Annex A: Projects

1) Using machine learning to diagnose intracranial haemorrhage

Project Description:

In Singapore, traumatic brain injury, or what is commonly known as head injury, is a leading cause of disabilities and deaths in adults below 40 years old. Head injuries can occur after traffic accidents, falls, fights, sports and recreational injuries. Every week, the National Neuroscience Institute sees 20 – 30 patients with traumatic brain injuries being admitted.
As part of the medical assessment for these patients, Computed Tomography (CT) brain scans are done. This is to check for any intracranial haemorrhage or bleeding that occurs inside the skull, which could require surgery. The CT brain scans need to be interpreted quickly and accurately by trained doctors to ensure patients have the best outcomes.

This project aims to develop a rapid, accurate and automated process for reading CT brain scans when patients suffer a traumatic brain injury. The main benefit of this project would be in reducing the time needed to initiate treatment. Once the diagnosis is made, the patient will be able to have treatment initiated by physicians before surgical treatment is carried out. When it comes to injuries that affect the brain, time is a critical factor as delays of a few minutes can mean the difference between a good and a poor outcome.

Artificial intelligence computational algorithms have demonstrated successes in the field of decision-making in complex games, at times gaining victories over human experts. They have also performed well in image classification tasks. These successes can potentially be translated into classifying radiological images, such as those from Computed Tomography (CT) brain scans.

In this proposed study, we will be training and applying a machine learning algorithm to differentiate between CT images of different patterns of intracranial haemorrhage. The algorithm can potentially lay the foundation for artificial intelligence-assisted medicine in the realm of traumatic brain injuries.

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2) A machine learning approach to deep brain stimulation surgery

Project Description:

Parkinson's disease is a chronic and progressive neurological disorder that primarily affects a patient's movement and ability to walk. It is also associated with mental health conditions such as depression and dementia. Three out of every 1,000 people aged 50 years and older have this disease.

Deep brain stimulation is a surgical procedure to implant a medical device in the brain. The device sends electrical impulses to specific targets in the brain. This changes brain activity in a controlled manner, blocking abnormal nerve signals that cause symptoms such as tremors and movement difficulties. Deep brain stimulation has been performed routinely for suitable patients from the National Neuroscience Institute (NNI).

For such procedures, a neurophysiologist uses electrodes to determine a target area in the brain. The neurosurgeon then implants the device in that location.

This project aims to help doctors identify the location for the implant more precisely through machine learning. This refers to a subfield of computer science where machines learn from construction of algorithms and classification, without being explicitly programmed. From analysing large amounts of data transmitted by the electrodes, machine learning can discover patterns that were previously not apparent and determine more precisely, sections of the brain controlling critical functions such as movement.

This is an exciting area of progress, which can foster a better understanding of neural circuitry – how nerve cells carry and transmit information. These methods can help replace or restore useful function for people severely disabled by their disease or injury.

We aim to use machine learning in our surgeries to improve treatment outcomes and to improve our patients' quality of life.

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