STROKE PREDICTION SYSTEM

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ABSTRACT:

A brain Stroke is a condition when the supply of blood to a portion of the brain is interrupted. This prevents the brain tissues from getting oxygen and nutrients. The brain cells thus begin to die. It is medical emergency and needs immediate treatment. Stroke is a significant global health problem and a major cause of mortality and morbidity. In India stroke is fourth leading cause of death and fifth leading cause of disability.

It is very important to frequently monitor chronic ill patients with high blood pressure, uncontrolled diabetes, high cholesterol levels, carotid & periphery artery disease and smoking habits as they are more susceptible to getting a stroke.

The proposed business idea is to develop an application compatible with smart watches which can record and monitor real time BP, heart rate and glucose continuously and get alarmed when any of these levels are high.

PROBLEM STATEMENT:

To develop ML model which can accurately predict the threat levels of the BP, heart, glucose, atrial fibrillation level.

MARKET/CUSTOMER NEED ASSESSMENT:

The android/iOS smart watch market is already flooded with smart watches with several features, such as GPS, mobile notification alerts, smart voice assistance, bp, heart rate, sleep monitors. Even though basic health features are present they're solemnly designed in a way to simply monitor and maintain the fitness of healthy people.

There is lack in design and materialization of features that are mandate for monitoring individuals with chronic illness. This health smart watch aims to design AI watches for target customers with existing chronic illness or elderly persons.
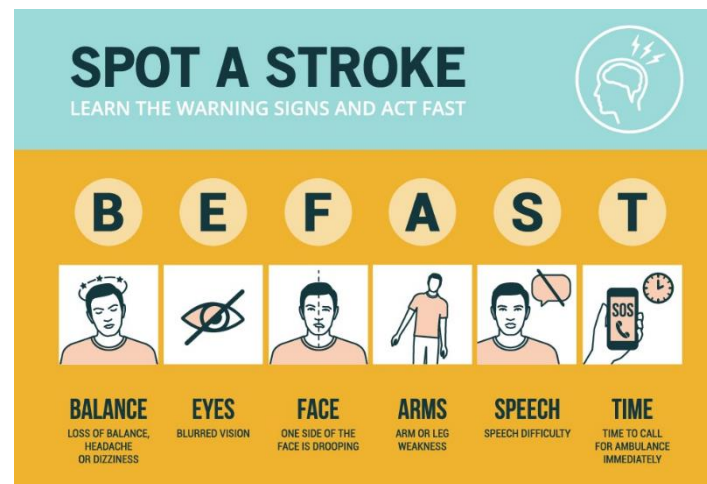
TARGET SPECIFICATIONS/ CHARACTERIZATIONS:

This smart health watch is exclusively designed for persons who are already affected by stroke or more susceptible to getting stroke. Elderly individuals who are chronically ill with disease conditions such as Hypertension, Cardiac malfunction, Diabetic, Age-related disability can also use this smart watch for better lifestyle.

- To develop smart watches for elderly and chronic ill patients (susceptible to stroke).
- Adding Glucose, Atrial fibrillation monitor.
- Adding stroke specific features – Facial drooping, slurry speech, fall detection.

Above mentioned targets can be achieved by:

- ✓ Observational study of stroke patients.
- ✓ Using face recognition tools for identifying facial drooping.
- ✓ Using speech recognition tools for detecting slurry speech.
- ✓ Deploying continuous glucose monitor (CGM) sensor along other common heath parameter sensors.
- ✓ Using tri-axial accelerometer and gyrometer for fall detection.

EXTERNAL SEARCHES:

https://www.nhs.uk/conditions/Stroke/

http://stroke-india.org/

https://www.superwatches.com/health-tracking-smartwatches/

https://www.lively.com/health-and-aging/what-is-fall-detection/

https://www.superwatches.com/glucose-monitoring-wearables/

https://patents.google.com/

https://www.alliedmarketresearch.com/smartwatch-market

https://www.researchgate.net/publication/264116605_Stroke_in_India_-_Factsheet_Updated_2012

PM Dalal, Madhumita Bhattacharjee. Stroke Epidemic in India: Hypertension-Stroke Control Programme is Urgently Needed. JAPI. Vol 55. October 2007.

Sethi P, Anand I, Ranjan R, Sethi N, Torgovnick J. Stoke: the neglected epidemic: an Indian perspective. Internet J of Neur 2007; 8 (1): 1-8

Tripathy A, Jeemon P, Ajay V, Prabhakaran D, Reddy K. CVD profile of India. IC Health and WHO 2007; APW SE/06/226543

BENCH MARKING:

There are several top brands offers smart watches with health-tech features. The leading smart watch manufacturing brands include Apple, Fitbit, Fossil, Google, Samsung, Garmin etc.

Each one offers different health monitor, but BP, heart rate, steps count seems to be commonly available in almost all brands.

