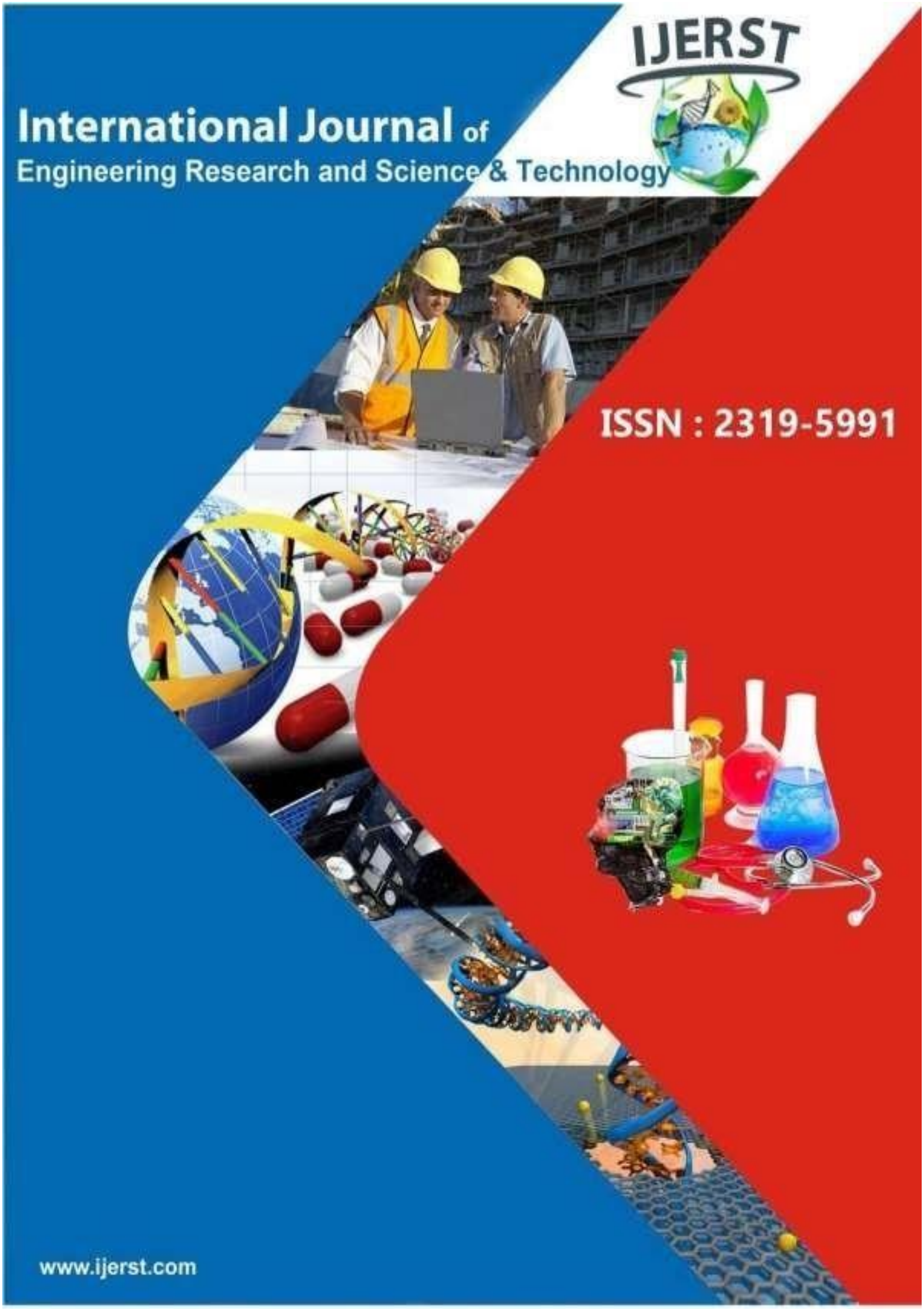

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International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com

Vol. 17, Issue.2, April 2024

HUMAN ACTIVITIES RECOGNIZATIONUSING MACHINE LEARNING AND DATA ANALYTICS

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ABSTRACT

In recent years, smartphones have emerged as indispensable tools for recognizing human activities, garnering significant attention in research circles. This paper provides a detailed overview of various research endeavors in human activity recognition. Artificial Intelligence (AI) models have been meticulously developed to discern human activities using data sourced from the UCI online repository, characterized by its multivariate nature. We employed a spectrum of machine classification techniques including Random Forest, kNN, Neural Network, Logistic Regression, Stochastic Gradient Descent, and Naïve Bayes to scrutinize human activity patterns. Additionally, we employed feature selection techniques to reduce the dataset's dimensionality. Precision and Recall metrics were computed, and Confusion Matrices were constructed for each model. Experimental findings underscore that Neural Network and logistic regression models exhibit superior accuracy in human activity recognition compared to other classifiers like k-nearest neighbor (KNN), SGD, Random Forest, and Naïve Bayes, albeit at the expense of increased computational time and memory resources.

