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Human Activity Recognition Using Multi Features

BANUSHRI S

Abstract:

Human Activity Recognition (HAR) is a multidisciplinary field that uses computational algorithms to understand and categorize human behaviors. Recently, the focus has been on utilizing multiple aspects to enhance the depth and accuracy of identification algorithms. This survey provides a comprehensive overview of the advances made in HAR, with a particular emphasis on the integration and synergistic use of various features. We explore a wide range of properties that are relevant to HAR, including spatial and temporal data, physiological indicators, and detailed environmental variables. By adopting a multi-feature approach, we can broaden the scope of recognizable activities while also improving the precision and adaptability of identification systems, addressing the dynamic and multifaceted nature of human activities. However, combining multiple attributes complicates data processing, model training, and real-time applications. This survey delves into these issues, providing insights into potential solutions and future prospects. As we enter a new era in HAR, the combination of various aspects promises a more comprehensive, context-aware, and nuanced understanding of human actions, with enormous potential for applications ranging from healthcare to smart home systems.

Introduction:

Human Activity Recognition (HAR) is the process of automatically identifying and categorizing physical activities that humans engage in. This is achieved through the analysis of sensor data, and it has become increasingly important in areas such as healthcare, aged care, and fitness. The goal of HAR is to provide reliable information about people's activities in order to assist them in carrying out their daily tasks or to prevent emergencies.

HAR is a significant field of study that uses sensing technologies in various context-aware applications. However, there are several challenges and obstacles that need to be overcome to improve the accuracy of activity detection systems in more realistic settings. For instance, there may be intra-class variability, which means that different individuals may perform the same activity in different ways. Similarly, there

may be intra-class similarity, which refers to classes that are fundamentally different but exhibit very similar characteristics in sensor data. This can reduce recognition performance and processing time consumption during testing of activities, especially when it comes to online datasets.

Human actions can be recognized through various data sources, such as cameras (both image and video), wearable/environmental sensors, and cell phones. While vision-based HAR algorithms are highly accurate, they have certain limitations such as compromising privacy, requiring suitable lighting, and needing direct visibility of the target. This makes data collection challenging when there are obstacles or walls in the way. Wearable sensors may also cause discomfort or disruption while performing activities and can raise privacy concerns. Therefore, collecting data for human action recognition requires careful consideration of the data sources and their associated limitations sent signal from Wi-Fi access points using smartphones has become a standard solution that benefits over other approaches in privacy, availability, ease of installation and use, and cost.

DL and ML are advanced methods used for categorizing and predicting human activity. CNNs are becoming popular for HAR as they extract features automatically, unlike ML which requires expertise. However, CNNs need training, leading to the cold-start problem. This study evaluates the use of a pre-trained CNN feature extractor in real-world situations.

Monitoring physical activity can help manage and reduce the risk of diseases such as obesity, cardiovascular disease, and diabetes. Several studies have been conducted to create an effective human activity identification system using smartphones. It is crucial to research the role of each sensor in the smartphone for activity recognition. Artificial neural networks have shown excellent performance in human activity recognition recently.