APPLICABLE PATENTS:

Below mentioned patents are taken into consideration while design and development of the product. Features pertaining to monitor the health of elderly and chronic ill patients are

- US6918879B2 - Method and device for monitoring blood pressure
- US20060089540A1 - Device for diabetes management
- CN103529684A - Intelligent health watch for automatically measuring and recording health data and intelligent health system.
- CN105573108A - Customized watch for old man or woman
- CN104678745A - Watch with falling detection function
- US5157640A - Medication alert watch and system
- Apple iWatch patent -https://www.patentlyapple.com/patently-apple/tech-accessories/

APPLICABLE STANDARDS:

- License as Manufacturer:

    The manufacturing of smart watches may be intended for sale in India, export or any other purpose like R&D, scientific investigation or research, this license is regulated under Model of The Legal Metrology (Enforcement) Rules, 2010 and the (State) Legal Metrology (Enforcement) Rules, 2011.

    The License as a Manufacturer can be obtained for minimum period of 1 year and maximum of 5 years subject to the prescribed fees to be paid and the renewal of such licenses needs to be filed 3 months prior to the date of expiry.

- Verification and stamping:

    The smart watches with weighing or measuring capabilities of the parameters listed under the Legal Metrology purview such as temperature, pressure, blood pressure, heart rate, distance measurements, etc., will need to get all their products verified and stamped from the State Legal Metrology Department after their manufacture or import in India.

    The verification and stamping are regulated under Model of The Legal Metrology (Enforcement) Rules, 2010 and The (State) Legal Metrology (Enforcement) Rules, 2011.

APPLICABLE CONSTRAINTS:

- ✓ Existing market
- ✓ The major constraint is integration of the sensors into single element.
- ✓ Deploying various sensors
- ✓ Budget constraints -Need more fund for product materialization.
- ✓ Patient concern (Stroke Patients) – willingness to subject for study.

BUSINESS OPPORTUNITY:

There is an increase in the demand for wireless electronics with rapid surge in the internet connectivity and digitalization. According to smartwatch market analysis, Apple shipped 31 million units of its smartwatches in 2019, which is expected to be 50% more than the entire Swiss wristwatch industry. The shipment of Apple smartwatch has been increased by 36% since 2018.

The increased investment in methods to develop smart technologies for further support in healthcare and fitness drives the market growth. The day-to-day wellness activities such as steps taken, calorie burnt, bp, heart rate and others can be easily monitored and tracked using smartwatch.

Below graph represent the result of smart watch market segmentation analysis.
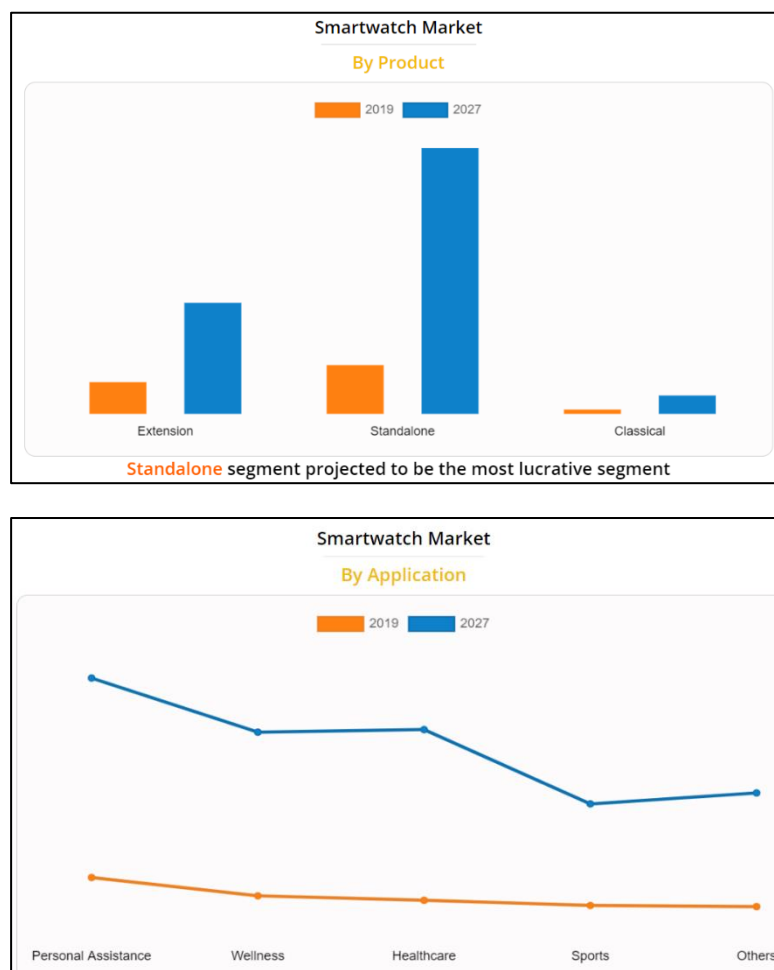
CONCEPT GENERATION & DEVELOPMENT:

Stroke is a life-threatening case and urgent treatment is essential. The sooner a person receives treatment for a stroke, the less damage is likely to happen

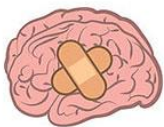The incidence rate of stroke in India is between 145-154 per 1,00,000 individuals per year.

