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EZLiving: Shopping Application for Visually Challenged

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Abstract – This research introduces EZLiving, a web-based solution that is particularly designed to address the daily challenges faced by visually impaired individuals when engaging in online shopping activities. These challenges range from logging into the system to searching for desired products, browsing products, reviewing products, adding items to the cart, managing cart items, and making payments. The difficulties arise primarily due to colour blindness and low vision. We are providing solutions to these challenges through the implementation of voice instructions integrated throughout the web application, which we developed using voice synthesis also known as text-to-speech and automatic speech recognition also known as speech-to-text mechanisms. EZLiving aims to provide visually impaired users with a convenient shopping experience by leveraging this modern technology to overcome obstacles.

Keywords— speech-to-text, text-to-speech, web Application, visually Impaired

1. Introduction

In a world that is more digital, online shopping has become an essential part of modern life, revolutionizing the way people access goods and services. However, this convenience has not always extended equally to all members of society. Because they are primarily aimed at sighted people, software developers frequently disregard visually impaired people. As a result, those who are visually impaired encounter terrible user experiences when using these applications. Addressing this disparity, this research aims to develop a home appliance shopping web application that places inclusivity at its core, providing advanced assistive technologies to empower visually challenged individuals. For sighted people managing a shopping application may not be important. But for visually challenged these tasks can be tough. Due to their condition Complex website structures, understanding product details, features and navigation can be confusing. Hence decided to provide a solution to these problems with modern technologies. Below table [1] shows the impaired vision types and the corresponding percentages.

Table I. Color Blind Types & Percentages[2]

VisionType	Percentage
Normal vision	92%
Deuteranomaly (red-green deficiency)	2.7%
Protanomaly	0.66%
Protanopia	0.59%
Deuteranopia	0.56%

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EZLiving is a web application developed to solve above mentioned problems in shopping experience. The web application is chosen for enhanced shopping experience of the user from home. A web application must be perceivable, operable, understandable, and robust to be accessible for visually impaired users.

This application is user centred which designed according to the visual challenge type and gives magnifying effect to low visual users as well. As with voice synthesis and voice navigation, user can easily overcome previous issues that will enhance user experience. Through the research it was found that the visually challenged people struggle to find functions, navigate through pages, take closer look at items, read description, handling cart, identify colour patterns etc. EZLiving is developed to solve these problems to customer. Initially EZLiving have five main modules. Profile management, inventory management, shopping cart, Reviewing, payment management. And giving customer voice synthesis and providing themes for different visual challenge and voice assistance cart and hand magnifier for inventory and audio descriptions and effect.

2.   Related Works

This section shows the past research [3] and many have tried to deliver convenient approach for the users in matter but most of them fail to fulfil every requirement. Below are some results of a web-based survey [4] on the subject.

Visually impaired friendly E-commerce website - Mallika Chand [5], built to target blind and colour-blind persons using the method which provides recorded voice guiding for the interaction in each interface. They achieved the 70% accuracy in their method.

E-Commerce Website for Visually Impaired - Anagha S Kulkarni [6], developed application using voice synthesis which includes speech recognition and voice commands. They achieved 70% accuracy.

Keyboard-less online shopping for the visually impaired users using natural processing and face recognition mechanisms - Rallabhandy S [7] through their research paper they have proposed a method to create a more user-friendly website using face recognition. However, it does not give an online payment method for visually.

E-commerce based online shopping for visually impaired people using speech recognition - Kunal Mohadikar and Rahul Nawkhare [8], Research paper shows that they are mainly focusing on speech recognition that carried out using Deep Learning.

Web Accessibility for visually impaired people: Requirements and Design issues – Mexhid Ferati [9], research is focused on Accessibility challenges,actions and adaption approaches for visually impaired users.

