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THE SIGNIFICANCE OF MAKING ACCESSIBLE USER INTERFACES IN DIGITAL APPLICATIONS

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THE SIGNIFICANCE OF MAKING ACCESSIBLE

USER INTERFACES IN DIGITAL

APPLICATIONS

by

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Presented to the Faculty of the Honors College of

The University of Texas at Arlington in Partial Fulfillment

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I would like to dedicate the success of this project to my parents for always, always being there for me all throughout college. I want to thank them for financing my education, supporting my decisions enthusiastically, and always pushing me to achieve the best. I would like to thank God for looking after me and bestowing me with strength when I broke down. I truly would not be here if it was not for God's constant blessings. Thanks to my brother, for always reminding me about the better things in the world and for making me smile when I thought I could not go any further. I want to thank my boyfriend for always having faith in me, and for standing by my side like a pillar of strength. Next, I would also like to thank my professors for believing in me, for constantly guiding me, and for shaping me into the responsible person I am today. The contribution of my friends for supporting me, and for creating some of the best memories of my life, cannot be overstated. College would never be so enriching without them. Finally, I would extend a big thank you to my team members for being by my side and for helping me out when troubles came my way. This project would never have reached this point of success without their constant efforts.

May 4, 2018

ABSTRACT

THE SIGNIFICANCE OF MAKING ACCESSIBLE

USER INTERFACES IN DIGITAL

APPLICATIONS

Vaishanavi Mirapurkar, B.S. Software Engineering

The University of Texas at Arlington, 2018

Faculty Mentor: Christopher McMurrough

Individuals with autism spectrum disorder, specifically sensory disintegration disorder, have trouble adjusting to certain environments. As a result, certain environmental conditions are not conducive to relaxation for such individuals. Vcare is a mobile (Android) application that can be used by family members of people with autism, or even people with autism, to find suitable and "autism-friendly" recreational places to enjoy. The application allows users to make profiles, view their profiles, search among a list of places stored on the database, view the details of a place, rate the place, etc. The application also has Google Maps functionality incorporated in order to make it user-friendly. The intended audience for the application are individuals without disabilities, and individuals with disabilities, including individuals with autism. Amid a smorgasbord of mobile and web applications, Vcare is an innovative and disruptive technology that will make a major difference in the

lives of individuals suffering from autism spectrum disorder. Since this is a digital application, user experience is critical to its success. One parameter which influences user experience or UX is accessibility. In design context, accessibility means that a product or service should be able to be used by everyone, regardless of a person's physical, economic, or cultural status. Since people with disabilities form one of the largest user groups in the world, UX designers must investigate some key areas of disabilities and follow certain principles and guidelines in order to make accessible designs for such users.

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CHAPTER 1

INTRODUCTION

According to statistics, more than 3.5 million Americans today live with Autism Spectrum Disorder [1]. An autistic individual is immediately regarded as diseased, without knowing what the disorder entails. The bottom-line is: what is autism, and how does it affect individuals afflicted with it? Autism, or autism spectrum disorder, refers to a range of conditions characterized by challenges with social skills, repetitive behaviors, speech, and nonverbal communication, as well as by unique strengths and differences [2]. Autism is a complex developmental disability. It is now proven that there is not one type of autism, but many different types that are primarily caused by different combinations of genetic and environmental differences. Autism is a "spectrum condition," and the term "spectrum" is used to reflect the wide variations in challenges faced and strengths possessed by each individual suffering from autism [2].

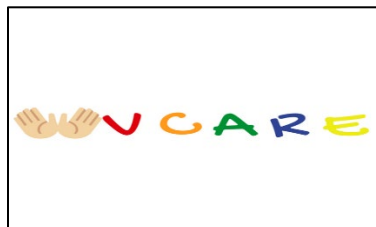1.1 Overview of Vcare Android Application

