Real-time Navigation System for Visually Impaired People

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Specialized in Software Engineering

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute 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 acknowledgment is made in the text.

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

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ABSTRACT

A person is considered to have visual impairment if their eyesight is not capable of being corrected to a normal level of vision. People who are blind or visually impaired must overcome several challenges in order to satisfy their fundamental requirements. One of the difficulties that persons who are visually impaired have to deal with is navigating their way around outside environments. When they travel, they are exposed to a variety of distinct dangers and risks. In order to get outdoors, people may opt to either walk by themselves or utilize any transit means. Choosing to walk alone as a mode of transportation is a more difficult endeavor than selecting any other mode.

Walking lanes are not the same as roads. They are made separately to walk by the people or the disabled people can use to travel there being safe from the vehicles. This will assist visually impaired people to travel safely. In this paper, it is discussed, how they can be assisted using Machine Learning and Image Processing.

Walking lanes are structures that resemble lanes and are located on both sides of major roads. These lanes are intended solely for pedestrians to use while they are walking. Walk lanes are available for use by those who are visually impaired; nonetheless, it is quite difficult to walk through walk lanes without stepping into traffic. The purpose of this work is to provide a hardware solution that, with the assistance of machine learning, may assist those who are visually impaired in navigating through walking lanes without striking the main road. Visually impaired individuals will have the confidence to walk along the walk lanes if this strategy is implemented. The hardware component consists of a camera and a Raspberry Pi, both of which are fastened to the eyeglasses in some kind. People who are visually challenged may use our gadget to receive spoken instructions in their headphones, which will guide them through the walk lanes..

Keywords – *Machine Learning, Raspberry Pi, Visually impaired, Image Processing*

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ML – Machine Learning

VI – Visually Impaired

1. INTRODUCTION

1.1 Background

Walking lane detection is an essential technology that we need in this day and age to help visually impaired persons and aid them in traveling in a secure manner. Accident rates are at an all-time high these days as a direct result of both high levels of traffic and poor driving. A diminished capacity to see increases the risk of experiencing an unintended physical harm. Previous research has provided light on the relationship that exists between the nature, magnitude, and frequency of injuries, in addition to the form of vision impairment, and the degree to which it is present. The kind of injuries that are often taken into account include ones that were caused by falling, being hurt while working, or being involved in an accident with a moving vehicle. Individuals who have visual impairments have a higher chance of inadvertently harming themselves as a consequence of falls, as shown by the results of an in-depth examination of the research that was conducted on the topic. This is in comparison to the danger that falls pose to the general population. However, aside from the research that was done on accidents that involved falls, very few studies were discovered that linked visual impairment to other types of injuries, such as those that were sustained on the job or in automobile accidents. This is in contrast to the research that was done on accidents that involved falls. The risk of crashing into obstacles is one of the key themes of this contribution. This is a subject that has only been touched on briefly in one piece of earlier research, so this is a welcome addition to the conversation. For the purpose of that study, each individual participant in a group of older participants was asked to complete a visual self-evaluation. This assessment included questions such as whether or not the person had accidently bumped into objects that they had failed to see.

When going outdoors, those who are blind or visually handicapped run the danger of tripping and colliding with other people. Even if the use of mobility aids such as the long cane and the dog guide can help lessen the severity of this risk, it is still important to exercise caution and think things through. The first research question that will be addressed by this paper is whether or not accidents involving a blind ambulator in a "static" environment (that is, accidents that are not due to traffic or to moving objects or persons near the blind person) represent a significant aspect of the experience of walking without sight, or if they should be considered sporadic and inconsequential incidents. The second research question that will be addressed by this paper is whether or not accidents involving a blind ambulator in a " This topic will be answered by assessing whether or if accidents involving a blind ambulator in a "static" environment (This problem, along with others like it, should be relevant to everyone engaged in the invention of new mobility devices for people who have visual impairments) (such as Electronic Travel Aids or ETA). Other types of accidents, such as those that involve automobiles and other modes of transportation, are obviously just as important and need to be investigated by appropriate research; but, investigating these other types of accidents is not within the scope of this specific piece of work.

Loss of vision is associated with a variety of negative side effects, one of which is a heightened feeling of anxiety over one's safety when moving around alone or traveling alone. Those who are blind or have limited vision have a difficult time navigating new area on their own, particularly when they are outside in the fresh air. This is especially true for people who are blind or have limited eyesight. The ability of pedestrians to walk along sidewalks without being endangered should be the major focus of attention. The specialists who work in the field of orientation and mobility take into consideration a wide variety of skills and tools in order to help visually impaired persons navigate the outdoors in a manner that is secure for them. People who are blind or visually impaired may get assistance with their movement and orientation as a result of this practice. Canes, dogs that have been taught to help individuals who have mobility challenges, and training to promote general mobility are a few examples of the types of mobility aids that are available. Numerous research have been carried out in order to study the challenges that could be faced in natural environments as well as the means by which these challenges might be successfully managed. The most cutting-edge methods incorporate cutting-edge technology such as Radio-Frequency Identification (RFID), Global Positioning System (GPS), Infrared Light-Emitting Diode (LEDs), wireless sensors, Navigation (NAVIG) devices, remote sighted guidance, an aid to increase the independent mobility of blind travelers (MoBIC), infrared verbal guidance systems, and computer vision modules. It has also been shown that increasing one's mobility via training may lead to improvements in one's performance with relation to mobility.

It is of the utmost importance to take into consideration the user's point of view on pre-existing issues in the surrounding area of the property. It is essential to make use of a trustworthy assessment method that is founded on client-centered perspectives in order to evaluate and comprehend the challenges that individuals who are blind or visually impaired face while they are indoors and at home. This is the case in order to evaluate and comprehend the challenges that these individuals face. It is essential that this be done in order to be able to analyze and comprehend the challenges that these particular folks encounter. It has been proposed that it would be beneficial to make use of the perspectives of the subjects about how well the home environment fits them. It is very essential for medical professionals to take these different points of view in mind when they are designing educational programs for persons who have a visual impairment.

Inclusion of persons who are blind or have low vision as part of the consultation process is one of the essential measures that must be taken in order to improve the overall quality of the information. As a result of this, suppliers of services are able to have a more in-depth understanding of the many different kinds of services that need to be delivered. It is possible that people who have a visual impairment could be a helpful source of information for the design of a system that is used in vision rehabilitation; however, in order to do so, it would be necessary to have an understanding of the unique strategies that people who have a visual impairment use. Therefore, before beginning any kind of adjustment, it is essential to talk the individual who will ultimately be applying this alteration. This should be done before beginning any kind of adjustment. It is important to have this dialogue before making any kind of adjustment. Because of this, it will be able to determine the requirements of the user in a way that is more detailed. Listening to members of the community and obtaining their points of view is the most effective method for accomplishing the primary objective of this research project, which is to gather data from the point of view of persons who are visually impaired.

Figure 1 Smart cane

As was just shown, there are now "smart canes" available to aid persons who are visually impaired in remaining safe. However, given that they are simply sensors, their security cannot rely only on them. The visually impaired person will be provided with a smart glass that contains a sensor and camera to detect the walking lane. This smart glass will be connected to a raspberry pi board via an extended cable and will have wired earphones to alert the user. The system that has been proposed will be implemented. They will be better able to prevent accidents as a result of this whether they are walking on a busy road or a regular one.

The following paragraphs provide an analysis of the relevant literature that was carried out for the purpose of this research in order to provide support for this inquiry. This analysis was carried out in order to facilitate the goals of this investigation. They are now the subject of an inquiry, and the results of the research are being incorporated into the design of this project on an ongoing basis as it moves forward.

1.2 Literature Survey

Knowledge regarding the research impacts, research problems, and research gaps can be obtained through the processes of conducting a literature survey and conducting an analysis of the existing research works discovered between 2017 and up to the present that have similar functionalities and technologies. In this part, we take a look back at some of the most notable pieces of study.

