TABLE IDENTIFICATION AND INTERPRETATION MODEL WITHIN THE SYSTEM

Project Id: 2022-024

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(Specialization in Software Engineering)

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The dissertation was submitted in partial fulfilment of the requirements for the B.Sc. Special Honors degree in Information Technology (Specialization in Software Engineering)

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DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Dilitha Ranjuna G.P.	IT19156484	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor   Date

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(Dr. Anuradha Jayakody)

ABSTRACT

An analysis of the population across the globe demonstrates that there is a sizeable proportion of people who are affected by various impairments. ([1] In addition, a "print difficulty" can refer to a learning impairment, a visual handicap, or a physical disability. Those who have this handicap must contend with a number of challenges.

Even though people who are blind or visually impaired may read using braille, not all written materials and texts are made available to them. Because certain topics, such graphs, tables, and mathematical equations, are incapable of being translated into braille, a third party must be utilized in these cases.

In order to recognize texts, words, tables, diagrams, and mathematical computations, we built this digital assistant application with such capabilities.

This program contains everything you require in a one area and comes with an instructional guide that is simple to follow, which means that it will be simple to use.

Additionally, it will analyze the table data, determine which equations are there, and provide the client who is unable to read printed material with accurate information through speech output.

As a result, the focus of this research is on the interpretation of tabular data from printed materials and the provision of better solutions for enabling those who are visually impaired to comprehend tables and other required data that are contained in printed documents.

The fundamental goal of the development of this tool is to construct an algorithm that can explain complex mathematical computations as well as text, graphs, and tables to the user. This will be accomplished through the development of this tool.

Keywords: Print Disability, Tabular Data, digital design tool

DEDICATION

This research is dedicated to all people with vision impairments and print disabilities. This program was created primarily to assist them and those who have trouble reading and writing. Furthermore, they are unable to do their task without the aid of a second person who will serve as their eye. Additionally, there isn't a program or application that the general public may use to read and convert pictures, tables, diagrams, and mathematical equations into braille. Therefore, we developed this tool to assist them, and they may use it to do their own difficult task on their own.

ACKNOWLEDGEMENT

First of all, I sincerely appreciate all of Dr. Anuradha Jayakody supervisor for his assistance, encouragement, and support in making our study fruitful and beneficial. Every inch of our road was walked with us by him. His enthusiasm for assistive technology also contributed to its success. He was well-known for creating technological items and doing research to aid those with disabilities. He led us in a thought-provoking discussion regarding current research methods and emerging technology. Above all, his connections with influential people in the sector help us improve our research via their knowledge and point us in the proper path for competitiveness by using their networks. Without his leadership, we would not have succeeded.

Finally, I would like to thank our co-supervisor, Ms. Shashika Lokuliyana, for initiating, providing external supervision for, and directing this research project throughout.

Finally, I would like to express my gratitude once again to Dr. Anuradha Jayakody and Mrs. Shashika Lokuliyana for their support and help in making this a success.

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1. INTRODUCTION

A sizable portion of the population in this planet suffers from disabilities, and "printing disability" is one of them. A visual, bodily, or learning impairment that makes it difficult for a person to read print items is referred to as having a print disability. This can include those who are blind, dyslexic, or have motor impairments and limited vision.
Since Louis Braille, who was born blind, invented the Braille Method in 1824, people who are visually handicapped have been using it. This approach enables blind persons to read a document, but it has limitations because it can only be used to manually read physical copies of certain types of documents and text files. Additionally, certain handicapped people can find this approach ineffective. Because the braille system cannot represent some content, such as charts, graphs, tables, figures, and math or algebraic equations, these people must seek the help of a third party. This makes it possible for sensitive, private, or legal information to get into the wrong hands and become insecure. additionally, the conventional, time-consuming, and slow procedures now in use. Some book publishers currently offer digital versions of their publications, and colleges may even offer digital textbooks. The issue of being unable to identify figures remains.

1.1. Background & Literature Survey

For the creation of public health policy, estimates of the prevalence of blindness and vision impairment on a worldwide and regional scale are essential. We attempted to give global blindness and vision impairment numbers, trends, and projections. The age-standardized prevalence of blindness and visual impairment is decreasing, but the world's population is growing and ageing, resulting in a significant increase in the number of persons afflicted. These findings, together with a significant contribution from uncorrected presbyopia, underline the importance of increasing vision impairment alleviation efforts at all levels. Based on world population statistics for 1990, the first estimate of the global data on blindness was released in 1995 . This estimate was expanded to account for changes in demographics and the global population between 1996 and 2020. In response to these numbers, the Global Initiative for the Elimination of Avoidable Blindness, often known as "VISION 2020: the Right to Sight," was established in 1999. Since the 1995 release of the Global Data on Blindness, population-based studies on the prevalence of blindness and visual impairment have been carried out in practically all WHO regions. The WHO's streamlined population-based assessment approach for visual impairment and causes was utilized in the majority of these surveys, with some modifications made in a instance. Additionally, the findings of these studies offer broad information on the prevalence of visual impairment in persons aged 50 and older. Numerous recent research has targeted older individuals explicitly in addition to the RACSS surveys. The availability of new data has enabled the update of regional and global estimates of visual impairment and its causes.

Table 1.1 -Blindness prevalence by age group and the number of blind persons.

WHO subregion	Prevalence of blindness (%)			No. of blind persons (millions)		
	<15 years of age	15–49 years	≥50 years	<15 years of age	15–49 years	≥50 years
Afr-D	0.124	0.2	9	0.191	0.332	3.124
Afr-E	0.124	0.2	9	0.196	0.336	3.110
Amr-A	0.03	0.1	0.4	0.021	0.114	0.560
Amr-B	0.062	0.15	1.3	0.085	0.369	0.937
Amr-D	0.062	0.2	2.6	0.017	0.075	0.241
Emr-B	0.08	0.15	5.6	0.039	0.117	0.920
Emr-D	0.08	0.2	7	0.043	0.146	1.217
Eur-A	0.03	0.1	0.5	0.021	0.204	0.713
Eur-B1	0.051	0.15	1.2	0.020	0.136	0.462
Eur-B2	0.051	0.15	1.3	0.009	0.043	0.090
Eur-C	0.051	0.15	1.2	0.021	0.192	0.822
Sear-B	0.083	0.15	6.3	0.102	0.332	3.779
Sear-D	0.08	0.2	3.4	0.390	1.423	6.530
Wpr-A	0.03	0.1	0.6	0.007	0.070	0.315
Wpr-B1	0.05	0.15	2.3	0.162	1.166	6.404
Wpr-B2	0.083	0.15	5.6	0.041	0.120	1.069
Wpr-B3	0.083	0.15	2.2	0.002	0.006	0.017
World				**1.368**	**5.181**	**30.308**

The prevalence of blindness (Table 1.1) was calculated for the 17 WHO epidemiological sub regions using a model based on data from the 55 countries listed in Table 1 and from additional sources, as explained below. The model calculated the prevalence of blindness for three age groups: children under the age of 15, people between the ages of 15 and 49, and adults 50 and over. The rates of childhood blindness were estimated for each of the 17 WHO sub regions. This was accomplished using information from two papers that had grouped countries using standards akin to those found in the WHO's classification of sub regions. According to the mortality stratum, the prevalence of blindness in adults aged 15 to 49 were calculated for each sub region as follows: 0.1% for sub regions with mortality stratum A; 0.15% for sub regions with mortality stratum B or C; and 0.2% for sub regions with mortality stratum D or E. These estimations were based on data from the studies that were chosen as well as interpolations that were previously made from data on childhood blindness and data for participants who were 50 years of age and older. Population-based surveys were used to determine the prevalence for people aged 50 and over. In order to account for the sex and age makeup of the sample and/or the survey area, prevalence estimated for the age group as a whole were employed. Prevalence was extrapolated for regions for which there were no data from regions with similar access to eye care, epidemiology of eye illnesses, and services for which data were available. National census data were used to estimate population size in various locations, and the population structure was established using the country's UN estimate. In other cases, the population as a whole was analyzed using data from a single region that had been assumed to be typical of the entire nation.

The prevalence of blindness was extrapolated for nations for which recent epidemiological data were unavailable from data gathered in nations within the same sub region or from neighboring sub regions that share comparable epidemiological, socioeconomic, ecological, and eye care service characteristics. A sub region's countries' total number of blind individuals were estimated using age-group-specific prevalence. Following that, the sub regional prevalence of blindness was determined using this figure. Since none of the countries in the sub region Eur-C had any suitable population-based surveys, this method could not be used there. Instead, prevalence was assumed to be the same as in the sub region EurB1, which also included low vision. As explained for blindness, prevalence of low vision across all ages were computed. It was estimated the ratio of reduced eyesight to blindness. Because ratios for the sub regions Eur-C and Wpr-B1 could not be determined due to a lack of data, the mean value of the ratios from 15 sub regions was applied to these regions. Limitations The accuracy of the estimations is constrained by the fact that the model of visual impairment offered is based on both population-based surveys and assumptions. One or more of the following factors can lead to potential causes of error: Despite the adoption of the standard WHO procedure, there is variation in the survey methodologies for data collecting and ophthalmic examinations; extrapolations of data from various regions of a country to provide national estimates; The extrapolation of prevalence found in studies conducted over the previous five to ten years to current populations, the use of correction factors to determine the prevalence of best-corrected visual acuity in studies that used non-WHO definitions, the use of assumptions to obtain estimates of blindness for the age range of 15 to 49 years, the extrapolation of data for nations and regions for which there are no data available; and • potentially non-standard diagnoses, testing procedures, and comorbidity definitions for eye illnesses. The studies were chosen in accordance with the criteria outlined in Methods in order to reduce the bias brought on by the constraints mentioned above. According to data internally obtained by prevention of blindness programs during the course of their operations around the world, extrapolations between countries were developed.

