



The Healthcare Hub: Empowering International Students' Healthcare

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Abstract

This research project introduces the development of a medical website specifically designed to address international students' health and well-being needs. The proposed website addresses the healthcare challenges international students studying in the UK face. As the number of international students grows, providing adequate support in navigating unfamiliar healthcare systems and addressing their health-related concerns becomes crucial.

This comprehensive website will offer a wealth of information on common healthcare issues relevant to international students, including sleep disorders, diet and nutrition, language barriers, and general wellness tips. It will also provide practical how-to guides and resources to help students understand and access the local healthcare services and manage insurance policies.

To enhance the user experience, the website will incorporate interactive tools such as an AI-powered medical chatbot, BMI calculator, and a dietary planner application. It will be designed with a responsive layout to ensure seamless browsing on various devices, making it accessible to students using computers, smartphones, or tablets.

By empowering international students with relevant information and resources, the proposed website seeks to promote their overall well-being, academic success, and positive experiences during their educational journey abroad. It aims to bridge the gap between healthcare services and international students, fostering a supportive environment and ensuring their health needs are met effectively.

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Table of Contents

Abstract.....	1
Acknowledgments.....	2
Table of Figures	5
Table of Tables	5
1. Introduction	6
1.1. Problem Statement	6
1.2. Aims and Objectives	7
2. Background Material	8
2.1. Healthcare Challenges of International Students	9
2.2. Technological Solutions in Healthcare.....	9
2.3. Websites as Healthcare Resources	10
2.4. AI-Driven Chatbots in Healthcare: A Growing Trend	10
2.5. The Impact of AI-Driven Chatbots on Public Health.....	11
2.6. Ethical and Regulatory Considerations for AI-Driven Solutions.....	11
2.7. Gaps in the Literature	12
2.8. Related Commercial products	13
3. Approach	17
3.1. Medical Information Source (UK NHS)	18
3.2. Software Development Methods	19
4. Product.....	21
4.1. Requirement Specification	21
4.2. Design.....	26
4.3. Technology Stack	32
5. Implementation.....	36
5.1. Chatbot Implementation.....	36
5.2. Website Implementation.....	50

5.3. Deployment of the Website	56
6. Result and Analysis	59
6.1. Testing	59
6.2. Future Scope.....	84
6.3. Ethical Considerations.....	86
7. Conclusions	88
8. Reflection.....	89
References.....	90
Appendices.....	94
Appendix A: Initial Project Work Plan.....	94
Appendix B: The NHS Website	96
Appendix C: Azure Dashboard	96
Appendix D: Chatbot Architecture in Azure	97
Appendix E: Chatbot Final Product	97
Appendix F: Flask Application Directory Structure	98
Appendix G: Final Product	98
Appendix H: Testing Evidence.....	101
Appendix J: Google Lighthouse Report.....	105
Appendix K: Github Repository	111

Table of Figures

Figure 1: Use Case Diagram for the website	28
Figure 2: Use Case Diagram for the Chatbot.....	29
Figure 3: Configuration settings used in ParseHub for web scraping.	37
Figure 4: Excel file displaying the extracted medical condition data.	38
Figure 5: The process of adding sources for the knowledge base within Language Studio.....	39
Figure 6: Managing sources in Language Studio.	40
Figure 7: The process of creating question-answer pairs within Language Studio.	41
Figure 8: An example of a question-answer pair within the Language Studio knowledge base.	42

Table of Tables

Table 1: AAA testing Example	60
Table 2: Table for Functional Testing-1	61
Table 3: Table for Functional Testing-2	62
Table 4: Table for Functional Testing-3	63
Table 5: Table for Functional Testing-4	65
Table 6: Table for Functional Testing-5	67
Table 7: Table for Chatbot Accuracy Testing.....	69
Table 8: Table for Chatbot Conversational Flow Testing	73
Table 9: Table for Chatbot Boundary Testing	74
Table 10: Table for Chatbot Error Handling Testing	75
Table 11: Graph for Average Response Time of Chatbot	77
Table 12: Table for Non-Functional Testing-1	79
Table 13: Table for Non-Functional Testing-2	82

1. Introduction

The globalization of higher education has seen a significant surge in international students studying abroad. Amid their pursuit of academic excellence and cultural immersion, these students often face daunting healthcare challenges. Accessing healthcare services can be especially challenging due to language barriers, unfamiliar systems, and differing cultural norms. Common health issues include mental health concerns, infectious diseases, vaccination requirements, and general wellness. However, limited availability, high costs, and transportation barriers hinder students from seeking essential medical attention.

To address these challenges and promote the health and well-being of international students, we propose creating a comprehensive website. This website will serve as a resource centre, providing vital information, guides, and resources to empower international students in managing their healthcare effectively. The project aims to equip international students with knowledge and tools to navigate local healthcare systems and make informed health decisions. Interactive features, such as an AI-powered health chatbot and BMI calculator, will cater to students from diverse linguistic and cultural backgrounds.

1.1. Problem Statement

This study focuses on healthcare challenges faced by international students in foreign countries. These challenges result from language barriers, cultural disparities, mental health stigma, and difficulties accessing healthcare services. These obstacles often lead to suboptimal healthcare resource utilization, impacting the international student population's health.

As an international student arriving in the UK, I was confronted with a daunting healthcare system characterized by unfamiliarity and uncertainty. Questions swirled in my mind – How do I register with a GP? What do I do in a medical emergency? How does the prescription system work? These questions mirrored the very problem the healthcare platform aimed to solve. I found myself at the intersection of the challenge and the solution.

My early days as an international student were characterized by palpable frustration due to the scarcity of reliable healthcare information. While the university's orientation provided a basic

overview, it often lacked the practical details needed for day-to-day navigation. Online sources, too, offered a mixed bag of information, often conflicting or outdated. Government websites and leaflets only seemed to add to the confusion.

This personal frustration ignited my commitment to the healthcare platform project. I understood firsthand the need for clear, concise, and up-to-date information about healthcare in the UK. What started as an academic pursuit evolved into a dedicated mission. It transformed from addressing my personal confusion to ensuring that every international student can access the clarity they deserve. This problem gains significance with the globalization of education, increasing international students studying abroad. However, their healthcare needs are often inadequately met, perpetuating underutilization and suboptimal health outcomes.

1.2. Aims and Objectives

The project aims to design and develop a comprehensive website addressing international students' healthcare needs abroad. It will systematically tackle common healthcare issues, provide tools, resources, and knowledge, and enhance their educational journey.

Objectives:

1. **Research Analysis:** Conduct in-depth research to identify prevalent healthcare challenges for international students studying abroad, gathering insights from reliable sources and online communities.
2. **User-Centred Website:** Design a user-friendly website with an intuitive interface, ensuring accessibility across devices and catering to diverse cultural backgrounds.
3. **Comprehensive Information and Guidance:** Offer information on healthcare services, including primary care, mental health support, emergency services, and specialist care, along with guidance on navigating the host country's healthcare system.

4. **AI-Powered Tools:** Incorporate interactive tools, such as an AI chatbot, for real-time healthcare queries and access to health-related information.
5. **Testing and Iteration:** Rigorously test website features and functionalities, implementing an iterative process to enhance its effectiveness continually.

By achieving these objectives, the project aims to provide a dependable online platform empowering international students to manage their health while studying abroad, fostering academic success with improved well-being. To view the prototype in action, please watch the following video on YouTube: <https://youtu.be/pLEux1Dbj24>

In subsequent sections, we will delve into the website's key components, outlining how it addresses common healthcare issues and provides tools and resources. We'll also explore research methodology and requirement analysis, ensuring the website meets the needs of international students studying abroad.

2. Background Material

This chapter presents a comprehensive review of existing literature related to the healthcare challenges faced by international students and the role of technology, particularly websites, in addressing these challenges. The literature review aims to provide insights into the current state of healthcare support available to international students, identify gaps in existing solutions, and highlight the potential of a dedicated website to effectively address these shortcomings.

2.1. Healthcare Challenges of International Students

International students often encounter unique challenges when navigating healthcare systems in a new country. About 80% of international students reported changing their views to access healthcare because of the COVID-19 pandemic (Masai et al., 2021). These challenges encompass navigating unfamiliar healthcare systems, language barriers, cultural differences in health practices, mental health concerns, and access to essential healthcare services (Tang et al., 2018). The internationalization of higher education has led to an increase in the number of international students, but their healthcare needs are often not adequately met (Anoushirvani and Golaghaie, 2019). Additionally, international students may experience difficulties in adapting to a new healthcare system and may suffer from psychological symptoms such as feelings of inferiority, confusion, homesickness, loneliness, and anxiety (Naro, 2019). It is important for educational institutions to provide support and resources to help international students navigate the healthcare system and ensure their well-being (Tang et al., 2018). These challenges collectively contribute to suboptimal utilization of healthcare services among international students.

2.2. Technological Solutions in Healthcare

Technological solutions in healthcare have the potential to improve early diagnosis and management of diseases, leading to better health outcomes and reduced healthcare costs (Mehrotra and Joshi, 2021). (Anzböck and Dustdar, 2005) explores the modelling and implementation of medical web services, demonstrating the use of web service protocols like SOAP (Simple Object Access Protocol), WSDL (Web Services Descriptive Language), and more. These technologies offer potential solutions for streamlining medical services delivery. (Aljaberi et al., 2018) demonstrate that perceived quality of care significantly influences international students' satisfaction and behavioural intentions. This highlights the capacity of technology-driven solutions to enhance healthcare services for international students. Additionally, the presence of websites and online platforms, as observed in (Tang et al., 2018) provides a means to overcome challenges such as understanding health services, high costs, and communication barriers. This indicates the potential of AI-driven technologies to enhance the quality of healthcare services for international students. Such technologies offer convenient platforms for healthcare access and information dissemination.

2.3. Websites as Healthcare Resources

Both (Nair and Fellmeth, 2017) and (Tang et al., 2018) underscore the importance of online platforms in offering healthcare information, support, and communication channels. Websites are emerging as vital resources for international students facing healthcare challenges. (Tang et al., 2018) indicates that websites serve as essential tools for international students to navigate host country health services. Similarly, (Nair and Fellmeth, 2017) highlight the significance of curricular reform in medical education. Online platforms play a pivotal role in aligning medical education with national health priorities and providing updated and relevant healthcare information to international students.

2.4. AI-Driven Chatbots in Healthcare: A Growing Trend

AI-driven chatbots have emerged as a transformative trend in the healthcare industry. These chatbots have revolutionized patient interactions and healthcare delivery through their ability to understand natural language and provide personalized medical advice (Chow and Xu, 2021).

This advancement facilitates direct communication between patients and healthcare providers, offering quick and accurate responses to patient queries. These intelligent chatbots offer quick and accurate responses to patient queries, improving the overall patient experience and reducing the burden on healthcare providers. AI-driven chatbots excel in their capacity to offer rapid and accurate information, enhancing the overall patient experience and reducing the burden on healthcare providers (Chow and Xu, 2021). The integration of chatbots with Electronic Health Records (EHR) systems further enhances their capabilities, enabling seamless data exchange and informed decision-making during medical consultations (Maher et al., 2022).

Despite their numerous advantages, challenges related to privacy, security, and continuous updates must be addressed to ensure successful implementation in healthcare settings. Overall, AI-driven chatbots hold immense potential in shaping the future of healthcare services.

2.5. The Impact of AI-Driven Chatbots on Public Health

The integration of Artificial Intelligence (AI) into the healthcare landscape has birthed transformative tools, among which AI-driven chatbots stand as a promising innovation. Chatbots, fortified by AI capabilities, have emerged as potent vehicles for disseminating health information, promoting preventive measures, and providing personalized healthcare services. Drawing from the perspectives provided by (Chow and Xu, 2021) underscores the dynamic applications of chatbots, particularly in cancer therapy, spanning diagnosis, treatment, monitoring, and health promotion.

Yet, the integration of AI-driven chatbots in public health is not devoid of challenges, as expounded by (Lebedev, 2021). Ethical, security, and regulatory concerns must be addressed to ensure the responsible deployment of these technologies.

2.6. Ethical and Regulatory Considerations for AI-Driven Solutions

The integration of Artificial Intelligence (AI) into healthcare systems has introduced transformative capabilities, particularly through AI-driven solutions such as chatbots. However, as the healthcare landscape evolves with these innovative technologies, a critical examination of the ethical and regulatory dimensions becomes imperative. While AI-driven solutions hold immense potential for improving healthcare access and patient outcomes, their deployment raises complex ethical questions. The rapid advancement of technology can outpace the establishment of ethical frameworks, leading to potential pitfalls. For instance, AI-driven chatbots in healthcare require careful consideration of issues like data privacy, patient consent, and transparency in algorithmic decision-making. Ensuring that technological innovation aligns with ethical principles becomes a crucial endeavour.

Chow and Xu (2021) highlight the transformative impact of AI-driven chatbots in healthcare. However, it also underscores the need for addressing challenges related to privacy, security, and continuous updates. This highlights the critical balance that must be maintained between technological advancement and the ethical implications associated with patient data privacy and security.

The dynamic nature of AI-driven solutions necessitates the formulation of robust regulatory frameworks. (Lebedev, 2021) underscores the need for global standardization to maintain consistency and clarity in AI implementation across diverse

healthcare contexts. Regulatory bodies play a pivotal role in establishing guidelines that govern AI use, ensuring that solutions adhere to ethical standards and prioritize patient safety. These frameworks also encompass issues such as data security, bias mitigation, and accountability.

Anzböck and Dustdar (2005) emphasize the importance of web service protocols in medical applications. While their paper focuses on technical aspects, the establishment of standardized protocols can also extend to ethical considerations in AI-driven healthcare solutions, ensuring that AI chatbots adhere to predefined standards of ethical behaviour.

2.7. Gaps in the Literature

The exploration of the literature reveals several gaps that warrant further research. While the identified papers provide valuable insights into the potential and challenges of AI-driven chatbots in healthcare, there is a need for more extensive studies that delve deeper into the nuances of ethical and regulatory considerations. Specifically, further research could explore the long-term ethical implications of AI-driven chatbots, the development of standardized ethical frameworks, and strategies for addressing the evolving challenges of data privacy and security in healthcare settings. Moreover, investigating the patient perspectives and concerns regarding AI-driven healthcare technologies can provide a holistic understanding of their impact and guide the formulation of comprehensive ethical guidelines.

As demonstrated by the papers (Anzböck and Dustdar, 2005), (Lebedev, 2021), and (Chow and Xu, 2021), each technology possesses its own set of ethical and regulatory challenges. However, an integrated investigation that encompasses AI, chatbots, and websites in healthcare is essential for a holistic understanding of their impact. Such a study could provide a more complete picture of how these technologies interplay within the healthcare ecosystem, enabling a more robust framework for ethical decision-making and regulatory guidance.

The application of artificial intelligence (AI) in healthcare holds significant promise, particularly in tasks such as breast cancer detection and chronic pain management (Woollaston, 2022). However, this promise is accompanied by critical challenges related to data limitations, which form the bedrock of AI algorithms. These concerns

underscore the importance of responsible data management and utilization in AI applications.

In parallel, it is worth noting that the implementation of AI in healthcare does not come without its set of ethical and practical concerns. The unique abilities of human healthcare providers, such as empathy, intuition, and extensive clinical experience, remain unparalleled (Altamimi et al., 2023). However, it is crucial to acknowledge that AI cannot fully replace human doctors due to its limitations. AI systems may generate false positives and false negatives, raising concerns about their reliability in critical medical decisions. Future research should delve into strategies for minimizing these errors and clarifying the appropriate roles of AI in healthcare alongside human practitioners.

2.8. Related Commercial products

The realm of technological innovation in healthcare has given rise to an array of commercial products aimed at addressing the unique healthcare challenges faced by international students. These solutions leverage cutting-edge technology to improve access to quality healthcare services, facilitate effective communication, and nurture a supportive healthcare ecosystem. Several notable commercial products have emerged in recent years, contributing to the advancement of healthcare support for international students.

2.8.1. MyStudentMedical: Enhancing Student Healthcare

MyStudentMedical, operated by The Allen J. Flood Companies, Inc., is a renowned online platform dedicated to enhancing healthcare services for students. With over six decades of experience, MyStudentMedical collaborates with educational institutions, insurance brokers, and risk management departments to cater to the unique healthcare needs of students and their families.

Functionalities:

- **Plan Brochure:** Provides a detailed breakdown of plan benefits, costs, and covered services, aiding informed decision-making.

- **Online Enrolment:** Streamlines enrolment through a user-friendly form, accessible even on mobile devices.
- **Online Waiver:** Enables students to opt out of provided insurance plans by submitting existing insurance details online.
- **Claim Guidelines & Forms:** Offers clear guidelines and forms to initiate and navigate the claims process efficiently.

2.8.2. HealthBuddy+: A Journey in Pandemic Support and Beyond

HealthBuddy+ is a collaborative initiative by UNICEF and WHO, offering reliable COVID-19 information. Since its inception in 2020, it has engaged over 850,000 individuals, providing essential guidance during the pandemic.

Functionalities:

- **Evidence-Based Information:** Offers trustworthy information on COVID-19, serving as a guiding light during uncertain times.
- **Preventive Measures:** Encourages adoption of preventive measures like hand hygiene and distancing to safeguard health.

2.8.3. StudentCare: Empowering Health and Well-being

StudentCare offers an advanced platform with personalized support for healthcare management. Beyond appointments and resources, it enhances well-being through AI-driven assistance.

Functionalities:

- **Appointment Scheduling:** Allows users to book medical appointments seamlessly.
- **AI-Driven Chatbot:** Provides instant health responses, enabling quick access to information.
- **Comprehensive Support:** Offers holistic healthcare management, from appointments to AI assistance.

2.8.4. HealthCompanion

HealthCompanion integrates medical information, appointments, and health resources, employing AI algorithms for tailored recommendations.

Functionalities:

- **Centralized Platform:** Consolidates healthcare services in one accessible platform.
- **AI-Driven Recommendations:** Offers personalized healthcare suggestions based on user preferences and history.

These products highlight the potential of technology to empower international students in managing their well-being within the healthcare system. Through their functionalities and innovative features, they contribute to enhanced healthcare accessibility, communication, and support for this demographic.

2.9.Comparative Analysis: My Website vs. Related Commercial Products

In assessing the distinctive value proposition of my website in comparison to the related commercial products outlined in section 3.8, we identify areas of strength where the approach excels, as well as noteworthy aspects for potential refinement.

Strengths:

- a. **Holistic Approach:** The website's dedication to a comprehensive healthcare ecosystem, bolstered by personalized AI-driven chatbot assistance, positions it as a robust solution. This approach underscores the commitment to proactive health management and meeting the diverse needs of international students.
- b. **User-Centric Design:** The user-centric design of our platform, featuring a no-signup and effortless resource access, ensures a seamless experience. The emphasis on user convenience showcases the dedication to delivering value through accessible means.

Areas for Consideration:

- a. **Learning from HealthBuddy+:** The closure of HealthBuddy+ underscores the importance of anticipating evolving healthcare challenges even after a global crisis subsides. Ensuring the platform's adaptability to address emerging healthcare needs remains a vital aspect of sustaining its relevance.
- b. **Diverse Language Support:** While the platform aims to overcome language barriers, integrating robust multilingual support like MyStudentMedical could amplify accessibility for international students from diverse linguistic backgrounds.
- c. **Continuous Innovation:** The AI-driven recommendations offered by HealthCompanion demonstrate a level of personalization worth exploring. Continuously enhancing our AI-driven assistance to deliver tailored health guidance has the potential to elevate our platform's value proposition.
- d. **Sustainability:** The closure of HealthBuddy+ serves as a reminder of the importance of sustainability. Ensuring that the platform's resources remain pertinent beyond specific crises is crucial to its enduring impact.
- e. **Global Partnerships:** Analogous to MyStudentMedical's collaborations with educational institutions and insurance brokers, forging partnerships with various stakeholders could extend our platform's reach and influence.

By analysing the strengths of related products and considering areas for potential enhancement, we can refine our platform's value proposition. The key takeaway is the need for perpetual evolution, innovation, and responsiveness of international student healthcare needs.

3. Approach

To address the unique healthcare challenges of international students, this study adopts a comprehensive approach that leverages technology to enhance healthcare accessibility, communication, and support. The chosen solution involves the development and implementation of an integrated online platform comprising websites and AI-driven chatbots. This approach offers real-time healthcare guidance, access to relevant resources, and personalized assistance, while adhering to ethical and regulatory standards.

The integrated platform approach was selected for several reasons:

- **Comprehensive Solution:** Integrating websites and AI-driven chatbots offers a holistic solution that combines timely guidance with access to resources, addressing both information dissemination and real-time interaction needs.
- **Personalized Assistance:** AI-driven chatbots enable personalized interactions, providing tailored responses based on individual queries, and enhancing user engagement and accuracy.
- **Ethical Considerations:** Chatbots can provide real-time responses aligned with healthcare guidelines and data privacy regulations, addressing ethical and regulatory concerns.
- **User-Centric Design:** The integration creates a user-centric experience, offering both self-directed research through websites and real-time interaction with chatbots.
- **Empowerment and Engagement:** The approach empowers users by offering tools for self-directed research and real-time assistance, promoting proactive health management.

Contrast with Other Approaches:

The discarded approaches, such as standalone websites or mobile applications, lacked the comprehensive and real-time support needed to address the multifaceted healthcare challenges of international students. The selected approach addresses this divide by integrating websites

and chatbots, thereby establishing a unified healthcare ecosystem that serves diverse aspects of international students' healthcare requirements.

3.1. Medical Information Source (UK NHS)

The strategic choice to designate the UK National Health Service (NHS) as the primary repository for all medical information integrated into the project stems from a purposeful evaluation of various significant factors. Appendix B contains supplementary information related to the healthcare resources available on The NHS Website, which influenced the project's content. This selection is anchored in the distinctive attributes of the UK NHS, aligning seamlessly with the project's overarching objectives:

1. **Global Prestige:** The UK NHS commands worldwide recognition for its exceptional healthcare services and clinical proficiency. The decision to leverage information from this esteemed institution ensures that users access advice underpinned by world-class healthcare practices.
2. **Rigorous Evidence Basis:** The UK NHS is committed to delivering medical information firmly rooted in evidentiary foundations. Regular review and updating processes ensure alignment with contemporary scientific research and breakthroughs. This emphasis on accuracy and currency resonates harmoniously with the project's mission of offering dependable health insights.
3. **User-Centric Orientation:** The UK NHS champions a robust focus on tailoring healthcare information to suit diverse user demographics, including the distinctive needs of international students. Its user-friendly resources embrace the requirements of diverse populations, positioning it as an optimal source for the project's target audience.
4. **Authoritative Trustworthiness:** Incorporating information sourced from the UK NHS amplifies the platform's credibility and reliability. The NHS's endorsed recommendations and guidelines command respect from the medical community, affording users access to medically accurate and dependable healthcare counsel.
5. **Alignment with Project Aims:** The project's ambitions pivot around empowering international students to efficiently manage their health during their educational sojourn abroad. The utilization of information from the UK NHS seamlessly aligns with the

UK's healthcare paradigms and policies, ensuring users receive counsel that harmonizes with the local healthcare ecosystem.

