A Case Study on Human Activity Detection and Recognition

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ABSTRACT

Purpose: *The goal of this research paper is to provide a knowledge of the current state of the Human Activity Recognition (HAR) by carefully combining the available HAR literature. The essay also tries to provide a suitable HAR system that may be utilized for real-time activity detection, including healthcare, surveillance, and suspicious conduct.*

With a focus on complex and multi-task human activity recognition across various domains, this review study aims to examine the state of human activity detection and recognition techniques while also outlining promising directions for future research and development in the area.

Design/Methodology/Approach: *By gathering and evaluating the necessary material from worldwide and national journals, conferences, databases, and other resources found through Google Scholar and other search engines, a systematic literature review process was employed.*

Findings/Result: *The comprehensive analysis of the study revealed several techniques for identifying and detecting human activity. There is still room to investigate the role of this technology in different domains to improve its robustness in detecting and recognizing of multiple human actions from preloaded CCTV cameras, which can aid in detecting abnormal and suspicious activities and ultimately reduce aberrant human actions in society. This is true even though the current study reports the investigations of several aspects of Human activity detection and recognition.*

Originality/Value: *This essay proposes a concept map and uses a methodical approach to analyze the variables that affect the identification and detection of human activities. The research project adds to the growing body of study on information sharing by demonstrating its importance.*

Paper Type: *Case Study*

Keywords: Human Activity Recognition, Human Activity Detection, Human Action Detection.

1. INTRODUCTION :

Due to advances in the science of computer vision, computers can now imitate human visual systems. As a subset of artificial intelligence, it uses data from digital photos or videos and processes it to ascertain the content, quality, etc (Zhang, H. B, et al. (2019). [1]). The entire process involves collecting photos, screening them, analyzing them, identifying them, and extracting information from them. Computers are able to correctly understand any visual input due to this deep processing. MHAR (Multitask Human Action Recognition), which recognizes human action and interaction, is an important part of current research. Understanding motion and clutter in a given image or video is a complex and difficult problem in multi-task based systems, which is what MHAR employing computer vision entails (Efthymiou, N. et al.(2018). [2]).

In essence, a method called Human Activity Recognition (HAR) can detect a person's motion and function to determine what they are doing (Friday, N. H. et al. (2018). [3]).The main goal of HAR is to

recognize a person's behavior using a variety of technologies, including cameras, motion sensors, location sensors, and time. A wide range of subjects, including social sciences, ubiquitous computing, artificial intelligence, human-computer interaction, healthcare, health outcomes, and rehabilitation engineering, depend on the ability to recognize human movement. User actions are important in a variety of ubiquitous and pervasive computer systems (Khong, V. M., & Tran, T. H. (2018). [4]). Systems can achieve context awareness with the help of human behavior, which provides a lot of context information. It assists with functional diagnostic and health outcome evaluation during rehabilitation. Recognition of human action is an important sign of involvement, quality of life (Rasheed, M. B. (2015).[5]).

Human activity recognition is an important area of computer vision research. Its applications include surveillance systems, patient monitoring systems, and a variety of systems that involve interactions between persons and electronic devices such as human-computer interfaces. Most of these applications require an automated recognition of high-level activities, composed of multiple simple (or atomic) actions of persons.

2. LITERATURE REVIEW :

This section provides a summary of the HAR related articles obtained from various databases, including internet, Google Scholar, Science Direct, and others. The articles were gathered using keywords such as Action Recognition, Action Detection, Activity Detection, Suspicious Activity Detection.

In the study by (Mohana H S. et.al. (2021). [6], the focus was on person activities, which were classified as person acts, interactions, and group actions. The ability to identify actions in input video is highly valuable in computer vision technologies and enables the development of models that can detect and recognize activities. The interactions between electronic devices and people are important in various surveillance environment systems, healthcare systems, military, patient monitoring systems (PMS), and other HAR applications.

(Mohana, H. S., & Mahanthesha, U. (2020). [7]). conducted an exhaustive review of the existing literature on human action recognition and proposed future research directions in this domain. Despite the substantial body of work dedicated to human action recognition, it remains a formidable challenge in real-world scenarios due to factors like intricate body poses, occlusions, and background interference. In their analysis, the authors assessed various methodologies for recognizing human actions, encompassing manually crafted action features in both RGB and depth data, action feature representation techniques based on deep learning, approaches for recognizing human-object interactions, and action detection methods. They presented the most notable and effective approaches within these research paths, providing a concise overview for researchers interested in these fields. Their study yielded several key insights into the realm of human action recognition.

