**Introduction**

**Background**

**Global Facts**

According to World Health Organization (WHO), around 50 million people with epilepsy live on the earth. This count makes epilepsy the most common neurological disorder globally. Around 80% of the patient live in those countries that are low or middle-income wise. The general proportion of active cases (continuingly facing seizure attacks or needing treatment on urgent bases) is 4 to 10 for every 1000. Around 70% of people could be cured from this disorder if they are properly treated. It is estimated that 5 million people are diagnosed with epilepsy on yearly basis. And for high-income countries, 49 per 100,000 people got positive for epilepsy each year.

**Locals Facts**

And for the country level, Pakistan has 1% of its total population which is about 2.2 million patients with epilepsy.

**Consequences**

According to the research of National Library of Medicine, epilepsy has quite severe consequences including lifespan shortening, excessive bodily injury, neuropsychological and psychiatric impairment, and social disability. These consequences separate the population of epilepsy from the rest of the world.

**Motivation**

With time, life expectancy rises as technology develops. The [World Health Organization (WHO)](https://www.who.int/news-room/fact-sheets/detail/ageing-and-health#:~:text=Between%202015%20and%202050%2C%20the,from%2012%25%20to%2022%25.) predicts that the proportion of elderly persons in the population will double between 2015 and 2050, from 12% to 24%. Therefore, it is extremely difficult for medical professionals and researchers to embrace new techniques and develop existing ones that enable seniors to live independently.

**Objective**

To address the above-mentioned needs, IoT-Vision proposed a solution that provide the early detection of abnormal events that could happen with elderly people like falling, epileptic seizure attacks. IoT would model the daily activities of elderly people with machine learning models, and would generate alarm to their caregivers when some abnormal activity happens. And for more accuracy, IoT-Vision would provide the concept of personalized model. This means that for every epileptic patient, a separate smart model working in the system. This would work as the smart care taker that understand the behavior and working pattern of that patient. This would eliminate the need of care taker to be with the patient every time that make elderly people independent.

**Scope**

IoT-Vision would install cameras in the environment of the patient (Hospital or Home). These cameras would very from patient to patient. Like for a patient lying on the bed may be complete covered with the single camera and a patient doing activities in home might need multiple cameras to cover all its sights. Through these cameras, the main goal is covering the daily activities of the patient like drinking, sitting, lying, reading, etc. These activities could further be divided as drinking from bottle, drinking from cup or drinking from can, etc. For a person above than 60 years, his/her daily activities are limited and for most of the cases have the same pattern for the long time. So, if all these activities are learned by the model, then the model could easily detect abnormality in the pattern.

**Problem Statement**

IoT-Vision Enabled Assistance for Epileptic Patient focuses to improve the quality of life and enable independence for older epileptic patients, a cost-effective, reliable, and accessible system for monitoring daily activities, pre-seizure detection and notification, and risk analysis is being developed. The main goal of an Internet of Things (IoT) and Computer Vision (CV)-enabled assistant for epileptic patients is to research the use of multiple cameras and sensors for seizure detection before they occur, recording of lifestyle patterns, and the development of intelligent mechanisms for converting visual input into precise and accurate situational assessment and quick response.

**Challenges**

* **Lightning**

Lighting is a challenge in covering the daily activities of a person.

* **Different Resolution**

When multiple cameras are installed in an environment and they all sending their input to the same machine to process, then it is necessary that they have same parameters on which they are evaluated.

* **Synchronization of multiple cameras**

When multiple devices are in an environment working parallelly, they must be synchronized. Synchronization means the system taking input from all cameras at the same time to process the end output. For the system development and maintaining accuracy of overall system, synchronization of camera is important as well as challenging task.

* **Occlusion**

Occlusion is a medical term means closing or blockage in a blood vessel. In computer vision occlusion means hiding part of one object under another object. In our case occlusion occurs when patient is behind another object in camera scope.

**Conclusion**

In short, IoT-Vision for epileptic patient is a machine learning based monitoring system that based on continuous online learning of personalized model for a patient. Personalized model is trained on the activities, behavior and daily work patterns. And that elder epileptic patient go under the situation of epileptic seizure attack, care taker would be informed with alarm and GPS location of the patient. This would result in the independent and mind satisfactory life of both patient and his/her care taker.

To address the above-mentioned consequences, an IoT-Vision-enabled system proposes a solution that provides epileptic patients an opportunity to live independently without any concern of being dependent on their caregivers all the time. The use of vision-based technology helps in providing a cost-effective solution that can also reduce the financial burden on epileptic patients and their caregivers which can also eliminate the inequality among epileptic patients. Epilepsy is a brain disorder that occurs as a result of abnormal electrical activity in the brain causing frequent seizures that alter the normal behavior of an epileptic patient. Recently, most of the work done on epileptic seizure detection mainly focuses on tonic-clonic seizures or convulsive seizures that invoke the whole body. Most of the devices that are available in the market provide a one-fit-all approach for epileptic seizure detection which is not suitable for all patients as physiological and external symptoms vary from person to person so it can generate many false alarms causing anxiety in most of the patients and their caregivers. Therefore, a solution is desirable that can avoid missing alarms or generating false alarms. Thus the development of such IoT-Vision-based system is of paramount importance that can focus on some personalized model techniques that can utilize by only one specific person at a time. The model is trained by observing the real-time behavior of an epileptic patient which can result in better accuracy for seizure detections as compared to previously available solutions. Our approach follows the same technique along with cameras and sensors that are used for the real-time monitoring of patients. If any abnormal physiological symptoms are detected, an alarm will be generated that can alert the caretakers to provide immediate assistance to the patient to avoid any severe accident. The IoT-Vision-enabled assistant for epileptic patients has four main purposes: ● A cost-effective system promoting acceptance of home nursing for epileptic patients. ● To ensure the accuracy and reliability of the Vision/IoT-enabled assistant device in detecting seizures, and to optimize its performance to minimize false positives and false negatives. ● To acquire knowledge of epilepsy detection methods and algorithms, identify knowledge gaps, and present significant research data. ● To understand computer vision and machine learning algorithms, image and video processing in real-time. Last but not least, a mobile/web interface for this system is integrated with a database to record patients’ health states.