PROJECT PROPOSAL
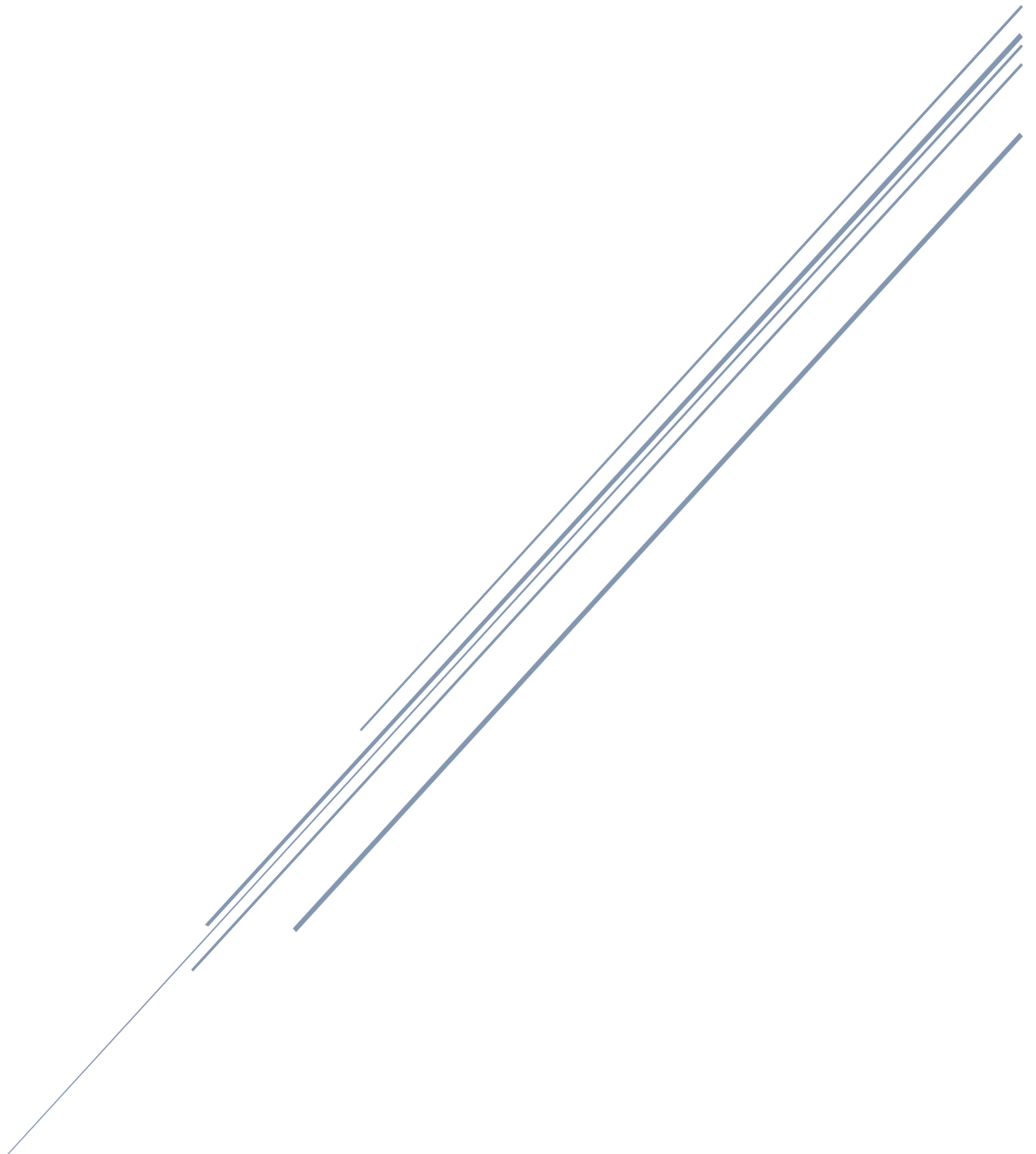
Wellnest Technology

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Table of Contents

1.   Identify the Problem

System Vision Document

1.1 Problem description

As a leading healthcare service provider, Wellnest Technology has always been committed to enhancing customer well-being. With a growing customer base, ensuring seamless health monitoring and management has become crucial. However, the company relies solely on social media to showcase its products, leading to insufficient data information and customer trust. Overcoming this obstacle and establishing strong customer acceptance is where LifeCare360 System comes into play. With its comprehensive health tracking and management features, LifeCare360 System empowers Wellnest Technology to offer personalized care plans, real-time health insights, and efficient communication channels between medical professionals and customers. This cutting-edge system not only enhances the care quality provided by the company but also reinforces the commitment to delivering optimal health outcomes for each service recipient.

1.2 System Capabilities

- A website that connects to medical institutions records all medical records, it can also be viewed by medical institutions in order to give advice
- A website allows customers to book appointments online within any medical institution.
- A website that can customize provided service.
- A digitalised accounts system manages personal data and includes language and culture customization.
- A system can store the information of customers and coach them to the database.
- A big data analysis system can analyse the data and generate reports based on it.
- A cybersecurity system to protect user privacy and data security.
- A lifetime management system creates a personalised timeline for each customer.
- A health management system that gives health monitoring reports, dietary advice and fitness plans.
- A LifeCare360 application displays the data analysis reports and gives personalized advice, including an emergency help function.

1.3 Expected Business Benefits

- Increasing overall company revenue: By offering paid membership plans and incorporating advertisements and sponsorships.
- Enhancing user satisfaction and loyalty: By providing a comprehensive life management solution, users can better meet their diverse needs, thus increasing overall user satisfaction, trust and loyalty.
- Gaining a competitive advantage: Developing LifeCare360 as an intelligent life management system can significantly enhance the company's competitive edge.
- Product optimization: Leveraging collected customer information to optimize Wellnest's product offerings.

- Boosting brand awareness and exposure: Promoting LifeCare360 can elevate Wellnest Technology's brand awareness, making it more recognizable and trusted.
- Expanding partnerships: Utilizing the platform of the new system to establish long-term collaborations with relevant industries, thus diversifying revenue sources.

2.   Quantify Project Approval Factors
2.2   Estimated Time for Project Completion

Times Estimation for LifeCare360			
Subsystem	**Functional Requirement**	**Iterations Required**	**Estimated Time**
Data Collection and Integration Subsystem	2	2	2 weeks
Big Data Analysis Subsystem	2	3	3 weeks
Health Monitoring and Tracking Subsystem	3	2	6 weeks
Time Management and Itinerary Planning Subsystem	2	2	1 weeks
Security and Privacy Subsystem	1	1	3 weeks
Personalized account subsystem	2	1	2 weeks
Total			**17 weeks**

Table 2a – Estimated Project Completion Time

Data collection and integration subsystem: collect data from various sources, such as user devices like smartphones, and medical sensors. It ensures that the data is collected efficiently, securely, and in a standardized format. Then integrates this data into the LifeCare360 platform making it available for further processing and analysis.

Big Data Analysis Subsystem: processes and analyses the vast amount of data collected. This subsystem identifies patterns, trends, and valuable insights related to users' health conditions, lifestyle behaviours, and preferences.

Health Monitoring and Tracking subsystem: allows users to access their health data, such as blood pressure, blood sugar, weight, heart rate, sleep patterns,...It also supports integration with compatible medical devices to ensure accurate and real-time health monitoring.

Time Management and Itinerary Planning: manage personalized schedules and itineraries for users. By considering their work arrangements, meetings, social activities, and health-related appointments.

Security and privacy subsystem: ensure the protection and confidentiality of user data. It implements robust security measures to prevent unauthorized access, data breaches, and cyber threats

Personalized Account Subsystem: manages user accounts within the LifeCare360 platform. It allows users to create and customize their profiles, and set health goals, preferences, and privacy settings.

2.3 Development Cost of Project

SUMMARY OF DEVELOPMENT COST	
Expense category	**Amount**
Project Manager (1)	$27,696
Software Developers (2)	$42,364
Data Analysts (1)	$16,211
Software Licenses	$1025,425
Hosting services	$255
Facilities	$2337,5
Equipment	$7785
Total	**$97673,925**

Table 2b – Development Costs for the project

The Project Manager is responsible for overseeing the entire LifeCare360 project. They are crucial in planning, organising, and executing the project to ensure it is completed on time, within budget, and meets the specified objectives. The average annual salary of a project manager in Australia is $91,487, which is equivalent to around $ 40.73 per hour (payscale, 2023). The working arrangement would be 40 hours per week and 17 weeks in total:

$40.73*40*17 = $27,696

Software Developers are responsible for designing, coding, and testing the software components of the LifeCare360 system. The average annual salary of a software developer in Australia is $76,963, which is equivalent to around $ 31.15 per hour (payscale, 2023). The working arrangement would be 40 hours per week and 17 weeks in total:

$31.15*40*17 * 2= $42,364

Data Analysts: They use data analysis techniques to extract valuable insights and patterns that can be used to create personalised health plans and lifestyle recommendations for users. The average annual salary of a data analyst in Australia is $65,957, which is equivalent to around $ 23.84 per hour (payscale, 2023). The working arrangement would be 40 hours per week and 17 weeks in total:

$23.84*40*17 = $16,211

Software Licenses needed for project development, including Microsoft Office 365, MySQL, Power BI. The duration is for 4.25 months:

$4.6 * 4,25+ $889 + $27.50*4,25 = $1025,425

Hosting service for project development is Amazon Web Services (Amazon, 2023) which offers scalable and flexible solutions that can be suitable for healthcare platforms:

$60 * 4,25 = $255

Renting an Office as a facility for working purpose for all project staffs, the average office rent is $550 per month (Serviced Offices Brisbane, 2023):

$550 * 4,25 = $2337,5

Equipment for the project team members, including 5 laptops, 5 extra monitors, and 5 sets of keyboard and mouse:

$1349*5 + $149*5 + $5*59 = $7785 (Jbhifi, 2023)

2. 4 Estimated Annual Operating Costs of Project

Summary of Estimated Annual Operating Costs	
Recurring Expense	**Amount (AUD)**
Hosting Costs	$255
Development and Maintenace Costs	$6600
Customer Support Costs	$53,360
Software Licenses and Tools	$1025,425
Data Security and Compliance	$1188
Marketing and Advertising Costs	$10,000
Total	**$72,428.425**

Table 2c – Estimated Annual Operating Costs

Amazon Web Services Hosting cost, annual cost:

$60*4.25 = $255(Amazon Web Services, 2023)

Development and Maintenace Costs :

$550*12 = $6600 (Serviced Offices Brisbane, 2023)

Data Security and Compliance:

$99*12 = $1188 (Itoc, 2023)

Software Licenses and Tools costs:

$1025,425

Customer Support Costs will support and address customers' issues. The annual salary is:

$53,360 (payscale, 2023)

2.5 Cost/Benefit Analysis

2.5.1 Tangible and Intangible Benefits

Tangible Benefits

- **Cost Savings:** Lifecare360 system can save costs by streamlining healthcare processes, reducing paperwork, and optimizing resource utilization

- **Increased revenue from the subscription model**: by adopting a subscription-based pricing model, Wellnest can generate recurring revenue streams from customers who subscribe to the platform's services.

- **Increased revenue from existing products**: improvements in brand recognition leading to the subsequent increase in the visibility and sales of the company's existing products.

- **Attracting increased investment**: can provide the company with the necessary funds for research and development, marketing efforts, and scaling the platform to reach more customers, further enhancing revenue potential and market share.

- **Reduced marketing costs**: Satisfied users are likely to recommend the system to others, potentially reducing the need for extensive marketing efforts.

Intangible Benefits

- **Product optimization:** Leveraging collected customer information to optimize Wellnest's product offerings.

- **Positive user experience**: The user-friendly interface and personalized features can create a positive user experience, fostering a sense of trust and loyalty towards the system and the company behind it.

- **Brand reputation and trust**: Successfully implementing the LifeCare360 system can enhance the company's brand reputation and position Wellnest as a trusted and innovative med-tech provider.

- **Competitive advantage**: Being an early adopter of cutting-edge technology and offering comprehensive healthcare and lifestyle solutions can provide Wellnest with a competitive edge in the med-tech market.

- **Social impact**: The system's focus on proactive health management can contribute to a positive social impact by promoting healthier lifestyles and reducing healthcare burdens.

- **Employee satisfaction**: If Wellnest is successful in implementing and marketing the LifeCare360 system, it can lead to higher employee satisfaction as they see the positive impact of their work on people's lives.

2.5.2 Estimated Annual Benefits

Estimated Annual Benefits	
Benefit/ cost saving	**Amount (AUD)**
Increased Revenue from Subscription Mode and existing products	$50,000
Collaborated with equipment companies and hospitals	$30,000
Reduced Advertising and Marketing cost	$5,000
Total	**$85,000**

Table 2d – Estimated Annual Benefits

After the implementation of a new system, the LifeCare360 system has the potential to attract a larger user base over time. As more users adopt the system and pay for its services, the revenue generated from existing products, subscriptions, premium features, or additional services will increase. Expecting the number of users to increase by **20%** each year, the estimated annual revenue growth could be **AUD 50,000.**

Collaborating with well-known equipment companies (e.g., Apple, Samsung, Huawei) can provide several benefits as leading to revenue-sharing or licensing agreements, generating additional income for Wellnest. The estimated annual benefit from such partnerships could be **AUD 30,000.**

As the LifeCare360 system gains popularity and positive word-of-mouth spreads, the need for extensive advertising and marketing campaigns may decrease. Reduced marketing expenses can lead to cost savings of **10%** annually, the estimated annual savings could be **AUD 5,000.**

3. Risk and Feasibility Analysis
3.1 Organisational Risk & Feasibility

3.1.1 Concerns about uncertainty in the development of the new system

There may be uncertainties and concerns within the organization regarding the development of the new system. To alleviate these concerns, it is essential to ensure that employees have a clear

understanding of the project's planning, objectives, and potential benefits. Effective and transparent communication should be provided to help employees comprehend the importance of the project and its potential advantages. Additionally, hiring experienced individuals with relevant project expertise can offer guidance and support, enhancing the feasibility and success prospects of the project.

3.1.2 Concerns about the security of the new system

Management may be worried about the reliability and security of the new system. As the system will gather a large amount of personal and sensitive information, responsible management is concerned about ensuring the security of this data. Data breaches could impact the company's reputation and lead to a crisis of trust. To address this concern, company management should prioritize data security and privacy protection and establish strict security measures and policies.

3.1.3 Resistance to the adoption of new system

Employees' unfamiliarity or resistance to new technology may arise. To mitigate this resistance, the company should encourage employees to voice their questions and feedback and promptly address any difficulties encountered in using the technology. This will enhance employees' acceptance and efficiency in using the new system.

3.1.4 Insufficient funding

The company may face risks of inadequate funding, as the development and operation of the new system require significant investment. To ensure the feasibility of the project, detailed financial planning should be established, and avenues for financing or exploring partnership arrangements should be pursued.

3.2 Technological Risks and Feasibility

3.2.1 The complexity of technical architecture

Integrating health management, time management, and other functionalities in LifeCare360 requires establishing a complex technological architecture to ensure seamless integration and interaction among different modules. To effectively mitigate technological risks, the company needs meticulous planning of the system architecture, ensuring smooth interaction and data sharing among modules. Adopting suitable technological standards and communication protocols ensures system scalability and flexibility to accommodate future expansion and upgrades.

3.2.2 Device Compatibility

LifeCare360 will run on various devices, such as smartphones, tablets, smartwatches, and computers. To ensure compatibility and stability, extensive device testing and optimization are necessary to guarantee smooth operation and provide an excellent user experience across different devices. Employing responsive design and device adaptation techniques ensures that the system displays and functions seamlessly on diverse devices.

3.2.3 Big Data Management and Analysis

LifeCare360 will collect a substantial amount of user data for health management and time management functionalities. To address this challenge, the company needs to establish efficient big data management and analysis capabilities. Implementing advanced data storage and processing technologies ensures data security and integrity. Additionally, using data analysis tools and algorithms provides accurate and real-time data insights, offering personalized health and time management recommendations to users.