6. **Cultural Universality:** The UK stands as a sought-after haven for international students hailing from a diverse spectrum of cultural backgrounds. The UK NHS's healthcare resources are thoughtfully curated to embrace cultural diversity, rendering its assets accessible and pertinent to an extensive array of users.

The resolute decision to choose the UK NHS as the source of medical information embodies the project's unwavering dedication to providing accurate, reliable, and user-centric healthcare insights. By assimilating the UK NHS's rich reservoir of knowledge, the project ardently endeavours to arm international students with the resources needed to enact well-informed healthcare decisions and foster their holistic well-being as they traverse their academic odyssey in the UK.

3.2. Software Development Methods

The strategy employed to address the multifaceted challenges inherent in the project is rooted in a systematic and interdisciplinary framework that integrates cutting-edge technologies, ethical considerations, and user-centric design principles. Given the constraints of being the sole developer of the healthcare platform, with limited resources, an Agile-inspired approach is adeptly adapted to our unique circumstances. Agile methodologies are known for their user-centred and iterative behaviour, making them suitable for innovative projects where problem-solution duo co-evolve over time (Fernandes, Belfort and Campos, 2021). Agile project management is a response to current business-changing trends and computing needs, and it has been successfully applied in IT projects, such as the Books for Africa Project (Etim et al., 2021). While traditional Agile methodologies typically involve cross-functional teams and structured roles, we have tailored the approach to align with our specific situation. This approach encompasses a series of pivotal stages:

1. Scope Definition and Goal Setting:

The initial step involves collaborative discussions with the project supervisor to define the scope of the project. Clear objectives are set, outlining the core functionalities and features that will address the healthcare challenges faced by international students.

2. Feature Prioritization:

Given the limitations, a careful assessment of the identified features is carried out. Prioritization is based on their significance in tackling primary healthcare challenges. The emphasis is placed on building a functional product that delivers value in addressing these challenges.

3. Incremental Development:

Recognizing the resource constraints, the development process is divided into smaller, manageable cycles. These cycles resemble Agile sprints, lasting one to two weeks. Each cycle focuses on developing, testing, and refining specific features or functionalities.

4. Weekly Check-ins:

Regular communication with the project supervisor is integrated into the approach. Weekly check-in meetings are scheduled to discuss progress, present developed functionalities, and gather feedback. These interactions ensure that the project stays on track and aligned with the intended objectives.

5. Iterative Feedback Loop:

The iterative nature of the Agile approach is maintained. As each mini sprint concludes, feedback is collected from the project supervisor. This feedback loop enables adjustments and refinements, ensuring that the developed features are in line with the project's goals.

6. Time Management Framework:

Considering the limited timeframe, effective time management is crucial. A structured time allocation is defined for development, testing, and communication. Adhering to this framework ensures a balanced workflow.

7. Ongoing Communication:

Continuous communication is maintained with the project supervisor. Regular updates on progress, challenges, and potential solutions are shared. The collaborative nature of this communication aids in addressing roadblocks promptly.

8. Flexibility and Adaptation:

An essential Agile principle – flexibility – is embraced. The approach is adaptable to changes in requirements, unforeseen obstacles, and evolving circumstances. This flexibility enables efficient adjustments while maintaining the project's trajectory.

9. Minimal Viable Product (MVP) Development:

Acknowledging resource limitations, the project's focus is directed towards creating a Minimal Viable Product (MVP). The MVP encompasses essential features that address core healthcare challenges, providing a functional prototype that can be iteratively improved.

For a detailed breakdown of the initial project timeline and development phases, please refer to Appendix A.

4. Product

In this section of the report, we delve into the various phases of the project's development journey, shedding light on the methodologies and strategies employed to translate the identified requirements into tangible outcomes. Each subsection explores a distinct facet of the project's evolution, culminating in the realization of a functional healthcare platform tailored to the needs of international students. From requirement definition to implementation, project management, and results, we offer a comprehensive overview of the processes and decisions that shaped the project's trajectory. This section serves as a connection between the initial problem statement and the tangible solutions that were developed. It underscores the interdependence of comprehensive analysis, strategic design, precise execution, and, ultimately, the realization of the envisioned benefits.

4.1. Requirement Specification

Thorough investigation into challenges faced by international students has yielded comprehensive development requirements. These span a user-friendly healthcare platform providing medical info, telemedicine, and community support. In software development, functional and non-functional requirements differentiate system behaviour and qualities.

Functional Requirements define system functionalities, features, and interactions. They outline intended behaviour and system responses to inputs, specifying operations and capabilities.

Non-Functional Requirements focus on system qualities like performance, security, usability, and reliability. They address constraints, standards, and essential qualities for user satisfaction.

These requirements address language barriers, cultural nuances, and foreign healthcare complexities. They are categorized as "Must Have," "Should Have," and "Won't Have" to guide strategic development.

Must Have: Essential functionalities critical to core system purpose. They form the minimum viable product (MVP), ensuring usability and value.

Should Have: Important enhancements improving usability and value. They enhance user experience and meet expectations.

Won't Have: Excluded functionalities outside the current scope. Deferred due to constraints or future releases, managing expectations and scope.

Based on the problem, a particular set of functional requirements were set. But during development, these requirements were extended. Following are all the initial requirements:

Must haves:

1. Healthcare Information and Resources:

The platform must provide a comprehensive repository of healthcare information, including medical services and health resources relevant to international students. This information should be presented in an easily understandable format, considering potential language barriers and cultural differences.

Acceptance Criteria:

- Users should be able to easily find relevant healthcare information based on different categories.
- Medical services and health resources should be presented in a language that is easily understandable by international students.

2. AI-Driven Chatbot:

Integration of an AI-driven chatbot is essential to provide instant responses to user queries related to healthcare. The chatbot should utilize natural language processing

(NLP) algorithms to understand and accurately respond to user inquiries, offering personalized medical advice and general health-related information.

Acceptance Criteria:

- The chatbot should respond accurately to at least 80% of user queries, providing relevant information and guidance.
- Users should be able to engage in natural language conversations with the chatbot without encountering significant misunderstandings.

3. Feedback and Improvement Mechanism:

Incorporate a system that gathers user feedback and suggestions for platform improvements. This iterative approach ensures that the platform evolves according to users' changing needs and preferences.

Acceptance Criteria:

- Users should be able to submit feedback through a designated interface.
- The platform should provide confirmation to users upon successful submission of feedback.

Should have:

1. BMI Calculator:

Include a user-friendly BMI calculator tool on the platform. This tool should allow users to input their weight and height, and then provide an instant calculation of their BMI. Additionally, the tool could categorize the BMI results into different ranges (e.g., underweight, normal weight, overweight, obese) and provide a brief explanation of what each range means for the user's health.

Acceptance Criteria:

- The BMI calculator tool should provide accurate calculations based on user input.
- The tool should categorize BMI results correctly and offer clear explanations for each category.

2. Dietary Meal Planner:

Incorporate a user-friendly meal planner tool that allows users to create personalized dietary plans based on their health goals, preferences, and dietary restrictions. Users should be able to input their dietary preferences (e.g., vegetarian, vegan), health objectives (e.g., weight loss, muscle gain, balanced nutrition).

Acceptance Criteria:

- Users should be able to create a personalized dietary plan by selecting dietary preferences, health goals, and restrictions.
- The generated dietary plan should accurately reflect the user's selections and align with nutritional objectives.

Won't have:

1. Full Medical Diagnosis and Treatment Recommendations:

The platform won't provide full medical diagnosis or detailed treatment recommendations. Users should be advised to consult qualified healthcare professionals for specific medical concerns.

2. Emergency Medical Services:

The platform won't offer emergency medical services. Users should be directed to local emergency services or healthcare providers in case of emergencies.

3. Complex Social Networking Features:

The platform won't incorporate complex social networking features such as private messaging or extensive user profiles. The focus is on healthcare information and support.

4. Integration with Local Healthcare Systems:

The platform won't integrate directly with local healthcare systems for appointment scheduling or medical records access. It will provide general guidance on navigating the healthcare system.

The non-functional requirements are as follows:

1. Performance and Responsiveness:

This requirement relates to how fast the platform responds and delivers information to users.

Acceptance Criteria:

- Page load times should not exceed 3 seconds for any section of the platform.
- Users should experience smooth interactions, with minimal delays when navigating between pages.

2. Usability and Accessibility:

This requirement focuses on the user experience, ensuring that the system is intuitive, screen reader compatibility, keyboard navigation and overall user-friendliness for individuals with diverse needs.

Acceptance Criteria:

- Conduct usability testing using simulated user scenarios to evaluate the platform's ease of use, intuitiveness, and overall user-friendliness.
- Make platform content comprehensible to users from diverse linguistic backgrounds.
- The platform's UI should be responsive and display correctly on various devices (desktop, tablet, mobile).
- Users should be able to navigate to different sections of the platform without encountering usability issues.

3. Scalability and Compatibility:

Here, we ensure the platform can grow as more users join and can work well on various devices and browsers.

Acceptance Criteria:

- The platform should be able to accommodate up to 10,000 concurrent users without experiencing performance degradation.
- The platform should function consistently across major web browsers (Chrome, Firefox, Safari) and devices (desktop, tablet, mobile).

4. Accuracy of AI-Driven Chatbot:

This pertains to how correct and helpful the chatbot's responses are in assisting users.

Acceptance Criteria:

- Responses provided by the chatbot should align with accurate medical information and recommendations.
- Users should find the chatbot's responses helpful and relevant to their inquiries.

5. Reliability and Availability:

Availability requirements define the system's uptime and reliability.

Acceptance Criteria:

- The platform should aim for at least 99.9% uptime, with scheduled maintenance communicated to users in advance.

4.2. Design

In the section of the project, the focus shifts towards the intricate details of structuring and organizing the proposed solutions—the healthcare platform's website and the accompanying chatbot. This section outlines the fundamental design decisions made to fulfil the established requirements and ensure the seamless functioning of both products. By delving into the design considerations, factors, assumptions, and quality criteria, we aim to provide a comprehensive overview of how the proposed solutions are tailored to address the healthcare challenges faced by international students. This design phase is pivotal in translating the identified needs and requirements into practical and user-centric solutions, ensuring that the resulting products align with the project's overarching goals.

4.2.1. Use case diagram.

In software design and development, use case diagrams serve as powerful tools to visually capture the interactions between users and a system. A use case diagram provides a clear representation of how users (referred to as "actors") engage with a

system to achieve specific goals or tasks. Each use case depicts a distinct user interaction, showcasing the functionality offered by the system. These diagrams are instrumental in mapping out the requirements and functionalities of a system, making it easier to understand the system's behaviour from a user's perspective.

For our healthcare platform project, we employ use case diagrams to illustrate the scenarios in which our two standalone products – the healthcare platform's website and the integrated chatbot – are utilized. By presenting these diagrams, we provide a comprehensive view of the user interactions, functionalities, and relationships associated with each product. This not only aids in clarifying the user experience but also highlights how the chatbot's capabilities enhance the website's utility. In the subsequent sections, we delve into the specific use case diagrams for both the website and the chatbot, offering a detailed insight into their respective functionalities and interactions.

Website Use Case Diagram:

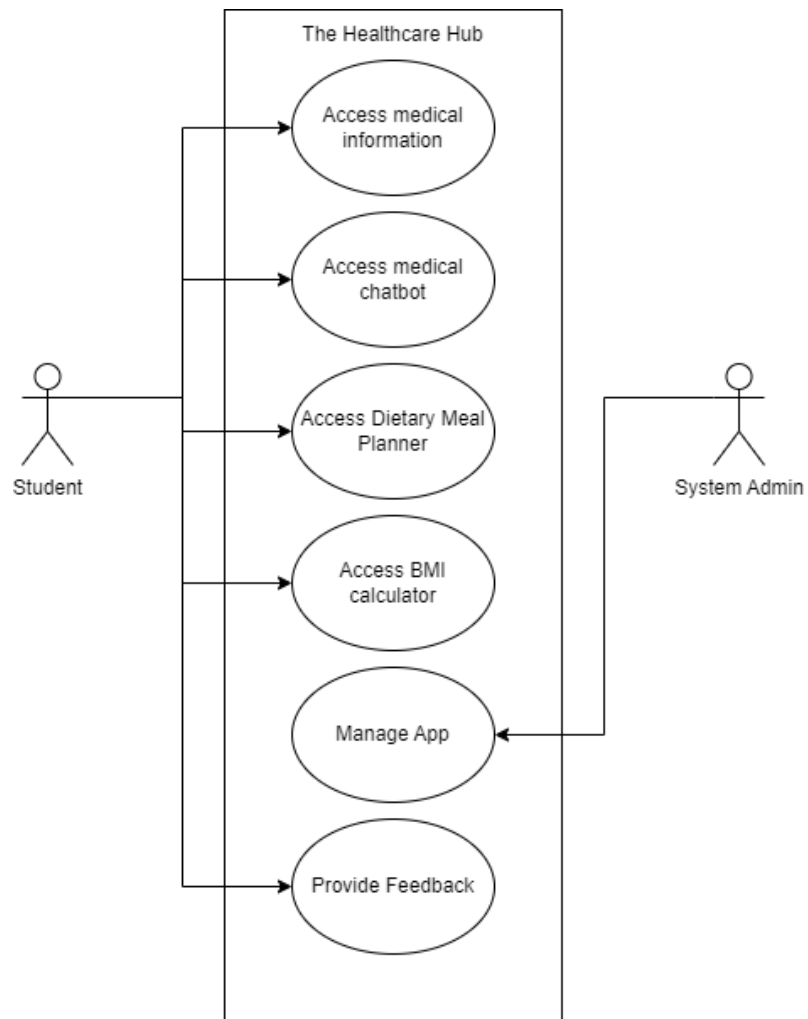


Figure 1: Use Case Diagram for the website

Chatbot Use Case Diagram:

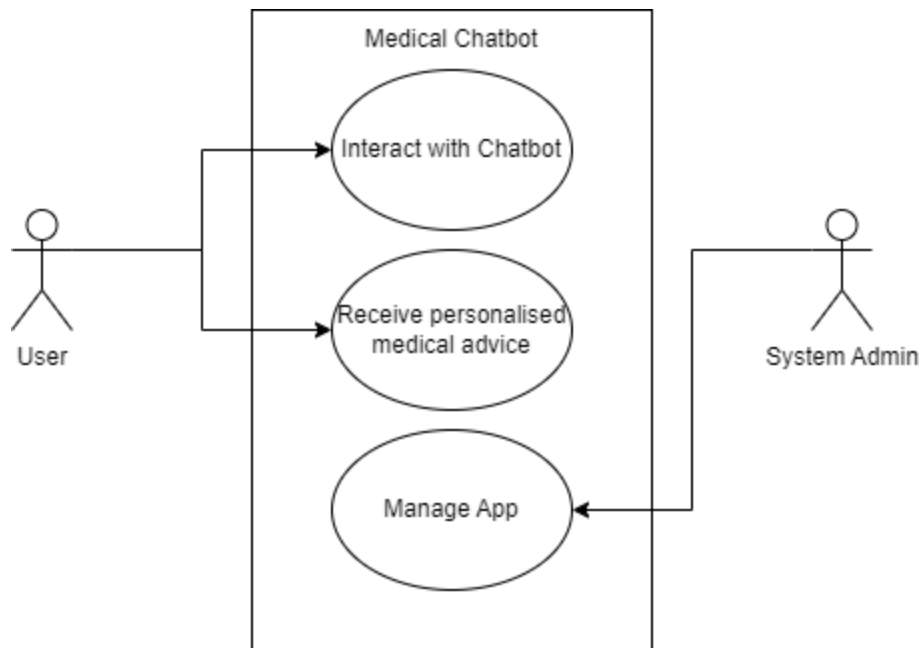


Figure 2: Use Case Diagram for the Chatbot

4.2.2. Website UI and UX Design

Designing the user interface (UI) and user experience (UX) for the website involves creating a visually appealing and intuitive platform that caters to the needs of international students while addressing their healthcare challenges. Here's an overview of the design considerations and elements for the website:

Design Considerations:

1. **User-Centric Approach:** Prioritize the needs and preferences of international students, considering their diverse cultural backgrounds and technological literacy.
2. **Accessibility:** Ensure the website is accessible to users with different abilities and devices, adhering to web accessibility guidelines.

3. **Language and Clarity:** Use clear and concise language, considering potential language barriers.
4. **Intuitive Navigation:** Design a user-friendly navigation structure that allows users to easily find information, access features, and navigate through the platform.
5. **Consistency:** Maintain a consistent design across all pages, using a cohesive colour palette, typography, and visual elements.
6. **Responsive Design:** Create a responsive layout that adapts seamlessly to various screen sizes and devices, including mobile phones and tablets.

UI/UX Elements:

1. **Homepage:**
 - Welcome message and introduction to the platform's purpose.
 - Clear navigation bar with links to different sections.
2. **Medical Information:**
 - Categorized sections for different health topics.
 - Easily accessible articles, videos, and infographics.
3. **AI-Driven Chatbot Integration:**
 - Prominently placed chatbot interface for instant assistance.
 - Clear instructions on how to interact with the chatbot.
4. **Personalized Features:**
 - Customizable dietary meal plans and BMI calculations.
5. **Feedback Mechanism:**
 - User-friendly form to provide feedback and suggestions for improvement.
 - Acknowledgment of user feedback and a promise to address it.
6. **Footer:**
 - Contact information and links to social media platforms.
 - Privacy policy, terms of use, and disclaimers.

Visual Design:

1. **Colour Palette:** Use a harmonious colour palette that resonates with the target audience and creates a welcoming environment.
2. **Typography:** Choose easily readable fonts for headings and body text to enhance legibility.

3. **Images and Graphics:** Incorporate relevant images, icons, and graphics to enhance visual appeal and support content.
4. **Whitespace:** Utilize whitespace effectively to create a clean and organized layout.
5. **Buttons and Calls to Action:** Design visually distinctive buttons that guide users to take desired actions, such as accessing information or interacting with the chatbot.

4.2.3. Chatbot UI and UX Design

The user interface (UI) and user experience (UX) design of the chatbot within our platform are critical components that directly influence user engagement, satisfaction, and overall usability. A well-designed chatbot interface enhances the interaction between users and the platform, providing seamless and intuitive communication. Here, we outline the key principles and considerations that guide our chatbot's UI and UX design.

Conversational Flow and Natural Language Processing (NLP):

Our chatbot's UI is designed to replicate a natural conversation, fostering a sense of familiarity and ease for users. Conversational flow is meticulously crafted to ensure that interactions feel intuitive, allowing users to engage with the chatbot as if interacting with a human. The integration of advanced NLP technology enables the chatbot to understand and interpret user queries accurately, ensuring meaningful and contextually relevant responses.

User-Friendly Interface:

The chatbot's interface prioritizes simplicity and accessibility. The design minimizes clutter and presents users with clear prompts and options. Responses are displayed in a format that is easy to read and comprehend. Icons, buttons, and intuitive navigation elements guide users through the chatbot interaction, making it effortless to explore features and retrieve information.

Emotional Intelligence and Empathy:

Our chatbot's UI and responses are designed to exhibit emotional intelligence and empathy. The chatbot acknowledges users' emotions and concerns, offering empathetic responses when appropriate. This feature fosters a positive user experience, establishing a genuine connection and rapport between users and the platform.

Multi-Platform Compatibility:

The chatbot's UI is designed to ensure compatibility across various devices and platforms. Whether accessed through a desktop computer, tablet, or mobile device, users can expect consistent functionality and visual coherence. This compatibility promotes a seamless user experience regardless of the device used.

4.3. Technology Stack

Our website harnesses a range of advanced technologies to deliver a seamless and effective healthcare solution for international students. These technologies are strategically employed to enhance user experience, facilitate efficient healthcare access, and provide real-time support. Below, we highlight the key technologies that underpin our platform's functionality:

4.3.1. Technologies Powering the Website

Our website has been crafted using a carefully selected set of technologies that synergize to create a seamless and dynamic user experience. From the robust backend to the visually appealing front end, each technology plays a crucial role in shaping the functionality and aesthetics of our platform.

Flask: Backend Foundation

Flask serves as the foundation of our backend development. As a micro web framework for Python, Flask provides the essential tools for handling routing, requests, and data management. Unlike other frameworks, Flask allows developers to have the freedom to choose their own development guidelines and extensions (Grinberg, 2018). Its lightweight nature ensures efficient performance, while its extensibility allows us to integrate various functionalities seamlessly.

HTML5: Structuring the Content

HTML5 is the cornerstone of our website's content structure. It allows us to define the elements that make up our platform, creating a clear and organized layout. By incorporating semantic elements, HTML5 enhances the accessibility and search engine optimization of our website.

CSS: Visual Appeal

CSS (Cascading Style Sheets) is responsible for the visual aesthetics of our platform. It enables us to apply styles, layouts, and responsive design principles. (Fraun, 2012) suggest that responsive web design based on HTML5 and CSS3 is not only feasible but also effective in improving the user experience on different platforms and screen sizes.

Bootstrap: Responsive Design

Bootstrap, a popular CSS framework, enhances our website's responsiveness. It provides pre-designed templates, components, and grids that streamline the development of responsive web pages. Responsive web design is important for ensuring that websites function well on mobile devices, tablets, and computers, making it easier for users to access and navigate the site (Bilić, 2018). With Bootstrap, our platform effortlessly adapts to different screen sizes, offering a consistent experience on desktops, tablets, and smartphones.

JavaScript: Interactivity and Dynamic Elements

JavaScript powers the interactivity and dynamic elements of our website. It enables features like interactive forms, real-time notifications, and smooth animations. With JavaScript, we create an engaging and user-centric experience that responds to user actions promptly.

SQLite: Structured Data Storage

Underpinning our data storage needs, SQLite serves as a lightweight and efficient relational database management system. It enables us to seamlessly store and retrieve data for various components of our platform, including the dynamic user

feedback collected on the "Feedback" page. SQLite's integration further contributes to the cohesive functioning of our website.

4.3.2. Web Scraping: Information Curation

Our platform employs cutting-edge web scraping technology to enhance data accessibility and curate accurate healthcare information. This technology allows us to aggregate real-time data from credible online sources, ensuring users have up-to-date insights for making informed health decisions. By automating data collection, we maintain accuracy while streamlining the process, offering users a user-friendly interface for accessing essential health resources. Our ethical approach to web scraping ensures compliance with regulations and the highest standards of integrity, empowering users with the tools they need for proactive health management.