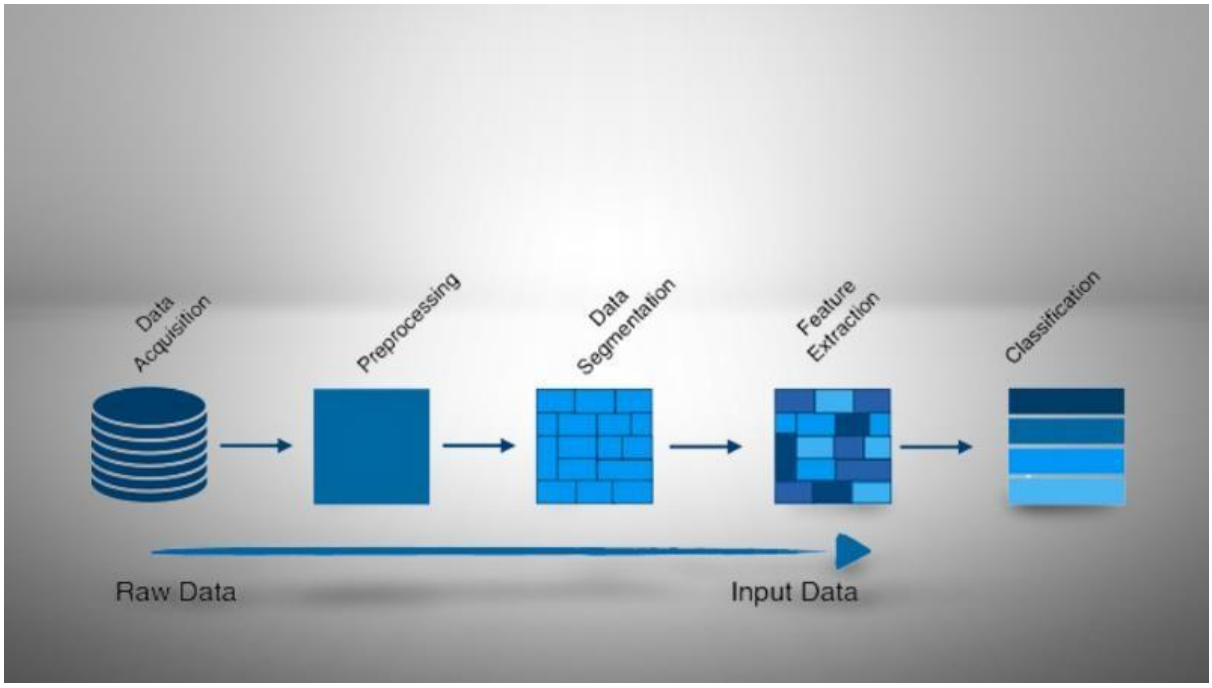

Fig: HAR Flow

Review Criteria:

[1]. Advanced Sensing and Human Activity Recognition in Early Intervention and Rehabilitation of aged Population

This paper dives into the multiple issues that the elderly face, taking both health-related and socioeconomic factors into account. The primary purpose was to identify key areas of concern and make recommendations for appropriate remedies.

The work emphasises the varied character of the problems that the elderly encounter. While health difficulties are unavoidable with aging, they argue that societal challenges be catered to by governmental measures, public awareness campaigns, and community support structures.

The study was designed as a cross-sectional study. Convenience sampling was used to draw from a population of older people in a certain area. Structured questionnaires were used to interview participants. The questionnaires included a wide range of topics, including physical health, emotional well-being, societal integration, and perceived barriers.

Descriptive statistics were mostly used to understand the acquired data, with inferential statistics used to determine correlations.

Physical Health: A notable proportion of the elderly reported chronic health concerns, the most common of which were mobility issues.

Mental Health: The majority of the individuals reported feelings of loneliness and depression. Another source of worry was cognitive deterioration.

Societal Integration: Many elderly people reported feeling marginalized, blaming it on ageism and a lack of societal comprehension of their needs.

Economic Challenges: Several participants mentioned the economic hardship caused by healthcare bills and limited post-retirement income.

Fig: Sensors in HAR

[2]. Patient Monitoring by Abnormal Human Activity Recognition Based on CNN Architecture.

This work presents a novel technique for patient monitoring based on the detection of anomalous human activities using video recordings. The project aims to improve patient safety and prompt treatments by capitalizing on advances in computer vision and deep learning. The key goal in this case is to create a

dependable system that can precisely differentiate between normal and abnormal actions, with a focus on activities that may signal patient concern or potential injury.

The trained model demonstrated promising levels of accuracy in discriminating between normal and pathological activities. During real-world testing, the system successfully detected worrying occurrences, allowing for prompt medical assistance. This method not only ensures patient safety but also helps medical staff by adding an extra layer of monitoring, especially during times when patient-to-staff ratios are high.

A dataset developed from recordings was classified as normal or aberrant. The raw video data was pre-processed, with frames shrunk and noise minimized. Using techniques such as optical flow and edge detection, spatial and temporal information were retrieved. To identify and classify activities, a CNN was trained on these features. The robustness of the model was evaluated using a separate validation set. The system was installed in a hospital setting for real-world application, with alarms programmed to warn medical staff of discovered anomalous activity.

[3]. Privacy-Preserving Human Activity Recognition from Extreme Low-Resolution

The study's goal is to develop a solution for accurate HAR without jeopardizing user privacy. This study digs into the issues and solutions associated with maintaining privacy while recognizing human behaviors using sensor data. With the proliferation of wearable and IoT gadgets, there is growing concern about personal data loss.

The authors have used encrypted sensor data, which ensured that raw data was inaccessible during the recognition procedure. A unique homomorphic encryption-based algorithm was introduced. This method can directly handle data which is encrypted without requiring decryption, ensuring data privacy. The efficiency and precision of the system were compared to traditional HAR approaches.

The proposed privacy-preserving HAR system outperformed standard approaches in terms of accuracy while also improving the privacy of the user. The implementation of homomorphic encryption ensures that sensitive user data stays encrypted, addressing data breaches and unauthorized access concerns.

[4]. A review paper on Internet-based healthcare and monitoring system

The usage of Internet-based platforms appears as a critical achievement in the field of Human Activity Recognition (HAR). The aim of this research is to explain the design and workflow Internet-based HAR system that makes use of cloud computing and IoT devices. The fundamental goal is to use

the Internet's capacity to enable real-time, scalable, and distributed activity detection, particularly in scenarios involving large amounts of data and various sensor sources.

Using powerful machine learning techniques, cloud infrastructure processes, and analysis of real-time data. The system is designed to be modular, allowing for the simple addition of new sensors and data sources.

The Internet-based HAR system displayed strong performance and scalability in managing enormous amounts of data from many sources. The system assures real-time processing and provides a flexible architecture adaptable to varied applications by offloading computing activities to the cloud.