3.2.4 System Performance and Backend Stability

LifeCare360 demands high system performance and backend stability to handle simultaneous user access, and data processing efficiently and avoid system crash. To ensure system performance, the company needs to optimize system code and database queries to guarantee responsive and stable system behaviour. Moreover, establishing robust backend support and monitoring mechanisms enables timely identification and resolution of potential performance issues, ensuring the system's stable operation.

3.2.5 Frequent Technology Updates and Upgrades

As technology continually evolves, LifeCare360 must keep pace with frequent updates and upgrades to remain competitive and meet user expectations. The company should closely monitor technology trends, assess the applicability and advantages of new technologies, and promptly undertake system updates and upgrades to maintain the system's security, performance, and continuous functional improvements. Simultaneously, providing training and technical support to employees ensures their proficiency in using new technologies and tools.

3.3 Resource Risk & Feasibility

3.3.1 Incorrect cost estimation

May lead to an increase in project expenses. To mitigate the risk of cost estimation errors, the company can hire experienced personnel with expertise in project development and management. They can accurately assess the required resources and costs for the project. Additionally, ensuring that the project manager and team members fully understand the proposed system and project expectations will help in creating detailed project plans and budgets to avoid exceeding the allocated budget.

3.3.2 Lack of resources for maintaining the new system

To address this issue, the company can provide training and guidance to employees, equipping them with the necessary skills and knowledge for maintaining the new system. Investing in employee training and skill development will ensure that the new system receives proper maintenance and support after its implementation.

3.3.3 Inadequate office resources and environment for the new team

Before commencing the project, the company should carefully evaluate the existing office resources and environment to ensure that they are suitable for the needs of the new team. If required, necessary adjustments and improvements should be made to provide the new team with a conducive workspace, promoting teamwork and efficient project execution.

3.3.4 Availability and reliability of hardware and software

Ensuring the availability and reliability of the required hardware and software is crucial for the project. Adequate preparation should be done before the project commences, ensuring that employees have access to the necessary hardware and software resources. Additional resources should be provided to employees as per the budget, to meet the project's technical requirements. Regular data backups and system checks should be carried out to ensure effective preservation and protection of the project's progress.

3.4 Schedule Risk & Feasibility

3.4.1 Project Changes
During the project execution, there might be new requirements or changes that could impact the system's scope or functionality, thus affecting the project timeline. To mitigate this risk, the project team needs to establish an effective change management mechanism. This includes timely communication and assessment of new requirements' impact, involving relevant stakeholders in decision-making. The project manager should ensure that change priorities and effects are appropriately evaluated and collaborate with the team to adjust the project plan and schedule accordingly.

3.4.2 Inaccurate Specification Estimation
Insufficient initial information may lead to complexity in system specifications and solutions, resulting in inaccurate estimation of project specifications or task assignments. To alleviate this risk, the project team should conduct detailed system requirements analysis and planning, closely collaborating with business analysts and technical experts to ensure a comprehensive understanding of the system's functionalities and technical requirements. Additionally, the project manager should review specification estimations with the team members to ensure accurate and feasible time and resource allocation for each task.

3.4.3 Inaccurate Time Estimation
The time estimation given for the project may not be precise, leading to project delays or exceeding expected timelines. To mitigate this risk, the project team needs to engage in thorough discussions and evaluations during the project planning phase. The project manager, together with team members, should assess the complexity and workload of tasks, consider potential risks and challenges, and develop reasonable time estimations. Moreover, establishing effective progress monitoring mechanisms will aid in detecting and resolving potential time delays promptly.

3.4.4 Inadequate Project Planning by the Project Manager
The project manager might face the risk of inadequate planning, leading to improper project execution and coordination issues within the team. To address this concern, the company should hire experienced project managers, collaborating with business analysts and technical experts to perform comprehensive project planning and evaluation. The project manager needs to establish a clear project plan, define task priorities and assignments, ensuring team members understand their roles and responsibilities. Regular communication and coordination with the team will help address potential issues and ensure the project proceeds smoothly as planned.

4. Establish the Project Environment
4.1 Captured Information/ Project Tools and Software

The successful execution of this project relies upon a diverse array of tools and software meticulously selected to effectively manage and capture the multifaceted realm of digital information. A comprehensive overview of these vital resources is delineated in Table 4.a, demonstrating the strategic integration of technology to facilitate seamless project operations.These tools collectively

underscore the project's commitment to holistic data management and integration, resulting in a cohesive and informed approach to decision-making and project execution.

Electronic Digital Repositories		
Information Captured	**Electronic Tools**	**User Access**
Task Progress	Trello, Microsoft Project	Project Manager (edit), Developers (view)
User data records	MySQL, MongoDB	Data analyst (edit)
User Behavior	Google Analytics	Data analysts (edit), Project Manager (view)
User inquiries	Amazon Web Service	Customer support (edit), User (edit)
Health indicators report	Microsoft Excel	User, Data Analysts
Financial Data	Microsoft Excel, Google Drive	Project manager (Edit), Data analysts (Edit)
Location Data	Google Map	Data analysts (Edit)
Emergency contact information	Emergency Help Function	,Developers (Edit), Data analyst (view)
Program code	Visual Studio Code	Developers (edit)
Team Coordination meetings	Teams, Outlook	All team members view and update
Progress Tracking	GanttProject	All team members view and update
Source code	Git	Developers (view, edit)
Progress Schedule	Trello, GanttProject	All team members view and update

Project files	Google Drive	All team members view and update

Table 4a – Information Captured

4.2 Project Work Environment

The project work environment is a crucial factor in project management and production. Ensuring sufficient resources, appropriate equipment, tools, workspace, and support will contribute to the development and success of the project.

i. Hardware
- A Laptop with high specifications for each employee, preferably with at least an M1 chip, 7-core GPU, 256GB SSD. High-performance laptops ensure that team members can efficiently handle complex tasks and run resource-intensive software (Apple MacBook Air 13-inch with M1 chip, 7-core GPU, 256GB SSD [2020]).

- Monitors: Each employee should be equipped with a suitable monitor to enhance productivity and provide a comfortable working environment.(Blaupunkt 24" Full HD Monitor)

- Sets of Keyboards and mouse for managers, developers, and data analysts.(Dell KM5221W Pro Wireless Keyboard and Mouse)

- Server and cloud infrastructure to handle data storage and processing.

- Advanced network equipment to ensure seamless communication between devices and servers.

ii. Software
- Communicating by using Microsoft Teams, and Outlook

- Scheduling project timelines by using Microsoft Project and Trello

- Handling documents and reports by using Microsoft Word, power point, Google Drive and Power BI

- Using Visual Studio Code for coding and development iterations.

- Source code, version control, collaboration and development iterations are managed by git and Githu

- Analysing data and manipulation for project-related data by using Excel

iii. Physical Environment
- Spacious leased offices to ensure each employee has enough space.

- The office will provide scanning and printing equipment for the team to use during the project.

- The project team will use meeting rooms for discussions, planning, and progress reviews

- The meeting rooms will be equipped with whiteboards, projectors, and screens.

- Necessary facilities such as a kitchen and restrooms will be provided.

- A rest area will be available for employees to relax and take breaks, including comfortable seating and other amenities.

- Fitness facilities will be provided to promote employee health and well-being and enhance comfort.

iv. Support Staff
● Office Management: Staff to ensure the rented office space is fully equipped with the appropriate equipment and stationery to support the project's needs.

● Technical Support: Staff that provides technical assistance to the project team, resolving any issues related to hardware, software, or network connectivity.

● Electrical Support: Enlist a technician to assist with office-related electrical problems and ensure a safe and efficient working environment in the rented office.

4.3 Project Process and Procedures

i. Reporting and Documentation
● The Project Manager will be responsible for documenting and storing information from client meetings and team meetings, using Microsoft Word for documentation and storage, and Microsoft PowerPoint for presentations and speeches.

● All meetings will be conducted via Microsoft Teams to ensure timely and effective communication.

● Team meeting records will be created and stored in Google Drive for formal document compilation by the Project Manager.

● The project proposal will be prepared and written by the Project Manager using Microsoft Word, ensuring clarity and precision in project objectives and plans.

● The project schedule will be developed by the Project Manager using Microsoft Project, ensuring proper time allocation and smooth execution of project tasks.

● Project team members will use Microsoft Word and Excel to write project progress reports and related financial accounts, ensuring tracking and documentation of project progress.

● Test reports will be written by the developers and reviewed by the Project Manager using Microsoft Word.

● Risk matrix analysis will be prepared and managed by the Project Manager using Microsoft Excel, identifying and addressing potential project risks.

● All documents and files will be stored in Google Drive and Teams for easy access and collaboration.

ii. Programming
● The Project Manager will be responsible for assigning programming tasks to 2 developers, based on the complexity and technical requirements of the project.

● The developers will determine the approach and integration of the tasks based on their nature and technical requirements, ensuring efficient completion of the tasks.

● The development of databases like MySQL will be handled by a specialized developer dedicated to database management, while the development of website interfaces will be led by a developer with expertise in website construction.

- The big data analysis system will have a Systems Analyst as the primary lead, responsible for its development and implementation.

- The remaining subsystems will be collaboratively developed by the team in a joint programming effort

iii. Testing
- Developers will be responsible for conducting system testing after each iteration to ensure code quality and functional integrity.

- All items scheduled for testing will be marked as 'Ready for Testing' in a centralized Excel document and formally communicated through team meetings and email.

- The Project Manager and developers will review the test results together and make necessary adjustments and improvements to ensure project feasibility and product quality.

- For specific subsystems such as account management, forms, medical information, and heart rate detection, user testing will be provided to ensure user experience and functionality completeness.

- After testing all subsystems, developers will perform a final test for the entire system.

- All test results and issues will be documented in the team's Excel document, facilitating tracking and resolution by the team.

iv. Deliverables
- Our project delivers the complete LifeCare360 system, which includes all the subsystems and functional modules listed in 2a, along with relevant project documentation.

- All deliverables will be confirmed and prepared for handover to the client by the Project Manager after testing and review.

- Once approved by the Project Manager, the deliverables will be ready to be submitted for client approval.

- After client approval, the deliverables will be handed over to the client.

- A comprehensive system demonstration will be conducted for the client to ensure they have sufficient understanding and are able to use the system clearly.

v. Code & Version Control
- As developers will collaborate on the coding tasks during the project, version control tools ()such as Git) will be used to manage the code and ensure code coordination and version consistency.

- The use of Git and GitHub will help the team track code modifications and history more effectively, facilitating debugging and bug fixing when issues arise.

5. Schedule the Work
5.1 Project Work Breakdown Structure (WBS)

The table below presents the second iteration of the work breakdown structure for the Health Monitoring and Tracking Subsystem. This iteration encompasses various components of each core process, including project planning, analysis, design, and testing tasks.

Throughout the project planning phase, the involvement of the Project Manager and Data Analyst will be paramount. As we move into subsequent tasks, a coordinated effort between two Software Developers and Data Analysts will be integral, contributing their expertise to different facets of the subsystem's development.

Totalling 266 hours, this iteration is a comprehensive endeavour. While some tasks are dependent on predecessors, a significant number can be executed concurrently. Additionally, collaborative efforts between the Software Developers and Data Analysts will optimize efficiency and reduce the overall time required for completion.

Work Breakdown Structure Health Monitoring and Tracking Subsystem - 2nd iteration				
Task ID	**Task Description**	**Duration**	**Predecessor**	**Resources**
Project Planning				
1	Preliminary Meeting with stakeholders	2 hours	0	1 person
2	Project team meeting for defining general scope	1 hour	0	4 people
3	Develop plan and schedule	2 hours	1,2	4 people
4	Create Work Breakdown Structure	1 hour	3	1 person
5	Review and finalize project plan	1 hour	4	4 people
Analysis Tasks				
6	Gather requirements for health monitoring and	5 hours	5	1 person

	tracking subsystem			
7	Analyze existing data, requirements and resources	3 hours	6	1 person
8	Identify strategy of collaboration with medical experts	3 hours	7	1 person
9	Identify necessary sensors wearable devices, or data inputs	2 hours	7,8	1 person
10	Analyze potential risks and mitigation for the subsystem	3 hours	9	1 person
11	Create a detailed subsystem requirements documents	3 hours	8,9,10	2 people
Design Tasks				
12	Design subsystem hierarchical structure	2 hours	11	3 people
13	Design integration with wearable health devices and sensors	2 hours	12	2 people
14	Create data schema for health metrics	2 hours	12	2 people
15	Design notification and alert mechanisms for health-related updates	3 hours	12	2 people
16	Design user interface for health data entry	3 hours	14	2 people
17	Design algorithms for health data analysis and trend prediction	6 hours	14	2 people
18	Design website layouts and structure	2 hours	17	1 person
19	Design health tracking advice modules	5 hours	18	2 people
20	Project team meeting to review designs	3 hours	19	4 people
21	Client meeting for design presentation and	2 hours	20	1 person

	confirmation				

Build Tasks					
22	Build notification and alert functions for health-related updates	3 hours	15	3 people
23	Integration of user interface	6 hours	16	2 people
24	Build health data analysis and trend prediction	5 hours	17	3 people
25	Develop health tracking advice modules	5 hours	19	2 people
26	Implement integration with wearable health devices and sensors	6 hours	25	2 people
27	Develop collaboration with medical experts	3 hours	26	2 people
28	Modify all functions and generate report documents	4 hours	27	3 people

Test Tasks					
29	Conduct unit testing for individual components	4 hours	28	2 people
30	Perform integration testing to ensure different modules work together seamlessly	2 hours	29	2 people
31	Perform user acceptance testing	2 hours	29	1 person
32	Perform health trend analysis tests	2 hours	29	2 people
33	Verify data accuracy and reporting functionalities	2 hours	32	2 people
34	Test notification and alert mechanisms for accuracy and effectiveness	2 hours	33	2 people
35	Generate final test reports	5 hours	34	1 person

5.2 Gantt Chart

The table and Gantt Chart presented below are generated based on the given Work Breakdown Structure, utilizing Microsoft Project. The Gantt chart illustrates 35 tasks that take 24,26 days, each with distinct IDs, task descriptions, durations, predecessors, and allocated resources. Among these tasks, five major categories are identified: project planning, analysis tasks, design tasks, build tasks, and test tasks.

In the initial phase of project planning, the client meetings will involve only the project manager. Following these meetings, the manager will formulate the project plan, create a schedule, and compile detailed information for presentation to the project team. This team will comprise Data Analysts and two Software Developers. According to the Gantt chart, the project planning stage is expected to require a maximum of 0,75 days.

Moving on to the subsequent stage, the tasks are conducted by the analyst and are estimated to take approximately 5,63 days. This phase necessitates close collaboration between Data Analysts and the two Software Developers, with the project manager also participating in discussions.

The subsequent stages encompass design and build tasks, which are projected to spa 7,25 days and 5,5 days respectively. In these stages, the Data Analysts and two Software Developers will operate under the supervision of the project manager to ensure timely task completion.

The final stage is centred around subsystem testing taking 5,13 days. While the primary responsibility for testing rests with the Data Analysts and two Software Developers, the project manager will also play a role in specific tasks. This stage will additionally involve a client follow-up approval meeting and a team retrospective on this project iteration.

This plan streamlines the critical tasks as outlined in the calendar section of the chart. The critical path is represented by the blue diagonal stripes on the bars. Furthermore, the Gantt chart provides a designated start and end date to approximate the completion time for this iteration. Any delay in these tasks will consequently impact the timeline of subsequent tasks.