Data Empowerment through ParseHub:

By utilizing ParseHub, we empower our platform with dynamic web scraping capabilities, enabling us to collect and present essential healthcare information from diverse online sources. This integration allows users to access comprehensive and up-to-date insights, enhancing their knowledge and aiding informed healthcare decisions. Through ParseHub's technology, we ensure users have a seamless experience while accessing crucial health resources, contributing to their proactive health management journey.

4.3.3. AI Integration: User Interaction with Azure Bot Service and Language Studio

At the heart of our platform's user interaction enhancement lies the seamless integration of AI-driven features, specifically chatbots. Leveraging the power of Azure Bot Service and Language Studio, we've crafted an intelligent conversational agent that revolutionizes how users engage with our platform.

Azure, also known as Microsoft Azure, is a comprehensive cloud computing platform and infrastructure offered by Microsoft. It provides a wide range of services that enable organizations to build, deploy, and manage applications and services through Microsoft-managed data centers. Azure offers a flexible and scalable environment for businesses to create and manage resources, from virtual machines and databases to networking and analytics tools, without the need to

invest in physical hardware or infrastructure. Appendix C provides detailed visual representations of the project's Azure infrastructure.

Development Framework - Microsoft Bot Framework:

The Microsoft Bot Framework is a set of tools, services, and an SDK (Software Development Kit) that aids in building chatbots across multiple platforms, including web and messaging platforms. The framework provides pre-built classes and methods that streamline chatbot development.

Knowledge Base & NLP Service - Azure QnA Maker and Azure Language Studio:

Azure QnA Maker: This service allows developers to create a question-and-answer layer over their data. It's used for building chatbots that can provide responses to user queries based on a set of predefined questions and answers.

Azure Language Studio: While not directly observed in the code, Azure Language Studio (previously known as Azure LUIS - Language Understanding) is a service used for natural language processing (NLP). It helps chatbots understand the intent of user inputs and extract relevant information.

4.3.4. GitHub for Source Control

Throughout the development process, we harnessed the power of GitHub as our source control platform. GitHub provided version management, collaboration tools, and code tracking capabilities, enabling seamless collaboration among our development team. The project's source code and version history can be accessed in the GitHub repository <https://github.com/Yedukrishnaj/TheHealthcareHub> (refer to Appendix K).

5. Implementation

The implementation phase of the healthcare platform project involved translating the defined requirements and design decisions into concrete products, including the website and the integrated chatbot. This section provides a comprehensive overview of the key aspects of the implementation, showcasing how the products were developed to fulfill the established requirements and design principles. As the whole project has two standalone parts: the website and the chatbot, we will be explaining the implementation of both separately and how they were integrated together to form a single product later.

5.1. Chatbot Implementation

This section provides an in-depth exploration of the chatbot implementation, a pivotal component of the healthcare platform project. The chatbot, integrated seamlessly into the website, enhances user engagement by offering instant responses, personalized medical advice, and appointment scheduling assistance. Leveraging Azure Bot Service and Language Studio the chatbot's development process is elaborated upon to provide insights into its creation and integration.

5.1.1. Data Collection: Web scraping for Medical Condition Information

The initial step in the implementation of the healthcare platform project involved data collection through web scraping. The goal was to gather relevant medical condition information from the NHS website, a crucial aspect of providing comprehensive healthcare support to users. To achieve this, the ParseHub tool was employed to extract data efficiently and accurately.

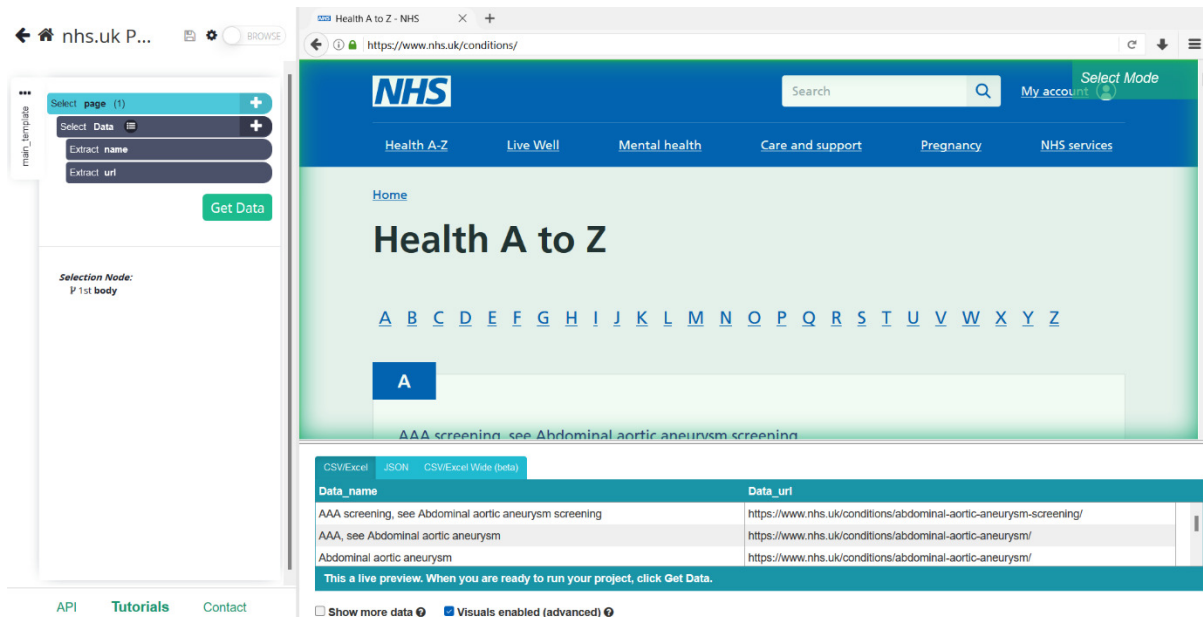


Figure 3: Configuration settings used in ParseHub for web scraping.

Utilizing ParseHub for Web scraping

ParseHub emerged as the tool of choice for web scraping due to its user-friendly interface and powerful capabilities. This platform facilitated the extraction of valuable data from web pages by creating custom scraping projects. The target was to retrieve the names and URLs of various medical conditions listed on the NHS website, enabling users to access detailed information about these conditions through the healthcare platform.

Extracting Medical Condition Data

By crafting a ParseHub project tailored to the structure of the NHS website, the tool was configured to navigate through web pages, locate relevant data elements, and extract them systematically. Specifically, ParseHub was programmed to identify medical condition names and their corresponding URLs from the NHS website's pages. This automated process ensured accurate data retrieval while minimizing manual effort.

Upon completion of the data extraction process, the collected information was compiled into an Excel file, allowing for easy organization and analysis of the extracted medical condition data. This automated approach not only enhanced the efficiency of data collection but also ensured the integrity of the data for subsequent stages of the project.

The Excel file containing the extracted medical condition data is displayed below:

	Data_name	Data_url
1		
2	AAA scree	https://www.nhs.uk/conditions/abdominal-aortic-aneurysm-screening/
3	AAA, see A	https://www.nhs.uk/conditions/abdominal-aortic-aneurysm/
4	Abdominal	https://www.nhs.uk/conditions/abdominal-aortic-aneurysm/
5	Abdominal	https://www.nhs.uk/conditions/abdominal-aortic-aneurysm-screening/
6	Abortion	https://www.nhs.uk/conditions/abortion/
7	Acanthosis	https://www.nhs.uk/conditions/acanthosis-nigricans/
8	Achalasia	https://www.nhs.uk/conditions/achalasia/
9	Acid and cl	https://www.nhs.uk/conditions/acid-and-chemical-burns/
10	Acid reflux	https://www.nhs.uk/conditions/reflux-in-babies/
11	Acne	https://www.nhs.uk/conditions/acne/
12	Acoustic n	https://www.nhs.uk/conditions/acoustic-neuroma/
13	Acromegaly	https://www.nhs.uk/conditions/acromegaly/
14	Actinic ker	https://www.nhs.uk/conditions/actinic-keratoses/
15	Actinomyc	https://www.nhs.uk/conditions/actinomycosis/
16	Acupuncture	https://www.nhs.uk/conditions/acupuncture/
17	Acute chol	https://www.nhs.uk/conditions/acute-cholecystitis/
18	Acute kidn	https://www.nhs.uk/conditions/acute-kidney-injury/
19	Acute lymj	https://www.nhs.uk/conditions/acute-lymphoblastic-leukaemia/
20	Acute mye	https://www.nhs.uk/conditions/acute-myeloid-leukaemia/
21	Acute pani	https://www.nhs.uk/conditions/acute-pancreatitis/
22	Acute resp	https://www.nhs.uk/conditions/acute-respiratory-distress-syndrome/
23	Addison's	https://www.nhs.uk/conditions/addison-disease/
24	Adenoidec	https://www.nhs.uk/conditions/adenoidec/
25	Age-relate	https://www.nhs.uk/conditions/cataracts/
26	Age-relate	https://www.nhs.uk/conditions/age-related-macular-degeneration-amd/
27	Agoraphol	https://www.nhs.uk/mental-health/conditions/agoraphobia/

Figure 4: Excel file displaying the extracted medical condition data.

This automated data extraction process, tailored to the NHS website's structure, enabled the project to gather comprehensive medical condition information efficiently and accurately. The extracted data serves as a valuable resource for the project's objectives of providing relevant and evidence-based healthcare information to international students.

Enhancing Healthcare Platform Data

The successful completion of the web scraping process augmented the healthcare platform's database with a diverse array of medical condition information. This data, sourced directly from the NHS website, empowered users to access in-depth details about various conditions, symptoms, treatments, and preventive measures. The extracted data was subsequently utilized to build the knowledge base for the chatbot, enabling it to provide accurate and reliable information to users seeking guidance about medical conditions.

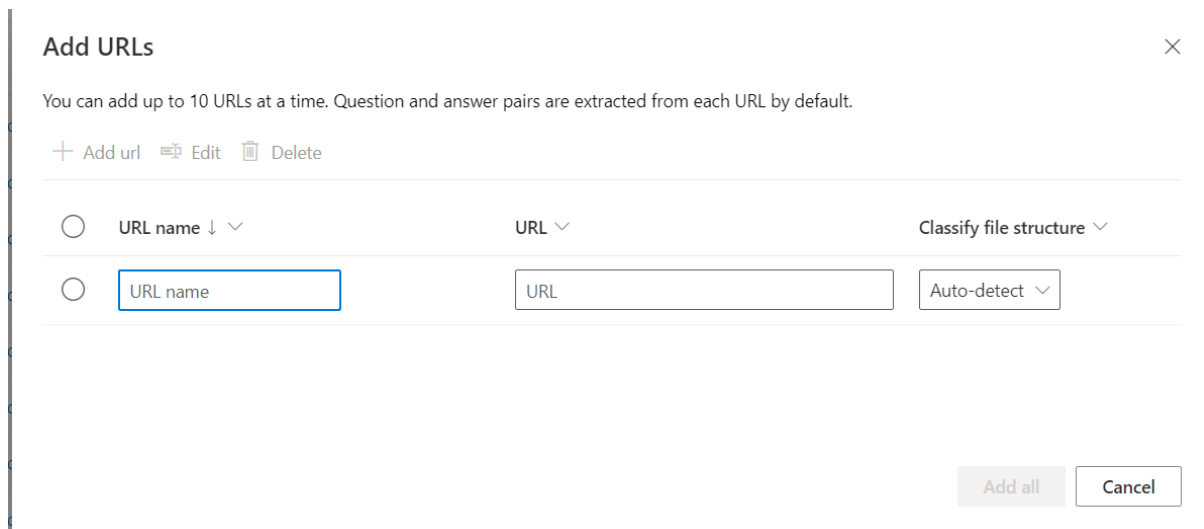
5.1.2. Building a Knowledge Base in Language Studio

An integral phase of the healthcare platform's implementation involved constructing a comprehensive knowledge base using the Language Studio. This knowledge base, derived from

data sourced from the NHS website, plays a crucial role in facilitating accurate and reliable responses to user queries related to various medical conditions. This section delves into the process of building this knowledge base and the role it plays within the project.

Creating Question-Answer Pairs

The first step in building the knowledge base was to extract pertinent data from the NHS website. Due to dataset size constraints, a subset of around 100 medical conditions was randomly selected for inclusion in the knowledge base to align with the MVP's scope. This data encompassed a myriad of medical conditions, their symptoms, treatments, and self-care advice. Once this data was acquired, it was organized into structured question-answer pairs (QAs). Each QA pair represented a specific medical condition and its corresponding information.



The screenshot shows a modal window titled "Add URLs" with a close button (X) in the top right corner. Below the title, a message states: "You can add up to 10 URLs at a time. Question and answer pairs are extracted from each URL by default." Below this message are three icons: a plus sign for "Add url", a double-headed arrow for "Edit", and a trash can for "Delete". The main area of the dialog contains a table with three columns: "URL name ↓", "URL", and "Classify file structure". The first row of the table has input fields for each column. The "URL name" field contains the text "URL name", the "URL" field contains "URL", and the "Classify file structure" dropdown menu is set to "Auto-detect". At the bottom right of the dialog are two buttons: "Add all" and "Cancel".

URL name ↓	URL	Classify file structure
<input type="text" value="URL name"/>	<input type="text" value="URL"/>	<input type="button" value="Auto-detect"/>

Figure 5: The process of adding sources for the knowledge base within Language Studio.

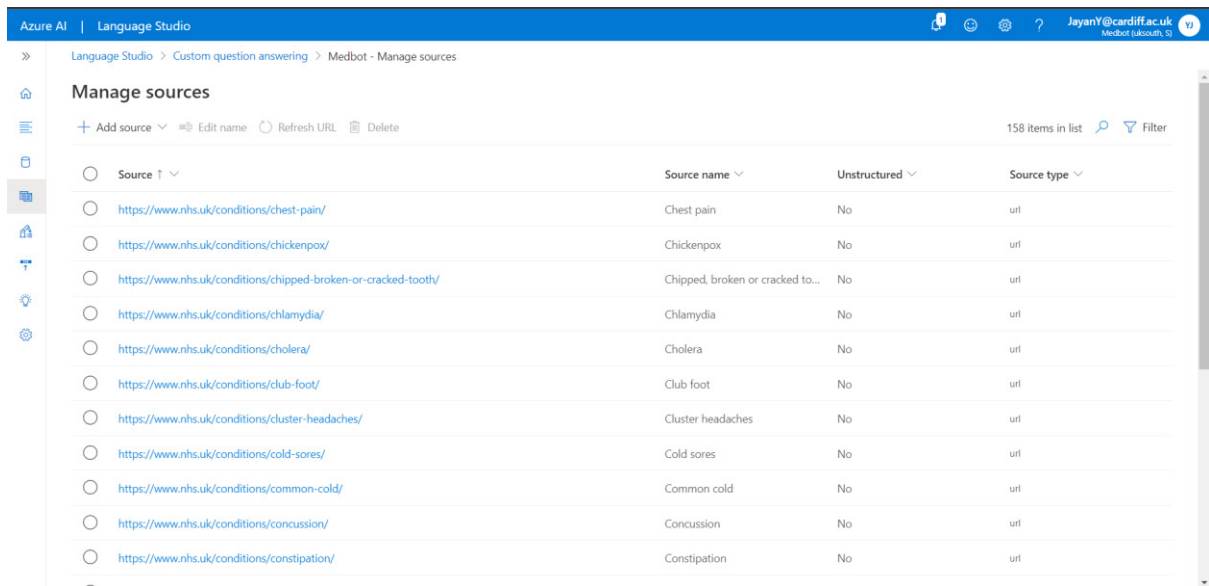


Figure 6: Managing sources in Language Studio.

Add a new question answer pair



Add a new question answer pair by entering a question, answer, and selecting the source.

Source *

Select a source



Question *

Type text here ...

Answer *

Type text here ...

Add metadata (optional)

+ Metadata

Add follow up prompts (optional)

+ Follow up prompt

Done

Cancel

Figure 7: The process of creating question-answer pairs within Language Studio.

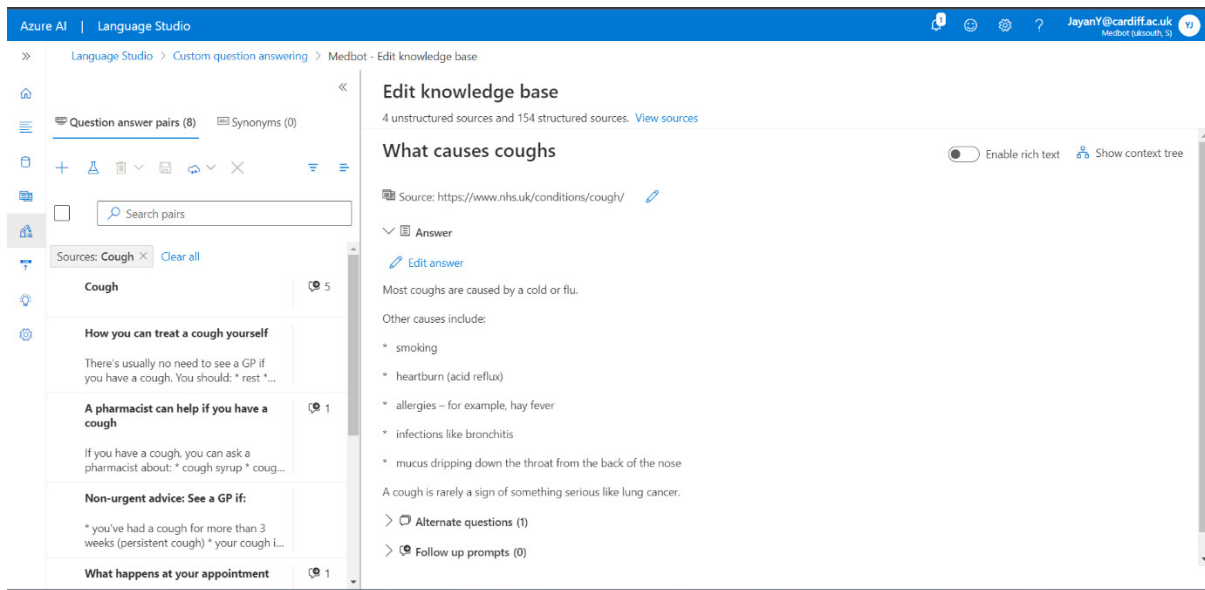


Figure 8: An example of a question-answer pair within the Language Studio knowledge base.

Enabling Accurate Responses

By creating dedicated QA pairs for each medical condition, the knowledge base becomes a reservoir of accurate and reliable information. This enables the chatbot to respond with precision to user queries about symptoms, treatments, and other health-related aspects. Users can pose questions naturally, and the chatbot harnesses its AI capabilities to match these questions with the most suitable QA pairs.

Aiding User Engagement

The knowledge base serves as the backbone of the chatbot's question-answering functionality. It empowers the chatbot to engage in informed conversations with users, delivering relevant information promptly. Users can seek advice on medical conditions, understand symptoms, and access self-care recommendations, all within the confines of a conversational interface.

Adaptable and Evolving

The construction of the knowledge base is not a one-time endeavour. As the medical field evolves and new information becomes available, the knowledge base can be updated and expanded. This ensures that users always have access to the most current and relevant information, enhancing the platform's credibility and utility.

5.1.3. Implementing Azure Bot Service with Knowledge Base Integration

In the progressive journey of implementing the healthcare platform, the next significant stride involved leveraging Azure Bot Service to construct a bot that integrates seamlessly with the knowledge base generated from the NHS data. This synergistic blend of Azure's capabilities facilitated the creation of an intelligent and interactive solution for users seeking healthcare information and guidance. Appendix D offers an in-depth exploration of the chatbot's architecture within the Azure environment.

Constructing the Bot

The creation of the bot is facilitated through a collaborative interplay between Azure Bot Service and the knowledge base. The bot is designed to comprehend user inquiries, interpret their intent, and retrieve relevant information from the knowledge base. Azure Bot Service's Natural Language Processing capabilities enable the bot to grasp user input and extract key information, ensuring that the responses provided are precise and tailored to the user's needs. In the context of this project, we made a practical decision based on time constraints. Instead of developing the entire bot system from the ground up, we opted to leverage the Azure Bot Builder tool. To provide a deeper understanding of the bot's technical workings, we explain all the important parts involved during the building of a custom bot.

1. Framework and Environment

The chatbot which is named “Medbot” is developed using the Microsoft Bot Framework, specifically leveraging the Bot Builder SDK.

2. Configuration Management

2.1 appsettings.json


```

{} appsettings.json X
{} appsettings.json > ...
1  {}
2  "DefaultAnswer": "",
3  "DefaultWelcomeMessage": "",
4  "MicrosoftAppType": "UserAssignedMSI",
5  "MicrosoftAppId": "f4a31ce0-13c4-4326-a95c-f29d9dd94f4a",
6  "MicrosoftAppPassword": "",
7  "MicrosoftAppTenantId": "bdb74b30-9568-4856-bdbf-06759778fcbc",
8  "QnAEndpointHostName": "",
9  "QnAEndpointKey": "",
10 "QnAKnowledgebaseId": "",
11 "DisplayPreciseAnswerOnly": "false",
12 "EnablePreciseAnswer": "true",
13 "LanguageEndpointHostName": "https://Medbot.cognitiveservices.azure.com",
14 "LanguageEndpointKey": "273505506ce647c38b01cd083e73fded",
15 "ProjectName": "Medbot",
16 "ScmType": "None"
17 }

```

This file is the central hub for configuration. It contains:

- Authentication details for Azure.
- Service endpoints for QnA Maker and potentially Azure Language Studio.
- Bot-specific settings, like default messages.
- Sensitive data like keys and endpoints are redacted for security purposes.

3. Service Initialization (BotServices.cs)

The bot establishes connections to Azure services through this class.

```

public BotServices(IConfiguration configuration)
{
    ...
    QnAMakerService = new QnAMaker(new QnAMakerEndpoint
    {
        KnowledgeBaseId = QnAKnowledgebaseId,
        Host = QnAEndpointHostName,
        EndpointKey = QnAEndpointKey,
        ...
    });
}

```

- If Language Studio configurations are provided, it connects to the Language Studio.

- If QnA Maker configurations are available, it initializes the QnAMakerService to communicate with the QnA Maker Knowledgebase.
- Throws an exception if neither service's configuration parameters are available.

4. Error Management and Logging (AdapterWithErrorHandler.cs)

Medbot is designed to handle errors gracefully:

```
public AdapterWithErrorHandler(BotFrameworkAuthentication auth, ILogger<BotFrameworkHttpAdapter> logger, ...)
{
    OnTurnError = async (turnContext, exception) =>
    {
        logger.LogError(exception, $"[OnTurnError] unhandled error : {exception.Message}");
        await turnContext.SendActivityAsync("The bot encountered an error or bug.");
        ...
    };
}
```

- Uses an adapter to intercept exceptions during the bot's turn.
- Logs the error, potentially integrating with Azure Application Insights for telemetry in production.
- Sends a user-friendly error message to the user, guiding them about the potential issue.
- Clears the current conversation state to ensure the bot doesn't enter an error loop.

