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**Date: 2021/03/24**

Investigating ways of Improving Diagnosis of Schizophrenia with SVM Machine Learning Model



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A dissertation submitted in partial fulfilment of requirements of Technological University Dublin for the degree of

M.Sc. in Computer Science

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# DECLARATION

I certify that this dissertation which I now submit for examination for the award of MSc in Computer Science, is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the test of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Technological University Dublin and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute’s guidelines for ethics in research.

**Signed: Maksymilian Drzezdzon**

**Date:**

# ABSTRACT

Machine learning classifiers can be used with MRI and fMRI images in order to help clinicians avoid misdiagnosis. Young girls tend to not be diagnosed with ADHD because how unalike its manifestation is when compared to boys, having better tools for diagnosing disorders will greatly improve people’s quality of life.

There have been a few short comings in diagnosing of serious mental health disorders, there is no process to date that properly diagnoses D.I.D, despite it being acknowledged as a mental illness in the 1950s, research between then and now has been conducted but was found fraudulent or difficult to reproduce.

Disassociation and schizophrenia are very disabling mental health disorders with huge time requirements to attain a diagnosis, assuming that a patient can avoid years of misdiagnosis due to showing less severe symptoms which are harder to spot with the naked eye.

This study has investigated the potential ways of improving the diagnosis of schizophrenia among other serious disorders through prototyping of models and suggesting potential avenues for future work.

Keywords: Machine Learning, Mental Health, Diagnosis Prediction, Brain Disorder Classification, Schizophrenia, Precision Psychiatry

# ACKNOWLEDGEMENTS

Notes for later:

Thank supervisor etc

# LIST OF FIGURES

# ACRONYMS

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# INTRODUCTION

## Background

Machine learning is gaining popularity in many industries, one industry that is having difficulty in adopting machine learning is diagnostics in healthcare that require explainable results, some of the most powerful tools available don’t produce explainable models. Having said that machine learning still has the capability to be used as a tool in the hands of trained clinicians and fill a much-needed area in psychiatric diagnosis.

A diagnosis for dissociative disorders and schizophrenia among other disorders rely on the interpretation of an assessment completed by a clinician, (HSE, 2021) this can be difficult when a patient does not express extreme symptoms such as hearing voices or delusions, the flattening of emotions in psychology is a condition in which a person is unable to express emotions the same way other people might. (Timothy J. Legg, 2017) Similar overlapping symptoms can cause a misdiagnosis and lead a patient astray for years before finally being diagnosed for instance with schizophrenia or a disassociation disorder.

Currently there is no non-invasive methods for diagnosing schizophrenia and no established biomarker for diagnosis besides using the process of elimination.

One way to reduce misdiagnosis is with the use of machine learning classification in conjunction with MRI and fMRI images. Once a biomarker for other illnesses such as depression or anxiety can be identified they can then be acknowledged and ‘omitted’ when searching for definitive biomarkers that help hone in on schizophrenia or disassociation disorders.

An obstacle that occurs when one begins collecting data to analyze, apart from privacy concerns and difficulty obtaining such data due to regulations, schizophrenia only afflicts ~1% of the population making it very scarce. (mentalhelp.net, 2021) When working with images one can rotate them to create more samples.

## Research Problem

Usually, MRI images are used for detecting mental health disorders. This project investigates the use of coordinates provided in the dataset extracted from MRI images, the methods used to acquire these coordinates are currently unknown. Coordinates provided are FNC which are correlation values which stand for between brain maps over time. They describe the connection level between pairs of brain maps over time. SBM are standardized weights. They describe the expression level of ICA brain maps derived from grey-matter concentration.

Other than one on one assessments in conjunction with trial and error no none invasive ways of diagnosing schizophrenia currently exist, especially when trying to identify patients with milder symptoms.

If this can be accomplished, what is the accuracy of the new model, how does it compare to other methods, how accurate is it if applied to other mental health disorders?

## Research Objectives

There are a few objectives for this project. The first is to perform a deeper literature review and investigate how these coordinates were derived from fMRI and MRI images in order to get acquainted with the topic. Then research how one could better select features from such a dataset. Dimension reduction can be used for feature selection to potential identify biomarkers and record any positive effects when making predictions. Finally build and evaluate a classification model prototype with appropriate metrics exploring the effect of feature selection on such a models performance using the data provided.

## Research Methodologies

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## Scope and Limitations

The scope of this project is to build a classification model and identify its performance when feature selection is employed.

## Document Outline

Chapter 2 - Literature review

Existing literature covering mental illness classification using machine learning is reviewed and discussed. The aim is to become acquainted with current research and apply machine learning classification algorithms to processed fMRI and MRI images. Along with what led to this research.

Chapter 3 - Design and methodology

This chapter focusses on how the project is conducted, the dataset used, preparation and the proposed solution. Evaluation is discussed along with a description of how the project will be conducted providing methods employed to test the hypothesis.

Chapter 4 - Results and evaluation

This chapter focusses on summarizing results of the experiment and evaluate the proposed method. The chapter concludes with a discussion on strengths and limitations of the proposed solution highlighting potential improvements.

Chapter 5 - Conclusion

A summary of key findings, conclusions and areas for future research.

# LITERATURE REVIEW

## Introduction

This chapter covers all required components of this project. A quick overview of schizophrenia will be provided along with a review of papers and methods used to synthesize the dataset from MRI and fMRI images. This will be augmented with a short list of popular classification methods used in disorder classification in respect to current literature. Finishing with an account on machine learning application in mental disorder classification.

## Overview of schizophrenia

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## Functional Network Connectivity – FNC

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## Sourced-Based Morphometry – SBM

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## Machine learning & Deep learning

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### Support Vector Machine

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### Neural Network

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## Machine learning for precision psychiatry

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## Conclusion

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SVM can be replaced with any other model as I gain more insight into this topic, schizophrenia can be replaced with dissaciative disorders depending on data availability, the dataset I’m planning on using is pulled from schizophrenia MRI images.

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