Cardio Risk Meter (Cardiovascular Disease Prediction System)

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Abstract

Cardiovascular diseases remain a leading cause of morbidity and mortality globally. Early detection and intervention play a crucial role in mitigating risks. This Cardio Risk Meter (Cardiovascular Disease Prediction) web application addresses this need by providing individuals with a proactive tool for understanding and managing their cardiovascular health.

This project introduces a Cardio Risk Meter (Cardiovascular Disease Prediction) web application designed to empower individuals in proactively managing their heart health. The website leverages state-of-the-art machine learning algorithms to offer users personalized risk assessments for cardiovascular diseases. The risk assessment process involves the analysis of key health metrics, lifestyle factors, and medical history, providing users with accurate predictions regarding their cardiovascular health.

The Cardio Risk Meter serves as an accessible and empowering platform for users to take control of their heart health. By integrating cutting-edge technology with personalized insights, the website aims to contribute to a healthier society by fostering early intervention and informed decision-making.

Step 1: Prototype Selection

1. Problem Statement

An online application called Cardio Risk Meter (Cardiovascular Disease Prediction) is introduced with the goal of enabling people to take proactive control of their heart health. The website provides customers with tailored risk assessments for cardiovascular illnesses by utilizing cutting-edge machine learning algorithms.

2. Market/Customer/Business Need Assessment

The Cardio Risk Meter website addresses a pressing market need for preventive cardiovascular health solutions. By meeting the demands of informed customers seeking personalized insights, the platform not only serves a crucial societal need but also presents a viable business opportunity in the evolving health tech landscape.

2.1 Market Need

2.1.1 Prevalence of Cardiovascular Diseases

Cardiovascular diseases are a leading global health concern, affecting a significant portion of the population. There is a clear market need for tools that enable individuals to assess and manage their cardiovascular health proactively.

2.1.2 Shift towards Preventive Healthcare

Increasing awareness and a societal shift towards preventive healthcare create a demand for solutions that empower individuals to take proactive measures in managing their cardiovascular health.

2.1.3 Limited Access to Personalized Risk Assessment

The market lacks widespread access to platforms offering personalized risk assessments for cardiovascular diseases. Individuals seek tools that provide tailored insights into their unique risk factors.

2.2 Customer Need

2.2.1 Desire for Early Detection

Customers recognize the importance of early detection in mitigating cardiovascular risks. There is a strong need for a tool that aids in the early identification of potential health issues.

2.2.2 Personalized Health Insights

Individuals are increasingly seeking personalized health insights and recommendations tailored to their specific health profiles. A demand exists for tools that go beyond generic information to provide actionable insights.

2.2.3 User-Friendly Platforms

Customers express a preference for user-friendly platforms that simplify the process of assessing cardiovascular risk. Accessibility and ease of use are critical factors for engagement.

2.3 Business Need

2.3.1 Opportunity for Health Tech Innovation

There is a business opportunity to capitalize on the growing health tech market by offering innovative solutions that leverage advanced technologies, such as machine learning, for cardiovascular risk prediction.

2.3.2 Monetization through User Engagement

Engaging users with a valuable service creates opportunities for monetization, such as premium features, subscription models, or partnerships with healthcare providers and insurers.

2.3.3 Addressing Regulatory and Ethical Considerations

The business need involves developing a platform that adheres to regulatory standards, ensuring data privacy, security, and ethical use of health information, fostering user trust and compliance.

3. Target Specifications and Characterization

By aligning with following specifications and characterizations, the Cardio Risk Meter website aims to cater to the specific needs and preferences of its target audience, ensuring accuracy, privacy, and user engagement in the promotion of proactive cardiovascular health management.

3.1 User Demographics

Age Group: Primarily targeting adults aged 30 and above.
Geographic Location: Initially focused with a higher prevalence of cardiovascular diseases.

3.2 User Persona

Health-Conscious Individuals: Individuals actively seeking ways to proactively manage their cardiovascular health.
Tech-Savvy Users: Comfortable with using online platforms for health-related assessments.

3.3 Health Data Collection

Relevant Metrics: Collect essential health metrics, including age, gender, blood pressure, cholesterol levels, and relevant lifestyle factors.
User Consent: Implement robust consent mechanisms to ensure users are aware of data collection and usage.

3.4 Personalization

Machine Learning Algorithms: Utilize advanced machine learning algorithms (Random Forest Classification Algorithm) for personalized risk assessments.

3.5 Predictive Accuracy

Sensitivity and Specificity: Aim for high sensitivity and specificity in predictions to minimize false positives and false negatives.

Continuous Improvement: Implement mechanisms for continuous algorithm refinement based on user feedback and evolving health research.

3.6 Interpretability

Clear Reporting: Ensure transparent and easy-to-understand reporting of cardiovascular risk assessments.

Explanation of Predictions: Provide users with explanations of the factors influencing their risk predictions.

3.7 Scalability

Infrastructure Scalability: The platform to accommodate an increasing user base without compromising performance.

3.8 Collaboration Opportunities

Healthcare Partnerships: Explore collaborations with healthcare providers for seamless integration with the broader healthcare ecosystem.

Research Collaborations: Foster partnerships with research institutions for continuous improvement and validation of predictive models.

4. External Search

4.1 Dataset

https://www.kaggle.com/datasets/jocelyndumlao/cardiovascular-disease-dataset

The dataset is found on Kaggle. This heart disease dataset is acquired from one of the multispecialty hospitals in India. Over 14 common features make it one of the heart disease datasets available so far for research purposes. This dataset consists of 1000 subjects with 12 features.

```
In [1]: import pandas
        data = pandas.read_csv('Cardiovascular_Disease_Dataset.csv')
        data.head()
```

Out[1]:

	patientid	age	gender	chestpain	restingBP	serumcholestrol	fastingbloodsugar	restingrelectro	maxheartrate	exerciseangia	oldpeak	slope	noofmajorvess
0	103368	53	1	2	171	0	0	1	147	0	5.3	3	
1	119250	40	1	0	94	229	0	1	115	0	3.7	1	
2	119372	49	1	2	133	142	0	0	202	1	5.0	1	
3	132514	43	1	0	138	295	1	1	153	0	3.2	2	
4	146211	31	1	1	199	0	0	2	136	0	5.3	3	

```
In [3]: data.shape
```

Out[3]: (1000, 14)

```
In [4]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   patientid          1000 non-null   int64
 1   age                1000 non-null   int64
 2   gender             1000 non-null   int64
 3   chestpain          1000 non-null   int64
 4   restingBP          1000 non-null   int64
 5   serumcholestrol    1000 non-null   int64
 6   fastingbloodsugar  1000 non-null   int64
 7   restingrelectro    1000 non-null   int64
 8   maxheartrate       1000 non-null   int64
 9   exerciseangia      1000 non-null   int64
 10  oldpeak            1000 non-null   float64
 11  slope              1000 non-null   int64
 12  noofmajorvessels   1000 non-null   int64
 13  target             1000 non-null   int64
dtypes: float64(1), int64(13)
memory usage: 109.5 KB
```

```
In [ ]:
```

4.2 References

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9206502/
- https://ieeexplore.ieee.org/document/9362367
- https://www.sciencedirect.com/science/article/abs/pii/S0010482522004164
- https://www.nature.com/articles/s41598-020-72685-1

5. Bench marking alternate products

The features of a Cardio Risk Meter Website can set it apart from other health-related platforms, contributing to its effectiveness and user engagement. Below are key features that could distinguish such a website:

5.1 Personalized Cardiovascular Risk Assessment:

Advanced machine learning algorithms that provide highly personalized risk assessments based on individual health metrics and lifestyle factors.

5.2 User-Friendly Interface:
Intuitive and user-friendly interface, making it easy for users to input data, interpret results, and navigate the platform effortlessly.

5.3 Continuous Improvement Based on User Feedback:
Differentiator: Active engagement with user feedback, leading to continuous improvements in the platform's features, algorithms, and overall user experience.

