A Digital System to Promote Vegetable-based Nutrition

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ABSTRACT
This paper presents a simple system that integrates technology and nutrition to promote healthier living through increased vegetable consumption. The system allows the user to select a vegetable, and it will display a picture of the vegetable, description, and what is used for. It also allows the user to choose a disease, and it will display the vegetable that can help manage the disease. In general, it helps individuals make informed dietary choices and maintain healthy habits. Results show that technology can effectively support awareness and motivation for vegetable-based nutrition and overall well-being.

Keywords
Healthy living, Nutrition, Technology integration, Vegetable consumption, Mobile application, Health tracking, Dietary habits, Wellness system, Personalized nutrition, Digital health.

1. INTRODUCTION
Vegetables are the most nutrient-dense and accessible foods available. They are packed with essential vitamins, minerals, fibers, and antioxidants, and thus play a critical role in preventing chronic diseases such as heart attack, diabetes, and certain cancers [1]. A comprehensive meta-analysis by Stanaway et al. [2] confirms that increasing vegetable intake to 306–372 grams per day is associated with significant reductions in the risk of ischemic stroke (−23.2%), ischemic heart disease (−22.9%), hemorrhagic stroke (−15.9%), and esophageal cancer (−28.5%). However, they remain under-consumed across much of the world. In response, researchers have increasingly explored digital interventions, especially web-based systems, to promote vegetable intake and improve dietary habits. By combining nutrition education with engaging design and interactive features, these systems can help individuals make informed food choices and build a healthier lifestyle. Livingstone et al. conducted a systematic review of digital behavior change interventions and found that tailored messaging, goal setting, and feedback loops were effective in increasing vegetable consumption among adults [3]. Similarly, Seid et al. reviewed smartphone-based dietary apps and concluded that internet-based tools consistently improved healthy eating behaviors across randomized controlled trials [4].

Since children's eating habits are formed at a young age, focused treatments are essential. Campaigns to increase children's consumption of vegetables were examined by AJP Focus, which discovered small but significant gains through social marketing and school-based initiatives [5]. These findings highlight the potential of structured educational environments and targeted media messaging in shaping positive dietary choices. However, sustaining these improvements often requires continuous engagement beyond the classroom. To increase engagement and relevance, Ares et al. placed a strong emphasis on participatory design, allowing teenagers to co-create nutrition strategies [6]. This strategy ensures that health messages are perceived as relevant and useful, while also fostering youth empowerment and a sense of ownership. Participatory and school-based approaches can work in conjunction to help children and adolescents develop healthier eating habits that are more robust and long-lasting by using behavioral insights, peer influence, and creative involvement. Ghammachi et al. explored web-based nutrition education for young adults, highlighting the importance of sustainability and simplicity in design. Among the 22 studies focused on web-based nutrition education for young adults, 82% showed positive outcomes in increasing fruit and vegetable intake. Most interventions used websites or mobile apps and were grounded in behavior change theories like the Transtheoretical Model and Theory of Planned Behavior [7]. In a similar concept, another research was conducted, which was more focused on working-age individuals, noting that digital tools must be culturally relevant and easy to use to be effective [8]. Both studies emphasize the need for simple, user-centered, and culturally relevant digital systems to support sustainable dietary improvements.

Results from the PHaSE project, which investigates how persuasive technology might promote sustainable and healthful eating practices, are presented by Rapp and Boldi. The chapter examines 20 HCI studies and highlights the main flaws in the digital interventions that are now available, including their inability to enable contextual awareness, user sense-making, and individualized coaching. The authors demonstrate techniques for enhancing conversational agents, such as empathy, clarity, dependability, and flexibility, during three design workshops. Web-based programs that encourage the intake of vegetables can benefit greatly from these insights, particularly those that use interactive, user-centered design to encourage long-lasting behavior change [9]. A user-centered design study of a meal recommender system implemented in actual workplace environments is presented by De Croon et al. To help users choose healthier meals, the system incorporates explanation interfaces and customized nutritional profiles. Even when recommendations didn't exactly match preferences, the authors discovered through iterative prototyping and a 7-week proof-of-principle research with 136 participants that explanations increased user understanding and confidence. Transparency, control over food preferences, and striking a balance between meal diversity and nutritional advice were important design objectives. The study emphasizes how explanation-driven interfaces might encourage the intake of vegetables and assist in making well-informed dietary decisions in real-world settings [10].

