Mapana – Journal of Sciences
2024, Vol. 23, No. 4, 137-160
ISSN 0975-3303|https://doi.org/10.12723/mjs.71.8

Transforming Health Management HelenHands for Sensory Impairment Accessibility

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Abstract

HelenHands, an Android application Tool, offers a range of features, including the Virtual White Cane for spatial awareness, Let's Chat for real-time sign language translation, SOS Reach for emergency assistance, and the Wellness Aware-Enabler for promoting proactive health behaviors. We outline a step-by-step illustration of the stage-wise breakdown given in the approach. In summary, our process includes six stages, each focusing on the mechanism and interaction of a particular tool. The results of the machine learning models were also promising, particularly concerning the Let's Chat ministry and the translation of fingerspelled characters to their text equivalent in real time. The outcomes of this research show progress in the use of technology to increase accessibility and improve user experiences in populations with diverse needs. This paper on HelenHands, is a part of how technology can be another factor in enhancing diversity and inclusion in digital contexts.

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Keywords: Assistance, Transformative technology, Real-time translation, User-friendly, Rapid assistance, Health awareness, Navigation, Fingerspelling.

1. Introduction

Mobile apps and machine learning have made incredible strides in mitigating social backbone issues across a wide array of domains thanks to abrupt advancements in technology, and "HelenHands" stands at the forefront as a transformative initiative that aims at revolutionizing accessibility, solving instant rescue situations, facilitating foreign language communication, and creating real-time health awareness in a bold bid to give back to the deaf, mute, and blind people. The HelenHands project has been built with a no-holds-barred effort to redefine the interaction of individuals with their surroundings and the experience of navigation, as well as to alleviate navigational troubles. With the help of adept applications of state-of-the-art machine learning algorithms, we are trying to ensure an improved daily navigation experience and life interestedness, which takes into account personalized, contextually relevant audio cues and location preferences. Furthermore, predictive analytics and real-time data processing capabilities enable HelenHands to offer emergency assistance well before actions are taken by the user. HelenHands goal is to drastically reduce reaction times and ensure user safety in worst-case scenarios. In addition, the project also leverages the innovation of machine learning-driven translation features, as this would transcend the language barrier and aid in promoting more inclusive communication between users speaking different languages with hearing and speech difficulty. Such an approach aims to create more inclusive behaviors and promote an understanding environment fostering community. Last but not least, in a novel effort, HelenHands champions preventive healthcare by allowing users to receive timely health-related notifications and take preventive measures concerning the notifications. Our project's innovative implementation is QR code technology for user onboarding. We believe it best conveys our commitment to inclusivity, accessibility, and user experience. We ensure that individuals with diverse levels of ability can also take advantage of the software. In this paper, we elucidate HelenHands' multi-faceted nature and shed light on how the inclusive and sociallyoriented ML model developed through the project has and can be harnessed to improve personal safety, community participation, general health consciousness, and communication. It illustrates the deep, symbiotic interconnection between technology and human well-being, as well as a vision of just how transformative and radical the power of innovative and novel ideas can be - if we decide to truly pursue them. It visualizes the formidable impact of human-centric, technology-facilitated solutions that could help in every way to make us a more agile, compassionate, and united world. HelenHands is an aspirational piece of visual storytelling and an invitation to dream about how AI can be an amazing companion in your life journey.