The writers of the article titled "Wearable Smart System for Visually Impaired Persons" often give a wearable good system that is intended to assist visually impaired people (VIPs) in traveling about independently on the streets and in public areas and in asking for assistance. A microcontroller board, various sensors, cellular connection and GPS modules, and a star panel make up the majority of the system's components. Multiple sensors are used by the system in order to keep track of the path and keep the user apprised of any potential hazards that may lie ahead. Because they are alerted by a buzzer sound as well as wrist sensations, it is helpful for persons who have trouble hearing or who are in loud environments. In the event that the user falls or requires help, those who are immediately nearby will be notified by the technology. As a direct result of this, the notification together with the current location of the system is sent as a text message to the mobile phones of all of the registered members of the family as well as the caretakers. In addition to this, the registered phones may access the system location anytime it is necessary and initiate the VIP search period. In order to confirm that the system model is both practicable and efficient, we do exhaustive testing on it on a regular basis. The approach that has been recommended offers more flexibility than earlier systems that have been used to do the same function. Quite frequently, we make the assumption that it will be a helpful tool that has the potential to improve the quality of life for VIPs [1].

The authors of the paper "Autonomous walking stick for the blind employing echolocation and image processing" claim that a good walking stick, which they refer to as the "Assistor," enables blind people to recognize obstructions and offers assistance in order for them to be able to achieve their goal. Echolocation, image processing, and a navigation system are just some of the technologies that have been made possible as a result of the Assistor's work. It is possible for people who are blind or have other visual impairments to get benefits from utilizing the Assistor, which would ultimately lead to an improvement in their quality of life. Numerous initiatives and lines of investigation are now being pursued in the hope of enhancing the standard of living of those who are blind or visually impaired. The user is able to move about with the assistance of a variety of walking sticks and systems, both inside and outdoors; however, none of these aids provide real-time autonomous navigation in addition to object detection and recognition alerts. This is the situation, despite the fact that there are a number of walking aids and systems available. The Assistor makes use of detectors to reverberate sound waves and locate things; the human ear is unable to hear the signals produced by these detectors. Image sensors are used to detect objects in front of the user as well as for navigation by capturing runtime photographs [2]. A smartphone app is used to direct the user to the destination by using GPS (Global Positioning System) and maps. An image sensor is also used to direct the user to the destination.

According to the authors of the research paper "IoT based smart walking cane for typhlotic with voice help," humans are compelled to move about in the surroundings. The most problematic aspects of day-to-day life for blind people include navigational tasks including travelling from one location to another, crossing streets, and determining where they are at any given moment in time. If they go into an area that is unfamiliar to them, not only do they put themselves in danger, but also the other individuals with whom they are going and maybe even other people. It is thus necessary for the family members of the visually impaired people as well as organizations that aid the blind to be notified of their current location. A reliable walking cane that also provides electrical assistance for mobility (ETA). The problem might be remedied with the assistance of a reliable walking cane if an investigation of both internal and external impediments, advice at grade crossings, and the location of visually impaired individuals in their present location were carried out. In order to indicate the position of those who are visually impaired, the Global Positioning System (GPS) is used. Additionally, inaudible sensors are utilized in order to identify impediments, and Reflective Below Red (RIR) sensors are utilized in order to offer level crossing direction. Through the use of a Wi-Fi module, the current location of the blind is sent to the cloud. A text-to-speech converter, together with stereo headphones, are used in order to provide information and instructions to the user of a high-quality walking cane. In a very noisy environment, it may be helpful to utilize both a buzzer and a vibrating circuit to help locate the target. This strong walking cane satisfies the required criteria for those who are blind to travel in a manner that is comparable to individuals who are visually impaired in terms of location and direction [3].

The authors of the paper titled "Efficient Multi-Object Detection and Smart Navigation Using Artificial Intelligence for Visually Impaired Individuals" claim that blind people face a variety of challenges on a daily basis and that technological advancements may be able to assist them in overcoming these challenges. The findings of this study suggest the development of an assistive technology that is capable of identifying a wide range of different things. Due to the fact that the user receives auditory inputs in real time, a visually impaired person may have an easier time understanding their environment. For the purpose of developing a deep learning model, many different photographs of items that are of particular importance to a person who has visual loss are employed as training data. The trained model receives a considerable increase in accuracy when it is provided with additional enlarged and manually annotated coaching pictures. In addition to computer vision-based approaches for object detection, the gadget also has a distance-measuring detector so that it can identify any obstructions to the user's path as they go from one location to another. This makes the device more comprehensive. This makes the device more useful in a variety of situations. During the process of scene segmentation and obstacle identification, the auditory data that is sent to the user has been updated. This change was made in order to speed up the collection of additional data and the analysis of video frames. It is believed that the proposed method is 95.19 percent accurate when it comes to the detection of items and 99.69 percent accurate when it comes to the identification of objects. Because the temporal complexity is kept to a minimum, it is possible for a user to comprehend their immediate environment in real time [4].

According to the authors of the paper "Efficient Multi-Object Detection and Smart Navigation Using Artificial Intelligence for Visually Impaired People," technology is developing every day in many different areas, making it possible to offer adaptable solutions for those who are blind or visually impaired, such as a good cane (stick). The development of current technology occurs at a rate that is exponential. A person who is blind, on the other hand, cannot be led or supported in a crisis by even a technology that has just a modest level of intelligence. The purpose of this investigation is to propose a practical gadget that makes use of inaudible sensors to identify the position of obstructions along a route. Those users who have issues with their eyesight will be able to traverse this system with the assistance of a cane that is linked to a robot application. Simply pushing the emergency button on the emergency handle of a cane that is equipped with a GSM radio makes it possible for a blind person to send an SMS message or make a phone call to a previously programmed number. In addition, individuals will get a notification whenever an urgent message is posted to their Facebook status. You may create an Android app that is not only brilliant but also straightforward and easy to use by following this strategy. A blind person may use their walking cane as an electric lantern that shines on its own while they are out walking at night in public places [5].

People who have visual impairments have a more difficult time moving about since their eyesight is impaired, as stated by the authors of "A Design review of Smart Stick for the Blind Equipped with Obstacle Detection and Identification using Artificial Intelligence." In addition, a blind person's ability to organize their daily activities and their navigational skills within a specific environment are essential to their overall health and welfare. If a blind person has not acquired the ability "to discriminate | to totally separate | to tell apart" between a variety of objects using just their hands, such as prescription containers and prepared meals, it will be very challenging for them to organize any usual activity. One of the most disheartening aspects of the problem is the fact that tens of thousands of people with visual impairments all over the globe suffer from this and are dependent on other people for their health and happiness. The encouraging news is that rapid advances in technology have led to the creation of improved support systems for those who are disabled in some way, including those who are blind. One example of one of these improved technologies is a pair of glasses powered by artificial intelligence that can give blind people with intelligent navigation. In this essay, the construction of a "smart cane," also known as a "sensible stick for the blind," which is outfitted with technology that allows for the detection and exploitation of obstacles is broken down in great detail. The incorporation of AI technologies into their trip enables a substantial increase in the amount of virtual visibility that is available. This demonstrates that a stick such as this could be of significant assistance to individuals who are blind [6].

The authors of "Smart Eye for Visually Impaired-An Aid to Help the Blind Persons" say that they outlined a plan for the development of an intelligent system that has the potential to assist those who are visually impaired in performing the activities of daily living. This tactic is described in the book "Smart Eye for Visually Impaired: An Aid to Help the Blind People," which is available on Amazon. In point of fact, those who are blind or who have visual impairments must conquer a range of obstacles in order to lead normal lives. They need continual support in the majority of situations, especially in reference to the tasks that comprise their everyday lives. One of the most significant challenges that people have to deal with in this day and age is how tough it is to go from one location to another without the assistance of another individual. There are a lot of additional concerns, such as difficulty in identifying persons and challenges with police investigations, among many others. There are also a lot of other problems. As part of our work, we often suggest using a "smart eye system" as a means of avoiding the complications described in the previous paragraph. It's possible that the tool will be a computerized device with a voice-activated interface that can guide a blind person through doing common tasks. A variety of different technologies that are currently in use have been combined into a single appliance in order to enable those with visual impairments with the ability to utilize a single helpful gadget. In this study, we investigate the design of such a system and, therefore, the difficulties that were encountered throughout the process of constructing the apparatus [7].