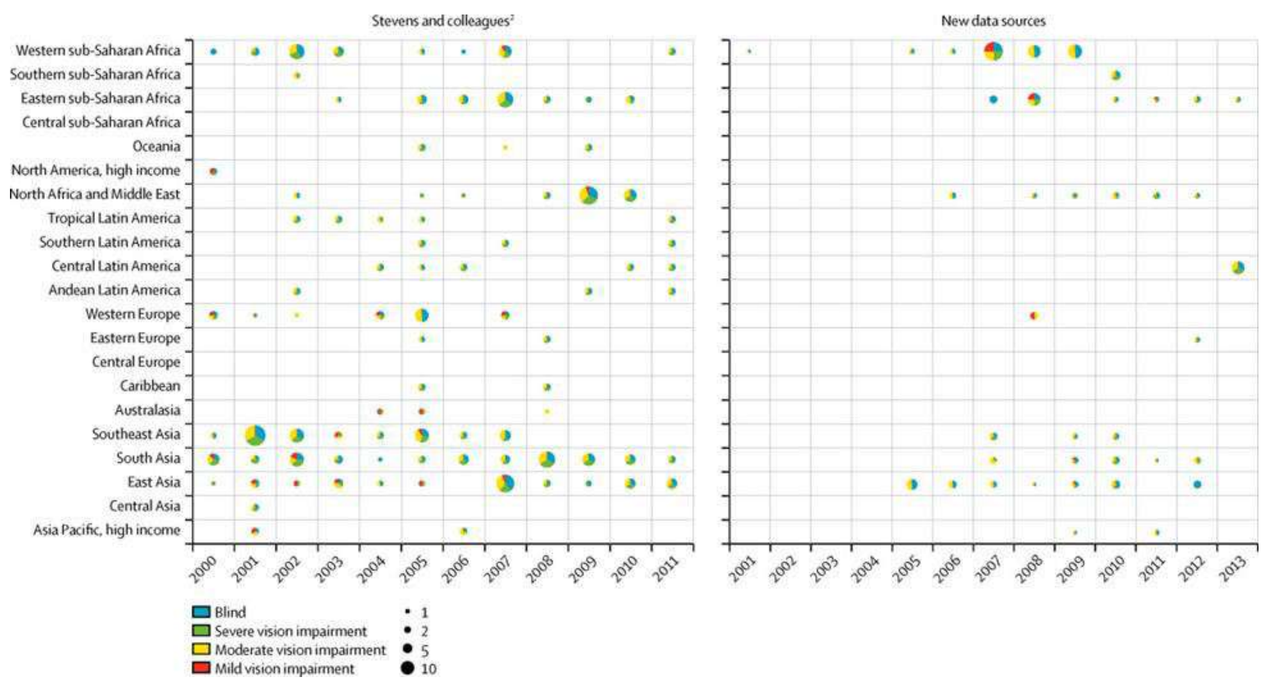


Figure 1.1 - Population - based prevalence studies of blindness and vision impairment in the global vision data base.

Recent decades have seen the introduction of new technological ways for detecting images in printed materials and content. The problem of how to recognize graphs, charts, and mathematical equations remains unsolved. Therefore, we are providing this digital design tool as a solution to detect paragraphs, words, tables, diagrams, and mathematical computations. This tool is user-friendly and has everything you need in one convenient location, making it simple to use. Plus, this program will assess the information in the tables, identify the equations, and provide the print-impaired user with the precise information via voice assistance.

This tool's main objective is to develop an algorithm that will help users understand text, graphs, and tables as well as challenging mathematical calculations.

Before we talk about our new solutions, it is crucial to examine the current scenario. Many people at least get to engage with those who experience such limitations, even if they don't themselves have a print handicap. Therefore, in order to acquire data from the community, we ran an online survey.

First, we found that most people have come into contact with visually challenged people. We were able to get some crucial information through our survey. Despite the fact that many respondents mentioned the Braille method as a well-known tool, when asked about its effectiveness in reading various documents, many people responded that it couldn't be utilized in all circumstances.

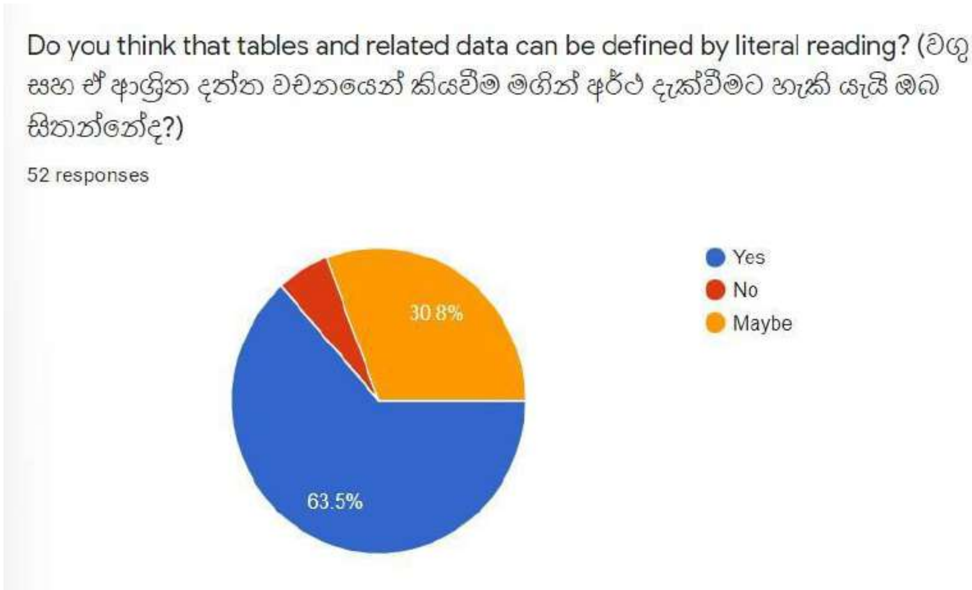
The effectiveness of it is unknown to a sizable portion of the population. We have deduced from the foregoing justifications that Braille cannot be employed as a way to recognize mathematical equations, graphs, diagrams, and so on. Since Braille cannot be used to read specialized information like tables, charts, etc., some individuals are unaware of this or have never heard the idea. We can see, however, that the Braille method is not always effective because the majority of respondents responded.

Other tools cited by respondents included "Orbit Reader" and "Be my eyes."

Evidently, most participants felt that those who are blind or visually impaired may require assistance using a mobile device since they are unable to see the interface. As a result, we can use our tool to implement such a guiding process.

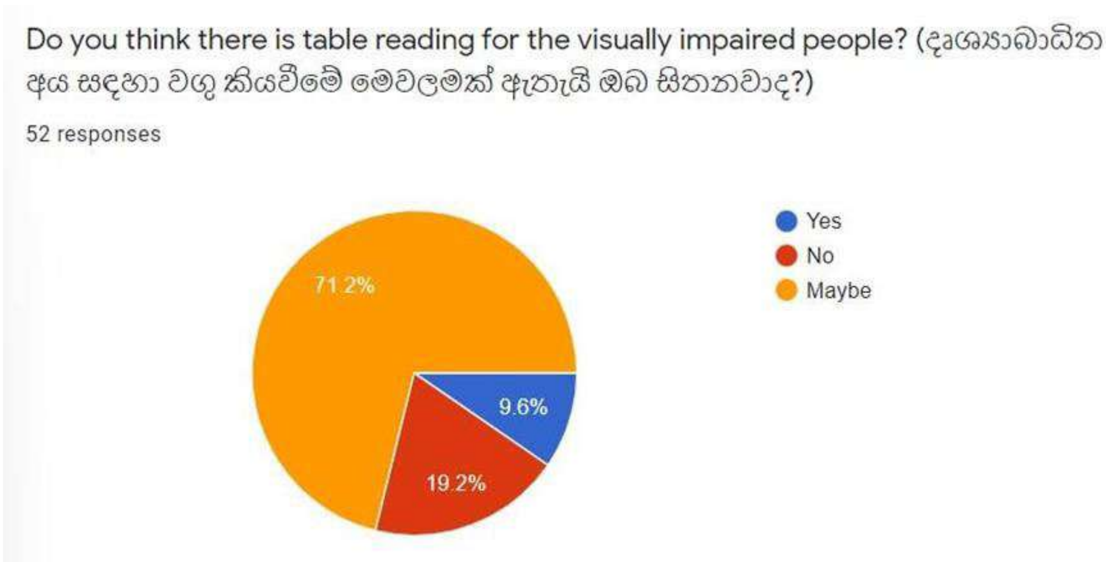
We were able to deduce from the poll that the optimal way for those with visual impairments to access the process is through voice recognition of input. Also, a good deal of text magnification through zooming or changing font size was considered, as well as a gesture system. When asked if literal reading might be used to convey data in tables and charts, many people said that it was a viable option.

Figure 1.2- Summary of responses for what people think that table reading process.



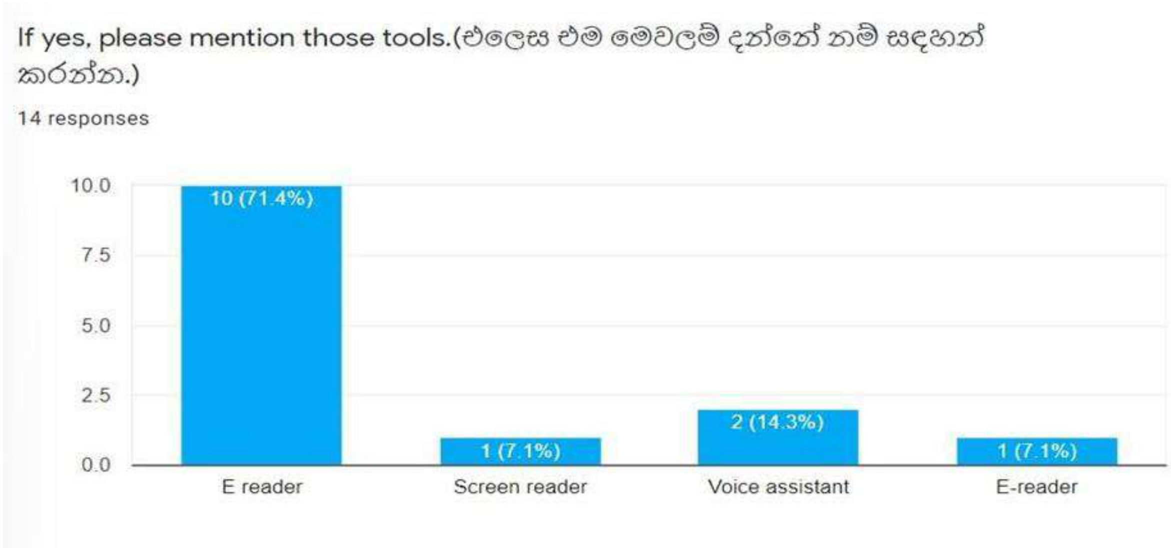
A minority, though, were hesitant to use this approach to convey and describe the precise facts in such charts, graphs, etc. Regarding the subject of whether people are aware of such tools for reading tables , we found that many people are not familiar with this type of tool. Only 9.6% of respondents said that they were aware of such a tool, highlighting the need for developing a new approach for those who are blind or visually impaired.

Figure 1.3- Summary of responses for what people think that there is a tool for table reading process



E-readers were noted by a large number of respondents. Only around 20% of those polled provided voice assistant and screen reader responses.

Figure 1.4- Summary of responses about known tools.



The majority of respondents who were asked whether a tool to read tables was necessary agreed that a way for persons who are blind to recognize this information was required, demonstrating the necessity of putting this new system into place. We asked our respondents for their thoughts on the criteria that should be present in such a tool. Many people mentioned voice help, but a decent number also noted screen readers.