Figure 1.1: Vcare Logo

Vcare is a competitor in the Simons Foundation Powering Autism Research for Knowledge (SPARK) Mobile App contest, which is an online research initiative that

aims to speed up research and advance the understanding of autism [3]. So, when faced with a prospect of producing an idea for a mobile application, we researched and found that certain environments are uncomfortable to varying degrees for people suffering from autism. While some public places have poor lighting, others have excessive background noise, while some others have décor that elicits negative emotions in individuals suffering from autism. These conditions, which often go unnoticed because they do not affect the general population, can cause extreme discomfort to people suffering from autism. Moreover, often in restaurants, the staff is oblivious or even insensitive to the conditions faced by the people suffering from autism. The underlying question is: how do we make it possible for the autistic community to find public places that are suitable to their needs? To address this challenge, using our engineer's instincts, we decided to put to use our acquired skills in software engineering to find a solution. Through this project, we created a phone (Android) application that seeks to aid the autistic community in looking up public recreational/business places (restaurants, parks, etc.) that are better suited to individuals with autism. This Android application aims to assist the people suffering from autism and their loved ones to look up recreational places that are suitable to their needs or "autistic-friendly" and that will help them have an enjoyable experience. We also found that while there are several applications like Autism Track, a data tracking tool for the parents of children with autism that helps them conveniently keep track of behaviors, interventions, and symptoms in one place, there has never been an application like Vcare. This is a first-of-its-kind prototype. So, we decided to proceed forward with this unique idea.

It cannot be denied that individuals suffering from autism and their families deserve a relaxing and enjoyable family time. Decidedly, it is imperative that their condition should

not come in the way of a good quality of life. Since software can be used as a tool to solve countless baffling problems, we used our knowledge of the Agile software development process to build an Android phone application that will add value to the lives of individuals with autism. This app also provides an opportunity for business owners to see how people perceive their businesses. It gives them a chance to make their businesses more inclusive of people with autism. Also, it is a great platform for businesses to actively make efforts to make their place more friendly and safe for people with autism and attract more customers.

1.2 Salient Features of Vcare

Vcare is a minimum viable product, and hence has basic functionalities implemented. It has the following features:

- Sign up: Users can use their email, a unique username, and date of birth to register.
- Sign in: The user can sign in using their unique ID and password.
- View user profile: The user can conveniently access their profile and view it once they are signed in.
- Search/view public places: The user can conveniently look up the stored places (restaurants, parks, malls etc.) on the application. If the search is successful, they can view the details of the place. These details are name of the place, location, hours of operation, rating, reviews, and comments.
- Create a review: The user can compose reviews for any place that they have visited. This feature is available on the information page for that place.
- Rate a place: The user can provide ratings in terms of the number of stars. This will be shown on the information page of that place.
- Maps: Vcare has Google Maps functionality incorporated. This feature allows users to view their location and the locations of the other places in the database.

<u>1.3 Project Methodology</u>

The development of this application spans over a period of two semesters, and a funding of $800 has been set aside for the project by the Department of Computer Science and Engineering at the University of Texas at Arlington. Our client/sponsor for the project was Dr. Christopher McMurrough from the CSE Department at UT Arlington. The first step was requirements gathering, and documentation of the business and the technical requirements. Next, the project charter, which consists of the general information about the application and the project timeline, was put together. Following the charter, the architectural design of the project, which consists of a brief overview of the internal functioning of the product, was compiled. Finally, the application was implemented and tested. The application was implemented using the Agile development methodology, which is a popular software methodology in the software engineering industry today. Team member Shivendra Raghav, Hoang Pham and I worked on the backend of the application, while team member Pushkar Thakkar worked on the frontend.

1.3.1 Software Requirements Elicitation

Simply defined, requirements are the capabilities that the system must deliver. Commonly called requirements gathering, software requirements elicitation is the practice of gathering the business requirements from the users, customers, and other related stakeholders. As easy as this step sounds, one cannot look up requirements like one can collect information for a term paper or study for a test. As Frederick P. Brooks, Jr. emphasizes, "the hardest single part of building a software system is deciding precisely what to build – i.e., the requirements."

Unlike sources on the web, requirements reside in the minds of the stakeholders, and in the feedback that is yet to be obtained from the end users of the system etc. When one comes to think of it, most users are not very aware of what the application should entail and sketch out vague requirements. This can lead to several errors that can eventually result in system failure, and this can result in huge costs that are due to complete loss or the expense of fixing the mistakes. Thus, the importance of requirements cannot be overstated, since they are the cornerstone of any software development project.

For this project, the team had a meeting with Dr. McMurrough for drawing out the requirements. The team also discussed and outlined the technical requirements and compiled them into the scrum product backlog, which is simply a list of items that need to be implemented.

