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# Smart Shoes for Blind or Visually Impaired People insideNavigation Using Visible Light Communication

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**ABSTRACT**
A person who is blind has completely lost all of their sense of light. One type of blindness is complete blindness. Problems with mobility and direction have a major impact on a blind person's daily functioning. Walking canes and guiding dogs are two common and traditional mobility aids for those who are blind or visually impaired. The two main problems with these assistive gadgets are their restricted movement and data transfer. This idea gives the visuallyimpaired person a smart shoe that uses voice commands that are transmitted through a light source to help with navigating. Additionally, the shoe may warn the wearer of impending danger. The smart shoe incorporates cutting-edge features like voice commands and light-based navigation to enhance the capabilities of traditional walking aids. Because voice instructions are so consistent and easy to use, the user can move around with confidence and make the most of their surroundings. The built-in light source in the shoe will help those who depend on residual vision or light perception since it offers a concrete point of reference and real- time information about the path ahead. The obstacle identification feature, which warns the user of potential hazards and aids in collision avoidance, also makes navigating safer.

**Keywords-** Li-Fi, Voice Command, Ultrasonic Sensor, Water Sensor, Obstacle Detection, Navigation System.

## I. INTRODUCTION

Like Wi-Fi, Li-Fi allows for rapid wireless data transfer between devices. Given its shortcomings, Li-Fi can be considered a better option than Wi-Fi. Li-Fi technology can be used to carry data using inexpensive LEDs. Compared to Wi-Fi, this wireless communication technology is more affordable and has a faster download rate. Li-Fi avoids the interference problems that Wi- Fi has since it uses a spectrum that is unrestricted and safe for the environment. As light cannot flow through walls, Li-Fi is safeto use indoors. If the LED is lit up, the user can send a digital string of 1, and if it's dark, a string of 0. This is because of the incredibly fast switching mechanism, which provides potential for instantaneous data transmission. Line-of-sight (LOS) is necessary for communication while utilizing Li-Fi. A light detector detects the light that the LED generates. The generated digital signal is thenconverted back into its analog form to get thedesired result. The problems with radio bands that Wi-Fi and other technologies are havingcan be resolved thanks to this idea. It is essential to have a system that provides relevant and timely navigational data in real time so that users can choose the best path within a building. Blindness is the most severe of the several visual impairments. GPScan be used to determine the user's location. In a blind and blindfolded performance test, the efficacy of this prototype was compared to the standard white cane. Significant offset values were also noted in the identification of obstacles below sight and in the detection of wet and muddy surfaces. Furthermore, compared to other comparable gadgets already on the market, the suggested cane weights a lot more. A smart cane was proposed by Mutiara et al. in 2017 to aid the mobility of those with vision impairments. This prototype has the ability to look through holes and walls as well as feel which way they are traveling. The prototype could be used as a listening guide system. With Google Maps, this Android app provides turn-by-turn directions in real-time. The shoes that the user wears act as a sensor, providing data. Because it relies on the user'ssmartphone, this setup is not portable. Additionally, the user may be

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harmed by the GPS's accuracy while interacting with moving obstructions and position offset. Smart shoes were developed in 2017 by Khder et al. to identify obstacles and provide voice directions to blind users. The sound's intensity is dependent on how far away from the barrier it is. The fact that this prototype is limited to Android devices is one of its primary problems. Another problem is that the hardware is not watertight. Another issue is that the hardware is not watertight. Users of this technique have also claimed that the generated mobile application is hard to operate and does not allow data to be saved for analysis or later use. In the same year (2017), Khan et al. developed a smart cap/shoe unit that would protect the blind and visually challenged. Miniaturized vibrators are used in the construction of this system. The external ultrasonic sensors on the shoe and cap will activate when they come into contact with a solid object. With GPS and GSM modules, the blind person's whereabouts can always be monitored. The experimental results demonstrated how weak the audio signal from this system is at 150 cm from the shoes. In this field, a great deal more research and technology have been developed and put into use. The following citations are supplied for the convenience of interested parties. In conclusion, none of the systems that were recommended had any of the four qualities mentioned above. Furthermore, no investigator has presented an electrical safety design that reduces unnecessary processing and erroneous alerts. Their ultimate goal is to make the world a safer and more easier environment for those with vision impairments to navigate. With the innovative combination of footwear and technology, smart shoes enable people with low eyesight to have more flexibility. Wearers may move around with more confidence and awareness of their immediate surroundings because to the high-tech sensors and navigational help that are included into these trainers. Smart shoes transform the way blind individuals can move around by combining technology and style.