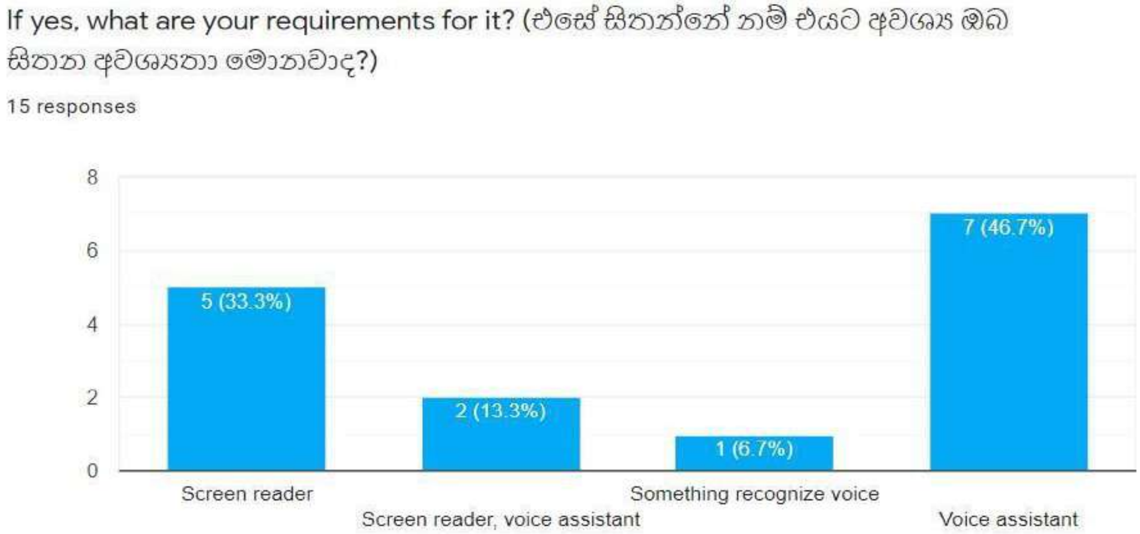


Figure 1.5 - Responses about what are the requirements needed for a tool.

Therefore, we can draw the conclusion that introducing a new instrument into the social fabric of the present is crucial. Even though the technology is fairly advanced, it is a gaping area that we have not prioritized. It is crucial at this time to pay attention to the requirements of those who are visually impaired. Additionally, the data indicates that screen readers, gestures, and voice assistants are all available. Their experience can be much improved by a relatively small change, such as better user instruction when using such a technology.

1.2. Research Gap

Age inevitably plays a role in the majority of blindness cases. Even though cataract surgery is now more widely available in many parts of the world, cataract is still the main cause of blindness globally, accounting for about half of all instances even though it is not a major cause in developed nations. Cataract is the primary cause of low vision in all subregions, making it even more prominent as a contributing factor. The surveys show that age-related macular degeneration is the third most common cause of blindness, with glaucoma ranking second globally and in the majority of areas. Trachoma, various corneal opacities, infantile blindness, and diabetic retinopathy all have a similar incidence (about all 4-5%). It is interesting that, in contrast to past estimations, the significance of trachoma as a cause of blindness has reduced. Maturity level macular degeneration is becoming more important as a cause of blindness, as would be predicted given the growing number of individuals over the age of 70; it is the top cause of blindness in industrialized countries and the third leading cause worldwide. Trachoma may be the primary cause of corneal blindness in locations where this ailment is known to be endemic. In other locations, it is primarily caused by trauma and a lack of vitamin A.

- Data processing and identification

  In order to find information on distance vision impairment, we hired York Health Economics Consortium to conduct a systematic review of population-based studies published between January 1, 1980, and July 8, 2014, as well as unpublished data that members of the Vision Loss Expert Group who met for the 2010 GBD study had discovered. Specifically, studies that were included in the Global Vision Database had to meet the following criteria. Measurements of the reported prevalence of blindness, visual impairment, or both were made using cross-sectional random sample surveys of representative people of any age in a given nation or region. Studies utilizing blindness registries, hospital or clinic case series, and interview studies with self-reported visual status were excluded.

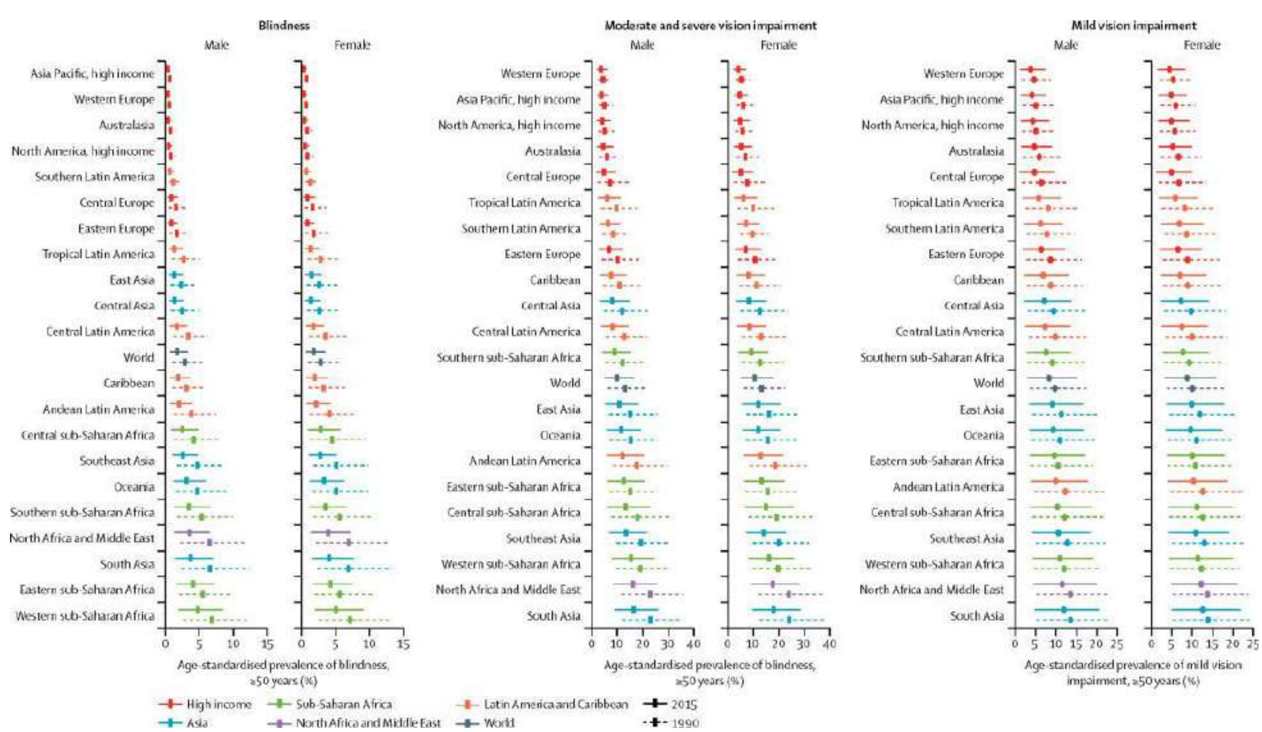
- Evaluation of data that are age-specific

The age-specific prevalence of vision impairment for 5-year age intervals serves as the foundation of our statistical model (e.g., 20–24-year-olds). When studies reported the prevalence of vision impairment across a wider age range, such as people over 50 or all ages, we translated these to 5-year age groups in the manner described below. Using meta-analysis to include papers that provided prevalence for the smaller age groups, we fitted two universal age patterns, one for the prevalence of blindness and one for the prevalence of moderate and severe vision impairment. We then used the aggregated dataset for a large age range and the fitted age patterns to compute prevalence over 5-year age intervals.

- Data on visual impairments are analysed statistically

With one model for the prevalence of blindness and one model for the prevalence of moderate and severe vision impairment, we fitted two hierarchical Bayesian logistic regressions to estimate the prevalence of visual impairment over time, by age group, sex, and country. When available, study data from the same nation were used to inform country-specific estimates of vision impairment, as were study data from other countries in the same region or the same year, using fully Bayesian statistical inference.

Figure 1.6:Age standardised prevalence of blindness, moderate and severe vision



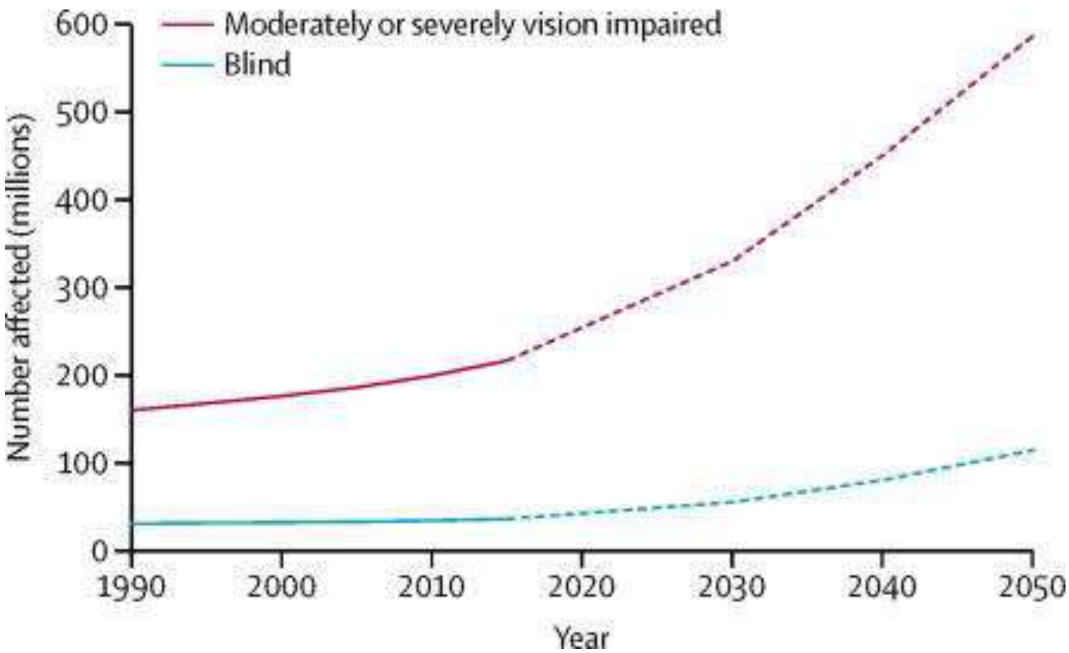
impairment.

Blindness affected more women than men. Female prevalence of blindness was higher than male prevalence in all globe areas after correcting for age, with the limitations of residual confounding brought on by women's longer survival and consequent overrepresentation in extremely high age groups.