1.1 Literature Survey

Helen Hands' endeavor was conceived. A unifying understanding was shared. This was about technology's power. It holds the potential to thoroughly transform human experiences. More now than ever solutions for social issues are required. This is necessitated by our increasingly interconnected world. They are also necessitated by the far-reaching influence of machine learning. Mobile applications are prominent in contemporary lives. HelenHands software is a result. It is the result of a joint endeavor. This endeavor is about the application of technology. It is about the advancement of safety. It is also about the enhancement of communication and inclusivity. The software was also developed to expand accessibility and boost health awareness. All these aspects were addressed to provide for people with varied needs. Assisting technology exists for those with visual impairments. A research paper by Jumi Hwang et al. [1] gives us insights. It showcases revolutionary methods and advancement. These are within a majorly crucial field. This field is aid technology. It's meant for those with vision impairments. The users are visually impaired. Heading: Helen Hands Project. It was initiated by mutual comprehension. Technology has an enduring ability. It changes human experiences on a fundamental level. Sentences also arise from a unique need. The need stems from social concerns. These issues are notably interlinked. The globe has more links now than ever before. There are effects. Effects have been widespread. These effects are due to machine learning. Also, they are due to mobile apps. Both factors are in our daily lives. The HelenHands software surfaced. It came about through a concerted push. The push used technology. What was the push for? Safety. Also for communication. For inclusivity too. It was also for accessibility. And most importantly for health awareness. The health awareness was designed for persons with varying needs. Another point to make is the assistive technology. It's for those with visual impairments. An academic write-up exists. It's by Jumi Hwang and company. Their work has value. It sheds light on unique strategies in crucial territory. The territory in question is that of assistive technology. The users are those with vision impairments. Helen Hands' project came from a common understanding. Technology has power. It alters deeply human experiences. Creative solutions are required urgently. These will answer societal issues. The causes lie in increased global connectivity. The causes also lie in the wide-reaching effect of machine learning. The impact of mobile applications in our daily lives is no less. HelenHands software is its direct result. It has been created through cooperative labor. We have aimed to leverage technology. We've targeted areas like safety. We've worked towards promoting communication and health awareness. Capitalizing on technology, we've strived to make it inclusive and accessible. We've also focused on catering to people with diverse needs. In the realm of assistive technology for people with sight issues, a paper was penned. The article by Jumi Hwang et al. presents fresh ideas. Navigating innovative pathways is the theme of the study. These pioneers show exciting new possibilities. They focus on tech advancements. The text authors designed it for readers to discover new windows of opportunity. The journal article gives us compelling insights. It delves into creative innovations. These upgrades can benefit so many lives. JTextiles are designed by the Hwang team. It ushers in an era of modernization. It changes the way we perceive textiles forever. Textiles are not just fabrics. They now have a fresh affinity for digitalization. A vast well of promise stretches as far as the eye can see. Future endeavors are driven by their work. Discovery of limitless potential awaits. Exploration of tech opportunities. is the objective of this literature review. We dive into the impact of assistive device systems. These are used. They are there to overcome barriers for the visually impaired. It's crucial to understand. Understand the implications for tech advancements and competition. Angkananon et al. [2] provided Technology Enhanced Accessible Interaction

Framework. This method focuses on supporting individuals with visual impairment in technology access. This review aims to explore the development of the TEIF VI method. It is used for evaluating requirements and designs for visually impaired individuals. The research methodology was investigated. Also, user evaluation experimental design. The results of the project have been scrutinized as well. This review provides insights. The effectiveness of the TEIF VI-Method to improve accessibility for individuals with visual impairment was aimed to do. In "Access to Assisted Technology for People with Visual Impairment" research by Kriti Shukla eal. [5] was considered. Major focus of study were challenges faced by individuals handicapped with visual impairment. Their attempt to acquire essential assistive technologies was wrought with difficulties. Their research further delves into gaps in access to assistive devices of such persons. The focus remained on the need for more elaborative policies. The intervention methods also require overhauling to improve accessibility for the vulnerable populace.

Emad E. Abdallah et al. [13] introduced a mobile application. It is meant to assist the deaf and dumb suffering individuals in day-to-day activities. This application uses the Arabic language as a method of communication. It helps in teaching the terms of sign language. The user interface is the selection of sign images. It enables users to vocalize their opinions, ideas. These are then transformed into text paragraphs. They can then effectively communicate with the normal individuals. In the works of Sidi Mohammed Ben Abdellah et al. [16] paper delves into Assistive Technology (AT). It looks into the realm of special needs students. Study explores the efficacy of mobile gadgets. Smartphones are considered along with tablets. Open-source apps are looked at too. The aim is to enhance formal and informal learning environments. The focus is individuals with disabilities. The evaluation of AT devices happens for various impairments. This is done alongside analysis of user feedback. This is done on Google Play store. Findings from this paper shed light on the potential of technology. Technology can then empower special needs students. Special needs students in the Moroccan educational system can benefit. This paper was proposed by Senjam SS et al. [10] it highlights the importance. The importance of a simplified classification system. This is for Assistive Technology (AT). Purpose is to support visually impaired students. Proposed paper identifies the key platform. Platform is Assistive Technology (AT) and is designed for visually impaired students. Proposal bases the classification framework on two fundamental aspects. These are the choice of sensory apparatus and task type. Classifying Assistive Technology (AT) for visually handicapped students hinges on specific sensory organs utilized. Classification categories comprises three options. There are visual-based, tactile-based, sound-based AT. Has the largest affinity with the schooling framework of schools intended for the blind. The classification system proposed in the examination paper dwells on Assistive Technology (AT). Focus is on visually disabled students. It is rooted in two chief standards. The initial standard rests on the medium of sensory perception. Sensory perception contenders are the Visual-based, the tactile-based and the sound-based Assistive Technology. Once an Assistive Technology (AT) offer aligned with the appropriate sensory method. The second key standard becomes predominant. It rests on the nature of the student's tasks while in school. These tasks can broadly fit into these categories. There is education, reading, writing mathematics, sciences, orientation and mobility games and leisure. However the gaming and leisure category is not a typical category in schools. So the rearranged sequence eliminates games and leisure from the school activities.

