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This publication URL: https://archive-ouverte.unige.ch/unige:166094

Recognition System for Behavior & Activities of Daily Living Among Patients with Dementia Using Smart Algorithms and Assistive Technology

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ABSTRACT

Dementia is a syndrome consisting of a group of symptoms that cause progressive brain dysfunction and impairment of cognition or intellects. Dementia causes problems with memory, orientation and thinking processes to the extent that it decreases functionality in Activities of Daily Living (ADL) and causes behavior change. Several studies have focused on the unusual behavior detection and pattern detection of daily activities using in-home sensors. Activities are detected either through specific rules or by applying learning techniques. This study focuses on utilizing adaptive algorithms where the relationship between environmental and cognitive state will be predicted. To automatically assess cognitive health based on activity and behavior, this research will focus on introducing a method to automatically predict the behavior of patients at homes in a smart way and predicting the patient's cognitive state.

KEYWORDS

Pattern Recognition, Anomalous Behavior, Cognitive Impairment, Assistive Technology, Activities of Daily living

1 INTRODUCTION

The number of senior citizens living alone is increasing rapidly and the number of people diagnosed with dementia is expected to rise in the coming years. The cost of care for this condition will increase dramatically. A smart solution is required to support these individuals living alone, especially older individuals with dementia, Alzheimer's, and patients with acute or mild cognitive impairment. A workforce shortage and lack of technology exist to support and

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monitor such patients and older adults living alone. Needs for smart solutions arise to monitor those patients and deal with possible risks. Research has been conducted to analyze human behavior and what kinds of behaviors indicate the decline of the patients' mental health [1]. With emerging technology wearable and non-wearable devices are being used to monitor the health of patients and older adults.

Usually, a monitoring system involves wearing a wearable device to observe the behavior and state of the patients. With the emergence of smart technology and AI smart algorithms and smart techniques can be used to detect the behavior of the patients and their activities of daily living in a residential space. To derive the behavioral pattern, the monitored person must be observed for a long time [2].

Abnormal behavior could be any like a person sitting sedentary on a sofa or chair for long periods of time, a person standing close to TV and staring at it, coming, and going in the same room again & again in a specific short time, sitting on a sofa and tapping with hands for longer periods of time, eating poorly or behaving unsafely, hitting objects, showing agitation or aggression.

2 OBJECTIVE

The goal of the current work is to develop an innovative living environment which will empower people with dementia and their caregivers to benefit from healthcare support and have better quality of life in their own homes. This project will integrate physiological and environmental data and will utilize adaptive algorithms where the relationship between environmental and physiological data will be considered in extracting health and well-being-related information and detecting any unusual behavior of patients for continuous monitoring of people with dementia in their own homes.

After training the software, there will be test conditions to test the software's accuracy. The proposed system for pattern and unusual behavior detection of different activities within a smart suite apartment will be highly valuable and probable. With an analysis system capable of making judgments and recognizing patterns and anomalous behavior in activities. The development of this project could be replicated in ambient assistive living projects for older adults and patients with dementia.

3 METHODS

Detecting abnormal behaviors using computer vision and pattern recognition is a long-standing challenge. Our contribution consists, firstly, of using a dataset composed of different videos. We have

Figure 1: Example of input and output for behavior detection

identified some datasets that can be used in our project like *MSRAction3D, MSRAction3DExt, UTKinect-Action, MSR Daily Activity 3D, SBU Kinect interaction, HDMO5, HMDB51, CMU.* These datasets include videos of daily activities.

Unsupervised learning techniques will be used to train the data. A video sequence of different scenes will be used as raw data, which will then be trained to extract/determine the anomaly of the behavior. Instead of using a supervised learning framework, the framework that will be used for the unusual/abnormal behavior detection will be done through unsupervised or self-supervised deep learning frameworks. To meet the need of intelligent camera/video-based monitoring of the patient, an unsupervised anomaly detection algorithm will be used. A founding principle of any suitable machine learning model is that it requires datasets—anomaly detection benefits from even more significant amounts of data. Anomaly detection is the process of finding the outliers of the dataset; that is, those items that don't belong. For this purpose, a large dataset is required as the founding principle of machine learning [3]. Anomaly detection benefits from large datasets because the assumption is that anomalies are rare. Using video sequences of different scenes as raw data, the algorithm will be trained to detect the unusual behavior in patterns of daily activities. Figure 1

4 SOFTWARE

A set of python scripts for analyzing the activity pattern. Pattern recognition framework and outlier detection algorithm will be used to detect anomalous/unusual behavior. Pattern recognition systems can recognize familiar patterns quickly and accurately. Moreover, HYBRID algorithms are used for pattern recognition [4]. Some of the best neural models are back-propagation, high-order nets, time-delay neural networks and recurrent nets. We will develop machine learning and data analytics algorithms that will combine physiological and environmental data to learn and discover changes in patients' health and well-being. This will allow early identification of patients' needs and provides better quality of care for people with dementia. A set of algorithms will be used to develop machine learning algorithms to analyze the correlation between environmental data and the behavior of the patient.

5 SETUP

Generally, activities are detected either through specific rules or by applying learning techniques using labelled data that is not available for uncontrolled, real-world environments [4]. However, in this project, we aim to provide a robust and more generic approach to discover the underlying pattern of participants' activities given a large data set that contains unlabeled data.

After the image from the video is captured, it will be sent to the computer, the scenario will then be categorized & analyzed.

6 RESULTS

We will compare our results with other frameworks and classifiers to demonstrate the accuracy and efficiency of our technique. This research work is focused on monitoring the health of older adults and patients with dementia or cognitive impairment.

Using this technique, it will be possible to monitor patients by classifying the patient's daily behavior using surrounding data and detecting the unusual behavior using deep learning techniques and various pattern and sequencing algorithms.

REFERENCES

[1] Varun C, Arindam B, Vipin K (2019) Anomaly detection: a survey. ACM Comput Surv 41(3):15. DOI: https://doi.org/10.1145/1188913.1188915
[2] Yang Y, Yu Z, Yukun C, Jianhua F, Xing X (2009) Mining individual life pattern based on location history. In: 2009 10th International Conference on Mobile Data Management: Systems, Services and Middleware, pp 1–10. DOI:https://doi.org/10.1145/567752.567774
[3] Van Der Aalst W (2011) Process mining discovery, conformance and enhancement of business processes. Springer, Heidelberg. DOI:https://doi.org/10.1007/3-540-09237-4
[4] Marwan H, Sergio S, Florian R, Thomas S (2015) Efficient process discovery from event streams using sequential pattern mining. In: Proceedings of IEEE Symposium Series on Computational Intelligence, pp, 1366–1373.