Missliv [11] and HealKitchen [12] are recent design-driven interventions that show how persuasive technology can be used to promote healthy eating habits through individualized, culturally relevant digital platforms. Missliv, created by Escorza, supports sustainable nutrition in line with the UN Sustainable Development Goals using microlearning, geolocation, and AI-driven recommendations. Similarly, Sowande's smartphone app HealKitchen uses adaptive feedback and behavioral science to track habits and provide motivational cues to promote meals high

in vegetables. Both projects place a strong emphasis on contextual personalization, accessibility, and user-centered designs that are becoming increasingly important for creating web-based solutions that effectively improve dietary behavior. It is evident from the data that digital interventions that are based on behavioral science and user-centered design can significantly increase vegetable intake. Several public health frameworks provide helpful directions to guarantee that such systems are not only efficient but also scalable and in line with policy. The CDC's strategic suggestions highlight prescriptions, point-of-decision cues, and culturally appropriate messaging as effective ways to boost consumption of fruits and vegetables. By compiling evidence-based materials that emphasize digital health and community-level nutrition improvement initiatives, Healthy People 2030 further support these strategies [13] [14]. The nutritional Guidelines for Americans [15] published by the USDA and HHS offer a fundamental framework for coordinating digital content with national nutritional recommendations for all life stages. The Urban Institute also lists important policy levers that can support the expansion of healthy food access initiatives, including digital platforms, such as Medicaid flexibility and USDA-health agency cooperation [16]. When combined, these frameworks highlight how crucial it is to create nutrition education resources that are not only interesting and tailored to everyone but also in line with larger public health objectives and resources.

2. DESIGN

This project is a simple system which enables a user to get information about natural curing characteristics of different vegetables or lists vegetables names and recipes that help with specific diseases or symptoms. It will have a simple graphical user interface that will help the user find the information required.

The system will:

- allow the user to search for vegetable by name. The system will display: a picture of the vegetable, description, and what is used for. For example, what disease the vegetable helps cure/ease.
- allow the user to enter/choose vegetable name by either entering the name of the vegetable or choosing it from a drop-down menu. The user will then hit the search button.
- display description of the symptom/ disease and picture of the vegetables, its description and how it can be used to help ease these symptoms. For example, onions prevent cancer.

For proof of concept, this system populated the dataset with information of 10 vegetables.

The usability and user experience goals are:

- The system should be efficient to use.
- The system should be easy for a new user to learn how to use.
- The system should be easy for a returning user to remember how to use.
- The system should be effective to use.
- The system should be engaging to the user.
- The system should be satisfying for the user to use.
- The system should be helpful to the user.

Design goals questions are:

- Is the system capable of allowing users to maintain a steady flow of work at a productive level?
- How difficult is it for a user to learn how to use the system through exploration and trying different parts of the interface?
- After a user returns from not using the system for some time, is it difficult to remember all the functions of the system?
- Does the system allow a user to access all the information they might need?
- Is the system engaging to the user while they are using it?
- Does the user feel satisfied with their experience and the information they gathered from using the system?
- Did the user feel that the system was helpful and answered the questions they had?

The main tasks are:

- The user is able to see a picture and description of a vegetable.
- The use is able to find out what the vegetable is used for.
- The user is able to look at different symptoms or diseases and see what vegetables cure or help it.
- The user is able to easily find the information they are looking for.

3. IMPLEMENTATION

This webpage will allow users to look up different vegetables to view their medical qualities. The user will use dropdown menus to select a vegetable and then view its information. They can also look up specific diseases using a dropdown menu. This will display brief information about the disease and list the vegetables that help with the diseases. The user is able to easily navigate from one page to another. HTML, CSS, and JavaScript were used to complete this project. Using HTML, CSS, and JavaScript to develop a system about healthy living with vegetables offers a powerful and flexible approach. HTML provides the structure for displaying information such as vegetable types, nutritional facts, and recipes, making the content organized and accessible. CSS enhances the system's visual appeal by adding colors, layouts, and responsive design, ensuring it looks attractive and works well on desktops, tablets, and mobile devices. JavaScript adds interactivity, allowing users to search, filter, or sort vegetables, calculate nutrient intake, and engage with dynamic features like quizzes or charts. Together, these technologies create an educational, engaging, and user-friendly system that effectively promotes healthy living with vegetables.Also, HTML, CSS, and JavaScript are essential for creating a good graphical user interface (GUI) for a system. HTML provides the basic structure and elements of the interface, such as buttons, forms, menus, and content areas. CSS enhances appearance by controlling colors, fonts, spacing, and layout, ensuring the interface is visually appealing and easy to navigate. JavaScript adds interactivity, enabling dynamic features like dropdown menus, search filters, animations, and real-time updates. Together, these technologies allow developers to build intuitive, responsive, and engaging GUIs that improve user experience and make the system more accessible and enjoyable to use.

