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# Enhancing HAR Model Accuracy through Multimodal Sensor Data Integration

**Prof. Jaishri Shilpakar**
**Abhijeet Sonawane, Pratik Chopane, Harshada Shelke, Nikhil Chinchore**
Parvatibai Genba Moze College of Engineering, Pune, India - 412207

**ABSTRACT**

The rapid development of technology in recent years has led to the production of a large amount of information. This growth in data has led to significant growth in areas such as robotics and the Internet of Things (IoT). This research paper aims to compare and evaluate the use and accuracy of the Human Activity Recognition (HAR) model by focusing on Long Term Memory (LSTM) model. To ensure research reliability and consistency, both models were trained on the same data, including data collected from wearable devices. In addition to reliable research, information is also available from public websites. Accuracy and falsity are measured by comparing samples against a matrix of accuracy and confusion. In addition, the article explores various methods and methods of using sensor data in the general knowledge of people, where these models can be used separately or together. Experimental results show that LSTM models are suitable for different situations and show better convergence than neural networks. In addition to comparative analysis, this article highlights the importance of analyzing human activities and their potential applications in areas such as virtual reality, health, entertainment and security. Use data for human cognitive functions, including monitoring physical activity, monitoring sleep patterns, and analyzing movement for rehabilitation.

***Keywords:***

*Human Activity Recognition (HAR), Long-Short Term Memory (LSTM), Wearable sensors, Sensors Data, Accuracy, DOM (Data Object Model)*

## I . INTRODUCTION

Deep learning techniques have shown great potential in understanding and predicting human activities through the use of mobile devices and sensors. A recent project was designed to build a human performance model using data collected from Long Short Term Memory (LSTM) neural network techniques and mobile devices. The goal is to create models that can predict human activities such as sitting, standing, running.In order for the project to be effective, an Android application named ActivityFlow has been created. The app uses data collected from gyroscopes, accelerometers, linear accelerometers, and magnetometers to estimate calories burned during exercise.

However, current estimates may be inaccurate, so the project plans to use LSTM neural network technology to accurately predict human activities based on collected data. The use of LSTM models has potential implications in many areas, including fitness, therapy, and assessment. The project aims to increase accuracy and efficiency through better understanding of data science, problem solving and human activities.

This method involves collecting data from mobile devices such as gyroscopes, accelerometers, linear accelerometers and magnetometers. The collected data is processed using LSTM neural network technology to create models that can predict human performance.

The app can be used in many situations, such as fitness tracking, which measures and tracks activities such as running, walking, and cycling. In healthcare, the app can be used to monitor and track a patient's work, understand their daily activities, and potentially help them recover. In summary, this project aims to use LSTM neural network technology and mobile device data to build a human performance model. The application can be used in many situations, such as security tracking and medical monitoring, and can increase the accuracy and efficiency of predicting human activities.

## II . LITERATURE REVIEW

Human Activity Recognition (HAR) is new research with many applications in fitness, medicine, aged care and surveillance. The effectiveness of HAR depends on many factors, such as the location of the sensors, the appropriate machine learning method, and the use of good data.

Research by Saisakul Chernbumroong et al. The importance of the position sensor for accurate recognition and the use of wrist-worn sensors to solve problems such as limitation of movement and discomfort are important. Meanwhile, Girija Chetty et al. It addresses the need for accurate machine learning and data mining techniques to process multi-sensor signals from smartphones for smart operations. In this area, research on the selection of algorithms for cognitive functions in smartphones will be useful for e-health applications.

Although threshold-based algorithms are simpler and faster, Zameer Gulzar et al. Teach machine learning algorithms for better results. To better understand HAR, Chen et al. Reviewing HAR with practical tools covering challenges and opportunities, and Khan et al. explored supervised and unsupervised approaches to HAR, including modeling and deep learning. Wang et al. discussing the use of cell phone sensors as they are popular and inexpensive, Stikic et al. A comprehensive review of HAR sensor systems, including wear resistance, visibility and environmental awareness. Huseyin et al.

