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DETECTION OF A CARDIOVASCULAR DISEASE RISK THROUGH ARTIFICIAL INTELLIGENCE

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ABSTRACT

Cardiovascular diseases (CVDs), principally ischemic heart disease (IHD) and stroke, are the leading cause of global mortality and a major contributor to disability. Cardiovascular diseases remain the leading cause of disease burden in the world. CVD burden continues its decades-long rise for almost all countries outside high-income countries, and alarmingly, the age-standardized rate of CVD has begun to rise in some locations where it was previously declining in high-income countries. There is an urgent need to focus on implementing existing cost-effective policies and interventions if the world is to meet the targets for Sustainable Development Goal 3 and achieve a 30% reduction in premature mortality due to noncommunicable diseases.[1] The creation of a web-based tool for cardiovascular risk assessment is suggested as a solution to this gap. People will have an easy-to-use platform to enter health data, such as age, blood pressure, cholesterol, and lifestyle factors, with this revolutionary technology. With the use of Artificial Intelligence, the application would compute and display

the user's risk of CVD as a graphical representation in real time. This instantaneous feedback method represents a major breakthrough in the field of digital health innovation, as it is intended to raise awareness and encourage proactive health management.

KEYWORDS: Cardiovascular Diseases, Web-based tool, Artificial Intelligence, Graphical Representation, Real Time.

1 INTRODUCTION

In recent years, artificial intelligence (AI) technologies have greatly advanced and become a reality in many areas of our daily lives. In the health care field, numerous efforts are being made to implement the AI technology for practical medical treatments. With the rapid developments in machine learning algorithms and improvements in hardware performances, the AI technology is expected to play an important role in effectively analyzing and utilizing extensive amounts of health and medical data.[2]

The rise in cardiovascular diseases has a significant impact on the worldwide health landscape and raises serious issues for public health. These ailments, which include hypertension, heart disease, and stroke, are becoming more common and impact millions of people globally. The necessity for creative fixes and proactive measures to reduce the hazards related to cardiovascular illnesses is highlighted by their increasing prevalence. Our emphasis on these issues seeks to raise awareness and provide support for people who are suffering with or at risk from these illnesses.

We are creating a web application that uses artificial intelligence (AI) to estimate a person's risk of cardiovascular disease based on their personal data, which is an innovative approach to digital health. With the use of complex algorithms, this cutting-edge tool evaluates a range of lifestyle and health indicators to predict future heart-related diseases. Apart from its forecasting powers, the application has an interactive, instantaneous statistics panel that offers understanding of both general patterns and specific instances. This makes it possible to have a thorough understanding of cardiovascular health from both a macro and micro perspective. In addition, the application has a specific patient table feature that helps medical practitioners effectively monitor and follow up with their patients. This methodical strategy improves patient management and care coordination in addition to helping in the early detection and prevention of cardiovascular disorders. This web application is a shining

example of technological innovation in preventative healthcare since it combines user-friendly interfaces with AI-driven analytics.

2 MATERIALS AND METHODS

2.1 MATERIALS

For the creation of this application and the monitoring station, the following tools and resources were required: Visual Studio Code, Python, JavaScript, HTML, CSS, and a CSV file containing 70,000 patient registrations that were suggestive of cardiovascular testing.

2.1.1 VISUAL STUDIO CODE

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C#, Java, Python, PHP, Go, NET).[3]

2.1.2 PYTHON

Python is an interpreted, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high level dynamic data types, and classes. It supports multiple programming paradigms beyond object-oriented programming, such as procedural and functional programming. Python combines remarkable power with very clear syntax. It has interfaces to many system calls and libraries, as well as to various window systems, and is extensible in C or C++. It is also usable as an extension language for applications that need a programmable interface. Finally, Python is portable: it runs on many Unix variants including Linux and macOS, and on Windows.[4]

2.1.3 JAVASCRIPT

The JavaScript language was initially created for web browsers. Since then, it has evolved into a language with many uses and platforms. A platform may be a browser, or a web-server or another host, or even a “smart” coffee machine if it can run JavaScript. Each of these provides platform-specific functionality. The JavaScript specification calls that a host environment. A host environment provides its own objects and functions in addition to the language core. Web browsers give a means to control web pages. Node.js provides server-side features, and so on.[5]

2.1.4 HTML

HTML is the language in which most websites are written. HTML is used to create pages and make them functional. It stands for Hyper Text Markup Language. Hypertext means that the document contains links that allow the reader to jump to other places in the document or to another document altogether. A Markup Language is a way that computers speak to each other to control how text is processed and presented.[6]