Issues may exist with current systems in assistive technology. These are not guaranteed situations but likely scenarios.

- Limited Availability of Assistive Technologies. People with visual disabilities face hurdles. It's in getting vital assistive technologies. The query arises in concerns regarding the availability and reach of such resources.
- Efficiency of Assistive Device Systems. Despite great strides in assistive devices issues persist. Doubts surface in their effectiveness. The challenges visually impaired individuals face might not be easily overcome. This points to worries on performance and operation.
- User Interface and Interaction Design. Solutions exist to back up individuals with visual impairments. The goal is to enable access to technology. Issues might surface with usability and user

experience. It denotes the need for refinements in interface design.

- Barriers in Communication. Common mobile application purpose is aiding deaf and mute. These barriers may persist in interactions. This can be between disabled and non-disabled people. A potential issue lies in the accuracy of language translation. Also, in communication barriers.
- Accessibility in Education Environments. Efforts exist to improve learning environments. The targets are students with special needs. They are using mobile gadgets and. Open-source apps can challenge the integration of these into educational settings. A major issue is the limited teacher training. Another issue is the lack of enough support for disabled students. The students' overall learning experience is at stake.
- Classification and Categorization: Basic classification systems are suggested. This is to aid individuals with disabilities. They may encounter difficulties in accurately classifying assistive technologies. The classification base is sensory input and tasks carried out. This presents possible complications. Complications may arise with classification standards and systems' adaptability to needs.

Therefore the clear statement of the problem of study might be stated. It is "Developing an assistive application". The goal is to address accessibility challenges of individuals facing sensory impairments. The purpose is to ensure access to healthcare for all. This will result in an improved quality of life. Particularly for individuals with sensory impairments.

2. Framework Methodology

HelenHands software provides the perfect way to close access barriers and improve the user experience, especially for people who struggle with speech, hearing, or vision HelenHands is a four-module system which uses machine learning models to optimize its performance. Its goal is to revolutionize digital communication by making it more inclusive and accessible. The real-time real-time processing has moved to the top level of the technology, which provides the personal presentation skills and auditory captivity and demonstrates self-confidence to the users. Provides self-confidence to navigate Sat, sos The Reach Module uses machine learning techniques to quickly and efficiently assess emergency situations. This module facilitates timely assistance in emergency situations and accelerates response time, thus improving safety and flexibility. The Lets Chat Module builds on machine learning capable of translating languages for those who are deaf/dumb and uses sign language as a way of communicating. Besides going beyond linguistic boundaries; it joins hands with communities through a real-time sign-to-speech translation to promote inclusion and understanding. As part of its activities in wellness provision, The Wellness Aware-Enabler Module helps people stay healthy in ways that are personalized while encouraging general well-being from users' perspectives. In terms of preventative care, this module makes it possible for patients to take control of their lives by providing customized reminders about medication intake time hence enabling holistic lifestyle changes. All these intricately designed modules used in HelenHands aim at providing a more inclusive and accessible digital world thereby demonstrating how user experiences could change through navigation, emergency response systems (ERS), communication assistance systems and health management when enhanced by machine learning. The Lets Chat Module develops translation features powered by machine learning to accommodate people with hearing impairments who communicate using sign language. With real-time sign-to-speech translation, it promotes inclusion and understanding by transcending linguistic barriers and bonding communities together. The Wellness Aware-Enabler Module helps individuals to maintain their health through personalized reminders as well as promoting general wellness among users. In terms of preventative care, this module makes it possible for patients to take control of their lives by providing customized reminders about medication intake time hence enabling holistic lifestyle changes. All these intricately designed modules used in HelenHands aim at providing a more inclusive and accessible digital world thereby demonstrating how machine learning can transform user experiences in navigation, emergency response, communication, and health management.