The primary objective of the study conducted by (Holte, M. B.et al.(2012). [8],was to enhance the Human-Robot Interaction (HRI) experience by incorporating computer vision techniques. Their research was dedicated to advancing the capabilities of an action recognition system in challenging HRI scenarios, with a specific focus on situations involving special user groups such as children.

(Aggarwal, J. K., & Park, S. (2004). [9]). undertook an investigation into the utilization of mobile or wearable sensors for the purpose of activity recognition. Initially, they provided a concise overview of contemporary deep learning methodologies employed in the context of human activity recognition.

Mohana, H. S., & Mahanthesha, U. (2018).[10], explored the utilization of multisets generated by multiple sensors for the purpose of human action recognition. They introduced two innovative techniques for amalgamating data from diverse sets: Biset Globality Locality Preserving Canonical Correlation Analysis (BGLPCCA) and Multiset Globality Locality Preserving Canonical Correlation Analysis (MGLPCCA). These methods are capable of acquiring a lower-dimensional shared space that retains both local and global structural characteristics of the data samples. Furthermore, they put forward two distinct descriptors for depth and skeleton information and introduced a novel framework

for human action recognition. This framework leverages either BGLPCCA or MGLPCCA to learn a common subspace from a range of data sets, including skeleton, depth, and optical flow data. The effectiveness of this proposed framework was extensively demonstrated through rigorous testing on five publicly accessible datasets, which encompassed the MSR Action3D, UTD multimodal human action dataset, multimodal action database, Kinect activity recognition dataset, and SBU Kinect interaction dataset.

Sapiński, T. et al. (2019). [11], emphasized that prior surveys in the field of human action recognition have traditionally concentrated on either vision sensors or inertial sensors in isolation. However, recognizing the inherent limitations of each sensor modality, recent research has increasingly demonstrated that combining data from visual and inertial sensors can significantly enhance recognition accuracy.

Shuvo, M. M. H. et al. (2020).[12], investigated a new method for detecting human activities in 3D movies using RGB and depth data. The method suggested in involves using Bag-of-Information techniques to extract local-spatial temporal features from all frames of a video and to distinguish between human activities. To achieve this, K-means clustering and multi-class Support Vector Machines are utilized for classification, and the system is designed to be invariant to scale, rotation, and lighting.

The main objective (Singh, V. et al. (2020). [13], was to conduct a thorough evaluation of various data fusion and multiple classifier system techniques for human activity detection, especially for mobile and wearable sensors.

Pareek, P., & Thakkar, A. (2021).[14], proposed a facial recognition model that aims to detect and notify the system when a specific person is identified in a designated area monitored by CCTV cameras. The system is composed of a centralized server that receives live streaming footage from multiple camera feeds and maintains a database of individuals to be found. The proposed method uses image processing techniques to match the real-time facial images with previously stored images of the individual in question.
Basly, H. et al. (2020). [15], to investigate how the use of acoustically mimicked ground materials can affect the production and recognition of emotional walking. In the first experiment, the researchers found that the auditory feedback influenced emotional walking patterns in various ways, but the impact was not consistent. Some more related works reported in the literature are summarized in Table 1

Table 1: Scholarly literature on Classifiers and Machine Learning algorithms used for Human Activity Detection & Recognition, Source [16-25].

S. No.	Area and Focus of Research	Outcome of Research	Remarks	Reference
1.	A study on recognizing human activities using eyesight	This article examines the many HAR approaches and challenges.	Understanding daily activities over a longer time frame can be difficult. It is also challenging to categorize the same action when it is carried out in several ways. Both of these challenging activities need to be improved.	Beddiar, D. R et al. (2020). [16]
2.	Survey of human activity recognition systems	The various vision-based HAR systems that are currently in use were compared in this article.	The usage of inexpensive, subpar cameras has been observed to affect the accuracy and speed of	F Abdul Manaf, (2021). [17]