ID	Task Name	Duration	Start	Finish	Predecessor
1	**Project Planning**	**0.75 days**	**Fri 11/08/23**	**Fri 11/08/23**	
2	Preliminary Meeting with stakeholders	2 hrs	Fri 11/08/23	Fri 11/08/23	
3	Project team meeting for defining general	1 hr	Fri 11/08/23	Fri 11/08/23	
4	Develop plan and schedule	2 hrs	Fri 11/08/23	Fri 11/08/23	2,3
5	Create Work Breakdown Structure	1 hr	Fri 11/08/23	Fri 11/08/23	4
6	Review and finalize project plan	1 hr	Fri 11/08/23	Fri 11/08/23	5
7	**Analysis Tasks**	**5.63 days**	**Fri 11/08/23**	**Mon 21/08/23**	
8	Gather requirements for health monitoring and tracking subsystem	5 hrs	Fri 11/08/23	Mon 14/08/23	6
9	Analyze existing data, requirements and resources	3 hrs	Tue 15/08/23	Tue 15/08/23	8
10	Identify strategy of collaboration with medical experts	3 hrs	Wed 16/08/23	Wed 16/08/23	9
11	Identify necessary sensors wearable devices, or data inputs	5 hrs	Thu 17/08/23	Thu 17/08/23	9,10
12	Analyze potential risks and mitigation for the subsystem	3 hrs	Fri 18/08/23	Fri 18/08/23	11
13	Create a detailed subsystem requirements documents	3 hrs	Mon 21/08/23	Mon 21/08/23	10,11,12
14	**Design Tasks**	**7.25 days**	**Mon 21/08/23**	**Wed 30/08/23**	
15	Design subsystem hierarchical structure	2 hrs	Tue 22/08/23	Tue 22/08/23	13
16	Design integration with wearable health devices and sensors	2 hrs	Wed 23/08/23	Wed 23/08/23	15
17	Create data schema for health metrics	2 hrs	Wed 23/08/23	Wed 23/08/23	15
18	Design notification and alert mechanisms for health-related updates	3 hrs	Mon 21/08/23	Mon 21/08/23	
19	Design user interface for health data ent	3 hrs	Thu 24/08/23	Thu 24/08/23	17
20	Design algorithms for health data analysis and trend prediction	6 hrs	Thu 24/08/23	Thu 24/08/23	17
21	Design website layouts and structure	2 hrs	Fri 25/08/23	Fri 25/08/23	20
22	Design health tracking advice modules	5 hrs	Mon 28/08/23	Mon 28/08/23	21
23	Project team meeting to review designs	3 hrs	Tue 29/08/23	Tue 29/08/23	22
24	Client meeting for design presentation and confirmation	2 hrs	Wed 30/08/23	Wed 30/08/23	23
25	**Build Tasks**	**5.5 days**	**Fri 25/08/23**	**Fri 1/09/23**	
26	Build notification and alert functions for health-related updates	3 hrs	Fri 25/08/23	Fri 25/08/23	18
27	Integration of user interface	6 hrs	Mon 28/08/23	Mon 28/08/23	19
28	Build health data analysis and trend pred	5 hrs	Mon 28/08/23	Mon 28/08/23	20
29	Develop health tracking advice modules	5 hrs	Tue 29/08/23	Tue 29/08/23	22
30	Implement integration with wearable health devices and sensors	6 hrs	Wed 30/08/23	Wed 30/08/23	29
31	Develop collaboration with medical expe	3 hrs	Thu 31/08/23	Thu 31/08/23	30
32	Modify all functions and generate report documents	4 hrs	Fri 1/09/23	Fri 1/09/23	31
33	**Test Tasks**	**5.13 days**	**Fri 1/09/23**	**Fri 8/09/23**	
34	Conduct unit testing for individual compo	4 hrs	Fri 1/09/23	Fri 1/09/23	32
35	Perform integration testing to ensure different modules work together	2 hrs	Mon 4/09/23	Mon 4/09/23	34
36	Perform user acceptance testing	2 hrs	Tue 5/09/23	Tue 5/09/23	34
37	Perform health trend analysis tests	2 hrs	Tue 5/09/23	Tue 5/09/23	34
38	Verify data accuracy and reporting func	2 hrs	Wed 6/09/23	Wed 6/09/23	37
39	Test notification and alert mechanisms for accuracy and effectiveness	2 hrs	Thu 7/09/23	Thu 7/09/23	38
40	Generate final test reports	5 hrs	Fri 8/09/23	Fri 8/09/23	39

Table 5b - Gantt Chart

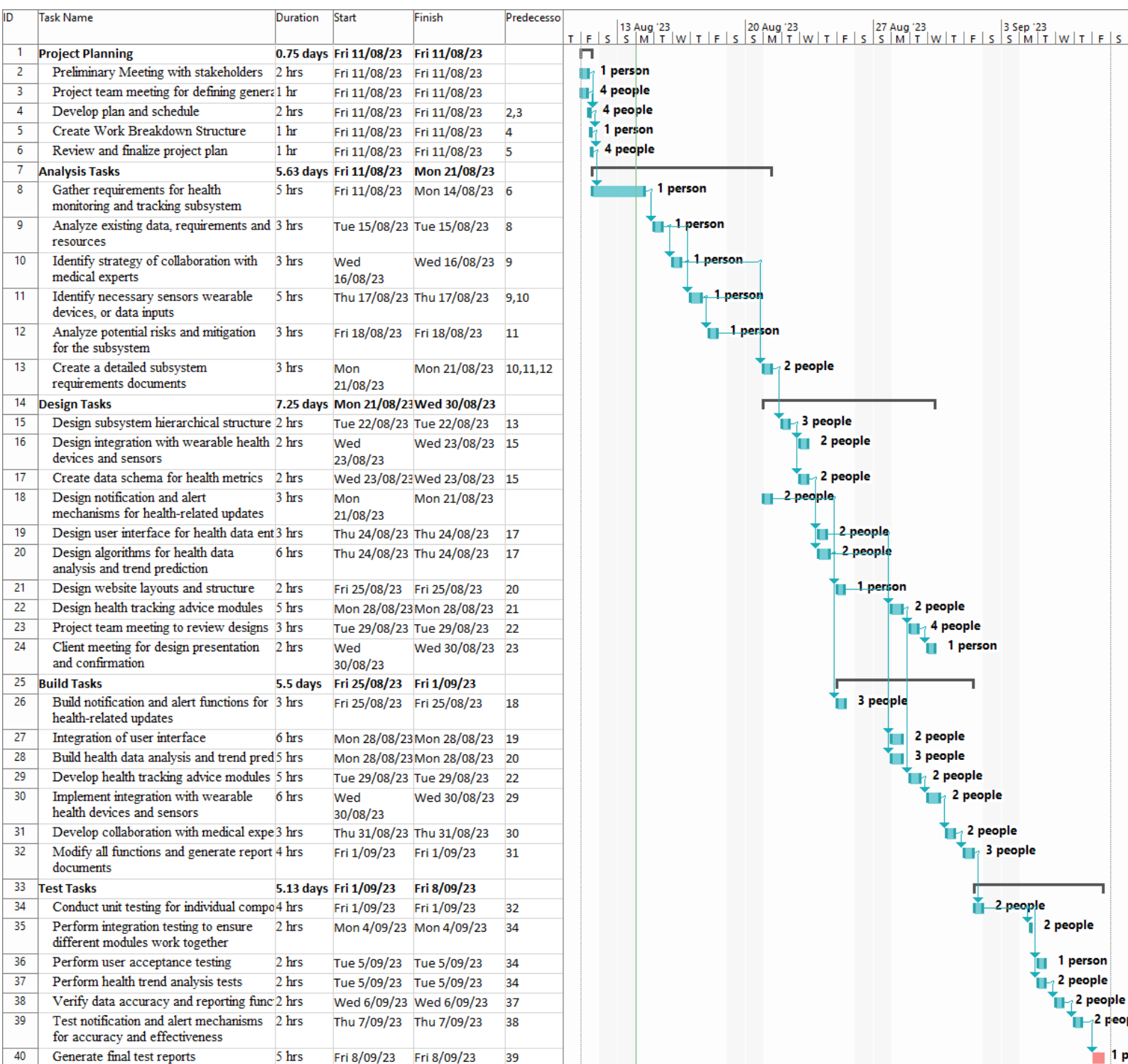Critical Path (Task ID refer to Table 5a):

Project team meeting for defining general scope (Task ID 2)

Design subsystem hierarchical structure (Task ID 12)

Build health data analysis and trend prediction (Task ID 24)

Perform user acceptance testing (Task ID 31)

Generate final test reports (Task ID 35)

Note: any of the tasks on critical path get delayed, the end date of this project will result in delay

6. Functional and Non-Functional Requirements (FURPS+)

When creating a system, it's crucial to establish both functional and non-functional requirements. Functional requirements involve what the system needs to do and are categorized into different subsystems. They describe the tasks the system should accomplish. On the other hand, non-functional requirements encompass various characteristics and attributes that the system should possess. These characteristics relate to the system's quality and performance.

In the LifeCare360 project, a detailed set of functional and non-functional requirements has been outlined. These requirements play a vital role in ensuring the effective development and deployment of the health management system. They cover a wide range of aspects, including the system's capabilities, how well it performs, how easy it is to use, and the technical aspects that support its operation.

6.1 Functional Requirements

The functional requirements outline the specific functionalities that the LifeCare360 system must deliver to its users. These requirements span across different subsystems, including Data Collection and Integration, Big Data Analysis, Health Monitoring and Tracking, Personalized Account, and Time Management and Itinerary Planning. Among these requirements are the ability to provide real-time health insights, personalized care plans, seamless integration of health data, efficient appointment scheduling, and more. Each requirement is meticulously designed to cater to the diverse needs of users and enhance their health management experience.

Functional Requirements		
Subsystem	**Functions**	**Description**
Data Collection and Integration Subsystem	Collect User Health Data	When a user grants access to health data, the system should collect health-related data from users' devices and sensors.
	Third-party Data Sharing	When a user grants access to health data, the system should allow users to have the option to share their health data with authorized third-party applications.
	Data Validation and Cleaning	When collected data from user, the system should validate and clean collected data to ensure accuracy and consistency.
	Real-time Data Synchronization	When health-devices are connected, the system should provide real-time syncing of user health data across devices.
	Historical Data Storage	When health-devices are connected, the system should provide real-time syncing of user health data across devices.

	Health Data Export	When user requests data export, users should be able to export their health data in a standard format.
	Manage Data Permissions	When ser accesses data permission settings, the system should allow user to have control over who can access their health data.
	Integration with Wearable Devices	When the wearable device is paired with the system, the system should integrate with the wearable health devices.
	Error Handling for Data Collection	When data collection is ongoing, the system should able to handle errors or failures during data collection
Big Data Analysis Subsystem	Data Aggregation	When data is collected, the system should able to aggregate data from various sources
	Data Visualization	When analysing the data, the system should provide tools for visualizing data trends.
	Data Exploration	When analyzing the data, the system should provide tools for exploring data trends.
	Anomaly Detection	When analysing the data, the system should be able to identify the anomalies within the collected data.
	Predictive Modelling	When cleaned data is available, the system should able to develop predictive models based on health data.
	Trend Analysis	When cleaned data is available, The system should able to analyse trends in health data over time.
	Health Risk Assessment production	When cleaned data is available, the system should assess users' health risks based on their health data.
	Demographic Analysis	When cleaned data is available, the system should able to analyse health data based on demographic factors.
	Comparative Analysis	When cleaned data is available, the system should enable users to compare their health data with others.
	Long-term Health Prediction	When cleaned data is available, the system should be able to predict long-term health outcomes for users.

Personalized Account Subsystem	User Registration	When a user accesses the registration page, users should be able to create an account by providing the necessary information.
	User Login	When a user accesses the login page, registered users should be able to log in to their accounts by entering the correct password.
	Password Reset	When a user accesses the password reset page, the user should be able to reset their password.
	User Profile Management	When users log in, users should be able to view and edit their profile information.
	Account Deactivation	When users log in, users should have the option to deactivate or delete their account.
	Health Data Integration	When the user is logged in, the user should be able to integrate their health data from other sources into their account.
	Personal Preferences	When a user is logged in, the user should be able to set and customize their personal preferences.
	Subscription Management	When the user is logged in, the user should be able to manage their subscription for hospital and notification preferences.
	Personal Health Recommendations	When the user is logged in, the system should be able to provide recommendations for the user's health improvement.
	Historical Data Viewing	When the user is logged in, the user should be able to view their historical health data stored in the system.
Health Monitoring and Tracking Subsystem	Record health Signs	When a user is logged in website or uses health devices, the user should be able to record and input their vital signs, such as heart rate, blood pressure, and temperature.
	Activity Tracking	When a user is logged in website or uses health devices, the system should track and record users' physical activities, such as steps taken and distance walked.
	Medication Tracking	When the user is logged in to the website or uses health devices, the user should be able to record their medication details, including dosage and schedule.
	Health Diary	When the user is logged in website, the user should have the

		option to maintain a health diary, recording daily activities and observations.
	Sleep Pattern Monitoring	When the user is logged in website or uses health devices, the system should track and analyse users' sleep patterns, including sleep duration and quality.
	Nutrition Tracking	When the user is logged in to the website or uses health devices, the User should be able to log their dietary intake and nutrition information.
	Water Intake Tracking	When the user is logged in to the website or uses health devices, the system should allow users to log and track their daily water intake.
	Stress Level Tracking	When the user is logged in website or uses health devices, the user should be able to log and track their stress levels through self-assessment.
	Progress Tracking	When the user is logged in to the website or uses health devices, the user should be able to track their progress toward health goals over time.
	Reminder Notifications	When the user is logged in the website or uses health devices, the system should send users reminders for medication, activities, and health goals.
Time Management and Itinerary Subsystem	Schedule Creation and Automation	When the user is logged in, the system should be able to create schedules and itineraries for the user's daily activities.
	Activity Prioritization	When the user is logged in and the Schedule created, the system should allow users to prioritize their activities based on importance and urgency.
	Travel Planning	When the user is logged in and the Schedule created, the system should assist users in planning travel itineraries, including flights, accommodations, and activities.
	Event Notifications	When the user is logged in and the Schedule created, the user should receive notifications for upcoming events and activities.
	Calendar Integration	When the user is logged in and the Schedule created, the system should integrate with external calendars to sync and display users' schedules.

	Collaboration and Sharing	When the user is logged in, the user should be able to collaborate and share schedules with others.
	Task Allocation	When the user is logged in and the Schedule created, the system should help users allocate specific time slots for tasks within their schedules.
	Time Estimates	When the user is logged in and the Schedule created, the system should provide time estimates for each scheduled activity to help the user manage their time effectively.
	Calendar Views	When the user is logged in to the website or uses health devices, the user should be able to view their schedules in various formats, including daily, weekly, and monthly views.
	Time Management and Itinerary	When a user is logged in and the Schedule created, the system should identify and alert the user of any conflicts or overlapping activities in their schedule.

Table 1. Functional Requirements

6.2 Non-Functional Requirements

Complementing the functional requirements, the non-functional requirements address the system's overall performance, design, compatibility, and support aspects. These requirements consider factors such as design consistency, scalability, accessibility, and security. They also encompass technical constraints, implementation practices, software compatibility, and communication protocols. Ensuring reliable operation, user-friendly interfaces, and adherence to data protection regulations are key considerations in these non-functional requirements. Collectively, they contribute to the holistic success of the LifeCare360 system by creating a robust, secure, and user-centric health management platform.

Category	Requirements
Usability	The system's user interface should be user-friendly to various users.
	The system should provide clear and concise instructions for using its features.
	The system should provide error messages and guidance to users in case of input errors or conflicts.
	The user interface shall be responsive and accessible on various devices, including desktop and mobile or wearable devices.
Reliability	The system should have a high level of uptime and availability to ensure users can access their schedules whenever needed.
	The system should have data loss prevention measures, including regular backups and data recovery options.
	The system should automatically save users' schedule changes to prevent loss of data.
	It shall have failover mechanisms in case of server failures to minimize downtime.
Performance	The system should respond quickly to user actions, ensuring minimal latency between interactions.
	The system should be able to handle a large number of users accessing their schedules simultaneously without slowdowns.
	The system should be optimized to reduce the time taken for generating and updating schedule views.
	The system shall have monitoring tools to track performance metrics and identify bottlenecks.