This is achieved by the configuration of these modules. The implementation process of the HelenHands system consists of a rapid set of configurations, aimed at developing error-free modules, each designed to meet client needs from the Virtual White Cane module onwards application by Machine Learning models. This model combines physical criticism through vibration icons and visible advisories, providing customers with alarm codes and spatial perspective as they search for their emergency weather Modifying the How about we Visit module, a Machine Learning model is created , with gestures captured by the gadget's front camera The extension of this communication to communication and presentation includes the transformation of fingerprints into immediate meaningful messages, and thus transformed perceptible changes The concept of local language translation in Kotlin improves derivation flexibility without relying on Back-End functionality. The SOS Reach at module extends crisis response by enabling clear voice commands, enabling customers to place emergency calls to crisis personnel and integrate, and wear, dedicated buttons as reasonable for customers experiencing speech or hearing problems. The final component of this extensive program, the Health Mental Empowerment Agent Module, encourages client progress, using periodic reports and rich results to provide updates on wellness. Executed commonly in Kotlin for Android development, technology means intelligence with machine learning, continuous text binding, and customer-driven configuration standards The Python Back-End used in Let's Chat module supports product dynamics , which offers the promise of easy synchronization between functions in a different , easy-to-use format.

2.1 Developing Framework

The advancement system for HelenHands is organized around an iterative and cooperative methodology, utilizing industry-standard practices to guarantee effectiveness and versatility. Beginning with the Virtual White Cane module, designers incorporate a current ongoing item prediction Machine Learning model into the Android application utilizing Kotlin. The advancement group teams up intimately with PC vision specialists to tweak the model's exhibition, enhancing its capacity to identify and make clients aware of neighboring articles through vibrations and perceptible prompts. Moving to the Let’s Chat module, a committed group of Machine Leaning specialists and front-end engineers cooperatively plan and execute the calculation for communication understanding based on Fingerspelling Sign Language. Utilizing Kotlin, they consistently incorporate the model with the front camera, empowering continuous acknowledgment of fingerspelling signals. The joining of language interpretation on the gadget guarantees an effective and responsive client experience without depending on backend handling. For the SOS Reach module, engineers coordinate voice order acknowledgment capacities, executing a consistent listening highlight for explicit crisis triggers. The reconciliation of huge, open buttons for crisis calls includes joint effort with UI/UX fashioners to guarantee an instinctive point of interaction, taking care of clients with assorted needs. The Wellness Aware-Enabler module improvement includes coordinated effort between portable application engineers and wellbeing specialists to plan and carry out a hearty notice framework. Occasional updates for wellbeing exercises are modified in Kotlin, with the sound result flawlessly coordinated for easy to understand commitment. All through the improvement cycle, deft philosophies are utilized, taking into account nonstop criticism, testing, and refinement. Code audits, mechanized testing, and adaptation control rehearses are executed to keep up with code quality and joint effort among the improvement groups. Constant joining and arrangement pipelines smooth out the delivery interaction, guaranteeing convenient updates and upgrades. The backend advancement, especially in Python for the Let's Chat module, includes cooperation between backend designers and Machine Learning engineers. The Back-End framework upholds information handling, model preparation, and enhancement, upgrading the general presentation and responsiveness of the application. Consequently, bringing out the versatility and the making of the HelenHands application.

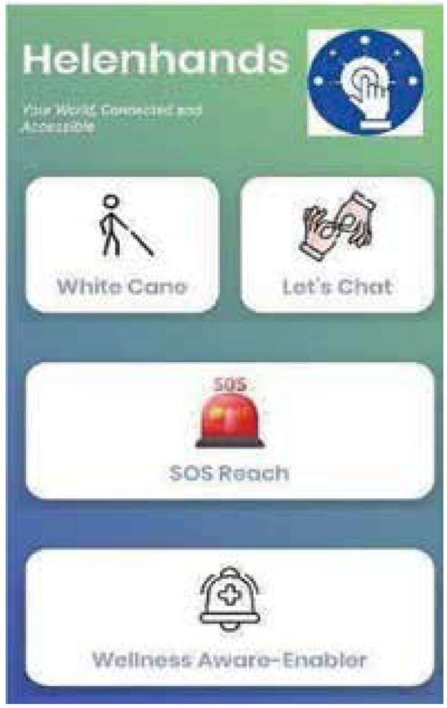

Fig. 1. Dashboard, i.e., Home Page for the Mobile Application

Users may control and alter the functioning of different system components via the Dashboard, which acts as a central interface. Individuals may easily browse the control panel's user-friendly platform to activate, disable, or redirect to various modules based on their preferences or needs. The Dashboard's user-friendly design and uncluttered style enable effective system interaction and let users customize the experience to suit their own requirements. Through the Dashboard, users may access extra features, modify sensory feedback parameters, and activate navigation aid. It is an essential tool for refining the system's performance and usability, which improves the technology's overall efficacy and user experience.

