Research Work

IOT-ML-FALL DETECTION SYSTEM

Presented by D.Adhithya

Overview

- Brief Summary of project
- Why Analysing Novelity ?
- Prior Research and Work
- Non-novel components
- Novel-components
- CRI guidlines to our project
- Risk and weakness
- Summary and references

Project Summary

Our project is a Smart Fall Detection System built using ESP32, MPU6050 accelerometer–gyroscope sensor, and a cloud-based machine learning backend.

The device works in two modes:

1. Data Collection Mode
    - Collects accelerometer + gyro readings
    - Computes 24 statistical features
    - Sends them to the backend via MQTT
2. Prediction Mode
    - Reads features
    - Sends them to the ML model
    - Gets fall/non-fall predictions
    - Activates LED signals

On the cloud, we built:

- A real-time data dashboard
- A live labeling interface
- A one-click retraining pipeline
- A monitoring and analytics UI

Question Used

Fall detection is a heavily researched field—hundreds of papers use similar sensors and ML techniques. So we wanted to understand:

1. What parts of our project are truly new?
2. Which parts already exist in published research?
3. Which components can be patented under Indian Patent Law, especially under the CRI Guidelines from 2016?
4. What technical risks arise from non-novel or common methods?
5. How can we strengthen the novelty of our invention?

This analysis is directly connected to the Guidelines for Examination of Computer Related Inventions

Prior Research

When comparing our system with research literature

Common Findings Across Research

- Most fall detection systems use accelerometer + gyroscope
- They extract statistical features (mean, variance, max, min)
- They apply ML models like SVM, Random Forest, Decision Trees, CNNs
- Many use smartphone or IoT-based approaches
- Evaluations are often done on simulated falls

these parts of our system are not new and cannot be considered as inventive step.

Where Research Is Weak

- Very few systems support live labeling
- Almost none have continuous retraining
- No two-mode switching system was found
- No integrated edge-to-cloud architecture with retraining loops exists in literature
- No IoT + dashboard + auto-retrain combination appears in existing patents or papers

This helped us identify our novelty pockets.

Non-Novel Parts

Based on the literature review, the following parts are not new, meaning they have very high prior art

1. Using MPU6050 accelerometer–gyroscope
2. Extracting mean, max, min, variance
3. Using Random Forest classifier
4. MQTT communication
5. LED actuation
6. Feature vectors of 100 samples
7. Statistical thresholds and fall recognition logic

These components alone cannot form a patent claim because they fall under common techniques already used for years. Under CRI Guidelines, such elements would be considered:

- **“software per se”**
- **“algorithm”**
- **“data processing”**
- **and hence excluded under Section 3(k)**

Novel Parts

The following components in our system show novelty and can be considered for patent protection:

1. Two-Mode Hybrid Device (Data Mode + Prediction Mode)

A dynamic switching mechanism using hardware pins that changes the device's entire functioning.

2. Real-Time Data Labeling Dashboard

A live system that streams incoming data, allows fast labeling, and updates datasets instantly.

3. One-Click Cloud Retraining Pipeline

Newly labeled data triggers an automated ML retraining workflow—very rare in existing literature.

4. Self-Improving IoT Architecture

The complete flow:

sensor → ESP32 → MQTT → backend → dashboard → retrain → redeploy

This forms the basis of system-level novelty, which is patentable.

According to the 3-stage test :If the contribution is **only software** will be **rejected**,If **software + new hardware features** can be patentable This applies directly to **our architecture.**

CRI-Guidlines

Not Patentable

- Mathematical methods
- Algorithms
- Business methods
- Software programs per se
- Computer programs stored on a device

Patentable

- Software works together with novel hardware
- There is a technical improvement in a device
- The system solves a technical problem
- The invention is not purely data processing

What This Means for Us:

- Our ML model alone cannot be patented
- Our dashboard or code cannot be patented
- **But our complete IoT system architecture, including hardware-software interaction, can be patented**

Risks & Weaknesses

Because several parts of our invention are based on standard techniques, there are risks:

1. **High Competition / Prior Art**

Many fall detection projects exist, increasing chances of patent rejection.

2**. Model Weakness**

Small datasets → poor generalization → high false positives.

3. **Power Instability**

Battery and buck converter issues → reliability problems.

4. **Security Vulnerabilities**

MQTT without TLS → opens doors to message spoofing and interception.

5. **Implicit Bias in Data**

Dataset collected mostly from young volunteers → model may fail on elderly.

By addressing these risks and adding more hardware-level innovation, we can significantly improve novelty.

Summary

Our project contains both common and innovative components.

- According to CRI Guidelines, only system-level technical innovations involving hardware + software can be patented.
- Our unique contributions—the two-mode operation, continuous retraining pipeline, real-time labeling dashboard, and cloud-integrated self-improving system—can be framed as patentable inventions.
- Non-novel parts (sensors, features, ML model) cannot be patented.

References

1. Paper-1
2. Paper-2
3. Paper-3
4. ChatGPT

Thank You

For your attention