In addition, Visual Studio Code (VS Code) was used for implementation, and it is an ideal tool for developing a system about healthy living with vegetables because it combines efficiency, flexibility, and ease of use. Its features like syntax highlighting, auto-completion, and intelligent suggestions make coding in HTML, CSS, and JavaScript faster and less error-prone. Extensions such as live server and debugging tools allow developers to test changes in real time, ensuring the system's layout, interactive charts, and content work smoothly. VS Code also integrates with Git for version control, making updates and collaboration easier. Additionally, its customizable interface and cross-platform support provide a user-friendly environment that

helps developers build a clean, interactive, and engaging system for promoting healthy living.

From the main menu [Figure 1] the user can choose to view 'Vegetables' or 'Diseases/Symptoms'. If they choose vegetables, a message is displayed and then they can click on 'Select Vegetable' button [Figure 2]. The user can also choose diseases/symptoms that will display that page and allow them to click on 'Select Disease' button [Figure 3]. Both buttons will show a drop-down menu with the available vegetables [Figure 4] or available diseases [Figure 5].
Figures 6, 7, 8, 9 show the pages displayed when a specific vegetable is chosen from the drop-down menu. For example, it will show the description and use of beets, broccoli, onion and spinach.
Figures 10, 11, 12, 13, and 14 display short description of Cancer disease and list of vegetables used for treatment
Figures 15 and 16 display short description of diabetes disease and list of vegetables used for treatment
Figure 17, 18, 19, and 20 display short description of eye disease and list of vegetables used for treatment
Figures 21, 22 and 23 display short description of heart disease and list of vegetables used for treatment.