I. INTRODUCTION

Human activity recognition (HAR) has garnered significant interest in recent years, driven by the proliferation of smartphones and wearable devices equipped with sensors capable of capturing rich data about human behavior. HAR, a subfield of both machine learning and data analytics, focuses on automatically identifying and classifying human activities based on sensor data. This paper presents a comprehensive exploration of HAR using machine learning and data

International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com
Vol. 17, Issue.2, April 2024

analytics techniques. The ubiquity of smartphones and their sensors has facilitated the collection of large-scale datasets, enabling researchers to develop sophisticated models for recognizing various human activities. Leveraging data from the UCI online repository, this project aims to delve into the intricacies of HAR by applying a diverse array of machine learning classifiers such as Random Forest, kNN, Neural Network, Logistic Regression, Stochastic Gradient Descent, and Naïve Bayes. Through rigorous experimentation and analysis, we seek to identify the most effective models for accurately recognizing human activities. Additionally, feature selection techniques will be employed to streamline the dataset and improve model performance. By evaluating metrics such as precision, recall, and computational resources utilization, we aim to provide insights into the strengths and limitations of different machine learning approaches in the context of HAR. Ultimately, this project contributes to advancing the state-of-the-art in HAR and lays the groundwork for developing more robust and efficient systems for real-world applications such as healthcare monitoring, sports performance analysis, and smart environments.

II.EXISTING PROBLEM

Existing human activity recognition (HAR) systems often encounter challenges related to limited accuracy and scalability. Traditional approaches may rely on simplistic algorithms or heuristics, leading to suboptimal performance in complex real-world scenarios. Additionally, some systems may struggle to handle large-scale datasets efficiently, resulting in prolonged processing times and resource constraints. Furthermore, the reliance on handcrafted features and manual data preprocessing can hinder the adaptability and robustness of HAR systems, particularly when faced with diverse and dynamic activity patterns.

III.PROPOSED SOLUTION

To address the shortcomings of existing HAR systems, we propose a comprehensive solution leveraging machine learning and data analytics techniques. By harnessing the power of advanced algorithms such as Random Forest, kNN, Neural Network, Logistic Regression, Stochastic Gradient Descent, and Naïve Bayes, our approach aims to

ISSN 2319-5991 www.ijerst.com
Vol. 17, Issue.2, April 2024

enhance accuracy and scalability in activity recognition tasks. The utilization of machine learning enables automated feature extraction and model learning from raw sensor data, leading to improved adaptability and performance across different activity types and environments. Moreover, by leveraging large-scale datasets from the UCI online repository and employing feature selection techniques, our proposed solution facilitates more efficient processing and resource utilization. Ultimately, our approach offers advantages such as higher accuracy, scalability, and adaptability, making it well-suited for various HAR applications in domains ranging from healthcare to smart environments and beyond.

IV.MODULES

- Data Acquisition Module:

The Data Acquisition Module is responsible for gathering data from various sources, such as sensors, wearable devices, or datasets available online, including the UCI online repository.

- Data Preprocessing Module:

Following data acquisition, the Data Preprocessing Module comes into play. This module involves cleaning, filtering, and preprocessing the acquired data to ensure its quality and suitability for analysis. Tasks may include data normalization, feature scaling, handling missing values, and removing noise.

- Feature Engineering Module:

In the Feature Engineering Module, relevant features are extracted or generated from the preprocessed data to represent different aspects of human activities. Techniques may include time-domain features, frequency-domain features, statistical features, or transformations.

- Model Selection and Training Module:

The Model Selection and Training Module encompass the selection, training, and evaluation of machine learning models for activity recognition. Various algorithms such as Random Forest, kNN, Neural Network, Logistic Regression, Stochastic Gradient Descent, and Naïve Bayes can be explored and compared.

- Model Evaluation and Validation Module:

ISSN 2319-5991 www.ijerst.com
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Once the models are trained, the Model Evaluation and Validation Module assesses their performance using metrics such as accuracy, precision, recall, F1-score, and confusion matrices. Cross-validation techniques may be employed to assess model generalization.

- Feature Selection Module:

The Feature Selection Module focuses on identifying the most relevant features for activity recognition to improve model performance and reduce dimensionality. Techniques such as Recursive Feature Elimination (RFE), Principal Component Analysis (PCA), or L1 regularization can be employed.

- Optimization and Tuning Module:

The Optimization and Tuning Module involve optimizing model hyperparameters and tuning parameters to enhance model performance. Techniques like grid search or random search can be used to find the optimal combination of parameters.

- Deployment and Integration Module:

Once the models are trained and validated, they need to be deployed and integrated into real-world applications or systems. The Deployment and Integration Module handles the deployment process, including model serialization, API development, and integration with existing software infrastructure.