According to the authors of "Shopping and tourism for blind people leveraging RFID as an application of IoT," their goal was to provide a service that would benefit visually impaired individuals. They presented data in favor of the concept that individuals who have visual impairment would prefer to shop on their own, without the aid of other people. In order for this to take place when a visually impaired person is strolling around a shopping mall, it is necessary for that person to get familiar with the local companies as well as the goods and services offered by those businesses. The envisaged software application will aid blind persons in their searching by localizing them, supplying them with relevant information about each nearby company, and directing them to the locations that they have selected as their goals. The radio frequency identification (RFID) technology will make this a reality. Another feature that the program may provide is a notification service. [Case in point:] The current time, the estimated amount of time required for shopping, and the resultant closing time of a particular firm are all taken into consideration, and the user is thus provided with sufficient warning to allow them to finish any intended purchases before the business closes. Through the use of this study, the software package has seen a significant level of success both in terms of its creation and in terms of the success it has achieved [8].

The ability to safely navigate outdoor environments might be difficult for those who have vision impairments. This work makes significant strides in the development of a navigational aid that is accessible to those who are blind. We provide a dependable method for locating lanes that are allocated specifically for pedestrians at junctions with traffic. Verification of the lane markers and the extraction of the regions of interest (ROI) are the two processes that make up the recommended technique. The ROI is determined by using the data on the color and intensity of the area. After the ROI has been retrieved, it is next confirmed by making use of a probabilistic framework that employs a number of different geometric signals. The findings of the trials have shown that the recommended technique is robust in challenging lighting conditions and delivers higher levels of performance when compared to the strategies that are currently being used [9].

The recognition of pedestrian lanes is an important feature that is included in many assistive and autonomous navigation systems. In this study, a unique approach for recognizing pedestrian lanes is presented. The method is designed to be used in unstructured environments, where pedestrian lanes may have arbitrary surfaces and no painted markers. A hybrid deep learning-Gaussian process network, abbreviated DL-GP, is recommended for use in this approach for the purpose of segmenting a scene image into lane and backdrop portions. This network is a combination of a modest convolutional encoder-decoder net with a powerful nonparametric hierarchical GP classifier. The network that is produced as a consequence has fewer trainable parameters, which contributes to the reduction of the problem of overfitting while maintaining its capacity for modeling. In addition to producing a segmentation output for each test image, the network also generates a map of uncertainty. This uncertainty map is a metric that has an inverse connection with the degree to which we can trust the segmentation. This statistic is very important for applications that identify pedestrian lanes since the accuracy of the app's forecast affects the users' ability to stay safe. In addition, we provide a new data set consisting of 5000 pictures available for testing and improving the algorithms that are used to recognize pedestrian lanes. It is hoped that the collecting of this data would make pedestrian lane detection studies less difficult, especially when DL is used. When compared to a variety of other techniques that are already in use, the recommended network achieves much better results when evaluated on this data set [10].

It is critical for manufacturers to identify quality issues during production and halt the distribution of defective products to end users. We investigate the possibility of employing deep neural networks to automate quality control checks rather of relying on human inspectors as is now done. These checks would be based on image processing. The ability of a deep neural network to recognize problems with product quality was put to the test and investigated with the assistance of a real-world industrial case study. In contrast to the accuracy of a human inspection, which may range anywhere from 70–80% of the time, the findings reveal that the network has an accuracy of 94.5%, which is satisfactory [11].

Numerous researchers from a variety of backgrounds have conducted studies on the subject of traffic lane identification. The vast majority of methods, on the other hand, rely on human-designed representations of lanes, either in the form of shapes or colors. An method for identifying traffic lanes that is built entirely on fully convolutional neural networks is proposed by this study. In order to extract the feature that corresponds to the correct lane, a miniature neural network is built and used to carry out the process of feature extraction from a huge number of photographs. The parameters of the lane classification network model are used in the initialization of the layers' parameters in the lane detection network. The fully convolutional lane detection network is designed to be trained with the use of a detection loss function. The network's output contains pixel-wise identification of lane categories and location. The desired detection loss function is made up of a lane classification loss and a regression loss. Instead of complicated post-processing, lane marking may be easily accomplished by utilizing observed lane pixels and reaching agreement based on random samples. The results of the experiments indicate that the categorization network model has an accuracy of more than 97.5% for each category. In addition, the detection accuracy of the model that was trained using the suggested detection loss function can potentially reach 82.24% in 29 different scenarios involving roads [12].

It is essential for both assistive and autonomous navigation systems to overcome the difficulty of automatically determining the pedestrian lane in a scenario. This paper presents a vision-based technique for pedestrian lane detection in unstructured scenarios, which are conditions in which the colors, textures, and forms of the lanes change widely and in which there are no painted signs to designate the lanes. The method that has been described creates an adaptive lane appearance model by making use of a sample picture region that is automatically detected from the vanishing point of the image. This paper also presents a method for quickly and accurately estimating the vanishing point, which is based on the color tensor and the dominant pixel orientations of color edges. The proposed pedestrian lane detection method is evaluated using a newly created benchmark dataset. This dataset contains photographs taken in a variety of indoor and outdoor settings, along with images of several types of unmarked lanes. [13] This article presents the results of experiments that demonstrate the efficacy and robustness of the method in compared to numerous other ways currently in use.

The ability to recognize lanes is an essential component of an intelligent transportation system. The identification of lanes provides a helpful boost to both the assessment of the road geometry and the lateral placement of the vehicle. Compression and an improved version of the Hough transform are the two primary tools used in the development of a system for recognizing fast lanes. A lossy compression method is used for JPEG when encoding digital photographs. Using the Hough transform, it is possible to locate the lane markers. Combining JPEG compression with the Hough transform in order to speed up the process is the key objective of this project. After then, the efficiency of the algorithm will be assessed based on the results of a series of trials [14].

Finding one's way across pedestrian lanes and avoiding collisions with barriers may be difficult for those who are blind. A specialized instrument or an aide is required for the individual to carry out their regular responsibilities. Processing the data that was acquired by the camera required the employment of both the camera function and a little personal computer specifically designed for data processing. Initially, the RGB image that the camera had shot was converted into the XYZ color scheme after it had been taken. This color palette does a great job of calling attention to the pedestrian walkway while drawing less attention to other elements of the space. After that, a color filter was used in order to get rid of any unnecessary things, and after that, close morphology was utilized in order to find the pedestrian channel. The final product is a white area that is meant to depict a walkway for pedestrians. Moments were then used in order to establish the main axis, and the angle of this axis, which was determined by rotating counterclockwise with respect to the x-axis, was sent to the user in order to point them in the appropriate direction. During the process of identifying obstacles, a neural network was trained by feeding it numerous RGB image samples. Following that, the model was used as a potential obstacle detector. After that, test data were generated by using RGB photographs that had been taken by a camera. Results with a value higher than 0.7 were considered to be barriers [15].

People who are blind or have other visual problems may only move about as freely as their conditions let them to. Finding one's way about a city without the assistance of a person might be challenging for those who are blind or have other vision impairments. This article proposes both a theoretical framework and a system architecture for an electronic support tailored specifically to the needs of those with visual impairments. The purpose of this project is to develop a wearable Bluetooth headset that can be attached to a walking stick in order to provide assistance to blind individuals who are navigating the outside world. The Internet of Things refers to the connectivity of numerous systems, either by signals or a network, in order to facilitate communication between the systems. It is possible to detect the whereabouts of persons with visual impairments at this very moment by using the Global Positioning System (GPS), which is included into the cane. The recommended stick and the headset may be linked together with the use of a Bluetooth Stick. IoT may provide assistance to visually impaired people in finding their way back home by establishing a link between their headset and walking stick, both of which are Bluetooth-enabled and provide device communication [16].