## II. LITERATURE SURVEY

"Assistive technologies for the visually impaired: A comprehensive review" by Smith,J., et al. (Journal of Assistive Technology, 2018) This review provides an overview of various assistive technologies developed for visually impaired individuals, including walking aids, navigation systems, and smart wearables. It highlights the importance of user-centered design and discusses the challenges andopportunities in this field

"Smart shoes for the visually impaired: A state-of-the-art review" by Lee, H., et al. (IEEE Transactions on Human-Machine Systems, 2020) This paper presents a comprehensive review of smart shoe technologies designed specifically for the visually impaired. It analyses the features, sensors, and algorithms used in existing smart shoe prototypes and assesses their effectiveness in improving navigation and obstacle detection.

"Human-computer interaction in smart shoes for the visually impaired: A systematic literature review" by Wang, Y., et al. (International Journal of Human-Computer Interaction, 2019) This systematic review examines the human-computer interaction aspects of smart shoes for the visually impaired. It discusses user experience, usability, and design considerations to ensure the technology is user-friendly and efficient

"Voice-based navigation systems for the blind: A comparative review" by Garcia, L., et al. (Journal of Accessibility and Inclusive Design,2017) Focusing on voice-based navigation systems, this review compares various voice command interfaces used in assistive devices for the blind. It evaluates the accuracy, response time, and user satisfaction to identify the most effective solutions.

"A review of indoor localization methods for the visually impaired" by Kim, S., et al. (Journal of Location Based Services, 2021) This reviews paper focuses on indoor localization methods that can assist the visually impaired in navigating indoor environments. It discusses technologies like Bluetooth beacons, Wi-Fi positioning, and indoor mapping.

"Wearable haptic devices for navigation assistance in the visually impaired: A review" by Yang, L., et al. (IEEE Transactions on Haptics, 2018) This literature review examineswearable haptic devices designed to provide tactile feedback and navigation assistance to visually impaired individuals. It evaluates the effectiveness of haptic feedback in enhancingspatial awareness.

"Challenges in developing assistive technologies for the visually impaired: A critical review" by Sharma, R., et al. (Disability and Rehabilitation: Assistive Technology, 2019) This critical review discusses the challenges faced in the development and implementation of assistive technologies for the visually impaired. It covers issues related to accessibility, affordability, and acceptanceby users and society.

"User perspectives on smart shoes for the visually impaired: A qualitative review" by Martinez, A., et al. (Journal of Assistive Technology, 2022) This qualitative review explores the experiences and feedback of visually impaired users who have used smartshoes or similar assistive technologies. Itprovides valuable insights into user preferences and requirements.

"Designing inclusive smart shoes for the visually impaired: A literature synthesis" by Wang, Z., et al. (International Journal of Inclusive Design, 2023) This literature synthesis examines the principles and guidelines for designing inclusive smart shoesfor the visually impaired. It emphasizes the need for user involvement in the design process and explores ways to address diverseuser needs.

Smart shoes are being used to enhance the mobility and freedom of blind or visually impaired people through the use of visible light communication (VLC) technology innew ways. To detect and analyze light signals from strategically placed VLC transmitters, these shoes are outfitted with sensors, microcontrollers, and VLC receivers. When aperson enters an area covered by VLC, the sensors in the smart shoes detect light signals. The microcontroller determines the direction and location of the user based on the information it has received after processing the signals. The information is then conveyedto the user via auditory signals or haptic feedback to provide real-time navigation help. Using VLC for interior navigation in smart shoes has a number of benefits. Because VLC functions indoors with reliability and doesn't require any external infrastructure, unlike GPS, it's ideal for navigation in complex interior areas like shopping malls, airports, and office buildings. Moreover, VLC offers outstanding accuracy, enabling users to explore with confidence and precision. To enhance the user experience, smart shoes can also include other technologies like obstacle detection sensors, voice assistants, and smartphone apps. These added features allow users to navigate with total confidence, avoiding obstacles and getting to their destinations fast and safely.

