Project Deliverable 1 Part 2

Project Scope:

The project focuses on data visualization and machine learning in the field of public health and healthcare. The machine learning component utilizes a dataset from the Behavioural Risk Factor Surveillance System (BRFSS) of the Centres for Disease Control and Prevention (CDC) to identify and avoid heart disease risk factors. This involves developing machine learning algorithms to forecast and control the risks of cardiac disease. Furthermore, the initiative broadens its focus to include data visualization methodologies, with the objective of furnishing clear and perceptive graphical depictions of the dataset. The combined scope provides a thorough method that improves comprehension and decision-making in the prevention of heart disease by leveraging both machine learning and visualization.

Domain:

The project focuses on the fields of healthcare and public health. The complexity of health data, the requirement for precise forecasts, and the emphasis on proactive healthcare management are some of this domain's distinctive characteristics. Due to the sensitivity of health information and potential biases in the dataset, challenges include privacy and data security. The research addresses the potential to enhance heart disease prevention and management by utilizing machine learning.Stakeholders in this domain include healthcare providers, researchers and individuals concerned with public health. The project seeks to deliver actionable insights into heart disease risk factors by merging machine learning with data visualization. This will help with informed decision-making for specific treatments and promote public health practices.

Literature Review:

Research paper:

“The Impact of Heart Rate Variability Monitoring on Preventing Severe Cardiovascular Events”.

Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10378206/

The research paper, "The Impact of Heart Rate Variability Monitoring on Preventing Severe Cardiovascular Events," investigates the application of heart rate variability (HRV) monitoring as a non-intrusive means of gauging cardiovascular risk. It delves into the association between HRV and diverse health conditions, encompassing cardiovascular ailments, cognitive disorders, and depression. The document assesses various technologies employed in HRV monitoring, ranging from ECG and Holter monitoring to smartwatches, chest patch monitors, chest strap monitors, upper armband monitors, ring-shaped biosensors, and clothing monitors. The conclusion underscores the significance of autonomous monitoring, particularly among the elderly, and highlights the potential of telemedicine in curbing healthcare expenses.

Book:

“Braunwald's Heart Disease, Single Volume, 12th Edition”

Link:
https://www.us.elsevierhealth.com/braunwalds-heart-disease-single-volume-9780323824675.html?nosto=nosto-page-category1

The 12th Edition of Braunwald’s Heart Disease remains the leading and trusted resource in the field of cardiology, offering practitioners and trainees up-to-date and evidence-based information. Edited and authored by a global team of experts including Peter Libby and Robert O. Bonow, this edition introduces 76 new contributing authors and 14 extra chapters that delve into contemporary subjects such as Artificial Intelligence in Cardiovascular Medicine, Wearables, and the intersection of COVID-19 with Cardiovascular Disease. With 1,850 illustrations, video access, and incorporation of the latest guidelines from AHA, ACC, and ESC, the text maintains its unmatched status as a multimedia reference in the dynamic realm of cardiovascular medicine. The enhanced eBook version adds to its accessibility for practitioners.

News Article:

“AI may accurately detect heart valve disease and predict cardiovascular risk”

Link:
https://newsroom.heart.org/news/ai-may-accurately-detect-heart-valve-disease-and-predict-cardiovascular-risk#:~:text=Published%3A%20November%2006%2C%202023%20%0A%0A,2023%2C%20Abstracts%20Mo3070%20and%20306

The American Heart Association's news article, published on November 6, 2023, highlights two significant studies on heart disease. These studies, presented at the Scientific Sessions 2023, focus on the application of AI in cardiovascular health. The first study reveals that AI, analyzing heart sound data from digital stethoscopes, outperforms traditional stethoscope methods in detecting heart valve disease. The second study employs AI to analyze retinal images from UK Biobank data, identifying cardiovascular disease risks in individuals with prediabetes and Type 2 diabetes. These findings represent a pivotal advancement in using AI for early detection and risk assessment in heart disease.