For blindness, moderate and severe vision impairment, and mild vision impairment, the global female to male age-standardised prevalence ratio among adults was 105, 107, and 105, respectively. The total number of blind persons increased from 30.6 million in 1990 to 36.0 million in 2015, an increase of 17.9%. The three elements that contributed to this increase were the percentage change brought on by population growth (38%) after accounting for population ageing (34%) and the change in age-specific prevalence (36%) From 159.9 million to 216.6 million (35%) more people developed moderate or severe visual impairment, and the proportions of each of these three factors that contributed to this rise or decline were identical (population growth: 38.4%; population aging: 29.2%; and age-specific prevalence: 24.2%).This global tendency is explained in more depth. For blindness (60%, 77%, and 73%, respectively) and moderate and severe vision impairment (61%, 67%, and 39%, respectively; data not shown), we additionally looked at changes for each of these three categories between 2010 and 2015.Out of a total global population of 7.75 billion, we predicted that 38.5 million (80% UI 13.2-70.9), 0 50%, and 80% UI 0 17-0 92) people would be blind in 2020, and 114.6% (23.39-229.0; 11.8 percent, 0 24-236) people would be blind in 2050. The predictions for people with moderate and severe vision impairment were 237 million (101 million-399 million; 3 percent, 1 31-5 15) in 2020 and 587 million (155 million-1093 eight; 6 percent, 1 61-11 29) in 2050. Figure 1.7 displays estimates of the total population who will be blind or have moderate to severe visual impairment for each decade between

2020 and 50.

Figure 1.7 : Global Trends and predictions of number of people who are blindness from 1990 – 2050.



Approximately 36 million people were estimated to be blind in 2015 (visual acuity of less than 3/60), 217 million had moderate to severe vision impairment (visual acuity of less than 6/18 but 3/60 or better), and 188 million had mild vision impairment (visual acuity of less than 6/12 but 6/18 or better). While the age-standardised prevalence of blindness was highest in western sub-Saharan Africa, eastern sub-Saharan Africa, and south Asia, the majority of those who were blind or had moderate to severe vision impairment lived in south Asia, east Asia, and southeast Asia. Although the lack of presbyopia data in 2010 prohibited a meaningful examination of the condition's prevalence, we were nevertheless able to estimate that 666 7 million persons over the age of 50 and 1 09 billion people over the age of 35 suffer from uncorrected presbyopia-related near vision impairment. As a result of the availability of more recent published data for this category, we are now able to present more precise regional estimates for this disability, which has an impact on quality of life. In 2010, we were only able to present a global estimate for mild vision impairment due to the lack of available data sources.

The results of a literature research make it abundantly clear that many studies and applications have been put into practice to provide assistance to people who have difficulties printing. On the other hand, a significant amount of inquiry was carried out in order to locate the text. In addition, there are a few applications of this that occur frequently. Every visually impaired person has the right to hear a volunteer voice narrate all that they encounter. This program is known by its name, which is "Be my eyes" [7]. On the other hand, they are unable of reading legal documents or other private documents by themselves. They have no choice except to seek assistance from another party. They see it as a solution that involves some element of risk. When it comes to the braille language, there are just a few things that can be converted, and changing a table or an arithmetic problem to braille is tough. Reading a text written in braille is a challenging activity. As a direct consequence of this, the specific application in question requires little effort to put into effect.

During this time period, advances in technology have been made to make the human condition more bearable on a day-to-day basis. Apps can also be used by humans to input images or documents and have them converted to voice; this can be done by scanning them. As I've already mentioned, there is currently no app available for people who are unable to read printed material. As a result of this, the research project that we established is called "Be My Eyes." And in spite of the fact that there are not many programs available, we found that using them can be somewhat challenging for a person who is totally blind. This is due to the fact that there are many different analyzing components and variations on the process of scanning a printed page to convert it to a voice output. Some of them allowed users to submit components, including images, which would then be transformed into vocal output. This strategy presents a number of challenges for a person who is blind. The "Be my eyes" program, on the other hand, may be navigated without any difficulty even by a blind person.

Because it is so easy to use, users are able to gain a fast impression of what they have scanned, which allows them to read a printed document in a matter of steps using this software. In addition to scanning texts, tables, or images, the software can also scan photographs. This software has a voiceover that will guide you through the process from the very beginning to the very end. Due to the fact that it is simple to use, the user can protect their privacy by preventing other people from viewing their sensitive or legal documents on their behalf. A person who is blind can really benefit from this opportunity.

Table detection and extraction model called "TableNet" was proposed by S.S. Paliwal et al.[8] (Research A). TableNet is a deep learning model for end-to-end table detection and tabular data extraction from scanned document pictures. The table identification and semantic interpretation system that Namysl, M. et al. [9] (Research B) developed was supposed to be able to recognize the most common table formats. Hashmi, K. A. et al.[10] (Research C) released their investigation of using deep neural networks to recognize tables in document pictures.

Table 1.2: Research Gap Table extraction and interpretation with existing systems.

	Research A	Research B	Research C	Our Solution
Assist documents scanning	No	No	No	Yes
Detect tables in the document	Yes	Yes	Yes	Yes
Detect table structure of the table	Yes	Yes	Yes	Yes
Realtime scanning method	No	No	No	Yes
Detect text and data in the table	No	Yes	No	Yes
Explain the data in the table in a simple way	No	No	No	Yes
Using gestures and voice recognition for navigate menus	No	No	No	Yes

With this developed solution can be applied to our needful people and we can implement this with very innovative and creative way and will be a fully functional document detection and summarizing model system.

1.3. Research Problem

In the current time, technological development is occurring at a dizzying speed. Everyone is needed to educate themselves and be up to date on developments in order to be a helpful and connected member of the community. People who are blind or visually impaired fall behind in this field due to the inherent constraints they have. [11] Technology needs to be modified in order to make it simpler for persons in these situations to participate as active members of the communities in which they live. Due to the fact that having access to new information is both a trending fact and a necessity, the majority of blind individuals, in addition to persons who are illiterate, face a substantial obstacle as a direct result of this fact. Converting everything we see into braille is a tremendous task, and as a result, persons who are blind, as well as people who are unable to read printed text, have many difficulties understanding the essential ideas that are presented. There is a few software that were designed at the research level to read text and paragraphs, but there is no mechanism to transform photos, mathematical equations, graphs, or tables into braille. Therefore, they are in need of assistance from a third party.

A person who is visually impaired will frequently find that those around them, be they strangers, friends, or family members, are pleased to be of assistance. When someone acts in this manner, they almost always make the assumption that the blind or low-vision person needs assistance, even if this is not the case. It is possible for a blind person to finish a regular task in the allotted amount of time, but this does not mean that they are unable to do so. It's possible that rushing in to aid blind people without first asking them or being asked could make them feel more helpless and less independent. In addition, if a person who is visually impaired is not given the opportunity to do a task on their own, they will not be able to learn how to do it on their own. [12] When it comes to reading legal documents, however, this presents a new challenge because it invades the privacy of the individuals who are affected in some way.

The use of technology and mobile devices, such as smartphones, has evolved into an integral part of modern life. It is anticipated that there will be nine billion people using smartphones worldwide by the year 2022. People's habits of learning have been significantly disrupted as a direct result of the proliferation of mobile phone use. Studies have shown that one in three people who own smartphones put their gadgets to use for educational reasons. [13] People who are blind or have other visual impairments continue to have difficulty using smartphones, despite the widespread adoption of these devices. In order for this community to participate in its full capacity, it is necessary to find solutions to a variety of difficult accessibility problems. Accessibility issues have emerged as a prominent area of study in recent years, which has led to the development of thousands of apps for mobile devices that can assist people who have visual impairments. Some examples of these apps include screen readers, voiceover services, talkback services, and navigators.

The number of mobile applications that are accessible to those who are visually impaired has been steadily growing over time. There is a wide selection of software designed specifically for use on mobile devices that can assist people with disabilities. Text, phone numbers, contacts, short message service (SMS), alarms, calendars, email, and the web can all be easily converted to braille; however, converting photographs, graphs, and diagrams is more difficult. In this particular instance, however, we have focused our efforts on developing a new digital design tool that is capable of describing photographs, graphs, tables, and mathematical equations and solving them by using this interface. As a result, the lives of blind people have become significantly simpler.

These applications and configurations were developed especially for individuals who are blind or have another visual impairment. In addition, there is a user-friendly guiding system integrated, in addition to a multitude of other capabilities. People who have trouble seeing will undoubtedly find this to be an exciting new experience, as it will provide them the opportunity to be differently abled.

2. RESEARCH OBJECTIVES

2.1. Main Objective

The primary motivation for the creation of this software was to provide assistance to individuals who struggle with reading and writing. In addition to this, there is no way for them to complete their task without recruiting the assistance of a third party who will serve as their eye. In addition, there is no application or tool that is readily available to the general public that can read pictures, tables, diagrams, or mathematical equations and convert them to braille.

As a consequence of this, our goal in developing this digital design tool was to provide assistance to persons who are unable to print in overcoming the difficulties they face.

The primary functions of this program are the scanning of tables and the automatic translation of the resulting text into spoken language by means of an engine. to the extent that the user may quickly obtain a summary of the scenario just by listening to the audio, the situation is described as a understandable explanation.

2.2. Specific Objectives

In addition to the overall purpose of this execution, there are a few more aims that are more particular in nature.

- If the user scans the table, they will be able to recognize the table heading, as well as the rows and columns of the table.
- After reading the table, it will automatically convert the text to audio using a speech engine. The user will have the option to listen to the audio and gain a fundamental comprehension of what it is because this tool provides a brief description of the table. This opportunity will become available once the conversion has been completed.
- The user is provided with assistance on how to use this tool to scan the graph, diagram, or mathematical problem by virtue of the fact that it is a user-friendly guide. Following the completion of the scanning procedure, it will make use of a text-to-speech engine to transform the text file into an audio file that the user can then listen to. As a consequence of this, the end user is provided with a general comprehension of the entire process in a manner that consists of only a few easy stages.

3. METHODOLOGY

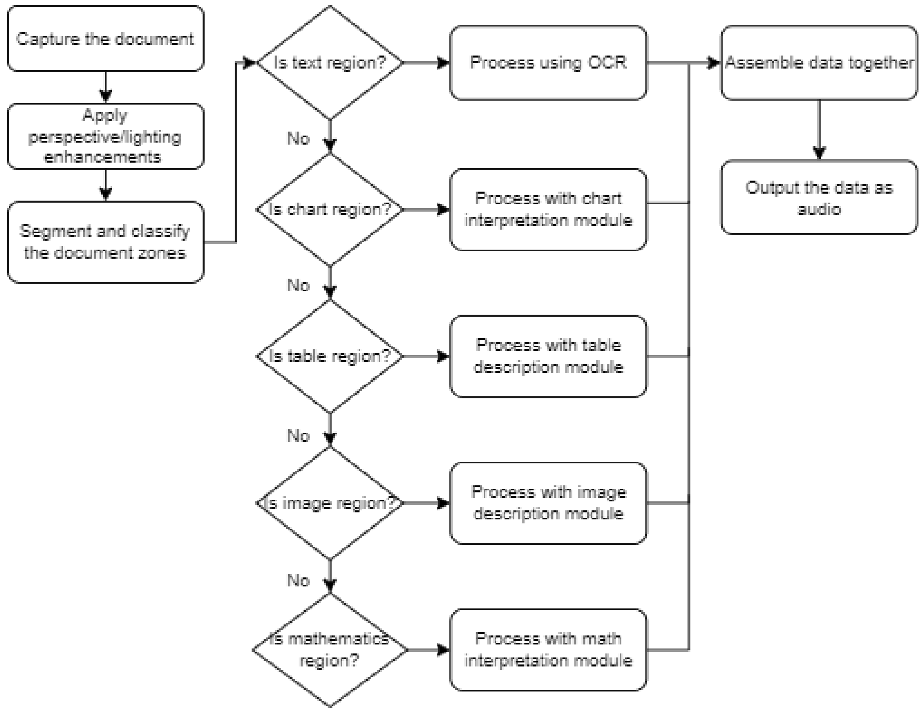
3.1. Methodology

In the very beginning of our research, we found there is a major issue with the blind people as well as the people who are with print disabilities having lot of troubles that when they received a physical document or other relevant documents, they have to assist another person, or they can’t even read that document. In this research we produced a solution to read this physical document in a smart way. For that we have implemented a mobile app to read physical documents. In this part, we are describing about the application and the components of this application. Basically, at present time blind people also using a smart phone to make their task very easy manner and they are using special applications that developed with special features that blind users can use. In here user can directed to the application and the system will assist the user to scan the document and system will giving a proper explanation about the document content in an audio output. When user having the physical document, the mobile application will be identifying the document by an object detection method, and it will identify the borders of the page and after that it will process all the contents of the page.