Security	User data should be encrypted during transmission to ensure confidentiality and prevent unauthorized access.
	The system should have secure authentication mechanisms to protect user accounts from unauthorized access.
	Sensitive user data, such as personal health information, should be stored securely and comply with data protection regulations.
	The system shall have intrusion detection and prevention systems to safeguard against cyber threats and regular security audits
Supportability +	The system should provide user support through help documentation, tutorials, and responsive customer service.
	Update and patch systems shall be easily deployable to ensure ongoing system maintenance.
Physical +	The system's software should be deployable on the company's designated servers or cloud infrastructure
	Redundant power and network connections shall be in place to minimize physical failures.
	Hardware shall be regularly inspected and maintained to prevent hardware-related issues.
Design +	The system should consider scalability in design to accommodate future growth in the number of users and data volume.
	The user interface shall follow modern design principles, including responsive design for different screen sizes.
	The system shall have a consistent and visually appealing design across all pages and modules.

Table 2. Non-Functional Requirements

7. System stakeholder

The stakeholders of the system encompass a diverse group of individuals which are listed in Table 3, both internal and external, fulfilling various operational and executive roles. Operational stakeholders engage with the system directly, while executive stakeholders utilize the system's information or hold financial interests. Internal stakeholders are those within the organization, while external stakeholders reside outside the organization's boundaries.

	Operational	Executive
Internal	- Data analysts - IT Development team - Marketing team - Customer support team - IT support team - Administration	- Management team - Board of directors - IT department management
External	- Customers - Medical institutions - Medical Professionals - Insurance companies	- Investors - Government health agencies - Financial Analysts - Healthcare industry experts - Legal advisor

Table 3. Stakeholders

Internal Operational stakeholders:

- **Data analysts:** Responsible for analyzing data, generating insights, and improving system algorithms.
- **IT Development team:** Develops, maintains, and troubleshoots the technical aspects of the system.
- **Marketing team:** Utilizes system data to design targeted marketing strategies.
- Customer support team: Assists users with system-related queries and issues.
- **IT security team:** Manages the cybersecurity aspects of the system.
- **Administration:** are responsible for configuring, maintaining, and overseeing the operation of the LifeCare360 System.

Internal Executive stakeholders:

- **Management team:** Guides strategic decisions, resource allocation, and overall system

direction.

- **Board of directors:** Oversee the company's direction and utilize system-generated insights for decision-making.
- **IT department management:** Ensures the IT team aligns with the project goals and has the required resources.

External Operational stakeholders:

- **Customers:** Interact with various aspects of the system, including health tracking, appointments, and personalized care.
- **Medical institutions:** Provide and access medical records, offer advice, and manage appointments.
- **Medical Professionals:** Engage with patients through the system, provide advice, and manage care plans.
- **Insurance companies:** May access system data for assessing health trends and offering insurance plans.

External Executive stakeholders:

- **Investors:** Hold financial interest in Wellness Technology and the success of the system.
- **Government health agencies:** May use system data for policy-making and public health monitoring.
- **Financial Analysts:** Utilize system-generated data for assessing company performance and growth potential.
- **Healthcare industry experts:** Offer insights and recommendations for optimizing the system's healthcare features.
- **Legal advisor:** Provide legal counsel and guidance related to the operation of the LifeCare360 System. They ensure that the system adheres to legal and regulatory requirements.

8. Questionnaire

Customer Support Team Questionnaire

This questionnaire is intended for the customer support team who will be interacting with users to address users' issues.

We value your expertise and input in shaping the LifeCare360 System to meet your needs effectively. This questionnaire aims to gather your insights regarding the system's features and functionalities. Kindly take a few moments to complete it.

Part I. Please answer yes/no questions based on a typical 8-hour workday.

1. Is the LifeCare 360 system integrated well with other tools and systems you use in your role?

☐Yes.   ☐ No

2. Have you received proper training on the system and services?

☐Yes.   ☐ No

3. Have you encountered any technical issues or challenges when using LifeCare 360 in your daily tasks?

☐Yes.   ☐ No

Part II, Please rate below statements or questions below by circling a number from 1 to 5

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. LifeCare360 provides quick access to customer information and case histories.	1	2	3	4	5
6. The system's reporting and analytics tools offer valuable insights into customer trends and support performance.	1	2	3	4	5
7. The user interface design of the system is easy to use and intuitive.	1	2	3	4	5
8. LifeCare 360 offers benefits for effectively managing and tracking customer inquiries and issues.	1	2	3	4	5

Part III. Please give your comments and opinions

9, Are there any specific challenges or difficulties you've encountered while using the system, and how do you think they could be addressed or improved?

_____

_____

_____

_____

_____

10, Do you have any suggestions for additional features or enhancements to the system that would significantly improve your effectiveness in assisting customers?

_____

_____

_____

_____

_____

11, Please share any other feedback or comments you have regarding your experience with the system and how it impacts your role in customer support.

_____

_____

_____

_____

_____

9. Brief Use Case Descriptions:

Table 4 delivers a comprehensive overview of the use cases encompassed by the Health Monitoring and Tracking Subsystem. This table delineates the individual use cases, specifies the participating actors, and provides concise descriptions. Upon customer login, they have the option to input personal health information, including weight, height, and more. Subsequently, customers receive tailored advice and plans from medical institutions, leveraging their data analyzed by data analysts. Additionally, customers can monitor their real-time health status and promptly receive health emergency alerts when needed.

Brief Use Case Descriptions: Health Monitoring and Tracking Subsystem		
Use Case	**Actor**	**Description**
Log into system	Customer	Customers can log into the LifeCare360 System using their credentials, gaining access to their personalized

		health information, features, and services.
Check Real-Time Health	Customer	Customers can continuously monitor vital health metrics such as heart rate, blood pressure, and glucose levels using connected devices or wearable technology.
Receive Health Emergency Alarm	Customer, Medical institutions	A customer has received an emergency health alert within the system, and the system notifies both medical institutions and emergency services when facing critical health emergencies.
Receive Health Emergency Case	Medical institutions	Medical institutions receive and respond to health emergency alerts, providing immediate assistance and care to customers in crisis situations.
Generate Health Data	Customer	Customers input and generate health data within the system, which includes vital signs, symptoms, and medication records, to track their health over time.
Analyse Health Data	Data analyst	Data analysts use the system to analyze the health data collected from customers, generating valuable insights and trends for improved healthcare decision-making.
Receive Health Insights	Customer	Customers receive personalized health insights and recommendations based on the analysis of their health data, helping them make informed choices for well-being.
Track Health Goal	Customer	Customers set and track their health and wellness goals within the system, such as weight loss or fitness achievements, to monitor progress.
Generate Meal Plans	Medical Professional, Customer	Medical institutions can create customized meal plans for customers based on their health data and dietary preferences to promote healthier eating habits.
Generate Dietary Advice	Medical Professional	Medical institutions offer personalized dietary guidance and suggestions to customers, taking into account their health information and dietary requirements
Generate Exercise Plans	Medical Professional, Customer	Medical institutions and customers can collaborate to create personalized exercise plans, including workout routines and fitness goals.
Create Health Reports	Medical Professional	Medical institutions generate comprehensive health reports for customers, summarizing customer health data, trends, and recommendations for healthcare

		professionals.
Modify Plans	Medical Professional	Medical institutions can make adjustments and modifications to meal plans, exercise routines, and health recommendations based on the changing needs of customers.
Log out system	Customer	This use case allows the customer to securely log out of the LifeCare360 System, ensuring the protection of their health data and privacy

Table 4. Brief Use Case Description

10. Use a Case Diagram

The use case diagram below illustrates the details of the users of the Health Monitoring and Tracking Subsystem and their interactions with the system (IBM, 2021). In the diagram, users are divided into internal and external. Internal user (data analyst) is on the left while external users (medical institutions, customer and medical professional) are on the right. Within this subsystem, customers can access valuable health insights, including the ability to track their health goals and monitor real-time health data. These insights are derived from the analysis of their health data by a dedicated data analyst. Moreover, based on the analyzed data, medical professionals can collaborate with customers to craft comprehensive health reports. Additionally, these professionals can work with customers to develop personalized meal plans, which may include dietary advice, and exercise plans to promote overall well-being.

In critical situations such as heart attacks or breathing difficulties requiring immediate attention, the system extends its functionality by sending an emergency alert to customers, in line with real-time health monitoring. Simultaneously, the system dispatches an emergency case notification to medical institutions, ensuring rapid response to the customer's urgent needs.
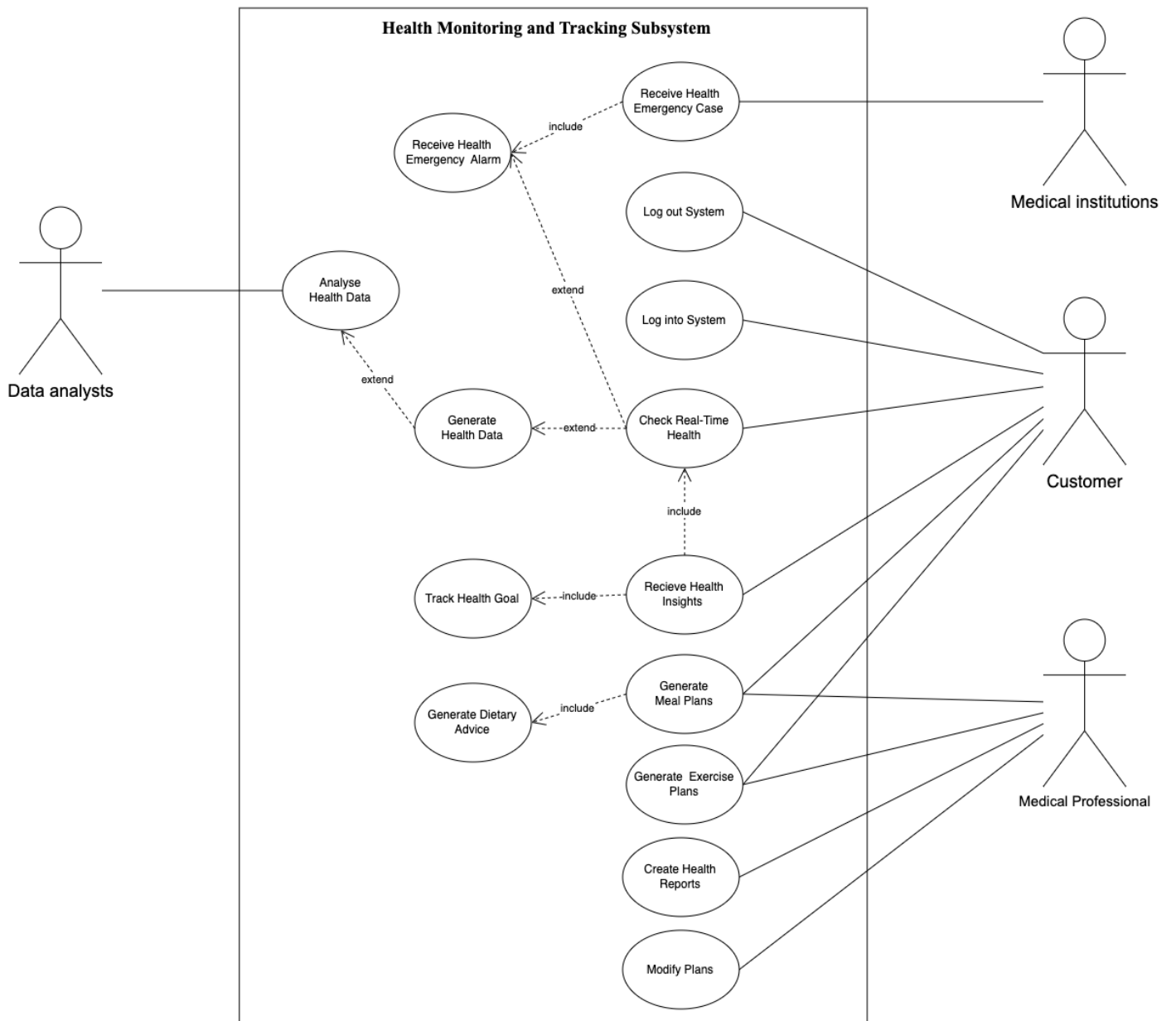
Diagram 1 - Use case diagram

11. Domain Model Class Diagram

The following diagram shows the domain model class for the Lifecare360 system. The system mainly to provide a holistic and personalized healthcare experience to its users, ensuring that their health and wellness data is managed and utilized effectively (Visual Paradigm,2022).

The model includes 4 main groups for these attributes: User Management, Health and Wellness, Device and Application, and Payment.

Firstly, the user management group encompasses attributes related to the management and interaction of users within the system. It includes Administrators, who oversee system configurations; and NormalUsers, individuals using the system for health and wellness management.

Secondly, the health and wellness group focuses on attributes central to users' health and well-being. HealthMonitoring records vital health metrics, while Reminders help users manage their health routines. FitnessActivity and NutritionPlan facilitate fitness and dietary planning. Medication and Appointment attributes are vital for health management and medical appointments. MedicalProfessionals provide access to healthcare experts, and SystemNotifications keep users informed of critical health updates.

Thirdly, the device and application group involves attributes related to technology components. Devices represent various monitoring and health tracking devices integrated with the system. Applications encompass the software interfaces through which users interact with the system, bridging the gap between users and their health data.

Finally, the payment group focuses on attributes that manage user subscriptions and financial transactions. PaidUsers are subscribers to premium services, and PaymentDetails handle payment processing and subscription information.

These distinct attribute groups enable the LifeCare360 system to effectively manage user accounts, provide comprehensive health and wellness services, integrate with monitoring devices and applications, and handle subscription and payment-related functions, thereby creating a holistic healthcare management ecosystem.
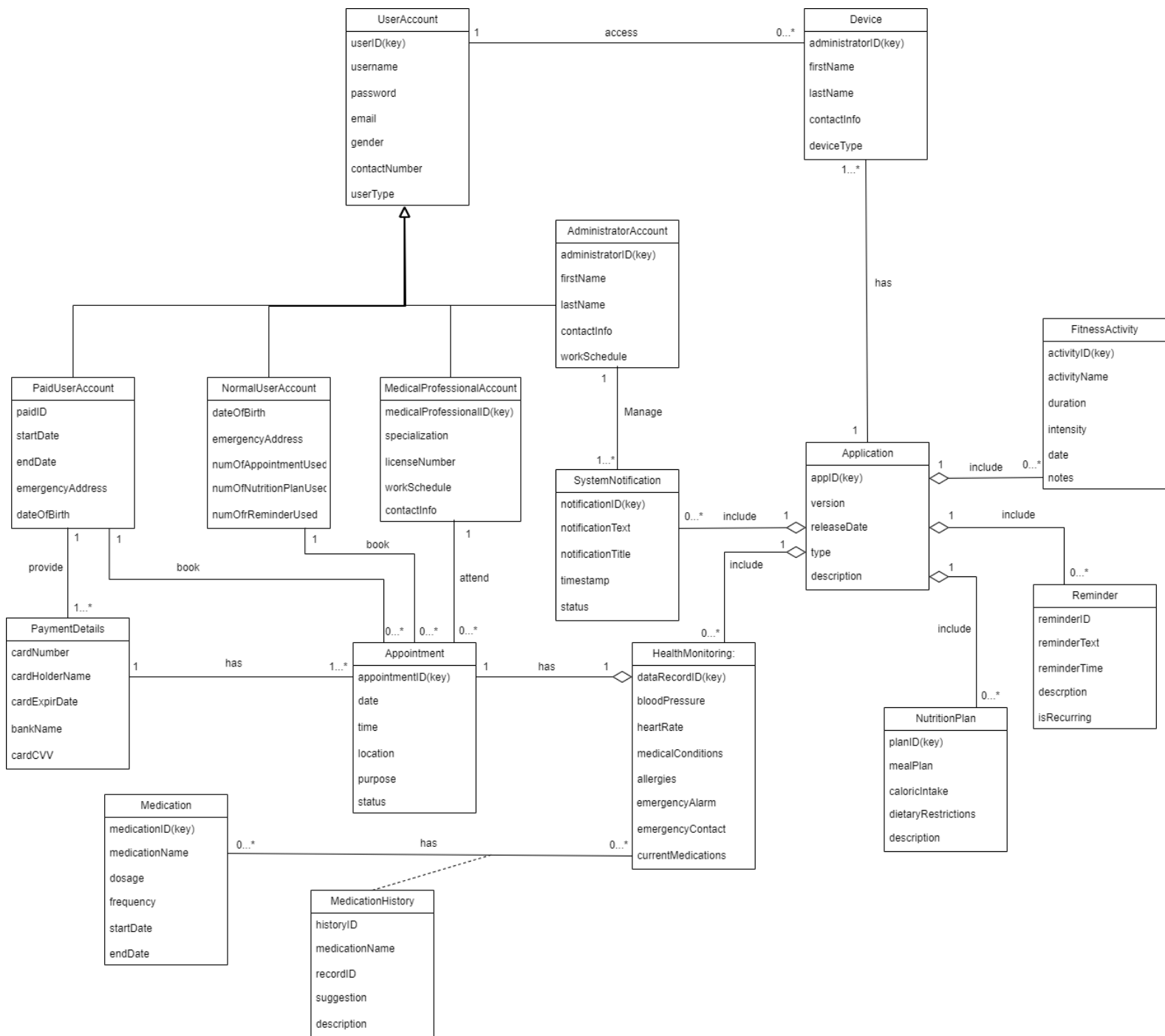
Diagram 2 - Domain model class diagram

12. Fully Developed Use Case Description

A fully developed use case provides a comprehensive understanding of the actions and interactions involved in a particular use case(Satzinger et al., 2020). Table 5 outlines the "Check Real-Time Health" use case, originally introduced in Table 4.