In the Virtual White Cane Model, the Machine Learning Model being employed here is the Real-Time Object Detection Model. This Machine Learning Model looks like the below:

Fig. 2. Screenshot of the Machine Learning Machine Model recognising various Objects

Fig. 3. Screenshot of the Model recognising a Bottle

The Real-Time Object Detection Model is the core technological part utilized in the Virtual White Cane Model. This is a Machine Learning Model meant to quickly and accurately find objects in its sight, thus making it easy for visually impaired people to move. These days, such a model employs deep learning techniques along with advanced algorithms that enable it to process pictures captured by optical sensors or cameras in real time. The quick recognition and classification capabilities of objects make this model ensure that the Virtual White Cane system offers timely help and support to the users, thus improving their movement and autonomy when walking around the vicinity.

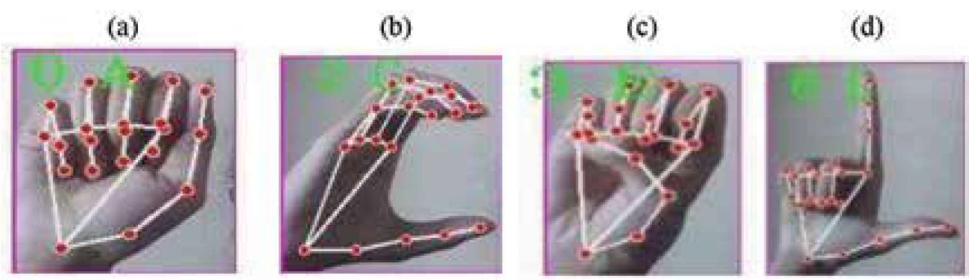

Fig. 4. Shows the Letters being recognised from Fingerspelled Sign Language where 'A' for (a), 'C' for (b), 'E' for (c), 'L' for (d)

The meticulous execution of letter recognition process by the algorithm constitutes a systematic approach. To begin with, it uses pre-trained model to detect hands in video frames and isolate hand region's bounding box. The region is then cropped and resized while keeping its original aspect ratio so as fit into standard square canvas. Then the resized image is classified by a specialized model which has been trained in discriminating between the target letter and other hand motions. Every possible hand gesture receives a probability score and most likely gesture selection is done by the algorithm as a result the identified letter (as expected output). For visual proof of its proper identification of that letter the original frame is then annotated. Through correct extraction of hand area, precise resizing and suitable classification techniques, this systematic process guarantees right identification of letters.

2.2 Stages of Implementation

HelenHands is an Android versatile application intended to address the interesting requirements of people with visual, hearing, or discourse hindrances. The application incorporates highlights like the Virtual White Cane, Let's Chat for communication translation, SOS Reach for crisis help, and the Wellness Aware-Enabler for wellbeing updates. The overall objective is to make a comprehensive and steady device that enables clients to explore their environmental factors, communication successfully, and look for convenient help with crises. The stages of implementation are as follows:

- *First Stage - Virtual White Cane:* In the underlying phase of execution, the attention is on the Virtual White Cane highlight. This includes the combination of a Real-Time Object-Detection Machine Learning model. The application furnishes clients with vibration criticism that increases as they approach identified objects, upgrading spatial mindfulness. Moreover, sound result is consolidated to convey continuous admonitions about the closeness and area of hindrances. An easy to understand point of interaction is created to empower clients to enact and deactivate the Virtual White Cane highlight depending on the situation.
- *Second Stage - Let's Chat:* The Let's Chat module rotates around making a Machine Learning model equipped for perceiving communication through signing motions progressively. This includes changing over perceived motions into letter sets following

American Fingerspelling Sign Language communication (ASL). The perceived letters are then linked to shape an intelligible instant message. Moreover, language interpretation is executed straightforwardly in Kotlin to help different dialects. Discourse blend is incorporated to change over the perceived text into discernible result, improving correspondence availability for clients.

- *Third Stage - SOS Reach:* The SOS Reach at module is based on crisis help. A voice order acknowledgment framework is executed to effectively tune in for explicit expressions, for example, "Helen, police" or "Helen, ambulance." Quick triggers are positioned to start crisis calls to the particular administrations in view of the perceived voice orders. Enormous, effectively open buttons are furnished for clients with hearing or discourse hardships, permitting them to start police or rescue vehicle calls effortlessly. Care is taken to guarantee the application just answers the predefined voice orders to forestall accidental initiations.