3.1.1. System Architecture

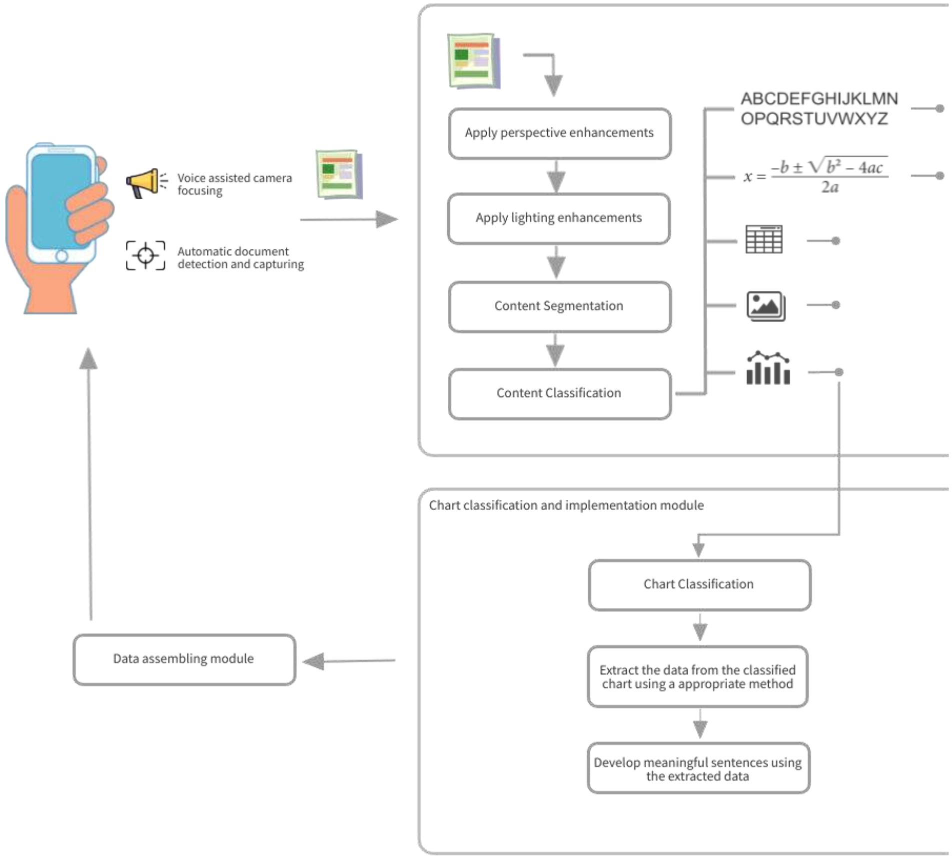
The key components of the overall system are a mobile application and a backend Django server. Since mobile processors are unable to handle high workloads like CNNs and image processing methods, document capturing and voice assistance are implemented in mobile applications while compute intensive image processing components are located on the backend server.

Figure 3.1 : Overall data flow of the system



As seen in figure the user will first use the help to capture the document from the mobile device. Next, the backend will receive the picture of the document that was collected for processing. The document will be divided into many areas in the backend, and the regions will then be categorized. The split pieces will then be forwarded to the appropriate algorithms for interpretation. The author will use the chart interpretation component in this research component as well to discuss discovered charts in the paper. First, a chart classification model classifies charts into various categories in the chart interpretation component (Horizon bar, Vertical bar, Pie, Line). Then, using the appropriate techniques, pertinent data will be collected from the categorized chart image.

Figure 3.2 : The method of categorizing optical patterns



The method of categorizing optical patterns present in a digital image is known as optical character recognition (OCR). Segmentation, feature extraction, and classification are used to recognize characters. The fundamental OCR concepts presented in this chapter will help you better grasp the text. An overview of the background and development of OCR systems opens the chapter. Afterwards, the various OCR system methodologies, including optical scanning, location segmentation, pre-processing, segmentation, representation, feature extraction, training and recognition, and post-processing, will be discussed. The various applications of OCR systems are then emphasized, followed by a discussion of the OCR systems' present state. Finally, a presentation of the OCR systems' future is made. The field of pattern recognition includes character recognition as a subset.

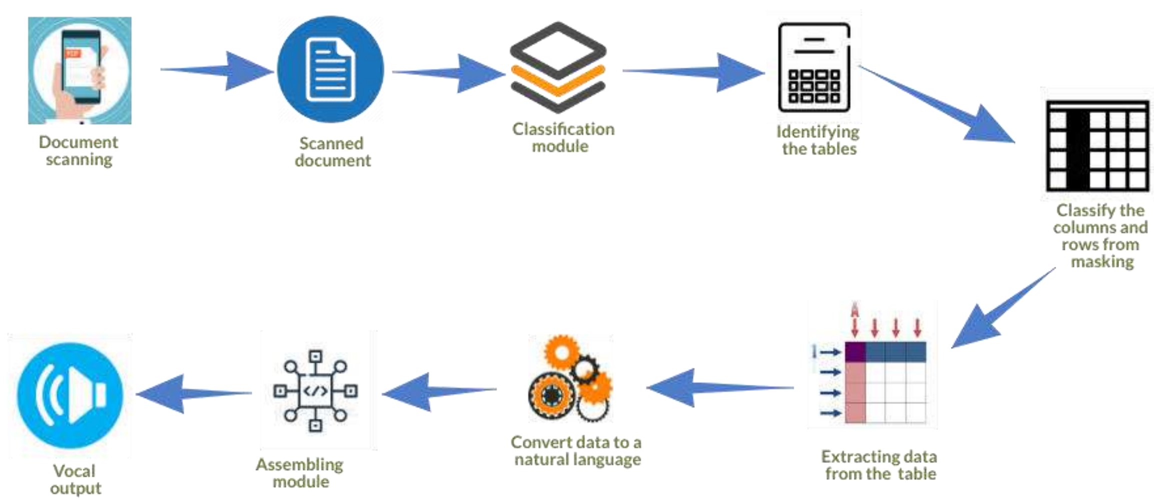
OCR draws on a number of principles and methods from pattern recognition and image processing. Character recognition, on the other hand, gave pattern recognition and image analysis the impetus they needed to become established branches of science and engineering. Writing, which was the most natural means of collecting, storing, and sending knowledge for centuries, today functions not only for human-to-human communication but also for human-to-machine communication. The intensive research effort in the field of OCR was motivated not only by the challenge of simulating human reading, but also by the fact that it provides efficient applications such as automatic processing of large amounts of paper, data transfer into machines, and web interface to paper documents.

Machines replicating human functions and making the machine execute ordinary tasks like reading is an ancient fantasy. C.R. Carey of Boston, Massachusetts devised the retina scanner in 1870, which was an image transmission system based on a mosaic of photocells. Early versions required training with photos of each character and only worked on one font at a time. OCR may be traced back to 1900, when Russian scientist Turing attempted to design an assistance for the visually impaired. With the introduction of digital computers in the mid-1940s, the first character recognizers developed. The early work on automatic character recognition focused on either machine printed text or a small set of well-distinguished handwritten text or symbols. During this time period, machine printed OCR systems often used template matching, in which a picture is compared to a library of images. Low level image processing techniques were employed on the binary image to extract feature vectors, which were then input to statistical classifiers for handwritten text. Successful but limited algorithms have largely been built for Latin characters and numerals. However, investigations on Japanese, Chinese, Hebrew, Indian, Cyrillic, Greek, and Arabic characters and numerals in both machine-printed and handwritten contexts were also initiated. Nipkow invented the sequential scanner two decades later, which was a significant development for both modern television and reading machines. Several attempts were made during the first few decades of the nineteenth century to construct devices to aid the blind through trials with

OCR.

The contemporary version of OCR, however, did not arrive until the mid-1940s, when the digital computer was introduced. The motivation for developing OCR systems began when people considered various business and commercial uses. The primary idea behind automatic pattern recognition is to first teach the machine which types of patterns may emerge and what they look like. Letters, numerals, and special symbols such as commas, question marks, and other characters are used in OCR patterns. Machines are taught by showing them instances of characters from various classes. Based on these instances, the machine creates a prototype or description of each class of characters. During recognition, unfamiliar characters are compared to previously obtained descriptions and given to the class that provides the best match. In most commercial systems, character recognition training is done in advance. Some systems, however, incorporate training facilities in the event that additional classes of characters are added.

Figure 3.3 : High-level diagram in the application



As shown in the above high-level diagram in the application first user will directed into the application and application will assist the user to scan the document. In the system there's special feature that is the segmenting the document image content into sub levels as described in the overall diagram it will segment into four main sections. Those are chart and diagrams, images, math interpretations and table. After segmenting the document system will pass the table captures into this level. Then after system using some masking and filtering methods and the image convert into clear formatted csv file. Then after that the models are identifying the rows and columns separately. All the tabular data will identified with those methods and it will be analyzing the document content with pandas and with other analyzing libraries. The final outcome sent to a summarizing model and it will generating a summarized explanation within the system and it will very useful to a blind user because that person can know what are the highlighted things and how the table is and etc. After summarizing the table data system will directed the data into voice output and from the voice engine application will giving the summarized description in a voice output. Finally, there are some dependencies with the image quality but the system will try to give the accurate summary by doing the image making and filtering methods.

3.1.2. Data collection methods

In this section we are explaining about the data collected methods in brief. In the initial phase we studied lot of data set with creating new algorithms. For that we used VGG-19 architecture with some common data sets. For table detection model we used ICDAR-17 Table -Extraction, Marmot are some datasets we used. When we training the datasets into extract tables, we found another issue when processing the data there were getting lot of processing time for image extraction. As a result of that we tried with some pre trained models to process the content and for the summarizing part we used some models to generate quality output.