Object	Feature
App	App uses location services
App	App uses an internet connection
User	User can sign up
User	User can sign into account
User	User can search for places on the app
User	User can create a review for a particular place
User	User can like a review for a particular place
User	User can sort businesses based on overall rating
User	User can sort businesses based on distance
User	user can sort reviews for each business based on attributes

Figure 1.2: Initial Product Backlog

1.3.2 Agile Development Methodology

The Agile developmental methodology is a particular approach to project management that is utilized in software development [4]. As opposed to the traditional model of software development, Agile is centered around some general principles:

- Adaptive Planning – response to change quickly and easily is crucial and should be embraced for client's competitive advantage.

- A greater focus on delivering working software frequently.
- Working software is the chief measurement of progress.
- Software developers and the clients must work closely on all aspects of the software development.
- The best way to transfer information within and from a team is face-to-face communication.

A method that emerged as a reaction to the traditional method of software development, the Agile methodology has taken the software development and the testing world by storm and has rapidly cemented its place as "the gold standard" in the past few years [4]. This method of developing software is based on four core principles that are outlined in a compilation called the Agile Manifesto:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

Agile uses incremental or iterative work sequences that are commonly termed sprints. A sprint is defined as the time allocated for the phase of a project. This period varies depending on the team. For this project, an Agile sprint consisted of two weeks. Tasks were allotted to each team member at the beginning of each sprint, following which there would be an in-class sprint presentation to let the class and the sponsor (Dr. McMurrough) know about our plans for the sprint. Following the same trend, there was a presentation at the end of each sprint to inform our stakeholders about our project. This practice was put in place to imitate one of the principles of Agile: software developers and the clients must work closely on all aspects of the software development.

1.3.3 Implementation

Since each organization is unique, different organizations have different challenges and regulations. To accommodate the varying needs of different organizations, different techniques like scrum and extreme programming (XP) have been devised under Agile [4]. The Agile methodology used in this project is scrum, which focuses on defining key features and objectives before each sprint. Each accumulation of requirements for a sprint is a sprint backlog, a subset of the larger product backlog. In a team, "stories" or tasks are picked from the sprint backlog and assigned to each team member. To discuss progress, and address issues with the assigned tasks, we had 15-minute daily scrum meetings. Utilizing various front-end and back-end software technologies, we implemented the application in an Agile manner

CHAPTER 2

AUTISM: A DEEPER LOOK

2.1 Symptoms of Autism

Autism spectrum disorder is a condition that affects the nervous system. The signs of autism are said to become visible during early childhood, and largely affect the individual's social ability--interaction and communication. It affects individuals in three major areas--social interactions and relationships, verbal and non-verbal communication, and limited interests in activities or play [5]. Some of the known core symptoms of autism are as follows [5]:

Social interactions and relationships:

- Significant problems developing non-verbal communication skills such as facial expressions, erect body posture, and eye-to-eye gazing.

- Inability to establish friendship with children within the same age group.

- Lack of empathy. They are characterized by difficulty in understanding others' emotions such as pain or sorrow.

- Absence of interest in sharing interests or achievements with others.

Verbal and non-verbal communication:

- Lack of or delay in the ability to talk. In fact, as many as 40% of the autistic community never speak

- Trouble in starting a conversation. Most suffer from problems in continuing a conversation after it has begun.

- People with autism often repeat a phrase they have heard previously multiple times. This condition is named echolalia.

- They often experience difficulty in construing their listener's perspective. For instance, an autistic individual may not interpret someone's humor and might fail to catch implied meaning.

Limited interests in activities or play:

- Younger children with autism tend to have an unusual focus on pieces. They often focus on parts of toys rather than concentrating on the entire toy.

- Individuals with autism often have stereotyped behaviors. These typically include body rocking and hand flapping.

- They often crave a need for routine. For example, a child with autism may insist on eating bread before salad or driving through the same route to school every day.

Apart from these symptoms, anxiety, change in voice and intense sensitivity to loud noise and lighting are some other noticeable symptoms [5]. A change in environment, difficulty in adjusting to new places, and trouble adapting to crowded places are some other possible symptoms.
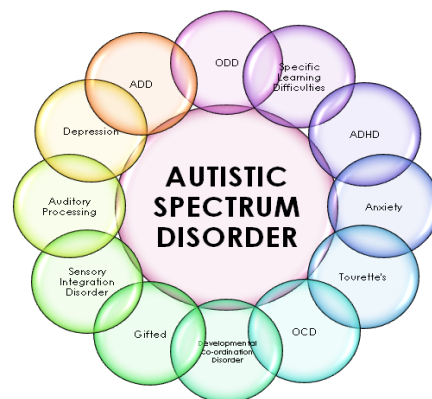
Figure 2.1: Autism Spectrum Disorder

2.2 Autism and Sensory Differences

Sensory processing refers to the bodily mechanism using which the nervous system receives messages from the senses of the body and turns them into appropriate motor and behavioral responses [6]. For the success of any activity performed by the senses, be it touching a hot cup of coffee or inhaling a sweet fragrance, accurate processing of sensation is necessary.