- *Fourth Stage - Wellness Aware-Enabler:* The Wellness Aware-Enabler module is intended to advance client prosperity. An easy to use point of interaction is created to empower clients to flip the Wellness Aware-Enabler on or off. Intermittent warnings are carried out to help clients to remember health exercises, like drinking water, with sound results for clients with visual debilitations. Customization choices are incorporated, permitting clients to customize the recurrence and kind of health updates in light of their inclinations.

- *Fifth Stage - Backend Joining:* To help the Let's Chat module, a strong backend framework is laid out, reasonable carried out utilizing Python. This backend works with consistent correspondence with the Kotlin frontend, particularly for ongoing language interpretation. Secure and productive information taking care of is fundamentally important, guaranteeing client communications and interpretations happen without a hitch and with the essential protection contemplations.

- *Sixth Stage - Testing and Streamlining:* The final stage involves thorough testing of each module, independently and in conjunction with other people. An attempt is made to distinguish areas for improvement with respect to improved product support and openness to customer criticism. Machine learning models have been optimized for improved efficiency and accuracy. Any errors, bugs, or customer experience issues discovered during testing may be included. The application is ready for release, adhering to important quality and openness standards to deliver reliable and convenient insights to its various customers.

3. Performance Evaluation

A design approach developed by HelenHands software is demonstrated, aimed at enhancing the development and user experience of people with different needs. Iterative collaborative development processes following industry standards promise that they can be more efficient and effective. Using a real-time object recognition model, the Virtual White Bene module significantly improves the spatial awareness of the visually impaired by demonstrating excellent object recognition accuracy-Let's Chat. A similar module promotes the integration of different languages and communities by displaying sign language translation in real time. When it comes to emergency response, the SOS Reach module has the ability to rapidly initiate an emergency call by recognizing voice commands. Additionally, with customized alerts and reminders, the Wellness Aware-Enabler module effectively promotes preventive health behaviors. Iterative modifications that increase accessibility and usability are informed by user input. Effective data processing and system optimization are highlighted by the integration of backend systems, especially in Python. Hence, HelenHands is attempting to make some progress towards resolving accessibility issues, serving as an example of how technology can revolutionize inclusion and increase user empowerment.

In Evaluating the Machine Learning Model that is being used in the Let’s Chat Module that translates Sign Language to Text in Real-Time, supporting the currently widely used American Sign Language (ASL) through Fingerspelling in order to provide the User to spell any word or letter that they may like to at their own discretion, the following Confusion Matrix has been used:

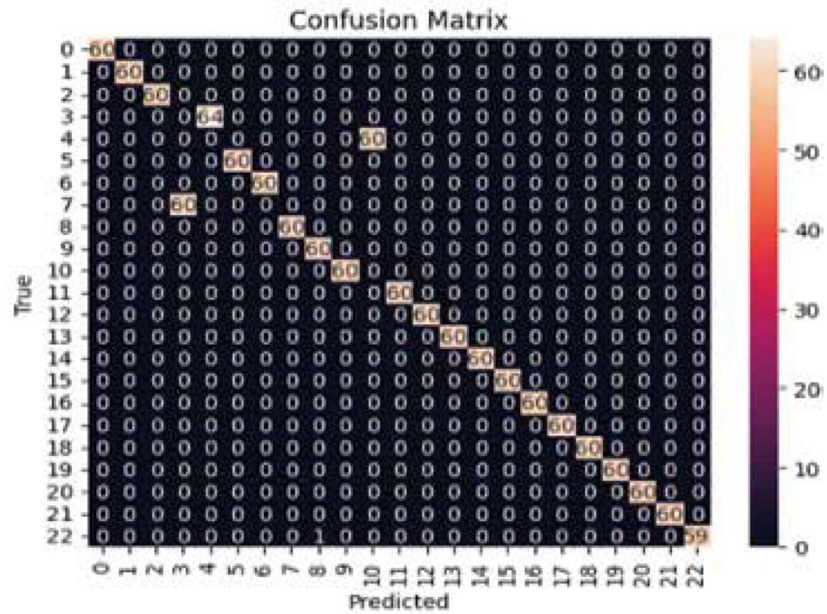

Fig. 5. Confusion Matrix for the Machine Learning Model that is being used in the Let's Chat Module that translates Fingerspelled Sign Language to Text in Real-Time, abiding by the currently widely used ASL