2.1.5 CSS

The acronym CSS means "Cascading Style Sheets" and is based on a simple but very powerful concept: applying styles (colors, shapes, margins, etc...) to one or more documents (generally HTML documents, web pages) in a way automatic and massive. It is called cascading styles because the code is read, processed and applied from the top down (following a pattern called inheritance) and in the case of ambiguity (code that contradicts itself), a series of rules are followed to resolve this ambiguity.[7]

3 RESULTS AND DISCUSSION

3.1 RESULTS

A dataset in CSV format, consisting of 70,000 patient records related to cardiovascular risk, was utilized in a Python script. This script was developed to train an AI model capable of predicting the risk percentage. The model displays the calculated risk percentage alongside a circular graph on the user interface. Risks below 50% are classified as “healthy”, while higher risks are labeled as “dangerous”. For patients in the dangerous category, the interface presents a button to access a PDF file. This file contains helpful health tips and dietary suggestions tailored to mitigate cardiovascular risk.

The online application includes a dynamic bar graph that shows the total number of registered patients, the number of patients classed as high cardiovascular risk, and the number of patients classified as healthy. The bar graph updates in real time. It also has an extensive table with all patient data listed in it. This table allows medical personnel to follow and annotate each patient's progress in therapy because each entry has a comment field.

This online application's main goal is to make the process of identifying cardiovascular disease risk more efficient. It uses artificial intelligence to examine the most recent health information on a patient. Within seconds, the application provides accurate risk evaluations

based on its quick processing of the input data and saves them in order to monitor the treatment's progress.

Figure 1 shows the primary interface of the application's formulary.

Figure 1: Web Application Formulary Page.

Figure 2 shows the output displayed for a patient deemed healthy. It shows a risk of a cardiovascular disease of 8.09%.

Figure 2: Graphical Representation and Percentage of the Results from a Healthy Patient.

Figure 3 shows the application's output for a patient identified as having a high risk of cardiovascular disease (CVD). It shows a risk of a cardiovascular disease of 82.30%.

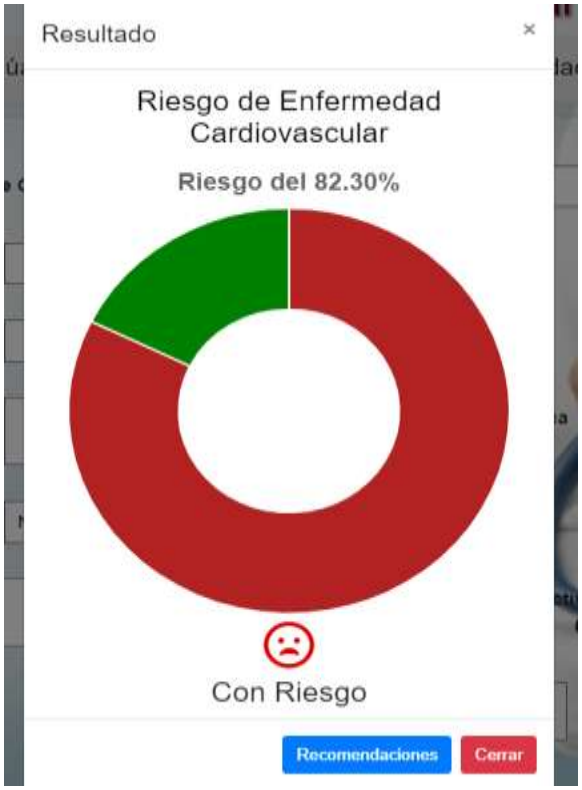
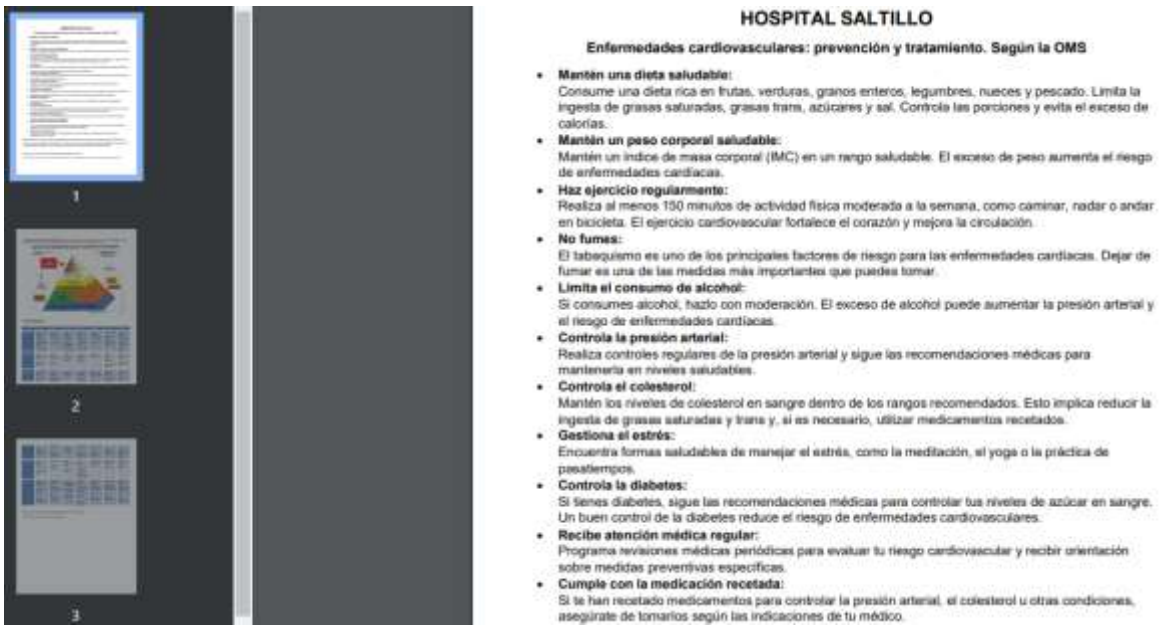