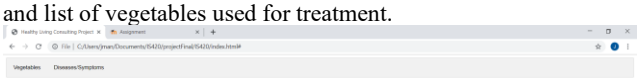

Fig 1: Main menu

Fig 2: Select Vegetables page

Fig 3: Select Disease page

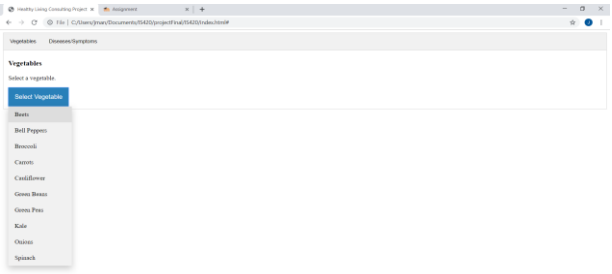

Fig 4: drop down menu of vegetables

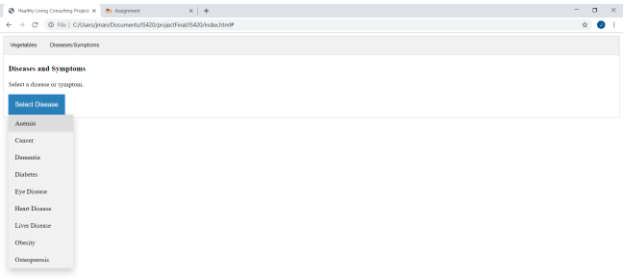

Fig 5: drop down menu of diseases

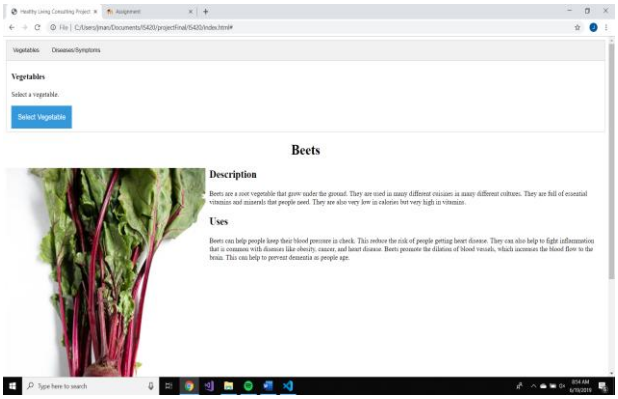

Fig 6: displaying description and uses of Beets

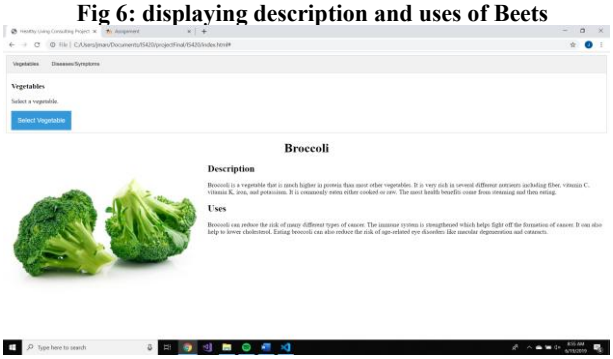

Fig 7: displaying description and uses of Broccoli

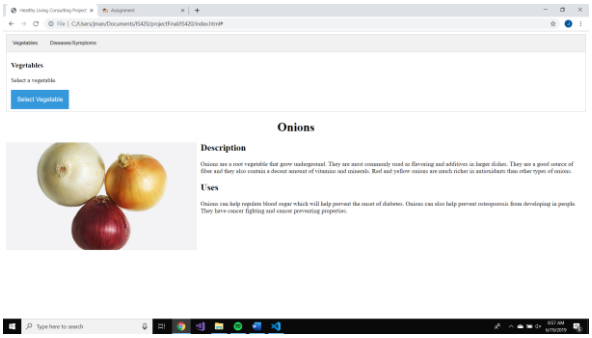

Fig 8: displaying description and uses of Onions

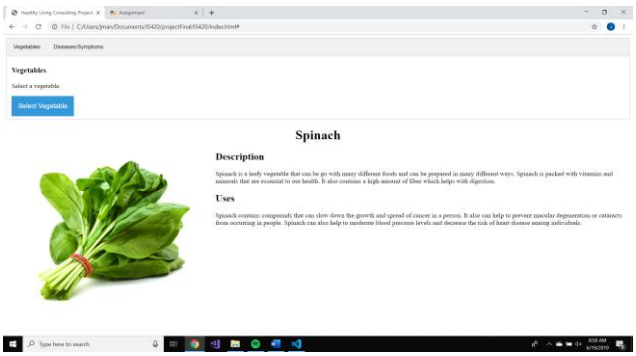

Fig 9: displaying description and uses of spinach

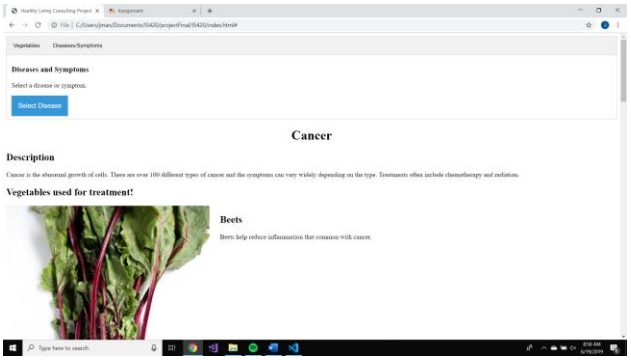

Fig 10: displaying short description of Cancer disease and list of vegetables used for treatment 1/5

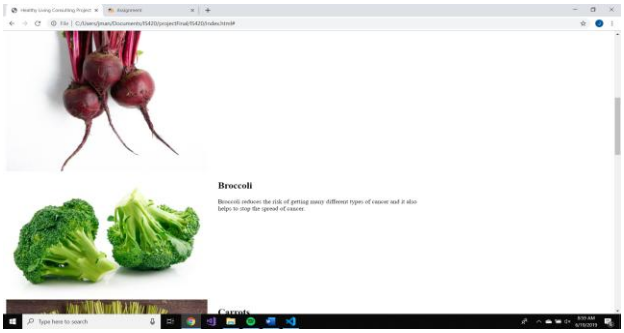

Fig 11: displaying short description of Cancer disease and list of vegetables used for treatment 2/5

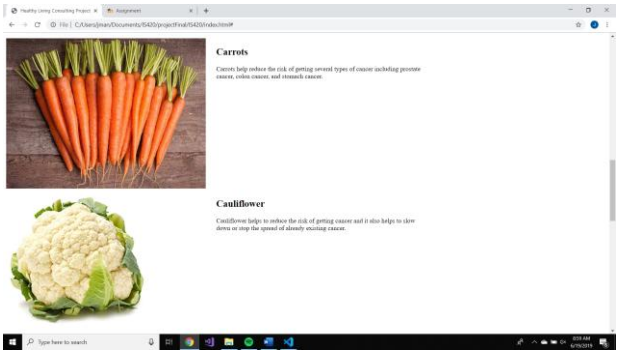

Fig 12: displaying short description of Cancer disease and list of vegetables used for treatment 3/5

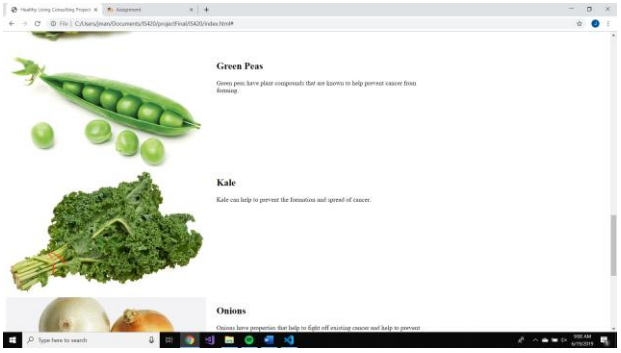

Fig 13: displaying short description of Cancer disease and list of vegetables used for treatment 4/5