Since the beginning of time, those who struggle with their vision have had trouble doing even the most fundamental tasks of daily life. It becomes increasingly difficult to recognize commonly used items. The use of walking sticks and guide dogs has historically made it simpler for blind people to perform basic navigational tasks. These kinds of strategies suffer from a number of limitations and are often ineffective in a wide range of contexts. Because of developments in technology such as computer vision and pattern recognition (CVPR), image processing (IP), the internet of things (IoT), and many others, these constraints have been greatly circumvented. The Internet of Things offers a wide variety of technical and automated solutions that may be of assistance to those who are blind or visually impaired. The approach makes extensive use of analytics and data science in many capacities. Data acquired by a multitude of sensors may be analyzed, used to locate obstacles, and enhanced via voice and haptic feedback. The raw data is then processed further and put through a number of different analysis. After this has been done, it is converted into a format that the system is able to understand and then instantly parses in order to carry out the various application components. These applications address a wide range of subjects, some examples of which include consumer, navigation, entertainment, and safety. These applications cover a wide range of technical domains, each with its own own hardware, software, and communication protocols. There are now a number of choices accessible that are both accurate and practical from an economic standpoint. However, there is still a difficulty with optimization. These devices have, in most cases, made living much easier for those who are blind or have some other kind of visual impairment. The primary objective of this article is to give readers with useful information about real-world applications of the Internet of Things in the fields of education, healthcare, entertainment, security, navigation, and finding solutions to difficulties that blind people face on a daily basis [17].

The incidence of visual impairments has significantly increased over the course of the last several decades. People who are visually impaired often need the assistance of others in order to carry out their duties and obligations on a daily basis. With the use of an automated system for identifying common items and currency, people who are visually impaired may be able to move about more safely and engage in more transactional activities. The solution that has been presented provides an audible message to warn the user and assists the blind in detecting a number of different objects. The system identifies moving objects by using four laser sensors to detect motion in the front, left, right, and ground directions respectively. The Single Shot Detector (SSD) model, in conjunction with MobileNet and Tensorflow-lite [18], is implemented in the system that is proposed in order for it to be able to identify objects and the money note in a real-time scenario in both indoor and outdoor settings.

Finding one's way around may be a constant difficulty for those who are blind or have other visual impairments. Because of this similar factor, the use of walking sticks has evolved into common practice. Nevertheless, there are several drawbacks associated with relying only on a blind stick. The user will be notified about the nature of the impediment by a method that is more suitable, which should also help in guiding the user to the location of the obstruction. In this body of work, we present an architecture for a shoe-based support system that makes use of Internet of Things (IoT) devices, sensors, and computer vision algorithms to provide a variety of features including navigation, obstacle avoidance, and more. The method utilizes the voice assistance of a smartphone and guides the user with appropriate haptic feedback that is decided by a number of sensors and actuators [19].

By the year 2021, the world's population will include close to 286 million people with some kind of vision impairment. When it comes to the number of people who are blind or visually impaired, India is in first place worldwide. India is home to 22 percent of the world's blind and visually impaired population. In India, there are a great many care facilities available for those who are blind or have some other kind of visual impairment. These individuals face a wide array of obstacles on a regular basis in their lives. When moving from one location to another, those who struggle with their vision sometimes have difficulty identifying obstacles that may be in their way. It is possible that they may engage in activities that are harmful to themselves or others if they do not get the necessary alert information at the appropriate time. We recommend that this blind individuals monitoring system be used to gather information concerning activities of this kind. This technology alerts visually impaired people in advance of the various impediments that are in their path and advises them to walk with the utmost caution by detecting the obstacles in advance. Our system alerts visually impaired care institutions of the exact location of visually impaired persons who are in need of immediate assistance when these individuals use emergency services. People who are blind or have some other kind of visual impairment have their whole behavior recorded and maintained in a database [20].

1.3 Research Gap

Blind and visually impaired persons may use current solutions to help them cross roads safely. But they don't really help kids walk securely; they only provide information. In order to identify the research gap, the following compares the planned study with previous studies.

Functions	**Smart Cane**	**Paper[6]**	**Paper[7]**	**Proposed system**
Image processing	✓	✓	✓	✓
Walking lane recommendation	X	X	X	✓
Moving out of road	✓	X	X	✓
Navigation alert	✓	X	✓	✓
Use of battery backup	✓	✓	✓	✓
Use of wired headphones to alert	X	X	X	✓
Use of mobile application	✓	X	✓	X
Object and people identification	✓	✓	✓	√

Table 1 Comparision Table

1.4 Research Problem

If a person's eyesight cannot be improved to a normal level with the use of corrective lenses or surgery, then they are regarded to have a visual impairment. People who are blind or have visual impairments have a number of obstacles that must be conquered in order for them to be able to fulfill their essential needs. Outside situations may be challenging to navigate for people who have vision impairments, which is one of the challenges these individuals face on a daily basis. When they travel, they put themselves in situations that might put them in harm's way in a number of different ways. People have the option of going for a solitary stroll or using public transportation in order to access the great outdoors. The decision to walk alone as a form of transportation is a more challenging venture than the decision to pick any other mode of transportation.

Walking lanes are distinct from roadways in every other way. They are constructed in a manner that allows individuals, including those with mobility impairments, to walk on them without fear of being run over by passing automobiles. People who are blind or have low vision will find this to be of great assistance while traveling. In this article, we will examine how the Internet of Things (IoT) technology might help them in several ways.

Structures that mimic lanes and are designed specifically for pedestrian use are known as walking lanes. These lanes may be seen on both sides of major roadways. When walking, only pedestrians are permitted to use these lanes, which have been specifically designated for their usage. People who are visually impaired have the option to utilize walk lanes; nevertheless, it is very difficult to go across walk lanes without stepping into traffic. The objective of this effort is to develop a piece of hardware that, in conjunction with the use of machine learning, has the potential to guide those who are visually impaired through walking lanes without causing them to collide with the main road. If this method is put into action, those who are blind or visually challenged will have the self-assurance to stroll along the designated pedestrian lanes. Both a camera and a Raspberry Pi board, which are both attached to the spectacles in some way, make up the hardware component. Both of these components are attached to the eyewear. The visually impaired may use our device to get spoken instructions in their headphones that will direct them through the walk lanes. This will be helpful for those who are unable to read signs.

People who have impairments may get aid and support through the internet of things in order to live better lives. Traveling presents a number of difficulties for those who are visually impaired (VI). In spite of the extensive research that has been conducted in this field, there is no one solution that has gained widespread acceptance by the blind community. This is mostly due to the fact that the mobility requirements of VI cannot be met by any of the current systems. People who are blind or visually impaired sometimes have a difficult time walking alone on a busy highway or on a standard street since they cannot see their surroundings as well. Therefore, it is vital to discover a solution to this problem and assist them in walking independently by recommending the adjacent walk lane, assisting them in remaining in the walk lane, and providing obstacle and person detection.

1.5 Research Objectives

1.5.1 Main Objective

Using the IoT gadget that was developed, guide persons who are blind or visually impaired to the appropriate walking lanes so that they may prevent accidents and help them identify obstacles and other people who are approaching from behind..

1.5.2 Sub Objectives

Following are the sub objectives for this proposed study.

- Development of smart glass
- Creating image processing system integrated with the device.
- Development of integrated system.

2. METHODOLOGY

2.1 Methodology

Our consistent point of reference are the lines on the road that demarcate the lanes and tell us where to go. For lane detection, we are making use of a canny detector-Hough transform based system.

2.1.1 System Overview

A System diagram is a visual diagram of the system that contains the components and their interactions with supporting documentation. The below system diagram shows the overall system planning. It shows how the codes are compared and given marks. This system shows the processes step by step how it is done and also helps to understand the core components.

In this research paper, we have to discuss about the image processing along with raspberry pi to create a device to assist visually impaired people with the assistance of battery backup and wired headphones.