This table consists of several sections. First, it identifies the use case, including the scenario and the triggering event, which initiates the use case. A brief description of the use case is provided, along with the identification of the sole actor, the customer. Additionally, related use cases, including "Receiving Health Emergency Alarms," "Generating Health Data," and "Receiving Health Insights," are acknowledged, as they may have direct or indirect involvement in the use case.

Two key stakeholders are also recognized: customers and medical professionals, although their direct involvement may vary. Preconditions that must be met for the use case to execute successfully and postconditions representing the system's state after the use case's completion are defined.

Furthermore, the flow of activities encompasses six steps that elucidate the interactions between customers and the system, detailing how they work together. Lastly, exception conditions are described, addressing potential errors or exceptional scenarios that could arise during the use case, often resembling if/else conditions in handling these exceptional situations.

Fully Developed Use Case Description	
Use Case Name:	Check Real-Time Health
Scenario	Customer wishes to monitor their real-time health data.
Triggering event	The customer wants to view their current health status and vital signs in real time.
Brief Description	This use case outlines the process by which a customer can access and view their real-time health data within the LifeCare360 System. It allows customers to continuously monitor their vital signs and health metrics for proactive health management.
Actors	Customer
Related use cases	Receive Health Emergency Alarm, Generate Health Data,Recieve Health Insights

Stakeholders	Customers, Medical Professional	
Precondtions	- The customer must be registered and logged into the LifeCare360 System. - The customer's health monitoring devices are connected to the system and actively sending real-time data. - The customer has a compatible device with internet access.	
Postconditions	- The customer can view their real-time health data. - The customer can identify any significant changes in their health metrics. - The system continues to monitor and update the customer's health data.	
The flow of activities	**Customer**	**System**
	1. Navigate to the "Check Real-Time Health" feature.	1. Show the 'Check Real-time Health' feature on page
	2.Turn on the 'real-time monitoring' function	2. Collects real-time health data from the customer's monitoring devices.
		3.1 Sends updated health metrics to the customer's interface. 3.2 Alerts the customer to any critical health changes.
	4.1 Views real-time health metrics, including heart rate, blood pressure, oxygen levels, and more. 4.2 Confirm the critical health changes 4.3 Monitor their health data continuously	
	5. Turn off the 'real-time monitoring' function	
		6. Stop 'real-time monitoring' function
Exception Conditions	1.1 Customer doesn't wear the device 1.2 System downtime 2.1 The customer's device loses internet connectivity.	

	2.2 Low device battery
	3.1. The device/sensor is broken

Table 5 - Fully developed use case description

13. Activity Diagram

An activity diagram serves as a visual representation that intricately illustrates the sequential actions and interactions between the actors (Teorey et al., 2011), in this case, the customer and the system, for the "Check Real-Time Health" use case. This diagram encapsulates the following key components. Firstly, the activity begins using a start node which is the commencement of the activity diagram and is signified by a single start node, marked with a discernible black dot. Each activity undertaken by either the customer or the system is distinctly depicted as a rectangular box, accompanied by concise textual descriptions. For selections, decision points within the process are visually denoted by diamond-shaped symbols, complemented by pertinent text. These points underscore the necessity for a decision that has 2 outcomes: yes and no.

Besides, the diagram employs solid lines for directional representation, elucidating the unidirectional flow of activities from one stage to the next. Also, black horizontal bars, functioning as synchronization bars, serve to demarcate branches and loops within the diagram. In contrast, for loops, these bars signal both the initiation and culmination of a loop. In the diagram's context, a loop signifies an ongoing conversation between the customer. Finally, the end node is the ultimate completion of the use case and is visually conveyed by a solitary end node, symbolizing the conclusion of the entire process.

This activity diagram, following the model of Diagram 3, effectively elucidates the intricate sequences of actions, decisions, and interactions between the customer and the system throughout the "Check Real-Time Health" use case.
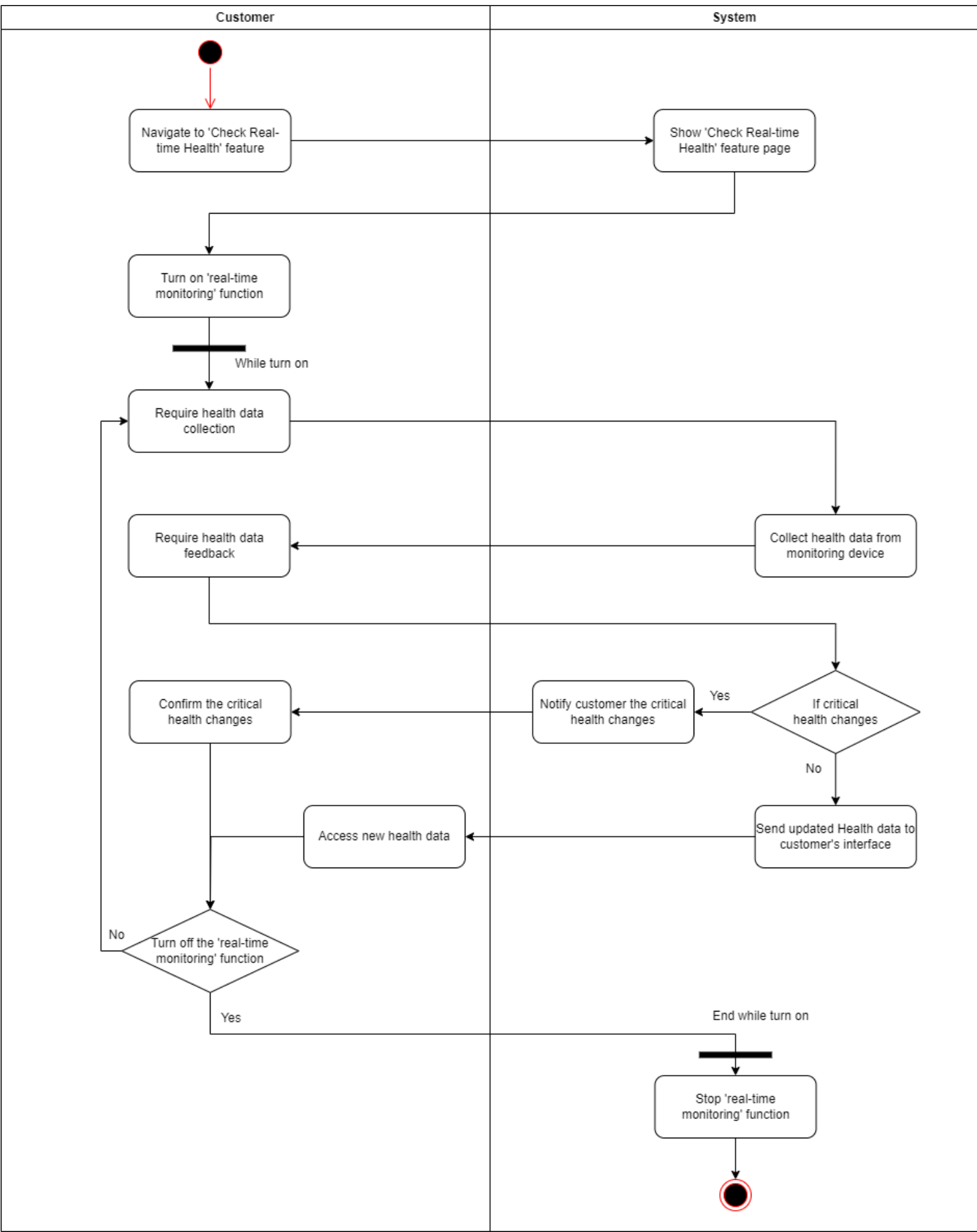
Diagram 3 - Activity Diagram

14. System Sequence Diagrams

A System Sequence Diagram is a visual representation that illustrates the flow of information into and out of a system during an interaction. This diagram depicts the input messages from the customer and the output messages from the system, providing a clear view of communication processes within the context of a specific use case (Wikipedia, 2023).

The construction of a System Sequence Diagram is guided by the information presented in the fully developed use case descriptions (Table 5) and the activity diagram (Diagram 3).

The left lifeline represents the actors (in this case, the Customer), while the right lifeline represents the system. These lifelines delineate the participants in the interaction. Normal arrows moving from right to left depict messages initiated by the customer to convey commands and input values to the system. Conversely, dashed arrows moving from left to right signify the return messages and outputs generated by the system in response to the customer's inputs.

A loop frame is employed to signify the repetition of several sequential messages within the interaction. An alt frame is utilized to denote if-else operations encompassing a series of sequential messages, indicating decision points in the process.

The process begins with the customer navigating to the monitoring page, prompting the system to display the monitoring page. Subsequently, the customer decides to activate monitoring, initiating a loop wherein the system collects health data. If the system detects critical health changes, it notifies the customer, who then confirms the information. In the absence of critical changes, the system proceeds to update the customer's health data and grants access to this information. Finally, the system concludes and stops the monitoring function.
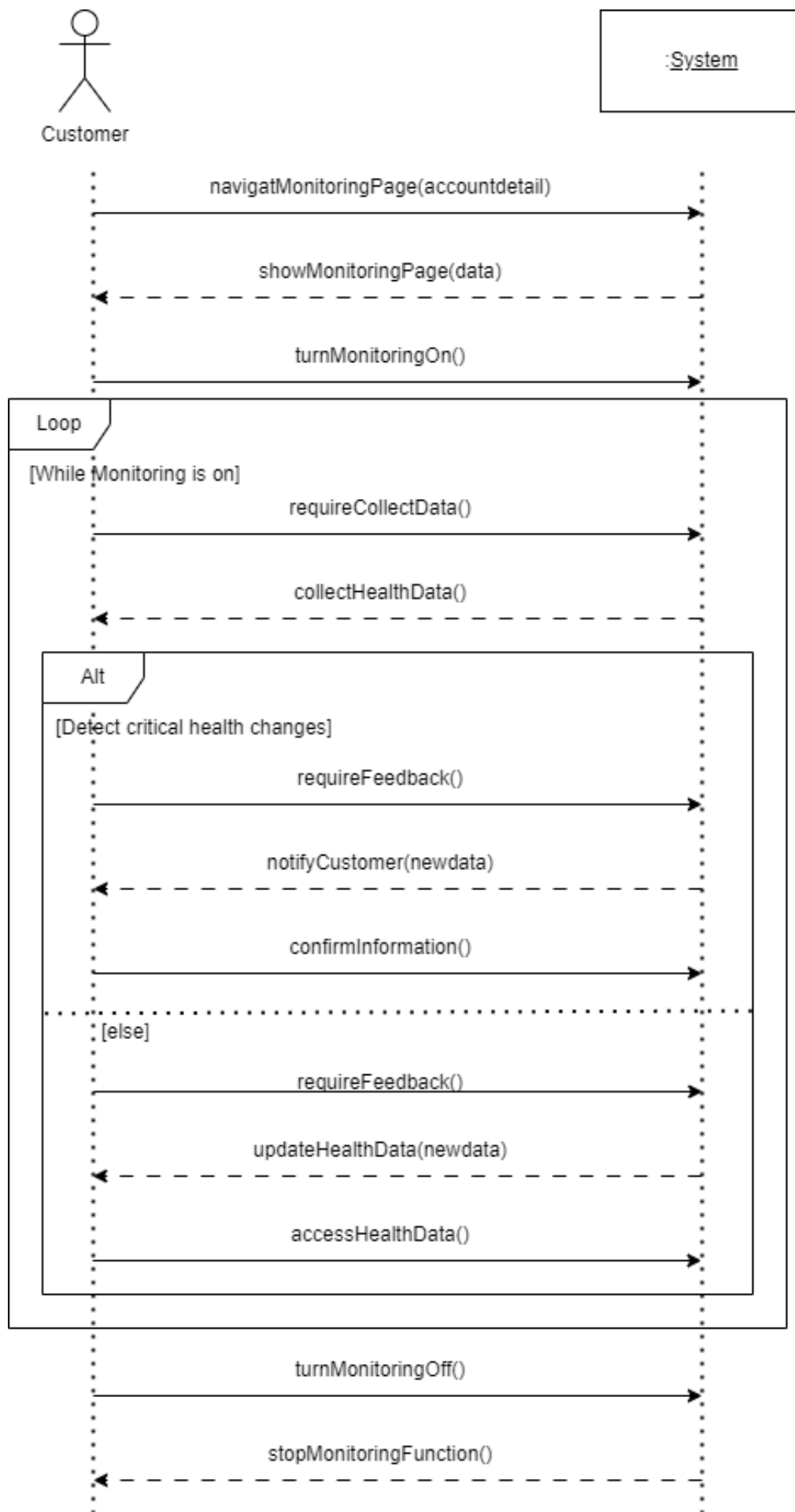
Diagram 4 - System Sequence Diagram

15. Design the Environment

The LifeCare360 system operates within a complex networked environment that facilitates seamless communication between various stakeholders, including customers, medical institutions, the company, and external entities. The system architecture is designed to ensure the secure and efficient flow of data while maintaining the integrity and confidentiality of sensitive health information. An operating system is the most important software that runs on a computer (Satzinger et al.,2015). It manages the computer's memory and processes, as well as all its software and hardware. It also allows you to communicate with the computer without knowing how to speak the computer's language.

Server Network:

The server network serves as the backbone of the LifeCare360 system. An Internal Internet Firewall ensures that data from the internet undergoes stringent security checks before entering the server network. VPN technology is employed for data sent back to the internet, allowing authorized personnel to access server data securely.

Within this network, switches and routers manage data traffic efficiently. Various servers, including web servers, application processors, and data management servers, handle specific functions. Each server communicates with its respective databases, such as application databases, web databases, business databases, customer databases, and shipper databases.

Business Network:

At the heart of the system are the company's internal operations, supported by a range of hardware and software components. This includes PCs, laptops, scanners, and copiers used for administrative tasks. Additionally, wearable devices, mobile devices, tablets, and laptops provide wireless access to the LifeCare360 system. The modem connects these devices to the network, while a switch and routers manage internal data traffic.

To enhance security, a Virtual Private Network (VPN) is employed to transfer data securely between the VPN and the switch, ensuring data integrity during transmission. A robust Company Hardware and Software Firewall safeguards the internal network when data is sent back to the internet, protecting against potential threats like viruses.

External Network:

The external network serves as a bridge to customers and medical institutions. Customers access the system through wearable devices, laptops, mobile devices, and tablets. These devices connect wirelessly via a modem and switch, with data protected by a firewall and routed through a router.

Similarly, medical institutions utilize laptops, PCs, and copiers to connect to the system. These devices connect to the network via modems, routers, and switches. A dedicated Medical Institutions Firewall enhances security by protecting sensitive medical data.

Bank Network:

A separate bank network is established for secure financial transactions. This network is protected by a firewall and comprises switches, routers, and modems. Bank servers handle financial transactions and interact with the bank database to ensure the integrity of financial data.