Sensory Integration Disorder happens when sensory signals are either not detected or do not get organized into appropriate responses. It has been likened to a neurological "traffic jam" by A. Jean Ayres, PhD, a pioneering occupational therapist, educational psychologist, and neuroscientist. As a consequence of this disorder, many autistic people suffer from sensory issues, which affect one of more their senses, leaving them over-developed (hypersensitive) or under-developed (hyposensitive) [6]. For instance, one person with the disorder may over-respond to tactile sensory input. Clothing on skin or other kinds of physical touch might be unbearable to them. On the other hand, another person might under-respond and show little to no reaction to extreme situations like pain or extreme hot or cold. Most importantly, this disorder can drastically impact how people perceive and experience certain environments and can disrupt their everyday activities. Some of the things that can stimulate their nerves negatively are:

- High arousal colors, for instance yellow, and patterned wallpaper. Patterned floors can be confusing to walk on and increase anxiety.
- Fluorescent or harsh lighting can cause harm to the eyes of an individual suffering from autism, mainly because they perceive these types of lights as flickering or hear them hum. As a result, soft lighting is preferred.
- Some autistic people have trouble blocking out noise that others can simply filter out and ignore.

- People with autism tend to feel overwhelmed by subtle smells, like perfume or deodorant or even the smell of fabrics, that might go unnoticed by others.

Vcare seeks to target the above-mentioned consequences of autism. With an accessible UI (chapter 3), and the functionalities for searching, rating, commenting, and reviewing public places, this application gives the people suffering from autism and their families a chance to look up suitable public places expediently and puts them at ease.

CHAPTER 3

USER EXPERIENCE AND ACCESSIBILITY

According to the post-2015 software development framework, the goal of any digital application is to promote inclusion and accessibility to enable the equal and full participation of people with disabilities in society. Around the world, the one billion people with disabilities often encounter accessibility barriers in transport, buildings, as well as information and communication services, and these barriers hinder the inclusion of persons with disabilities into society. Accessible and assistive technology dramatically improves the quality of life of adults and children with disabilities, by making schools, employment, and other services more available.

3.1 Accessibility in User Experience (UX) Design

3.1.1 What Is Accessibility in UX Design?

User Experience or UX is critical to the failure or success of a product in the market. Although the phrase User Experience is often thought to be related to usability only, there are several factors that influence UX. Accessibility is one of them, and it is rather crucial [7]. Accessibility is the ability to access (i.e., use and/or interact with) a product or service. In the design context, accessibility means that a product or service should be able to be used by *everyone*, regardless of a person's physical, economic, or cultural status [8]. This is a topic which is often either highly misunderstood or taken for granted by software developers. It is very common to mistake the concept of accessibility

to involve only people with disabilities, even though we all find ourselves disabled in many contexts and situations. For instance, all users of mobile/handheld devices must divide their attention when driving and navigating using a GPS. Fortunately, good GPS software systems speak to the users, so they do not need to take their eyes off the road to anticipate how far ahead a turn is. This is an example of an accessible software design that shows awareness on the part of the developers. It must be known that a design can be regraded successful only if it is accessible to any user, anywhere, and at any time. With an inaccessible product, the users meant to use the product feel altogether excluded from utilizing it because they are barred from interacting with it for various reasons. For instance, people with visual impairment may have difficulty reading the text on a website. However, if accessibility is considered and implemented well, the user interface (UI) developer of the website will have the text properly formatted. Consequently, such users can use screen reading software to hear the words on the website.

All in all, accessibility translates into a designer's success or failure at the exact point of the release of the product. With that said, there is good news for UI developers: there are certain standards for accessibility that, if followed from the start of the design process, are easy to implement.

3.1.2 Accessibility for People with Disabilities

According to the Michigan Disability Rights Coalition, disability is perceived in different ways in society [9]. However, the two most common ones are the medical model of disability that, as described in figure 3.1, accuses the person as the cause for disability,

and the social model of disability that, as described in figure 3.2, asserts that the real cause of the stigma faced by the people with disabilities is the environmental, social, and attitudinal barriers imposed by society.

