# A Novel Image-Based Diagnostic System for Accurate Diagnosis of Autism

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**Summary**

This project aims to develop a clinically usable software tool for the accurate diagnosis of autism and to create a brain "map" showing the anatomical differences between the brains of autistic patients and controls through the use of Magnetic Resonance Imaging (MRI). These new machine learning tools developed will improve the delivery of healthcare in the UAE and worldwide by providing a new early diagnostic tool for accurate and early diagnosis of autism. For that, the same methodology will be adapted for the dataset collected from hospitals and families with children facing autism in UAE. Our technology will reduce the diagnostic costs of autism as demonstrated in our application, benefiting patients, payers, and health insurance organizations. Thus, if the technology is successful, it is expected to have a significant market capitalization benefiting the commonwealth of UAE through jobs from either startup companies that will be established by emirates students/faculty or venture capital companies that will license our technology. Furthermore, this problem is of great interest to the UAE health authority, the knowledge and expertise gained from this project will be a step towards the achievement of the knowledge-based economy as outlined by the UAE 2030 plan by developing a highly skilled and professional workforce. The publications which will result from this project and the know-how are part of Zayed University's research mission in the strategic area of computer and Artificial Intelligence Technology.

To achieve the goal of this research, we will implement an image analysis diagnostic system consisting of the following four main steps: (i) 3D surface analysis of the brain cortex (Image processing) (ii) thickness estimation of Cerebral White Matter (Segmentation)(iii), (Feature extraction) (iv) creating a brain map for the autistic brain (classification).

The innovation in this study is the fusion between stochastic approaches using a new Machine Learning model with geometric approaches, to quantify shape discrepancies in the brain cortex, in an effort to extract features that distinguish autistic patients from controls.

Our initial diagnostic results, based on the analysis of some independent cases consisting of both autistic and normal patients had very high accuracy. Therefore, instead of the existing diagnostic instruments, the proposed image-based diagnostic technique can be used. Also, the

preliminary results show that spherical harmonics-based shape analysis, and the centerline length of the Corpus Callosum are promising features for developing a non-invasive Computer Aided Diagnosis (CAD) system for the accurate diagnosis of autism.

We plan to extend this work to investigate other anatomical differences in the brain structures (e.g., cerebral cortex, hippocampus, thalamus, amygdala, etc.). And to build a computer simulated reality. The simulated environment creates lifelike experiences to individuals of all ages, and it is presently widely used as means of exposure therapy in anxiety disorders.