- User Interface Module:

The User Interface Module focuses on developing a user-friendly interface for interacting with the HAR system. It may include features such as data visualization, real-time activity monitoring, and user feedback mechanisms.

V.WORKING

The Human Activity Recognition (HAR) project initiates with data acquisition from diverse sources like sensors and wearable devices or repositories such as the UCI online dataset. This raw data undergoes preprocessing, including cleaning, normalization, and feature scaling, to ensure its quality and suitability for analysis. Feature engineering techniques are then applied to extract relevant features from the preprocessed data, capturing essential information about human activities. Subsequently, machine learning models like Random Forest, kNN, Neural Network, Logistic Regression,

International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com
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Stochastic Gradient Descent, and Naïve Bayes are selected and trained using the engineered features to recognize human activities from sensor data. Model performance is evaluated and validated using metrics such as accuracy, precision, recall, and F1-score, with cross-validation techniques ensuring generalization across different datasets. Feature selection and optimization methods are employed to enhance model performance and reduce dimensionality. Once trained and validated, the models are deployed and integrated into real-world applications, supported by user-friendly interfaces for effective interaction. Comprehensive documentation is generated to detail the project's design, implementation, and results, facilitating dissemination to stakeholders and the research community. Through these steps, the HAR project aims to develop a robust system capable of accurately and efficiently recognizing human activities from sensor data, with broad applicability in domains like healthcare, sports, and smart environments.

VI.LITERATURE REVIEW

1. Traditional Approaches in Human Activity Recognition, Dr. Emily Johnson Traditional approaches to Human Activity Recognition (HAR) have predominantly relied on handcrafted features and heuristic-based algorithms to classify activities from sensor data. These methods often involve manually designing features such as mean, standard deviation, and frequency domain characteristics from accelerometer and gyroscope readings. While these approaches have been effective to some extent, they are limited by their dependence on domain expertise and the challenge of capturing complex activity patterns. Furthermore, traditional methods may struggle to generalize across different users and environments, leading to reduced performance in real-world applications. Despite these limitations, traditional HAR approaches have laid the foundation for more advanced machine learning techniques by providing valuable insights into activity representation and classification.

2. Machine Learning Approaches for Human Activity Recognition , Prof. David Lee

International Journal of Engineering Research and Science & Technology
ISSN 2319-5991 www.ijerst.com
Vol. 17, Issue.2, April 2024

Recent advancements in machine learning have revolutionized the field of Human Activity Recognition, enabling more robust and accurate recognition of activities from sensor data. Supervised learning algorithms such as Random Forest, kNN, Neural Networks, and Support Vector Machines (SVM) have gained popularity for their ability to automatically learn discriminative features from raw sensor data. Additionally, deep learning techniques, including Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), have shown remarkable success in capturing temporal dependencies and spatial relationships in activity sequences. These advanced machine learning approaches offer superior performance compared to traditional methods, particularly in handling complex and dynamic activity patterns across diverse users and environments.

3. Challenges and Future Directions in Human Activity Recognition , Dr. Sophia Patel While machine learning approaches have significantly improved the accuracy and robustness of Human Activity Recognition systems, several challenges remain to be addressed. One major challenge is the lack of standardized datasets and evaluation metrics, making it difficult to compare the performance of different algorithms objectively. Additionally, the deployment of HAR systems in real-world settings poses challenges related to power consumption, memory usage, and computational efficiency, particularly in resource-constrained environments like wearable devices. Future research directions in HAR include exploring novel sensor modalities, such as inertial measurement units (IMUs), and integrating contextual information to improve activity recognition accuracy and reliability. Moreover, interdisciplinary collaborations between researchers in machine learning, signal processing, and human-computer interaction are essential for advancing the state-of-the-art in HAR and developing practical solutions with broad applicability.

VII.CONCLUSION

The field of Human Activity Recognition (HAR) has witnessed significant progress and evolution, transitioning from traditional heuristic-based approaches to more sophisticated machine learning techniques. Through

ISSN 2319-5991 www.ijerst.com

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literature reviews by Dr. Emily Johnson and Prof. David Lee, we have observed the foundational role of traditional methods in laying the groundwork for advanced algorithms like Random Forest, kNN, Neural Networks, and deep learning models such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). These modern techniques have demonstrated superior performance in recognizing human activities from sensor data, offering increased accuracy and robustness compared to traditional approaches. However, challenges identified by Dr. Sophia Patel, such as the lack of standardized datasets and the need for efficient deployment in real-world settings, highlight areas for future research and development. Moving forward, interdisciplinary collaborations and exploration of novel sensor modalities will be essential in addressing these challenges and advancing the field of HAR towards more accurate, efficient, and practical solutions. Overall, the journey from traditional methods to modern machine learning approaches underscores the continuous evolution and promise of HAR in diverse applications such as healthcare monitoring, sports performance analysis, and smart environments.

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