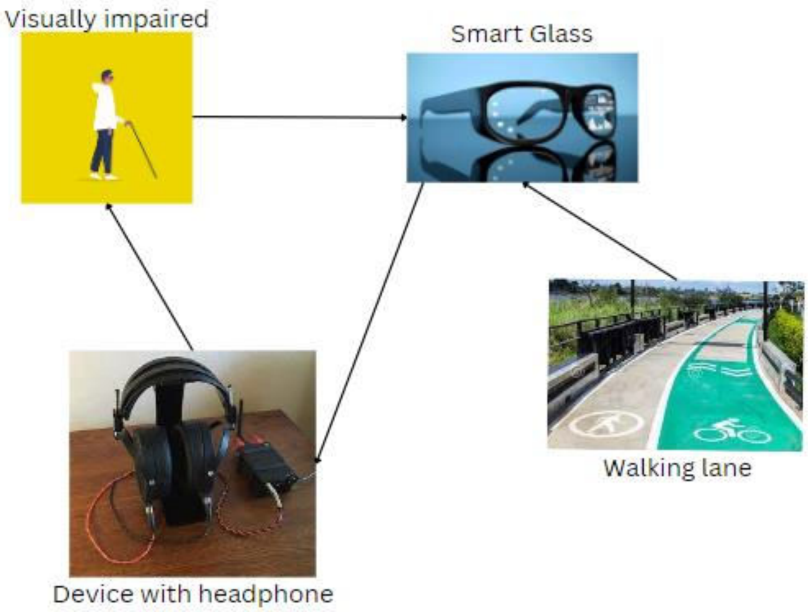

Figure 2 System overview diagram

2.1.2 Algorithm

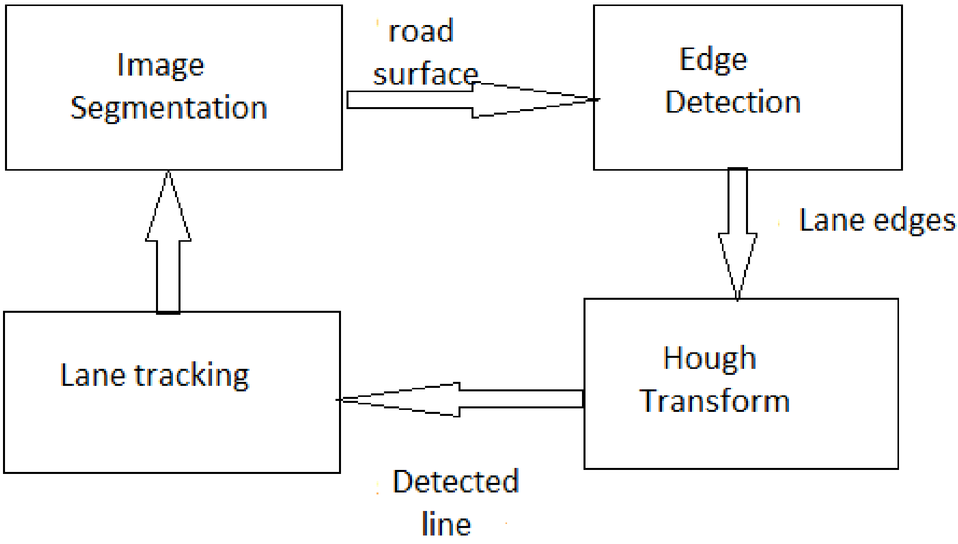

Figure 3 Algorithm of the system

2.1.2 Flow chart

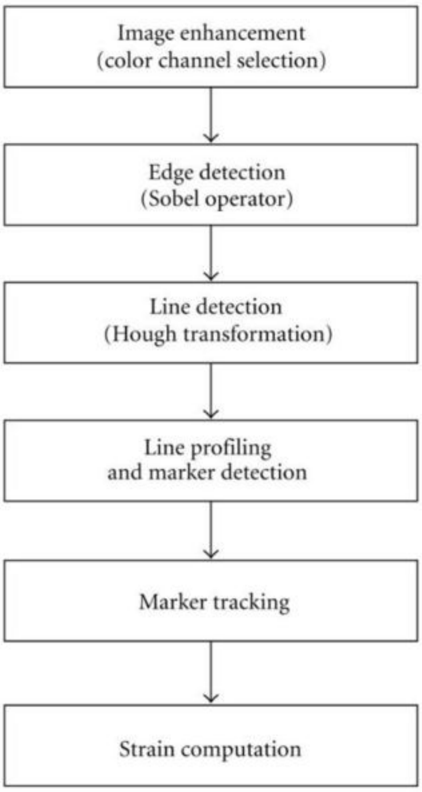

Figure 4 Flowchart of the system

2.1.3 Development Process

The Canny Edge detector only works with pictures in grey scale, thus we will need to transform our image into grey scale first. We are combining the Red, Green, and Blue pixel value channels into a single channel that will have a pixel value range of [0,255]. The next step involves applying a Gaussian blur to our grayscale picture; however, this step is optional since the canny detector will handle it for us. Each of these preprocessing processes must be performed differently depending on the data collection.

Yellow and white paint is always used to denote the lanes. The hue yellow may be difficult to identify while working in RGB space; thus, let's switch to the Hue Value Saturation, or HSV, color system instead. A search on Google will get the information you need to discover the desired range for yellow values. I've listed the ones I used below. After that, we are going to apply a mask on the primary RGB picture in order to get the pixels that we are interested in.

Check if opencv is already installed on your system. Install the numpy and matplotlib libraries on processing since we will be using them. Image preparation and preprocessing.

Image in greyscale The amount of complexity required to create greyscale pictures is far lower than that required to create color photographs. Without bringing up color, we may discuss a wide variety of aspects of pictures, such as brightness, contrast, edges, form, contours, texture, perspective, and shadows, among other things. After first providing a model for grayscale photos, it is possible to expand the model to color images.

Gaussian Filter: The primary objective of the gaussian filter is to lessen the overall amount of noise present in the picture. We do this because the gradients in Canny are particularly sensitive to noise, and since we want to get rid of as much noise as we possibly can, we do this.

cv2.GaussianBlur parameters: img, ksize, sigma

img: Image that will be taken by us in the future

ksize indicates the dimension of the kernel that is convolved over the picture.

The standard deviation is defined along the x axis by the symbol sigma.

detection of the canny edge: The core concept is to identify distinct transitions in brightness, such as a shift from black to white or white to black, and then label such changes as edges. Reduction of noise, intensity gradient, non-maximum suppression, and hysteresis thresholding are some of the techniques used. It has three different parameters.

- The img option allows us to specify the picture that will serve as the basis for edge detection.
- The threshold-1 option will filter out any gradients with a value that is lower than this number; these gradients will not be considered edges.
- The threshold-2 parameter is responsible for determining the minimum value that must be fulfilled before an edge may be deemed legitimate.
- Any gradient that falls in the middle of the two criteria will be taken into consideration if it is related to another gradient that is higher than the second criterion.
- Therefore, we were able to observe that it includes all of the edges in our picture, and we should focus on isolating the edges of the lane lines.
- Now that we have specified every edge in the picture, we need to separate out the edges that correlate with the lane lines so that we may analyze them separately. This is the approach that we will use to accomplish that.
- Using this function, a certain hard-coded portion of the picture that contains the lane lines will be extracted and isolated. It just requires one

argument, which is the Canny picture, and it will output the area that has been isolated.

- We are going to extract the picture dimensions by utilizing the numpy.shape function, which can be found at line 1.

Between lines 2 and 4, we are going to establish the parameters of a triangle, which will represent the area that we are going to partition off

In lines 5 and 6, we are going to make a black plane, and then in line 7, we are going to define a white triangle using the same dimensions that we used in line 2 for the black triangle.

We are going to separate the edges that match with the lane lines by performing the bitwise and operation in line 7, which will enable us to do so.

This one line of code is the most important part of the whole process. It performs the Hough line transform. It is referred to as the Hough Transform, and it is the component that is responsible for transforming the clusters of white pixels that originate from our isolated area into real lines.

- The isolated gradients are the first parameter.
  In the definition of the bin size, parameters 2 and 3, the value for rho is defined as 2, and the value for theta is defined as np.pi/180.

- Minimum number of intersections required to be deemed a line for each individual bin (in our case, its 100 intersections)
  Placeholder array, which is parameter 5
  Parameter 6: Minimum Line length
  Parameter 7: Maximum Line spacing

- Improving the Display and Optimizing the Lines

In order to calculate the average of the lines, we are going to construct a function that we will simply refer to as "average."

This function takes the lines produced by the cv2.HoughLinesP function and calculates their mean value. It will determine the average slope and y-intercept of the line segments on the left and the right, and then it will output two solid lines in their place (one on the left and other on the right).

Each line segment that is shown in the output of the cv2.HoughLinesP function contains two coordinates. The first coordinate indicates where the line begins, and the second coordinate indicates where the line concludes. We are going to determine the slopes and y-intercepts of each line segment by using these coordinates as inputs.