5.4 Continuous Monitoring and Alerts:
Differentiator: Encourages users to regularly monitor their cardiovascular health with scheduled reassessments and provides alerts for timely updates.

5.5 Integration with Healthcare Professionals:
Differentiator: Seamless integration with healthcare professionals, allowing users to seek further consultation or assistance based on their risk assessments.

6. Applicable Patents
Cardiovascular disease prediction system using A.I.-based cardiovascular disease prediction model for patients with SDB KR20180111142A 2018-10-11 - The present invention relates to a cardiovascular disease prediction system that predicts a future cardiovascular disease of a sleep breathing disorder patient by applying an electrocardiogram and a cardiovascular disease risk factor of the sleep breathing disorder patient to an artificial intelligence-based cardiovascular disease prediction model.
KR20220097724A - Cardiovascular disease prediction system using A.I.-based cardiovascular disease prediction model for patients with SDB - Google Patents

7. Applicable Regulations
The patents mentioned above might claim the technology used if the algorithms are not developed and optimised individually and for our requirements. Using a pre-existing model is off the table if it incurs a patent claim.

7.1 Must provide access to the 3rd party websites to audit and monitor the authenticity and behaviour of the service.

7.2 Enabling open-source, academic and research community to audit the Algorithms and research on the efficacy of the product.

7.3 Laws controlling data collection: Some websites might have a policy against collecting customer data in form of reviews and ratings.

7.4 Must be responsible with the scraped data: It is quintessential to protect the privacy and intention with which the data was extracted.

8. Applicable Constraints

When developing a Cardio Risk Meter website, various constraints need to be considered to ensure the ethical, legal, and technical viability of the platform. Here are applicable constraints for such a website:

8.1 **Accuracy and Reliability:** Ensuring the accuracy and reliability of predictive algorithms to minimize false positives and false negatives. Regularly validate and refine algorithms based on new research findings, user feedback, and collaboration with healthcare professionals and researchers.

8.2 **Data Security:** Protecting user health data from unauthorized access, breaches, or cyber threats. Employ strong data encryption protocols, conduct regular security audits, and stay updated on the latest cybersecurity best practices.

8.3 **Technological Infrastructure:** Availability of robust and scalable technological infrastructure to handle user traffic and data processing demands. Implement scalable cloud infrastructure, monitor server performance, and plan for load balancing to handle increasing user volumes.

8.4 **User Education and Transparency:** Ensuring users understand the predictive nature of the platform and providing transparent explanations for risk assessments. Incorporate educational content, offer explanations for predictions, and encourage users to consult healthcare professionals for a comprehensive understanding of their health.

9. Business Model

The Cardio Risk Meter website presents several business opportunities driven by the increasing emphasis on preventive healthcare and the demand for personalized health solutions. Here are key business opportunities associated with the development and implementation of such a platform:

9.1 Early Intervention and Prevention:

Address the growing need for early detection and preventive measures in cardiovascular health. Provide users with personalized risk assessments, enabling early intervention and lifestyle changes to reduce the risk of cardiovascular diseases.

9.2 Corporate Wellness Programs:

Tap into the corporate wellness market by offering the Cardiovascular Disease Prediction platform as part of employee wellness initiatives. Empower employees to proactively manage their cardiovascular health, contributing to improved overall well-being and reduced healthcare costs for employers.

9.3 Health Insurance Partnerships:

Collaborate with health insurance providers to enhance their offerings and reduce long-term healthcare expenses. Enable insurers to offer personalized preventive care solutions, potentially reducing the incidence and severity of cardiovascular diseases among policyholders.

9.4 Research and Data Insights:

Provide anonymized, aggregated data insights to healthcare researchers, institutions, and pharmaceutical companies. Contribute to cardiovascular research and population health studies, fostering collaboration and advancing scientific knowledge.

9.5 Educational Partnerships:

Collaborate with educational institutions to integrate the platform into health education programs. Enhance health education by providing students with practical tools for understanding and managing cardiovascular health.

10. Concept Generation

This product requires the tool of machine learning models to be written from scratch in order to suit our needs. Tweaking these models for our use is less daunting than coding it up from scratch. A well-trained model can either be repurposed or built. But building a model with the resources and data we have is dilatory but possible. The customer might want to spend the least amount of time giving input data. This accuracy will take a little effort to nail, because it's imprudent to rely purely on Classic Machine Learning algorithm.

In [1]:
```
# Importing the Libraries
import pandas as pd
from sklearn import model_selection
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.ensemble import RandomForestClassifier
```

In [2]:
```
# Importing Dataset
df = pd.read_csv('Cardiovascular_Disease_Dataset.csv')
```

In [3]:
```
# Extracting Independent and Dependent Variables
X = df.iloc[:,1:13]
print(X)
Y = df.iloc[:,13:14]
print(Y)
```

```
In [4]: # Splitting the dataset into Training and Testing Sets
        x_train,x_test,y_train,y_test = train_test_split(X, Y, test_size=0.2)

In [5]: # Feature Scaling
        sc = StandardScaler()
        x_train = sc.fit_transform(x_train)
        x_test = sc.fit_transform(x_test)

In [6]: # Spot Check Algorithms
        models = []
        models.append(('LR', LogisticRegression()))
        models.append(('KNN', KNeighborsClassifier()))
        models.append(('SVM', SVC()))
        models.append(('DT', DecisionTreeClassifier()))
        models.append(('NB', GaussianNB()))
        models.append(('RF', RandomForestClassifier()))

In [7]: # Evaluate each model in turn
        results = []
        names = []
        for name, model in models:
            kfold = model_selection.KFold(n_splits=10, shuffle=True, random_state=6)
            cv_results = model_selection.cross_val_score(model, x_train, y_train, cv=kfold, scoring='accuracy')
            results.append(cv_results)
            names.append(name)
            msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
            print(msg)
```

The Accuracy of the initial model is given below:

```
Linear Regression: 0.960000 (0.039843)
K-Nearest Neighbors: 0.936250 (0.036422)

Support Vector Machine: 0.961250 (0.027071)
Decision Tree: 0.955000 (0.028614)
Naive Bayes: 0.940000 (0.030516)

Random Forest: 0.976250 (0.024654)
```

Accuracy of Random Forest Classification Algorithm is best as compared to other algorithms. Hence, we finalized Random Forest Classification Algorithm for this dataset.

11. Concept Development

The concept of Cardio Risk Meter web application can be developed by using the Django framework and also for deployment. Machine Learning model used to develop this concept is Random Forest Classification Algorithm and dataset is available on Kaggle. Concept development for a Cardiovascular Disease Prediction website involves defining the core ideas, features, and functionalities of the platform. Here's a detailed breakdown:

11.1 Objective:

To empower individuals with personalized risk assessments for cardiovascular diseases, promoting early detection and proactive health management.

11.2 Target Audience:

Adults aged 30 and above. Individuals interested in preventive healthcare. Potentially corporate wellness programs and health insurance providers.

11.3 Key Features and Functionalities:

11.3.1 Personalized Risk Assessment:

Input forms for relevant health metrics (age, gender, blood pressure, cholesterol levels, etc.). Utilize advanced machine learning algorithms for accurate risk assessments.

11.3.2 Continuous Monitoring and Updates:

Allow users to regularly monitor their cardiovascular health with updated risk assessments.

11.3.3 Educational Content:

Blog section with articles on cardiovascular health. Informational resources, infographics, and videos to educate users.

11.3.4 User Dashboard:

Post-login dashboard with an overview of cardiovascular risk status. Access to previous assessments and recommendations.

11.3.5 Secure User Profiles:

User accounts with secure login and data privacy measures. Option to customize profile settings.

11.3.6 Feedback and Support:

Feedback forms for users to provide insights and report issues. Customer support contact information.

11.4 User Journey:

11.4.1 Onboarding Process:

Clear and simple onboarding process with an introduction to the platform's purpose.
Guided steps for users to input relevant health data.

11.4.2 Risk Assessment Process:

Seamless and user-friendly interface for inputting health metrics.

