Title of Invention:

LIGHTO, AN AI-POWERED SMART CEILING LIGHT FOR FALL DETECTION AND ELDERLY MONITORING

Inventor(s):
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Background

Falls among older adults, particularly those living alone, remain a significant health risk, often resulting in injuries, loss of independence, or even fatalities. Existing solutions, such as wearable devices, panic buttons, or radar sensors, have limitations, including reliance on user interaction, privacy concerns, and reduced accuracy under diverse conditions. To address these challenges, we introduce LIGHTO. This AI-powered smart ceiling light integrates depth imaging and sound recognition technologies to provide comprehensive, non-intrusive fall detection and elderly monitoring.

Summary of Invention

LIGHTO is a dual-function smart ceiling light that combines advanced AI algorithms, depth imaging, and sound recognition to monitor and detect falls in real time. Designed for easy installation and affordability, it aims to enhance the safety and quality of life for older adults while maintaining their privacy and independence. LIGHTO eliminates the need for wearables or intrusive cameras, leveraging an unobtrusive design that fits seamlessly into any home environment.

Technical Features

1. **LED Light for the Smart Ceiling Light (110):**
    - The smart ceiling houses all the essential components and provides structural support for the LIGHTO system.

2. **Pan and Tilt Module with Depth Imaging Sensor (120):**
    - Utilizes depth sensors to create a 3D map of the monitored space.
    - Employs a pan and tilt module to scan the room, ensuring comprehensive coverage with a single LIGHTO unit per room.
    - Detects body posture, movement patterns, and fall events with high precision.
    - Operates effectively in various lighting conditions without compromising accuracy.

3. **Power Relay (130):**
   - Powers up the LED lights and is controlled by a wireless wall light switch.

4. **LIGHTO Ceiling Light (140):**
   - Provides illumination for the room with energy-efficient LED technology.
   - Functions as a regular ceiling light with dimmable and motion-activated lighting options.

5. **Depth Imaging Sensor (150):**
   - Acquires depth images from the real world to monitor the environment and detect falls.

6. **Microprocessor with Heatsink and Fan (160):**
   - Performs edge computing on vision and sound analytics.
   - Continuously processes depth and sound data to identify real-time fall events.
   - Minimizes false positives through contextual analysis of movements and sounds.

7. **Power Module (170):**
   - Powers up the LIGHTO system and ensures reliable operation.

8. **Light Sensor (180):**
   - Detects the light intensity inside the room.
   - Automatically turns on the lights when movement is detected in a dark room, enhancing safety and usability.

9. **Audio Interface (190):**
   - A microphone (210) and audio speaker (220) interface with the microprocessing board.
   - Captures and analyses specific sounds, such as distress calls or screams for help.
   - AI algorithms differentiate between normal household noises and potential emergencies.

10. **Pan Tilt Module (200):**
    - It consists of two motors that perform pan and tilt movements for the depth imaging sensor.

Data Capture, Analysis, and Transmission Workflow

1. **Image Data Workflow**
   - **Acquire Image from Depth Imaging Sensor (230):** Capture images using the depth imaging sensor.
   - **Vision Analytic System (240):** Process the captured images using advanced AI algorithms.
   - **Bed Object Detection (250):** Detect objects on the bed using vision analytics.
   - **Body Posture Recognition (260):** Recognize the person's body posture using the depth imaging data.
   - **Human Tracking (270):** Track the person's movements in real time.
   - **LIGHTO Rule-Based Engine (280):** Analyze data from bed object detection, body posture recognition, human tracking, and sound recognition to make informed decisions on alerts and motor control.

- **Cloud Server (290):** Each alert consists of a message, and a sound or video clip will be sent to the cloud server to determine which user account to trigger an alert on the call bell system (300) and mobile app (310).
- **Call Bell System (300):** Trigger a call bell system if an emergency is detected.
- **Mobile App (310):** Provide caregivers access to monitoring data and alerts via a mobile app.

2. Sound Data Workflow

- **Acquire Sound from Microphone (320):** Capture sound using the integrated microphone.
- **Sound Recognition System (330):** Process the captured sound using AI algorithms, analysing over 100 features in the sound.
- **Motor Control System (340):** Control the motor system using the analysed data to perform pan and tilt modules.

3. Privacy-Centric Design

- Does not use traditional cameras, ensuring no video recording or storage.
- Complies with strict privacy regulations and alleviates user concerns about surveillance.

4. Integrated Communication Features

- Mobile App (310): Caregivers receive alerts and access monitoring data.
- 24-hour call centre support for immediate assistance in emergencies.

5. Advantages Over Existing Solutions

- Non-Intrusive: Unlike wearable devices or cameras, LIGHTO does not require active user participation or compromise privacy.
- Comprehensive Monitoring: Combines motion, sound, and light analysis for highly accurate fall detection and safety enhancement.
- Affordable and Scalable: Designed for cost-effectiveness, with subscription-based pricing to make it accessible for households and welfare organisations.
- Ease of Installation: Simple plug-and-play setup requiring no significant modifications to the home environment.

6. Use Cases

- Home Monitoring: Provides continuous monitoring for older adults living alone.
- Welfare Organizations: Scalable solution for eldercare providers to ensure safety across multiple households.
- Hospitals and Care Facilities: Supplements existing monitoring systems in wards and residential care homes.
- Bedside Monitoring: Ensures safety during bed exits, reducing the risk of falls in critical moments.

Brief Description of the Drawings

FIG. 1 illustrates the LED light module of the LIGHTO smart ceiling light.

FIG. 2 illustrates the pan and tilt module with depth imaging sensor.

FIG. 3 illustrates the overall LIGHTO ceiling light system.

Conclusion

LIGHTO represents a breakthrough in elderly care technology, offering a non-intrusive, AI-driven solution that prioritises privacy, affordability, and ease of use. With features like automatic lighting in dark conditions and bedside monitoring, this invention significantly enhances the safety and convenience of older adults, providing peace of mind for caregivers and improving the overall quality of life for its users.

Claims

Claim 1: A smart ceiling light system comprising depth imaging and sound recognition technologies for detecting falls and monitoring elderly individuals.

Claim 2: A privacy-centric monitoring device that avoids traditional cameras while delivering accurate real-time analysis of body movements, sounds, and room brightness.

Claim 3: An AI algorithm that processes depth, sound, and light data to identify fall events, minimise false positives, and provide automatic lighting control.

Claim 4: A 24-hour communication system integrated with a mobile app and call centre to provide immediate support during emergencies.

Claim 5: A dual-function design that combines safety monitoring with energy-efficient lighting capabilities.

Claim 6: A monitoring feature to prevent bedside falls by analysing movements during bed exits.