5. Core Bot Logic (Bots/QnABotWithMSI.cs)

This class dictates the primary behavior of Medbot.

5.1 Initialization

On instantiation:

```
public QnABotWithMSI(IConfiguration configuration, ...)
{
    var welcomeMsg = configuration["DefaultWelcomeMessage"];
    ...
}
```

- The bot reads the welcome message from the appsettings.json.

- Initializes properties like ConversationState, UserState, and the main Dialog.

5.2 Turn Processing (OnTurnAsync Method)

Each user interaction is termed a "turn". After each turn:

```
public override async Task OnTurnAsync(ITurnContext turnContext, ...)
{
    await base.OnTurnAsync(turnContext, cancellationToken);
    await ConversationState.SaveChangesAsync(turnContext, false, cancellationToken);
    ...
}
```

The bot ensures that any state changes (both user-specific and conversation-wide) are saved.

5.3 Message Handling (OnMessageActivityAsync Method)

On receiving a message from a user:

```
protected override async Task OnMessageActivityAsync(ITurnContext<IMessageActivity> turnContext, ...)
{
    await Dialog.RunAsync(turnContext, ConversationState.CreateProperty<DialogState>(nameof(DialogState)), cancellationToken);
}
```

- The bot invokes the main dialog for processing.
- It's within this dialog (whose details are not provided in the reviewed code) that the bot likely communicates with the QnA Maker service to fetch responses.

5.4 Welcoming New Users (OnMembersAddedAsync Method)

When a new user joins:

```
protected override async Task OnMembersAddedAsync(IList<ChannelAccount> membersAdded, ...)
{
    foreach (var member in membersAdded)
    {
        await turnContext.SendActivityAsync(MessageFactory.Text(defaultWelcome), cancellationToken);
    }
}
```

Medbot sends them a welcome message, which can be the default or a custom message from the configuration.

6. Integration with Azure QnA Maker

The chatbot's knowledge base is hosted on Azure QnA Maker. For querying:

```
QnAMakerService = new QnAMaker(new QnAMakerEndpoint
{
    KnowledgeBaseId = QnAKnowledgebaseId,
    Host = QnAEndpointHostName,
    EndpointKey = QnAEndpointKey,
    ...
});
```

- The bot uses the QnAMaker client to communicate with the service.
- The client uses endpoint details (like Knowledgebase ID, Host, and Endpoint Key) from the configuration.
- User queries are sent to the QnA Maker service, which returns the most relevant answer from the knowledge base.

User Interaction with the Chatbot

Crafting User Interactions

The user interactions with the bot are designed to mirror natural conversations. Users can pose questions related to various medical conditions, treatment options, or healthcare advice. The bot intelligently processes these queries, identifies the most relevant questions from the knowledge base, and furnishes accurate answers. In cases where the bot requires additional context or clarification, it adeptly prompts the user for more information, ensuring a seamless and informative dialogue.

Enriching User Experience

The integration of the knowledge base elevates the user experience significantly. Users can now engage with the bot to seek medical information and advice in a conversational manner. The bot's ability to tap into a wealth of healthcare insights empowers users to make informed decisions about their health and well-being. Additionally, the bot's proactive approach in guiding users through the knowledge base ensures that they receive comprehensive answers to their queries.

1. Greeting and Introduction

When a user initiates a conversation with Medbot, they are greeted with a welcome message. This is managed by the `OnMembersAddedAsync` method in the `QnABotWithMSI.cs` file.

```
protected override async Task OnMembersAddedAsync(IList<ChannelAccount> membersAdded, ITurnContext<IConversationUpdateActivity> turnContext, CancellationTok  
{  
    foreach (var member in membersAdded)  
    {  
        if (member.Id != turnContext.Activity.Recipient.Id)  
        {  
            await turnContext.SendActivityAsync(MessageFactory.Text(defaultWelcome), cancellationToken);  
        }  
    }  
}
```

- If the user is new to the conversation, Medbot checks the `appsettings.json` for a custom welcome message.
- If no custom message is set, the default message "Hello and Welcome" is used.
- This introduction provides an immediate response to the user, letting them know they've successfully initiated a conversation with the bot.

2. Processing User Input

Once the user sends a message to the bot, the bot's `OnMessageActivityAsync` method in the `QnABotWithMSI.cs` file gets triggered.

```
protected override async Task OnMessageActivityAsync(ITurnContext<IMessageActivity> turnContext, CancellationToken cancellationToken)  
{  
    await Dialog.RunAsync(turnContext, ConversationState.CreateProperty<DialogState>(nameof(DialogState)), cancellationToken);  
}
```

- This method initiates the main dialog associated with the bot to process the user's message.

- Within this dialog (the specifics of which were not provided in the reviewed code), the bot likely:
- Parses the user's message to understand its intent.
- If integrated with the QnA Maker, sends the user's query to the QnA Maker service to fetch an appropriate response from the knowledge base.
- Returns the fetched response to the user.

3. Error Handling

Should there be any unhandled errors during the bot's processing, the `AdapterWithErrorHandler` class steps in:

```
public AdapterWithErrorHandler(BotFrameworkAuthentication auth, ILogger<BotFrameworkHttpAdapter> logger, ...)
{
    OnTurnError = async (turnContext, exception) =>
    {
        logger.LogError(exception, $"[OnTurnError] unhandled error : {exception.Message}");
        await turnContext.SendActivityAsync("The bot encountered an error or bug.");
        ...
    };
}
```

- It intercepts the error and logs it for debugging and monitoring.
- The bot then sends an error message to the user to inform them of the issue.
- To ensure the bot doesn't get stuck in an error loop, it clears the conversation state.

4. Continuity in Conversations

The bot maintains a state throughout the conversation. This state remembers certain details about the conversation and the user, enabling a more fluid and context-aware interaction.

```

public QnABotWithMSI(IConfiguration configuration, ConversationState conversationState, UserState userState, T dialog)
{
    ...
    ConversationState = conversationState;
    UserState = userState;
    Dialog = dialog;
}

public override async Task OnTurnAsync(ITurnContext turnContext, CancellationToken cancellationToken = default)
{
    await base.OnTurnAsync(turnContext, cancellationToken);
    await ConversationState.SaveChangesAsync(turnContext, false, cancellationToken);
    await UserState.SaveChangesAsync(turnContext, false, cancellationToken);
}

```

- The bot uses ConversationState and UserState to manage this.
- After each turn (interaction), the bot saves any changes to these states using the OnTurnAsync method in the QnABotWithMSI.cs file.

For a visual representation of the final chatbot product, please see Appendix E.

5.2. Website Implementation

This section delves into the comprehensive implementation process of the website component within the healthcare platform project. The website serves as a crucial interface for users to interact with the platform's features and resources. By employing Flask as the backend framework, Jinja templating for dynamic frontend, and integrating Bootstrap for enhanced UI elements, this section elaborates on the multifaceted approach employed to create a user-centric and functional website.

Flask, chosen as the backend framework, offers a robust foundation for developing the website. The wsgi.py file initializes the Flask app, establishing the link between the app and the web server, enabling the request-response cycle to facilitate user interactions.

In the __init__.py file, the Flask app is configured, extensions are integrated, and database connections are established. This pivotal file ensures that the application is tailored to meet the specific project requirements.

The views.py file, designed as a blueprint, governs the routing system. Here, URLs are mapped to corresponding functions or classes responsible for processing user requests, interfacing with backend logic, and rendering responses. The blueprint structure promotes clean code organization and clear separation of responsibilities.

The `models.py` file drives database interactions. With technologies such as SQLAlchemy, data models and relationships are defined, enabling efficient storage and retrieval of data. This functionality ensures the persistence of healthcare information and user data. Appendix F presents the directory structure of the Flask application, offering insights into the code organization.

Bootstrap Integration for Enhanced UI

Bootstrap, a responsive frontend framework, is seamlessly integrated to enhance the user interface. Bootstrap's predefined CSS styles and JavaScript components streamline UI development and ensure consistent design across different devices and screen sizes.

Leveraging Bootstrap's grid system, the responsive layout is structured, enabling a fluid design that adapts to various screen dimensions. The incorporation of Bootstrap components, such as navigation bars, forms, and buttons, enhances the visual appeal and functionality of the website.

Jinja Templating for Dynamic Content

Jinja templating plays a pivotal role in rendering dynamic content within the website. The `base.html` file serves as the cornerstone template, establishing the foundational structure for all pages. Through template inheritance, other HTML pages inherit the base structure while accommodating unique content.

Jinja's template tags and filters empower the injection of dynamic content, manipulation of data, and iteration through collections. This dynamic integration ensures interactive user experiences that respond to data variations and user inputs.

5.2.1. Home Page

The "Home" page of the healthcare platform website is strategically designed to provide a compelling introduction to the platform's purpose and offerings. This section serves as the gateway to the website, aiming to captivate users' attention and encourage them to explore further.

5.2.2. Medical Issues pages

The medical issues pages on the website follow a consistent and user-friendly structure to provide valuable information about various healthcare topics.

5.2.3. Feedback Page

The "Feedback" page serves as a vital component of the healthcare platform, allowing users to share their valuable feedback and insights about their experiences. The page is thoughtfully designed to facilitate user interaction and gather feedback in an organized and user-friendly manner. Below is a comprehensive breakdown of the key structural elements and their significance on the page:

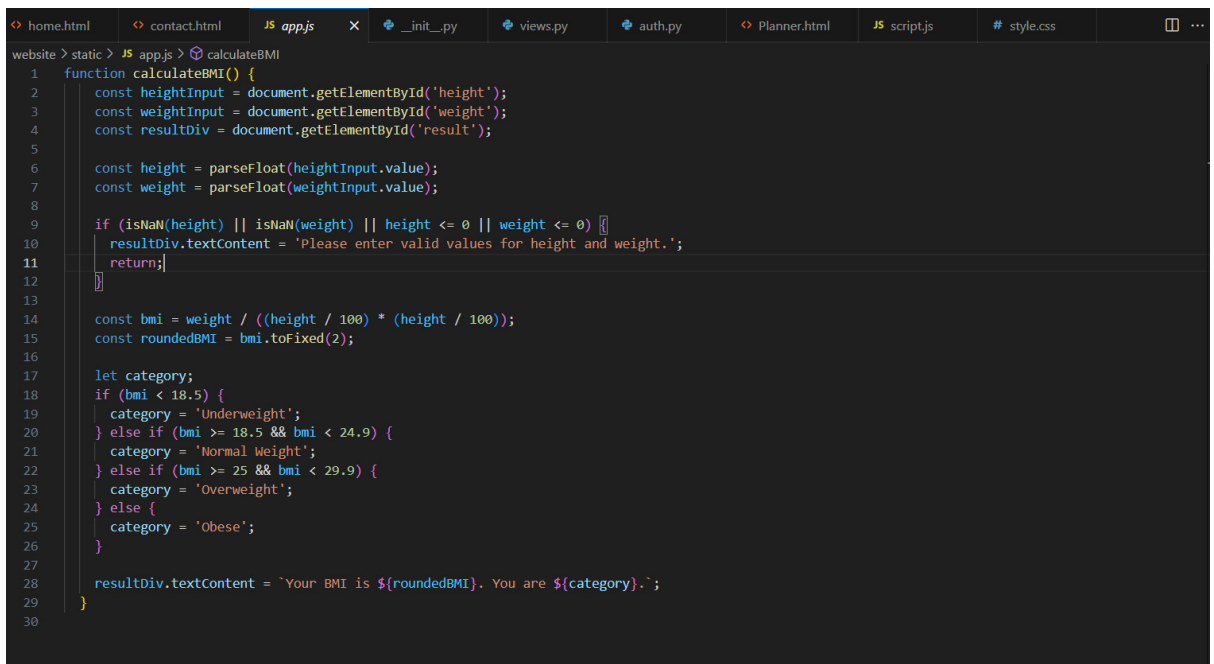
5.2.4. BMI Calculator

The "BMI Calculator" page serves as a valuable resource for users to compute their Body Mass Index (BMI) while also gaining insights into its significance and limitations. The underlying JavaScript code is essential for the accurate operation of the BMI calculator, enabling users to calculate their BMI based on their height and weight inputs. Subsequently, the code categorizes the calculated BMI result and delivers an interpretation of its implications. Here's an overview of the code's functionality:

Code Interpretation and Explanation:

The JavaScript code operates as the engine behind the BMI calculator's functionality. By extracting and processing user-provided height and weight values, it offers a quick and accurate method to calculate BMI. The calculated BMI is then assessed against

predefined ranges to determine its category, indicating the user's weight status.



```
1 function calculateBMI() {
2   const heightInput = document.getElementById('height');
3   const weightInput = document.getElementById('weight');
4   const resultDiv = document.getElementById('result');
5
6   const height = parseFloat(heightInput.value);
7   const weight = parseFloat(weightInput.value);
8
9   if (isNaN(height) || isNaN(weight) || height <= 0 || weight <= 0) {
10    resultDiv.textContent = 'Please enter valid values for height and weight.';
11    return;
12  }
13
14  const bmi = weight / ((height / 100) * (height / 100));
15  const roundedBMI = bmi.toFixed(2);
16
17  let category;
18  if (bmi < 18.5) {
19    category = 'Underweight';
20  } else if (bmi >= 18.5 && bmi < 24.9) {
21    category = 'Normal Weight';
22  } else if (bmi >= 25 && bmi < 29.9) {
23    category = 'Overweight';
24  } else {
25    category = 'Obese';
26  }
27
28  resultDiv.textContent = `Your BMI is ${roundedBMI}. You are ${category}.`;
29
30 }
```

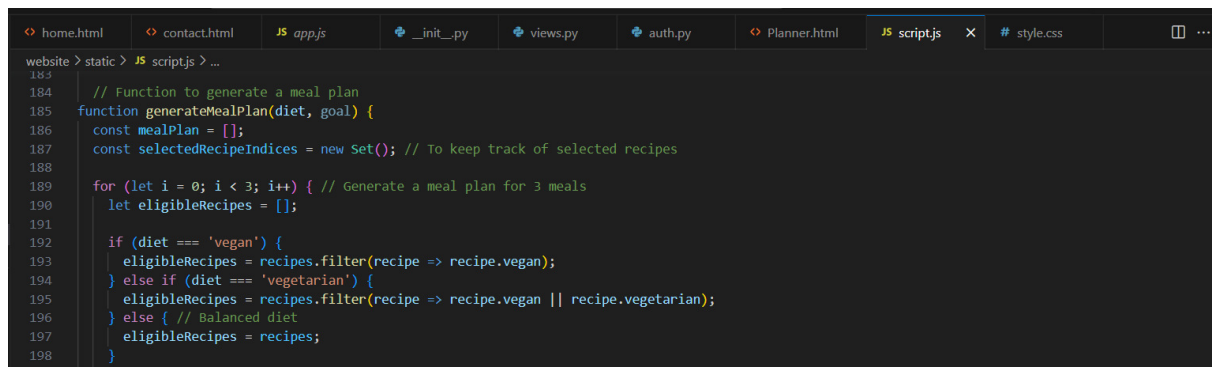
Here's a breakdown of what the code does:

- a. The calculateBMI function is defined, which will be triggered when the "Calculate BMI" button is clicked.
- b. The function retrieves references to the HTML input elements for height and weight, as well as the result display element.
- c. The function parses the input values of height and weight as floating-point numbers.
- d. It checks if the parsed values are valid (not NaN) and if they are greater than zero. If not, it displays an error message and returns early.
- e. The BMI is calculated using the formula: $\text{weight} / (\text{height in meters})^2$.
- f. The calculated BMI value is rounded to two decimal places for readability.
- g. Based on the calculated BMI value, the function determines the BMI category (underweight, normal weight, overweight, or obese).
- h. The function updates the result display element with a message that includes the calculated BMI value and its corresponding category.

5.2.5. Dietary Planner Page

The "Dietary Planner" page is designed to introduce and facilitate the use of the Dietary Planner Tool, which helps users create personalized meal plans based on their dietary preferences and goals. Here's an overview of the structure of the page:

It references an external JavaScript file ("script.js") to manage dynamic functionality, such as generating meal plans and shopping lists. The page's structure includes an introduction to dietary planning, tool presentation with instructions, user preference input, dynamic content generation, and real-time updates. The responsive design ensures accessibility across devices, promoting an engaging and user-centric experience.

A screenshot of a code editor with a dark theme. The top bar shows several open files: home.html, contact.html, JS app.js, __init__.py, views.py, auth.py, Planner.html, JS script.js (selected), and # style.css. The main editor area shows the content of 'script.js' starting from line 185. The code defines a function 'generateMealPlan(diet, goal)' which initializes an empty meal plan and a set for selected recipe indices. It then loops three times to generate meals. Inside the loop, it filters a 'recipes' array based on the diet type: 'vegan', 'vegetarian', or a default 'Balanced diet'.

```
185 // Function to generate a meal plan
186 function generateMealPlan(diet, goal) {
187   const mealPlan = [];
188   const selectedRecipeIndices = new Set(); // To keep track of selected recipes
189
190   for (let i = 0; i < 3; i++) { // Generate a meal plan for 3 meals
191     let eligibleRecipes = [];
192
193     if (diet === 'vegan') {
194       eligibleRecipes = recipes.filter(recipe => recipe.vegan);
195     } else if (diet === 'vegetarian') {
196       eligibleRecipes = recipes.filter(recipe => recipe.vegan || recipe.vegetarian);
197     } else { // Balanced diet
198       eligibleRecipes = recipes;
199     }
200   }
201 }
```

The provided JavaScript code outlines the functionality of generating a meal plan and displaying it along with a shopping list based on user preferences using the Dietary Planner Tool. Here's a breakdown of the code:

1. Sample Recipe Data:

The code starts with an array of sample recipe data. Each recipe has properties such as name, calorie content, protein, carbs, fats, dietary flags (vegan/vegetarian), and a list of ingredients with their quantities and units.

2. generateMealPlan Function:

This function generates a meal plan based on the user's selected dietary preference and goal. It iterates to create a meal plan with three recipes. It filters eligible recipes based on the chosen diet (vegan, vegetarian, or balanced). It then randomly selects recipes that haven't been chosen yet and adds them to the meal plan.

3. displayMealPlan Function:

This function takes the generated meal plan and displays it in the "mealPlanContent" section of the HTML. For each recipe in the meal plan, it creates a new HTML element and populates it with the recipe's details like name, calories, protein, carbs, and fats.

4. displayShoppingList Function:

This function generates and displays a shopping list based on the meal plan. It compiles a list of ingredients from each recipe and formats them for display in the "shoppingListContent" section of the HTML.

5. getIngredients Function:

This function extracts the ingredients from a recipe and formats them into a user-friendly string.

5.2.5. Integration of Chatbot into the Website:

The integration of the AI-driven chatbot into the website was a pivotal step in enhancing the user experience and providing instant access to medical information and assistance. To seamlessly incorporate the chatbot's functionality within the website, an iframe element was utilized.

An iframe (inline frame) is an HTML element that allows the embedding of another web page or document within the current page. This technology was employed to showcase the chatbot's interactive interface directly on the website, ensuring that users can access its features without being redirected to a separate platform.

Technical Implementation:

The integration process involved creating an iframe element within the website's HTML structure. This iframe was configured to display the chatbot's user interface, which includes the chat window and input area. The source URL of the iframe was set to the endpoint of the chatbot service, enabling real-time communication between the website and the chatbot.

```
<iframe src="chatbot-service-endpoint" id="chatbot-iframe" frameborder="0" scrolling="no"></iframe>
```

The src attribute points to the endpoint of the chatbot service, where users can interact with the chatbot.

User Interaction:

When users access the website, they are presented with the website's content alongside the embedded chatbot interface. Through the chatbot, users can ask health-related questions, seek medical advice, and access information from the knowledge base. The iframe ensures that the chatbot's responses and interactions are seamlessly integrated into the website's layout.

In essence, the integration of the chatbot using an iframe creates a harmonious blend of the website's content and the chatbot's functionality. Users can effortlessly navigate between the website's offerings and the chatbot's interactive assistance, contributing to an enriched and holistic user experience within the healthcare platform.

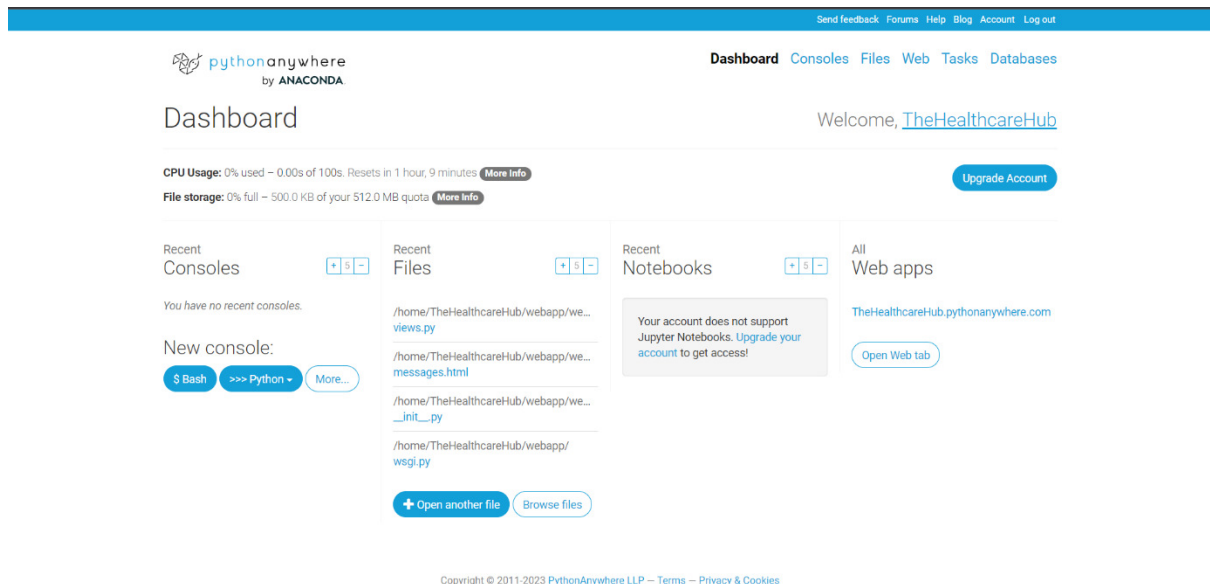
Appendix G provides access to the final product of the project.

5.3. Deployment of the Website

The final phase of implementing the healthcare platform involved deploying the website, providing users with seamless access to the intelligent chatbot. To achieve this, the PythonAnywhere server was utilized as the hosting platform, ensuring the accessibility and functionality of the application.

5.3.1. Selection of Hosting Platform

PythonAnywhere, a popular web hosting service, was chosen to host the website. This platform offers a user-friendly environment for deploying and managing web applications. It provides the necessary resources and tools to ensure the smooth operation of the deployed application.