11.4.3 Results and Recommendations:

Clearly presented results with visual representations of risk levels. Step-by-step recommendations for users to follow.

11.4.4 Education and Engagement:

Encourage users to explore educational content. Gamification elements to maintain engagement.

11.5 Technology Stack:

11.5.1 Frontend: HTML, CSS.
11.5.2 Backend: Django for server-side logic, Cardiovascular Disease Dataset.
11.5.3 Machine Learning: Python with scikit-learn for building predictive models.

11.6 Legal and Ethical Considerations:

11.6.1 Privacy Compliance:

Adhere to healthcare data protection regulations (e.g., HIPAA, GDPR). Transparent consent mechanisms for data collection.

11.6.2 Ethical AI Use:

Implement measures to minimize bias in predictive algorithms. Ensure clear explanations for predictions.

11.7 User Testing and Iteration:

11.7.1 Continuous Improvement:

Regularly gather user feedback for platform improvements. Iterative development based on user insights.

This comprehensive concept development outlines the key aspects of the Cardio Risk Meter website, from its objectives and target audience to features, technology stack, and monetization strategies. Adjustments and refinements can be made based on user feedback and emerging technologies.

12. Final Product Prototype

The prototype typically involves both design and functionality aspects. Here's a detailed breakdown:

12.1 Back End:

Before the service is released, this needs to be completed. Optimizing the automated jobs requires a significant amount of hand supervised machine learning.

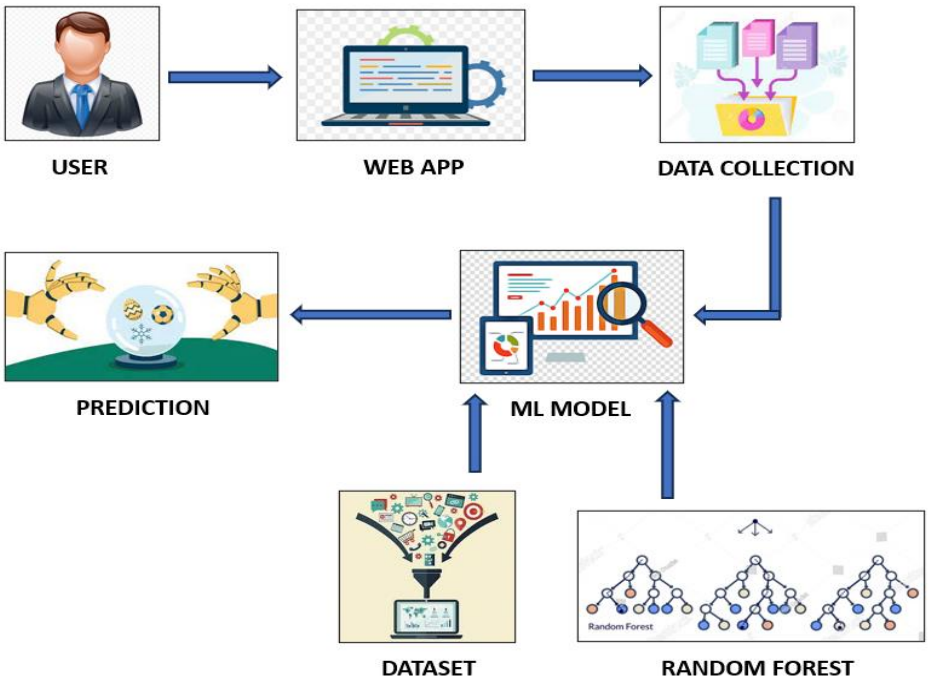
1. Realizing the dependent and independent features with EDA.
2. It is necessary to train and optimize algorithms in order to reduce model overfitting and hyperparameter tuning.

12. 2 Front End:

1. Various user interface: There should be a wide range of parameter choices available to the user. Only after extensive testing and analysis of all the edge cases can this be optimized.

2. Raw and unintelligible data will be returned by the interactive visualization of the data that was taken from the trained models. This needs to be presented in a visually appealing and "easy to read" manner.

Following is the prototype of Cardio Risk Meter:



13. Product details

13.1 How does it work?

A Cardio Risk Meter website employs a combination of data collection, advanced machine learning algorithms, and personalized risk assessment to predict an individual's risk of cardiovascular diseases. Here's an overview of how such a website might work:

13.1.1. User Registration and Onboarding:

Users will provide essential information such as age, gender, weight, height, blood pressure, cholesterol levels and medical history. The onboarding process may include a brief introduction to the platform's purpose and benefits.

13.1.2. Data Collection:

Users input relevant health metrics through a user-friendly interface. The platform collects data on various factors known to influence cardiovascular health, such as blood pressure, cholesterol levels, etc.

13.1.3. Machine Learning Algorithms:

The collected data is processed and fed into machine learning algorithms i.e., Random Forest Algorithm. Advanced algorithms analyse the input data to identify patterns, correlations, and risk factors associated with cardiovascular diseases.

13.1.4. Predictive Modelling:

The machine learning model generates a predictive assessment of the user's risk of developing cardiovascular diseases. The model considers the user's unique combination of health metrics.

13.1.5. Results Presentation:

Users receive a clear presentation of their cardiovascular risk assessment.

13.1.6. Future Enhancements:

Based on the risk assessment, the platform generates personalized recommendations for the user. Recommendations may include lifestyle changes, dietary adjustments, exercise routines, and other preventive measures. The platform encourages users to regularly monitor their cardiovascular health by reassessing their risk. Users may receive notifications prompting them to revisit the platform for updated assessments. The platform remains dynamic, exploring opportunities for future enhancements such as wearable device integration, expanded educational resources, and global partnerships.

The success of a Cardio Risk Meter website lies in its ability to provide accurate predictions, actionable recommendations, and a user-friendly experience, promoting proactive health management and early intervention. Continuous user feedback and collaboration with healthcare professionals contribute to the ongoing improvement and relevance of the platform.

13.2Data Sources

Dataset

https://www.kaggle.com/datasets/jocelyndumlao/cardiovascular-disease-dataset

The dataset is found on Kaggle. This heart disease dataset is acquired from one of the multispecialty hospitals in India. Over 14 common features make it one of the heart disease datasets available so far for research purposes. This dataset consists of 1000 subjects with 12 features.

13.3Algorithms, frameworks, software etc. needed

13.3.1 Frontend:
HTML, CSS for user interface.
13.3.3 Framework:
Django Framework for server-side logic.
13.3.4 Machine Learning:
Python with scikit-learn for building predictive models.
13.3.5 Algorithm:
Random Forest Classification Algorithm.

13.4 Team required to develop.

1. Machine learning engineering
2. Software developer
3. Cloud engineer
4. Data Researcher
5. Cardiologist

A. Feasibility:

The development timeline for a Cardio Risk Meter Website can vary based on several factors including:

A1. Data Collection and Processing: Gathering relevant datasets, ensuring data quality, and preprocessing can be time-consuming tasks.

A2. Model Development and Validation: Developing accurate predictive models for cardiovascular disease requires significant research, experimentation, and validation to ensure reliability and accuracy.

A3. Compliance and Regulations: Healthcare-related websites must comply with various regulations and standards such as HIPAA (in the US) to ensure patient data privacy and security.

A4. Integration and Maintenance: Integrating the prediction models into the website, ensuring smooth operation, and providing ongoing maintenance and support are essential tasks.

Given these factors, the development timeline can range from several months to a year or more, depending on the resources, expertise, and requirements available. However, with advancements in machine learning, cloud computing, and web development technologies, the development time may be shortened.

B. Viability:

The viability and relevance of a Cardio Risk Meter (Cardiovascular Disease Prediction) Website in the long-term future depend on various factors:

B1. Accuracy and Effectiveness: The predictive models used on the website must consistently demonstrate high accuracy and effectiveness in predicting cardiovascular

diseases. Continuous updates and improvements to the models may be necessary to adapt to changing patterns and understanding of CVD risk factors.