Figure 3: Graphical Representation and Percentage of the Results of a High Risk of CVD.

Figure 4 shows the set of recommendations provided by the application to mitigate the risk of cardiovascular disease (CVD) as a PDF document.



HOSPITAL SALTILLO

Enfermedades cardiovasculares: prevención y tratamiento. Según la OMS

- **Mantén una dieta saludable:**
  Consume una dieta rica en frutas, verduras, granos enteros, legumbres, nueces y pescado. Limita la ingesta de grasas saturadas, grasas trans, azúcares y sal. Controla las porciones y evita el exceso de calorías.
- **Mantén un peso corporal saludable:**
  Mantén un índice de masa corporal (IMC) en un rango saludable. El exceso de peso aumenta el riesgo de enfermedades cardíacas.
- **Haz ejercicio regularmente:**
  Realiza al menos 150 minutos de actividad física moderada a la semana, como caminar, nadar o andar en bicicleta. El ejercicio cardiovascular fortalece el corazón y mejora la circulación.
- **No fumes:**
  El tabaquismo es uno de los principales factores de riesgo para las enfermedades cardíacas. Dejar de fumar es una de las medidas más importantes que puedes tomar.
- **Limita el consumo de alcohol:**
  Si consumes alcohol, hazlo con moderación. El exceso de alcohol puede aumentar la presión arterial y el riesgo de enfermedades cardíacas.
- **Controla la presión arterial:**
  Realiza controles regulares de la presión arterial y sigue las recomendaciones médicas para mantenerla en niveles saludables.
- **Controla el colesterol:**
  Mantén los niveles de colesterol en sangre dentro de los rangos recomendados. Esto implica reducir la ingesta de grasas saturadas y trans y, si es necesario, utilizar medicamentos recetados.
- **Gestiona el estrés:**
  Encuentra formas saludables de manejar el estrés, como la meditación, el yoga o la práctica de pasatiempos.
- **Controla la diabetes:**
  Si tienes diabetes, sigue las recomendaciones médicas para controlar tus niveles de azúcar en sangre. Un buen control de la diabetes reduce el riesgo de enfermedades cardiovasculares.
- **Recibe atención médica regular:**
  Programa revisiones médicas periódicas para evaluar tu riesgo cardiovascular y recibir orientación sobre medidas preventivas específicas.
- **Cumple con la medicación recetada:**
  Si te han recetado medicamentos para controlar la presión arterial, el colesterol u otras condiciones, asegúrate de tomarlos según las indicaciones de tu médico.

Figure 4: PDF File Containing Guidelines and a Basic Diet Plan to Reduce CVD Risk.

Figure 5. shows a flow diagram of the Formulary development process.

