IT4010 – Research Project - 2024

Topic Assessment Form

Project ID: 24-25J-322

1. Topic (12 words max)

Enhancing the Efficiency of Diagnosing and Managing Mental Disorders using Machine Learning

2. Research group the project belongs to

Technology Integration & Management (TIM)

3. Research area the project belongs to

Bio-Medical and Health Informatics (HI)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

Identifying brain related diseases at the pre stages have become necessary. Most of the time it helps medical personnel to start immediate medication to cure the disease. Identifying the brain disease in the pre stage also can be used to plan the future of the patient and their families even if there is not any medical benefit [1]. Diagnosing these brain and mental issues are not as simple as diagnosing other physical diseases as it requires hours of sessions with patients and multiple medical reports that also needs to be analyzed by the doctors. Current technology enhancement in the medical field have been able to make these reporting parts more efficient. But the workforce related to neuro and mental health is limited. Autism, Parkinson, Alzheimer's and depression are four diseases that can be identified as brain diseases which needs hours of sessions with the patients and more time in medical report analyzing to diagnose. Even technology cannot replace the neurosurgeons or the psychiatrists there are some steps that can be helped by the technology to make patient handling and diagnosing efficient. Apart from that, diseases such as depression and Alzheimer's needs to be constantly evaluated throughout the time. To make that process efficient it is needed to be implementing a data visualization solution instead of complex medical records to make the patient handling efficient.

In conclusion, identifying severe brain related issues in the early stages helps not only to retrieve medical treatments but also to plan the future of patients' and their family [2]. We cannot replace the doctors. But we have ability to make procedures fast by using machine learning techniques to identify the possible patients without doctors to having long term sessions with the patients. Then also analyzing the brain imaging reports also can be automated.

After all, for efficient patient management the data visualization techniques can also be used.

References

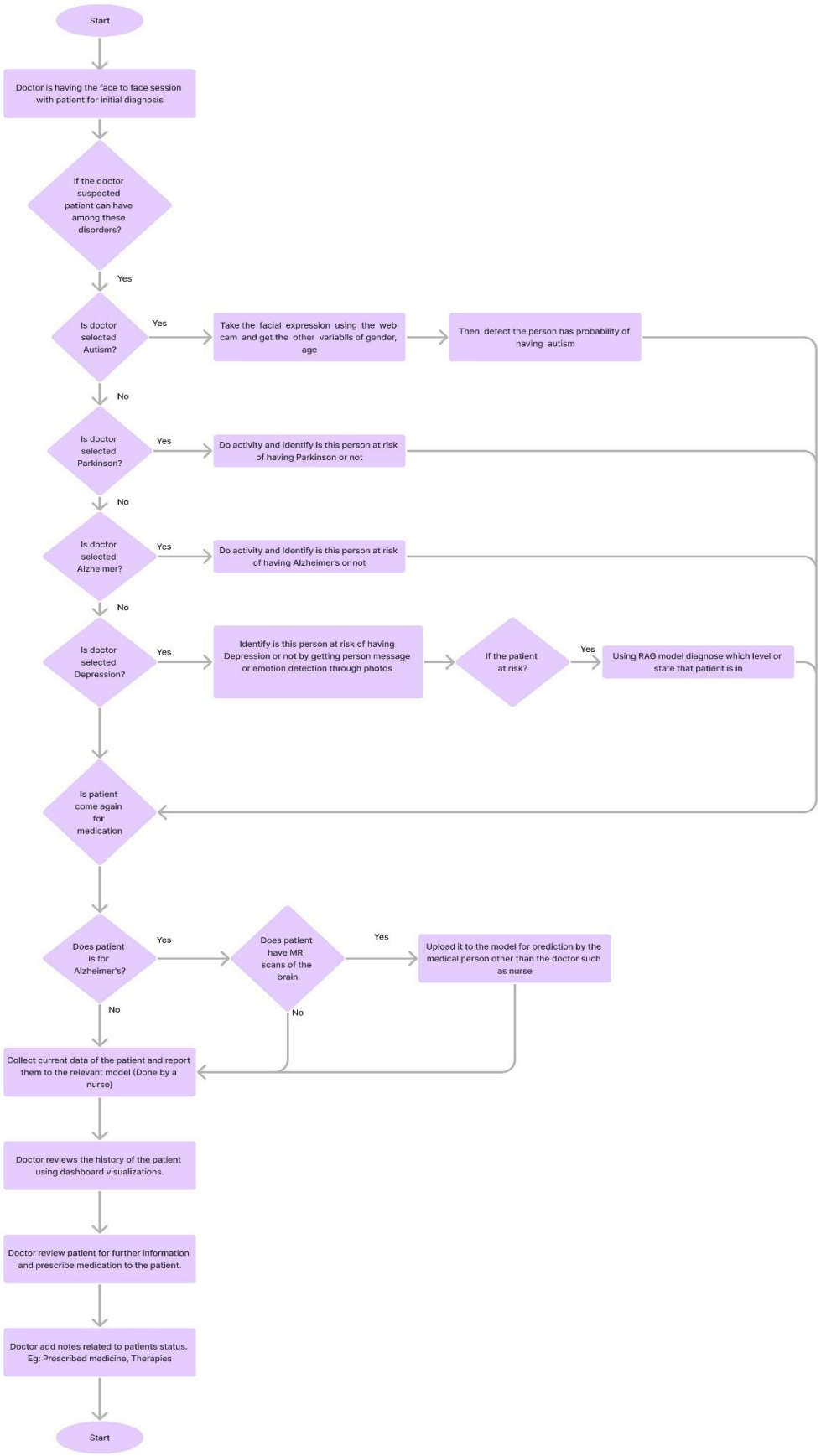
[1] https://link.springer.com/article/10.14283/jpad.2021.23