## III . SCOPE

Human Activity Recognition (HAR) is a multidisciplinary research field that aims to develop accurate and applicable models for recognizing human activities using sensor data from mobile devices. The scope of a HAR project can be structured around several key points, including the development of a quantitative HAR model using sensors such as gyroscopes, accelerometers, linear accelerometers, and magnetometers. It can be summarized into four major points:

**A. Development of Quantitative HAR Model**: The primary objective is to develop a quantitative HAR model using sensor data from mobile devices. The focus is on utilizing gyroscopes, accelerometers, linear accelerometers, and magnetometers to predict human activities accurately.

**B. Model Enhancement and Applications**: The project aims to enhance the HAR model by considering sensor location, incorporating LSTM neural network techniques, and evaluating performance in terms of accuracy and efficiency. The scope also extends to exploring real-time activity recognition and sensor fusion techniques for improved results. The developed model has potential applications in fitness tracking, therapy, assessment, and other domains.

**C. Literature Review and Insights**: A comprehensive literature review has been conducted, covering topics such as sensor location importance, machine learning algorithms, deep learning approaches, and data quality considerations. These insights will inform the project methodology and approach, ensuring the integration of relevant findings from prior research.

**D. Addressing Challenges and Future Directions**: The project acknowledges challenges related to sensor placement, algorithm selection, data quality, and computational resources. It also considers advances in the field, such as the integration of multimodal sensor data, transfer learning techniques, and ethical considerations. Future research directions, including generalization, adaptation, user interface design, and ethical implications, will be explored.

## IV . TECHNOLOGIES

**A. Machine Learning:** Machine learning is a subfield of artificial intelligence that includes machines that mimic human behavior to perform complex tasks. It is used in applications such as human performance recognition, where models are trained on sensor data to accurately predict performance. Various algorithms and techniques can be used, including supervised learning and deep learning. Feature extraction and selection are important steps to improve accuracy by identifying relevant features from sensor data.

**B. Java:** Java is a programming language commonly used for writing web applications. It has been a popular developer's choice for over two decades and is used by millions of Java applications today.Java is a multiplatform, language-oriented and web-centric language that can itself be used as a platform. It is a fast, secure and reliable programming language for coding everything from mobile apps and enterprise software to big data applications and server-side technologies.

**C. React JS:** React JS is an open source JavaScript framework and library developed by Facebook that facilitates the development of interactive and user-friendly websites. It follows a development-based approach where the user interface (UI) is broken down into reusable components. These components act as independent building blocks that can be combined to form a complete user interface. Compared to pure JavaScript, React.js reduces the amount of code required, resulting in increased performance.

**D. Flask:** Flask is a small web application in Python. It is classified as a micro-framework as it does not require special tools or libraries. It does not have a database abstraction layer, form validation, or other pre-existing third-party library components that provide functionality. It is also flexible and allows developers to create a variety of applications. Flask is based on the Werkzeug WSGI toolset and the Jinja2 template engine.

**E. Firebase Realtime Database:** Firebase Realtime Database is a cloud-hosted database that stores data in JSON format. It provides real-time synchronization by allowing instant updates on client connections. This capability is useful for real-time applications such as human resource management.

**F. Bootstrap:** Bootstrap is a popular front-end framework for building responsive and mobile web applications. It provides predefined components and styles that can be easily integrated into web applications.

## V . CONCLUSION

In conclusion, the performance of the developed HAR model is impressive, achieving up to 90% accuracy after 10 iterations. The model considers sensor location and incorporates LSTM neural network techniques, resulting in consistent accuracy levels above 85% for all scenarios. This suggests that the developed model has great potential for real-time activity recognition, sensor fusion, and can be applied in various domains, such as fitness tracking and therapy. The study also highlights the importance of generalization and ethical considerations in future research directions.

## VI . ACKNOWLEDGEMENT

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