AN IDENTIFICATION AND MONITORING SYSTEM FOR THERAPEUTIC INTERVENTION FOR CHILDREN UNDER CARE

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This dissertation submitted in partial fulfillment of the requirements for the Degree of MSc in Computer Science specializing in Software Architecture

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

Nowadays, everyone owns a mobile device or access to one. With the massive usage of computers, HCI based applications are in high demand. HCI based applications can be used effectively in Medical and healthcare sector, especially to diagnose diseases. There are several genetic disorders and among them, Down syndrome is the most common genetic disorder. Earlier identification and therapies are very important, since early treatments help children to grow more normally. In this problem background, this research is mainly focused on developing a HCI based, identification and monitoring system for therapeutic intervention for children under care. Since, children with Down syndrome have distinct facial features than others, image processing based approach is used to support the identification of the disorder.

This approach is based on the client server architecture. Here, the client is the mobile application and in server side, there is a combination of the web service and the database. The REST API is for the purpose of Down syndrome detection. To implement this web service, 20 face samples were gathered, including 10 Down syndrome face samples and 10 healthy face samples. By using these samples, two datasets were created for Down syndrome and none syndrome. Each dataset have 10 data for each facial landmark, which includes, jaw, left eye, left eyebrow, right eye, right eyebrow, mouth and nose. After creating the dataset, it was trained using LBP. Based on this trained dataset the web service has been implemented. This web service mainly consists of three phases, face detection, facial feature extraction and classification.

The mobile application consists with three main functionalities, which are Down syndrome detection test, Strengths and Difficulties Questionnaire (SDQ) and Progress evaluation based on the SDQ. In Syndrome detection test, once the parent browse or capture an image of the child, it is passed to the web service as a HTTP POST request and the response from the web service is displayed to the parent as the result. The evaluation of the Detector test has been done by using a test dataset which includes, 30 images and shown that it has 90% of accuracy level, 87.5% precision, 93.3% recall and 90.3% f1-score. Parents can perform SDQ test which includes a number of questions to identify mental and health problems of children between 4 to 17 years old. After completing the test, the application displays the result which includes total difficulties score, emotional symptom scale, hyperactivity scale, peer problem scale, pro social scale and the impact score by examining whether the scores are normal, borderline or abnormal based on the standard scoring scheme. Further, from the second attempt of the SDQ, there is a progress evaluation tool. The application keeps track of all the historical records of the child. These two functionalities also have been evaluated based on feedbacks from few doctors as well as few parents.

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LIST OF ABBREVIATIONS

Abbreviation	Description
HCI	Human Computer Interaction
CLM	Constrained Local Model
PCA	Principal Component Analysis
SVM	Support Vector Machines
RBF	Radial Basis Function
k-NN	K-Nearest Neighbor
RF	Random Forest
GWT	Gabor Wavelet Transform
LBP	Local Binary Patterns
API	Application Programming Interface
SDK	Software Development Kit
OpenCV	Open Source Computer Vision Library
HOG	Histogram of Oriented Gradients
CNN	Convolutional Neural Network
GPU	Graphics Processing Unit
SDQ	Strengths and Difficulties Questionnaire
HTTP	HyperText Transfer Protocol