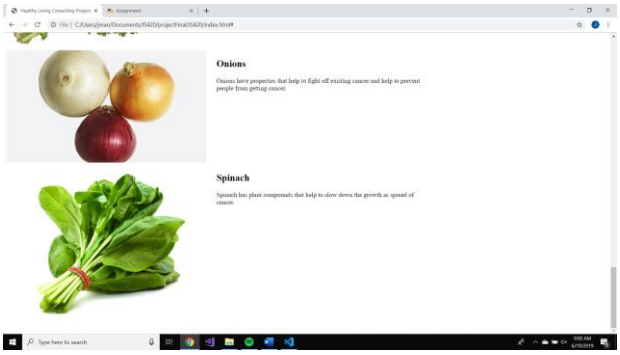

Fig 14: displaying short description of Cancer disease and list of vegetables used for treatment 5/5

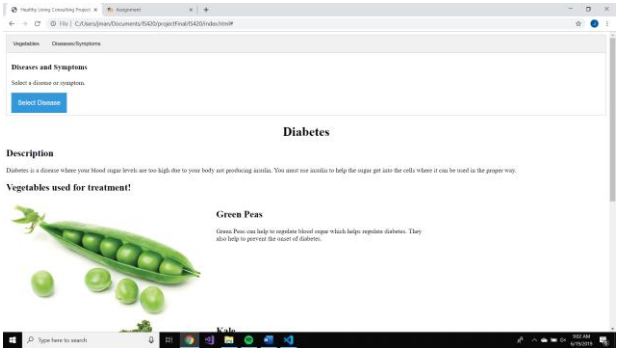

Fig 15: displaying short description of diabetes disease and list of vegetables used for treatment 1/2

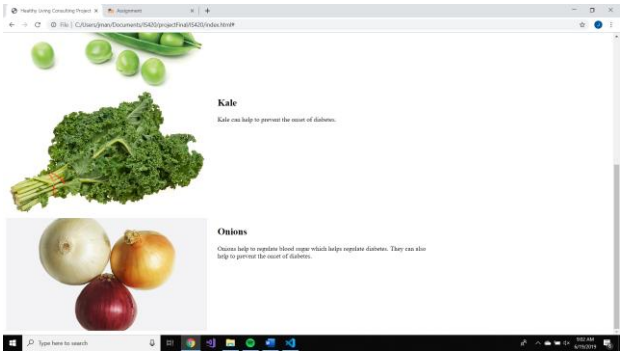

Fig 16: displaying short description of diabetes disease and list of vegetables used for treatment 2/2

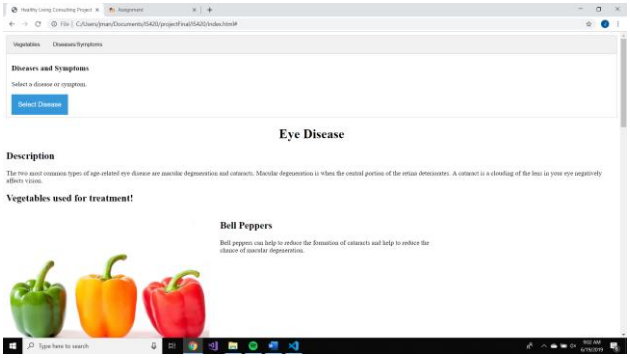

Fig 17: displaying short description of eye disease and list of vegetables used for treatment 1/4

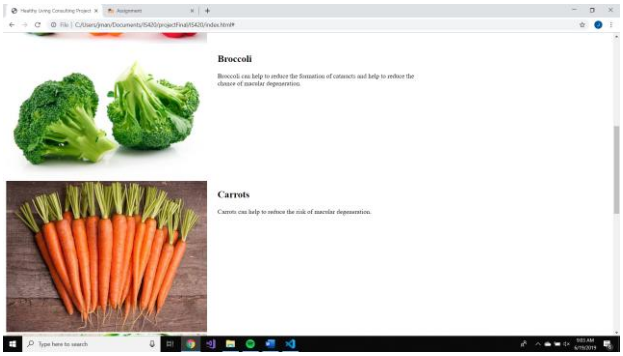

Fig 18: displaying short description of eye disease and list of vegetables used for treatment 2/4

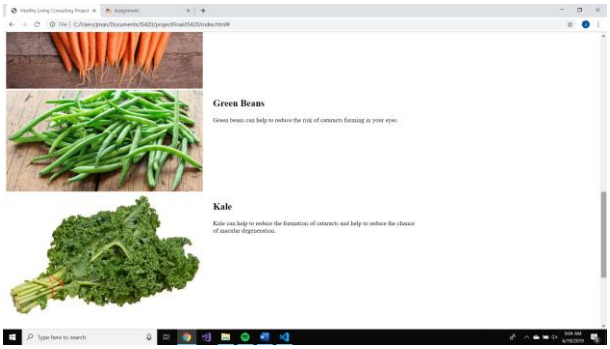

Fig 19: displaying short description of eye disease and list of vegetables used for treatment 3/4