In summary, the LifeCare360 system operates within a well-connected and secure networked environment. It effectively integrates various hardware and software components to provide a seamless experience for customers and medical institutions while maintaining the highest standards of data security and privacy.
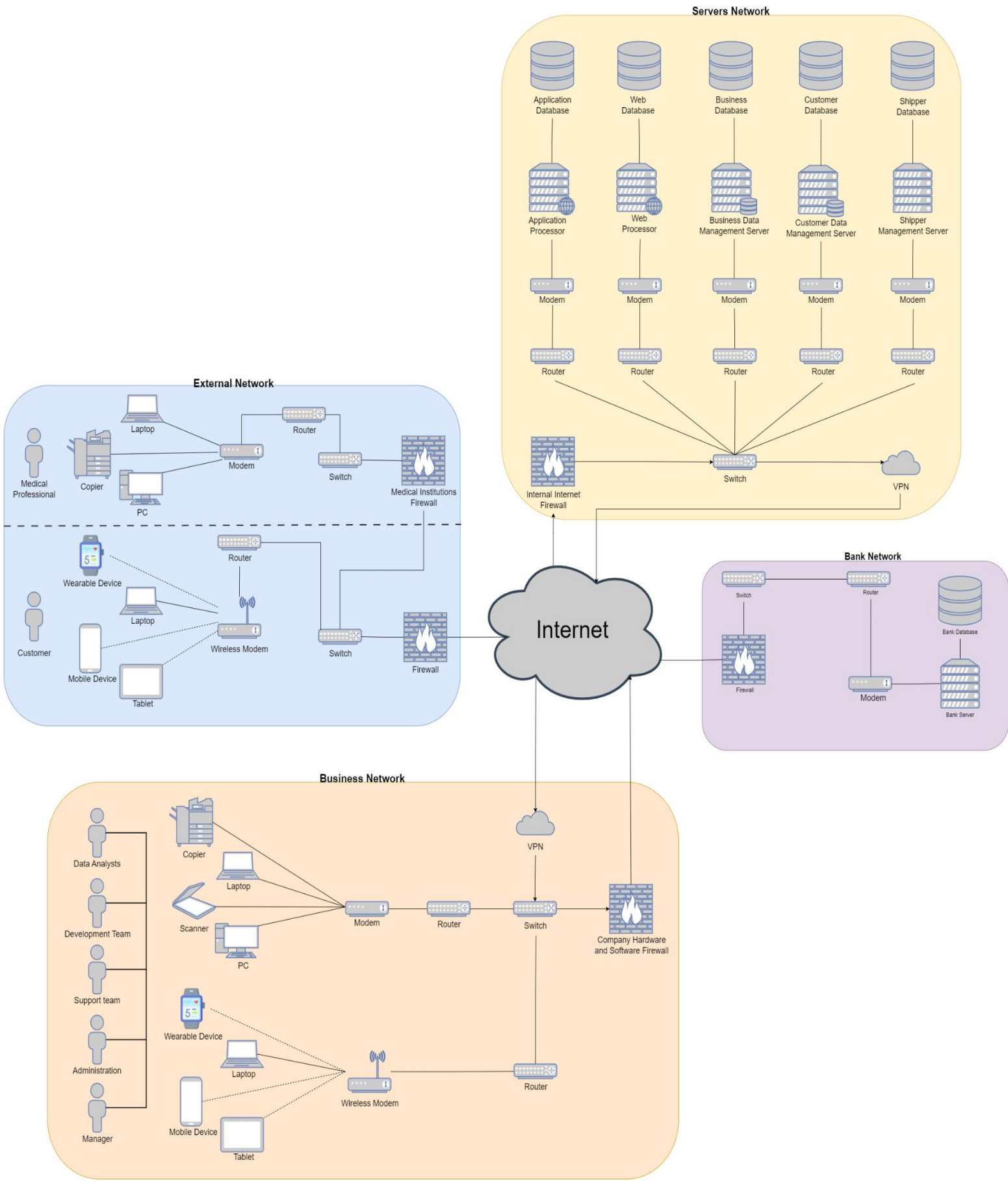
FIGURE 1 LIFECARE360 COMPONENTS DIAGRAM

16. Design the User Interface

When crafting the user interface for an information system, it is of utmost importance to adhere to established user interface design principles. This ensures that users enjoy the most optimal experience when interacting with the application. The true essence of technological advancement lies not solely in the technology itself but in how that technology interfaces with humans (Anderson et al.,2018). This underscores the pivotal role of the UI as the gateway for users to engage with digital systems, ultimately shaping the success or failure of an application or platform. In this pursuit, integrating best practices and UI design principles becomes imperative.

A well-crafted UI facilitates users in effortlessly navigating, comprehending, and effectively using the system, culminating in a positive user experience. As IBM aptly puts it, the absence of ease of use may not be immediately visible, but its importance is undeniable.

Furthermore, an intuitive UI simplifies tasks, reduces cognitive load, and minimises errors, thereby enhancing overall efficiency, echoing the sentiments of Robert L. Peters, who highlights how design contributes to shaping culture and values, ultimately influencing the future.

The requisites for an effective user interface encompass several key elements, including navigation, visual design, and functionality. In the words of Steve Jobs, design transcends mere aesthetics; it extends to how the system operates. This means that the UI should provide users with clear and coherent navigation pathways, enabling them to navigate seamlessly within the system. Additionally, thoughtful utilization of colour schemes, typography, and layout fosters an aesthetically pleasing and consistent UI. Equally essential, all UI components should perform as expected, delivering the intended features and functionalities to users.

The storyboards below show the user interface for Check real-time health on Lifecare360. Each storyboard is based on best practice user-interface design concepts: high usability and consistency in layout and format, and other design considerations will be discussed in detail for each storyboard.

The first storyboard depicts the Lifecare360 home screen, showcasing six distinct use cases accessible to customers who have already logged in: Real-time Health Check, Health Emergency Alarm, Meal Plans, Health Goal Tracking, Health Insights, and Exercise Plans. When a customer selects 'Check Real-time Health,' they will be directed to the second storyboard. In this storyboard, customers have the option to review their health history or activate 'Real-time Monitoring.' Selecting 'Real-time Monitoring' will transition to the third storyboard, displaying both the at-the-moment health data and the latest history data. To access more detailed 'Real-time Monitoring' information such as heart rate, running and walking distance, and more, customers can click 'Continue.' Additionally, customers have the flexibility to halt 'Real-time Monitoring' whenever they choose.

Business Logo | About us | Manage subscription | Your Account

Health Care 360

Check Real-Time Health

Track Health Goal

Health Emergency Alarm

Health Insights

Meal Plans

Exercise Plans
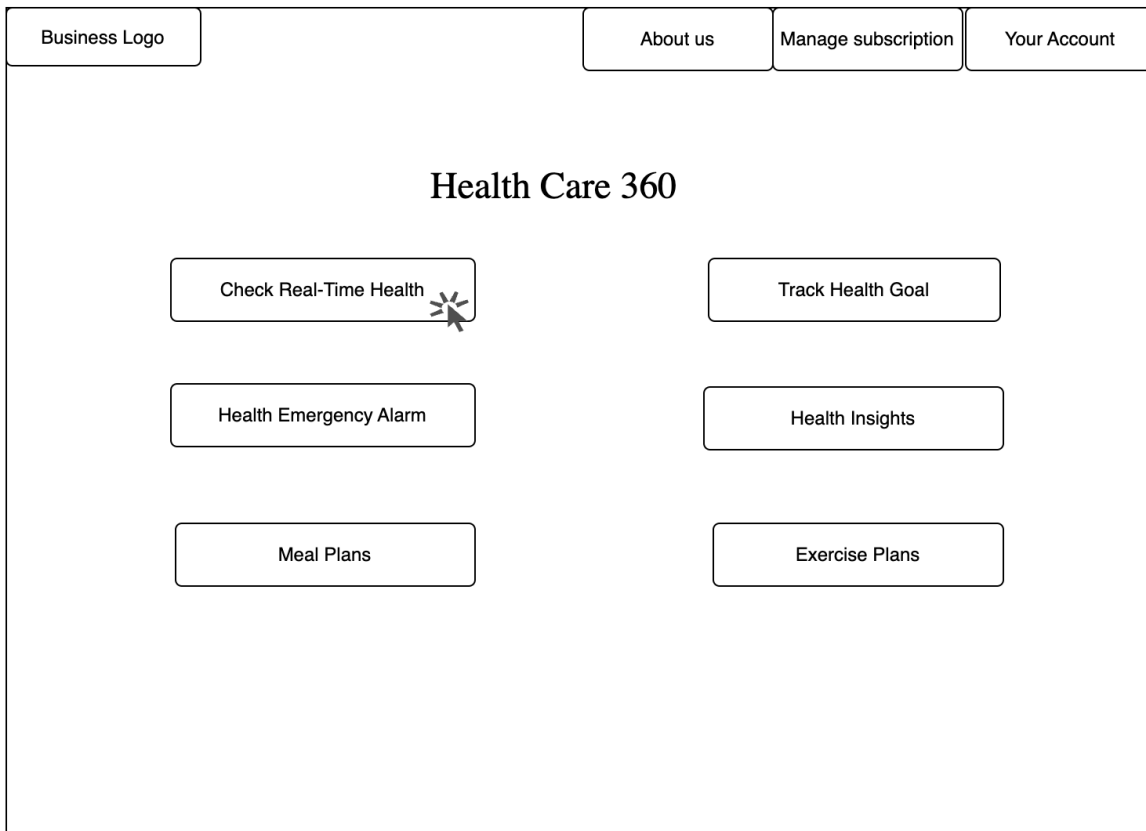
FIGURE 2 CHECK HEALTH WIREFRAMES 1

| Business Logo | | About us | Manage subscription | Your Account |

Check Real-Time Health

View Of History

Real-Time Monitoring
(Turn on)

FIGURE 3 CHECK HEALTH WIREFRAMES 2

| Business Logo | | About us | Manage subscription | Your Account |

Real-Time Monitoring

Today

26/09/2023

Heart Rate	03:00 pm
Latest	
72 BPM	

Blood Pressure	03:10 pm
Latest	
120 mmHg	

Oxygen Levels	03:11 pm
Latest	
98%	

Latest History

25/09/2023

Heart Rate	03:00 pm
70 BPM	

Blood Pressure	03:10 pm
100 mmHg	

Oxygen Levels	03:11 pm
96%	

Continue
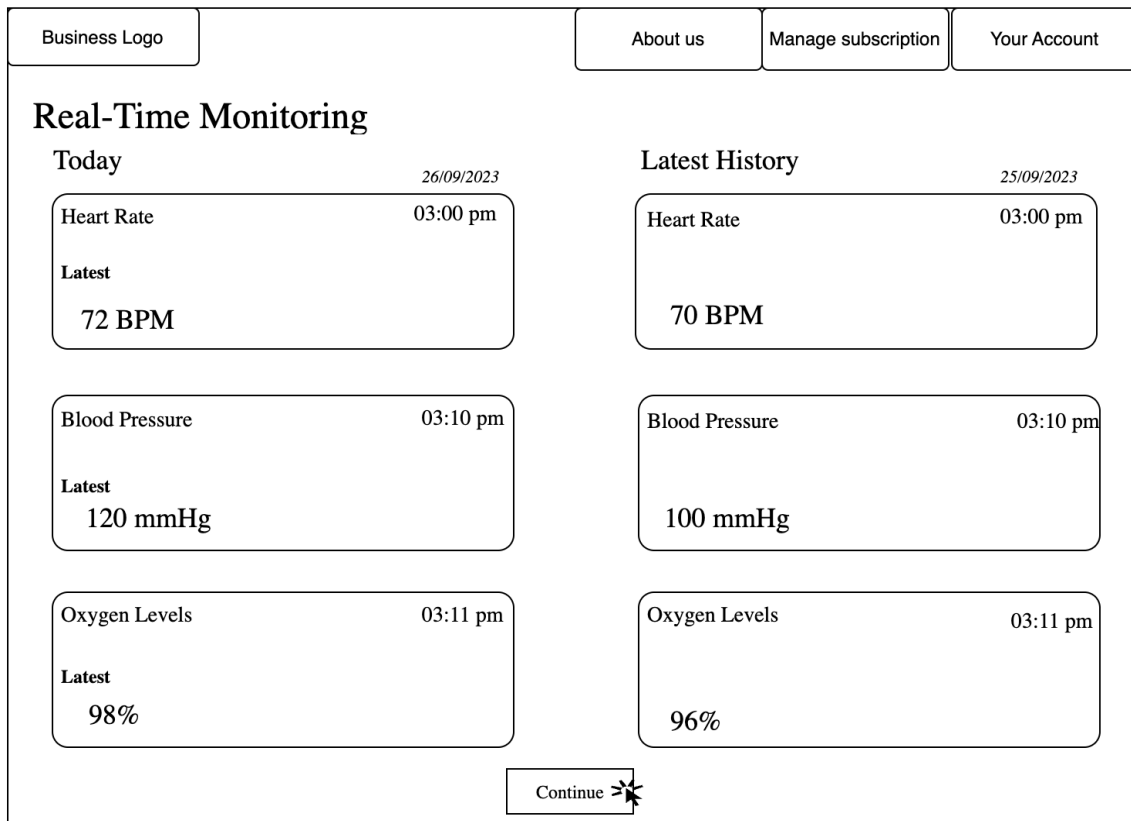
FIGURE 4 CHECK HEALTH WIREFRAMES 3
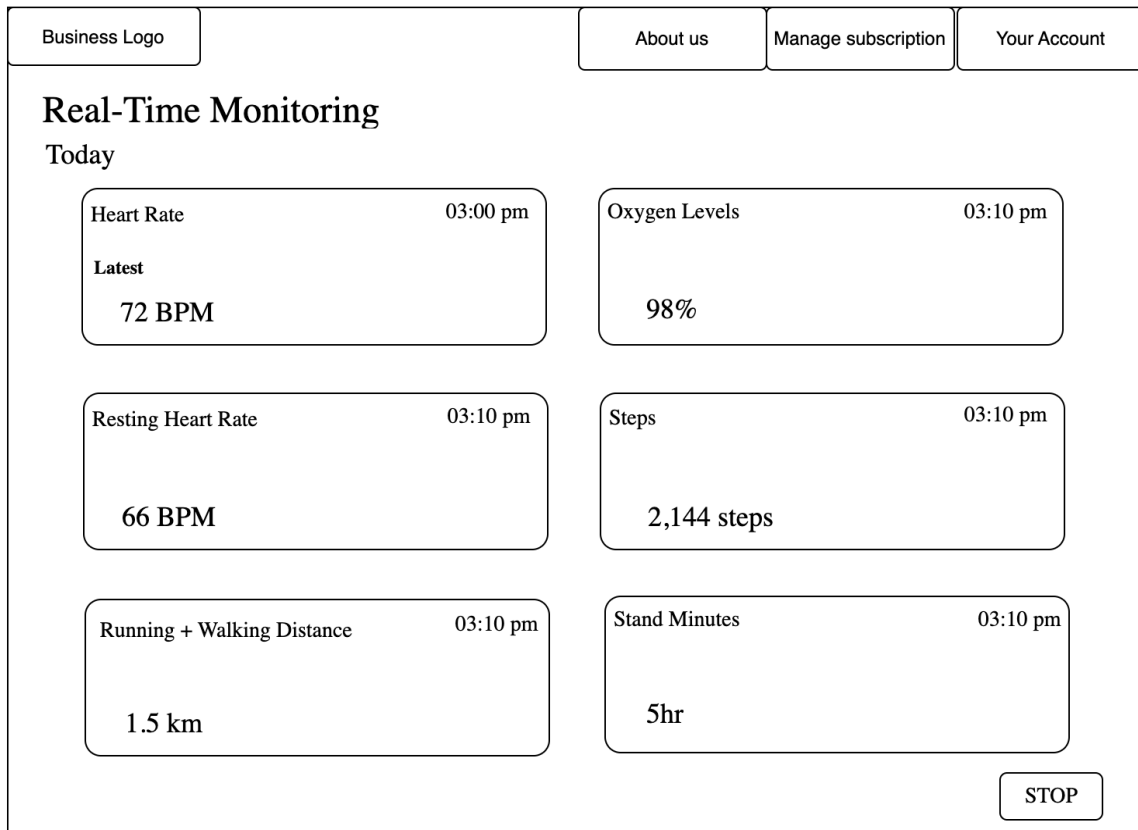
FIGURE 5 CHECK HEALTH WIREFRAMES 4

17. Design the Application Architecture and Software
17.1 Component Diagram

A component diagram serves as the architectural blueprint of a software system, elucidating the arrangement of its fundamental building blocks and their harmonious interconnection. It serves as a powerful tool to unravel the intricacies of system design, offering a visual representation that enhances comprehension and facilitates effective communication.