Table II. Comparison Between Ezliving & Similar Systems

	Voice navigation	Theme Customization	Magnification	Text to Speech	Speech to Text
Visually impaired friendly E-commerce website	No	No	No	Yes	No
E-Commerce Website for Visually Impaired	Yes	No	No	Yes	Yes
EZLiving – Shopping application for visually challenged.	Yes	Yes	Yes	Yes	Yes
Keyboard-less online shopping for the visually impaired using natural processing and face recognition	Yes	No	No	Yes	Yes
E-commerce based online shopping for visually impaired people using speech recognition	Yes	No	No	Yes	Yes

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Web Accessibility for visually impaired people: Requirements and Design issues	No	No	Yes	Yes	No

3. Methodology

The web application is developed using React, Node.js for the frontend, express framework, and MongoDB as the database. In this research identified the specific needs and challenges faced by the visually challenged peoples when they are doing shopping and attempting to implement them using latest tools and techniques. Information that is gathered from requirement gathering is used to design user interfaces and improve the user experience. These are the special features that are included in the system:

A.   Magnification over object

This Feature aids the observation on the application. If user needs to see texts or images in big sizes when browsing the web application magnification will help for that.

B.   Text to speech

The text-to-speech function can significantly enhance the accessibility and usability of the EZLiving app for individuals who have difficulty reading or interpreting text on the screen due to reduced eyesight. As users navigatethrough the EZLiving web app's product listings, they can simply activate the text-to-speech (TTS) function to hear detailed and accurate descriptions and other information about each item.

C.   Speech to text

The Speech-to-Text (STT) feature empowers users to effortlessly convert their spoken words into written text, enabling them to write reviews, provide feedback, and more [10]. It also allows them to conveniently fill out various forms across the website. This functionality enhances the interactivity of users with visual impairments, contributing to stronger overall user engagement on the website.

D.   Voice navigation

The Voice Navigation function integrated into the EZLiving web application empowers users to navigate various pages and sections of EZLiving web app using natural voice commands, ensuring every corner of the website is accessible at the mere sound of a user's voice. For instance, a simple command like 'Go to reviews' will redirect users to the reviews page. This functionality helps users with visual challenges to explore the website independently, eliminating the need for traditional visual cues [11].

E.   Change user interface themes according to the colour-blind types

If colour-blind users are using this web app, they can select their colour-blind type and the system will provide different user interfaces. It will increase the user experience of the web app. Advanced accessibility libraries were integrated to facilitate smooth interaction with screen readers and other assistive technologies. MongoDB is chosen to store product information, payment details, shopping cart details and user details. Document-based data structure feature of MongoDB is very useful to handle data.

Express Js is used for backend development and API handling. RESTful APIs was designed to handle product, cart, order management part and user authentication using Express Js.

Node Js is used to develop backend logics. It handled all the data interacted with MongoDB database and user authentication using JSON Web Token.

React Js used to develop user interface components which mainly focused on accessibility and user experience as shown in Fig. 1. React libraries are used to develop text to speech, speech to text and voice navigation features.
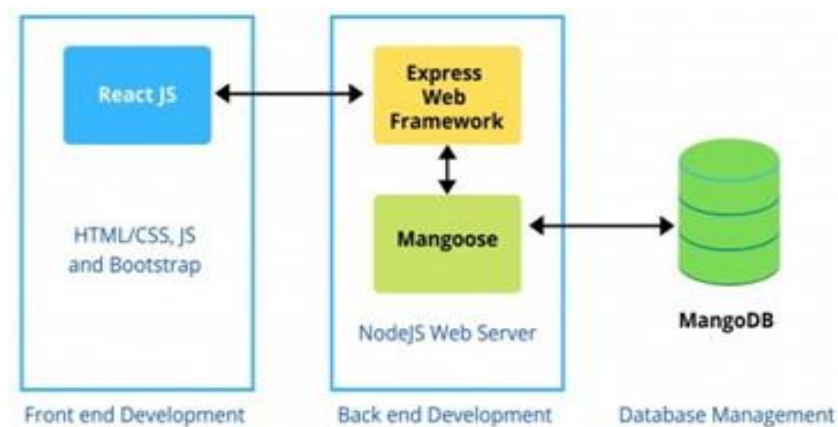
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Results