3.1.3. Tools and Technologies

In this research project, All the machine learning functions are developed by TensorFlow using python language. TensorFlow is useful when the system is processing images and it get much efficient processing time because of that the system implemented using TensorFlow. Application backend developed with Python language and with the Django framework. And for the frontend development we used the dart language with flutter framework and with the current trend it’s a most popular framework and having huge community. From that aspect developments were easy when we are getting new requirement to the application. Overall used tools and languages shown as follows.

Tools:

- Visual Studio Code
- TensorFlow
- Anaconda-Navigator
- Jupiter Notebook
- Postman
- Android Studio

Technologies:

- Dart
- Flutter
- Python
- Django
- OpenCV-python
- Pytesseract and tesseract-ocr
- Kotlin
- Pandas Library
- Numpy Libraries

- Keras Models
- SKLearn Models

3.2. Commercialization aspects of the product

Our main objective in this research project application is to keep those with print difficulties from becoming reading dependent. Therefore, we anticipate that every individual who is blind or has printing difficulty will utilize our program and will like using it. This program eliminates the need for a third-party translator for printed papers for blind people. People will currently experience some difficulties if they cannot even read a tangible document. A person cannot maintain their privacy when they receive any legal or confidential document. This is the best product to use if you have these problems.

Introducing this application to the community this application can subscribe to any person all around the world and especially since we are focusing on the disabled community. With this aspect, we are hoping to offer this product for free to use for selected groups who are with disabilities. And monetization will be collected by founding partnerships for the applications. Also, in the current time, Non-Government Organizations also provide funds to further improve this application.

In different disabled communities, there are a lot of projects running for these disabled people. Some of them are Kurzweil Education platforms, Refreshable Braille Displays, and Ultra Cane etc. With these platforms, we can promote this product as a new trending application especially for blind people. In the current period, people are obsessed with social media platforms and from that level, we can promote the application and we can get partnerships by demanding these applications by promoting the usefulness of this application to people who are with disabilities in our society.

The entire cost of installing the respiration rate measurement component is as follows:

Item	Cost (LKR)
App Publishing cost on google play	12500.00
Backend Hosting Cost	14800.00
Paper Publishing Cost	47500.00
Total	74800.00

3.3. Testing and Implementation

3.3.1. Implementation

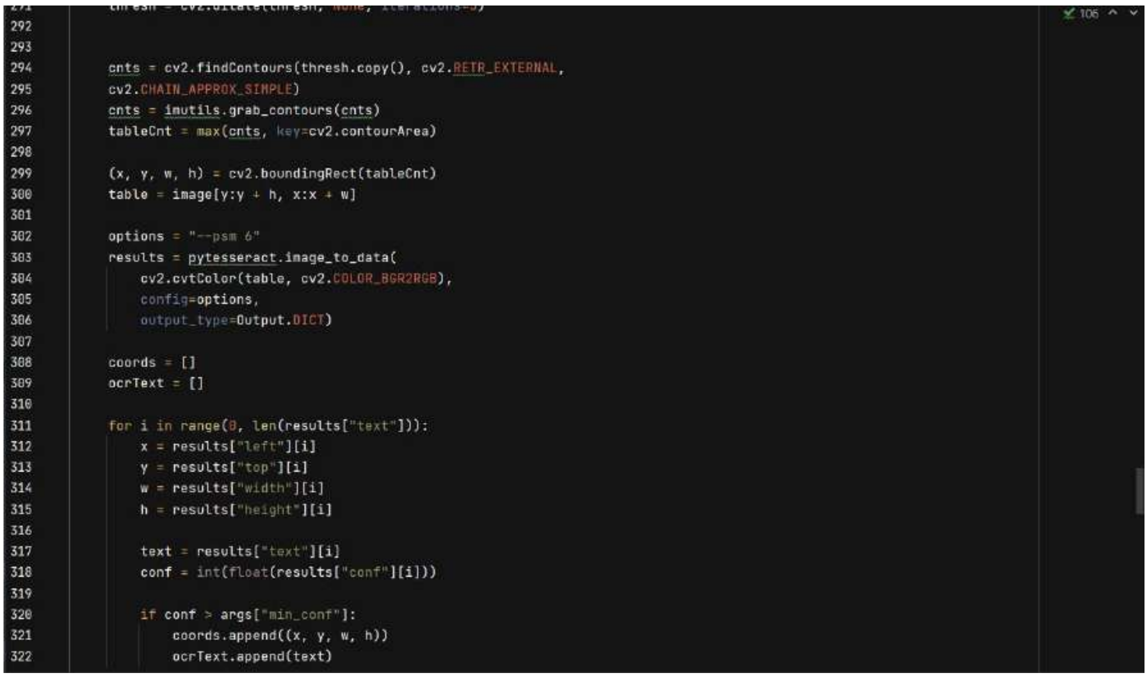
The current implementation for the document capturing and identification system first there was two major components. There were implementing proper module for the table identification and implementing an analysis method to summarize those data. For the implementation of the application, we have to link the component of the frontend with the backend as well as have to connect those models to analyze the document. For that purpose, there were some used technology stacks to implement the application.

- Document capturing and table extraction

  In here first user will directed into the mobile application. The mobile application is mainly developed using dart language with using the flutter framework. When user entered into the application it will assist the user that what he needs to select and there were two selections. There are selecting photo from a gallery or otherwise user can select to open the camera and capture the document. When capturing images there may have some usability issues when the user capturing the image. Sometimes user may have taken low quality images or else user having a phone with old versioned technology. For that issues our application will try to enhance the image from different ways to identify the document data in a clear format. For the latency of image processing and the real time processing works, TensorFlow is a suitable technique for this application. Google created the open-source library TensorFlow specifically for deep learning applications. Traditional machine learning is also supported. TensorFlow was first created without having deep learning in mind in order to handle huge numerical computations. However, it turned out to be quite helpful for the development of deep learning as well, so Google made it open source. In here we also using some machine learning models and by using TensorFlow technology we can handle large number of datasets and other processing activities as well.

The table detection module consists of image enhancement and first it will identify the table structure and the borders of the table by using x and y coordinates. From that system will identify the height width and all the coordinates of the table and it will identify the table with text. As shown in the below figure it will identifying the table and with using pytesseract libraries system can identify the image text and it can convert the image text into strings. From that system can clearly identify the tabular data of the document tables.

Figure 3.4 : Detecting tables from x and y axis



```
cnts = cv2.findContours(thresh.copy(), cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)
cnts = imutils.grab_contours(cnts)
tableCnt = max(cnts, key=cv2.contourArea)

(x, y, w, h) = cv2.boundingRect(tableCnt)
table = image[y:y + h, x:x + w]

options = "--psm 6"
results = pytesseract.image_to_data(
    cv2.cvtColor(table, cv2.COLOR_BGR2RGB),
    config=options,
    output_type=Output.DICT)

coords = []
ocrText = []

for i in range(0, len(results["text"])):
    x = results["left"][i]
    y = results["top"][i]
    w = results["width"][i]
    h = results["height"][i]

    text = results["text"][i]
    conf = int(float(results["conf"][i]))

    if conf > args["min_conf"]:
        coords.append((x, y, w, h))
        ocrText.append(text)
```

In this implementation, captured image has lot of color changes and shadow effect and other real time capturing issues. To avoid those issues our implementation has some image filtering options. For that purpose, there’s a library called Open CV and Open-Source Computer Vision Library is an open-source machine learning and computer vision software library. A unified infrastructure for computer vision programs was created with OpenCV in order to speed up the incorporation of artificial intelligence into products. When gazing at an RGB image, the human eye can easily detect color variations. However, programming a computer to detect such changes in the same way that the human eye does is challenging. Even if it is conceivable, when the system reaches an enterprise level, it might take a long time and require a lot of computing power. As a result, the retrieved picture was further processed using OpenCV libraries in built operations to make the system more efficient and less prone to the errors. As in the above figure system using the open cv libraries with lot of simple operational sub libraries of Open CV. For this system image will processing using lot of technologies such as filtering, resizing, masking and etc. Apart from that system identifying the threshold values and with using the x and y coordinates program can easily covert the image into the text format.

Figure 3.5 : Detecting tabular data from filtering and masking methods

```
    print(request)
    print("Image uploading************")
    fileObj=request.FILES['filePath']
    fs=FileSystemStorage()
    filePathName=fs.save(fileObj.name,fileObj)
    filePathName='media/'+filePathName
    text=processImage(filePathName)
    return Response({"text":text})

def processImage(img_path):
    np.random.seed(42)
    image = cv2.imread(img_path)
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (51, 11))
    gray = cv2.GaussianBlur(gray, (3, 3), 0)
    blackhat = cv2.morphologyEx(gray, cv2.MORPH_BLACKHAT, kernel)
    grad = cv2.Sobel(blackhat, ddepth=cv2.CV_32F, dx=1, dy=0, ksize=-1)
    grad = np.absolute(grad)
    (minVal, maxVal) = (np.min(grad), np.max(grad))
    grad = (grad - minVal) / (maxVal - minVal)
    grad = (grad * 255).astype("uint8")
    grad = cv2.morphologyEx(grad, cv2.MORPH_CLOSE, kernel)
    thresh = cv2.threshold(grad, 0, 255,
        cv2.THRESH_BINARY | cv2.THRESH_OTSU)[1]
    thresh = cv2.dilate(thresh, None, iterations=3)


    cnts = cv2.findContours(thresh.copy(), cv2.RETR_EXTERNAL,
    cv2.CHAIN_APPROX_SIMPLE)
    cnts = imutils.grab_contours(cnts)
    tableCnt = max(cnts, key=cv2.contourArea)

```

For this table extraction model there will be using some models to identify the data clusters. In here system having the Sklearn model with clustering models for the data classification. Sklearn library is statistical modeling tool that includes dimensionality reduction, clustering, regression, and classification. With these methods system has the ability to identify and extract the data tables very optimistic manner.

- Summarizing the tabular data

  In the real world when a person sees an object he can identify and get an idea about the object by looking at that. But when it comes to the blind person he can't identify or get an idea about anything without any assistant. For that issue we have identify blind people also wanted to get a proper idea of an object or anything that in this physical world. In this research, when capturing the document, it will not reading the whole document without any delays. In this application the system will identify the content and analyze all the contents of the document and giving a proper analyzed audio summary to the user. It is a special feature of this application and as we know when we see a chart or diagram or table, we can't get an idea by reading all the data in the document. We must analyze the content with our mind and after that we will get an idea about what are the special features of this chart or any other figure. For that purpose, there is a special feature that is the summarizing the tabular data into understandable explanation.

  This model implemented using data analyzing libraries. Mainly pandas libraries helpful for data manipulation and analysis process. For that purpose, in this this system there's a tabular data summarization module implemented with using some of the technologies. System getting the analyzation of the rows columns and the data values of the cells. After that it will giving a proper explanation to the user and user can get idea about the table by hearing to the explanation from the system.