			the system's recognition. Deep learning-based HAR can be used in real time to recognize emotional behaviors like happy sitting and angry running.	
3.	Human activity recognition using convolutional network tools	The inquiry was divided into four distinct input categories: multimodal sensing devices, telephones, radar, and vision devices. The CNN-based deep learning technique was detailed. It was covered in relation to numerous generic datasets.	With certain improvements, CNN can recognize numerous human activities in a single frame and use activity tracking to forecast future behavior.	Islam, M. M. et al. [18]
4.	Recent trends in machine learning	Each frame employs the Kalman filter to identify the moving human target. Through this technique, the CNN and Bayes Classifier algorithms for walking, running, punching, and trip detection are compared.	The experiments' findings show that the CNN method performs better than the Bayes classifier. The worth of false positives can be increased.	Ramasamy Ramamurthy.et al.[19]
5.	Recognition of human action using the CNN-SVM learning method	This method introduces the hybrid strategy to find human activities. The feature will be taken from the frames using CNN and assigned to SVM.	CNN has been demonstrated to be useful when applied to large datasets, despite the fact that this method was only tested on a small dataset.	Hend Basly. et al. (2021). [20]
6.	Information fusion for human action recognition via bisect	This study concentrated on a number of areas, including content-based video outline, human-PC connection, teaching, medical services, video observation, abnormal action discovery, sports, and entertainment, as well as a number of activity detection algorithms and HAR applications.	The future of activity recognition could be seen as a multimodal knowledge. Multi-person recognition might be added later. It is important to think about how to categorize recordings with overlapped actions. Make action predictions while also using activity detection techniques to a situation online.	Elmadany. et al. (2018). [21]

7.	Survey of depth and inertial sensor fusion for human action recognition.	The system employed activity normalization to separate individuals from moving items before categorization.	The recognition of multi-person actions might be improved.	Chen, C. et al. (2017).[22]
8.	Activity normalization in surveillance videos for activity detection	The system employed activity normalization to separate individuals from moving items before categorization.	The recognition of multi-person actions might be improved.	Al-Akam, R., & Paulus, D. (2018).[23]
9.	Data fusion and multiple classifier systems for human activity detection and health monitoring	The proposed methodology employs a variety of deep neural network algorithms on skeleton-based images.	The recognition of activity in terms of emotions can be improved.	Nweke et al. (2019). [24]
10.	Facial recognition system for suspect identification using a surveillance camera	When attempting to recognize human action, they first employed a tree-based classifier to extract motion data using a region of interest (ROI).	Some feelings are difficult to pinpoint precisely.	Kumar, V. A. et al. (2018). [25]

3. RESEARCH GAP :

The detection of real-time human actions in real-time contexts, such as the identification of suspicious behaviors, the observation of human behavior, human-computer interaction, etc., has received scant attention in this case study.

4. OBJECTIVES OF THE STUDY :

(1) To identifying the Human Activity Detection and Recognition.
(2) To study the prevailing methods and aspects used for human activity detection and recognition for simple and multiple/ complex human activities.
(3) To explore the future research directions for robust human activity detection and recognition methodology, especially for multi task human activity recognition in several domains.
(4) To analyse ABCD analysis of human activity and recognition.

5. METHODOLOGY :

The study utilized a systematic approach for conducting a historical literature review, which involved searching various resources from international and national journals, conferences, databases, and other sources of internet to collect and analyze relevant methods used for human activity recognition and to develop a robust HAR algorithm using a supervised learning framework, which can recognize many actions such as hand waving, running, jumping, bending, bowling, boxing, jogging, multiple human activity in crowded places, suspicious activity recognition in public etc. from the preloaded input video sequences.

6. IDENTIFYING THE HUMAN ACTIVITY DETECTION AND RECOGNITION :

Human activity detection and recognition is the process of automatically recognizing and classifying human behaviors based on inputs like video, sensor readings, or other sorts of data. In addition to video surveillance, healthcare, sports analysis, and human-computer interaction are some of the industries that use this technology.