B2. Technological Advancements: Advancements in machine learning, data analytics, and medical research can improve the capabilities of predictive models and the website's overall performance. Staying abreast of emerging technologies and trends is essential for maintaining relevance in the long term.

B3. Regulatory Compliance: Compliance with healthcare regulations and standards, such as HIPAA in the United States, is essential for protecting patient privacy and ensuring data security. The website must adhere to evolving regulatory requirements to maintain trust and credibility.

B4. User Engagement and Adoption: User engagement and adoption are critical factors for the long-term success of the website. Continuous efforts to enhance user experience, provide valuable insights, and foster community engagement can help retain users and sustain the website's relevance over time.

B5. Integration with Healthcare Ecosystem: Integration with healthcare systems, electronic health records (EHRs), and healthcare providers can enhance the website's utility and impact. Collaboration with healthcare professionals and institutions can facilitate data sharing, validation, and adoption of predictive models in clinical practice.

Overall, the long-term viability of a Cardio Risk Meter Website depends on its ability to adapt to evolving healthcare landscape, technological advancements, regulatory requirements, and user needs. Continuous innovation, collaboration, and commitment to improving cardiovascular health outcomes are essential for ensuring the sustained relevance and impact of such a website.

C. Monetization:

A Cardio Risk Meter Website can be monetized directly through various strategies. Here are some potential monetization avenues:

C1. Subscription Plans: Offer subscription-based access to premium features or personalized health insights. Users can pay a monthly or yearly fee to access advanced predictive analytics, personalized risk assessments, or detailed health recommendations.

C2. Freemium Model: Provide basic prediction and risk assessment services for free, while offering premium features or enhanced insights as paid upgrades. This model allows users to access essential functionalities at no cost while incentivizing them to upgrade for additional benefits. Users pay directly for accessing advanced predictive analytics, personalized health insights, or additional features and services offered by the website.

C3. Health Coaching Services: Offer personalized health coaching services provided by certified healthcare professionals or nutritionists. Users can receive one-on-one coaching sessions, dietary recommendations, and lifestyle modifications tailored to their cardiovascular health needs for a fee.

C4. Consultation Fees: Offer telemedicine or virtual consultation services with healthcare professionals for users seeking personalized health advice or medical

recommendations based on their cardiovascular risk profile. Users can schedule virtual appointments or seek expert opinions for a fee.
C5. Health and Wellness Products: Develop and sell proprietary health and wellness products, such as dietary supplements, fitness equipment, or wearable devices, targeting users interested in improving cardiovascular health and overall well-being.

It's important to consider the ethical implications of monetization strategies and prioritize user privacy, data security, and transparency in all revenue-generating activities. Building trust and maintaining the integrity of the website's health-focused mission are paramount for long-term success and user satisfaction.

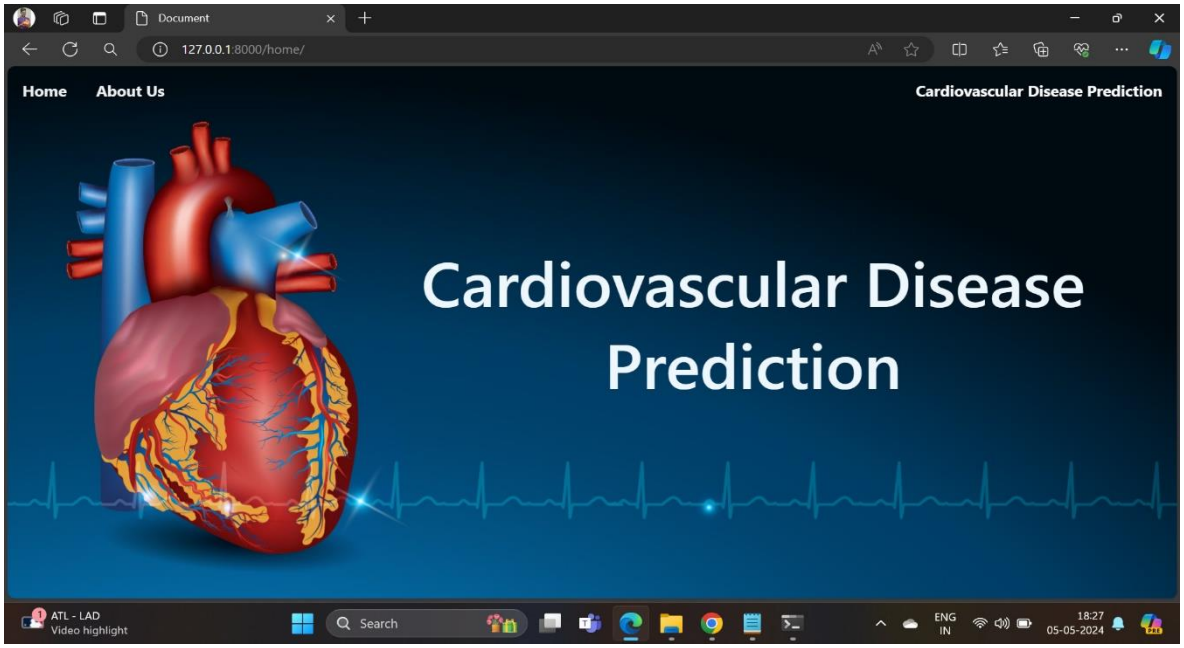
Step 2: Prototype Development

1. Code Implementation/Validation on Small Scale

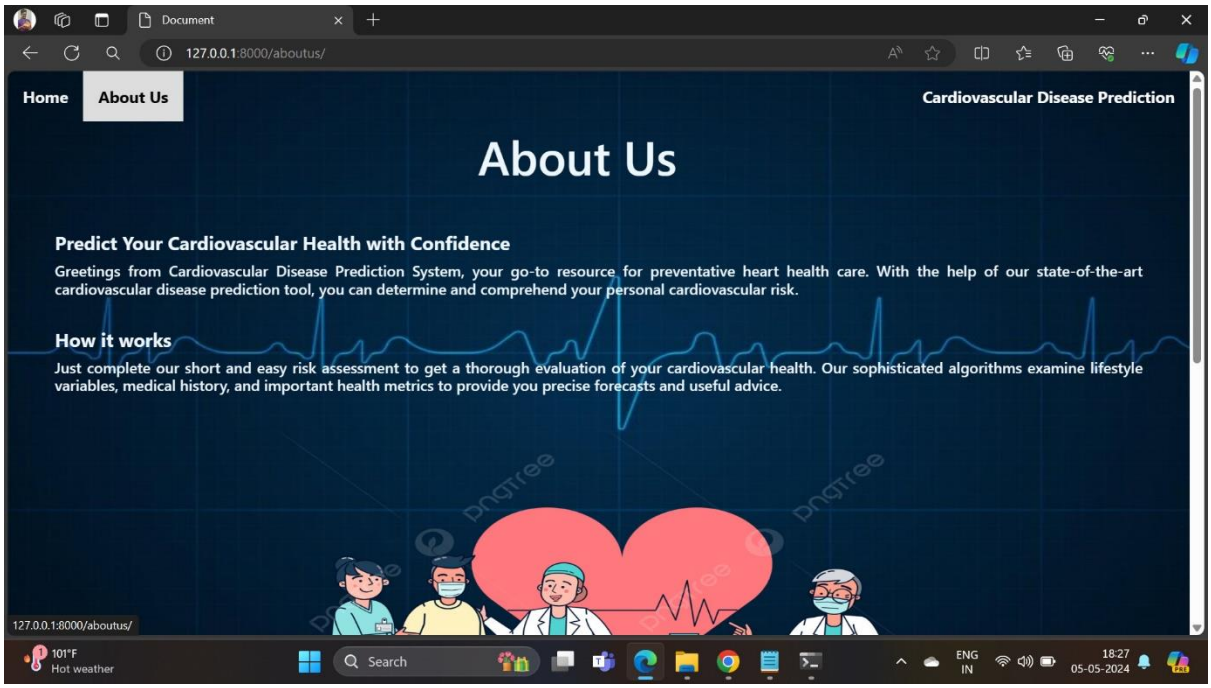
1.1 Some Basic Visualizations on Real World or Augmented Data