Research paper:

“Cardiovascular disease, risk factors and heart rate variability in the elderly general population: Design and objectives of the CARdiovascular disease, Living and Ageing in Halle (CARLA) Study”.

Link:
https://bmccardiovascdisord.biomedcentral.com/articles/10.1186/1471-2261-5-33

The CARLA Study in Eastern Germany examines the growing impact of cardiovascular diseases (CVD) among the elderly. Targeting individuals aged 45-80 in Halle, this research includes 1750 participants and delves into the connections between CVD, heart rate variability, and various risk factors. It seeks to understand the disparities in CVD prevalence across regions, taking into account factors like nutrition and psychosocial elements. The study gathers extensive data,

including personal and family medical histories, lifestyle behaviors, and results from medical tests such as ECGs. This investigation is crucial for decoding how lifestyle choices and autonomic dysfunction contribute to the prevalence of CVD in different demographics.

Books:

Heart Disease Prevention And Reversal: More Than 50 World Renowned Scientists Describe Ground-Breaking Scientific Methods for the Natural Prevention, Cure and Reversal of Heart Disease

Link: https://bookauthority.org/book/Heart-Disease-Prevention-And-Reversal/1495308413

In his book, Dr. Caldwell B. Esselstyn Jr. presents findings from a 20-year study, demonstrating that a diet free of animal products and oils can both prevent and reverse the effects of heart disease. He emphasizes the importance of diet over surgical procedures, which only provide temporary relief from symptoms. The book recommends a diet that strictly avoids meat, dairy, oils, and refined grains, and instead focuses on a variety of vegetables, legumes, whole grains, and fruits to maintain low cholesterol levels, essential for heart health. This approach is presented alongside real patient experiences and includes over 150 recipes.

Data Source:

The dataset (https://www.kaggle.com/datasets/kamilpytlak/personal-key-indicators-of-heart-disease/data) , which is available on Kaggle, compiles personal significant indicators of heart disease. It is composed of survey data about health that was gathered by the Behavioural Risk Factor Surveillance System (BRFSS) of the CDC. In order to facilitate the study and prediction of heart disease risks, the dataset offers useful information on variables like blood pressure, cholesterol levels, smoking habits,

diabetes status, obesity, physical activity, and alcohol use.

Domain-specific Challenges:

Analyzing a dataset on heart disease presents a number of domain-specific difficulties in the healthcare industry. Considering the sensitive nature of health information, privacy and data security are critical factors. Maintaining patient confidentiality requires rigorous adherence to laws like the Health Insurance Portability and Accountability Act (HIPAA). The handling of personal health data must be done carefully to avoid misuse or unauthorized access due to ethical concerns.Furthermore, biases in the dataset might come out and affect how accurate machine learning models are. The model may display bias, for example, if the dataset disproportionately covers particular demographic groups or geographic areas. This could result in differences in the identification of risk factors. A sophisticated strategy combining in-depth knowledge of healthcare laws and moral principles with sophisticated data analytics is required to address these issues and guarantee the ethical and responsible use of health information for the management and prevention of heart disease.

KPI's:

The Risk Factor Identification Rate is pivotal, ensuring the accurate pinpointing of factors contributing to heart disease for effective preventive measures. The Preventive Action Adoption Rate gauges the practical impact, measuring the percentage of cases where identified risk factors lead to successful preventive actions or interventions. A low False Positive Rate is essential to minimize unnecessary interventions, reflecting the precision of the model in identifying true cases. Sensitivity for High-Risk Individuals is vital to ensure that the model effectively identifies individuals at the highest risk of heart disease, guiding targeted interventions.The Precision for Preventive Actions assesses the accuracy of the model in recommending particular preventive actions. The overall model accuracy gives an overall assessment of how well the model identifies and prevents heart disease risk factors. A Population-level Impact Score reflects the machine learning model's overall effectiveness in promoting heart disease prevention and management at the population level by taking into account the number of risk factors that have been identified, adoption rates, and overall impact. Together, these KPIs offer a thorough framework for evaluation that is consistent with the

main objective of enhancing heart health outcomes through data-driven insights and interventions.