Types of Human Activities:

People engage in a vast variety of daily acts and behaviors, which are collectively referred to as "human activities." Depending on their nature and goal, these activities might be grouped in a number of different ways. Following are some typical human activities:

(1) Work and Employment: These activities include employment, careers, and ways for people to make a livelihood. This can involve working in factories, offices, farms, and a variety of other businesses.
(2) Leisure and recreation: These pursuits, which can include sports, hobbies, travel, reading, and entertainment, are meant to provide relaxation and enjoyment.
(3) Education: Any activity involving learning and knowledge acquisition, such as attending school or college or engaging in independent study.
(4) Social Interactions: These include communications with loved ones, friends, coworkers, and strangers. This entails networking, partnerships, and communication.
(5) Health and Wellness: Activities involved in preserving and enhancing one's health, such as physical activity, dietary changes, medical care, and wellness routines.
(6) Cultural and Creative Activities: These include artistic, musical, theatrical, dancing, and other creative endeavors
(7) Religious and Spiritual Practices: Activities related to one's religion, such as going to church, praying, meditating, and engaging in spiritual rites.
(8) Household and Daily Chores: These are regular tasks like cooking, cleaning, and house upkeep that are important for keeping a home.
(9) Shopping and commerce: Online and offline activities involving the purchase and sale of products and services.
(10) Transit and Travel: Activities that include moving from one location to another, such as driving, flying, or taking public transit.

7. THE PREVAILING METHODS AND ASPECTS USED FOR HUMAN ACTIVITY DETECTION AND RECOGNITION FOR SIMPLE AND MULTIPLE/ COMPLEX HUMAN ACTIVITIES :

A subfield of computer vision and artificial intelligence called "human activity detection and recognition" (HADR) aims to recognize and comprehend human activities and behaviors from a variety of data sources, including pictures, videos, sensor data, and more. It can be used for a variety of purposes, such as surveillance, healthcare, sports analysis, and human-computer interaction. The following are some crucial elements and methods for identifying and detecting human activity (Turchet, L., &Bresin, R. (2015).[26]).

(1) Data sources:
Video: Video data is a common input for human activity recognition systems. This may be from webcams, security cameras, or other video sources.
Sensors: Information from a variety of sensors, including wearable technology and accelerometers and gyroscopes, can also be utilized to identify activities.
(2) Preprocessing: Data cleaning and preparation for analysis frequently require preprocessing. This could entail operations like feature extraction, normalization, and noise reduction.
(3) Feature Extraction: The feature extraction stage of activity recognition is crucial. It entails transforming unprocessed data into informative features that may be applied to categorization. This can entail methods like optical flow analysis or feature extraction based on deep learning for image and video data.
(4) Deep Learning and Machine Learning: Deep learning and machine learning methods are frequently employed for activity recognition. Convolutional neural networks (CNNs), random forests, and other supervised learning techniques are frequently used for classification tasks.
(5) Models for Activity Recognition: Models are taught to identify particular activities. These can include simple tasks like standing, walking, and jogging as well as more difficult ones like dancing, cooking, or participating in sports.
(6) Temporal Analysis: A number of acts take place in a series over time. To capture the dynamic nature of activities, temporal analysis techniques like Hidden Markov Models (HMMs) or recurrent neural networks (RNNs) can be used.
(7) Context and Environment: Accurate recognition can be impacted by the context and environment in which actions take place. Utilizing additional sensors or contextual data, this information may be included (Liu, C. et al. (2018). [27]).

(8) Offline vs. Real-time Analysis: Depending on the application, human activity identification systems may need to function in real-time, identifying activities as they take place, or they may analyze recorded data offline.
(9) Difficulties: The diversity of human actions, as well as differences in appearance, lighting, scale, and viewpoint, make it difficult to identify human activity. An essential component of system design is making sure it can withstand these difficulties.
(10) Applications: A wide range of industries, including security and surveillance, healthcare such as fall detection for the elderly), sports analytics, human-computer interface, and virtual reality, use human activity recognition.
(11) Considerations for Privacy and Ethics: Privacy and ethical concerns should be taken into account when employing activity recognition systems, particularly in surveillance applications. Consent and proper data anonymization are essential (Santhoshkumar, R., & Geetha, M. K. (2018).[28]).
(12) Datasets: Datasets are crucial for developing and testing activity recognition models. Researchers use a number of publicly accessible datasets for benchmarking their algorithms (Santhoshkumar, R., & Geetha, M. K. (2018). [29]).

With the advancement of more complex machine learning and computer vision algorithms, human activity detection and recognition continues to advance, making it an exciting and quickly developing topic with important practical consequences.