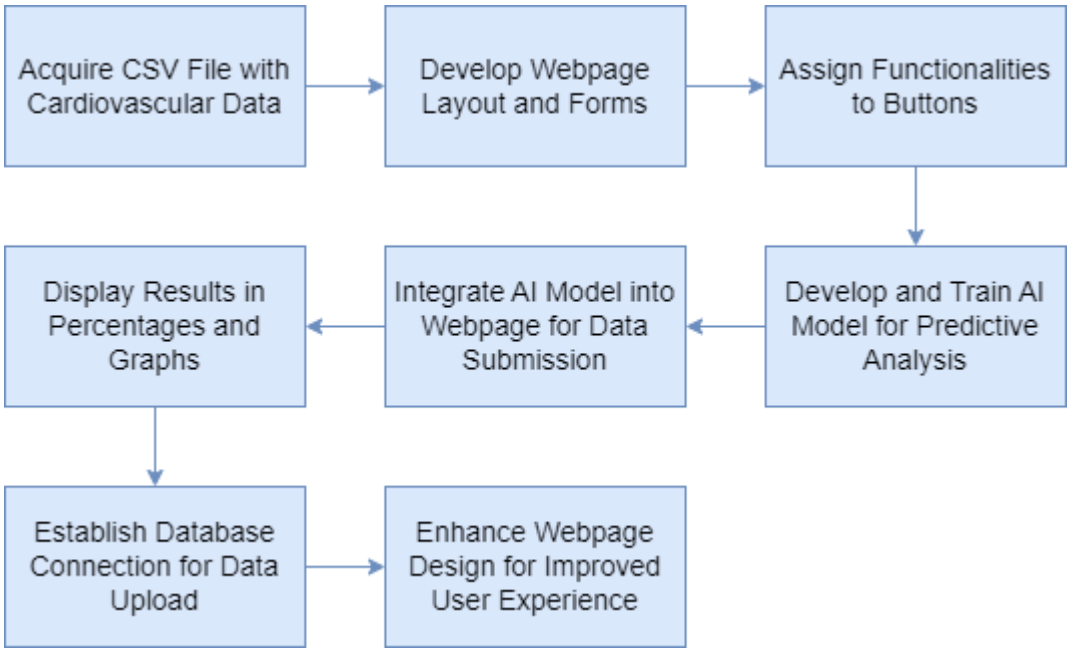


Figure 5: Step-by-Step Guide to Formulary Page Development.

Figure 6 shows a bar graph representing real-time data collection sourced from the submitted formularies. This graph offers a visual representation of the data as it is gathered and processed by the application. Patients with risk of a CVD were two persons, and patients with no risk were 5 persons.

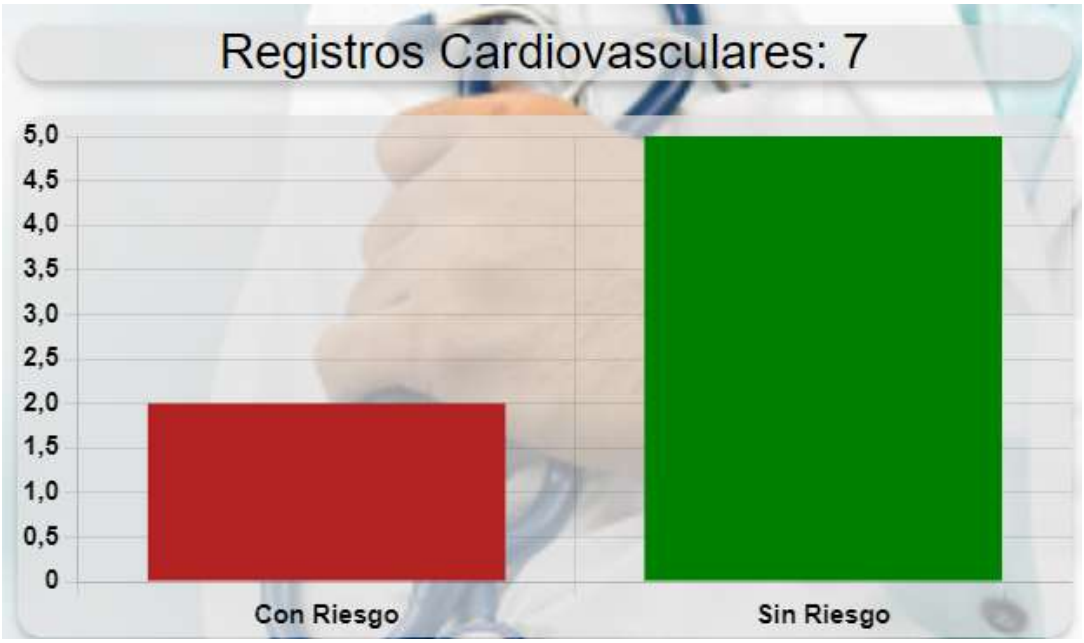


Figure 6: Real-Time Graphs Displaying Results with X-Axis Representing Risk Status (With/Without Risk) and Y-Axis Indicating the Number of People.

Figure 7 shows a diagram of the instructions for the Real-Time Graphs page development.