In this particular component diagram, the components are thoughtfully organized into a client-server three-layer architecture, delineating the view layer (responsible for the user interface), the domain layer (housing critical business logic), and the data layer (dedicated to data storage). Within the view layer, we discern two interfaces catering to customers: the web browser and the mobile application, both harnessed through JavaScript, PHP, and Go.

The domain layer, on the other hand, encompasses pivotal components such as the application server, web browser server, and the billing and payment system, employing languages like Java, PHP, Python, and C++. This layer acts as the bridge, facilitating the exchange of information between the user interface and the backend.

Lastly, the data layer comprises SQL databases, where all vital system data finds its abode, ensuring seamless and efficient information management. This component diagram embodies such perfection, where every element plays a crucial role in the grand symphony of the software system's architecture.
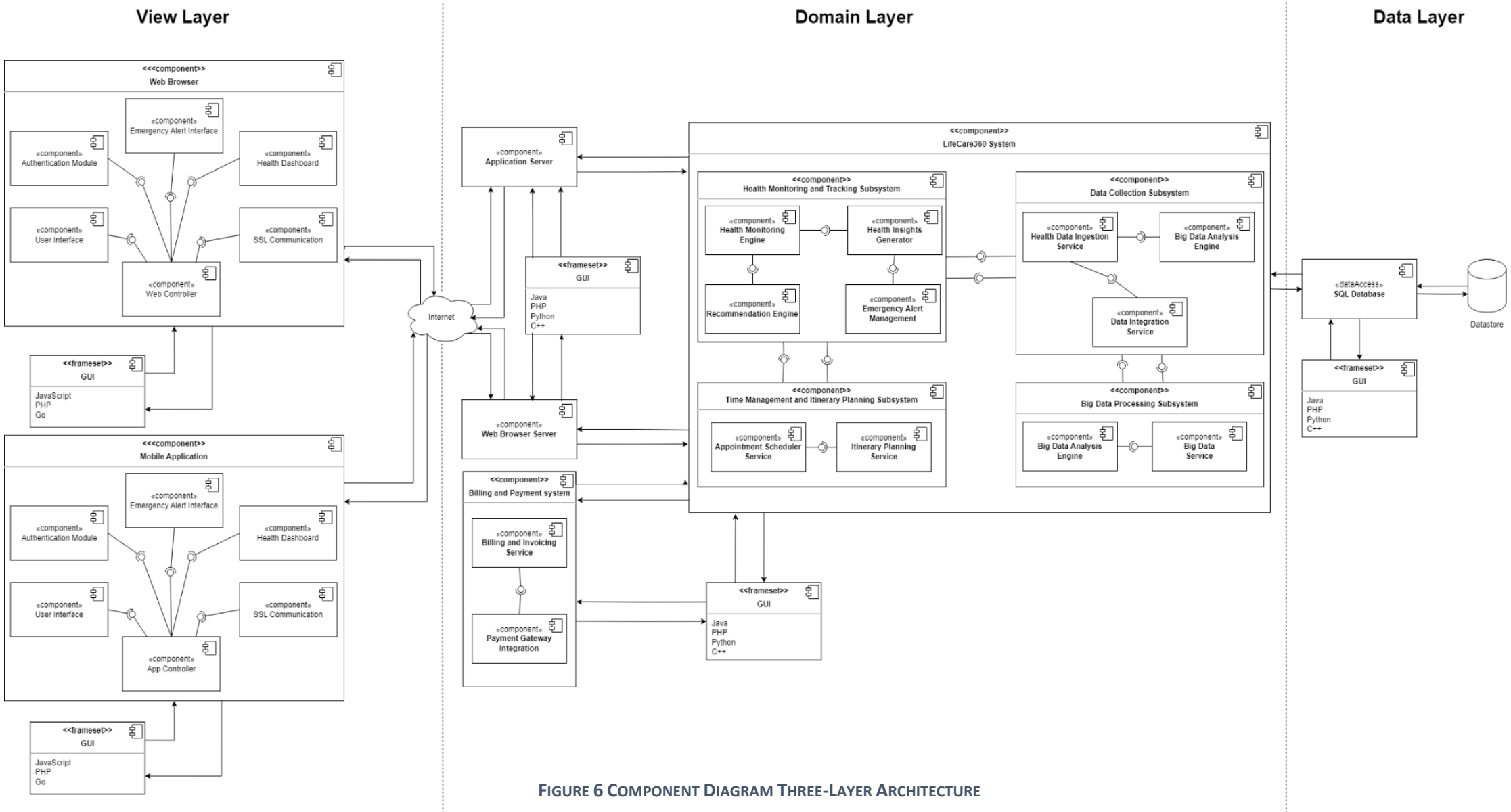
FIGURE 6 COMPONENT DIAGRAM THREE-LAYER ARCHITECTURE

1

17.2 Design Class Diagram

The provided class diagram represents the structure and design of the Lifecare360 system. This system aims to offer users a comprehensive and personalized healthcare experience, ensuring that health and wellness data is effectively managed and utilized.

The entire model can be broadly categorized into four main groups:

1. User Management
2. Health and Wellness
3. Device and Application
4. Payment

17.2.1 User Management

This section deals with how users are managed and interacted with in the system. It consists of:

- UserAccount: This serves as the foundational account type, holding basic details like username, email, and gender.
- AdministratorAccount: These accounts are responsible for the oversight of system configurations, and they store details like full name, mobile phone, and address.
- NormalUserAccount and PaidUserAccount: These are types of accounts for individuals who use the system to manage their health and wellness. While both hold general details like emergency addresses and date of birth, PaidUserAccounts have additional attributes related to premium subscriptions.
- PaidUsers: These users have subscribed to premium services, and their accounts have extended attributes to manage such subscriptions.

17.2.2 Health and Wellness

Central to the users' health and overall well-being, this section encompasses:

- HealthMonitoring: Captures essential health metrics like heart rate, blood pressure, and medical conditions.
- Reminders: Helps users maintain their health routines with attributes like reminder time and whether it's recurring.
- FitnessActivity: For those focused on physical activity, storing details about the activity name, duration, and notes.
- NutritionPlan: Assists in dietary management, with details about meals, calorie intake, and descriptions. Medication and
- MedicationHistory: Essential for tracking ongoing medications and their historical intake.
- Appointment: Helps users schedule and manage medical appointments.
- MedicalProfessionals: Offers users a connection to healthcare experts, recording details like specialization and contact numbers.
- SystemNotification: Ensures users stay updated with essential health notifications.

17.2.3 Device and Application

This section connects the system to technological elements:

- Device: Represents various health tracking tools and devices that can be integrated with the Lifecare360 system, holding details like device type and hardware info.
- Application: The software interface, bridging users with their health data, containing details like version, release date, and description.

17.2.4 Payment

Handling the financial aspects of the system:

- PaymentDetails: Manages all payment-related information like card details, bank name, and payment ID.
- PaidUsers: These class is relevant to the payment system, that have subscribed to premium services, and their accounts have extended attributes to manage such subscriptions.

In summary, the Lifecare360 system is a robust healthcare management platform, effectively harmonizing user accounts, comprehensive health services, technological integrations, and financial transactions to provide a holistic healthcare experience.

UserAccount
- userID: string {key}
- username: string
- email:string
- gender: string
- password: string
- userType: string

+ getUserDetails(UserID): list
+ sendEmail(email, string): void
+ changeGender(gender): void
+ getEmail(UserID): string

Device
- deviceID: string {key}
- userID: string
- hardware: list
- deviceType: string

+ loadInfor(userID): list
+ getSoftwareDetails(deviceID): list
+ getHardwareDetails(deviceID,hardware): list
+ getUsage(): list

FitnessActivity
- activityID: string {key}
- activityName: string
- duration: list
- note: string

+ getActivityDetails(activityID): list
+ changeDuration(activityID, duration): avoid
+ changeActivityName(activityID, activityName): avoid
+ changeActivityNote(activityID, note): avoid

AdministratorAccount
- administratorID: string {key}
- fullName: list
- mobilePhone: string
- address: string
- workSchedule: list

+ generateWorkTable(administratorID, workSchedule):list
+ changeWorkTable(administratorID, workSchedule):void
+ getInformation(administratorID): list
+ changeAddress(administratorID, address): avoid

Application
- appID: string {key}
- deviceID: string
- version: string
- releaseDate: string
- description: string

+ getAppDetails(appID):list
+ getUsageDetails(appID, deviceID): list
+ changeDescription(description, string): avoid
+ updatingVersion(version, string): avoid

Reminder
- reminderID: string {key}
- reminderText: string
- reminderTime: list
- isRecurring: boolean

+ getReminderDetails(reminderID): list
+ changeReminderText(reminderID,reminderText): avoid
+ changeReminderTime(reminderID,reminderTime): avoid
+ changeRecurring(reminderID,isRecurring): avoid

PaidUserAccount
- userID: string {key}
- paidID: string
- dateOfBirth: string
- emergencyAddress: list
- duration: list

+ getPaidHistory(paidID): list
+ getEmergencyAddress(paidID, emergencyAddress): list
+ changeDateOfBirth(userID, dateOfBirth): avoid
+ updatingDuration(paidID,duration): avoid

NormalUserAccount
- userID: string {key}
- dateOfBirth: string
- emergencyAddress: list
- inumOfAppointmentUsed: int
- numOfNutritionPlanUsed: int
- numOfrReminderUsed: int

+ updatingNumOfUsed:(numOfNutritionPlanUsed): avoid
+ getEmergencyAddress(userID, emergencyAddress): list
+ changeDateOfBirth(userID, dateOfBirth): avoid

MedicalProfessionalAccount
- medicalProfessionalID: string {key}
- specialization: string
- licenseNumber: string
- workSchedule: list
- contactInfo: list

+ generateWorkTable(licenseNumber, workSchedule):list
+ changeWorkTable(licenseNumber, workSchedule):void
+ getInformation(licenseNumber): list
+ changeContact(licenseNumber): avoid

SystemNotification
- notificationID: string {key}
- notificationText: string
- notificationTitle: string
- timestamp: string
- status: boolean
- administratorID: string

+ notify(notificationID,administratorID): avoid
+ generateNotification(administratorID, notificationText): list
+ changeStatus(notificationID status): avoid
+ changeText(notificationID, InotificationText): avoid

NutritionPlan
- planID: string {key}
- mealPlan: list
- caloricIntake: float
- description: string

+ getPlanDetails(planID): list
+ changeMealPlan(planID, mealPlan): avoid
+ changeCaloricIntake(planID, caloricIntake): avoid
+ changeDescription(planID, description): avoid

PaymentDetails
- cardNumber: string {key}
- cardHolderName: string
- cardExpirDate: string
- bankName: string
- cardCVV: int
- paidID: string

+ getPaidHistory(paidID): list
+ getCardNumber(paidID): string
+ getHolderName(paidID): string
+ getBankName(paidID): string

Appointment
- appointmentID: string {key}
- date: string
- time: string
- location: string
- status: boolean
- userID: string
- medicalProfessionalID: string

+ bookAppointment(userID,medicalProfessionalID,date,time):list
+ changeBookedTime(appointmentID, date,time): avoid
+ changeStatus(appointmentID, status): avoid
+ changeLocation(appointmentID, location): avoid

HealthMonitoring
- dataRecordID: string {key}
- bloodPressure: float
- heartRate: float
- medicalConditions: string
- allergies: string
- appointmentID: string
- emergencyAlarm: boolean

+ getAllHealInfor(dataRecordID): list
+ updateHearRate(dataRecordID,heartRate): avoid
+ updateBloodPressure(dataRecordID,BloodPressure): avoid
+ activeAlarm(emergencyAlarm): avoid

Medication
- medicationID: string {key}
- medicationName: string
- dosage: flloat
- frequency: list
- date: list

+ getMedicalDetails(medicationID): list
+ changeDosage(medicationID,dosage): avoid
+ changeFrequency(medicationID,dosage): avoid
+ changeDate(medicationID, date): avoid

MedicationHistory
- medicationID: string {key}
- dataRecordID: string {key}
- historyID: string
- suggestion: string
- description: string
- appointmentID: string

+ generateHistory(dataRecordID,medicationID): string
+ getAllDetails(appoinmentID): list
+ writeSuggestion(historyID,suggestion): avoid
+ writeDescription(historyID, description): avoid
- dataRecordID: string

Figure 4: Design Class Diagram

18. Design System Controls and Security
18.1 Access Controls

Access Control Systems are electronic systems that allow authorized personnel to enter controlled, restricted, or secure spaces by presenting an access credential to a credential reader (Alperen et al., 2012). The proposed information system plays a crucial role in ensuring the security and privacy of sensitive health-related data. Here are some potential access control measures specific to the LifeCare360 system:

- **User Authentication**: Implement a robust user authentication system to verify the identity of users accessing the LifeCare360 system. This should include secure login credentials (username and password) and the possibility of multifactor authentication for added security.
- **Role-Based Access Control**: Define roles within the system (e.g., medical professionals, administrators, customers) and assign specific permissions and access levels to each role. This ensures that users can only access the features and data relevant to their roles.
- **Patient Consent and Data Sharing**: Implement controls that allow patients to grant or revoke access to their health data. Ensure that only authorized medical professionals and institutions can access patient records with proper patient consent.
- **History access**: Maintain detailed logs of user activities and access attempts within the system. These logs can be invaluable for monitoring and investigating any unauthorised access or suspicious activities.
- **Access Revocation**: Develop mechanisms to promptly revoke access for users without permission to access the system, such as terminated employees or patients who withdraw consent.
- **Regular Security Audits**: Conduct periodic security audits and assessments to identify vulnerabilities and weaknesses in access controls. Address any issues promptly to maintain a secure environment.
- **Data Segmentation**: Implement data segmentation to ensure that users can only access data relevant to their responsibilities. For example, a medical professional should only access the health records of their assigned patients.
- **User Training and Awareness:** Educate users, including medical professionals, administrators, and support staff, about the importance of access control, data security, and best practices for maintaining system integrity.

- **Incident Response Plan:** Develop a well-defined incident response plan to handle security incidents and breaches promptly and effectively. This plan should include procedures for identifying, reporting, and mitigating unauthorized access or data breaches.

While these access control measures are not exhaustive, they provide a foundation for securing the LifeCare360 system and its sensitive health-related data. Access control is a critical component of any healthcare system to ensure patient information's confidentiality, integrity, and availability (Smith et al.,2010).

18.2 Encryption

In the LifeCare360 System, data encryption is employed as a fundamental security measure to protect both stored and transmitted data in the online environment (Satzinger et al., 2015). A substantial amount of confidential information, including credit card details, patients' medical histories, and personal records, is transmitted and stored on the Internet. To enhance security, the system incorporates encryption mechanisms for both data in transit and data at rest.

Encryption Type:

For data in transit, encryption is implemented to secure the communication between users' devices and the system's servers. Industry-standard encryption protocols like TLS/SSL are utilized to ensure data remains confidential during transmission.

Simultaneously, for data at rest, encryption is used to safeguard sensitive information stored within the system's databases and on servers. Robust encryption algorithms and secure key management practices protect this data.

Key Management:

Furthermore, within the LifeCare360 System, a meticulous approach to key management is implemented to ensure the security and accessibility of encryption keys. This includes:

- **Key Generation:** The system employs strong key generation techniques to create unique and secure encryption keys.

- **Key Distribution:** Secure distribution practices are applied to ensure that encryption keys are provided only to authorized personnel and system components.