5.3.2. Deployment Process

The deployment process encompassed several key steps:

5.3.2.1. Code and Configuration Upload

The source code of the website, along with the configuration files, was uploaded to the PythonAnywhere server. This included the bot's logic, configuration settings, and any necessary assets such as images or stylesheets.

5.3.2.2. Installation of Dependencies

Within the virtual environment, the required Python packages and libraries were installed using the package manager. This ensured that the application had access to the necessary tools and frameworks to function correctly.

5.3.2.3. Configuration Adjustments

The configuration settings were updated to reflect the deployment environment. This includes adjusting URLs, endpoints, and any other settings that need to be tailored to the production environment.

5.3.2.4. Web Application Configuration

PythonAnywhere offers a web application dashboard where settings such as the WSGI file, static files configuration, and domain settings can be configured. This dashboard was utilized to ensure that the website is accessible via the appropriate domain and that static assets are served correctly.

5.3.2.5. Testing and Debugging

Before making the website live, thorough testing and debugging were conducted. This included testing the bot's functionality, ensuring that user interactions yielded accurate responses, and verifying that the website's layout and design were responsive and user-friendly.

5.3.3. Making the Website Live

Once testing was successful, the website was made live by configuring the domain settings in PythonAnywhere. This ensured that users could access the website using the designated domain name. The website is available at the url <https://thehealthcarehub.pythonanywhere.com/>

```
Code:
What your site is running.
Source code: /home/TheHealthcareHub/webapp ➡Go to directory
Working directory: /home/TheHealthcareHub/ ➡Go to directory
WSGI configuration file: /var/www/thehealthcarehub_pythonanywhere_com_wsgi.py
Python version: 3.10 
```

5.3.4. Ongoing Management

After deployment, ongoing management included monitoring the website's performance, responding to user feedback, and addressing any potential issues that may arise. Regular updates to the bot's knowledge base and codebase were made to enhance its capabilities and accuracy.

Log files:

The first place to look if something goes wrong.

Access log: [thehealthcarehub.pythonanywhere.com.access.log](#)

Error log: [thehealthcarehub.pythonanywhere.com.error.log](#)

Server log: [thehealthcarehub.pythonanywhere.com.server.log](#)

Log files are periodically rotated. You can find old logs here: [/var/log](#)

6. Result and Analysis

The culmination of the healthcare platform's implementation marks a pivotal juncture, where the platform's performance and user engagement are evaluated to gauge its effectiveness in addressing the healthcare challenges faced by international students. This section delves into the results obtained from various assessments, shedding light on the platform's impact and user experiences.

6.1. Testing

6.1.1. Test Cases Development

In this section, we outline the comprehensive set of test cases that were developed to rigorously assess the healthcare platform. The testing approach was designed to validate the must-have, should-have, and non-functional requirements defined for the platform. Due to the limitation of involving external individuals for testing, a meticulous and structured internal testing

methodology was adopted. To ensure the quality, functionality, and reliability of the healthcare platform, a meticulous testing approach was adopted. The "Arrange-Act-Assert" (AAA) testing methodology was employed, providing a structured framework for the creation and execution of test cases (Jäger, Terry and Rance, 2021). AAA testing promotes better test coverage and helps in identifying and fixing bugs or issues early in the development process. The following example outline how the AAA methodology was applied to various aspects of the testing process.

Applying AAA Testing Methodology: Test Case Example

To provide a practical demonstration of how the AAA (Arrange-Act-Assert) testing methodology is employed, we present a test case scenario within the context of the healthcare platform. This example illustrates how AAA brings structure and organization to the testing process.

Table 1: AAA testing Example

Test Case Scenario	User Registration Process
Objective	To verify the user registration process, ensuring that users can successfully create accounts on the healthcare platform.
Test Steps	<p>Arrange: Navigate to the user registration page.</p> <p>Act: Fill in the required registration details and submit the form.</p> <p>Assert: Confirm that the user is redirected to the login page with a success message displayed.</p>
Expected Outcome	After completing the registration form and submitting it, the user should be redirected to the login page with a success message confirming the successful registration.

6.1.2. Functional Testing:

1. Healthcare Information and Resources:

The above test cases collectively ensure that the healthcare platform fulfills its intended objectives of providing accurate medical information, seamless user interactions, and a secure environment for international students. These tests were meticulously executed, and outcomes were recorded to address any identified issues through iterative development cycles.

Table 2: Table for Functional Testing-1

Test Case Scenario-1		Validate Language and Understandability
Objective		To verify that healthcare information is presented in a language that international students can easily understand.
Test Steps		Arrange: Access the "Healthcare Information" section. Act: Review the content related to a specific medical service, e.g., "Diet and Nutrition" Assert: Ensure that the content is written in clear and concise language.
Expected Outcome		The healthcare information is presented in a manner that international students can easily understand, promoting accessibility and inclusivity.
Status		Completed
Evidence		

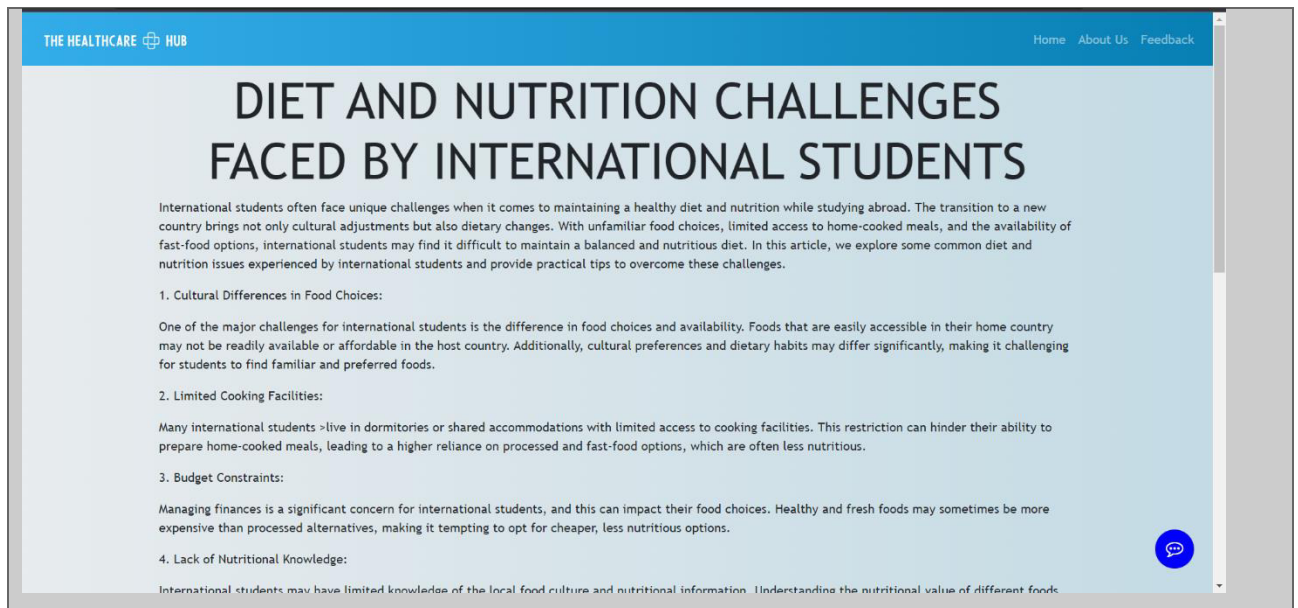


Table 3: Table for Functional Testing-2

Test Case Scenario-2	Validate Information Completeness
Objective	To ensure that healthcare information is comprehensive and provides relevant details.
Test Steps	<p>1. Arrange: Access a specific medical service or health resource.</p> <p>2. Act: Review the information provided on the page.</p> <p>3. Assert: Confirm that the information includes key details such as description, benefits, potential risks, and relevant contact information.</p>
Expected Outcome	The healthcare information should provide a complete overview of the selected medical service or health resource, including all relevant details for users' understanding.
Status	Completed
Evidence	

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SLEEP PROBLEMS

Adjusting to a new environment and dealing with academic stress can contribute to sleep problems among international students.

Common Sleep Issues:

- **Insomnia:** Difficulty falling asleep or staying asleep.
- **Jet Lag:** Disrupted sleep patterns due to crossing multiple time zones.
- **Nightmares:** Stress and anxiety can lead to distressing dreams.
- **Irregular Schedule:** Irregular class schedules and study habits can affect sleep routines.

Tips for Better Sleep:

Consider these strategies to improve your sleep quality:

- Establish a consistent sleep schedule.
- Create a sleep-conducive environment: comfortable mattress, dark room, moderate temperature.
- Avoid heavy meals and caffeine close to bedtime.
- Practice relaxation techniques before sleep.
- Limit screen time before bed.

Seeking Help:

If sleep problems persist, consider seeking help from a healthcare professional. Sleep is crucial for overall well-being and academic success.

Resources for Better Sleep:

Our campus offers resources to support your sleep health:

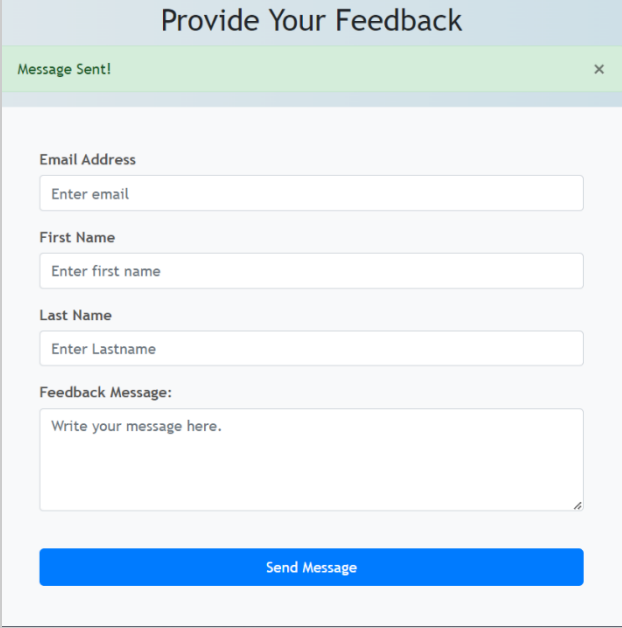
2. Feedback and Improvement Mechanism:

Table 4:Table for Functional Testing-3

Test Case	Objective	AAA Approach	Test Steps	Expected Outcome	Status
1	To confirm that users can successfully submit feedback through the platform's feedback mechanism.	Arrange: Access the "Feedback" section.	Act: Complete the feedback form with valid input and submit the form.	Assert: Ensure that the user receives a confirmation message indicating successful feedback submission.	Completed

2	To ensure that the feedback form captures all necessary information for effective feedback collection.	Arrange: Access the "Feedback" section.	Act: Review the feedback form and its fields.	Assert: Confirm that the feedback form includes fields for user's name, email, feedback type, and detailed feedback description.	Completed
---	--	---	--	--	-----------

Evidence



The screenshot shows a web form titled "Provide Your Feedback". At the top, there is a light blue header bar with the title. Below the header is a green success message bar that says "Message Sent!" with a close button (X). The form itself has a white background and contains the following fields:

- Email Address:** A text input field with the placeholder text "Enter email".
- First Name:** A text input field with the placeholder text "Enter first name".
- Last Name:** A text input field with the placeholder text "Enter Lastname".
- Feedback Message:** A larger text area with the placeholder text "Write your message here." and a small icon in the bottom right corner.

At the bottom of the form is a blue button labeled "Send Message".

3. BMI Calculator:

Table 5: Table for Functional Testing-4

Test Case	Objective	AAA Approach	Test Steps	Expected Outcome	Status	Evidence
1	Validate BMI Calculation	Arrange: Access the BMI calculator tool.	Act: Enter weight (70 kg) and height (175 cm).	Assert: Verify that the calculated BMI is accurate based on the provided weight and height values.	Completed	Refer to Appendix H
2	Validate BMI Categorization	Arrange: Access the BMI calculator tool.	Act: Enter weight (70 kg) and height (175 cm).	Assert: Ensure that the calculated BMI value is accurately categorized into the appropriate BMI range (e.g., Normal weight, Overweight).	Completed	Refer to Appendix H

3	Check the Explanation of BMI Categories	Arrange: Access the BMI calculator tool.	Act: View the explanation of BMI categories.	Assert: Confirm that the explanation for each BMI category (e.g., Underweight, Normal weight) is clear and informative.	Completed	Refer to Appendix H
4	Validate Clear Reset Functionality	Arrange: Access the BMI calculator tool.	Act: Enter weight and height values, then click the "Reset" button.	Assert: Verify that clicking the "Reset" button clears the input fields and calculated BMI.	Completed	Refer to Appendix H
5	Check Validation for Invalid Inputs	Arrange: Access the BMI calculator tool.	Act: Enter invalid weight or height values (e.g., negative values, non-numeric characters).	Assert: Confirm that the calculator displays appropriate validation messages for invalid inputs.	Completed	Refer to Appendix H

4. Dietary Meal Planner:

Table 6: Table for Functional Testing-5

Test Case	Objective	AAA Approach	Test Steps	Expected Outcome	Status	Evidence
1	Validate Dietary Preferences Selection	Arrange: Access the dietary meal planner tool.	Act: Select dietary preferences, such as "Vegetarian" and "Vegan."	Assert: Ensure that the selected dietary preferences are accurately reflected in the meal planner.	Completed	Refer to Appendix H
2	Validate Health Goals Selection	Arrange: Access the dietary meal planner tool.	Act: Select health goals, such as "Weight loss" and "Weight gain."	Assert: Confirm that the selected health goals are considered in the generated dietary plan.	Completed	Refer to Appendix H
3	Check Generated Meal Plan	Arrange: Access the dietary meal planner tool.	Act: Select dietary preferences, health goals, and other preferences.	Assert: Verify that the generated dietary plan aligns with the selected preferences and goals.	Completed	Refer to Appendix H

4	Validate Nutritional Information	Arrange: Access the dietary meal planner tool.	Act: View nutritional information for generated meals.	Assert: Ensure that the nutritional information (calories, macros) for each meal is provided and accurate.	Completed	Refer to Appendix H
5	Verify Meal Suggestions Variety	Arrange: Access the dietary meal planner tool.	Act: Generate multiple dietary plans with different preferences.	Assert: Confirm that the meal suggestions offer a variety of options and combinations.	Completed	Refer to Appendix H
6	Validate Modification and Customization	Arrange: Access the dietary meal planner tool.	Act: Modify generated meal plans and add custom meals.	Assert: Verify that users can customize meal plans and add personalized meals according to their preferences.	Failed	-

6.1.3. Effectiveness of Chatbot Services

Evaluating the performance of the chatbot is integral to gauging its value in providing healthcare information and support. Several dimensions contribute to assessing the effectiveness of the chatbot services:

6.1.3.1.Methodology:

Due to limitations in obtaining ethical approval for participant involvement and being a solo team member, traditional user testing involving participants was not feasible. As an alternative approach, a comprehensive evaluation of the platform's performance was conducted using various metrics to assess its functionality, user engagement, and chatbot effectiveness.





6.1.3.2.Effectiveness of Chatbot Services Metrics:

The effectiveness of the chatbot was evaluated through:

1. **Accuracy of Responses:** The percentage of user queries to which the chatbot provided accurate and relevant answers.

Table 7:Table for Chatbot Accuracy Testing

Question	Answer given by the Chatbot	Accepted Answer	Accuracy
What are the symptoms of the common cold?	<p>a blocked or runny nose</p> <ul style="list-style-type: none">• a sore throat• headaches• muscle aches• coughs• sneezing• a raised temperature• pressure in your ears and face• loss of taste and smell	Sneezing, runny or stuffy nose, sore throat, cough, mild headache, fatigue	Relevant

How is allergic rhinitis (hay fever) managed?	<p>do not cut grass or walk on grass</p> <p>do not spend too much time outside</p> <p>do not keep fresh flowers in the house</p> <p>do not smoke or be around smoke – it makes your symptoms worse</p> <p>do not dry clothes outside – they can catch pollen</p> <p>do not let pets into the house if possible – they can carry pollen indoors</p> <p>Get more tips on managing hay fever from Allergy UK </p>	Managing allergic rhinitis involves avoiding allergens and using treatments like antihistamines and nasal sprays	Irrelevant
What are the symptoms of asthma?	<p>The main symptoms of asthma are:</p> <ul style="list-style-type: none"> • a whistling sound when breathing (wheezing) • breathlessness  • a tight chest, which may feel like a band is tightening around it • coughing  <p>The symptoms can sometimes get temporarily worse. This is known as an asthma attack .</p>	Symptoms of asthma include shortness of breath, wheezing, coughing, chest tightness	Relevant
What are the symptoms of a migraine?	<p>A migraine tends to be a very bad headache with a throbbing pain on 1 side of the head</p> <p>You may get other symptoms just before a migraine, such as:</p> <ul style="list-style-type: none"> • feeling very tired and yawning a lot • craving certain foods or feeling thirsty • changes in your mood • a stiff neck • peeing more <p>You may also get warning signs you're about to have a migraine (called an aura), such as:</p> <ul style="list-style-type: none"> • problems with your sight, such as seeing zigzag lines or flashing lights • numbness or a tingling that feels like pins and needles • feeling dizzy • difficulty speaking 	Migraine symptoms often include an intense headache, sensitivity to light and sound, and sometimes nausea or vomiting	Relevant

How can I prevent the flu?	<p>A person with a cold can start spreading it from a few days before their symptoms begin until the symptoms have finished.</p> <p>The best ways to avoid catching a cold are:</p> <ul style="list-style-type: none"> • washing your hands with warm water and soap • not sharing towels or household items (like cups) with someone who has a cold • not touching your eyes or nose in case you have come into contact with the virus – it can infect the body this way • staying fit and healthy <p>The flu vaccine helps prevent flu but not colds. See how to wash your hands correctly</p>	Get an annual flu vaccine, wash hands frequently, avoid close contact with sick individuals	Relevant
How can I relieve a headache naturally?	<p>drink plenty of water</p> <p>get plenty of rest if you have a cold or the flu</p> <p>try to relax – stress can make headaches worse</p> <p>take paracetamol or ibuprofen</p> <p>try to stay at home and avoid contact with other people if you have a high temperature or you do not feel well enough to do your normal activities</p>	Natural headache relief methods include drinking water, resting, and using a cold compress	Relevant
How is hypertension (high blood pressure) treated?	<p>it increases your risk of serious problems such as heart attacks and strokes</p> <p>High blood pressure, or hypertension, rarely has noticeable symptoms. But if untreated, it increases your risk of serious problems such as heart attacks and strokes.</p> <p>Around 1 in 4 adults in the UK have high blood pressure, although many will not realise it.</p> <p>The only way to find out if your blood pressure is high is to have your blood pressure checked.</p>	Treatment for hypertension involves lifestyle changes (like healthy eating and exercise) and sometimes medication	Irrelevant

$$\begin{aligned}\text{Accuracy Rate} &= (\text{Number of Correct Responses} / \text{Total Number of User Interactions}) \\ &\times 100 \\ &= (8/10) \times 100 = 80\end{aligned}$$

The accuracy rate of 80% indicates that the chatbot provided correct and relevant answers to 8 out of 10 user interactions. This is a solid accuracy rate, indicating that the chatbot is performing well in delivering accurate information and responses to user queries. However, due to reduced number of test cases, the provided accuracy may not solely be considered for effectiveness.

- 2. Conversational Flow Testing:** Test the bot's ability to maintain a coherent conversation across multiple queries.

User Query	Bot Response								
What are the common symptoms of the flu?	<p>a blocked or runny nose</p> <ul style="list-style-type: none"> • a sore throat • headaches • muscle aches • coughs • sneezing • a raised temperature • pressure in your ears and face • loss of taste and smell 								
How can I differentiate between the flu and a cold?	<table border="1"> <thead> <tr> <th>Flu</th><th>Cold</th></tr> </thead> <tbody> <tr> <td>Appears quickly within a few hours</td><td>Appears gradually</td></tr> <tr> <td>Affects more than just your nose and throat</td><td>Affects mainly your nose and throat</td></tr> <tr> <td>Makes you feel exhausted and too unwell to carry on as normal</td><td>Makes you feel unwell, but you still feel well enough to do your normal activities</td></tr> </tbody> </table> <p>Differences between cold and flu.</p>	Flu	Cold	Appears quickly within a few hours	Appears gradually	Affects more than just your nose and throat	Affects mainly your nose and throat	Makes you feel exhausted and too unwell to carry on as normal	Makes you feel unwell, but you still feel well enough to do your normal activities
Flu	Cold								
Appears quickly within a few hours	Appears gradually								
Affects more than just your nose and throat	Affects mainly your nose and throat								
Makes you feel exhausted and too unwell to carry on as normal	Makes you feel unwell, but you still feel well enough to do your normal activities								
I have a high fever and body aches. Could it be the flu?	<p>normal</p> <hr/> <p>Flu symptoms come on very quickly and can include:</p> <ul style="list-style-type: none"> • a sudden high temperature • an aching body • feeling tired or exhausted • a dry cough • a sore throat • a headache • difficulty sleeping • loss of appetite • diarrhoea or tummy pain 								
What over-the-counter medications can I take for the flu?	<p>paracetamol</p> <hr/> <p>A pharmacist can give treatment advice and recommend flu remedies.</p> <p>Do not take paracetamol and flu remedies that contain paracetamol at the same time as it's easy to take more than the recommended dose.</p> <p>Find a pharmacy</p>								

Table 8: Table for Chatbot Conversational Flow Testing

Observations:

The bot's conversational flow testing demonstrated effectiveness in conveying information related to flu symptoms and differentiating between the flu and a cold. However, there's room for improvement in maintaining context throughout the conversation and providing relevant responses, as seen in the "Potential Flu Diagnosis" query. Further refinement could enhance the bot's ability to provide valuable assistance to users seeking medical information.

3. **Boundary Testing:** Test the bot's behaviour at the edges of its capabilities, such as using very long or very short inputs.

Table 9: Table for Chatbot Boundary Testing

User Query	Testing Scenario	Observation	Status
"What are the common symptoms of the flu?"	Boundary Testing: Long Input	The chatbot should be able to process and respond accurately to a query with a long list of symptoms.	Completed
"I am feeling very very unwell."	Boundary Testing: Emphasis	The chatbot should be able to recognize and appropriately respond to the emphasis placed on feeling unwell.	Completed
"I have a headache."	Boundary Testing: Short Input	The chatbot should provide accurate information for a short query about a common symptom.	Completed

"Can you help me?"	Boundary Testing: Vague Input	The chatbot's response to a vague query should prompt the user for more specific information to assist effectively.	Failed
"aaaaaaaaaaaaaaaaaaaaaaaaaaaaa..."	Boundary Testing: Long Input	The chatbot should be able to handle and respond to an input with an extremely long string of characters.	Failed

Observations:

While the chatbot performed well in some boundary testing scenarios, there were instances where it struggled to handle vague queries and extremely long inputs. These observations highlight areas where the chatbot's capabilities could be improved to enhance its performance across a variety of user interactions.