8. FUTURE RESEARCH DIRECTIONS FOR ROBUST HUMAN ACTIVITY DETECTION AND RECOGNITION METHODOLOGY, ESPECIALLY FOR MULTI TASK HUMAN ACTIVITY RECOGNITION IN SEVERAL DOMAINS :

Future research directions for reliable human activity detection and recognition are always changing, particularly when it comes to multi-task human activity recognition across diverse domains. Here are some prospective topics and factors to take into account for upcoming study in this area:

(1) Multi-Modal Sensor Fusion: This technique combines data from a variety of sensors, including cameras, microphones, wearable technology, and ambient sensors, to enhance the reliability and accuracy of human activity detection.
(2) Deep Learning and Neural Networks: Improvements in deep learning methods enabling better feature extraction and model training in human activity detection, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs).
(3) Transfer Learning: Investigating how well-performing models that have already been trained in one domain can be adjusted or adapted to perform well in other domains, minimizing the requirement for a large amount of labeled data.
(4) Spatiotemporal Modeling: Creating techniques to record the spatiotemporal elements of human activity, particularly in complicated circumstances where actions may cross both space and time.
(5) Context-Aware Recognition: This type of recognition considers the environment in which an activity takes place, as well as social interactions and personal preferences.
(6) Online and Incremental Learning: Algorithms that can incrementally adapt to new behaviors and data are essential for real-world applications.
(7) Privacy-Preserving Techniques: Using strategies like federated learning or on-device processing to make sure that human activity recognition systems respect people's privacy.
(8) Human-AI Collaboration: Focusing on human-in-the-loop systems, this area looks at how people and AI systems may collaborate to improve the precision and effectiveness of activity recognition.

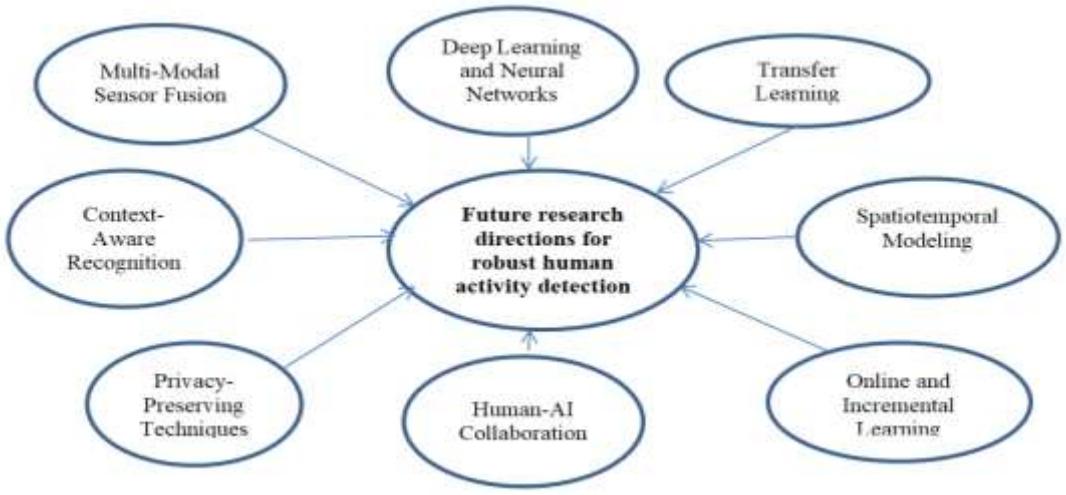

Fig. 1: Future research directions for robust human activity detection

Authors Source

The specific difficulties associated with multi-task recognition across several domains should be addressed in future research on robust human activity detection and recognition, and consideration should be given to the actual implementation of these technologies in real-world applications. For these technologies to be developed and deployed responsibly, cooperation between researchers, business, and government is necessary.

9. ABCD ANALYSIS OF HUMAN ACTIVITY AND RECOGNITION :

The main goal of an ABCD listing study is to identify the strategies that will best match a company's resources and skills with the requirements of the environment in which it operates. In other words, it serves as a springboard for assessing projected internal potential and constraints as well as external opportunities and threats. It considers all good and negative internal and external influences. Based on the information given, the ABCD listing review tool analyzes the internal and external elements of a firm or organization. These techniques provide a quick and systematic manner to identify various systemic issues and present a potential for further development. They provide thorough evaluations of many institutions and practices [30-36].