Fig. 1. Digital representation of MERN stack development structure

This online shopping web application provides all the information about each web page that users navigating, throughout the voice over. Not only that but also, they can navigate through web pages using voice commands. Even users cannot see the web pages properly throughout the voice over feature they can get proper idea about the web page. Also, every web page has magnifying feature users can see every image and every letter in bigger size with zoom in and zoom out effect.

After logging in to the system successfully users are navigated to the home page, immediately users came to the home page there was a voice over about which page users at now and how to navigate to the other pages through voice command. This voice over and voice navigation have been evaluated by visually challenged person and it worked with 85% accuracy level without having any delay. When users navigate to the product list page, they can select the product they want. Using voice control search bar users can search products without typing any word in the search bar as shown in Fig. 2. Each product has a sole product page which includes all the information about that product with product images. All letters and images on that page have magnifying features and the description of that product has been delivered through voice over as shown in Fig. 3. And the system provides some useful features for colourblind people to increase their user experience by providing separate user interfaces among their colourblind type.
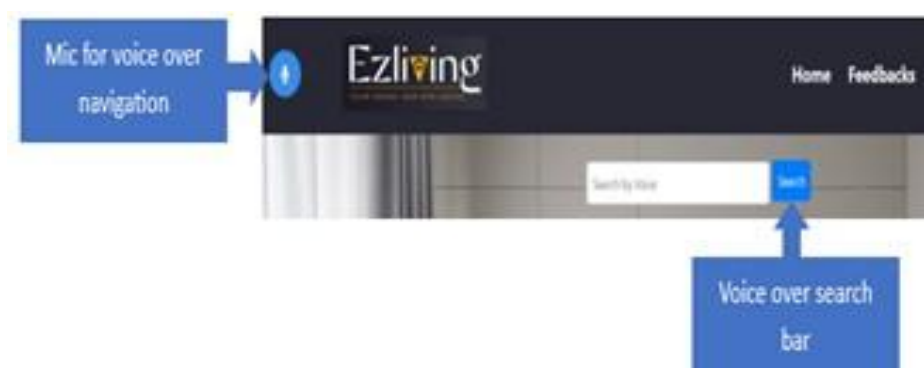

Fig.2. Voice over navigation bar and search bar

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voice over feature as shown in Fig. 4 and magnifying feature have been successfully evaluated by the visually challenged person and it worked with 85% accuracy level in any environment. And the user was happy about that experience. Then the users can add items to the cart using the add to cart button.

Fig.3. Voice over item description

After all products added to the cart users can navigate to the cart page by using navigation bar or using voice navigation feature. Users have to say "go to cart" command to navigate to the cart page. Instruction of all the commands will be provided through voice over.

After navigating to the cart page system says "now you are at cart page" through voice over feature, in cart page users can change the quantity of each product and remove products from the cart when product removing from the cart system requiring voice over confirmation. System asking, "do you want to remove [the specific product name] from the cart if yes say "remove"", users need to say "remove" command to remove that product from the cart. That feature was also assessed by visually challenged person, and it worked successfully with 80% accuracy level in a quiet environment. If users use this web app in a noisy environment, commands given by user can be changed with the other sounds because of that reason command will not work with 100% accuracy level.