## SCOPE

The integration of visible light communication (VLC) technology in smart shoes for the blind provides a state-of-the-art solution to issues related to indoor navigation. These shoes have the ability to drastically alter the way blind persons navigate unfamiliar interior environments, increasing their sense of security and freedom. This article examines the possible applications and scope of smart shoes for the blind and visually impaired, with a focus on indoor navigation with VLC. The blind and visually impaired can receive signals from indoor VLC transmitters thanks to the sensors and communication modules builtinto their smart shoes. VLC employs light toconvey data by utilizing variations in light intensity that are imperceptible to the human eye. When it comes to smart shoes, VLC canbe utilized to provide the user with location- specific information like landmarks, directions, and alerts about approaching obstacles. Precision and Accuracy VLC- based indoor navigation offers high precision and accuracy, which is necessary for traversing complex indoor environments. Real-time triangulation is made possible by the shoes' capacity to receive signals from many transmitters, allowing for the precise location of the wearer to be determined. Traditional GPS-based systems are unable toattain this level of accuracy indoors due to their inefficiency. Both autonomy and accessibility Smart shoes with VLC technology provide independence and accessibility for the blind. Users of the shoes don't require assistance from others because they provide them haptic or audio feedback. Gaining greater freedom can improve one's quality of life and sense of self. Keeping safe and avoiding hazards VLC-enabled smart shoes can identify obstacles and dangers in real time, allowing the wearer to get timely alerts. This feature increases safety by reducing the likelihood of collisions and accidents, especially in unfamiliar areas.

## EXISTING SYSTEM

The global positioning system (GPS) is the most used radio navigation technology for finding and identifying objects, especially in outdoor conditions. However, because buildings and other external obstacles scatter and degrade electromagnetic radiation, as well as because there are barriers in the line of sight between the satellite and the receiver, it is less effective in indoor environments. GPS is not a useful option for tracking position inside because most human activity occurs in enclosed settings, such as indoors. Infrared radiation (IR) systems are among the most widely used wireless positioning systems. Numerous wired and wireless gadgets, such as TVs, PDAs, and cell phones,use the infrared spectrum. It has been applied in numerous ways to the monitoring and identification of objects and people. Most infrared (IR) wireless devices use line-of- sight (LOS) communication, which is unaffected by strong light sources. The main advantages of using infrared (IR)-based system devices are their portability, light weight, and simplicity of usage. The IR systems carry out the indoor positioning determination process with extreme precision. IR-based indoor positioning systems have security and privacy issues in addition to these disadvantages. The ability of infrared signals to detect position is hampered by a few issues, including interference from fluorescent

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lights and sunshine. The IR-based indoor system also has expensive system hardware and maintenance expenses.

**PROPOSED SYSTEM**

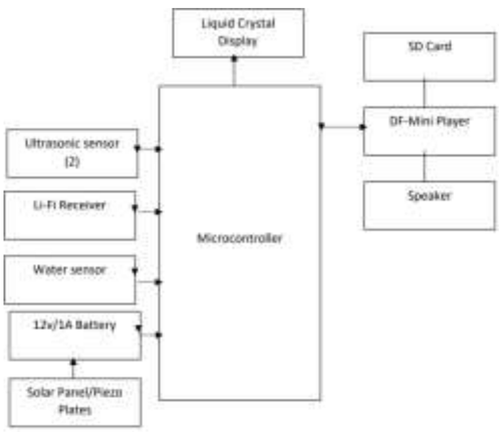
As the use of smartphones has increased overthe past few years, so has the necessity for precise location-based services (LBS), which has sparked an increased interest in the subject of indoor navigation. Traditional radio-wave-based indoor navigation systems have positioning precision ranging from afew meters to tens of milli meters. In this case, we propose an LED-based LiFi- powered indoor locating system. To ensure that it continues to work as a dependable power backup system even in the event that you forget, it also has a solar panel and piezoelectric sensor for battery charging.

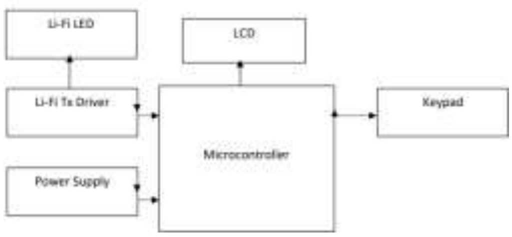
Effective barrier identification. Locating water, Reliable WiFi-based indoor navigation powered by solar backup.