4. **Error Handling Testing:** Intentionally provide incorrect or ambiguous inputs to see how the bot handles errors.

Example: Send a query with intentional misspellings and see if the bot suggests corrections or asks for clarification.

Table 10: Table for Chatbot Error Handling Testing

User Query	Testing Scenario	Expected Response	Status
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"Whut arr the sympotms of the flew?"	Misspelled Input	"Did you mean 'What are the symptoms of the flu?'"	Failed
"What's the cure for a common cold?"	Using Non-Medical Term	"I believe you're asking about the treatment for a common cold. Common colds are usually managed with rest and hydration."	Completed
"Tell me abt the treatment of allergi rhinitus."	Abbreviated Input	"Sure, I can provide information about the treatment of allergic rhinitis."	Failed
"Migrane cur?"	Ambiguous and Shortened Input	"Are you asking about the cure for migraine?"	Completed
"Flu precautio."	Partial Input	"It sounds like you're asking about flu precautions. Is that correct?"	Completed
"Can I take asprin for headech?"	Misspelled Medication	"It seems like you might be referring to 'aspirin' and a 'headache.' Aspirin can be used to relieve headaches but consult a healthcare professional for accurate advice."	Completed
"Whatt are symptooms of allergerc rhinitis?"	Misspelled Condition	"It looks like you're asking about symptoms of 'allergic rhinitis.'"	Completed

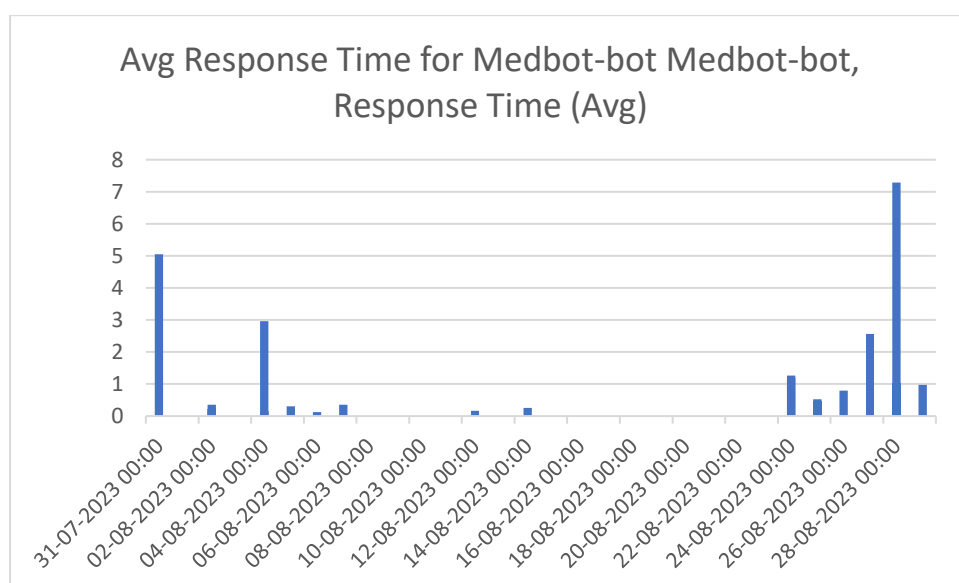
		Symptoms include sneezing, runny nose, and itchy eyes."	
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Observations:

The chatbot demonstrated the ability to handle various error scenarios by providing helpful suggestions, corrections, and seeking clarifications where necessary. However, there were instances where the chatbot's responses could be improved for better user understanding.

5. **Response Time:** The time taken by the chatbot to respond to user queries.

Table 11: Graph for Average Response Time of Chatbot



The graph depicting the average response time for the "Medbot-bot" over the provided time reveals several important insights regarding the bot's interaction dynamics and performance. Here are the key takeaways:

1. **Variable Responsiveness:** The "Medbot-bot" exhibits varying response times in addressing user queries throughout the observed time frame.
2. **Efforts to Improve:** There are instances of improved response times, indicating that steps have been taken to enhance the bot's efficiency in providing prompt answers.

3. **Challenges in Responsiveness:** Certain timestamps show notably high response times, signifying potential challenges or issues affecting the bot's real-time interactions with users.
4. **Consistency Patterns:** Consecutive time points often share similar response time patterns, suggesting that the bot's performance maintains a level of consistency during certain periods.
5. **Weekend Influence:** Response times on weekends differ from weekdays, potentially reflecting varied user engagement patterns during different days of the week.
6. **Recent Enhancements:** Towards the latter part of the observed period, there's a trend of reducing response times, indicating ongoing efforts to enhance user experience.
7. **Performance Monitoring:** Timestamps with exceptionally high response times may indicate the need for careful performance monitoring and optimization.
8. **User-Centric Approach:** Improving response times is crucial for providing users with a satisfactory experience and ensuring that their queries are addressed promptly.

Through a combination of accuracy assessment, knowledge base navigation evaluation, and latency and traffic metrics analysis, the chatbot's effectiveness in delivering accurate and relevant health information to international students was comprehensively evaluated. The metrics-based approach provided valuable insights into the chatbot's performance, user engagement, and responsiveness, despite limitations in external participant involvement. This evaluation contributed to understanding the chatbot's role in enhancing the healthcare platform's user experience and its ability to provide valuable medical guidance to international students.

6.1.4. Non-Functional Testing:

In the context of non-functional testing, a series of rigorous test cases were devised to assess the platform's performance and other critical attributes. The primary objective was to evaluate aspects beyond individual feature functionalities. One crucial test case aimed to measure the page load times of key sections, including the homepage, medical services, and chatbot. By accessing these sections and measuring the time taken for each to load, the platform's responsiveness and user experience were gauged. Google Lighthouse was the tool of choice

for conducting these performance assessments, providing quantitative data on loading times. For a detailed performance analysis of the website, readers are encouraged to consult Appendix J.

Another vital consideration was the platform's language and cultural sensitivity. Through careful examination of various platform sections, the content's accessibility and inclusivity were assessed to ensure its comprehensibility to international students of diverse backgrounds. Google Lighthouse's audits for accessibility and best practices were instrumental in this evaluation.

Scalability, a critical concern, was addressed by simulating increased user traffic. The platform's ability to accommodate concurrent users while maintaining performance standards was evaluated. Google Lighthouse's performance audit features were employed to gather insights on scalability.

Accessibility and User-Friendly Interface:

Table 12: Table for Non-Functional Testing-1

Test Case	Objective	AAA Approach	Test Steps	Expected Outcome	Status	Evidence
1	Validate Responsive Design on Different Devices	Arrange: Access the platform from a desktop computer, tablet, and mobile device.	Act: Navigate through different sections of the platform using each device.	Assert: Ensure that the platform's layout, content, and functionality adapt seamlessly to different screen sizes.	Completed	Refer to Appendix K

2	Check Font Size and Readability	Arrange: Access various sections of the platform.	Act: Review the text content and assess font size, readability, and contrast.	Assert: Confirm that the font size is suitable for easy reading and that there is sufficient contrast between text and background.	Completed	Refer to Appendix K
3	Validate Consistent Navigation	Arrange: Access the homepage of the platform.	Act: Navigate to different sections and pages using the navigation menu.	Assert: Confirm that the navigation menu items, and structure remain consistent throughout the platform.	Completed	Refer to Appendix K
4	Check Button Label Clarity	Arrange: Access interactive elements containing buttons.	Act: Review the labels on buttons, links, and calls to action.	Assert: Ensure that button labels are clear, concise, and accurately convey the intended action.	Completed	Refer to Appendix K

5	Verify Adequate Colour Contrast	Arrange: Access different sections of the platform.	Act: Review the colour scheme and assess the contrast between text and background.	Assert: Verify that text remains easily readable with appropriate colour contrast across all sections.	Completed	Refer to Appendix K
6	Validate Alternative Text for Images	Arrange: Access pages containing images.	Act: Inspect the images and their associated alternative text.	Assert: Confirm that each image has descriptive and meaningful alternative text.	Completed	Refer to Appendix K
7	Check Keyboard Navigation	Arrange: Access various pages of the platform.	Act: Navigate through the platform using only keyboard input (Tab, Enter, Arrow keys).	Assert: Confirm that all interactive elements and focusable areas can be navigated using the keyboard.	Completed	Refer to Appendix K

Usability and User Experience Testing:

Table 13: Table for Non-Functional Testing-2

Test Case	Objective	AAA Approach	Test Steps	Expected Outcome	Status	Evidence
1	Verify Intuitive Navigation	Arrange: Access the platform's homepage.	Act: Attempt to navigate to different sections using the provided menu or navigation links.	Assert: Confirm that the navigation is intuitive and that users can easily find and access different sections.	Completed	Refer to Appendix G
2	Verify Consistent Design	Arrange: Access multiple pages within the platform.	Act: Observe the design elements, colour scheme, typography, and layout.	Assert: Confirm that the design elements are consistent across all pages, providing a cohesive user experience.	Completed	Refer to Appendix G
3	Validate User Interaction Feedback	Arrange: Interact with buttons,	Act: Click buttons, follow links, and submit forms.	Assert: Ensure that users receive visual or auditory	Completed	Refer to Appendix G

		links, and forms.		feedback (e.g., highlighting, loading spinners) for their interactions.		
4	Verify User Guidance	Arrange: Access pages with complex features or processes.	Act: Attempt to perform actions like access medical resources or using the chatbot.	Assert: Confirm that users are provided with clear instructions or tooltips to guide them through complex tasks.	Completed	Refer to Appendix G
5	Check Error Handling	Arrange: Attempt to submit incomplete or incorrect information in forms.	Act: Submit forms with missing or invalid data.	Assert: Verify that users are provided with clear error messages indicating the issue and guidance on how to correct it.	Completed	Refer to Appendix G

6.2. Future Scope

The section explores how the platform can grow and improve to meet evolving needs. As healthcare and student requirements change, the platform can continue to be a valuable resource. This section outlines ways to expand its impact and address new challenges, ensuring the platform remains a reliable source of healthcare information and support for international students.

6.2.1. Additional Feature Enhancements

The potential for enriching the platform's value proposition extends to the incorporation of supplementary features that can enhance user engagement and satisfaction. Some notable additions could encompass:

- 1. Personalized Health Recommendations:** Implementing algorithms to provide tailored health suggestions based on user profiles, medical history, and preferences. This feature would foster a more personalized and effective healthcare experience.
- 2. Multilingual Support:** Expanding language options to cater to an even broader international student demographic, ensuring accessibility and inclusivity for users from various linguistic backgrounds.
- 3. Continuous Knowledge Base Enhancement:** The knowledge base, a cornerstone of the chatbot's effectiveness, should be continually updated and expanded. Collaboration with medical experts, research institutions, and relevant authorities can help ensure that the platform remains a reliable and up-to-date source of healthcare information.
- 4. Price Comparison Tool for Ingredients:** Introducing a price comparison tool for ingredients is a proposed enhancement to the dietary meal planner. This tool will enable users to easily compare ingredient prices across different grocery stores, aiding in cost-effective and informed meal planning. Benefits include economical choices, informed ingredient selection, enhanced user experience, time savings, and improved health management. This addition aligns with the platform's commitment to comprehensive solutions for international students' well-being.

5. **Student Forums:** Creating interactive discussion platforms where users can share experiences, seek advice, and engage with peers, fostering a supportive community atmosphere.
6. **Enhanced Data Security:** Strengthening data protection measures to ensure the confidentiality of user information, thereby enhancing user trust and compliance with privacy regulations.
7. **Health Tracking and Reminders:** Introducing tools for users to monitor health metrics, set medication reminders, and track progress towards health goals, promoting proactive self-care.
8. **Emergency Assistance Integration:** Partnering with emergency services or institutions to incorporate features that swiftly connect users to help in case of medical emergencies.
9. **Gamified Health Challenges:** Designing interactive challenges and activities that motivate users to adopt healthy habits and engage with the platform regularly.
10. **Collaborative Content Creation:** Allowing users to contribute health-related content such as articles, tips, and success stories, fostering a sense of ownership and knowledge sharing.
11. **Expansion of Medical Services:** The platform's reach and impact can be significantly expanded by incorporating a broader range of medical services and resources. Collaboration with medical professionals and institutions can facilitate the integration of specialized services such as mental health support, reproductive health guidance, and specialized treatments. This expansion will empower international students with a comprehensive suite of healthcare resources tailored to their diverse needs.

6.2.2. User Feedback Loop

Creating a strong feedback mechanism will drive ongoing enhancements by incorporating user insights. Conducting routine surveys, feedback forms, and user testing sessions can provide valuable input that shapes the platform's growth and addresses emerging challenges.

6.2.3. Data Analytics for Insights

Harnessing data analytics and user behaviour analysis can yield profound insights into user preferences, engagement trends, and content effectiveness. These insights can guide content creation, improvements in user experience, and strategic decision-making.

6.2.4. Regulatory Compliance and Security

As the platform evolves, upholding compliance with healthcare regulations and maintaining robust data security measures remains paramount. Regular audits, security assessments, and adherence to relevant standards will uphold the platform's credibility and user trust.

By integrating these future scope considerations, the healthcare platform can sustain innovation, user-focus, and meaningful impact in addressing the healthcare needs of international students. By embracing technological progress, fostering collaborations, and adapting to user feedback, the platform can continue to deliver valuable health information and support to international students across the globe.

6.3. Ethical Considerations

The development and deployment of the healthcare platform were guided by ethical considerations that prioritize responsible and respectful use of technology in healthcare services. It's important to note that due to not obtaining ethical approval, the collection of data for testing purposes was limited to personal data that belonged to me as the sole team member. The following ethical aspects were thoughtfully evaluated to ensure the platform's ethical alignment and user well-being:

- 1. User Privacy and Confidentiality:** The platform adhered to stringent data protection measures to safeguard personal and medical information. As data collection was limited to my own interactions, user privacy and confidentiality were maintained, and no external individuals' data was involved.

2. **Informed Consent:** The platform operated under the understanding that the data collected solely pertained to my interactions with the platform. As the only team member, I provided my own informed consent for the use of my data for testing and analysis.
3. **Accuracy and Reliability:** To ensure accurate and reliable information, the platform focused on maintaining the quality of data collected during my interactions. This internal testing methodology aimed to mitigate the risk of misinformation.
4. **Transparency:** The platform remained transparent in communicating its features, purpose, and limitations, especially given the absence of external user data. Users, in this case, were informed that the platform's data collection was limited to my own interactions.
5. **Feedback and Continuous Improvement:** Although the data pool was limited, a feedback loop was established to collect input for improving the platform. My interactions and feedback contributed to refining the platform's functionalities and user experience.
6. **Regulatory Compliance:** Adherence to applicable regulations and privacy laws was upheld in handling the data collected for testing purposes. The limited scope of data collection from my own interactions ensured regulatory compliance.
7. **Data Ownership and Usage:** It's important to highlight that all data collected for testing belonged to me as the sole team member. The platform respected data ownership and avoided any unauthorized use of external individuals' data.

While ethical approval limitations prevented the involvement of external participants, the platform's development was guided by ethical principles to ensure the responsible and secure

use of technology. The focus on internal data collection allowed for a controlled environment that upheld data privacy and ethical standards, acknowledging that all data collected was exclusively mine as the developer.

7. Conclusions

In response to the pressing healthcare challenges faced by international students studying abroad, the proposed comprehensive healthcare website stands to support and empower. y creatively combining information, interactive tools, and multilingual accessibility, this website aims to connect international students with healthcare resources. By equipping students with the knowledge, tools, and guidance they need, the website strives to enhance their health and well-being while navigating the complexities of studying in foreign countries.

The journey that began with recognizing the healthcare struggles of international students culminates in the development of a user-centric platform that addresses these challenges head-on. The commitment to fostering inclusivity, accessibility, and cultural sensitivity underpins the website's foundation. The incorporation of interactive tools, such as the AI-powered health chatbot and BMI calculator, adds a dynamic layer of engagement, allowing students to receive personalized support and guidance at their fingertips.

The proposed website is not just a repository of information; it's a dynamic ecosystem that empowers international students to make informed decisions about their health. By offering practical resources, guidance on healthcare systems, and addressing mental health concerns, the website becomes an ally in the students' academic journey.

As the digital gateway to improved healthcare experiences for international students, this website is poised to create a lasting impact. By empowering students with knowledge, tools, and resources, it contributes to their academic excellence, personal growth, and overall well-being. This culmination reflects the potential of technology to bridge gaps, empower individuals, and create positive change. The journey continues as this platform takes flight, becoming a trusted companion in the educational endeavours of international students around the world.

8. Reflection

Completing the MSc Project phase has been nothing short of a transformative journey that has profoundly influenced my academic and personal growth. This reflection encapsulates the essential lessons I have learned, not just as a researcher but as an individual, throughout this remarkable experience.

Challenges faced during the Project:

The inception of this project was humble, starting as a simple chatbot concept. Initially, my focus was solely on crafting an intelligent chatbot that could assist users with their healthcare queries. However, as the project progressed, my supervisor offered valuable guidance that encouraged me to think bigger. This pivotal moment prompted a fundamental shift in my project's direction. With limited time on hand, I had to rapidly brainstorm and expand the project's scope. It was challenging, to say the least, to transition from a narrow chatbot project to a more comprehensive healthcare resource platform. This experience taught me the importance of adaptability and quick thinking in the world of research and technology development and also utilising SDLC(Software Development Life Cycle) methodologies.

My fascination with Azure was sparked during my preparation for the AZ-900 exam. The deeper I delved into the world of Azure, the more captivated I became by its capabilities. This newfound understanding fundamentally influenced my decision to integrate Azure services into my project. Azure provided an incredible array of tools and resources that allowed me to bring my project to life in ways I had not initially imagined. The journey from being an exam candidate to an enthusiastic Azure user was both enlightening and rewarding, showing me the immense potential of cloud computing in modern technology solutions.

Building two standalone products, the chatbot and the complementary component, and seamlessly integrating them into a single, harmonious system was a formidable undertaking. It required not only technical prowess but also a keen sense of coordination and problem-solving. After exploring various integration methods and encountering numerous roadblocks, I stumbled upon the solution: iframes. Iframes provided the perfect framework to seamlessly embed one component within the other while maintaining their autonomy.

One of the most formidable challenges I encountered during this project was report writing. Constructing a comprehensive and coherent report demanded a level of precision and clarity

that I had not previously experienced. Structuring the report, ensuring that technical details were accessible to all readers, and maintaining a smooth flow of information were constant battles. However, the struggle was not in vain. Overcoming these obstacles strengthened my writing skills and honed my ability to convey complex technical concepts in a digestible manner.

Lessons About the Project's Subject Matter:

First and foremost, I learned that medical research is a dynamic and evolving field even in developing medical software. It demands not only a deep understanding of medical science but also an openness to adapt to new knowledge and technologies continually. Ethics emerged as a cornerstone of my experience. Learning to navigate the ethical complexities of research, including medical data, peer reviewed sources and consequences of incorrect diagnosis was both enlightening and humbling. It reinforced my dedication to conducting research with the highest standards of ethics.

My deep dive into Azure and Flask showcased the practical applications of cloud computing and web development. The technical skills acquired during the MSc Programme were pivotal in turning the project's vision into a tangible reality. This experience reinforced the importance of technical proficiency in an ever-evolving digital landscape and expanded my horizons about the real-world applications of technology.

The MSc Project phase has been an eye-opening and transformative journey. It has not only enriched my research skills but has also provided profound insights into my own strengths and weaknesses. Moreover, it deepened my understanding of ethical considerations, the importance of empathy in technology development, and the practical applications of technical skills. These enduring lessons will undoubtedly shape my future research endeavours and career path, underscoring the significance of responsible and adaptable research practices in an ever-changing world.

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Appendices

Appendix A: Initial Project Work Plan

Weeks 1-2: Scope Definition and Initial Planning

1. Project Kick-off and Scope Definition (Week 1)
 - Collaborate with the project supervisor to finalize project scope and objectives.
 - Define core functionalities and features to address international student healthcare challenges.
 - .
2. Feature Prioritization and Planning (Week 2)
 - Prioritize features based on their impact on addressing primary healthcare challenges.
 - Break down features into smaller tasks and create an initial backlog.

Weeks 3-4: MVP Development Cycle 1

3. Incremental Development (Week 3-4)
 - Focus on developing essential features of the MVP that address high-priority challenges.
 - Implement user interfaces, basic functionalities, and data integration.
4. Weekly Check-in and Feedback (Week 4)
 - Present the progress of the first development cycle to the project supervisor.
 - Gather feedback and insights for refinement and adjustments.

Weeks 5-6: MVP Development Cycle 2

5. Incremental Development (Week 5-6)
 - Continue building additional features of the MVP, considering feedback from the previous cycle.
 - Develop interactive elements, such as the chatbot interface.
6. Weekly Check-in and Feedback (Week 6)

- Present the progress of the second development cycle to the project supervisor.
- Discuss any necessary modifications based on feedback.

Weeks 7-9: MVP Development Cycle 3 and Testing

7. Incremental Development (Week 7-8)

- Complete the development of remaining MVP features, including data security measures.
- Focus on optimizing user experience and ensuring responsive design.

8. Functional and Usability Testing (Week 9)

- Conduct functional testing to ensure all MVP features work as intended.
- Test user interfaces for usability and responsiveness.

Weeks 10-11: Final Refinements and Testing

9. Refinements and Iterations (Week 10)

- Address issues identified during testing and refined user interfaces.
- Optimize performance and ensure compliance with data privacy regulations.