Figure 3.1: The Medical Model of Disability

To elaborate, a person in a wheelchair who has difficulties being employed as a result of inaccessible buses or staircases that hamper her access is a victim of the environmental barriers imposed by society. Similarly, a child with an intellectual difficulty might not be comfortable going to school because of the harsh attitudes of the school staff and even parents who are not open to children with different learning capabilities. This is an instance of an attitudinal barrier. Instead of placing the onus for the disability on the person suffering from the disability, and trying to fix him/her, the social model stresses on society's responsibility to remove attitudinal barriers to disabilities [9]. This model provides a deeper understanding and exhibits acceptance of people suffering from disabilities.

Based on the social model of disability, the United Nations adopted the Convention on the Rights of the Persons with Disabilities in 2006 and brought it into effect in 2007.

According to this Convention, the UN describes persons with disabilities as follows: "The term persons with disabilities is used to apply to all persons with disabilities including those who have long term physical, mental, intellectual or sensory impairments which, in interaction with various attitudinal and environmental barriers, hinder their full and effective participation in society on an equal basis with others." Since people with disabilities form one of the largest user groups of digital solutions, technology has an immense impact on their lives [9]. Subsequently, the responsibility of driving social integration trickles down to a UX designer's job as well. UX designers must follow the social model of disability and take environmental, social, and attitudinal barriers into consideration before designing applications.

Figure 3.2: The Social Model of Disability

Given that, software developers need to focus on some areas for making software design accessible for users with disabilities [8]:

- Visual: This area includes all forms of visual disabilities like long-sightedness, blindness, and color blindness.
- Motor/Mobility: This area includes certain muscular and skeletal conditions.

- Auditory: This area deals with the auditory defects that affect the ability to hear. The disabilities in this area can come in varying degrees of severity up to total deafness.

- Seizures: This area encompasses seizures from light, motion, flickering, etc. on the screen.

- Learning: This area encompasses learning and cognitive disorders as opposed to the physical disabilities.

3.1.3 Information and Communications Technology Accessibility

The UN, through the means of the above convention, states that access to Information and Communications Technology (ICT), a term that encompasses all digital devices and applications, is crucial to enable people with disabilities to live their lives independently and fully. What is more, the World Wide Web Consortium or W3C, an international organization that develops standards for the web, officially recognizes the access to ICT as a basic human right [9]. ICT accessibility has a great impact on UX design. Consequently, UX designers need to bear ICT accessibility in mind to implement digital solutions that are accessible. In an effort to make information and communication technology available to everyone, the World Wide Web Consortium launched the Web Accessibility Initiatives (WAI), which is responsible for specifying the guidelines, standards, and techniques for web accessibility. The WAI has outlined three core guidelines to improve accessibility [9]:

- Web Content Accessibility Guidelines (WCAG) – This guideline seeks to address the information contained in a certain web site. This information includes text, images, forms, sounds etc.
- Authoring Tool Accessibility Guidelines (ATAG) – This guideline specifically addresses the software that creates web sites.
- User Agent Accessibility Guidelines (UAAG) – This guideline encompasses web browsers and media players and other such technologies which assist web sites.

Out of the above outlined guidelines, WCAG 2.0 (the updated version of WCAG 1.0) is a significant source of reference for international accessibility policies, standards, and legislations. Moreover, it is an extremely reliable source of design principles, guidelines, and techniques for UX designers, developers, and content creators alike to follow in order to create highly accessible content on web sites. It is remarkable how these succinct and germane techniques have already been employed by designers at Apple, TED Talks and Twitter to accommodate persons with disabilities.

3.1.4 WCAG 2.0 Principles and Guidelines

The four principles of accessibility--namely Perceivable, Operable, Understandable, and Robust (POUR)--form the top layer of web accessibility guidance. Under these principles are the 12 guidelines that provide designers with the overall framework and objectives to make an accessible design [9].

Principle 1: Perceivable – Information and user interface components must be presentable to the users in ways they can perceive. The user interface must be designed in a way that people of varied perceptive needs and preferences should be able to make sense of it. It must provide useful alternatives to a user if they are unable to perceive the information using one of the senses.

Guideline 1.1 Text alternatives: This guideline entails providing text alternatives for any non-text content, so it can be changed into other forms people need such as large print, braille, speech, symbols, or simpler language. This means that all non-text content presented to the user has a text alternative that serves an equivalent purpose. A simple instance is a deaf person who can understand an audio file clearly because of text on the screen.