- **Key Rotation:** The system follows key rotation policies, periodically changing encryption keys to enhance security and reduce the impact of potential key compromises.

- **Key Backup and Recovery:** Comprehensive key backup and recovery mechanisms are established, ensuring data accessibility even in cases of key loss or system failures.

- **Access Control**: Stringent access control measures are in place to restrict access to key management processes, mitigating the risk of unauthorized key alterations.

The LifeCare360 System aims to provide a comprehensive and robust security framework that addresses data protection in transit and at rest. These encryption and key management practices, both within the system and as defined by Satzinger et al. (2015), contribute to the confidentiality and integrity of sensitive healthcare information, ensuring patient data remains secure and inaccessible to unauthorized parties.

18.3 Digital Signatures

Within the LifeCare360 System, digital signatures play a pivotal role in ensuring the security and reliability of sensitive healthcare data and communications. This sophisticated security technique relies on digital certificates, which encapsulate an organization's identity and its corresponding public key (Satzinger et al.,2015). These certificates are encrypted and validated by a trusted third party, known as the Certifying Authority.

When a document or message is digitally signed within our system, it undergoes encryption using a sender's private key. The crucial aspect of this process is that only the correct public key, widely recognized and often integrated into web browsers, can decrypt the encrypted content.

This approach offers several significant advantages for LifeCare360:

- **Authentication:** Digital signatures serve as a trust-enhancing mechanism by allowing us to verify the identity of document senders, bolstering the integrity of our system's communications.

- **Data Integrity:** By utilizing digital signatures, we can promptly detect any unauthorized modifications to documents during transmission. Should tampering occur, the digital signature will fail to match, raising a red flag.

- **Non-Repudiation:** Once a document or message is digitally signed, senders cannot deny their involvement or the content's authenticity. This feature holds paramount importance, particularly in legal and regulatory scenarios.

- **Certified Public Key:** We enhance trust by using digital certificates, issued by a Certifying Authority, to validate the legitimacy of public keys and their association with the claimed organizations.

Moreover, we implement the following features to fortify our digital signature capabilities:

- **Digital Signature Validation:** Our system employs digital signatures to verify the genuineness and integrity of electronic documents like medical reports and consent forms. Robust validation checks are in place to ensure the signatures are genuine.
- **Public Key Infrastructure (PKI):** We've established a robust PKI infrastructure to manage digital certificates and keys for digital signatures proficiently. This entails the issuance and revocation of certificates as the need arises.
- **User Authentication:** Leveraging digital signatures, we've fortified user authentication and authorization mechanisms for critical actions within the system. This ensures the utmost security for our users in their interactions with LifeCare360.

18.4 Secure Transactions

In the LifeCare360 System, we place paramount importance on secure transactions to ensure the confidentiality and integrity of sensitive healthcare data during data transmission. To accomplish this, we employ a comprehensive and layered security strategy that integrates industry-standard protocols and cutting-edge technologies.

- **Data Encryption:** Our system relies on the robust encryption protocols of Secure Sockets Layer (SSL) and Transport Layer Security (TLS) to establish a secure and encrypted communication channel between users' devices and our servers. This encryption guarantees that all data, including patient records and medical reports, remains confidential and shielded from any potential eavesdropping or unauthorized access.

- **Network-Level Security:** To provide an added layer of protection at the network level, we implement Internet Protocol Security (IPSec). This high-level security protocol ensures that every data packet transmitted across the network is encrypted and authenticated. Regardless of the network's potential vulnerabilities, data remains secure throughout its entire journey.

- **Web Interaction Security:** Our web-based components, such as the patient portal and administrative interfaces, employ the widely recognized and trusted Hypertext Transfer Protocol Secure (HTTPS). This standard protocol not only ensures the privacy of web interactions but also verifies the identity of our web servers, effectively preventing man-in-the-middle attacks and unauthorized access to sensitive data.

Additional Security Measures: In addition to these core security measures, we implement various other safeguards:

- **Secure Payment Processing**: If the system handles financial transactions, such as premium services, we adhere to industry security standards such as Payment Card Industry Data Security Standard (PCI DSS) compliance to guarantee secure payment processing.

- **Secure API Communications**: For any system integrations with external services or applications via APIs, we implement secure API authentication and authorization mechanisms. Our implementation follows best practices to prevent any unauthorized access.

- **Secure File Transfers:** In cases where file transfers are part of the system's functionality, such as medical records uploads, we utilize secure file transfer protocols. We also ensure rigorous validation and scanning of uploaded files to mitigate potential security threats.

Through this comprehensive approach to secure transactions, LifeCare360 stands committed to maintaining the trust of its users and ensuring the utmost confidentiality and reliability of patient data across all system interactions.

19. Unit Test the Software

In a complex project like LifeCare360, which involves multiple subsystems, database interactions, and external services, the use of test driver code and stubs offers several advantages:

- Isolation Testing
- Parallel Development
- Early Testing
- Interactions with External Systems

The use of test driver code and stubs contributes to the reliability, maintainability, and successful development of the LifeCare360 system by systematically validating each component's functionality and interaction with the larger ecosystem.

Below are the test driver code and stubs provided for the two classes, Item and PaymentDetails, are essential components of a software development project like LifeCare360.

for Device Class:

```
// Test driver for functions in Device
main() {
        // Declare input parameters and values
        String deviceID = "D001";
        String userID = "U001";
        String deviceType = "Mobile";

        // Perform test
        Device device = new Device(deviceID, userID, deviceType);

        // Display results
        device.LoadInfo(userID);
        System.out.println("Loaded Info: " + device.GetUsage());

        String description = "Updated Description";
        device.GetHardwareDetails(deviceID, device.hardware);
        System.out.println("Hardware Details: " +
device.GetSoftwareDetails(devic  eID));

        // Test ChangeDescription method
        device.GetUsage();
        System.out.println("Usage Details: " + device.GetUsage());
        }

// Stub method for loading information based on userID
        void LoadInfo(String userID) {
        System.out.println("Stub: LoadInfo called for userID: " + userID);
        }

// Stub method for getting software details based on deviceID
        List<String> GetSoftwareDetails(String deviceID) {
        System.out.println("Stub: GetSoftwareDetails called for deviceID: "
+ deviceID);
        return List.of("Software1", "Software2"); // Stub value
        }

// Stub method for getting hardware details based on deviceID and hardware
list
        List<String> GetHardwareDetails(String deviceID, List<String>
hardware) {
```

```
        System.out.println("Stub: GetHardwareDetails called for deviceID: "
+ deviceID);
        System.out.println("Hardware List: " + hardware);
        return List.of("HardwareDetail1", "HardwareDetail2"); // Stub value
        }

// Stub method for getting device usage details
        List<String> GetUsage() {
        System.out.println("Stub: GetUsage called");
        return List.of("UsageDetail1", "UsageDetail2"); // Stub value
        }
```

for PaymentDetails Class:

```
// Test driver for functions in PaymentDetails
main() {
        // Declare input parameters and values
        String cardNumber = "1234-5678-9012-3456";
        String cardHolderName = "John Doe";
        String cardExpireDate = "12/25";
        String bankName = "Bank of XYZ";
        int cardCVV = 123;
        String paidID = "P001";

        // Perform test
        PaymentDetails payment = new PaymentDetails(cardNumber,
cardHolderName, cardExpireDate, bankName, cardCVV, paidID);

        // Display results
        System.out.println("Payment History: " +
payment.GetPaidHistory(paidID));
        System.out.println("Card Number: " +
payment.GetCardNumber(paidID));
        System.out.println("Card Holder Name: " +
payment.GetHolderName(paidID));
        System.out.println("Bank Name: " + payment.GetBankName(paidID));
        }

// Stub method for getting payment history based on paidID
        List<String> GetPaidHistory(String paidID) {
        System.out.println("Stub: GetPaidHistory called for paidID: " +
```

```
paidID);
        return List.of("Payment1", "Payment2"); // Stub value
        }

// Stub method for getting card number based on paidID
        String GetCardNumber(String paidID) {
        System.out.println("Stub: GetCardNumber called for paidID: " +
paidID);
        return cardNumber; // Stub value
        }

// Stub method for getting card holder name based on paidID
        String GetHolderName(String paidID) {
        System.out.println("Stub: GetHolderName called for paidID: " +
paidID);
        return cardHolderName; // Stub value
        }

// Stub method for getting bank name based on paidID
        String GetBankName(String paidID) {
        System.out.println("Stub: GetBankName called for paidID: " +
paidID);
        return bankName; // Stub value
        }
```

20. Deploy the Solution

20.1 Initialising Data

In the context of 360LifeCare, the process of initializing data is a critical step in ensuring that the operational system has a fully populated database ready to support ongoing healthcare processes. This step involves acquiring the necessary data required for the system's startup from various sources to ensure a seamless transition (Satzinger et al., 2015). Here's how this process is implemented:

Data Sources: Data required at the system's startup is obtained from multiple sources, including:

- Files or databases of the existing system that is being replaced.
- Manual records containing vital healthcare information.
- Data repositories from other systems within the healthcare organization.

- Valuable user feedback is gathered during the normal operation of the system.

The responsibility for initializing data typically falls upon the **system administrators or data management** teams within the organization. These professionals are tasked with ensuring that the operational system has a fully populated database ready to support ongoing healthcare processes.

Reuse of Existing Databases: To streamline the data initialization process, existing databases are leveraged. This involves several actions:

- Modification or updating of existing data to align with the new system's requirements.
- Reloading databases with the most current and accurate information.
- Copying and converting data from legacy formats into a compatible structure for 360LifeCare.
- Exporting and importing data from distinct Database Management Systems (DBMSs) to ensure compatibility and data integrity.
- Performing data entry from paper documents, if necessary, to digitize critical healthcare records.

By implementing these strategies, 360LifeCare ensures that its database is fully populated with accurate and relevant data, supporting the seamless transition to the new system. This meticulous process guarantees that **healthcare professionals** have access to essential patient information from day one of system operation, ultimately enhancing patient care and system effectiveness.

20.2 Training Users

User training in 360LifeCare will be conducted by a dedicated training team comprising experienced trainers and educators. These professionals have in-depth knowledge of the system's functionalities and are skilled in conveying this information effectively to users and operators. The training team will work closely with the organization's IT department and subject matter experts to deliver tailored training programs. The training programs are designed to cater to the varying skill levels and roles of users within the 360LifeCare system:

- **Training for End Users**:
  - For healthcare professionals, such as doctors, nurses, and administrative staff.
  - Hands-on training emphasizing specific business processes relevant to their roles, such as patient record management, appointment scheduling, or billing.
  - Interactive sessions with practice exercises, Q&A segments, and one-on-one tutorials to address individual needs.
- **System Operator Training:**
  - Geared towards system administrators and IT staff responsible for managing and maintaining the 360LifeCare infrastructure.

- o Self-study resources, technical guides, and access to advanced training materials for operators who may have a solid foundation.
- o Emphasis on in-depth technical knowledge, system configuration, and troubleshooting skills specific to their responsibilities.

These training programs are designed to ensure that each user, whether a healthcare professional or system operator, is equipped with the skills and knowledge required to effectively use and manage 360LifeCare. Training is a critical component of the system's successful implementation, promoting efficient healthcare processes and the delivery of high-quality services. In addition to training, the following documentation is made available to support users and operators:

- **System Documentation:** This includes comprehensive descriptions of the system's requirements and architecture. It serves as a valuable resource for system maintenance and future upgrades, ensuring that the system remains current and efficient.
- **User Documentation:** User-centric documentation is provided to guide both end users and system operators in their interactions with 360LifeCare. This documentation outlines how to navigate, utilize, and make the most of the system's features, empowering users to leverage its capabilities effectively.

By combining robust training programs with accessible documentation, 360LifeCare ensures that its users and operators are well-equipped to harness the full potential of the system, promoting efficiency, accuracy, and quality in healthcare processes and service delivery.

20.3 Establishing the production environment

In the context of the 360LifeCare system, establishing the production environment is a critical phase that involves configuring servers, databases, networking components, and the necessary infrastructure to ensure the system's efficient and effective operation.

On the hardware side, provisioning servers with sufficient CPU, RAM, and storage capacity is essential to meet the system's demands. Additionally, storage solutions like Network-Attached Storage (NAS) or Storage Area Network (SAN) systems are deployed to manage patient records, medical data, and system logs. High-quality networking components, such as routers, switches, and firewalls, are set up to facilitate secure and smooth data flow. Database servers, whether relational or NoSQL, play a crucial role in managing and storing patient information.

Regarding infrastructure configuration, specific hardware components undergo careful configuration, including robust servers with ample CPU, RAM, and storage capacity. Networking components such as routers, switches, and firewalls are set up to facilitate secure data flow. Load balancers may also be deployed to efficiently distribute traffic, ensuring the smooth operation of the system.

Choosing the appropriate hosting or cloud service is a critical decision. This selection process involves determining whether on-premises infrastructure, a private cloud, or a public cloud service like Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP) is the best fit. The choice is guided by factors such as scalability needs, cost considerations, and alignment with the system's technology stack.

Reliability holds paramount importance in a healthcare system. To ensure uninterrupted service availability, redundancy and failover mechanisms are put in place. These mechanisms may involve setting up backup servers, implementing database replication, and employing automated failover strategies.

Security measures are a top priority to protect patient data and ensure regulatory compliance. This includes deploying security software, firewalls, intrusion detection and prevention systems, and implementing encryption protocols for data in transit and at rest.

Each of these aspects plays a vital role in creating a robust and efficient production environment for the 360LifeCare system, ensuring the integrity of healthcare services and patient data.

20.4 Deployment Method

The chosen deployment method for the 360LifeCare system will be phased deployment. In the context of introducing the 360LifeCare system, a phased deployment strategy is being considered. This approach involves the gradual introduction of the new system in stages, and it offers a balanced perspective between managing risk and controlling costs. It is particularly appealing for 360LifeCare due to its potential suitability. As a healthcare management system, the criticality of patient care and data continuity is paramount. Phased deployment aligns with this need by minimizing disruptions during the transition.

One of the key advantages of phased deployment is its capacity to facilitate a learning process for the organization. By implementing the new system incrementally, the organization can gain insights from each phase before advancing to the next. This incremental learning can be exceptionally valuable in a healthcare context, where patient data and system reliability are of utmost importance. The phased approach aligns with the organization's commitment to a seamless and secure transition to 360LifeCare while minimizing potential challenges and disruptions along the way.

20.5 Managing change and version control

The software development team will utilise GitHub, a cloud-based hosting service for Git repositories, to efficiently manage and coordinate programming tasks throughout the development of 360LifeCare. This process involves distinct stages and versions:

Development Version: The development version signifies an initial, incomplete iteration of the system primarily meant for in-house development purposes. During this phase, developers concentrate on constructing and refining the system's features and functionalities. It serves as a developmental stage where new components and functions are introduced. However, this version is not yet suitable for external use.

Alpha Version: The alpha version serves as a test version of 360LifeCare, albeit still incomplete. It is poised for rigorous integration and usability testing. This stage often involves internal testing by the development team to identify and rectify critical issues and ensure that the core functionality operates as expected.

Beta Version: The beta version represents a more stable iteration of 360LifeCare, ready for testing by end users over an extended period. This stage is pivotal for gathering feedback and fine-tuning the system based on user experiences and requirements. Beta testers may identify and report any remaining bugs, leading to further refinements before transitioning to the production stage.

Production Version: Commonly referred to as the release version or production release, this is the formal system version that is distributed to users or made operational for long-term use. It signifies a fully functional and rigorously tested version of 360LifeCare, considered ready for widespread adoption by healthcare professionals, patients, and other stakeholders.

Maintenance Release: The maintenance release comprises subsequent system updates that primarily focus on providing bug fixes and implementing minor changes to existing features. These updates are designed to preserve the system's performance, reliability, and security in response to user feedback and evolving requirements.

Through the systematic execution of these stages in change and version control, 360LifeCare ensures a structured and iterative approach to system development, testing, and maintenance. This streamlined process effectively manages the complexity of system evolution through multiple versions while upholding the expected quality, reliability, and security standards essential in a healthcare management platform. The use of GitHub enhances collaboration and version control, contributing to a more efficient and organized development workflow.

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