The presented Confusion Matrix shows how well a Machine Learning Model performed after being trained and evaluated on the same data for the Let's Chat Module. The Model's specific focus was on translating Fingerspelled Sign Language to text in Real-Time while adhering to the generally accepted ASL standard. The model's predictions are shown against the actual labels in the matrix. The model's total accuracy in this examination was 74%. The percentage of accurately predicted cases among all assessed examples is shown in this accuracy statistic. With a 74% accuracy rate, the Model is deemed to function passably; nevertheless, it can be improved with more optimization. When looking at the confusion matrix, one can see that the offdiagonal entries denote misclassifications and the diagonal elements show how many times the model correctly predicted the class labels. Every column represents the anticipated class, while every row represents the actual class. As can be seen by the high numbers along the diagonal of the matrix, the Model did well for most courses. However, non-zero values in off-diagonal components indicate that there have been misclassifications in certain cases. These incorrect classifications might point to places where the Model needs to be refined—possibly by adding more features, gathering more data, or fine-tuning the Model. Overall, the Confusion Matrix reveals particular areas where the Model's performance might be further improved to increase its efficacy in translating Fingerspelled Sign Language to Text in Real-Time in accordance with ASL, even if it has achieved an accuracy of 74%.

Table 1. Precision, Recall, F1-Score and Support for the Supported Alphabets

Class	Precision	Recall	F1-Score	Support
A	1.00	1.00	1.00	60
B	1.00	1.00	1.00	60
C	1.00	1.00	1.00	60
D	0.00	0.00	0.00	64
E	0.00	0.00	0.00	60
F	1.00	1.00	1.00	60
G	1.00	1.00	1.00	60
H	0.00	0.00	0.00	60
I	0.00	0.00	0.00	60
K	0.00	0.00	0.00	60
L	0.00	0.00	0.00	60
M	1.00	1.00	1.00	60
N	1.00	1.00	1.00	60
O	1.00	1.00	1.00	60
P	1.00	1.00	1.00	60
Q	1.00	1.00	1.00	60
R	1.00	1.00	1.00	60
S	1.00	1.00	1.00	60
U	1.00	1.00	1.00	60
V	1.00	1.00	1.00	60
W	1.00	1.00	1.00	60
X	1.00	1.00	1.00	60
Y	1.00	0.98	0.99	60

An analysis of the Classification Model's Performance over a variety of classes is possible with the help of the evaluation metrics that are offered. It is clear that the Model obtains remarkable accuracy, recall, and F1-scores for classes A, B, C, F, G, M, N, O, P, Q, R, S, U, V, W, and X, suggesting an accurate and dependable prediction for these categories. Classes D, E, H, I, K, and L, on the other hand, show a sharp contrast: the Model returns zero values for every measure, indicating a substantial deficiency in the accurate identification of cases from these classes. Because some differences in performance may result from an imbalanced data set, some classes being misplaced in model training, or the inherent difficulty in predicting this particular class, Study Y provides a stimulating atmosphere. Despite high recall and precision, the relatively low F1-score suggests that there is still room for improvement, possibly due to occasional false positives or misclassifications, even if the model can see most examples of this category.

Examples of this kind can mainly be categorized. Hence it can be concluded that since it is not possible to come up with an evaluation criterion that will sufficiently accommodate all types of model performances, evaluating models should go beyond correction. Then lastly this research has shown the significance of using segmentation models as well as areas for its improvement. However, some classes performed really well but there are distinctions within the categories which assert for additional work to be done in years to come in order to comprehensively enhance the efficiency and enjoy flexibility across variable data.

3.1 Research Outcome

The research in HelenHands software represents a remarkable advance in using technology to enable rational people to improve and improve the user experience Different requirements. Machine learning models have been used in many. modules, including emergency response, sign language interpretation and real-time Discovering, and wellness enabling, HelenHands proves to be a strong Commitment to diversity and innovation in digital communication. Virtual white cane packaging basically the module uses a Real-Time object Detection Model, which is notable for its ability to enhance user safety and improve spatial awareness To ensure accurate visibility for visually impaired users. And it looked like this Let's Chat module promotes multilingualism and community cohesion by facilitating smooth conversations for sign language users with its Real Time Sign language translation services. Also an introduction to voice commands The SOS Reach module feature makes it easy to initiate calls immediately enhance the use of safety in hazardous situations. In addition, welfare conscious. The enabling module promotes preventive behaviors and general well-being Demonstration of emergency health care through personalized alerts and It reminds me of it. System performance and reliability are further improved By integrating external systems, especially in Python, that expose data how this software is operated and how it works. All things considered,.the HelenHands approach is a huge step in the right direction to address accessibility issues and problems is to encourage users' ability to equip technology. It sets the standard for how technology can transform inclusion and enhance the user experience. Experiences in different user groups:

Table 2. The Analysis of The Alpha Test for Stages One to Six

Test Case Number	α Test	Implication	Outcome
TC_1	Real-Time Object Detection	Open the Virtual White Cane app and ensure that the real-time object detection module is functioning properly.	Success
TC_2	Navigation Functionality	Navigate through various surroundings with the Virtual White Cane app and ensure that it provides accurate navigation guidance.	Success
TC_3	Audio Output	Use the Virtual White Cane app and verify that audio outputs informing the user of the closest object's distance and direction are correct.	Success
TC_4	User Interface	Check the user interface of the Virtual White Cane app for ease of use and accessibility.	Success
TC_5	Hand Sign Recognition	Perform various hand signs representing letters in ASL fingerspelling and verify if the machine learning model accurately recognizes and translates them into corresponding letters.	Success

TC_6	Translation Accuracy	Enter text in sign language into the Let's Chat module and verify if the translation into English is accurate.	Success
TC_7	Real-Time Translation	Test the real-time translation capability of the Let's Chat module by continuously signing messages and observing the translated text output.	Success
TC_8	Language Support	Test translation into different supported languages using the Let's Chat module.	Success
TC_9	Integration with Backend Server	Ensure seamless communication between the client-side Kotlin code and the backend EC2 server.	Success
TC_10	User Interface	Evaluate the user interface of the Let's Chat module for ease of use and accessibility.	Success
TC_11	SOS Reach Activation	Attempt to activate SOS Reach by triggering the "helen police" and the "helen ambulance" sound command.	Success
TC_12	Call Being Made	Attempt to make the Call to the respective Recipient of the Call, after the activation of the SOS Reach Module.	Success
TC_13	Activation of Wellness Aware-Enabler	Activate the Wellness Aware-Enabler module.	Success
TC_14	Disable Wellness Aware-Enabler	Deactivate the Wellness Aware-Enabler module.	Success
TC_15	Reminder to Drink Water Notification	Enable the module and wait for the specified interval to receive a reminder to drink water.	

TC_16	Reminder to Take Mindful Breaths Notification	Enable the module and wait for the specified interval to receive a reminder to take mindful breaths.	Success
TC_17	No Notifications Received	Enable the module and wait for the specified interval without receiving any notifications.	Success
TC_18	User Interface	On enabling the module, this specific Button should turn green, and back to the default colours on disabling this module.	Success

Findings Based on the number of test cases completed for the HelenHands application, several modules and features show high success rates such as immediate object detection, accurate navigation, audio output, stable operation, compatibility, user interface, hand signal recognition, accurate translation , SOS activation, and wellness module operation Most important among the poor- All the features have been tested so the results show that the HelenHands software works on situations and application cases. The strength of the Virtual White Cane module in improving spatial awareness and safe use of the visually impaired is demonstrated by its success in real-time object detection, navigation guidance, audio output accuracy, and in a complex app Also, the Let's Chat module's ability to accurately recognize ASL and translate fingerspelling for smooth mute language users It highlights how it can support different languages and integration. Successful Back-End Server Integration ensures smooth data processing and connectivity, which maintains overall software reliability and efficiency Furthermore, the successful implementation and functionality of the SOS Reach module demonstrates how effective it is to deliver voice command calls for emergency calls, improving user safety in disaster situations Furthermore, the functionality and efficiency of the Wellness Aware Enabler module demonstrates its ability to promote active health care management by on personalized warnings and reminders.

4. Conclusion

It is a fact, however, that HelenHands is an Android application as detailed in the paper. The application has been developed in respect to persons who are blind, deaf or have speech difficulties for its utilization. A systematic procedure has been used by the paper to discuss sequentially various stages of implementation including use of machine learning models to find objects in real time; for example, provision of emergency services through voice commands and language translations into sign to enable smooth communication. Specific problems which these categories of users face are addressed during every phase and accessibility and usability being the main aims behind this design. Performance evaluation part gives important information about how well the machine learning models used in this app work especially when it comes to conversion of fingerspelled signs into text while users make them. In analyzing confusion matrices and classification measures, this work points out both potentialities and constraints of such technology that can be employed to help them solve their problems correctly. The accuracy achieved was however 74%, indicating more improvement areas that need attention for technological improvement purposes and thus shows that technological advancement is an ongoing process unlike some other domains where you get instant results even if they are not accurate. The research results also confirm also elucidate the significance.

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