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3.3.2. Testing

The final product of this research is mainly focused on blind people and specially the people who are with print disabilities. The testing phase of the software life cycle is crucial. Generally, there are only two types of testing. Functional testing and non-functional testing are the two types. Testing started from the very beginning of the life cycle and continued through various phases till the end. All these tests are carried out to see if the part has reached the client's data. Little components will undergo component smart testing in addition to functional testing. Testing continues until every component has been tested individually. While conducting functional testing, non-functional testing is carried out to validate the framework.

As this product made for blind people, we have visit some blind schools because in the school lot of people start learning about new things as well as getting knowledge. Because of that the most suitable users are the blind people also the school children. With our product we are looking to do the testing with those blind people and that's the best way to test this application.

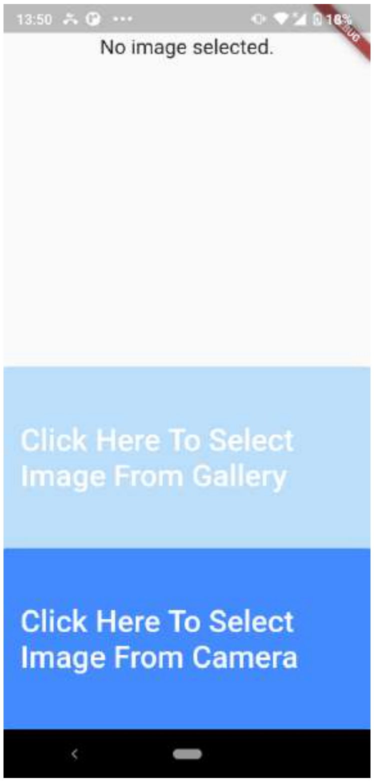
4. RESULTS AND DISCUSSION

This chapter discusses the information provided in the system and provides an overview of the entire study. It discusses the technique, theory, restrictions, recommendations, and final thoughts for additional research.

4.1. Results

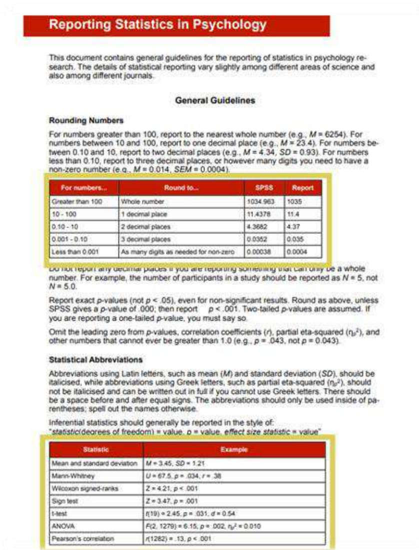
The application was identified some several significant results by table extracting and summarizing methodology. The identifying the table is initially done by the classification model and from that document will divided into some sub sections that are tables, charts, diagrams, images, and text likewise. At first system will assist the user by voice and it says about the application and main tasks to the user. As shown in the below figure that system will asking to select a surface in the mobile phone to scan the document or otherwise if there's a vision impaired or person with print disability, he or she can upload the gallery image as preference.

Figure 4.1 : Document scanning process



Next system will be getting the image and identifying the document edges because of that system can clearly process the document image. For this purpose, there should be enough light to capture and scan the document. After detecting scanning the document it will segmenting the document into separate section. From that all the table images will passing to the table extraction module. As shown in the below figures system identifies the tables and segmenting it.

Figure 4.2 : Identifying the tables within the document



Reporting Statistics in Psychology

This document contains general guidelines for the reporting of statistics in psychology research. The details of statistical reporting vary slightly among different areas of science and also among different journals.

General Guidelines

Rounding Numbers

For numbers greater than 100, report to the nearest whole number (e.g., $M = 6254$). For numbers between 10 and 100, report to one decimal place (e.g., $M = 23.4$). For numbers between 0.10 and 10, report to two decimal places (e.g., $M = 4.34$, $SD = 0.93$). For numbers less than 0.10, report to three decimal places, or however many digits you need to have a non-zero number (e.g., $M = 0.014$, $SEM = 0.0004$).

For numbers...	Round to...	SPSS	Report
Greater than 100	Whole number	1034.963	1035
10 - 100	1 decimal place	11.4378	11.4
0.10 - 10	2 decimal places	4.3682	4.37
0.001 - 0.10	3 decimal places	0.0352	0.035
Less than 0.001	As many digits as needed for non-zero	0.00038	0.0004

Do not report any decimal places if you are reporting something that can only be a whole number. For example, the number of participants in a study should be reported as $N = 5$, not $N = 5.0$.

Report exact p-values (not $p < .05$), even for non-significant results. Round as above, unless SPSS gives a p-value of .000; then report $p < .001$. Two-tailed p-values are assumed. If you are reporting a one-tailed p-value, you must say so.

Omit the leading zero from p-values, correlation coefficients (r), partial eta-squared (η_p^2), and other numbers that cannot ever be greater than 1.0 (e.g., $p = .043$, not $p = 0.043$).

Statistical Abbreviations

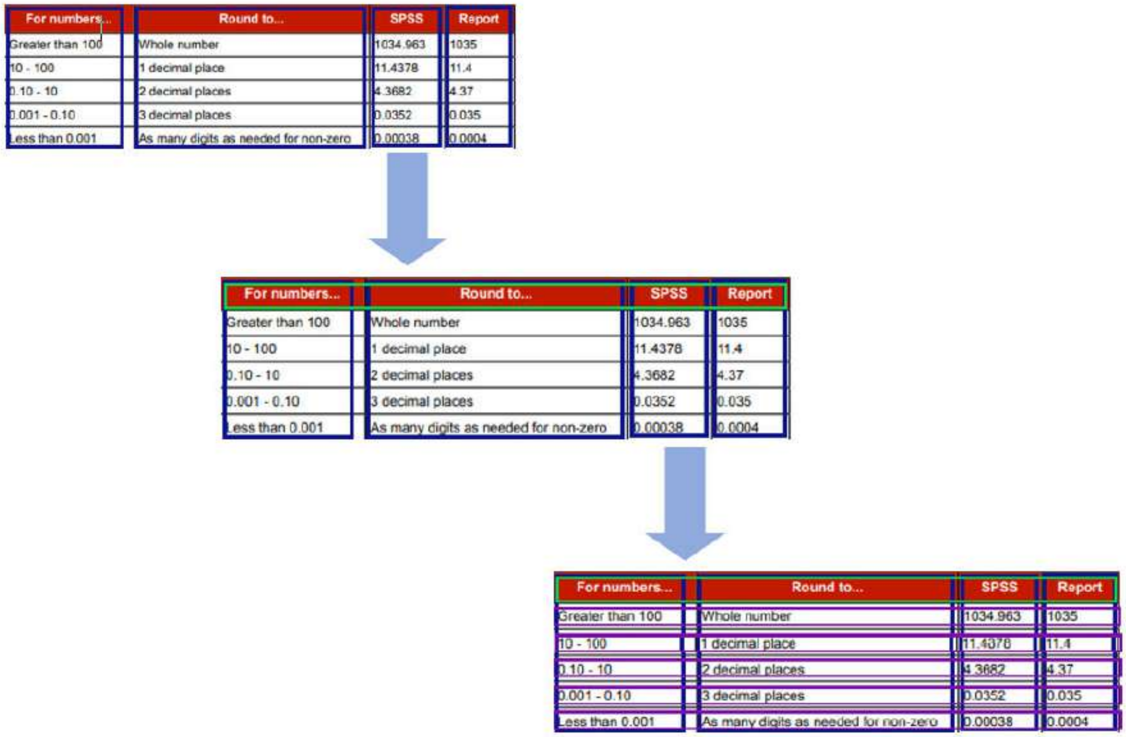
Abbreviations using Latin letters, such as mean (M) and standard deviation (SD), should be italicised, while abbreviations using Greek letters, such as partial eta-squared (η_p^2), should not be italicised and can be written out in full if you cannot use Greek letters. There should be a space before and after equal signs. The abbreviations should only be used inside of parentheses; spell out the names otherwise.

Inferential statistics should generally be reported in the style of:
"*statistic*(degrees of freedom) = value, *p* = value, *effect size statistic* = value"

Statistic	Example
Mean and standard deviation	$M = 3.45$, $SD = 1.21$
Mann-Whitney	$U = 67.5$, $p = .034$, $r = .38$
Wilcoxon signed-ranks	$Z = 4.21$, $p < .001$
Sign test	$Z = 3.47$, $p = .001$
t-test	$t(19) = 2.45$, $p = .031$, $d = 0.54$
ANOVA	$F(2, 1279) = 6.15$, $p = .002$, $\eta_p^2 = 0.010$
Pearson's correlation	$r(1282) = .13$, $p < .001$

Then after the table identification it will identify the rows and columns separately. For the purpose of analyzing system should identify all the column headers. After the identification of column headers system has the ability to identify the row wise details and in the model all the rows and columns identifies as follows.

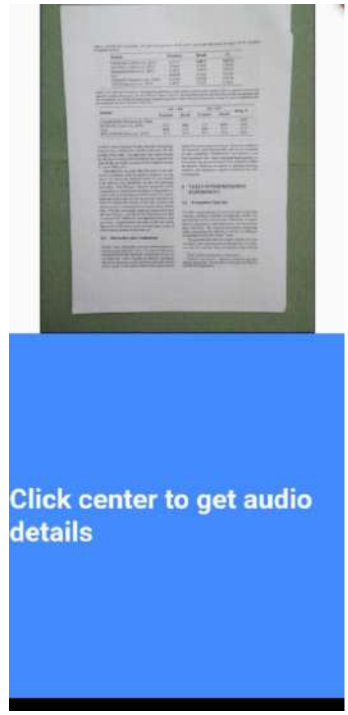
Figure 4.3 : Identifying the tables within the document



For numbers...	Round to...	SPSS	Report
Greater than 100	Whole number	1034.963	1035
10 - 100	1 decimal place	11.4378	11.4
0.10 - 10	2 decimal places	4.3682	4.37
0.001 - 0.10	3 decimal places	0.0352	0.035
Less than 0.001	As many digits as needed for non-zero	0.00038	0.0004

Then with summarizing module system will identifying the number of rows and number of columns. System will be identifying the data within a row and with each column system checking is there any numeric value columns and from that system will identifying the maximum and minimum values in each column.

Figure 4.4 : UI of the table interpretation



After the analyzation done it will prompt an explanation in voice output. There are some steps to follow to get the voice output and system will assist the user from the voice commands and user can easily hear the results as expected.

4.2. Discussion

A sizable portion of the population in this planet suffers from disabilities, and "printing disability" is one of them. The braille system cannot represent some content, such as charts, graphs, tables, figures, and math or algebraic equations, these people must seek the help of a third party. With having such advance technology in the current modernized world, it is time we have better options to help handicapped people in different areas. Therefore, we wanted to develop a tool as a solution to this issue.