After that, we will compile a list of all of the slopes of the line segments and place each line segment into either the list corresponding with the left line or the list corresponding with the right line (a negative slope corresponds to the left line, and a positive slope corresponds to the right line).

- On line 4, perform a loop that iterates across the array of lines.
- On Line 5, determine the x and y coordinates of the two points that are associated with each line segment.
- For lines 6–9, you need to figure out both the slope and the y-intercept for each line segment.
- Lines 10–13: Include the slopes with a negative sign in the list for the left lines, and include slopes with a positive sign in the list for the right lines.

NOTE: In general, a positive slope corresponds to the left line, and a negative slope corresponds to the right line. However, in this particular illustration, the y-axis is inverted, which is the reason why the slopes are inverted (all images in OpenCV have inversed y-axes).

Next, we need to get the average slope and y-intercept for each lists by averaging them together.

- Lines 1–2: Determines the average of each individual line segment for both lists and applies it to these lines (the left side and the right side).
- For Lines 3–4, this function computes the beginning and ending points of each line. (In the next paragraph, we will discuss the make points function.)
- Input the two coordinates for each line on line 5, which may be found below.

After determining the average slope and y-intercept for both lists, the next step is to determine the beginning and ending points for both sets of data.

This function prints the beginning and ending locations for each line, using as input the image containing the lane lines and a list containing the average slope and y int of the line. The function requires two parameters: the image containing the lane lines and the list.

- In the first line, provide the function.
- On Line 2, determine the average slope as well as the y-intercept.
- Lines 3–4: Specify the height of the lines in this section (the same for both left and right)
- Lines 5 and 6: Determine the x coordinates by rearranging the equation of a line from $y = mx + b$ to $x = (y - b) / m$. • Line 7: Produce the sets of coordinates.

To expand a little bit more, in line 1, the height of the picture is determined by the value of the y1 variable. This is because the y-axis is inverted in OpenCV, which means that 0 is located at the top of the picture and the origin is located at the height of the image (refer to the image below).

In addition, we increased the value of y1 by 3/5 in Line 2. This is because we want the line to begin at the picture's origin (y1) and terminate 2/5 up the image (the percentage is 2/5 rather than 3/5 since the y-axis is invested; hence, instead of seeing 2/5 up from 0, we see 2/5 down from the maximum height).

On the other hand, this function is solely responsible for calculating the points that are required to show these lines; it does not actually display the lines themselves. In the next step, we will develop a function that, given these points, may then be used to generate lines. This function takes in two parameters: the picture that we want to show the lines on, and the lane lines that were outputted from the average function. The image is sent in as the first argument, and the lane lines are passed in as the second parameter.

- Line 2: Create a black image with the same dimensions as our original image
- Line 3: Verify that the lists containing the line points are not empty
- Lines 4–5: Loop through the lists, and extract the two pairs of (x, y) coordinates
- Line 6: Create the line, and paste it onto the black image with the lines.
- Line 7: Output the black image with the lines

It's possible that you're questioning why we didn't just add the lines onto the actual picture rather than using a dark image. The raw image is a little too bright, so it would be nice if we could darken it a bit to see the lane lines a little more clearly. Well, the raw image is a little too bright, so it would be nice if we could darken it a bit to see the lane lines a little more clearly.Using the cv2.addWeighted function is the correct approach.

By assigning a weight of 0.8 to each pixel in the real picture, this function makes the pixels somewhat darker (each pixel is multiplied by 0.8). In a similar manner, we assign a weight of 1 to the blacked-out picture that contains all of the lane lines. As a result, all of the pixels in that image maintain the same intensity, which highlights it.

Here, all the functions that we've already specified are called, and the output of the function's result is written to line 12. The length of time an image should be shown for may be specified to the program through the cv2.waitKey function. Because we entered "0" into the function, it will hold off on closing the output window until it detects that a key has been hit.

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2.1.4 Feasibility Study

Feasibility study means the technological resources needed for the project should be identified and discussed. The technologies like image processing, raspberry pi are needed for the development of this research project. There are algorithms related to image processing. Therefore, this research project is almost technically feasible.

The following tools and technologies are used to develop this system.

- Python
- Open cv

- GIT
- Raspberry Pi

2.1.5 Requirement Gathering

This phase is one of the important steps that need to be done before implementing any system. Collecting the requirements is where the needs for the projects are identified and that helps to identify the functional and non-functional requirements of the system. It is a must to analyze and read a lot of previous research paper works related to this project, to know what kind of implementations to be done, which technologies were used in the previous research works, up to which extent they were successful or the accuracy and efficiency of those systems and what are the research lacks in those existing works. Those research papers no only describe about their systems, but also about the boundaries and issues with the system. Understanding them will be more helpful to find a new solution without those problems. The best source to gather the requirements is previous research works and existing systems. Also, the requirements are gathered from Google Scholar, Google and relevant people who use similar systems and also from the feedbacks given to existing systems.

2.2 Resources Used

2.2.1 Software Boundaries

- Visual Studio code:
  It is a freeware source-code editor that can be used in Linux, Windows, and macOS. It is used as the editor for this project

- GitLab

It is the web-based DevOps lifecycle tool that offers a Git repository for the continuous integration developed through GitLab inc. It is used for this project to integrate the project and also used for version control.

- Google Collab

  Collab has notebooks where we can execute our code in a single document. It allows anybody to write and execute codes and can be shared among team members using a link which is more helpful than sending as a zipped file or uploaded drive file. In the initial stage of the project, system was executed in Jupyter notebook and ran to test the system.

2.2.3 Hardware Boundaries

- Data Storage for research related documents and project work – 200 to 300MB.
- RAM- 16GB.
- Processor speed – 1.0GHz minimum.
- Server machine with higher processing power.
- Raspberry PI
- Camera sensors
- Headphone
- Required raspberry pi modules.headphones

2.3 Testing and Implementation

2.3.1 Implementation

2.3.1.a Vanishing point estimation

When looking at an image, the vanishing point is often identified by either utilizing line segments or by using local orientations. Estimating the vanishing point of an unstructured scene with edges that aren't straight is easier to do with the help of local orientations as opposed to utilizing line segments. On the other hand, the majority of currently available approaches that are based on local orientations have a high computational cost and are susceptible to background clutter. In addition to this, they only use the intensity channel, despite the fact that color channels include photometric information that might result in a more accurate identification of edges and local orientations. We propose in this work to increase the accuracy and efficiency of vanishing point identification by making use of color tensors to capture picture structure and concentrating primarily on edge pixels.

A color picture may have its local differential structure analyzed with the use of a tool known as the color tensor. Imagine you have a picture with three color channels: F=Fk, where k is a number between 1 and 3. Let's say that the derivatives of Fk along the horizontal x-axis and the vertical y-axis are denoted by Dk, x and Dk, y, respectively. Let the convolution kernel of a smoothing filter be denoted by the letter w. The representation of the image's color tensor is as follows:

$$\begin{pmatrix} G_{xx} & G_{xy} \\ G_{yx} & G_{yy} \end{pmatrix} \quad \text{where} \quad \begin{cases} G_{xx} & = \mathbf{w} * \left[\sum_{k=1}^{3} D_{k,x} \circ D_{k,x}\right] \\ \\ G_{yy} & = \mathbf{w} * \left[\sum_{k=1}^{3} D_{k,y} \circ D_{k,y}\right] \\ \\ G_{xy} & = \mathbf{w} * \left[\sum_{k=1}^{3} D_{k,x} \circ D_{k,y}\right] \end{cases} .$$

In this case, * represents the element-wise multiplication, and stands for the convolution in two dimensions (Hadamard product). We estimate the dominant local orientation θ and the edge strength λ for each pixel in the picture based on the eigenvalue analysis of the color tensor.

$$\theta = \frac{1}{2}\arctan\left(\frac{2G_{xy}}{G_{xx} - G_{yy}}\right) + \frac{\pi}{2},$$

$$\lambda = \frac{1}{2}\left(G_{xx} + G_{yy} + \sqrt{(G_{xx} - G_{yy})^2 + 4G_{xy}^2}\right),$$

where the mathematical operations are done on an element-by-element basis. After that, the non-maximum suppression and hysteresis thresholding techniques that are used in the intensity-based Canny edge detector are applied to the picture in order to locate the image's edge pixels. The primary distinction between this study and others is that the dominant local orientation and the edge strength are calculated with a higher degree of accuracy by making use of photometric data collected. For the input picture shown in below, the calculated local orientations are shown in Figure 5(b), and the estimated edge map is displayed in Figure 5(c).

