MULTI AGENT SYSTEMS FOR INTERPRETATION OF EEG SIGNALS

Brihadiswaran Nandikaran

(189389T)

Degree of Master of Science

Department of Computational Mathematics

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Artificial Intelligence.

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DECLARATION

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Name of the Student

B. Nandikaran

Signature of the Student: Date:

The above candidate has carried out research for the Masters thesis under my supervision.

Supervised By

Prof. Karunananda A.S

Signature of the Supervisor: Date:

DEDICATION

I dedicate this thesis to my family and friends. I will always appreciate the help of friends for the things all they have done and their valuable thoughts. I dedicate this work and give many thanks to people at University of Moratuwa for their help and specially for lecturer for providing guidance throughout this research.

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ABSTRACT

Electroencephalogram (EEG) has been the cheapest, most popular, and convenient brain imaging technique for a broad spectrum of applications. More importantly, EEG technology has influenced the future trends in cognitive systems in Artificial Intelligence. Devices to capture EEG signals range from those used in laboratory settings to wearable devices for personal usage such as entertainments, attention monitoring, meditation, and some clinical applications. The cost of personal scale EEG devices are increasingly becoming affordable. Most EEG devices are designed not only to capture the EEG signal but also to offer some basic, low-level interpretation of the captured EEG data. However, such interpretations are rather incomplete, unexplainable, and unreliable without feedbacks from an expert neurologist. Therefore, development of computer-based solutions to interpret EEG records has been a research challenge.

We have conducted a research to build Multi Agent System solution, EEGMA, to bring the effect of neurologists' interpretation for EEG signals. EEGMA reads EEG signal from an EEG headset and compute parameters, namely, most dominant frequency, continuity of frequencies, and all frequency distribution, eyeblink strength, and epoch size of an EEG session, and define four agents. These agents deliberate on parameters based on expert neurologist's knowledge of interpretation of EEG signals. This process is analogues to neurologist or a group of neurologists deliberating on the above parameters to give better interpretation for an EEG session so that mental image of a person could be explained. EEGMA has been developed using SPADE platform to implement the MAS solution to analyze and interpret EEG signals which come from an EEG device. EEGMA has been evaluated by comparing its performance with neurologists' interpretation of EEG signals. According to the results EEGMA has shown 70% accuracy in interpretation of EEG signals. EEGMA can be used by end users with some interest in EEG technology, EEG researchers, Neurologists, and developers of EEG-based solutions.

Key words: EEG, Multi Agent Systems, EEGMA

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LIST OF ABBREVIATIONS

Abbreviation	Description
MAS	Multi Agent System
EEG	Electroencephalography

ML	Machine Learning