A study was able to identify that the prevalence of risk factors such as hypertension and hypercholesterolemia were 7% and 10% higher respectively among the low-income urban population of Chennai compared with the middle-income population.

Men are more likely to have a stroke than women: the male/female sex ratio for India is 7:1 (Sethi 2002).

This may be due to differences in risk factors such as smoking and drinking which are more prevalent among men in India compared with women (Das Banerjee 2008).

The mean onset of stroke for men in India ranges from 63-65 for men and 57-68 for women (Bhattacharya et al 2005, Dalal et al 2008, and Sridharan et al 2009).

The above facts insists how important it is to act fast and F.A.S.T. A little life style modification (monitoring using smart watch) in heart/diabetic/chronic ill patient can save their life.
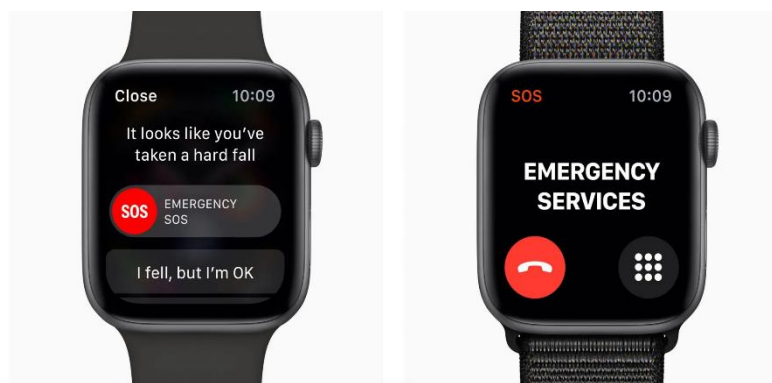
FINAL PRODUCT PROTOTYPE:

FACE RECOGNITION

HEART MONITOR - BP, heart rate, Atrial fibrillation
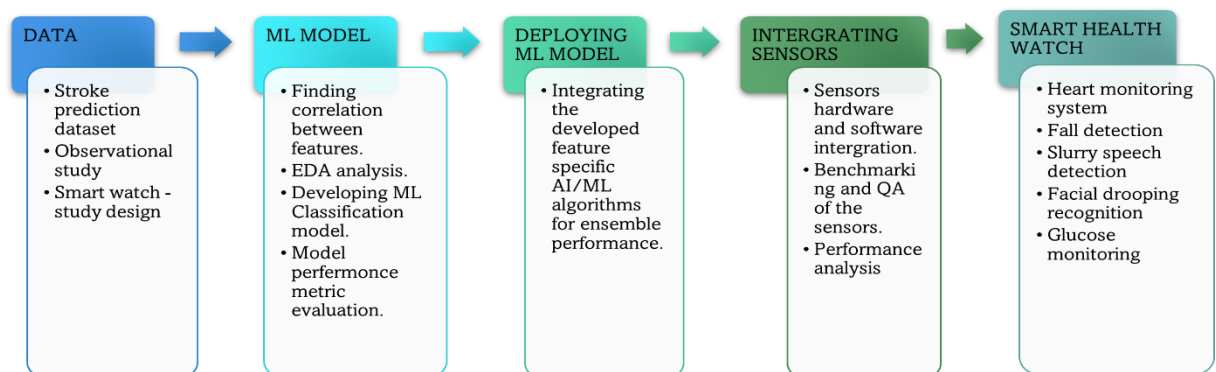

SLURRY SPEECH RECOGNITION

FALL DETECTION WITH SOS

GLUCOSE MONITOR WITH ALERTS

PRODUCT DETAILS:

DATA	ML MODEL	DEPLOYING ML MODEL	INTERGRATING SENSORS	SMART HEALTH WATCH
• Stroke prediction dataset • Observational study • Smart watch - study design	• Finding correlation between features. • EDA analysis. • Developing ML Classification model. • Model perfermonce metric evaluation.	• Integrating the developed feature specific AI/ML algorithms for ensemble performance.	• Sensors hardware and software intergration. • Benchmarking and QA of the sensors. • Performance analysis	• Heart monitoring system • Fall detection • Slurry speech detection • Facial drooping recognition • Glucose monitoring

Schematic diagram of product development workflow

ML models: Algorithms – Logistic regression, Decision tree, KNN classifier, Random Forest and SVM.

 Among all algorithms, Random Forest seem to be appropriate algorithm for stroke prediction.

Team required: ML engineer, Software developer, Business analyst, Data Analyst.

CODE IMPLEMENTATION:

https://github.com/shanmugapriyadhanasekaran/bioinfo_practice/blob/main/stroke-predicition-analysis.ipynb

CONCLUSION:

The smart health watch can be of great help in improving lifestyle and health management of chronic ill patient/ elders who are more prone to have stroke. An immediate alert (SOS) system combined with other basic health monitoring system can be a great life saviour.