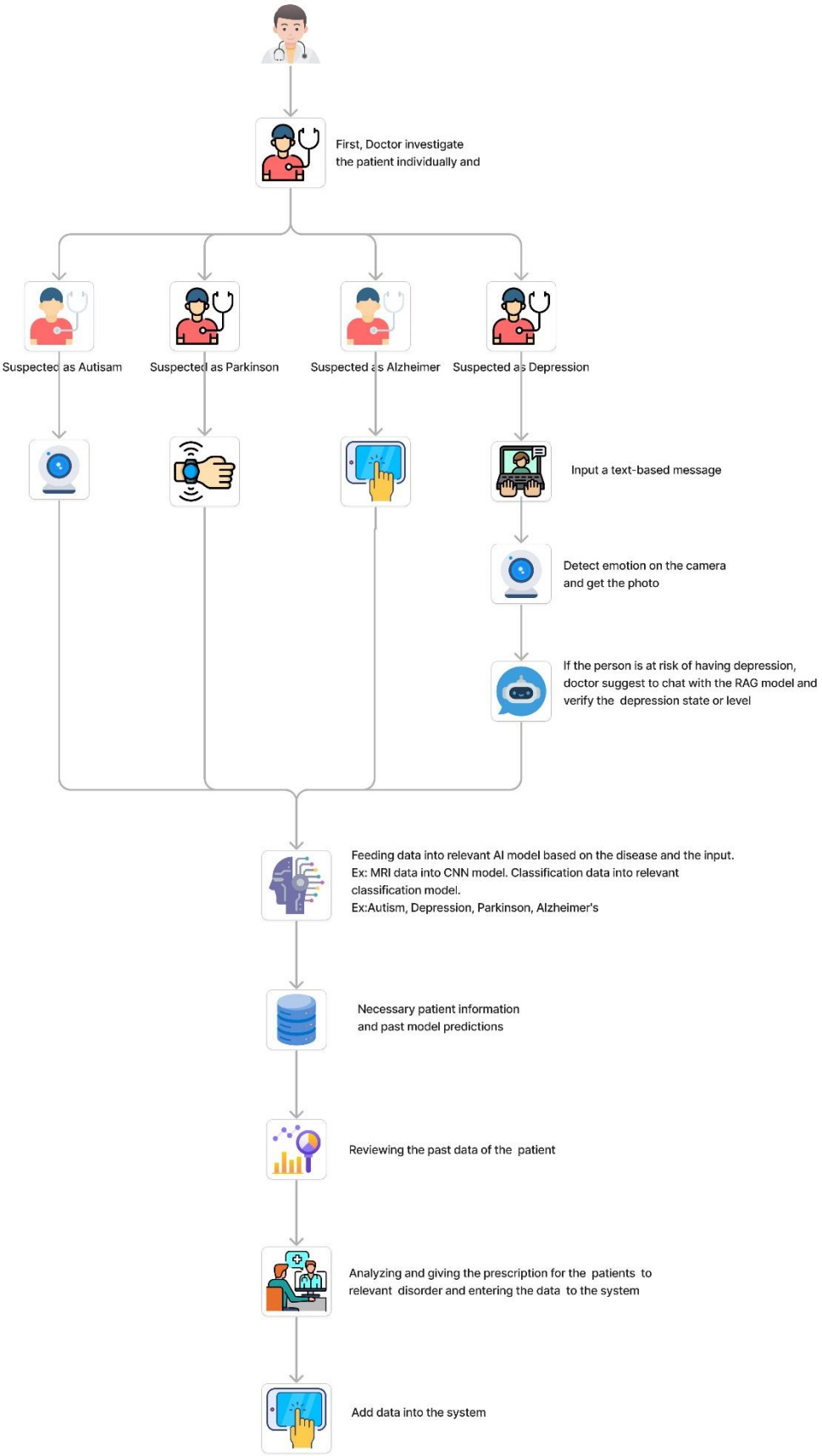
[2] https://academic.oup.com/schizophreniabulletin/article/33/4/877/1930127

