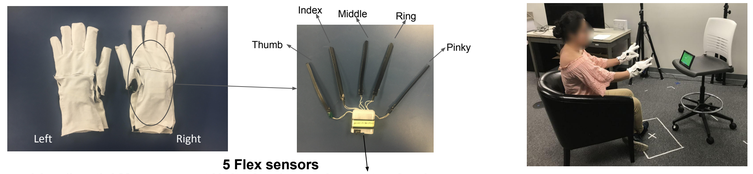
KAYA - Wearable E-Textiles for Telemedicine

Adityaraj Yerule, Shehjar Sadhu, Nick Constant, Kunal Mankodiya
Department of Electrical, Computer, and Biomedical Engineering, University of Rhode Island, Kingston, RI

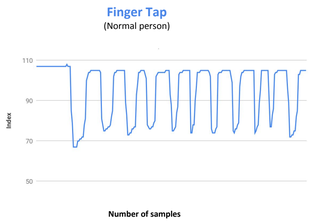
Parkinson's Disease(PD) Motor Detection

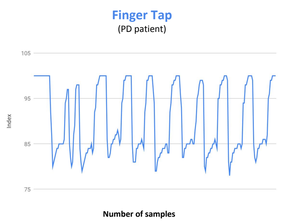
Parkinson's disease is a neurological disorder causing slowness, rigidity, tremor in patients. These symptoms are barely noticeable on the on-set of PD. Our goal is to quantify these symptoms and build a portable feedback mechanism for doctors and patients .



5 Flex sensors
1 Imu(Inertial Measurement Unit - 3-axis accelerometer, 3-axis gyroscope, and 3-axis magnetometer)
with Bluetooth Low Energy(Ble) nano 1.5

Edge Analytics





Comparison between PD and non PD patients. We notice here that the non PD finger taps have a dent on each finger tap, and continuous ups and down indicate tremor.

Sensor Selection

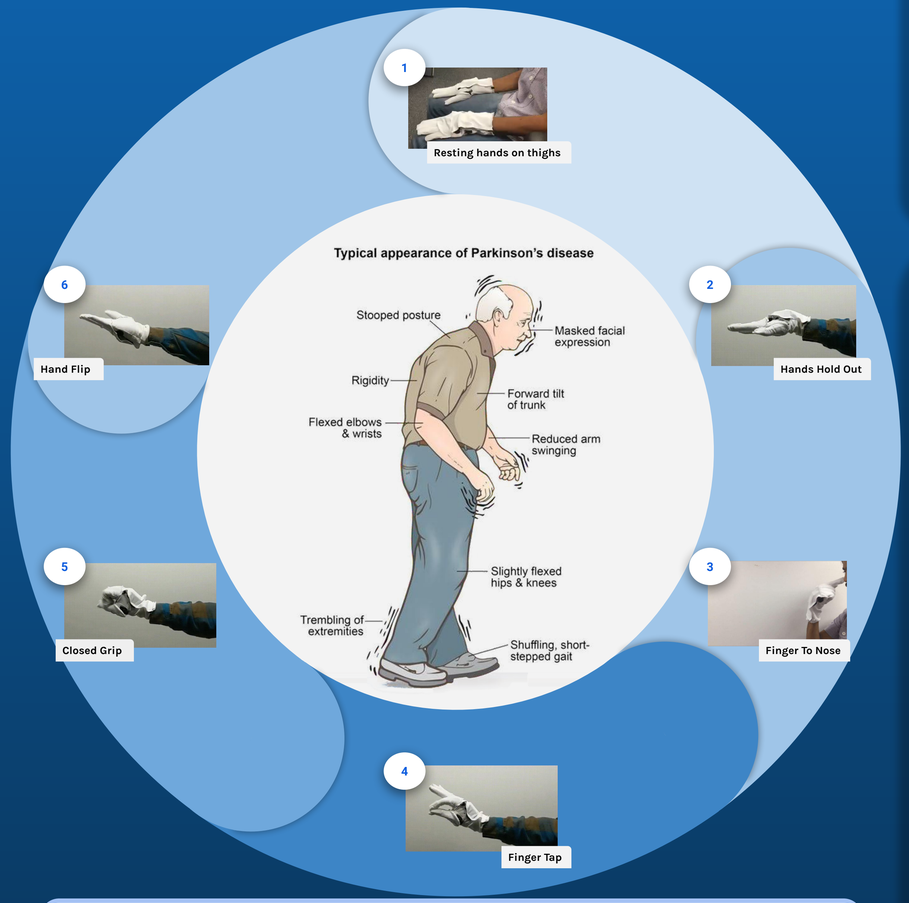
Flex sensors give information about the bending in the fingers by changing the resistance and imu sensors give the values of acceleration and gyration in all three directions.

Important factors to be looked over for signal processing.

Exercise Names	Most Important device type	Thumb	Index	AccX	AccY	AccZ	GyrX	GyrY	GyrZ
Hands Hold Out	*Imu*					x			
Finger to Nose	*Imu*		x	x					
Finger Tap	*Flex*	x							
Close Grip	*Flex*		x						
Hand Flip	*Imu*						x		
Resting Hands on Thighs	*Imu*	x	x	x	x	x			

Edge Computing

By Applying Machine learning techniques we aim to classify six hand exercises specified by Unified Parkinson's Disease rating scale(UPDRS).




Shehjar Sadhu


Adityaraj Yerule


Nick Constant
Mentor


Prof.
Kunal Mankodiya

Feature Selection

1	Frequency Domain	• Dominant Frequency • Dominant Frequency Magnitude • Mean Frequency • Median Frequency
2	Time Domain	• Power • Bandwidth • Variance in Peak • Max Peak • Min Peak • Mean Power
3	Statistical	• Maximum Value • Minimum Value • Variance

Result and Conclusion

Classifiers	Accuracy	Hyperparameters
Cosine KNN	71.70%	K = 5 , Distance metric = "Cosine"
Weighted KNN	75.00%	K = 5 , Distance metric = "Euclidean"
Linear Discriminant Analysis	78.30%	
Naive Bayes (Kernel)	78.30%	
Fine Tree	88.30%	Max number of splits = 30
Medium Tree	88.30%	Max number of splits = 20
Coarse Tree	88.30%	Max number of splits = 30
Naive Bayes (Gaussian)	86.70%	
SVM (One vs All)	87.00%	Kernel = Quadratic
SVM (One vs All)	88.30%	Kernel = Fine Gaussian
SVM (One vs All)	90.00%	Kernel = Linear

Confusion Matrix

True class

Predicted class	Closed Grip	Finger Tap	Finger to Nose	Hand Flip	Hands Hold Out	Resting Hands
Closed Grip	90%	10%				
Finger Tap		90%	10%			
Finger to Nose		20%	60%		20%	
Hand Flip				100%		
Hands Hold Out					100%	
Resting Hands on Thighs						100%

This Confusion matrix shows that finger tap was classified as finger to nose 20% of the time. This is due to the similarity of finger movement in the two exercises.