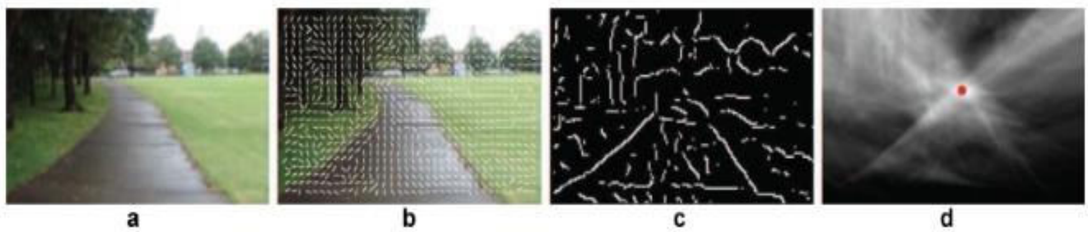

Figure 5 Image processing

An illustration of the suggested method for estimating the vanishing point: (a) the color input picture; (b) the local orientations estimated by the color tensor for sampled pixels; (c) the edge map acquired by the color Canny edge detector; and (d) the vanishing point map and the map of the vanishing point (in red). View the picture in full color on the screen.

Each pixel position is evaluated as a potential vanishing point (VP) candidate before a score for that pixel's VP is determined. This is done so that the vanishing point may be located. Let's call this group of edge pixels P, where yp is greater than yv. Let vp represent the difference between the dominant local orientation at pixel p and the angle of the vector lvp that connects v to p:. Let's say that the ratio of the length of lvp to the diagonal length L of the picture is denoted by the symbol vp: After considering a number of different options, we have decided to offer the following definition for the contribution of pixel p to the score of candidate pixel v:

$$s(v,p) = \begin{cases} \exp\left(-\Delta_{vp}\ \mu_{vp}\right), & \text{if } \Delta_{vp} \leq \tau_o, \\ 0, & \text{otherwise.} \end{cases}$$

A positive threshold on the orientation similarity between p and lvp is denoted by the symbol o in this context. According to equation (4), the value of s(v, p) will be large if the following conditions are met: I the orientation of pixel p is comparable to that of vector lvp; and (ii) pixel p is located in close proximity to v. The value of candidate v's VP score is equal to the total of the contributions made by each pixel in P:

$$S(v) = \sum_{p \in P} s(v,p) \, .$$

After much searching, the vanishing point was discovered to be the pixel with the greatest possible VP score. displays the vanishing point map as well as the vanishing point that was calculated for the picture in. Additional findings of the suggested approach for estimating the vanishing point are presented here.

2.3.1.b Sample region selection

It is difficult to obtain a reliable appearance model using off-line training because the appearance of pedestrian lanes in unstructured scenes can vary significantly in terms of color, edge, shape, and texture. Furthermore, illumination conditions have a significant impact on the appearance of pedestrian lanes. As a result, it is more rational to develop an appearance model by iteratively and directly extracting information from the input picture. Existing approaches, often pick the sample area as a tiny region at the bottom or in the middle of the input picture. This is done to accomplish this goal. Nevertheless, there is a good chance that non-lane areas will be included in the sample region if it is chosen in this way. The sample area is automatically established in our method by making use of the vanishing point, which was calculated in the step before to this one. After that, the sample region is confirmed by making use of the color and orientation attributes of both the lane borders and the lane regions.

Although a lane may take on a variety of forms, its primary component can often be represented by boundaries that are straight. Therefore, the boundary of the sample area may be represented with the help of imaginary rays if one so chooses. In order to do this, a series of rays are generated that extend outward from the vanishing point, as seen in. These rays have a consistent distance between them over the whole angle range [min, max] with respect to the horizontal direction. Finding a ray pair (ri, rj) that most accurately represents the primary portion of the pedestrian lane is the first step in locating the sample area.

Two characteristics are specified in relation to a certain ray r: the difference in orientation do between ray r and the pixels that are close to it; the difference in color dc between two areas that are adjacent to r. Let's say that the angle of ray r is denoted by r. Consider the group of pixels whose Euclidean distance to r is less than Le. This group will be denoted by. In this context, L denotes the length of the image's diagonal, while e stands for a threshold. The calculation for the orientation difference do between pixel r and its neighbors is as follows:

$$d_o = \frac{1}{|\mathcal{N}_r|} \sum_{p \in \mathcal{N}_r} |\theta_r - \theta_p| ,$$

where θ_p is the orientation of pixel p

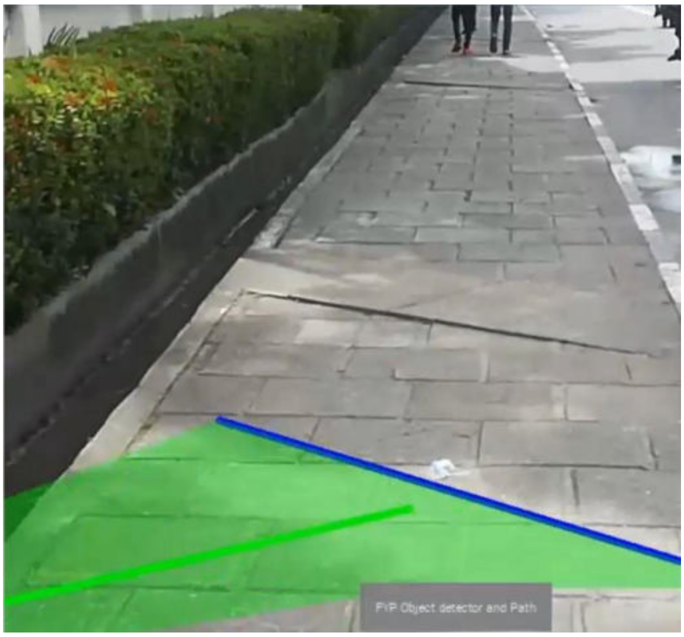

Figure 6 Walk-Lane Detection

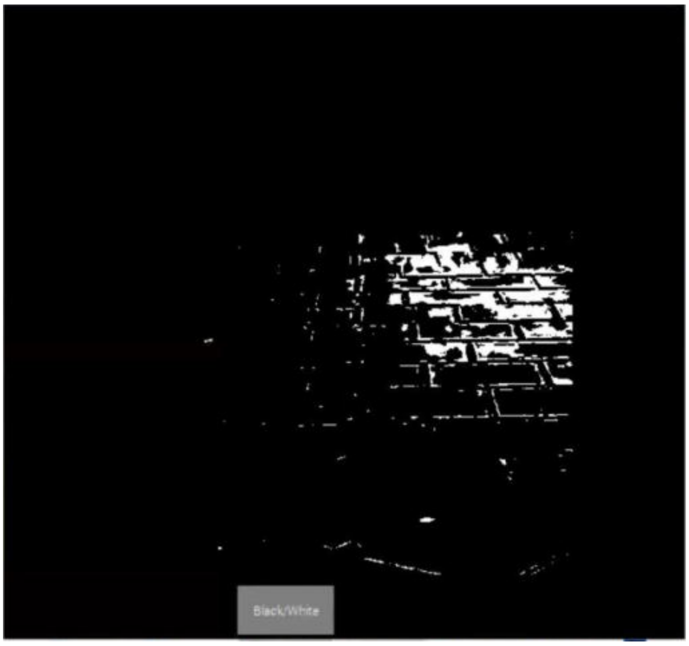

Figure 7 Edge Detection of Walk-Lanes

Figure 8 Person Detection in walk-Lanes

2.3.1.c Lane Segmentation

During this step, the input picture is first split into color homogenous sub-regions. These sub-regions might be any size. There are many different picture segmentation algorithms that may be used. Because it is quick and works well for our purpose, the graph-based segmentation technique that was published in is the one that we will be using in this study. This method starts with individual pixels for each sub-region it creates. The subsequent step is to combine adjacent sub-regions in an iterative manner, taking into account the color difference that exists between the sub-regions. The segmented areas for the input picture are shown in the figures that are located above.