Users can check out from the cart page, and they can successfully complete the payment providing their
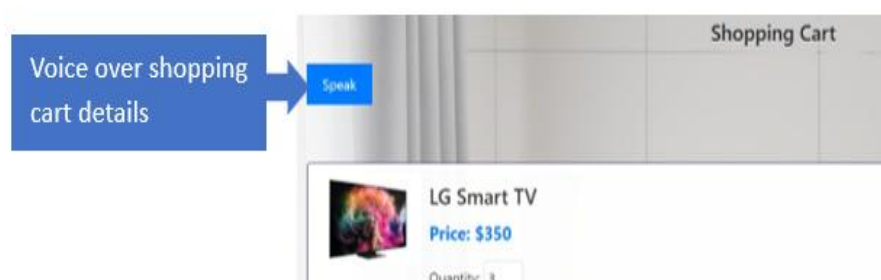

Fig.4. Voice over shopping cart details

credentials. Users can add feedback using speech to text feature about the user experience of the web app. Also, users can add reviews for the products that they bought using speech to text feature. In the feedback page users can hear all the feedback that users added by using text to speech feature. That feature was also evaluated, and it gave 85% accurate result. Same feature added to the product review page.

The admin of the system can manage all the inventory related functions. Admin can add new products, update existing products, and delete unavailable products. Also, admin can generate inventory reports when needed. All users can generate reports of their payment history. These functions were evaluated, and it gives 100% accurate results without any error in any environment.EZLiving is a fully functional online shopping app for visually challenged people. It works with 85% accuracy level without having any delay or any error. The visuallychallenged person who assessed the entire system gave good comments about the user experience as shown in Fig. 5.
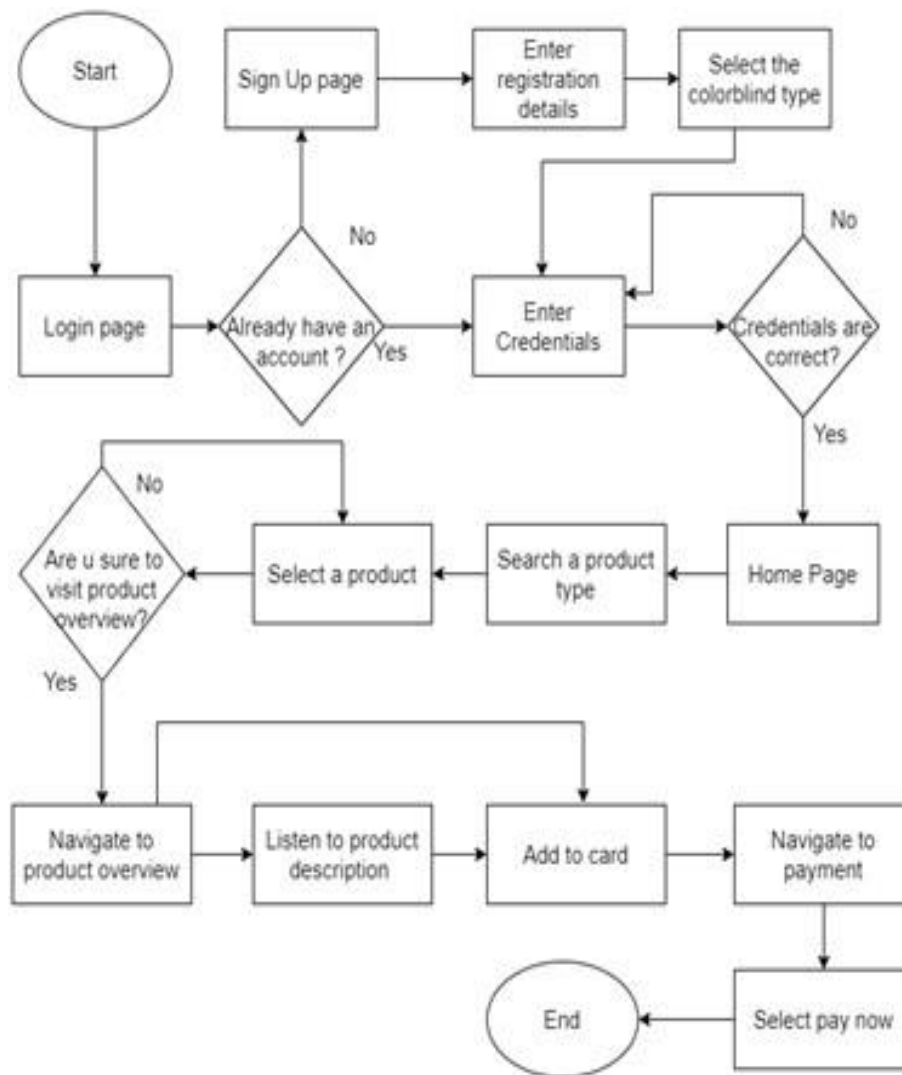
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Future Scope