First of all, some research was done on the topic to get an idea about the population of visually impaired people. Data from the global vision data base, elicited from population-based studies of blindness and vision impairment and age specific prevalence of blindness and number of blind people by age were stated in the literature survey.

After doing some background check on the matter we needed to get some first-hand data regarding the subject. That's when we conducted an online survey to collect some important information for the research. The survey was conducted by sharing a google form. Following questions were mainly directed to the audience to get an idea about the use of currently popular tools: Whether people think table related data can be expressed using literal reading? Whether they know of any alternative methods for visually handicapped people to read tables, graphs etc.? Which of such tools are they familiar with? What are the requirements for those above-mentioned tools?

Also, through this survey we got to know that many people have at least once come across with a visually impaired person and faced such issues while helping them out. Also, many responses stated that this kind of an innovation would be very helpful considering the hardships of sight-impaired community. Majority of the people mentioned applications such as E reader, Screen reader and Voice assistant. Also, our goal was to identify limitations of the currently prevailing tools so that we can provide solutions to these problems and enhance the facilities provided by our application.

Not only the technical side of this problem but also the biological causes of sight impairment were observed. We identified that cataracts which occur with age is a main reason for complete or partial blindness. While implementing such research it is very important to have a thorough knowledge about the target community. It is necessary to identify the age groups, genders etc.

We hired York Health Economics Consortium to conduct a systematic review of population-based studies published between January 1, 1980, and July 8, 2014.

Accordingly, we were able to identify that the probability to have a sight impairment increases with the age.

After analysing the data, we started working on our program. We wanted out program to be able to: assist documents scanning, detect tables in the document, detect table structure of the table, utilize real-time scanning method, detect text and data in the table, Explain the data in the table in a simple way, use gestures and voice recognition for navigate menus.

The user will first capture the document from the mobile device. Next, the backend will receive the input and will be collected for processing. The document will be divided into many areas in the backend, and the regions will then be categorized. The split pieces will then be forwarded to the appropriate algorithms for interpretation.

The special characteristic of this application which distinguishes it from other such tools is that it can easily identify and describe tables and charts including the information written in them. All the table images will be passed into the table extraction module, where the rows and columns will be identified separately. After the identification of column headers system has the ability to identify the row wise details. System will be identifying the data within a row and with each column system checking for any numeric values. The system will determine the maximum and minimum values in each column.

After the analyzation done it will prompt an explanation using a voice output. Not only that but the system will assist the user throughout the whole process.

5. CONCLUSION

Along the history of technological revolution people have created many useful as well as destructive creations for the humankind. But the true significance of human knowledge lies on our ability to change people's lives for the better. Although technology has left an opposite impression to what we call is humanness, we believe that it is also the solution to many problems in our society. We always tend to forget the needs and requirements of minority communities. Although it may seem unimportant to the rest, a simple effort in making things easy for a handicapped person might change their lives. That's why we see this attempt as a successful and very compassionate project.

Although, systems like Braille, Audio information have been widely used among the visually challenged community, they still don't have a proper solution in identifying print material such as tables, graphs, charts etc. Some other programs have also been developed as a solution to this problem, but we noticed that some of them lack many important features. Our goal was to create one program collectively with all the necessary attributes. Not only that but also, we have to remember that this kind of an application is being used by a person who needs special assistance. The interface and the process have to be specifically user-friendly and to be able to use the application by oneself, the program itself should guide the user till the final result. Also, as we identified in our research, most of the visually handicapped people are elderly people above age 70. These people have less contact with modern technology and don't have the knowledge to use such applications most of the times. This is also another reason why the program should be easy to navigate.

Also, the table extraction module which allows the system to analyse data in a table or a chart is a key feature which can come in handy as it cannot be done using traditional methods.

We visited a school for children with special needs and with the permission of the school staff we were able to accompany few visually challenged students to test the application and give us feedback about the program. We were very excited to see their successful attempts and positive reactions while using our tool. We hope it can be a useful element for sight-impaired people in studies, work or any other activity to independently handle documents and print material.

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7. APPENDICES

Appendix A: Online Survey I

Data Collection Survey for vision impaired students learning and identifying tables(වගු සහ ඒ ආශ්‍රිත දත්ත හඳුනා ගැනීම සඳහා දෘශ්‍යාබාධිත සිසුන් සඳහා දත්ත රැස් කිරීමේ සමීක්ෂණය)

We are final year students from Faculty of Computing at Sri Lanka Institute of Information Technology. Currently, we are working on an assistive tool to aid print disabled individuals to interpret printed materials. This survey is to asses the knowledge about available assistive tools and to asses the need of a proper tool to aid and gain reading equality with print disabled individuals.
This survey is only aimed for statistical purposes and we highly appreciate your contribution. Furthermore, your personal will not be recorded and the information you provide will be kept highly confidential with us. Thank you.

ranjunadilitha@gmail.com (not shared) Switch account

* Required

Do you interact with typically disabled / visually impaired people? *

- Yes
- No

Do you know about print file reading tools specifically for blind people? *

- Yes
- No

If Yes, mention if there is a tool you know.

Your answer

Do you think media like Braille can make blind people read all the articles? *

- Yes
- No
- Maybe

Do you think blind people should be guided in setting up a useful tool to read files over the phone? *

- Yes
- No

For vision impaired person what kinds of inputs will more accessible when using smartphone? *

- [ ] Input voice recognition
- [ ] use gestures system
- [ ] Zoom magnification/Font size
- [ ] Other:

Have you ever tried to read the warranty and related data from your mobile phone? ([illegible]) *

- ◯ Yes
- ◯ No

Do you think that tables and related data can be defined by literal reading? ([illegible]) *

- ◯ Yes
- ◯ No
- ◯ Maybe

Do you think there is table reading for the visually impaired people? ([illegible]) *

- ◯ Yes
- ◯ No
- ◯ Maybe

If yes, please mention those tools.([illegible])

Your answer

Do you think such a tool is essential for them? ([illegible]) *

- ◯ Yes
- ◯ No
- ◯ Maybe

If yes, what are your requirements for it? ([illegible])

Your answer

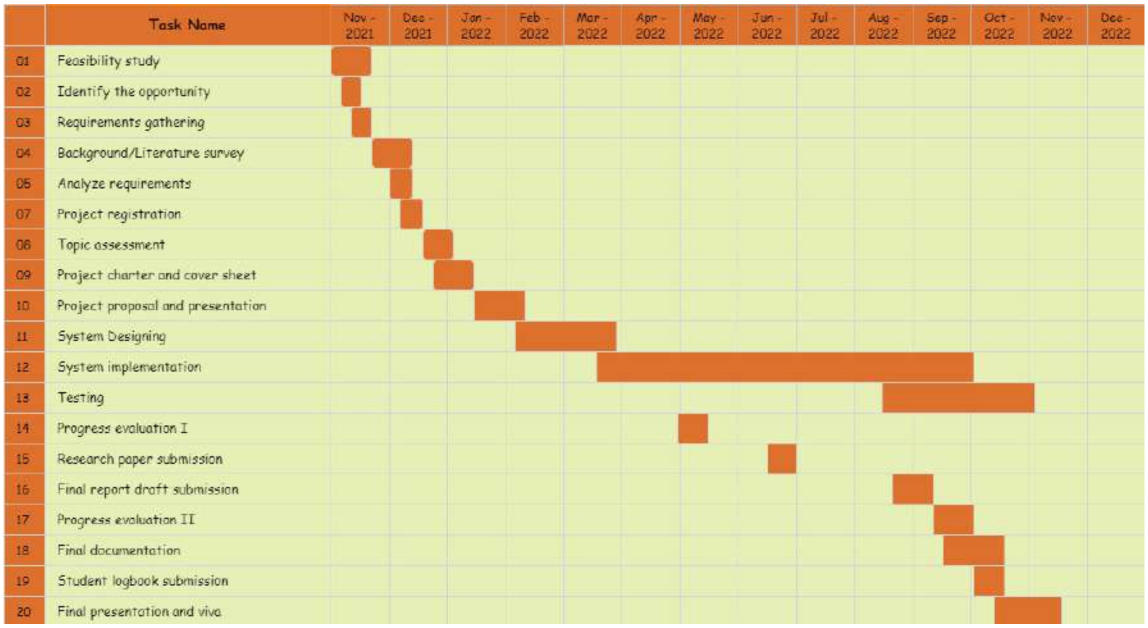
In addition, if you have an idea about reading tables and data, please let us know. ([illegible])

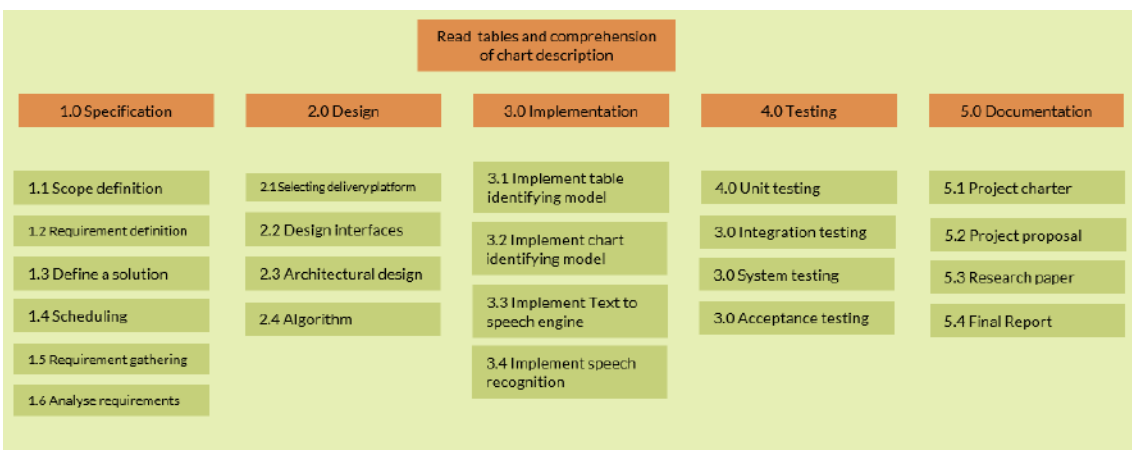
Your answer

Submit

Clear form

Appendix B: Gannt Chart and WBC





Appendix C: Plagiarism report

IT19156484_Dilitha_Ranjuna_G.P._Updated.pdf

ORIGINALITY REPORT

10%	6%	2%	8%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Sri Lanka Institute of Information Technology Student Paper	5%
2	Submitted to The University of the South Pacific Student Paper	1%
3	fugumt.com Internet Source	1%
4	www.hebe.ie Internet Source	<1%
5	Submitted to University of Abertay Dundee Student Paper	<1%
6	text-id.123dok.com Internet Source	<1%
7	Submitted to University of Moratuwa Student Paper	<1%
8	Ulisses Tirollo Taddei. "Efeitos de exercícios terapêuticos para o complexo tornozelo e pé na incidência de lesões, na funcionalidade e	<1%