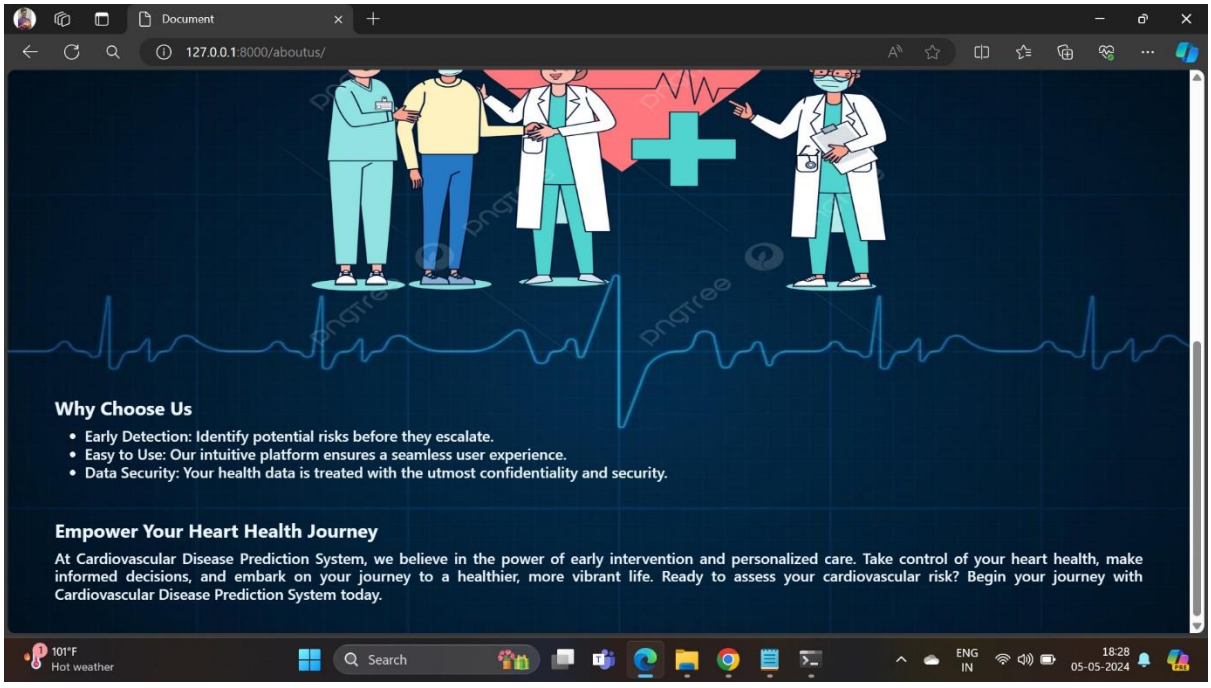
Following is the basic visualization of small-scale validation of Cardio Risk Meter web application:

1.1.1 Home Page:

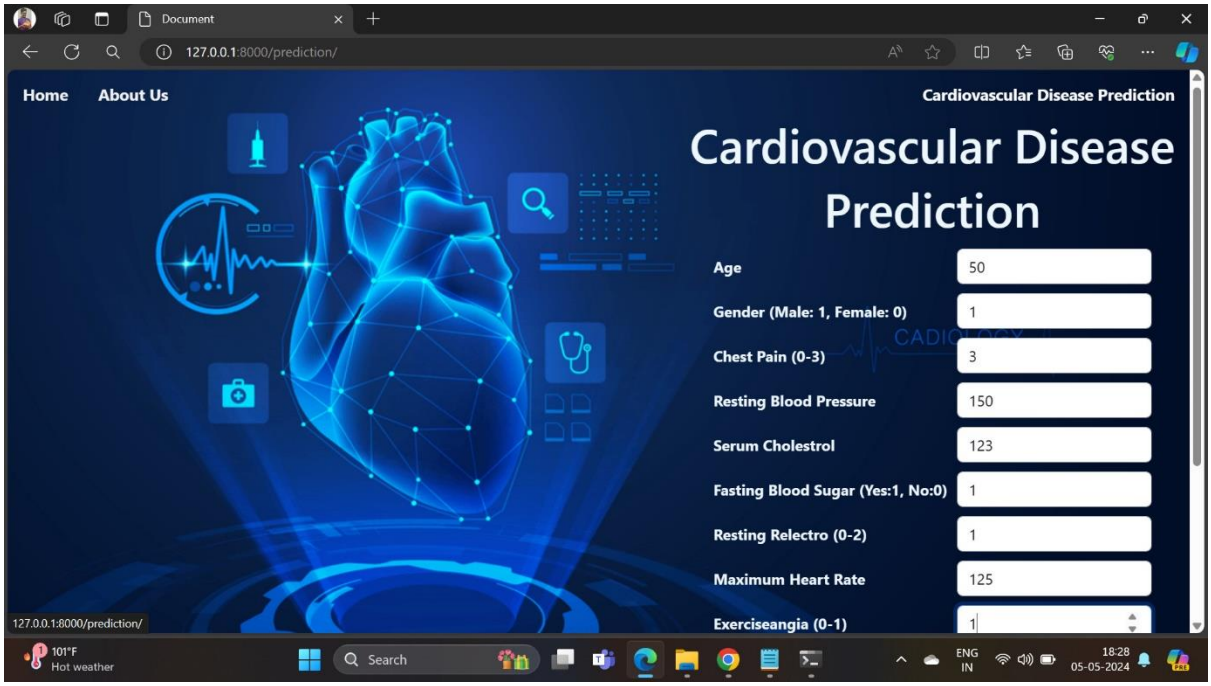


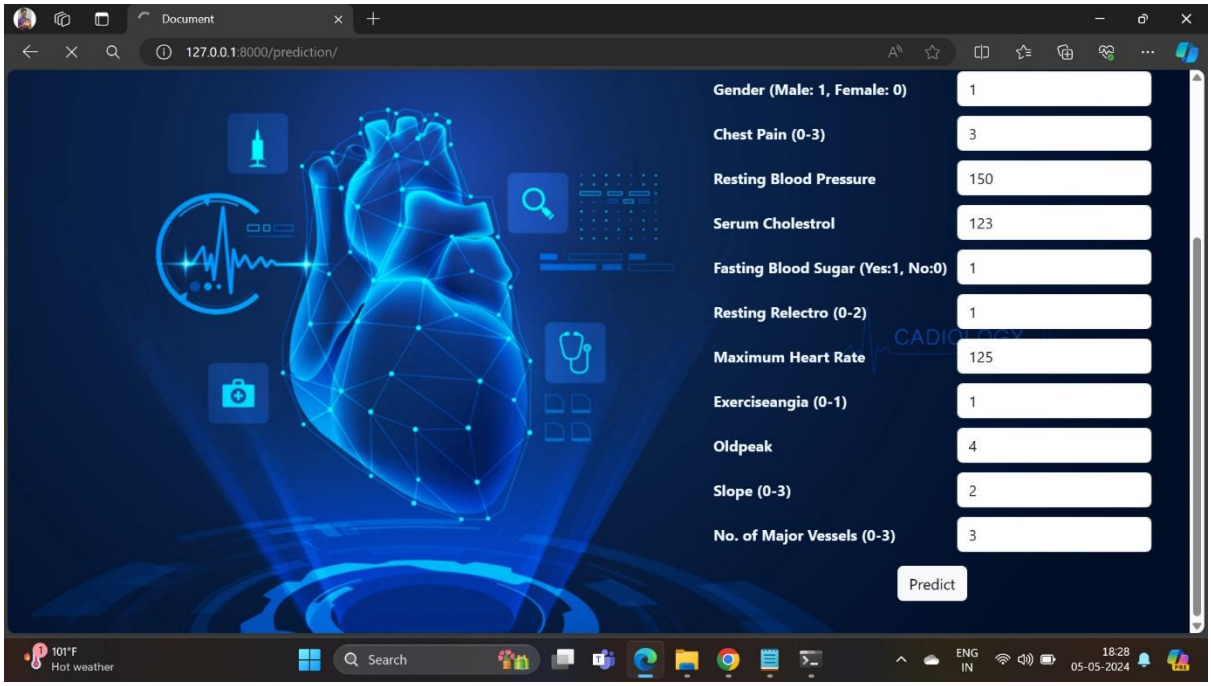
1.1.2 About Us:

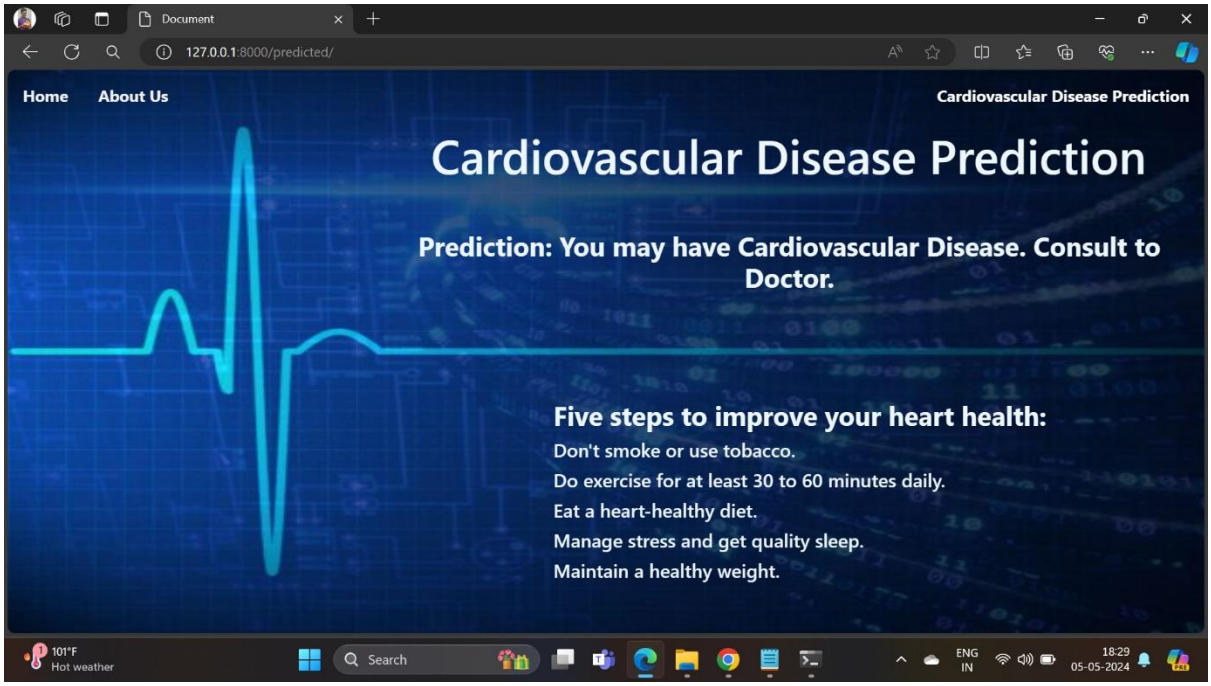

Document
127.0.0.1:8000/aboutus/
Home
About Us
Cardiovascular Disease Prediction
About Us
Predict Your Cardiovascular Health with Confidence
Greetings from Cardiovascular Disease Prediction System, your go-to resource for preventative heart health care. With the help of our state-of-the-art cardiovascular disease prediction tool, you can determine and comprehend your personal cardiovascular risk.
How it works
Just complete our short and easy risk assessment to get a thorough evaluation of your cardiovascular health. Our sophisticated algorithms examine lifestyle variables, medical history, and important health metrics to provide you precise forecasts and useful advice.
127.0.0.1:8000/aboutus/
101°F
Hot weather
Search
ENG
IN
18:27
05-05-2024


Document
127.0.0.1:8000/aboutus/
Why Choose Us
Early Detection: Identify potential risks before they escalate.
Easy to Use: Our intuitive platform ensures a seamless user experience.
Data Security: Your health data is treated with the utmost confidentiality and security.
Empower Your Heart Health Journey
At Cardiovascular Disease Prediction System, we believe in the power of early intervention and personalized care. Take control of your heart health, make informed decisions, and embark on your journey to a healthier, more vibrant life. Ready to assess your cardiovascular risk? Begin your journey with Cardiovascular Disease Prediction System today.
101°F
Hot weather
Search
ENG
IN
18:28
05-05-2024

1.1.3 Prediction Page:







1.2 ML Modelling

To meet our needs, this product necessitates the creation of machine learning models from scratch. It is less intimidating to modify existing models for our needs than to completely rewrite the code. A trained model can be constructed or repurposed. However, creating a model with the information and tools at our disposal is slow but doable. The client may wish to provide input data in the shortest possible time. Achieving this accuracy will need some work, as relying just on the Classic Machine Learning algorithm is not advisable.

In [1]:
```
# Importing the Libraries
import pandas as pd
from sklearn import model_selection
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.ensemble import RandomForestClassifier
```

In [2]:
```
# Importing Dataset
df = pd.read_csv('Cardiovascular_Disease_Dataset.csv')
```

In [3]:
```
# Extracting Independent and Dependent Variables
X = df.iloc[:,1:13]
print(X)
Y = df.iloc[:,13:14]
print(Y)
```

```
In [4]: # Splitting the dataset into Training and Testing Sets
        x_train,x_test,y_train,y_test = train_test_split(X, Y, test_size=0.2)

In [5]: # Feature Scaling
        sc = StandardScaler()
        x_train = sc.fit_transform(x_train)
        x_test = sc.fit_transform(x_test)

In [6]: # Spot Check Algorithms
        models = []
        models.append(('LR', LogisticRegression()))
        models.append(('KNN', KNeighborsClassifier()))
        models.append(('SVM', SVC()))
        models.append(('DT', DecisionTreeClassifier()))
        models.append(('NB', GaussianNB()))
        models.append(('RF', RandomForestClassifier()))

In [7]: # Evaluate each model in turn
        results = []
        names = []
        for name, model in models:
            kfold = model_selection.KFold(n_splits=10, shuffle=True, random_state=6)
            cv_results = model_selection.cross_val_score(model, x_train, y_train, cv=kfold, scoring='accuracy')
            results.append(cv_results)
            names.append(name)
            msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
            print(msg)
```

The Accuracy of the initial model is given below:

```
Linear Regression: 0.960000 (0.039843)
K-Nearest Neighbors: 0.936250 (0.036422)

Support Vector Machine: 0.961250 (0.027071)
Decision Tree: 0.955000 (0.028614)
Naive Bayes: 0.940000 (0.030516)
```

```
Random Forest: 0.976250 (0.024654)
```

1.3 Github link to the code implementation

Github link of Cardio Risk Meter Web Application along with Cardiovascular Disease Dataset is given below:

https://github.com/PrathamGaur108/CardioRiskMeter.git

Step 3: Business Modelling

1. Freemium Business Model

"Freemium" means "Free" and "Premium" service. It offers two types of services to the customers, 'free service' and 'paid service'. The free service users have limited access to the basic features whereas the premium services are unlocked when the person buys the paid service. The Freemium model should be adopted by companies when they are looking to grow their business and brand quickly. This model is preferred because everybody likes free stuff, and nobody wants to pay money for something they're not sure will work for them. So, the freemium model addresses that by providing such an enticing offer: giving users the ability to experience a new product without any risk.
For this service, it is beneficial to use Freemium Business Model, where it offers basic prediction and risk assessment services for free, while providing premium features, enhanced insights, or personalized health coaching as paid upgrades.

2. Benefits

2.1 Attracts a larger user base by offering essential functionalities at no cost, which can help drive traffic and user acquisition.

2.2 Allows users to experience the value of the website before committing to paid services, reducing barriers to entry and encouraging adoption.

