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ABOUT THE CONFERENCE

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6th International Conference on Signal Processing, Computing and Control (ISPCC 2k21) is being organized by Department of Electronics & Communication Engineering, Jaypee University of Information Technology, Waknaghat, India. The aim of the ISPCC is to serve for researchers, developers, educators working in the area of signal processing, computing, control and their applications to present and future work as well as to exchange research ideas. ISPCC 2k21 invites authors to submit their original and unpublished work that demonstrates current research in all areas of signal processing, computing, control and their applications.

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6th IEEE International Conference on Signal Processing, Computing and Control

(ISPCC – 2k21) 07th -09th October 2021

Programme

SESSION 3E: (Emerging Areas of Soft Computing, Internet of Things and Artificial Intelligence) (08 October, 2021, 10.00am– 11:00am)

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Fuzzy Logic on Long Short-Term Memory for Smart Person-Identification System through Electroencephalogram

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***Abstract*—Brain functions through communication in between the network of numerous nerves by means of electrical signals produced as a result of post synaptical potential. Electroencephalogram (EEG) is a technique in which specialized electrodes are placed in certain parts of the scalp in order to measure the magnetic fields arisen by the electrical signal transmission within the brain. The brain waves although follow a certain regular pattern, it still varies at a minute scale from person to person. This gives us the motivation to develop a smart decision-making system to identify a person based on brain waves. For this, we have developed a deep learning recurrent neural network model based on Long Short-Term Memory to outperform all existing work. We have also compared the results with other popular machine learning algorithm. The experiment has been conducted on 28 human subjects under different psychological conditions with consent and obtained over 90% identification accuracy. The model could be easily deployed for several theft or privacy protection application such as embedding the setup within a smart helmet and granting access to only the owner.**

***Index Terms*—Artificial Intelligence, Person Identification, Deep Learning, Signal Processing, Pattern Recognition**

I. Introduction

The Electroencephalogram (EEG) technique is a popular technique used by doctors and researchers worldwide to understand patterns of brain activity [1]. The post synaptical potential of nerves helps all nerves in the body to communicate by means of electrical impulses. The movement of electrical signals generates magnetic fields and specialized electrodes can be used to read the magnitude of these magnetic fields. This setup is called EEG and can be used to detect several abnormalities in the brain. Different attempts have also been made in order to understand the thinking of a person [2]. However, this is very tough to accomplish because each neuron function practically cannot be tracked with current technology. The limited amount of brain activity that can be recorded with the latest technologies shows that the brain signals of normal healthy subjects vary from person to person within a regular pattern [3]. This motivates us to utilize this variation in brain signals of a different person to individually identify them.

All attempts to identify the person with EEG till the date has either been made on a threshold basis or with machine learning [4], [5]. Threshold basis identification is performed by some form of clustering of the brain activities and it is good only for an isolated group of people however when exposed to a different larger group of people, the technique fails to recognize as they can have a different variation. On the other hand, the machine learning approach is smarter as it tries to learn the pattern of a dataset and can work well when exposed to a different group of people with different properties.

Neural Network is a subset of machine learning which amplifies patterns within a data mimicking human brain activity and uses them to identify different features similar to how human learns to identify a person. Long Short-Term Memory which has been used in the experiment is a form of deep learning neural network called Recurrent Neural Network (RNN) in which the output from a previous state is reused to understand the trend of the time series [6].

Fuzzy logic is a form of multi-valued logic where each real value between 0 and 1 can be associated with a different object. This logic can be used to assign different values between 0 and 1 to identify a different person and while detection an intermediate value can be rounded off to the closest match of the fuzzy logic truth values. This process can be utilized to train the model to individually identify a very large number of people [7].

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