Guideline 1.2 Time-based media: Provide alternatives for time-based media including only audio, only video, and audio and video combined. This involves providing an alternative that provides equivalent information like text-based transcript or captions for prerecorded audio and an equivalent alternative like an audio track for prerecorded video content.

Guideline 1.3 Adaptable: Present content in different ways. This guideline entails that web content created must be presented in various ways without losing information, for instance creating a simpler layout.

Guideline 1.4 Distinguishable: This guideline entails separating background from the foreground, hence making the default presentation as perceivable as possible. This involves focusing on the contrast, making it easier for the users to see as well as hear content. This involves contrasting the colors used in visual. For instance, if the use of color of words, background or other content is used to convey information, it is mandatory that the information conveyed by color differences is also available in text, and text cues are used whenever color cues are used. This is shown in figures 3.3 and 3.4.
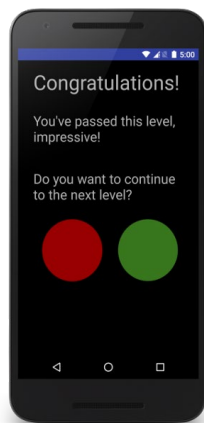

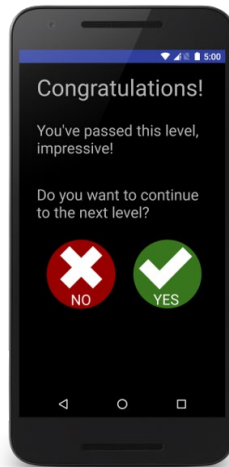Figure 3.3: Insufficient Use of Color

Figure 3.4: Acceptable Use of Color

TED Talks, live lectures that are recorded in front of a large audience, are a great instance in which textual transcripts are incorporated with audio-visual lectures. This way, people with hearing impairments can read the transcripts and people with visual impairments can listen to the audio lectures. This feature makes TED Talks accessible to a larger audience.

Principle 2: Operable – The interface must be designed such that the interface components and navigation are operable, i.e. there is no component that requires interaction the user cannot perform.

Guideline 2.1 Keyboard accessible: All functionality must be available from a keyboard. Other input devices like a mouse can be used to complement the keyboard. For instance, keyboard shortcuts to important links and form controls should be provided.

Guideline 2.2 Do not hurry anyone up: This entails providing users enough time to read, understand and use the content on the interface. For instance, if a page has session

time limits (where the time limit is controlled by the program implementing the page), the designer must give the user a chance to set a longer time limit or to turn the time limit off.

Guideline 2.3 Seizures: The interface must not be designed in a way that causes seizures. To accommodate users who suffer from seizures due to photosensitivity, an interface should not contain anything that flashes more than three times in a second. Also, it is mandatory to keep the area of the flashing component small.

Guideline 2.4 Focus on information architecture: This guideline entails ways to help users navigate, find content, and determine where they are. For instance, it is considered best practice to provide mechanisms to navigate to different sections of an application. Moreover, it helps to make navigation links visually distinct, and to have application pages with descriptive titles.

Facebook, the popular social networking website, is completely keyboard accessible. This means that users who have trouble utilizing a mouse, for instance users who lack the essential motor skills to operate a mouse, can access all the navigation links on the webpage using the *Tab* key on any keyboard. Also, the navigation links on Facebook are clearly marked and easy to understand.

Principle 3: Understandable – Information and operation of the user interface must be understandable.

Guideline 3.1 Easy to read, please: The content on an application interface must be made readable and understandable. This means that the content should be readable and understandable to not only users, but also assistive technologies that are commonly used by users with disabilities. The best practices to accomplish this are using clear and simple language appropriate for the content. Apart from writing it in a simple manner, designing

the content in a simple manner is important too. For instance, it is recommended that languages that are written left-to-right be formatted left-justified, and languages that are written right-to-left are right-justified.

Guideline 3.2 Make web pages appear and operate in predictable ways: This means that the designer must be consistent and coherent with the layouts, which will allow easy access to the information. Constantly changing contents and contexts is confusing to the user. For instance, launching a new window without warning when a radio button or a check box is selected or presenting navigation links in different relative orders on different pages/views are common mistakes that are overlooked. In order to make the page predictable, users must be given warning before opening a new window. Moreover, templates must be used across multiple pages to ensure consistency.