10. Final Testing and Quality Assurance (Week 11)

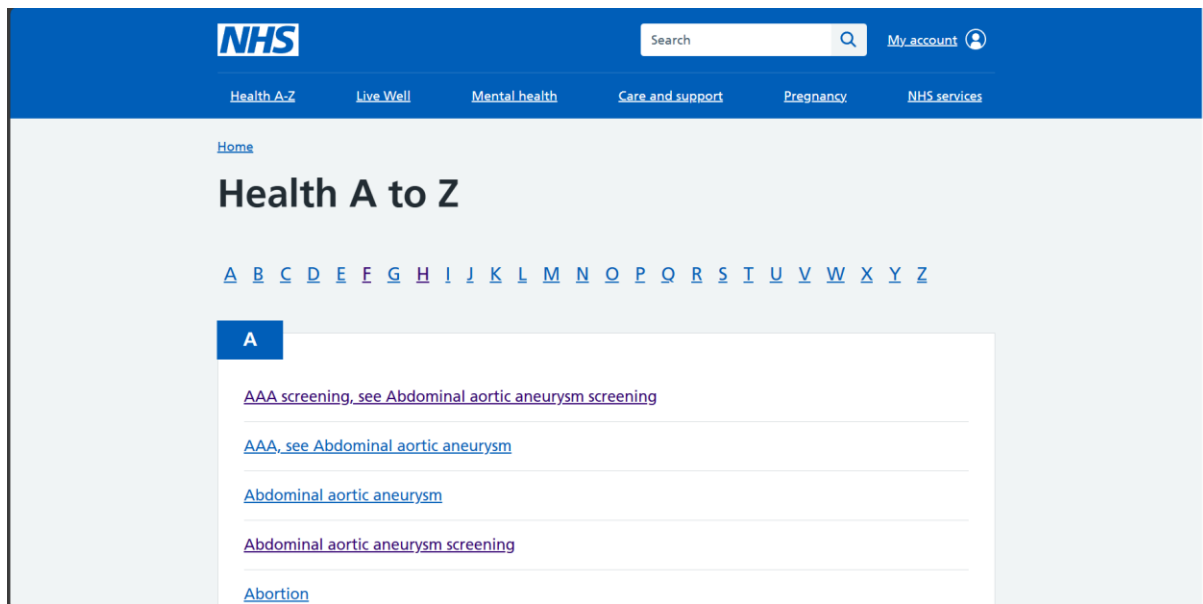
- Perform comprehensive testing of the MVP, including security and data protection measures.
- Verify seamless navigation and user experience.

Week 12: Deployment

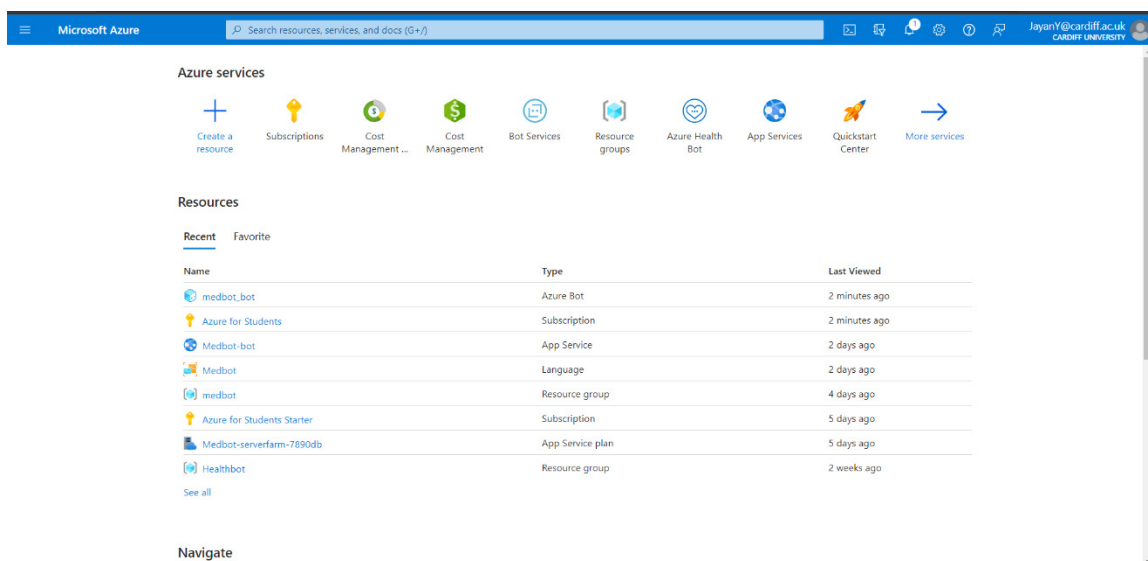
11. Deployment and Presentation (Week 12)

- Deploy the MVP to a hosting environment.
- Present the completed MVP to the project supervisor, showcasing its functionalities and features.

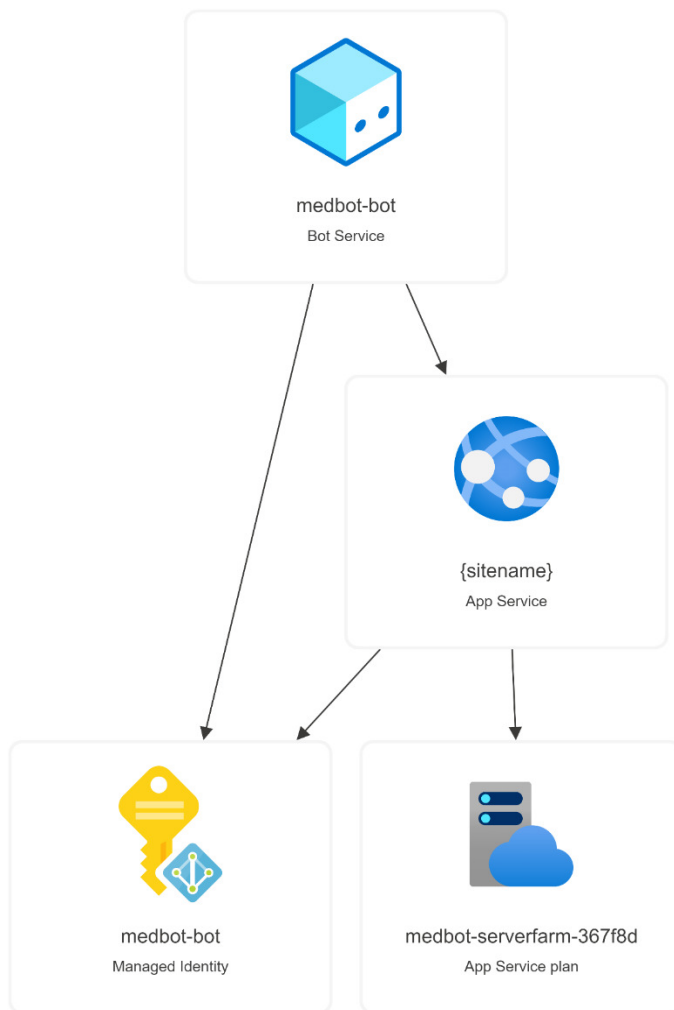
Appendix B: The NHS Website



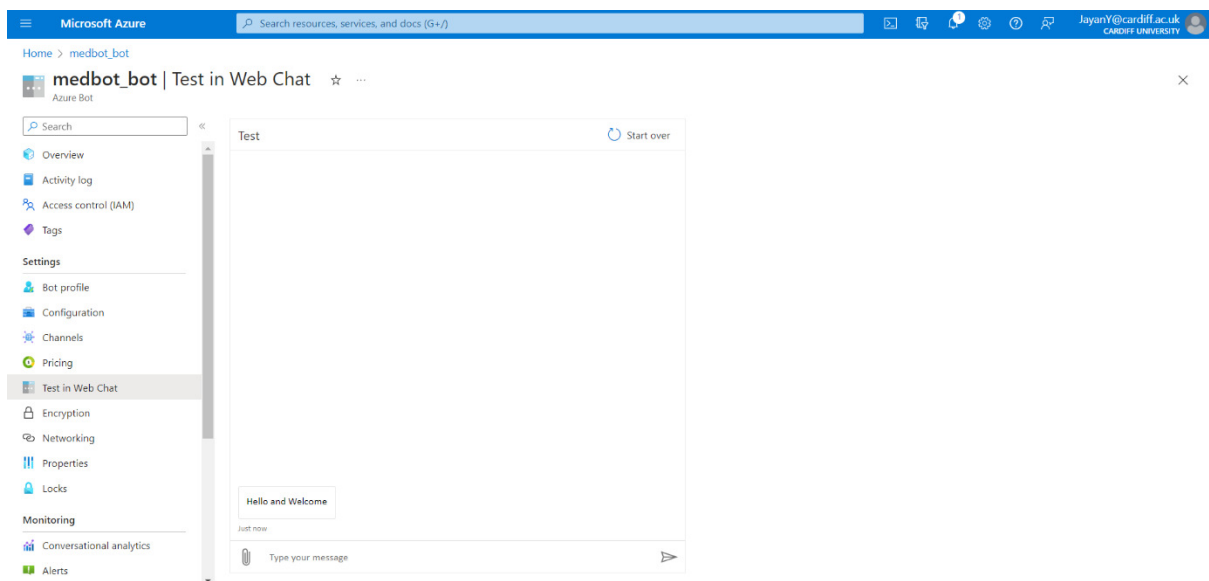
Appendix C: Azure Dashboard



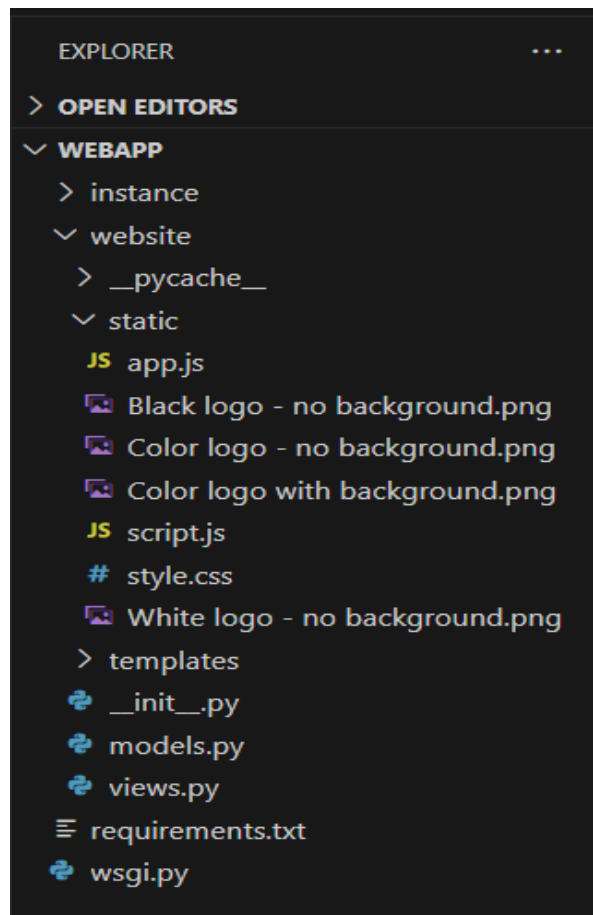
Appendix D: Chatbot Architecture in Azure



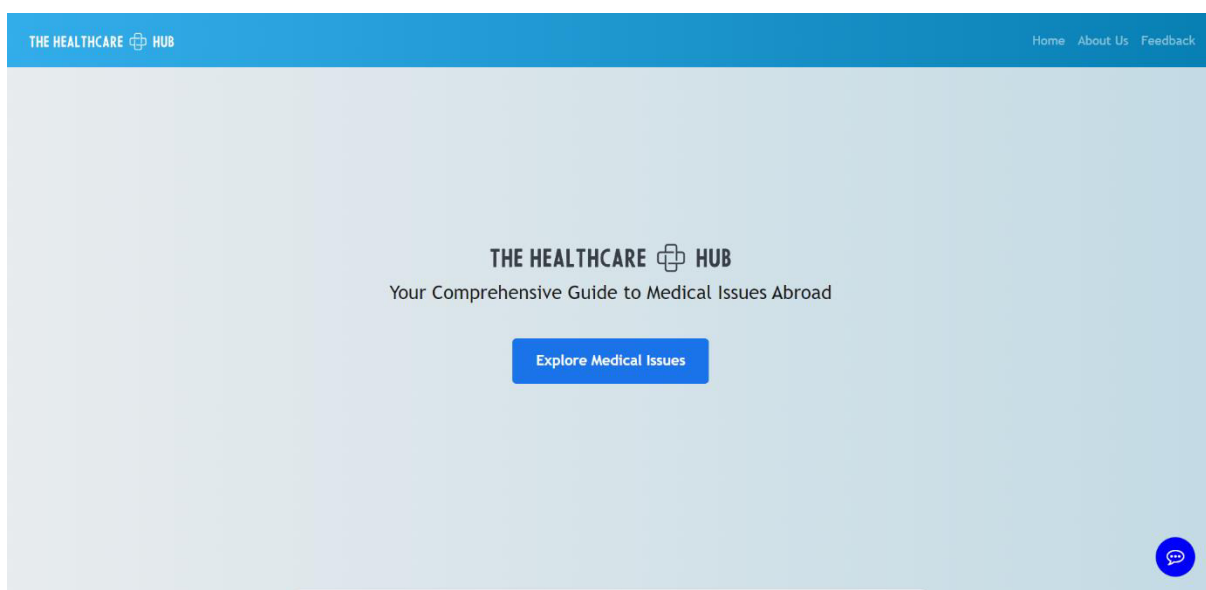
Appendix E: Chatbot Final Product

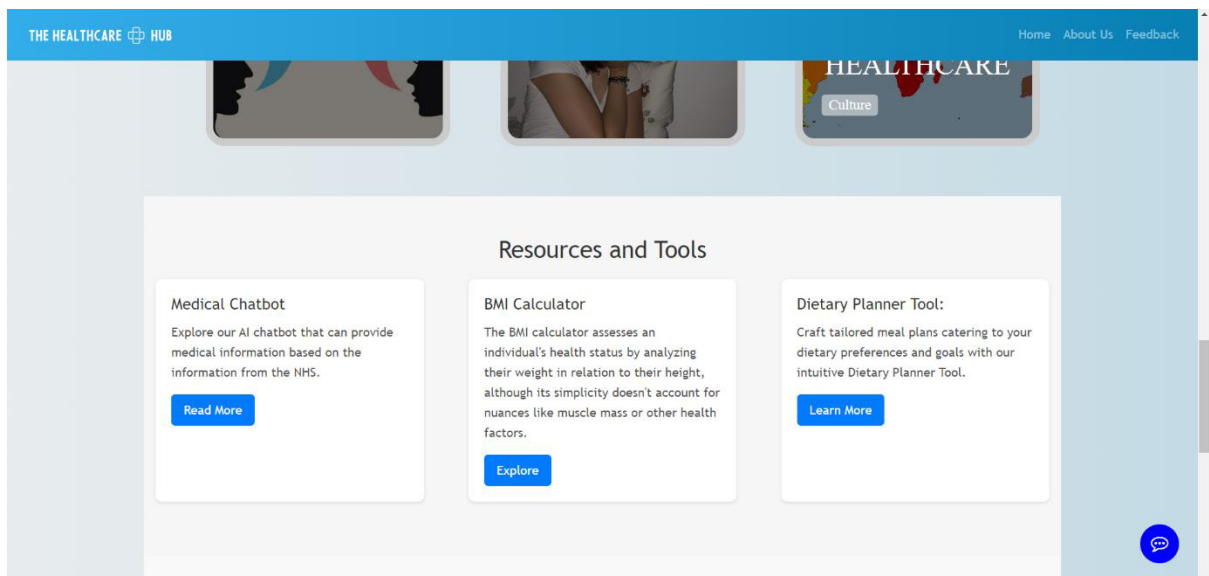
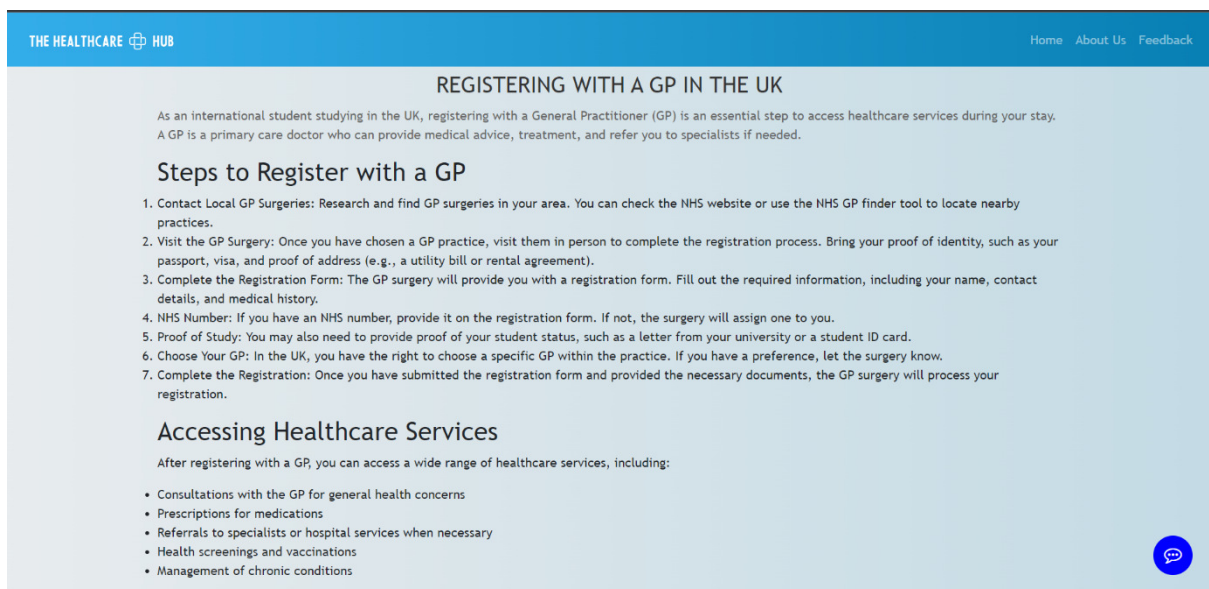
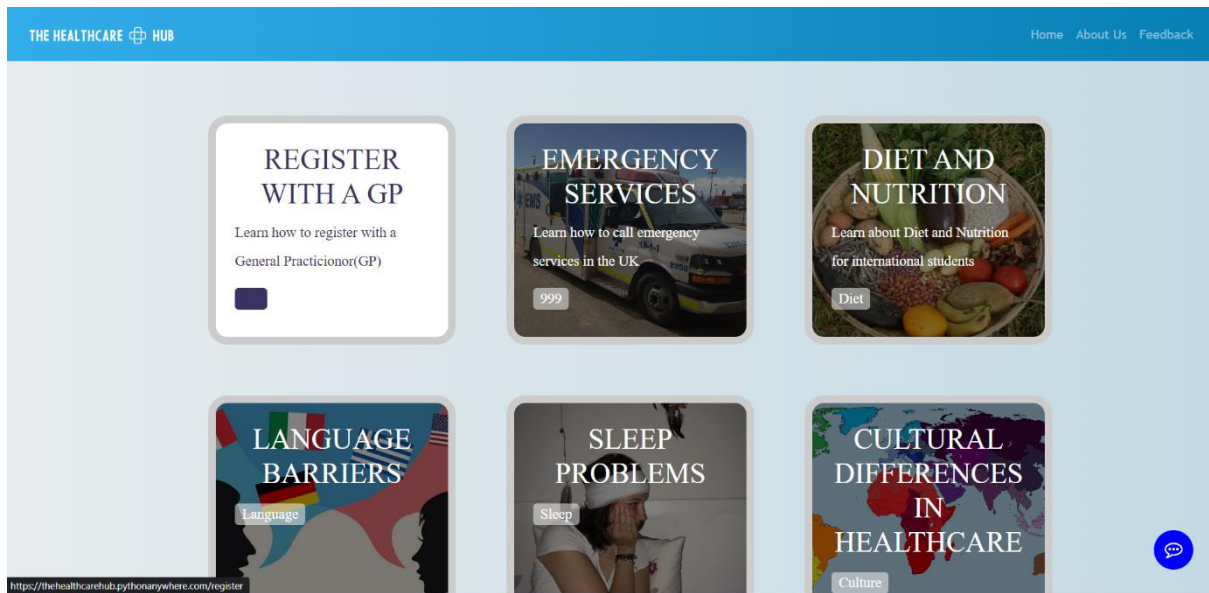


Appendix F: Flask Application Directory Structure



Appendix G: Final Product





THE HEALTHCARE HUB

HomeAbout UsFeedback

WELCOME TO OUR AI-DRIVEN HEALTHCARE CHATBOT

The AI-powered chatbot is a state-of-the-art conversational assistant designed to provide healthcare-related information and support.

Using advanced Natural Language Processing (NLP) and Deep Learning technologies, our chatbot can understand your queries and respond with relevant information.

Features:

- Identify symptoms and provide information on associated diseases.
- Offer insights into disease causes and recommended treatments.
- Provide user-friendly and interactive conversational experience.
- Seamless integration with Azure Health Bot service for easy access through web and mobile interfaces.
- Promote health awareness and informed decision-making for users.
- Adhere to ethical guidelines and avoid spreading misinformation.

How to Use:

Simply enter your symptoms or health concerns in the chatbox, and the chatbot will provide you with relevant information and recommendations.

Get started today and experience the benefits of our AI-driven chatbot for healthcare!

Let's Chat - Online

Hello and Welcome

Just now

Type your message

THE HEALTHCARE HUB

About UsMedical IssuesFeedback

Contact Us:
Email:

THE HEALTHCARE HUB

HomeAbout UsFeedback

Remember that BMI is just one of many factors that contribute to overall health. A healthy lifestyle, balanced diet, regular physical activity, and consultation with healthcare professionals are essential for maintaining good health and well-being.

BMI CALCULATOR

Height (cm):

Weight (kg):

Calculate BMI

Reset

THE HEALTHCARE HUB

About UsMedical IssuesFeedback

Contact Us:
Email:

THE HEALTHCARE HUB

HomeAbout UsFeedback

DIETARY PLANNER

Introducing Our Dietary Planner Tool: Eating healthy has never been easier! Our innovative Dietary Planner Tool helps you create personalized meal plans that align with your dietary preferences and goals. Whether you're a vegan, vegetarian, or aiming for a balanced diet, our tool generates customized meal plans that suit your lifestyle. Simply select your dietary preference and goal, and our tool will curate a diverse selection of recipes for you to enjoy. Worried about grocery shopping? Our tool also creates a convenient shopping list based on your meal plan. Say goodbye to dietary confusion and hello to a healthier you with our user-friendly Dietary Planner Tool! Feel free to adjust and customize this description to match the tone and style of your website. Plan your meals based on your dietary preferences and goals.

Preferences

Select Your Diet:

Balanced

Select Your Goal:

Maintain

Generate Meal Plan

Meal Plan

Shopping List

THE HEALTHCARE HUB

About UsMedical IssuesFeedback

Contact Us:
Email:
Phone:

31 August 2023

Appendix H: Testing Evidence

BMI CALCULATOR

Height (cm):

Weight (kg):

Calculate BMI

Your BMI is 22.86. You are Normal Weight.

Reset

BMI CALCULATOR

Height (cm):

Weight (kg):

Calculate BMI

Please enter valid values for height and weight.

Reset

BMI CALCULATOR

The BMI (Body Mass Index) calculator is a simple and widely used tool that helps individuals assess their body weight in relation to their height. It is commonly used to estimate whether a person is underweight, normal weight, overweight, or obese, and it serves as a general indicator of potential health risks associated with body weight.