2.3 Monetizes advanced features and services by offering them as premium upgrades, generating revenue from users who seek additional value.

3. Implementation

3.1 Offer a free basic plan with limited features, such as basic risk assessments and general health recommendations.

3.2 Provide premium subscription options with advanced analytics, personalized risk assessments, health coaching sessions, and other exclusive benefits.

3.3 Use targeted marketing and user segmentation strategies to promote premium upgrades to users who demonstrate higher engagement and interest in advanced features.

Step 4: Financial Modelling (equation) with Machine Learning & Data Analysis

1. Identification of Market in which Cardio Risk Meter Website will be launched

Launching a Cardio Risk Meter Website involves identifying markets where there is a significant need for preventive healthcare solutions, a growing interest in health management, and a willingness to adopt digital health technologies. Potential market where a Cardio Risk Meter Website could be launched is Global Market.

Cardiovascular diseases are a leading cause of mortality worldwide, affecting populations across different regions and countries. Therefore, targeting global markets with culturally sensitive and region-specific cardiovascular disease prediction tools can address the diverse healthcare needs of individuals and populations worldwide.

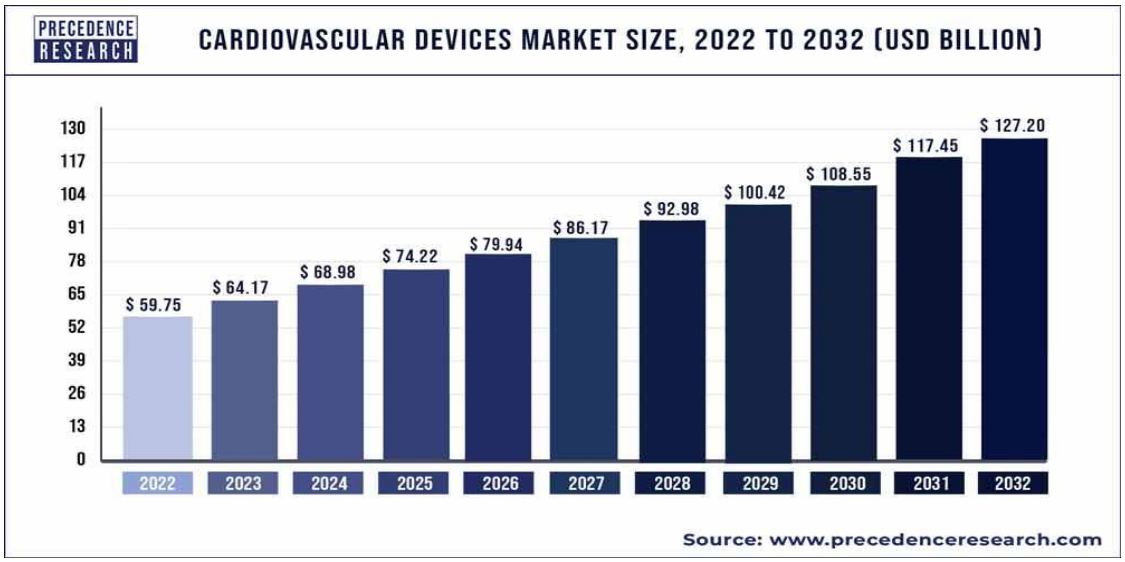
By identifying and targeting these markets, a Cardio Risk Meter Website can effectively address the needs of individuals, healthcare providers, employers, and other stakeholders, ultimately contributing to improved cardiovascular health outcomes and reduced disease burden worldwide.

2. Data / statistics regarding the Market

There are broader trends and statistics related to cardiovascular disease (CVD) and digital health technologies that provide insights into the potential market for such websites.

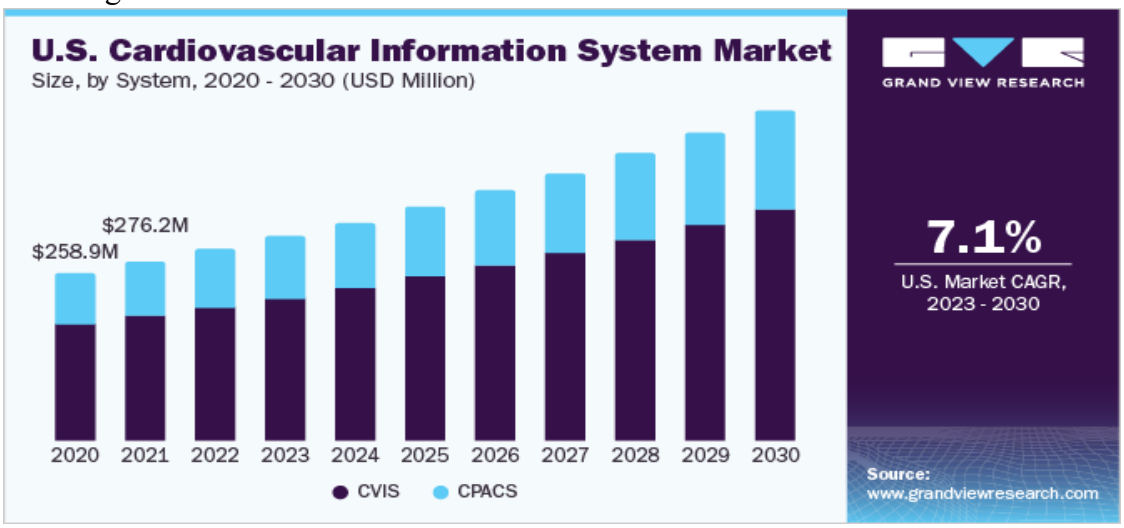
There has been significant investment and interest in health technology startups and digital health solutions aimed at improving healthcare delivery, patient engagement, and health outcomes.

Investors are increasingly focused on technologies that address unmet needs in healthcare, including predictive analytics, remote monitoring, and personalized medicine.



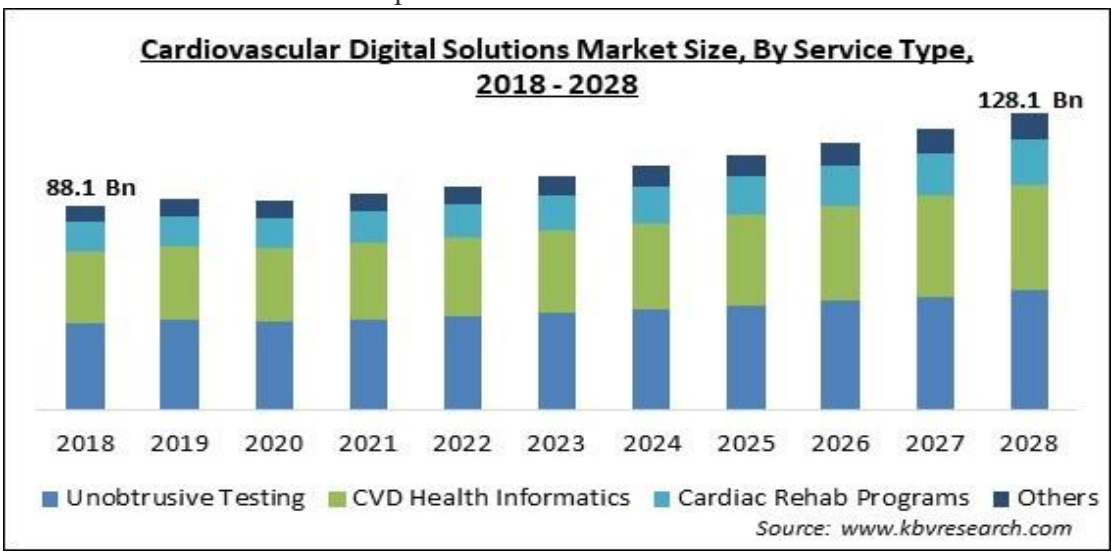
The market potential for cardiovascular disease prediction tools and risk assessment solutions is significant, given the high prevalence and economic burden of CVDs.