[3] https://www.sciencedirect.com/science/article/abs/pii/S0882596303001398

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

This solution consists of two software tools for the patient and for the doctor. The platforms of the software and the devices must be selected after proper research on usability which is supposed to be done by talking with the stakeholders. The potential patient of above four diseases should meet the doctor at first. Then if the doctor has a doubt the patient is in early stage of above brain disease, he can register the patient in the doctor's application. Then the patient will be examined by the protocols of the software to collect data about the patient to get the possibility of the relevant disease. This process can be done by other medica personnel such as nurse. After the inspection the doctor will be updated with the possibilities of the patients. After medications recommend by the doctor the patient will be tested again to review changes. Apart from that the depression patients will be given another app with simple activities which predicts the level of depression, and that information will also be updated in the doctor's dashboard. Then there is also a function to review brain image reports and find the possibility of the patient having the disease. All these possibilities, predictions and the status will be updated in the doctor's dashboard without having to have long sessions with patients.


Start
Doctor is having the face to face session with patient for initial diagnosis
If the doctor suspected patient can have among these disorders?
Yes
Is doctor selected Autism?
Yes
Take the facial expression using the web cam and get the other variablls of gender, age
Then detect the person has probability of having autism
No
Is doctor selected Parkinson?
Yes
Do activity and Identify is this person at risk of having Parkinson or not
No
Is doctor selected Alzheimer?
Yes
Do activity and Identify is this person at risk of having Alzheimer's or not
No
Is doctor selected Depression?
Yes
Identify is this person at risk of having Depression or not by getting person message or emotion detection through photos
If the patient at risk?
Yes
Using RAG model diagnose which level or state that patient is in
Is patient come again for medication
Does patient is for Alzheimer's?
Yes
Does patient have MRI scans of the brain
Yes
Upload it to the model for prediction by the medical person other than the doctor such as nurse
No
No
Collect current data of the patient and report them to the relevant model (Done by a nurse)
Doctor reviews the history of the patient using dashboard visualizations.
Doctor review patient for further information and prescribe medication to the patient.
Doctor add notes related to patients status. Eg: Prescribed medicine, Therapies
Start


First, Doctor investigate the patient individually and
Suspected as Autisam
Suspected as Parkinson
Suspected as Alzheimer
Suspected as Depression
Input a text-based message
Detect emotion on the camera and get the photo
If the person is at risk of having depression, doctor suggest to chat with the RAG model and verify the depression state or level
Feeding data into relevant AI model based on the disease and the input.
Ex: MRI data into CNN model. Classification data into relevant classification model.
Ex:Autism, Depression, Parkinson, Alzheimer's
Necessary patient information and past model predictions
Reviewing the past data of the patient
Analyzing and giving the prescription for the patients to relevant disorder and entering the data to the system
Add data into the system

7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

Domain Expertise

Identifying Parkinson, Alzheimer's, Autism and Depression is being grouped under brain science. Which means the experts of the domains can be considered as medical personnel who works with the patients with relevant diseases and the researchers and educators who are currently studying or studied about the domain. Usually, the medical personnel who works with potential patients are neurosurgeons and nurses and other hospital staff. Their expertise in the relevant domain can be used in most of the stages of the research such as data collection patient interviewing.

For data requirements overall the whole research is based on the data from the potential patients with the Autism, Parkinson, Alzheimer's and depression. These datasets are supposed to be used in training machine learning models for disease prediction. Basically, the research team is planning to be focused on patient's background information and medical images such as MRI. Apart from that the dataset which consists of text messages which can be used in making classification model to predict the mental health of patients.

For the knowledge requirement this research needs wide range of data science practices and the software engineering methodologies along with the knowledge of basics about the relevant diseases. Data visualization methodologies and the machine learning technologies such as CNN and the classification will be used in the whole project from start to the end.

