Notice for the PhD Viva Voce Examination

Ms Pranti Dutta (Reg. No. 1445003), PhD scholar at CHRIST (Deemed to be University), will defend her PhD thesis at the public viva voce examination on Friday, 07 May, 2021 at 11.00 am. The defense will be conducted online on the Webex Meeting platform.

Title of the Thesis	**:**	**Pain Detection System in Real Time Healthcare Environment**
Discipline	**:**	**Computer Science**
External Examiner (Outside Karnataka)	**:**	**Dr P L Chitra** Professor Department of Computer Science University of Madras Guindy Campus Chennai - 600205 Tamilnadu
External Examiner (Within Karnataka)	**:**	**Dr Indumathi S K** Associate Professor Department of MCA Dr Ambedkar Institute of Technology Outer Ring Road, Near Gnana Bharathi Bengaluru – 560056 Karnataka
Supervisor	**:**	**Dr Nachamai M** Data Scientist Siemens Healthcare Private Limited Electronic City Bengaluru – 560100 Karnataka

The faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva.

Registrar

Place: Bengaluru
Date: 03 May 2021

ABSTRACT

The negative feeling of pain is often involuntarily expressed through facial expressions. Facial expression therefore is an important non-verbal cue to determine if a person is in pain. This property can be applied for diagnosis of pain especially among patients who are differently challenged and lack the ability of expressing their issue. In spite of the developments made so far, this field still lags behind in finding pain expressing faces in an uncontrolled environment through unprocessed real time images and videos. To bridge this gap, the study proposed a hybrid or fusion model that could adequately detect a face expressing pain.

The model was executed with inputs taken from pre-recorded or stored videos and live streamed videos. It involved the combination of Patch-Based Model (PBM), Constrained Local Model (CLM), and Active Appearance Model (AAM) in concurrence with image algebra. This allowed the efficient pain identification from raw home-made stored videos and live stream even through a bad recording device and under poor illumination. The hybrid model was implemented in a frame-by-frame manner for feature extraction and pain detection. The feature extraction part was done in pixel-based and point-based representation. For point-based representation, a concept called 'image algebra' was used. For classification, three approaches viz. histogram technique, Feed Forward Neural Network (FFNN), and Multilayer Back Propagation Neural Network (MLBPNN) were implemented and analysed. The videos of different subjects showed facial expressions of pain::face, not::pain face and neutral::face. A home-made dataset was produced for storing the videos which was later used as the input and the selected features were stored. This dataset served as the training set for the proposed model. Though the data was not highly sensitive it was sufficient to confer adequate information for detecting pain expression.

To evaluate classification errors and to get the accuracy percentage of classification, a Receiver Operating Characteristic (ROC) curve was applied in a frame-by-frame manner. It gave the Hit Rate (HR) that depicted the recognition of true pain face. An accuracy of 63%-100% was observed in the detection of pain faces for the home-made dataset. The application of this model abridged the memory requirement and enhanced the time of processing. To check the versatility of the hybrid model, it was verified on UNBC-McMaster Shoulder Pain Database and a new pain face expression dataset with an encouraging success rate of 95% and 97% respectively.

Keywords: Pain Detection, Feature Extraction, Active Appearance Model, Constrained Local Model, Patch Based Model, Image Algebra, Histogram Technique, Multilayer Back Propagation Neural Network, Feed Forward Neural Network, UNBC-McMaster Shoulder Pain Expression Archive Database, Pain Expression Dataset