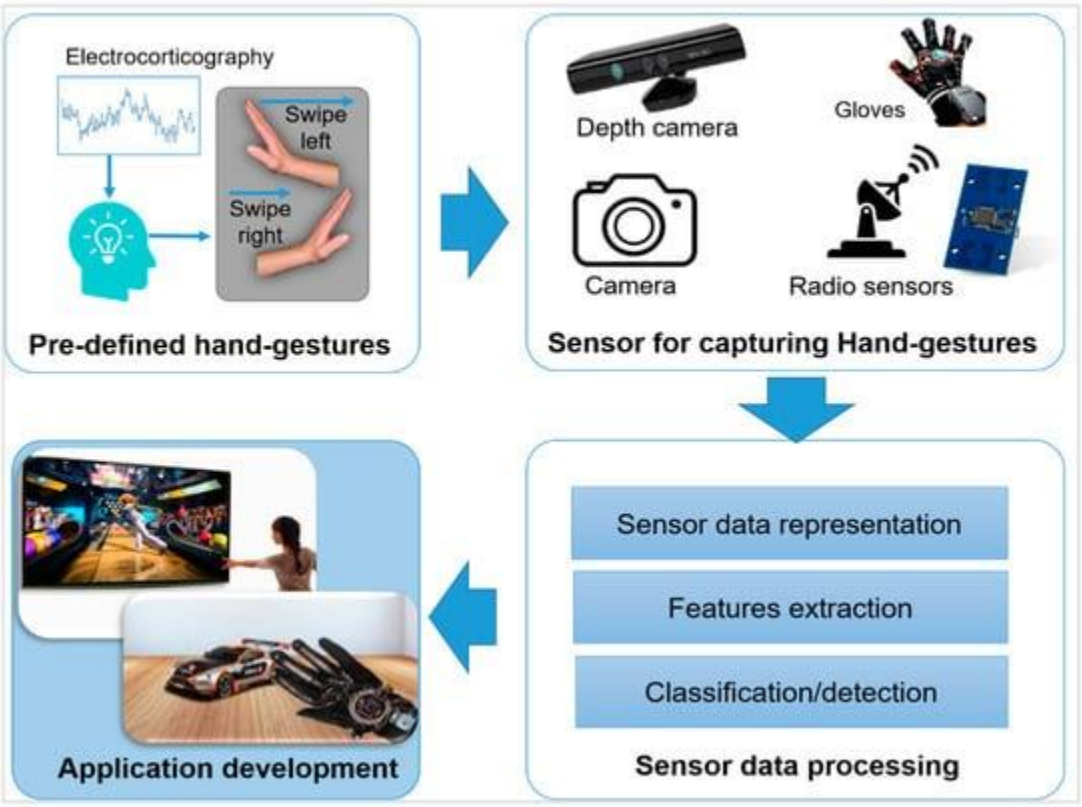

Fig 1. User performs pre-defined hand gestures

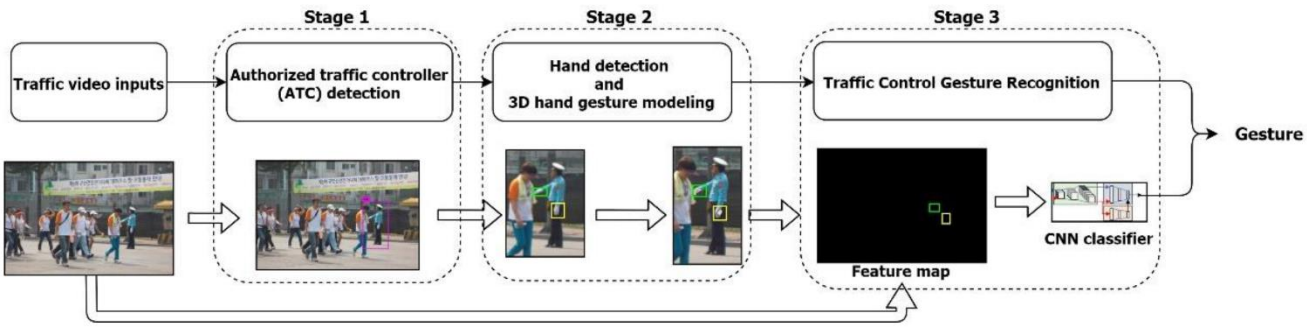

Fig 2. Authorized Traffic Controller Hand Gesture Recognition

Claims:

1. A wearable IoT device for enhancing road user safety, comprising:
    - a set of sensors configured to capture motion and gesture data of a road user;
    - a processing unit with machine learning capabilities, trained to recognize a set of predefined gestures based on said motion and gesture data;

- visual and audible indicators to provide alerts to the wearer and surrounding road users;
- a proximity sensor to detect nearby vehicles or obstacles;
- a communication module for transmitting data to a central traffic management system; and
- a power source to provide energy to the device.

2. The device of claim 1, wherein the set of sensors includes at least one accelerometer, gyroscope, and proximity sensor.
3. The device of claim 2, wherein the processing unit employs machine learning algorithms to analyze and classify gestures in real-time.
4. The device of claim 2, wherein the visual indicators comprise LEDs or other light sources to signal the intentions of the road user.
5. The device of claim 3, wherein the audible indicators emit sounds or notifications to alert surrounding road users.
6. The device of claim 3, further comprising a data logging capability to record and store motion and gesture data for analysis of road user behavior patterns.
7. The method of claim 4, further comprising detecting the presence of nearby vehicles or obstacles using the proximity sensor and providing warnings to the wearer.

Abstract:
This invention relates to an intelligent wearable IoT device designed to enhance road user safety through advanced gesture detection powered by machine learning. The device incorporates a compact array of sensors, including accelerometers, gyroscopes, and proximity sensors, to continuously monitor the user's movements and surrounding environment. Leveraging a machine learning model trained on a diverse dataset of gestures and road scenarios, the device accurately identifies critical hand gestures, body postures, or motions that indicate the user's intent or a potential safety hazard. Real-time data is processed on an edge-computing module and transmitted to a centralized IoT platform for actionable insights. The system supports features such as automatic signaling for lane changes, emergency alerts, and collision avoidance notifications to nearby vehicles or infrastructure. Designed for cyclists, motorcyclists, and pedestrians, the wearable integrates seamlessly with smart traffic management systems, ensuring proactive and context-aware safety interventions. The device emphasizes low power consumption, scalability, and adaptability to diverse road environments, promoting safer mobility for all road users.