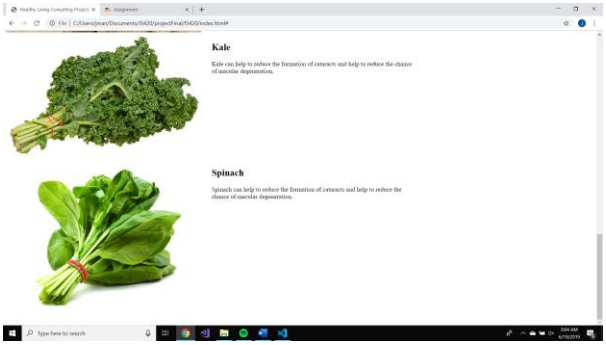

Fig 20: displaying short description of eye disease and list of vegetables used for treatment 4/4

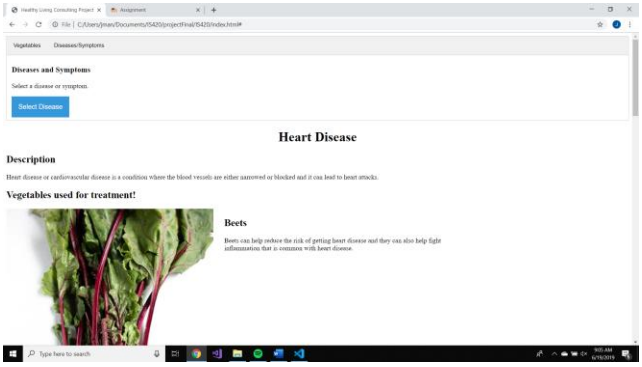

Fig 21: displaying short description of heart disease and list of vegetables used for treatment 1/3

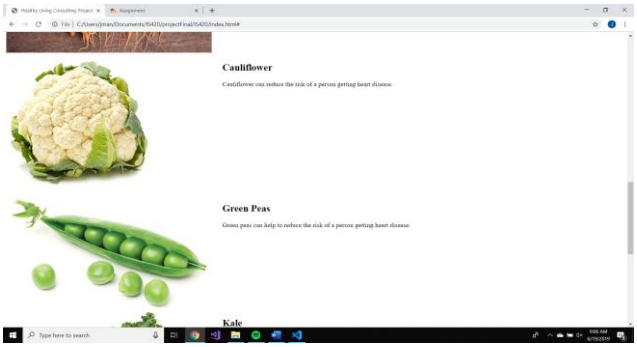

Fig 22: displaying short description of heart disease and list of vegetables used for treatment 2/3

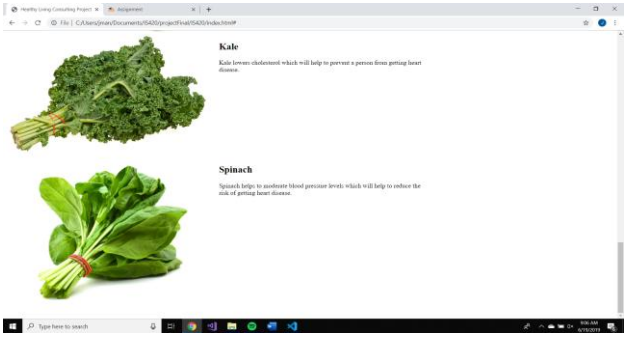

Fig 23: displaying short description of heart disease and list of vegetables used for treatment 3/3

4. EVALUATION

Qualitative evaluation was used, and the user was asked to complete the following questionnaire:

- How long did you spend using the program?
- Was the program designed in a way that what easy to use?
- What was your favorite art about the program? Why?
- What was your least favorite part about the program? Why?
- During your use of the program did you encounter any errors or bugs? If so, what happened?
- How would you rate your experience using the program on a scale of 1 to 5?

Some of the practical issues that were encountered is the lack of technology to record users while testing the program. The development team were not present and hence were not available to address any issues or to answer questions. Another issue was that the total time using the system was recorded but not the amount of time spent on a specific task. Also, it was not easy scheduling times for testing. One of the ethical issues is ensuring that the people asked to participate are willing to share their responses and opinions. All participant signed a consent form which explained the experiment and ensured that no demographic data is collected. They also were not monitored or videoed since they are completing it on their own devices.

