Diagnosis, Monitoring and Rehabilitation of Parkinson’s disease using Machine Learning & Big Data

Artificial Intelligence in medical diagnostics is becoming a very hot topic in modern medicine. Many research groups in universities and corporations are emerging across the world that are working on using Machine Learning in solving problems that would not have been possible a few years ago. According to Vinod Khosla (Founder of SunMicrosystems), “Computers will replace 80% of what doctors do”.

The 2022 IEEE Computer Society report also highlights the following technologies that will disrupt the state of the art:

1. Internet of Things
2. Machine Learning & Intelligent Systems
3. Big Data and Analytics
4. Bioinformatics and Computational Biology

Parkinson’s disease is the second most common neurodegenerative movement disorder in the world with over 10 Million people suffering globally. Parkinson's disease has no cure and has no definitive diagnostic test due to a lack of a bio-marker. Due to neurodegenerative nature of the disease, the condition of a person suffering from Parkinson's gradually worsens. Drugs also are effective till a certain limit and its effectiveness also wears off with time.

Many organisations around the world are working to solve this problem. Recently, Michael J Fox Foundation and Intel have partnered up to develop a 24/7 monitoring tool in order to gain valuable insights from the data collected from Parkinson's disease patients. IBM and Pfizer also did a similar collaborative partnership.

PKG Watch from Global Kinetics Corporation received a $14.8 Million AUD funding to develop a similar tool.

Our team has developed a complete solution for this problem by developing a complete range of tools for diagnosis, rehabilitation and monitoring of Parkinson’s disease. One first device is a Clinical Decision Support System (CDSS) that helps doctors diagnose Parkinson’s disease accurately by analyzing previous tremor patterns through Machine Learning and Big Data. We were able to achieve significant accuracy as compared to standard clinical practice through our CDSS. Our second device is a data driven management tool for optimised drug administration and 24/7 monitoring. Our third device uses latest physiotherapeutic techniques to control the symptoms of patients and gives them the ability to do their daily tasks normally.

Our tools use advanced signal processing and machine learning algorithms to predict, diagnose and monitor Parkinson’s disease. We also use different predictive methods and Kalman filters for real time tremor suppression. We published our results titled “Clinical Decision Support System for Parkinson’s disease and related Movement disorders” in IEEE International Conference of Acoustics, Speech and Signal Processing (ICASSP) 2017 in New Orleans Louisiana. This work also won a gold award in Asia Pacific ICT Award (APICTA) 2016 in Tertiary Student Project category.

For conducting clinical trials of our device, we partnered with National University of Medical Sciences Rawalpindi which has over 40 affiliated hospitals and rehabilitation centres across Pakistan. We designed the clinical trials ourselves and complied to international standards such as ISO & Helsinki Information
Protection Accord (HIPA). Complying to these aforementioned standards, we have tested our solution on more than 150 patients with very encouraging results.

For cross-validation, the proposed algorithm acted as the first hand diagnostic tool while the neurologist's assessment acted as a performance evaluator. Using this method, we were able to check the validity of our CDSS in a real hospital setting.

We distributed smartwatches to 10 patients who wore it for 24 hours. Using the smartwatch data we could easily see the patterns in tremor change prior to taking medication, after taking medication and while sleeping et cetera. Such data incorporated with data from the heart rate and other sensors gives valuable insights for predicting disease progression in Parkinson's disease.

For the rehabilitation tool, we used physiotherapeutic techniques commonly used in rehabilitation medicine to reduce tremor in real time. The device can be paired up with a smartwatch through bluetooth and a Nordic nRF52832 chip incorporated in the suppression hardware communicates with the smartwatch.

Our system provides complete solution for Parkinson’s disease by helping the doctor’s diagnose it accurately and helping the patient control his/her symptoms. Using the disruptive technologies according to the IEEE Computer Society 2022 Report, we have designed the system that is a complete relief solution for patients with Parkinson's disease and also significantly better than current practices.

Project Demo & Code: