Final Year Project Showcase Batch-2020
Year 2024

Department: Telecommunications Engineering Programme: Telecommunications Engineering	
1	**Project Title** Automated Diagnosis of Autism Spectrum Disorder using Deep Learning and Resting-State functional MRI Biomarkers
2	**Project Idea** To develop a system that can efficiently diagnose Autism Spectrum disorder. The traditional methods of diagnosing are slow and less productive. This approach uses a deep learning algorithm to develop a model using fMRI scans that can predict if a person has ASD or not. To reduce the effects of this disorder, it is necessary to detect it at an early stage which traditional methods cannot detect whereas an AI-based technique can be more suitable.
3	**Process** The ASD detection device takes an fMRI scan as an input, processes the file and give an output whether a person is Autistic or not. The detection device is made using Raspberry Pi 4 Module. A deep learning algorithm has been deployed in this device. The deep learning model has been developed using Python library Tensorflow. The algorithm used is Artificial Neural Network. All the software part that includes preprocessing, feature extraction and model training has been done using Python libraries.
4	**Outcome** As a result the developed model achieved an accuracy of 86% which was more than few previous works. The detection device offers real time detection while being economical and practically implementable. Innovative aspects of the outcome are: • **Integration of Neuroscience and AI**: Merging brain science with advanced AI techniques. • **Remote healthcare**: Enabling ASD detection from anywhere remotely. • **Cost-Effective Solution**: Affordable ASD diagnosis using accessible technology. • **Real-Time Detection**: Instant, on-the-spot detection for timely intervention
	Evidence (Theoretical Basis) Please provide the summary of the FYP instead of attaching the FYP report. The summarized version of the report can be defined in the following stages. 1. A brief systematic literature review of the topic was conducted using PRISMA guidelines to understand the flow of work. As a result, a review paper was compiled which is currently under review by a journal that is ISI-indexed and ranked Q2 in JCR. 2. The dataset used is **ABIDE I** fMRI data which is a collaborative dataset. The preprocessed data was acquired using a neuroimaging library offered by Python called Nilearn. The standard preprocessing techniques applied to the dataset included motion correction, spatial normalization, and smoothing.

5	3. The next step was Feature Extraction which was done to extract meaningful features from the fMRI data for the detection of ASD. The features included time series, Region of Interest (ROI) analysis, and connectivity matrices. Time Points analyzed the time-series data from different regions of interest (ROIs) in the brain. Connectivity Matrices were computed to find the correlation between different brain regions. 4. Model development: Now for the model training process, a neural network architecture was designed to be suitable for classification tasks. The model was trained on the extracted features from the fMRI data. A later testing phase was conducted which evaluated the model's performance on a separate test set to ensure its accuracy and generalizability. 5. To demonstrate the model's real-time diagnostic capability on a low-cost, portable device, the model was deployed on Raspberry Pi. This demonstrated the model's ability to detect ASD in real-time on the Raspberry Pi without the need for external computational resources.
6	**Competitive Advantage or Unique Selling Proposition** Redefining the possibilities in healthcare. The project has achievement a significant milestone with the development of a portable ASD device that can detect ASD with maximum accuracy as compared to few previous works. This project has been developed considering the United Nations Sustainable Development Goals to make it useful for different individuals and communities.
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) SDG #3, Good Health and well-being: The aim of the project is to detect brain disorder (ASD) using AI techniques which will yield an early diagnosis process which is a key requirement to treat ASD patients. SDG#10, Reduced Inequality: With the development of a portable ASD device, remote areas/ villages where there is a lack of resources can make use of this technology and cross-check with consultants.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.) No
c	**Cost Reduction of Existing Product** The developed product is a cost effective solution that can be used by doctors to treat ASD patients. The previous works have suggested usage of FPGA which is comparatively expensive than Raspberry Pi used in this project. Hence the solution provided is cost effective.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggests) • High cost and limited accessibility: Traditional methods are expensive and require professional assistance. This contributes to delay in diagnosis limiting early interventions. Solution: This project gives a cost-effective detection device using Raspberry Pi integrated with deep learning resulting in rapid and real-time ASD detection. • Time efficient: The traditional methods are time-consuming and require several rounds of assessments. ASD is often diagnosed incorrectly as any other disorder at times. Solution: This method takes an fMRI scan process it and gives results in no time. The method is fast and accurate.

e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market The strategies that should be focused for expanding market share are: • Targeting rural areas where there are low available resources. • Partnerships with educational institutions, healthcare sector,s and hospitals. • Clinical validation of the method to gain the trust of people.	
f	**Capture New Market** (e.g. Niche market or unaddressed segment) This device can be utilized in educational sectors where children are tested for ASD because this disorder is quite common among children aged between 3-6. So if this device is used in schools or preschools it will prove to be beneficial for early detection.	
7	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service The target market for this product is the healthcare, and medical sectors. This device can be used by hospitals, children's care center, and diagnostic centers for early ASD diagnosis.	
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11	**Video (If any)**	Please provide the link of the video https://drive.google.com/file/d/1REWrf4mbzNpMAdY45R8pG5X_VRUa4C3g/view?usp=sharing