[5]. A review of applications of activity recognition systems with regard to performance and evaluation

The study highlights the different uses of Human Activity Recognition (HAR) across several sectors, emphasizing its critical role in expanding technology's usability in everyday life. The fundamental goal of this research is to thoroughly investigate the HAR applications, which range from health and wellness to security and automation.

The authors conducted a screening of HAR implementations in many domains. With its ability to improve efficiency, safety, and convenience, HAR has seen a significant increase in usage across various industries. While the benefits are numerous, issues such as data protection, real-time processing, and scalability must yet be addressed before widespread adoption.

Some key applications identified are:

Monitoring patient activity to provide timely interventions and rehabilitation.

Elder Care: Assisting with fall detection and preserving older safety.

Smart Homes: Automating home systems on the behaviors of the occupants.

Detecting unauthorized or suspect activity in sensitive locations is referred to as security.

Comparative Study:

Sl No	Author (s)	Year	Approach	Gap Identification
1.	Lisa , Schrader et al	2020	Using sensor-driven technology to monitor and support older people's everyday activities and safety in real-time	✞ There is a dearth of diverse datasets covering various ethnic groups. ✞ The paper's methods have latency, emphasizing the necessity for efficient algorithms capable of real-time senior activity identification. ✞ Although the research mentioned IoT devices, it emphasized the study's limited investigation into merging HAR systems with wearable technology, which are growing increasingly popular among the elderly. ✞ The consequence of environmental variables such as lighting, room orientation, and furniture arrangement on HAR accuracy was not thoroughly investigated.
2.	Malik Ali'o Gul, Muhamma dHaroon usaf, Shah Nawaz	2020	The study applies a CNN trained on spatial and to detect and classify normal and abnormal patient actions, temporal information collected from video frames is used.	✞ The article uses only a limited number of video recordings, leaving an open question of how the system will perform with more diverse and extensive datasets, such as various patient demographics or settings. ✞ The research focuses on video data, and there is a gap in combining sensor data from other sources (such as wearables or bed sensors) that could provide complementing insights. ✞ The use of other deep learning architectures or hybrid models, as well as a comparison with the suggested CNN, was not included in the study.

3.	Michael . S Ryoo, Brandon Rothrock , Charles Fleming	2018	The research focuses on a privacy-preserving HAR system that leverages homomorphic encryption to directly analyze encrypted sensor input without decryption.	✞ While the study introduces the usage of homomorphic encryption, it does not go into detail about the computational costs and efficiency implications of such encryption approaches on real-time processing. ✞ While encryption is used, the suggested system's robustness
				against modern cyber threats, side-channel attacks, or sophisticated decryption techniques remains a possible subject of investigation. ✞ Handling encrypted data can make it difficult to ensure data integrity or recovery processes in the event of data loss or corruption.
4.	Garima Yadav, Dr. Ashok Verma	2022	The research uses cloud computing and IoT devices to create an Internet-based HAR system with a focus on real-time processing and dispersed data integration.	✞ While the system emphasizes realtime processing, there has been no research on the latency induced by cloud operations or potential optimisations. ✞ Data transmission over the Internet involves security problems. The report mentions the cloud and the Internet but does not go into detail on end-to-end encryption or other security techniques for protecting transferred data. ✞ The study does not go into detail on the potential issues or solutions for guaranteeing system interoperability across cloud providers or IoT platforms. ✞ Handling massive amounts of data from various sensors may pose storage and retrieval issues in a cloud setting, which has not been adequately addressed.

5.	Suneth Ranasinghe, Fadi Al Machot, Heinrich C Mayr	2016	This paper offers a detailed assessment of various Human Activity Recognition applications, analyzing their technology, benefits, and problems across industries.	✞ The report explores various applications but does not address HAR models' flexibility in dynamically changing real-world contexts. ✞ While the paper illustrates a variety of HAR applications across industries, there is no discussion of domain-specific difficulties, such as the differences in requirements or limits in healthcare versus security applications. ✞ Understanding why a specific HAR model makes a given prediction might be critical in applications such as healthcare. The need for more interpretable models is one potential gap.

Conclusion:

HAR has made significant progress, owing mostly to the usage of multi-features in recognition algorithms. It is evident from the scope of this investigation that utilizing a confluence of features—from spatial, temporal, physiological, to environmental—provides a nuanced and comprehensive view of human activities. This multimodal approach overcomes the shortcomings of single feature-based systems, paving the way for more accurate, flexible, and context-aware HAR models.

The combination of numerous features, on the other hand, increases difficulties in terms of data processing and model interpretability. As we face these issues, it becomes increasingly important to develop approaches that smoothly integrate and evaluate disparate data streams. The scalability, efficiency, and real-time responsiveness of these systems are still unexplored topics.

Interdisciplinary cooperation is on the horizon and will create the future terrain of HAR, leveraging the capacity of multi-features to replicate the complicated and dynamic character of human activities. With technology breakthroughs and deeper insights, we predict a paradigm change towards more intuitive, personalized, and contextually aware HAR systems that easily integrate into our daily lives.