How It Works:

- Input Height and Weight:** The user is required to input their height and weight into the BMI calculator. Height is usually entered in centimeters, and weight in kilograms.
- Calculation:** Once the user inputs their height and weight, the calculator applies the BMI formula to calculate the BMI value.
- BMI Result:** The BMI value is then presented to the user, typically rounded to two decimal places. The result provides a numerical representation of the individual's body mass index.
- BMI Categories:** Based on the calculated BMI value, the calculator categorizes the individual into one of the following categories:
 - Underweight: BMI less than 18.5
 - Normal Weight: BMI between 18.5 and 24.9
 - Overweight: BMI between 25 and 29.9
 - Obese: BMI 30 or greater

Plan your meals based on your dietary preferences and goals.

Preferences

Select Your Diet: Balanced ▼

Select Your Goal: Gain Weight ▼

[Generate Meal Plan](#)

Meal Plan

Healthy Salad

Calories: 250

Protein: 10g

Carbs: 30g

Fats: 12g

Pasta Primavera

Calories: 400

Protein: 15g

Carbs: 60g

Fats: 10g

Veggie Stir-Fry

Calories: 200


Protein: 15g

Carbs: 20g

Fats: 8g

Shopping List

- ✓ 2 cups cups of Mixed Greens
- ✓ 1 cup cup of Cherry Tomatoes



Meal Plan

Egg Salad Sandwich

Calories: 380

Protein: 20g

Carbs: 30g

Fats: 20g

Tofu Scramble

Calories: 280

Protein: 20g

Carbs: 10g

Fats: 18g

Pasta Primavera

Calories: 400

Protein: 15g

Carbs: 60g

Fats: 10g

Meal Plan

Grilled Chicken

Calories: 300

Protein: 25g

Carbs: 5g

Fats: 18g

Mediterranean Wrap

Calories: 380

Protein: 15g

Carbs: 50g

Fats: 15g

Healthy Salad

Calories: 250

Protein: 10g

Carbs: 30g

Fats: 12g

Meal Plan

Chickpea Salad

Calories: 320

Protein: 12g

Carbs: 45g

Fats: 10g

Mediterranean Wrap

Calories: 380

Protein: 15g

Carbs: 50g

Fats: 15g

Roasted Vegetable Wrap

Calories: 320

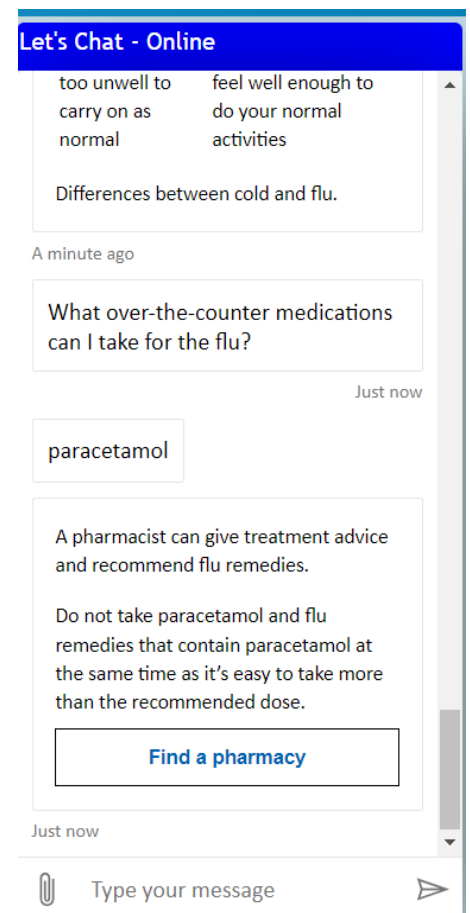
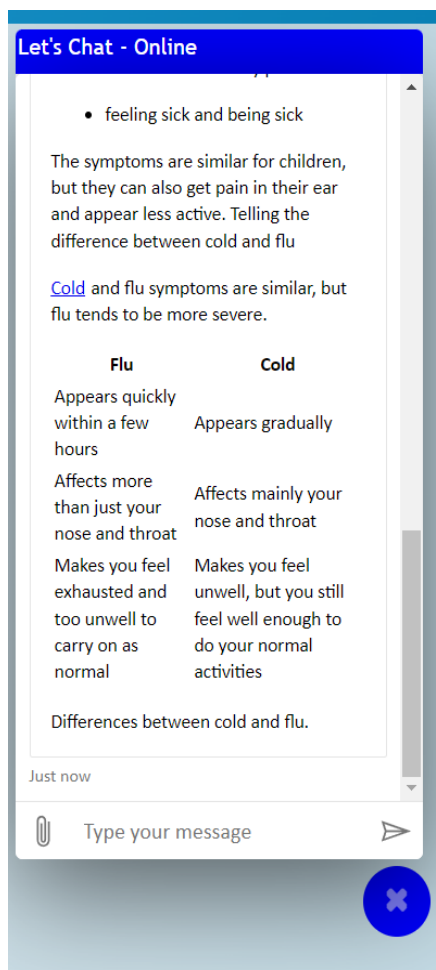
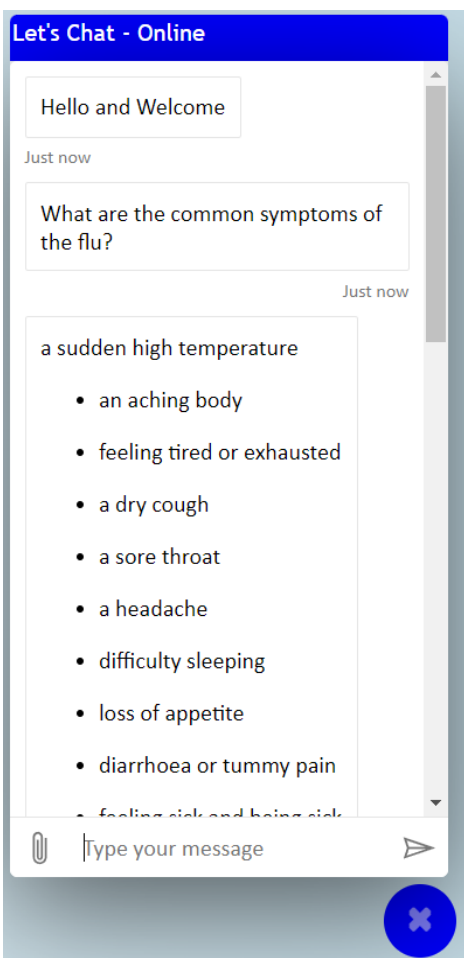
Protein: 8g

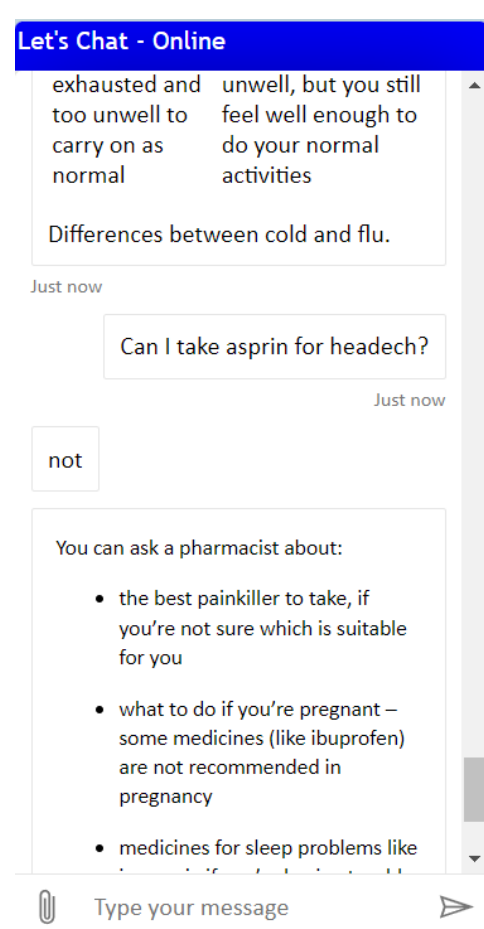
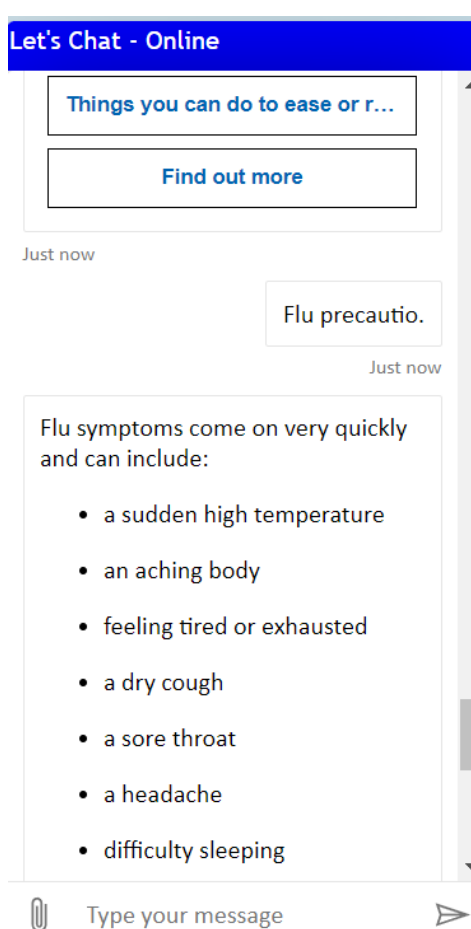
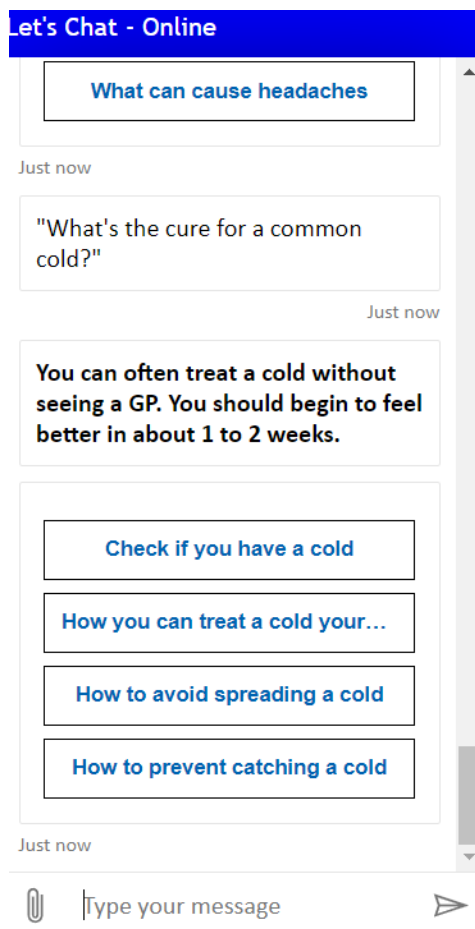
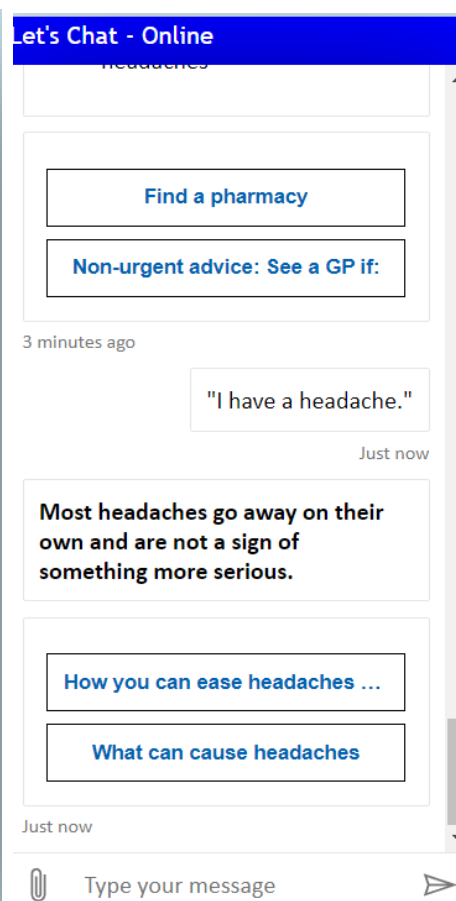
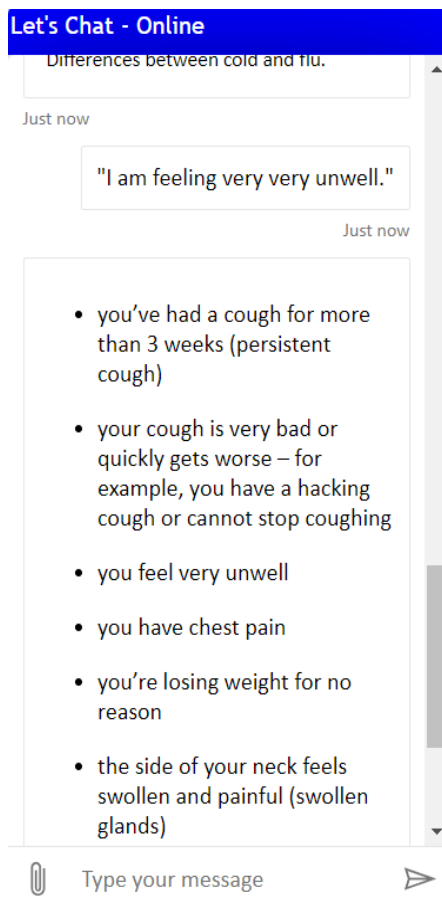
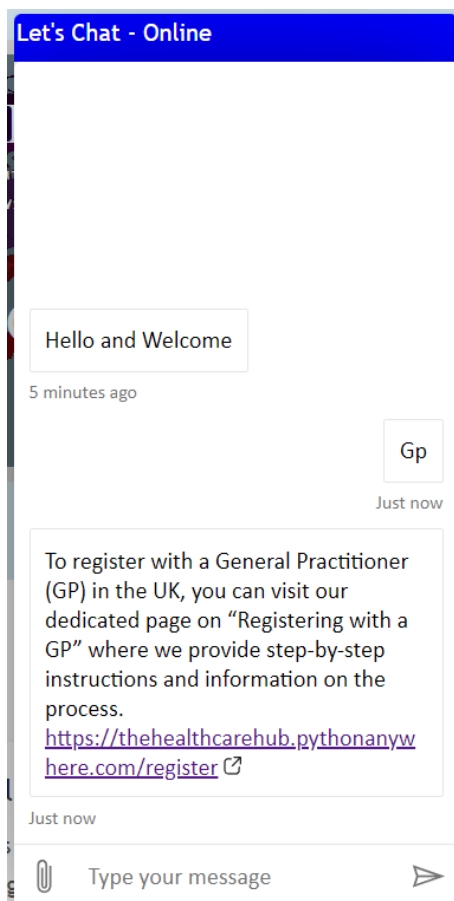
Carbs: 40g

Fats: 14g

Shopping List

- ✓ 1 cup cup of Canned Chickpeas
- ✓ 1 piece of Bell Pepper
- ✓ 1/4 piece of Red Onion
- ✓ 2 tablespoons tablespoons of Lemon Juice
- ✓ 1 tablespoon tablespoon of Olive Oil
- ✓ 2 tablespoons tablespoons of Fresh Parsley
- ✓ 1 piece of Whole Wheat Wrap
- ✓ 2 tablespoons tablespoons of Hummus
- ✓ 1/2 piece of Cucumber
- ✓ 1 piece of Tomato
- ✓ 4 pieces of Kalamata Olives
- ✓ 1/4 cup cup of Feta Cheese
- ✓ 2 cups cups of Assorted Vegetables
- ✓ 1 piece of Whole Wheat Tortilla
- ✓ 2 tablespoons tablespoons of Hummus
- ✓ 1 tablespoon tablespoon of Olive Oil





Let's Chat - Online

Non-urgent advice: See a GP if:

Just now

Whatt are symptooms of allergerc rhinitis?"

Just now



An allergy is where your body reacts to something that's normally harmless like pollen, dust or animal fur. The symptoms can be mild, but for some people they can be very serious.

Causes of allergies

Check if it's an allergy

What happens at your appoint...

Treatments for allergies

 Type your message 

Appendix J: Google Lighthouse Report

8/31/23, 8:27 PM

about:blank



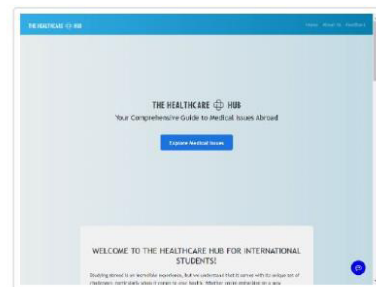
https://thehealthcarehub.pythonanywhere.com/



Performance

Values are estimated and may vary. The [performance score](#) is calculated directly from these metrics. [See calculator.](#)

▲ 0–49 50–89 90–100



METRICS

[Collapse view](#)

First Contentful Paint

0.6 s

First Contentful Paint marks the time at which the first text or image is painted. [Learn more about the First Contentful Paint metric.](#)

Largest Contentful Paint

0.7 s

Largest Contentful Paint marks the time at which the largest text or image is painted. [Learn more about the Largest Contentful Paint metric.](#)

Total Blocking Time

0 ms

Sum of all time periods between FCP and Time to Interactive, when task length exceeded 50ms, expressed in milliseconds. [Learn more about the Total Blocking Time metric.](#)

Cumulative Layout Shift

0

Cumulative Layout Shift measures the movement of visible elements within the viewport. [Learn more about the Cumulative Layout Shift metric.](#)

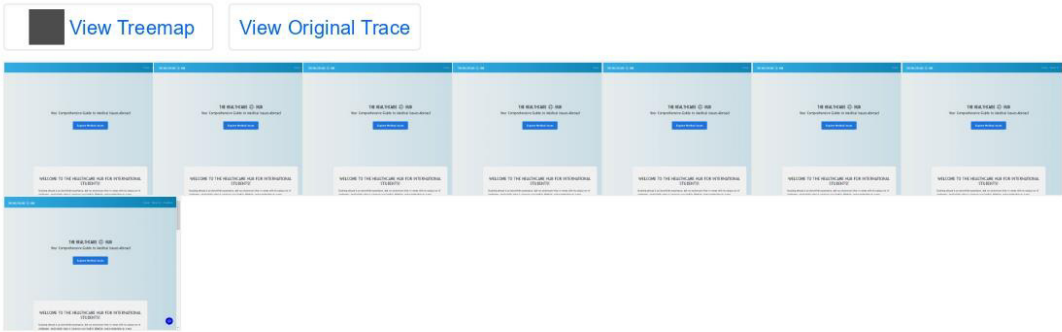
Speed Index

0.6 s

Speed Index shows how quickly the contents of a page are visibly populated. [Learn more about the Speed Index metric.](#)

about:blank

1/5























Show audits relevant to: [All](#) [FCP](#) [LCP](#) [TBT](#) [CLS](#)

OPPORTUNITIES

Opportunity	Estimated Savings
 Serve images in next-gen formats	1.56s 

These suggestions can help your page load faster. They don't [directly affect](#) the Performance score.

DIAGNOSTICS

 Serve static assets with an efficient cache policy — 7 resources found	
 Ensure text remains visible during webfont load	
 Image elements do not have explicit <code>width</code> and <code>height</code>	
 Page prevented back/forward cache restoration — 1 failure reason	
 Avoid enormous network payloads — Total size was 4,526 KiB	
 Avoid chaining critical requests — 7 chains found	
 User Timing marks and measures — 2 user timings	
 Keep request counts low and transfer sizes small — 23 requests • 4,526 KiB	
 Largest Contentful Paint element — 710 ms	
 Avoid long main-thread tasks — 1 long task found	

More information about the performance of your application. These numbers don't [directly affect](#) the Performance score.

PASSED AUDITS (29) Show



Accessibility

These checks highlight opportunities to [improve the accessibility of your web app](#). Only a subset of accessibility issues can be automatically detected so manual testing is also encouraged.

NAVIGATION

▲ [id] attributes on active, focusable elements are not unique	▼
▲ Heading elements are not in a sequentially-descending order	▼

These are opportunities to improve keyboard navigation in your application.

NAMES AND LABELS

▲ <code><frame></code> or <code><iframe></code> elements do not have a title	▼
--	---

These are opportunities to improve the semantics of the controls in your application. This may enhance the experience for users of assistive technology, like a screen reader.

INTERNATIONALIZATION AND LOCALIZATION

▲ <code><html></code> element does not have a [lang] attribute	▼
--	---

These are opportunities to improve the interpretation of your content by users in different locales.

ADDITIONAL ITEMS TO MANUALLY CHECK (10)	Show
---	------

These items address areas which an automated testing tool cannot cover. Learn more in our guide on [conducting an accessibility review](#).

PASSED AUDITS (15)	Show
--------------------	------

NOT APPLICABLE (29)	Show
---------------------	------



Best Practices

TRUST AND SAFETY

<div><div></div></div> Ensure CSP is effective against XSS attacks	▼
--	---

GENERAL

<div><div></div></div> Detected JavaScript libraries	▼
--	---

PASSED AUDITS (13)	Show
--------------------	------

NOT APPLICABLE (1)	Show
--------------------	------



SEO

These checks ensure that your page is following basic search engine optimization advice. There are many additional factors Lighthouse does not score here that may affect your search ranking, including performance on [Core Web Vitals](#). [Learn more about Google Search Essentials](#).

CONTENT BEST PRACTICES

<div><div></div></div> Document does not have a meta description	▼
<div><div></div></div> Links do not have descriptive text — 2 links found	▼

Format your HTML in a way that enables crawlers to better understand your app's content.

ADDITIONAL ITEMS TO MANUALLY CHECK (1)	Show
--	------

Run these additional validators on your site to check additional SEO best practices.

PASSED AUDITS (8)	Show
-------------------	------

NOT APPLICABLE (4)	Show
--------------------	------



PWA

These checks validate the aspects of a Progressive Web App. [Learn what makes a good Progressive Web App.](#)

INSTALLABLE

- ▲

Web app manifest or service worker do not meet the installability requirements — 1 reason

▼

PWA OPTIMIZED

- ▲

Does not register a service worker that controls page and `start_url`

▼
- ▲

Is not configured for a custom splash screen Failures: No manifest was fetched.

▼
- ▲

Does not set a theme color for the address bar.
Failures: No manifest was fetched, No `<meta name="theme-color">` tag found.

▼
- Content is sized correctly for the viewport

▼
- Has a `<meta name="viewport">` tag with `width` or `initial-scale`

▼
- ▲

Manifest doesn't have a maskable icon No manifest was fetched

▼

ADDITIONAL ITEMS TO MANUALLY CHECK (3)

Show

These checks are required by the baseline [PWA Checklist](#) but are not automatically checked by Lighthouse. They do not affect your score but it's important that you verify them manually.

■

Captured at Aug 31, 2023, 8:25 PM GMT+1

■

Emulated Desktop with Lighthouse 10.3.0

■

Single page load

■

Initial page load

■

Custom throttling

■

Using Chromium 116.0.0.0 with devtools

Generated by **Lighthouse** 10.3.0 | [File an issue](#)

Appendix K: Github Repository