An ABCD listing analysis' principal objective is to pinpoint the strategies that would most successfully match a company's resources and domain expertise with the demands of the environment in which it operates. It acts as a starting point for evaluating potential internal constraints and risks as well as external opportunities and threats. It takes into account all factors, both favorable and unfavorable, originating from both inside and outside the company. The ABCD listing is an evaluation method that evaluates the internal and external facets of a business or organisation using easily accessible data. These methods offer a quick and systematic manner to recognize numerous systemic issues and present chances for continued development. They offer an in-depth analysis of particular organizations and systems.

A. Advantages:

(1) **Fitness and Sports Tracking:** HAR can be used to keep track of a person's exercise routine and sporting accomplishments as well as to provide useful training and performance-enhancing information.

(2) **Monitoring and security:** Security systems use HAR to detect suspicious or unlawful activity and take the appropriate action, improving the safety of buildings and public areas.

(3) **Smart Homes and the Internet of Things:** HAR can automate a variety of functions in smart homes, including as providing voice commands for device control and adjusting lighting and climate control based on occupancy.

(4) **Gesture and Posture Recognition:** HAR in human-computer interaction enables gesture recognition for device control and virtual reality scenarios. It is utilized in gaming, virtual simulations, and robotics.

(5) **Quality Control in Manufacturing:** HAR can ensure that employees do tasks in industrial environments safely and accurately, reducing errors and accidents in manufacturing operations.
(6) **Accessibility and Assistive Technology:** HAR enables people with disabilities to operate equipment with their voice or body motions, making it easier for them to use technology and communicate.
(7) **Law Enforcement and Forensics:** HAR can help with witness identification, scene reconstruction, and suspect behavior analysis in criminal investigations.
(8) **Education and Training:** HAR can be used in educational settings to assess student involvement and performance, providing teachers with information to change their teaching methods.

B. Benefits:

(1) **Retail and customer behavior analysis**: HAR is used to monitor customer behavior and movements in retail locations, helping businesses to streamline their floor plans and marketing initiatives.
(2) **Activity and Workflow Optimization:** In order to increase efficiency and identify possible areas for development, HAR can be utilized in the workplace to monitor employee behaviors and workflows.
(3) **Environmental Monitoring:** By keeping an eye on environmental activities including animal behavior, weather patterns, and ecological changes, HAR can support scientific research and conservation programs.
(4) **Transportation and automobile Safety:** In the automobile industry, HAR can assist with driver monitoring, identifying driver fatigue, and enhancing vehicle safety. Autonomous vehicles must be able to perceive and anticipate the movements of people and cyclists.
(5) **Human-Robot Collaboration:** In sectors including manufacturing, healthcare, and logistics, HAR is essential for facilitating safe and effective human-robot interaction.
(6) **Public health and epidemiology:** HAR can be used to track disease transmission and track human contact patterns, helping to prevent and contain infectious disease epidemics.
(7) **Applications for augmented reality (AR) and virtual reality (VR):** HAR is crucial for providing a realistic and interesting user experience in AR and VR applications.
(8) **Data Analysis and Insights:** HAR generates valuable data that businesses and researchers may utilize to make data-driven decisions and better understand people's actions and behaviors.

While HAR has many benefits, it's crucial to address ethical and privacy concerns when putting these systems into place because they require gathering and analyzing information about people's habits and movements. HAR technologies must be used ethically and with privacy in mind if they are to be used responsibly.

C. Challenges:

Technologies for human activity recognition (HAR) and detection have their own set of drawbacks and difficulties. It's crucial to take these disadvantages into account while designing and putting into use HAR systems. Recognizing human behavior has some drawbacks, such as:

(1) **Privacy Concerns**: The possibility of privacy violations is one of the main negatives. Concerns regarding data abuse and eavesdropping can arise since HAR systems regularly collect and analyze data about people's movements and activities.
(2) **Data Security Risks:** Sensitive data may be present in the video, audio, and sensor data that HAR systems collect. If not adequately safeguarded, it can be vulnerable to hacking, unauthorized access, and data leaks.
(3) **Discrimination and bias:** Particularly for underrepresented or marginalized populations, HAR algorithms may be unfair or mistaken. These prejudices may reinforce and maintain existing inequalities.
(4) **Complexity and Cost:** HAR system development and deployment can be time-consuming and expensive. It frequently calls for specific tools, know-how, and resources that not all businesses or people may have access to.
(5) **Data Labeling and Annotation:** Labeled data must be used while training HAR models, which can be a time- and resource-intensive procedure. It can be difficult to compile a diverse and representative dataset.