The system was evaluated based on usability, accuracy, and its effectiveness in promoting healthier dietary choices. Overall, the system performed reliably, displaying correct vegetable information, images, and health-related benefits based on user selections. The disease-to-vegetable matching feature functioned accurately and provided clear guidance for users seeking nutritional support for specific conditions. Users found the interface simple and intuitive, making it easy to explore vegetable options and understand their nutritional value. The

system successfully increased awareness of vegetable benefits and encouraged informed decision-making. Although basic in scope, the results indicate that technology can play a valuable role in supporting healthy eating habits and enhancing overall well-being.

5. ANALYSIS

Some of the most common themes seen throughout the data collected is that the users seemed to think that the program was very simple to learn and use. Some even thought it was too simple and should be able to do more. The simplicity of figuring out how to use the program was paramount in the design. It also seemed that some of the users thought that the program needs to hold more information. Many of the participants saw potential in the program and suggested adding more functionalities and enhancing the dataset. In general, the average rating of program: 3.4/5 stars. Average time spent using the program was 18.9 minutes. All user indicated that they did not encounter any errors or bugs.

Qualitative Analysis of user replies to the question: 'Was the program designed in a way that was easy to use?' yield the following:

- Emerging Theme: Ease of Use: A dominant theme across all responses is *ease of use*. Participants consistently describe the program as *"simple to use," "easy to navigate,"* and *"well designed."* This indicates a positive user experience in terms of usability and accessibility. The repeated emphasis on simplicity suggests that the system's interface and workflow were intuitive and required minimal instruction.
- Subtheme: Simplicity as Both a Strength and a Limitation: While simplicity is praised, several participants also express that the system may be *"too simple."* Comments such as *"it almost seemed to be a little bit too simple"* and *"there should have been a couple more functions built in"* indicate that some users perceived the lack of advanced features as a limitation. This reflects a balance issue between usability and functionality—the system is easy to use but may not fully meet user expectations for depth or capability.
- Subtheme: Effective Design and Navigation: Multiple participants noted that the design contributed to ease of use, describing it as *"designed well," "easy to figure out,"* and *"no learning curve."* This suggests that the visual layout, structure, and flow of the program supported efficient user interaction. The comments highlight strong design principles such as clarity, intuitiveness, and immediate usability.
- Overall Sentiment: Overall sentiment is highly **positive**. Participants appreciate the system's simplicity and functionality, recognizing that it achieves its main goal effectively. Minor constructive feedback revolves around adding more features without compromising the program's ease of use.

Table 1 is a Summary of findings from user answers.

Table 1: Summary of findings from user answers to: Was the program designed in a way that was easy to use?

Theme	Description	Sentiment
Ease of Use	Users consistently describe the system as simple and user-friendly.	Positive
Simplicity vs. Functionality	Some users feel it may be too simple and lacks additional features.	Mixed
Design and Navigation	The design supports quick learning and easy navigation.	Positive

Qualitative Analysis of user replies to the question 'What was your favorite part about the program? Why?' yield the following:

- Emerging Theme: Simplicity as a Core Strength: Most participants highlighted *simplicity* as the most valued aspect of the program. Phrases such as *"very simple to use," "no learning curve,"* and *"minimalistic design"* indicate that users found the program intuitive and efficient. This strong consensus suggests that ease of use is the program's primary success factor, enhancing user satisfaction and accessibility.
- Subtheme: Effective Design and Functionality: Users frequently connected simplicity with good design. Comments like *"it all just seemed to make sense in how it all worked"* and *"minimalistic and only had what it absolutely needed"* imply that the layout and structure align well with user expectations. The absence of unnecessary features was appreciated, as it allowed the program to perform its intended functions smoothly.
- Subtheme: Concept Appreciation with Execution Concerns: Several participants expressed enthusiasm for the *idea* or *concept* behind the program, calling it *"my favorite part"* or noting that it *"has lots of potential with more work."* However, they also mentioned that it *"could have been executed much better."* This indicates that while users value the foundational idea, they perceive room for improvement in implementation—possibly in performance, added features, or user engagement.
- Subtheme: Reliability and Smooth Operation: Comments such as *"the program ran without any flaws"* suggest users found the system stable and reliable. This perception may be linked to the program's simplicity and limited number of functions, which reduced potential errors.
- Overall Sentiment: The overall sentiment is positive, centered on appreciation for the program's simplicity, clarity, and usability. Minor negative undertones relate to a perceived lack of depth or completeness in execution, but these are balanced by acknowledgment of the program's potential.

Table 2 is a Summary of findings from user answers.

Table 2: Summary of findings from user answers to: What was your favorite part about the program? Why?