## III. METHODOLOGY

People consider sight to be the most crucial sense, and others have sympathy for individuals who are blind persons are able to interact with their environment by using technology. Rapid and widespread information dissemination has a big impact on people's lives by expanding chances for comfort and amusement and, in many cases, lessening suffering and misery. Since there are blind people in the world, technology needs to have a significant impact on their lives in order to make things possible for them that were before unthinkable. Previous assistive technology for the blind comprised specialized hardware like color identification, spoken OCR products, and barcode scanners; due to rapid hardware advancements, these devices were expensive and had limited capability. The difficulties that blind or disabled persons face on a dailybasis are not well known. We would want to present the SMART SHOES application in this study, which helps blind people withsome of their problems by helping them with technology. The results of the applicationincrease understanding of the problems that blind people encounter on a daily basis and may stimulate more projects that support blind people's independence.

**ARCHITECTURE**



**IMPLEMENTATION**

Mobility and navigation issues greatly affect a blind person's day-to-day existence. The most traditional and traditional means of assisting those who are blind or visually impaired with their mobility are walking canes and guiding dogs. The limitations of these aids include their range of motion and the information they provide. Taking advantage of the quick advances in modern technology, this proposal proposes a smart shoe that employs spoken instructions transmitted by light sources to help visually handicapped persons navigate. The sneaker also detects any obstacles that stand in their path. The main objective of this research is to provide reliable mobility and navigation to individuals with visual impairments. The brains of the project will be an Arduino microcontroller, which we will employ to address this problem. The inputs of the microcontroller will be connected to each sensor, and data will also be transmitted via an inbuilt wi-fi transmitter. Lastly, we have areceiver kit that will enable us to play the audio output and receive the communicated data, helping those who are blind or visually challenged to navigate inside spaces.

## IV. RESULT

Due to the widespread usage of smartphones, interest in precise location-based services (LBS) has surged, which in turn has led to anincrease in interest in indoor navigation in recent years. The location accuracy of conventional radio-wave-based indoor navigation systems ranges from a few metersto tens of milli meters. In this instance, we suggest an indoor locating system powered by Li-Fi and based on LEDs. It also features a solar panel and piezoelectric sensor forbattery charge, so even if you forget, it will still function as a trustworthy power backup system. This study examines the effects of several approaches discussed in this paper and recommends smart shoes for obstacle detection and navigation for individuals withvisual impairments. The Arduino is one kind of embedded device used in the production of smart shoes. In that case, an intricate, stationary system is replaced by an embedded system that handles all of the tasks a user needs to accomplish. With the sensors turned on, data processing will take place dynamically while the user walks. Value processing is transmitted via the device hub from the Arduino board to the smartphone and from the Arduino board to the sensors.

## V. CONCLUSION

Li-Fi technology has emerged as a novel means of assisting individuals with visual impairments in navigating indoor environments. It also helps with real-time obstacle analysis and provides voice-based guidance for easier navigation. This invention doubles as a failsafe power backupsystem in addition to enabling people with visual impairments to navigate inside areas. It does this by integrating a piezoelectric sensor to detect movement and a solar panel to charge the batteries. We will be able to have more real-time solutions in the future thanks to Li-fi technology, which will be used as a hybrid system to replace Wi-Fi technology in the event of a clean and green energy crisis. This study examines the effectsof several approaches discussed in this paper and recommends smart shoes for obstacledetection and navigation for individuals with visual impairments. The Arduino is one kindof embedded device used in the production ofsmart shoes. In that case, an intricate,stationary system is replaced by an embeddedsystem that handles all of the tasks a user needs to accomplish. With the sensors turned on, data processing will take place dynamically while the user walks. Value processing is transmitted via the device hub from the Arduino board to the smartphone and from the Arduino board to the sensors. This will be simple to finish in a short amount of time and will rapidly reveal the obstacle. Based on the real-time routes and the obstacles in between, the proposed method would automate. Android smartphones are interfaced with via code that is programmed into Arduino. It analyzes barriers and starts aconversation.

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