To identify the depression

Dataset: https://www.kaggle.com/datasets/infamouscoder/depression-reddit-cleaned

Dataset: https://www.kaggle.com/datasets/ananthu017/emotion-detection-fer/data

Dataset Description: First dataset consists of 7732 textual inputs from depressed and normal people on reddit. This dataset covers vast area of people emotions and behaviors through texts. Second dataset consists of emotional detection dataset.

To identify Autism

Dataset: https://www.kaggle.com/datasets/fabdelja/autism-screening-for-toddlers?select=Toddler+Autism+dataset+July+2018.csv

https://www.kaggle.com/datasets/cihan063/autism-image-data

Dataset Description: The dataset consists of over 5880 face images with annotations of age, gender, and ethnicity. The images cover large variation in pose, facial expression.

To identify Alzheimer's

Datasets: https://www.kaggle.com/datasets/yasserhessein/dataset-alzheimer

https://www.kaggle.com/datasets/rabieelkharoua/alzheimers-disease-dataset

https://www.kaggle.com/datasets/madhucharan/alzheimersdisease5classdatasetadni

To identify Parkinsons'

Dataset: https://www.kaggle.com/datasets/rabieelkharoua/parkinsons-disease-dataset-analysis

8. Objectives and Novelty

Main Objective To enhance the efficiency of diagnoses for Depression, Alzheimer's, Parkinson and Autism at the early stages through the application of machine learning and image processing techniques.			
Member Name	Sub Objective	Tasks	Novelty
Dilshan G.A.M	Detecting the person has possibility of having Alzheimer's disease based on machine learning.	Identification of the possibility of using patients' information such as cholesterol levels. Identifying the possible patients using MRI scan images. Create platform to doctors to review patient status with	Creating a smart wearable to detect trembling and the sleep quality of a patient to work as input of the machine learning models.

		the medications and the medical reports.	
Wijayasooriya W.A.K.A	Developing a predictive model using machine learning techniques to identify individuals at risk of Parkinson's disease in its early stages.	The initial step involves the early identification of Parkinson's disease through analyzing physiological and behavioral data. This method entails collecting data such as voice recordings, handwritten samples, and gait patterns from individuals. By focusing on specific features, such as tremor intensity, handwriting irregularities, and changes in speech, rather than analyzing the entire dataset, the system can detect early-stage Parkinson's more efficiently. This focused approach allows for the early identification of Parkinson's symptoms, facilitating timely intervention and management.	By capturing and analyzing voice recordings, the system focuses on specific speech characteristics such as pitch, tone, and rate of speech. This targeted analysis enables the detection of unique speech patterns that are indicative of early-stage Parkinson's.

Chamaleen D.B.N	Detect the person has possibility of having autism disease	Initial step identification of autism through facial recognition. This method involves capturing an image of the patient's facial expression using a webcam. By analyzing specific facial landmarks rather than the entire face, the system can detect unique patterns indicative of autism more efficiently. rather the taking images of the facial expression taking the additional input of age and gender can get the more accurate prediction then using multiclass classification to extracted feature expression and identified categories of facial expression.	The current research solution introduces a novel approach to supporting individuals with autism by integrating automated facial recognition, capturing images of the patient's facial expression via webcam and focusing on specific facial landmarks.
Perera K.K.S	Identify the person is at a risk of having depression or not and observe the state or level that patient is in	There are lots of methods to identify depression. Depression causes many mental disorders too. In the initial step, identify whether the person is at a risk of having depression or not by	Retrieval Augmented Generation (RAG) model is used to diagnose the level or state of depression by making conversation.

		training machine learning model using text-based messages inputs and detecting persons' emotion and notify the doctor of person recorded medical condition. In the second phase of the task, if the patient is identified as a risk of having depression suggest building a conversation with RAG model and diagnose the patient depression level or state by gathering data of the users' behaviors, family background, sleeping patterns and such inputs. And notify all the predictions and patient's emotion and conversations to doctor for further actions.	

9. Supervisor checklist

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes	✓	No	

b) Does the proposed topic exhibit novelty?

Yes		No	

c) Do you believe they have the capability to successfully execute the proposed project?

Yes		No	

d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes		No	

e) Supervisor's Evaluation and Recommendation for the Research topic:

* Components needs to be enhanced with minor changes.

* b, c, d Sections cannot fill because the students haven't finalized the components at the time Supervisor Signed the document.

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Ms.	Wishalya	Tissera	19/06/2024
Co-Supervisor	Dr.	Kapila	Dissanayaka	Dissanayaka IKP
External Supervisor				
Summary of external supervisor's (if any) experience and expertise				

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Topic Assessment Form

<u>This part is to be filled by the Topic Screening Panel members.</u>

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

*__Important__:

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.