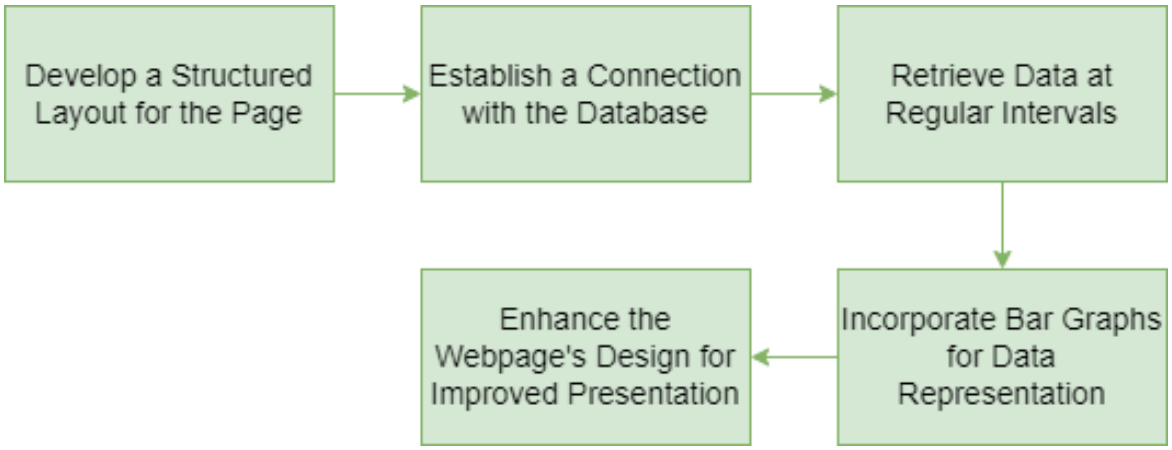


Figure 7: Guideline for Developing the Real-Time Graphs Page.

Figure 8 shows a table view of patient, this table includes information such as patient name, risk status, date of assessment, and options to show or delete patient records.

Figure 8: Overview Table Displaying the General Profile of Registered Patients.

Figure 9 shows a detailed view of all the data entered for each patient in the application. This view also includes an editable comment section, allowing healthcare providers to make and track notes regarding the patient's treatment and progress.

Figure 9: Registered Patient Information and Feedback Summary.

CONCLUSION

The creation of this web application represents a substantial development in the treatment of cardiovascular health. It evaluates patient data and predicts the risk of cardiovascular disease (CVD) with remarkable efficiency and accuracy by leveraging artificial intelligence (AI). One important aspect of the program is how quickly risk assessments can be delivered, which guarantees timely information for patients and healthcare providers alike. Real-time graphing features are also integrated, providing a dynamic and understandable visual depiction of data trends and personalized health markers. This feature facilitates decision-making by improving knowledge of cardiovascular risks. Additionally, the program has a carefully thought-out follow-up table that makes it possible to handle and monitor patients continuously. Healthcare providers can monitor patient progress, modify therapies, and give individualized care with the help of this table. All things considered, the web application is a shining example of predictive healthcare innovation, providing a complete solution for the early identification, efficient monitoring, and proactive management of cardiovascular health problems.

REFERENCES

1. Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., Bonny, A., Brauer, M., Brodmann, M., Cahill, T. J., Carapetis, J., Catapano, A. L., Chugh, S. S., Cooper, L. T., Coresh, J., Fuster, V. (2020). Global burden of cardiovascular diseases and risk factors, 1990–2019. Journal of the American College of Cardiology, 76(25): 2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010.
2. Park, C.-W., Seo, S. W., Kang, N., Ko, B., Choi, B. W., Park, C. M., Chang, D. K., Kim, H., Kim, H., Lee, H., Jang, J., Ye, J. C., Jeon, J. H., Seo, J. B., Kim, K. J., Jung, K.-H., Kim, N., Paek, S., Shin, S.-Y., & Yoo, S. (2020). Artificial Intelligence in Health Care: Current Applications and Issues. Journal of Korean Medical Science, 35(42): https://doi.org/10.3346/jkms.2020.35.e379.
3. Documentation for Visual Studio Code. (s/f). Visualstudio.com. Retrieved, December 18, 2023; from https://code.visualstudio.com/docs.
4. General Python FAQ. (s/f). Python documentation. Retrieved, December 18, 2023; from https://docs.python.org/3/faq/general.html.
5. Browser environment, specs. (n.d.). Javascript.info. Retrieved, December 18, 2023; from https://javascript.info/browser-environment
6. Moraes, F. (2015). Home. Html.com. https://html.com/.
7. ¿Qué es CSS? - CSS en español. (s/f). Lenguajecss.com. Retrieved, December 18, 2023; from https://lenguajecss.com/css/introduccion/que-es-css/.