(6) **Ambiguity and circumstance Sensitivity:** Human behaviors can be quite ambiguous and sensitive to circumstance. Accurate detection might be difficult since different activities can look identical, especially in situations that are dynamic and complicated.
(7) **Energy Consumption:** HAR systems, particularly those used by mobile or wearable devices, can use a lot of energy, which affects their overall usability and battery life.
(8) **Legal and Ethical Concerns:** The use of HAR technologies may give rise to legal and ethical concerns about consent, data ownership, and proper use. Regulations may differ depending on the jurisdiction, making the adoption of these technologies more difficult.

D. Drawbacks:
(1) **User Acceptance and Trust:** Users may be resistant to or distrustful of the technology if they feel uneasy about being constantly watched over or having their activities tracked.
(2) **Adaptation to New Activities:** The generalizability of HAR systems is constrained by their difficulty in adapting to novel or uncommon activities that were not included in the initial training dataset
(3) **Data Quality and Noisy Environments:** Sensor faults, noise levels, and lighting can all have an impact on how well an activity is recognized.
(4) **Ethical Use and Accountability:** It can be difficult to ensure that HAR systems are used ethically and are responsible for their deeds, especially when automated judgments have an adverse effect on people's lives or liberties.

For appropriate development and deployment, HAR system advantages and downsides must be balanced. To minimize potential downsides and secure people's rights and privacy, it necessitates taking into account ethical, legal, and social ramifications. It also necessitates putting in place the proper safeguards and transparency measures.

10. CURRENT STATUS OF HAR :

The literature review revealed that HAR research has made tremendous strides, particularly in the creation of computer vision methods and deep learning-based solutions. However, a number of brand-new difficulties and problems have also surfaced, including:

Current Status of human activity recognition:
1. **Sensor Technology:** HAR mostly uses sensor data from many sources, including accelerometers, gyroscopes, and wearable technology. The precision and data collection abilities of these sensors have continued to advance in technology.
2. **Machine Learning and AI:** In order to improve pattern recognition and create more precise HAR algorithms, machine learning and artificial intelligence approaches have advanced.
3. **Applications:** HAR technology has found use in a variety of industries, including security (seeing suspect activity in surveillance film), sports (tracking athletic performance), and healthcare (watching patient movements and activities).
3. **Applications:** Healthcare (watching patient movements and activities), sports (tracking athletic performance), and security (seeing suspect activity in surveillance film) are just a few of the industries where HAR technology has found use.

11. SUGGESTION :

HAC is a significant field of study with numerous real-world applications in areas including surveillance, healthcare, HCI, and sports analysis. Here are some ideas for study subjects and methods in this area:
1. Create systems for real-time human activity recognition that can identify and categorize actions as they take place. For uses like robotics and healthcare monitoring, this is essential.
2. Discover the newest deep learning architectures for recognizing human action, including Transformers, Recurrent Neural Networks, and Convolutional Neural Networks. Create neural network topologies that can successfully handle temporal data.
3. Broaden the focus to include group interactions and social interactions. This might be useful in applications like social robots and video analysis.

12. FINDINGS :

(1) Multi-tasking recognition and detection is potential to identify the complex object activities from videos enables the construction of several important applications. Automated surveillance systems in public places like airports and railway stations are required to detect abnormal and suspicious activities.
(2) The ability to recognize human activities also has significant applications in real-time monitoring within medical contexts for patients, children, and the elderly. It opens the door to developing gesture-based human-computer interfaces and vision-based intelligent environments, made feasible through activity recognition systems.

13. CONCLUSION :

There has been significant research in the area of HAR using computer vision technologies. This research has explored various approaches in identifying and recognizing human actions, including manual collection of motion photos, facial detection and identification methods, and the use of multiple sensors to recognize human actions. Deep learning-based solutions have been found to outperform other methods for action feature learning challenges. However, recognizing actions in real-life scenarios remains a difficult task due to several factors such as complex body postures, occlusion, and background clutter. Emerging research challenges include interaction recognition and action detection. Despite these challenges, researchers continue to work on developing HAR systems that can recognize and identify actions in a variety of situations, including those involving special users like children and also the literature survey reveals that there have been significant advancements in HAR research But there are also several challenges and gaps that need to be addressed.

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