Theme	Description	Sentiment
Simplicity and Ease of Use	Users consistently praised the program's simple design and intuitive navigation.	Positive
Concept and Potential	The idea behind the program was well-received, though users felt execution could improve.	Mixed
Design and Minimalism	Minimalistic design contributed to efficiency and ease of understanding.	Positive
Reliability	Users reported stable, error-free operation.	Positive

Qualitative analysis to user replies to the question 'What was your least favorite part about the program? Why?' yield the following:

- Emerging Theme: Lack of Content and Depth: A major theme across responses is insufficient information within the program. Participants repeatedly noted that there were *"too few records," "not enough vegetables listed,"* and *"not enough information about the vegetables and*

diseases." This indicates user dissatisfaction with the program's informational completeness, suggesting that while the system's framework is functional, the content does not meet user expectations for a practical or educational tool.

- Subtheme: Oversimplification and Limited Features: Several participants criticized the program as being *"too simple," "bland,"* or *"oversimplified."* Comments such as *"it needs serious work in design"* and *"should have incorporated more functions like back buttons"* highlight concerns about limited interactivity and a lack of engaging features. This aligns with earlier findings that simplicity—though appreciated initially—may have been taken too far, resulting in reduced usability and engagement.
- Subtheme: Design and Navigation Issues: Participants expressed frustration with aspects of the interface design, noting redundancy in navigation (e.g., *"redundant to click a tab and then another button"*) and a *"blank page with tabs"* that felt underdeveloped. These comments point to weaknesses in the visual and structural design, indicating a need for more intuitive layouts, richer visuals, and streamlined user flow.
- Subtheme: Need for Expanded Functionality: Respondents suggested enhancements such as additional features (*"more functions like back buttons"*) and a more complex menu system. This reflects a desire for a more dynamic and interactive experience that balances simplicity with richer capabilities.
- Outlier Response: One participant stated, *"I really did not have a least favorite part of the program,"* representing a minority view that contrasts with the overall critical tone. This indicates that not all users experienced significant dissatisfaction, though most did identify notable limitations.

Table 3 is a Summary of findings from user answers.

Table 3: Summary of findings from user answers to: What was your least favorite part about the program? Why?

Theme	Description	Sentiment
Lack of Information	Users felt the system contained too little data to be effective or useful.	Negative
Oversimplification	The program's simplicity was viewed as excessive, limiting depth and usability.	Negative
Design and Navigation	Users criticized the interface as bland, redundant, or underdeveloped.	Negative
Functionality	Participants wanted more interactive features and flexibility.	Mixed
Overall Impression	Most users saw the program as having potential but requiring major improvement.	Predominantly Negative

6. BENEFITS OF DEVELOPING THE SYSTEM

Developing this website is more than just a coding exercise—it combines design thinking, user experience evaluation, technical implementation, and communication skills, all of which are central to HCI education. It's a very practical and beneficial learning experience. In general, the students gained:

- Practical Application of HCI Principles by designing a website lets the student apply core HCI concepts such as usability, user experience (UX) design, accessibility, and intuitive navigation. The student can practice user-centered design, creating interfaces that meet the needs of real users interested in healthy living.
- Interface Design Skills as the project allows hands-on experience with layout design, color schemes, typography, and interactive elements, which are essential HCI skills. Students learn to make content engaging and readable, particularly for educational content about vegetables and nutrition.
- Experience Usability Testing as the student can conduct usability studies, surveys, or A/B testing with peers or target users, which is a core HCI activity. This teaches them how to interpret feedback and iterate designs, a key professional skill.
- Learn about Integration of Technology as developing the website involves HTML, CSS, and JavaScript, helping the student understand the technical constraints and possibilities of web interfaces. They also gain experience in making websites responsive and accessible for different devices.
- Enhance Communication skills and Education. The project requires communicating information effectively, such as nutrition facts or vegetable recipes, emphasizing the importance of clarity in interface design. They practice informing and motivating users through design, a subtle but crucial HCI skill.
- Portfolio Development as the completed website can serve as a portfolio project, demonstrating the student's ability to design and implement user-friendly systems. Future employers or graduate programs often value projects showing both technical and design thinking skills.
- Enhance their Critical Thinking and Problem Solving. Students must analyze how users interact with the system and solve problems like navigation issues, content overload, or engagement challenges.

7. CONCLUSION

This study demonstrates the potential of integrating technology and nutrition science to foster healthier dietary behaviors. The proposed system effectively allows the user to check the benefits of vegetables or by searching for a disease and listing what vegetables would help. Findings suggest that technology-driven interventions can enhance user engagement and awareness of healthy eating patterns. Future work will focus on evaluating long-term health outcomes, optimizing user interaction through adaptive algorithms, and expanding the framework to include broader dietary and lifestyle factors. Such advancements can further strengthen the role of technology in evidence-based nutrition and preventive health care.

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