Guideline 3.3 Help users avoid and correct mistakes: This means that the interface must be interactive enough to detect errors and help the user recover from them. For instance, if the interface contains a form that contains fields which are mandatory, the interface provides text description to identify the such fields. Another example is in case the information provided by the user needs to be in a certain format, the interface displays a text description prompting the user that the value entered is invalid.

Description

Let me only say that it fared with him as with the storm-tossed ship, that miserably drives along the leeward land. The port would fain g|
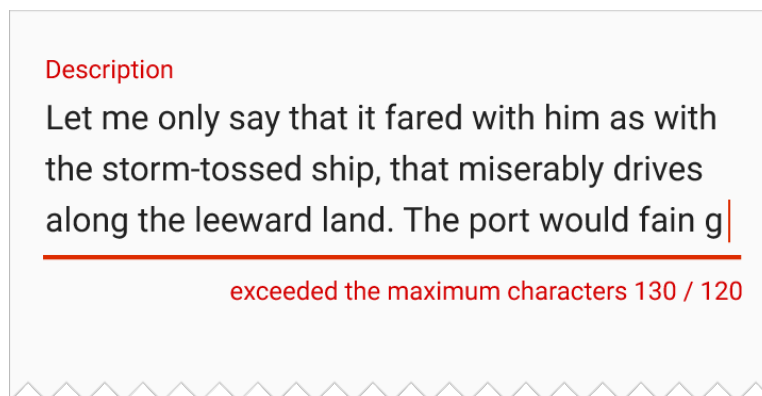
exceeded the maximum characters 130 / 120

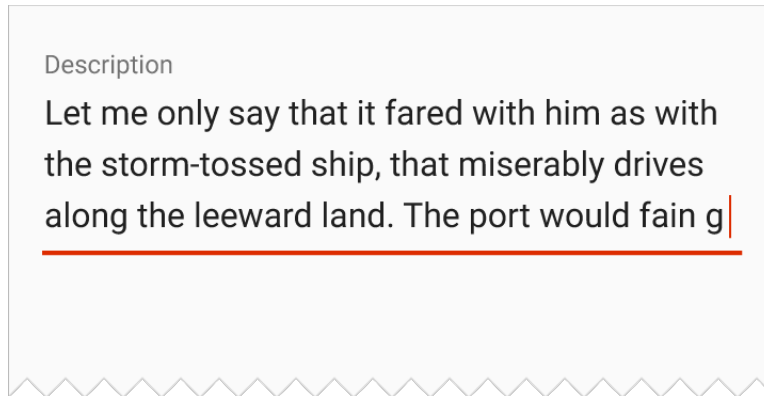Figure 3.5: Helping Users Rectify Mistakes

Figure 3.6: Incomprehensible Design

Twitter, another popular social networking website, has sign-up forms with clear and understandable error messages. In case a user fails to fill mandatory fields or enters invalid data, Twitter displays the error messages clearly written in standard English and marked in red. Moreover, these messages are placed right next to the input fields.

Principle 4: Robust – Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, which includes assistive technologies.

Guideline 4.1 Maximize compatibility with current and future user agents, including assistive technologies. This entails ensuring that the code written to implement the interface is as clean as possible and is compatible with devices. This way, the device would be able to render the page effectively.

Responsive web design, a web design approach invented by Ethan Marcotte in 2011, is a great way of making websites and web applications accessible. This approach enables designers to create websites that are compatible with various screen sizes – mobile phones, laptops, tablets etc.

The guidelines above are general guidelines that application developers need to bear in mind when making applications accessible for people with disabilities. Since autism

is a spectrum disorder, it is challenging to mesh out proper guidelines for applications specifically geared toward people with autism. Since Vcare is an application that might be used by people with autism as well as by their family members, who may or may not have a disability, we have followed the general guidelines outlined above, as well as a few other measures for people with autism. Some of these measures are:

- The screen is kept simple, and clutter is avoided.
- The foreground color is contrasted from the background color, while words are clearly visible.
- Flickering content has not been used on any screen, since such content can disorient the user.
- Touch targets have been made large because many individuals have trouble operating small touch targets on a device's screen because of large fingers or the result of a motor or visual impairment.
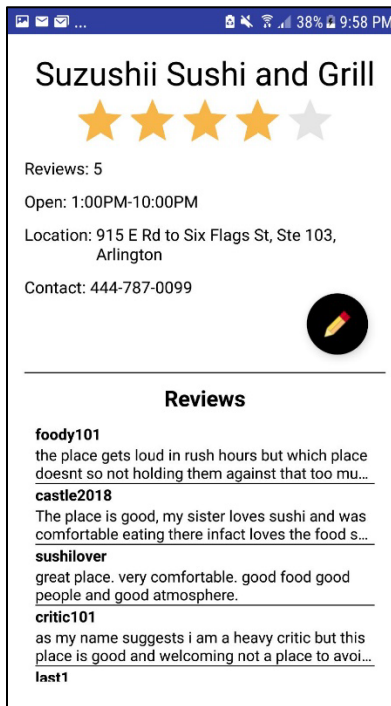

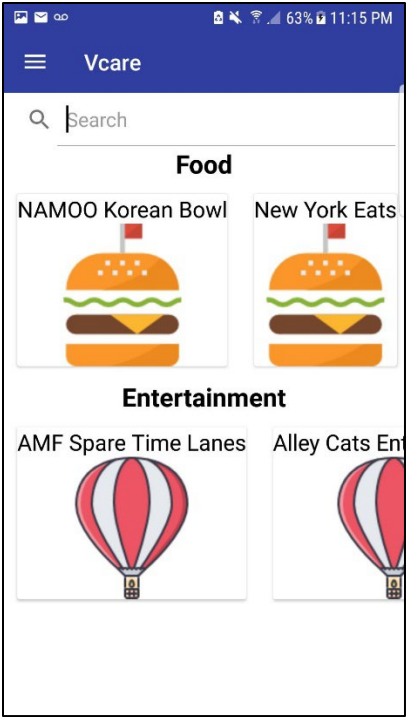Figure 3.7: Vcare Restaurant Information

Figure 3.8: Vcare Search Results Page

CHAPTER 4

CONCLUSION

Autism Spectrum Disorder is a developmental delay, and it manifests as a chronic condition. Following the Social Model of Disability, we must accept individuals with autism as an important part of society and be as accommodative of them as possible. It is undeniable that people with autism deserve to have a pleasant and entertaining experience with their families, just like others do. With Vcare, a pioneering idea to address the challenges faced by individuals with Sensory Integration Disorder (SID, a kind of Autism Spectrum Disorder), we hope to make enjoyment easier and more convenient for them. The other advantage is that it is also a good way to raise awareness among the business owners to make their places more "autism-friendly."

Simply put, a user interface is the front of an application that the user interacts with. With that said, it is essential that the user interface designers make it as user friendly as possible to enhance the user experience (UX). An accessible user interface translates into a product that can be used by a wide variety of people. It means creating perceivable, operable, robust, and understandable products that users with disabilities, including visual, auditory, physical, speech, cognitive, and neurological disabilities, as well as people with situational limitations, for instance having one's eyes on the road while navigating the way on a phone, can conveniently utilize. Accessibility is all about people. Consequently, an inaccessible design can mean the difference between the failure and success of a product in today's ultra-competitive market.

4.1 Vcare: Functionalities Planned for Future

While Vcare is a minimally viable product at this point, in the future, we plan to incorporate the following:

- Images to give the users a better idea of how a place looks. Business owners (applies to non-business places too) can add their places on the application. This screen will give the users an option to add JPG images of the places. This will enhance user experience and give the users a chance to view snapshots of a potential place of outing from the convenience of their home.
- A feature that gives users an option to look for places that are within a certain radius. This feature will let users select a certain radius and will display the places that are within that radius. This option will provide users with a chance to locate places near their homes.
- A feature that lets users look for places that have certain ratings. Using this feature, we will be adding a filter for users to select a particular rating. This feature will display the relevant places for users to choose from.
- A feature that lets users look for places based on a high rating in certain attributes of the place. Along with a general rating for a place, the application also has ratings for attributes of the place, namely lighting, noise, ambience, and staff quality. Like the previous feature, this new feature would allow users to filter places based on these attributes.

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BIOGRAPHICAL INFORMATION

Vaishanavi Mirapurkar was born in Mumbai, India, on May 29, 1996, and graduated high school in May 2014. She moved to the United States of America in the fall of 2014 to pursue an Honors Bachelor of Science in Software Engineering from the University of Texas at Arlington. Her interests in the field of Software Engineering are numerous and include web application development (frontend and backend) and data science. She is fascinated by the idea of combining computer science with business to automate functions. Following graduation, she plans to work at PricewaterhouseCoopers, and then she plans to attend graduate school.