Fig.5. Digital representation of the user flow

EZLiving online shopping application's future scope is about enhancing the user experience to perfection by providing users with every possible feature that are useful for people that are visually impaired. Currently EZLiving is equipped with text-to-speech, speech-to-text, voice navigation, magnification over objects and theme selection. These functions are well tuned to ensure a positive user experience.

The EZLiving online shopping applications is currently a web-based platform, which can make it challenging for mobile users to achieve perfect use of the web application. In future EZLiving web application will undergo research on conversion and adaptation to various platforms and devices, including mobile phones and tablets. Future research will try to explore innovative technologies to implement gestures and haptic feedback to mobile platforms aiming to enhance user interaction with the EZLiving mobile application and these enhancements will be available for free for every user.

For the web application that is currently implemented, functionalities will be improved further for better user experience. EZLiving online web app is currently facing challenges with highly valued voice navigation function and speech-to-text function when getting correct user inputs due to noise-interferences. Hence, the future scope will focus on implementing advanced noise cancellation capabilities to address this issue.

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The EZLiving web application is designed to be accessible for everyone around the world. To achieve a broader global reach, EZLiving will be actively exploring multilingual support to expand the user base on a global level. As the EZLiving platforms expand and welcome more users, security becomes an increasingly critical concern. To protect the interests of all users, security will be tightened as well in the future. The EZLiving web application's security measures will be strengthened to ensure that visually impaired users are not vulnerable to exploitation. This approach will help users to feel safer and more secure while browsing through EZLiving with confidence.

Future research endeavours will also be thoroughly exploring how to achieve more user compatibility for visually challenged and will include other small improvements for different use cases to optimize the web application interactions altogether. These enhancements will include a more functional screen reader, eye comfort modes to enable longer browsing sessions without causing eye fatigue and a refined user interface (UI) to provide maximum eye comfort to the visually challenged.

4.   Conclusion

With the development of technology, online shopping platforms are constantly evolving, and new requirements are rising to be fulfilled. This paper summarizes the implementation of an online shopping web application with the motive of providing a convenient way to perform online shopping for visually impaired people.

Through the phases of requirement gathering and literature review the essentials and demands were identified and it has been recognized that most of the existing systems have failed to satisfy them. With methodologies this paper shows that EZLiving provides a solid solution for visually impaired users to overcome the difficulties using latest technologies. The application is developed using voice synthesis including text-to-speech and speech-to-text mechanisms so that user interaction would be much more convenient. Magnification improves readability and accessibility of visual content of users and furthermore voice navigation system will allow users to navigate between the interfaces easily and system will introduce the interfaces processing voice outputs as they are redirected. Most of the existing systems don't apply enough concern to the convenience of colour-blind users. EZLiving records the colour-blind users as they register and provides them with custom themed interfaces to ensure a user-friendly environment. Such features are added to the system with the aim of increasing the independence of visually impaired users. An admin login is added to the system which does not include the mentioned features where admin can manage the inventory and review the user performance on the system.

The result segment reveals the user experience with the included features and how the system can be operated by the user. It demonstrates the features that are mentioned about making the application user friendly for visually impaired users by applying them into regular web application functions. Future Scope concludes the potential that EZLiving holds to expand for a greater scope. Implementation of EZLiving is a strong attempt to provide an adaptable environment for users.

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