The identification of the pedestrian lane comes next. Let us assume that the collection of subregions that are all the same hue is called. The pedestrian lane is handled as if it were a linked set Z of subregions of. If there are two linked pixels that fall inside the boundaries of subregions Ri and Rj, then the two subregions are regarded to be connected (e.g. 4-connected pixels).

A color feature as well as a form characteristic will be used to depict a linked zone. The mean of all the color pixels in Z is represented by the c color characteristic. The following formula may be used to get the lane score for any given color feature.

where is the probability density function that takes into account the lane class's conditional status. It is approximated using the color histogram of all of the pixels located in the sample lane area, which may be located by following the instructions in Section 3.2. In this study, we focus on analyzing color using two different color spaces: the red–green–blue (RGB) space and the illumination invariant space (IIS). The IIS has a lower sensitivity to changes in light and shading than the RGB does. Conversion from the RGB color space to the IIS color space.

The shape contexts that are presented in are used in order to extract the shape feature s. The shape contexts are well-known for their resistance to local deformation and partial occlusion, as well as their invariance to scale and rotation. This is a characteristic that sets them apart from other contexts. Imagine a form that has sample points scattered all across its contour. The histogram hp of the angles and distances between a sampling point and the other sample points provides insight into the form context of a sampling point p. The difference in the contour settings of the two points p and q is denoted by the symbol.

$$C(p,q) = \frac{1}{2}\sum_{k=1}^{K} \frac{[h_p(k) - h_q(k)]^2}{h_p(k) + h_q(k)},$$

where K is the total number of containers that make up each form context. C(p, q) is considered to be high since the shape contexts of the points p and q on a single form are distinct from one another. On the other hand, the shape contexts of two equivalent points p and q on two identical forms are similar, which means that the value of C(p, q) is low.

Consider the following: a collection of sample forms for pedestrian walkways. Figure 4 illustrates several examples of the shape templates that may be produced by using the training data. In order to acquire the shape feature s, the outside contour of area Z must first be sampled in a manner that is analogous to how the templates were. The model for calculating the matching cost D(s, T) between s and a template T reads as follows,

$$D(\mathbf{s},T) = \frac{1}{|\mathbf{s}|}\sum_{p\in\mathbf{s}} \min_{q\in T} C(p,q),$$

An exhaustive search across the subsets of may bring about the desired result of obtaining the ideal area Z, which has a computing cost of. We use a greedy-search method [35] to cut down on the amount of work that has to be done on the computer. This technique creates Z by repeatedly adding and eliminating sub-regions (see Algorithm 1). At each iteration, a sub-region is either added to or removed from Z only if the connectivity of the new Z is fulfilled and the lane score g(Z) is enhanced. If neither of these conditions are met, the sub-region remains in Z. In addition, in order to make the search go more quickly, we only take into account subregions that have a threshold that is more than or equal to c. The method will eventually converge on the correct solution due to the fact that there is a limited amount of sub-regions and the operators in Algorithm 1 are deterministic.

2.3.2 Testing

The system needs different types of testing methods in different phases of the development life cycle. These tests help to identify any weak points of the system. Testing is both a complex and critical component of the development of the application. Application testing includes usability, performance, security, functional and non-functional aspects. The testing will enhance the quality of the product. It is important to identify the weakness of the system in the early stage to avoid some issues. By writing test cases for each operation, bugs and issues can be fixed. Unit testing, module testing, integration testing, and system testing should be done for this project.

a. Unit Testing

Each and every module is tested individually and made sure that all the functionalities are working correctly according to the requirements. If the components are error-free, they can be integrated with other components easily..

b. Module Testing

Module testing is where each individual modules like classes, procedures in the program are tested instead of testing whole system. In this research, each and every file, component, and subsystem are checked during this testing method. It is done by another group member, the owner/author does not need to test their own modules. In this way, testing is shared among other members in order to check each other's part.

c. Integration Testing

Integration testing is done after integrating components or subsystems with each other. Here, subsystems like raspberry pi and the smart glass we made are connected and audio guidance needs to be tested..

d. System Testing

It is done after all the components are integrated and the system does not need to know the inner design of the component. Here, the system is checked with actual outputs and expected outputs to check whether marking system is functioning correctly. Through this testing, if there any errors related to integration exists, they can be found and repaired.
Below are some test cases that are done for each testing method.

2.3.3 Test Cases

Test Case	Test Case 001
Test case description	System must detect Walking lanes.
Pre-condition	User Must wear the Smart Glass.
Test procedure	User walks on the road. Glass detects the walking lane from the live video feed.
Test input	Live video of road
Expected Result	User should be alerted about walking lane.
Actual result	Worked as expected
Test Result	Pass

Table 2 Test case 1

Test Case	**Test Case 002**
Test case description	Headset giving correct alerts.
Pre-condition	User Must wear the Smart Glass.
Test procedure	1. User walks on the road with the smart glass.
Test input	Output from image processing
Expected Result	Proper voice alert given through the headset.
Actual result	Worked as expected
Test Result	Pass

Table 3 Test case 2

Test Case	**Test Case 003**
Test case description	System gives alert when the user moves away from the lane.
Pre-condition	User Must wear the Smart Glass.
Test procedure	1. User walks on the walking lanes and tries to move away from the lanes.
Test input	Output from image processing
Expected Result	Voice alert to notify about hitting the road.
Actual result	Worked as expected
Test Result	Pass

Table 4 Test case 3

Test Case	**Test Case 004**
Test case description	System gives people alert when walking on the road.
Pre-condition	User Must wear the Smart Glass.
Test procedure	User walks on the walking lanes.
Test input	Output from image processing
Expected Result	Voice alert to notify about the people in the specified region.
Actual result	Worked as expected
Test Result	Pass

Table 5 Test case 4

Test Case	**Test Case 005**
Test case description	System gives proper navigation when walking on the walking lanes.
Pre-condition	User Must wear the Smart Glass.
Test procedure	User walks on the walking lanes
Test input	Output from image processing
Expected Result	Voice alert about walk lane navigation.
Actual result	Worked as expected
Test Result	Pass

Table 6 Test case 5

3. RESULTS AND DISCUSSION

This chapter discusses the results obtained from the development of the application. This system will be helpful for students and teachers. For students, instant results will boost their knowledge by make them find a way to understand the code. And for teachers, it reduces the time taken for manual correction.

According to the outputs get from each phase, it is clear that accuracy of the system is depends on many factors. Those are algorithm, data set for training, and testing. According to the requirements, the system should be a device that assist the user using a smart glass and wired headphone with a battery backup. The device is,

- Simple and user friendly
  Just wear the glass and the device can be connected in the belt or bag strap or put inside the pocket. The headphone or earphone can be connected to the device and it will assist the visually impaired user in the road.
- Quick response
  The alert will be given to user with live processing.

There are some difficulties occurring during the implementation of this application.

- Accuracy can’t be exactly said to be 100%. It is up to 70 - 80% as there can be better solutions added in the process of partial matching percentage.

4. CONCLUSION

This research proposes a technique for detecting pedestrian lanes in unstructured settings by integrating color, edge, and shape characteristics. The approach was developed by the authors of this paper. The image processing is used to automatically select a sample lane area, and the vanishing point is used to evaluate whether the user is traveling out of lane. Based on this information, an adaptive lane model is developed. The results of an evaluation performed on a large data set have shown that the approach that was presented is able to recognize a variety of different kinds of unstructured pedestrian lanes, both outside and inside, even when subjected to difficult weather circumstances. In addition to this, its accuracy is superior to both of the currently available alternatives for detecting pedestrian lanes. The methods that have been proposed for detecting vanishing points and pedestrian lanes have a variety of potential applications. Some of these applications include navigational assistance for people who have vision impairments, intelligent wheelchairs, autonomous robots, and vehicles that operate on open roads.

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