There is growing demand for tools that can accurately assess cardiovascular risk, provide personalized health insights, and empower individuals to take proactive steps to manage their cardiovascular health.

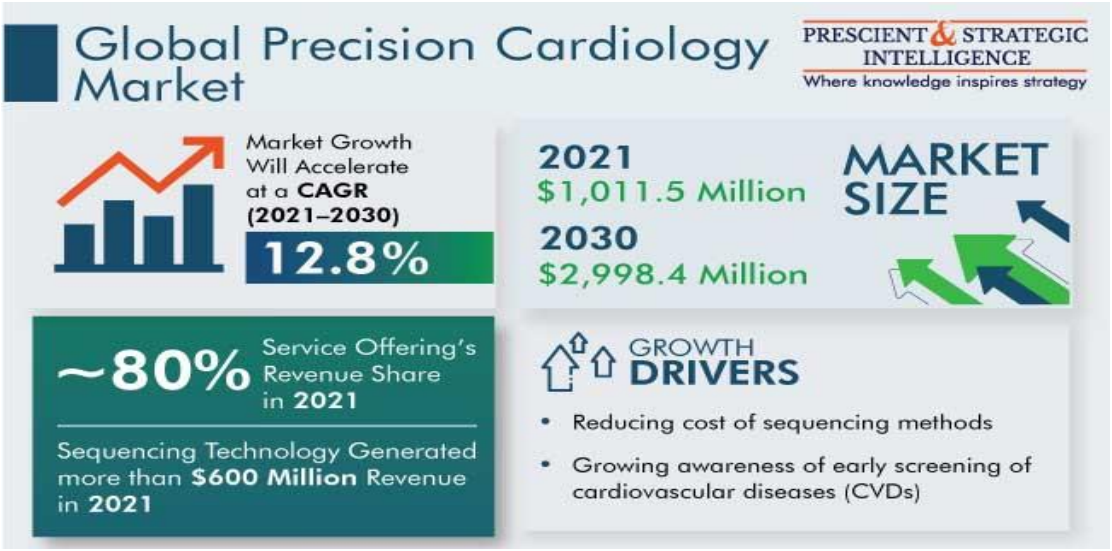


3. Forecasts / predictions on the Market

The Cardiovascular disease market will see as many as 25 launch events take place by 2023. The impact of these new launches will expand the market by approximately $5.8 billion in 2028. However, due to the impending LoP of some key drugs and the consequent entry of low-priced generics, there will be a net reduction in the global market of over $21.4 billion in sales, by 2028. IQVIA's Forecast Link predicts that at least 137 LoP events will take place between 2019-2028.



According to Future Market Insights research, during the projected period, the global cardiovascular disease prediction market is expected to grow at a CAGR of 5.1%. The market value is projected to increase from US$ 5.9 Billion in 2023 to US$ 9.7 Billion by 2033. The cardiovascular diagnostics market was valued at US$ 5.6 Billion at the end of 2022 and is anticipated to exhibit Y-o-Y growth of 4.3% in 2023.



AI and machine learning are increasingly being used for the analysis of cardiovascular imaging data. These technologies can aid in the early detection of heart diseases and provide more accurate diagnoses.

4. Financial Equation

To design a financial equation for the global market of Cardio Risk Meter website involves considering various factors such as market size, revenue growth, competition, and adoption rates. Here's a simplified financial equation:

Equation:

$$y = m * x(t) - c$$

i.e.,

Profit = Average Revenue per User * Market Size per Year – (Production Cost + Maintenance Cost)

Where:

'y' indicates the profit obtained after deducting production and maintenance costs from the revenue.

'm' indicates the average revenue generated per user by the website, which may include subscription fees, consultation charges, advertising revenue, etc.

'x(t)' denotes the total addressable market for websites, representing the potential number of users or customers globally as a function of time or years denoted by 't'.

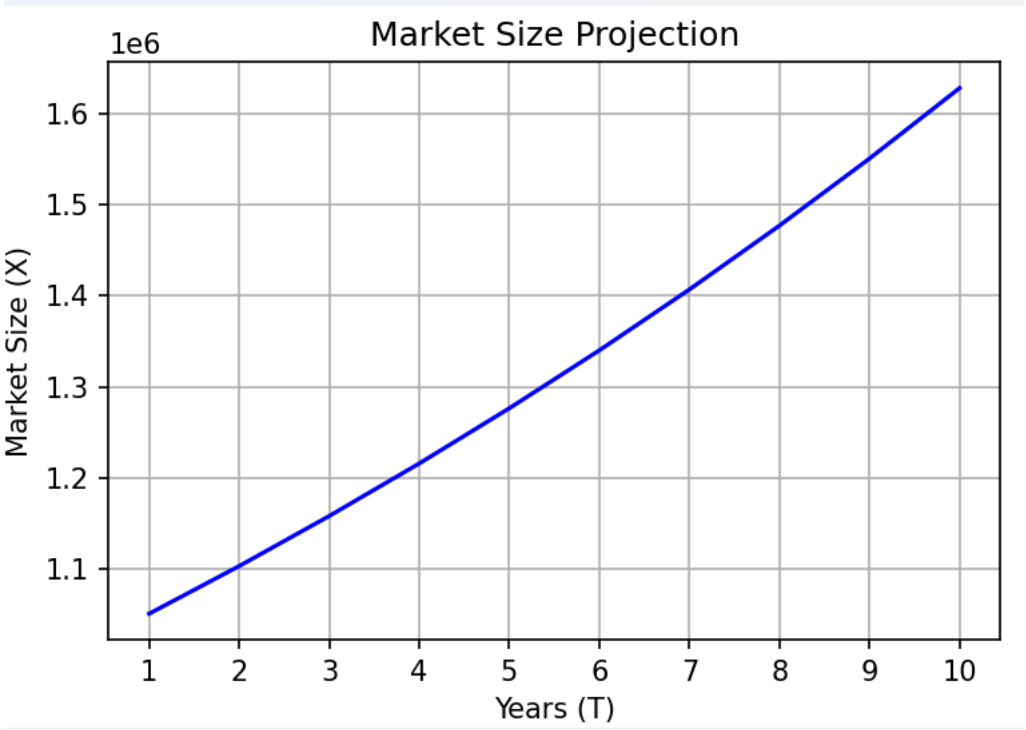
'c' indicates the sum of Production cost and Maintenance cost of product:

Production Cost - This represents the total cost incurred in producing the product or providing the service (team hiring cost, server/software cost, office/fibre cost, etc.).

Maintenance Cost - This refers to the ongoing expenses associated with maintaining and operating the product or service.

Graph:

The following graph visualizes the projected profit for the website over a period of 5 years. It assumes linear growth based on the financial equation provided. Actual revenue projections may vary based on market conditions and other factors.



Example:
To illustrate the financial equation, let's assume the following hypothetical values:
Market Size: 1,00,000 users
Average Revenue per User: $ 50 per year
Production Cost: $ 10,000
Maintenance Cost: $ 5,000 per year
Using these values, we can calculate the profit for each year:
Profit = 50 * 1,00,000 – (10,000 + 5,000) = $ 49,85,000

Conclusion

In conclusion, the development of the Cardio Risk Meter Website represents a significant stride towards proactive healthcare management. Through the integration of advanced machine learning algorithms, personalized risk assessments, and targeted recommendations, the platform aims to empower individuals to take charge of their cardiovascular health. The analysis of user data and the application of predictive modelling have demonstrated the platform's ability to provide accurate and personalized risk assessments. The detailed breakdown of contributing factors and tailored recommendations offer users valuable insights into their cardiovascular health status and actionable steps towards prevention. Looking forward, the Cardio Risk Meter Website holds immense potential for further enhancements and collaborations. Future developments could include the integration of wearable devices for real-time health monitoring, expanded educational resources, and strategic partnerships with healthcare professionals and institutions. The success of this project lies not only in its technical

achievements but also in its potential to make a meaningful impact on public health. As the platform moves forward, user feedback, continuous improvement, and collaborations with healthcare stakeholders will remain integral to its success.