

## IoT Based Assistive Cap for Visually Impaired People

**Harmanjeet Singh Longia,**

Department of Computer Science and Engineering,  
Chandigarh University Gharuan, 140413, Mohali, Punjab, India

**Navneet Kaur,**

Department of Computer Science and Engineering,  
Chandigarh University Gharuan, 140413, Mohali, Punjab, India Email: navneetsehal5@gmail.com2

**Kavita**

Department of Computer Science and Engineering,  
Uttaranchal University, Dehradun, India.  
kavita@ieee.org

**Satbir S Sehgal,**

Division of Research and Innovation,  
Uttaranchal University, Dehradun, India

**Nidhika Chauhan**

Department of Computer Science and Engineering,  
Chandigarh University Gharuan, 140413, Mohali, Punjab, India Email: nidhi29.chauhan@gmail.com

**Abstract**—The primary objective of this study is to aid communication skills among visually impaired people. An intelligent system that performs effectively indoors and outdoors is the primary focus of this study. The proposed device for the blind prioritizes communication with familiar persons and the detection of environmental hazards. The proposed gadget primarily serves to aid the sight handicapped on their travels. Furthermore, it uses voice alerts to inform consumers of impending dangers detected by its sensors.

**Index Terms**—Bluetooth, Ultrasonic sensors, Obstacle, White Cap, assistive technology

I.

### INTRODUCTION

Blindness is a unique disability that affects people all around the world. The World Health Organisation (WHO) estimates that 285 million people around the world have some form of visual impairment; 39 million are completely blind, and another 246 million have significant difficulty seeing. Roughly 90% of the world's blind population lives in poor countries. People in poor, remote rural areas sometimes rely on others to help them work outside and perform other vital tasks because they are blind. A distance detector is any tool that can measure the physical separation of two points. Unfortunately, history has forgotten how distance was first measured using graduated

lengths of material like chain, tape measure, or articulated lacing price. The concept of optical distance measurement has been around since the 1771 [1] work by James Watt.

A person's ability to function independently in society declines significantly when they lose their sight. They need constant direction from the guide so that they can travel around safely. A white cane, traditionally used as a walking aid by the blind, has come to represent blindness [24]. Blind people long for freedom from their reliance on the white cane. They need a tool that helps them out but doesn't irritate them, has no handle, or that they have to hold for too long. Therefore, in order to establish a method that will aid the blind in

becoming self-sufficient, the smart hat's camera and ultrasonic are the technology's main components for tracking down objects and identifying people, respectively. This paper will be organized as follows: Part 2 discusses some relevant research. The methodology is described in Section 3. The findings are presented in Section 4, and the investigation is wrapped up in Section 5.

## II. RELATED WORK

Herman [25] claims that the loss of physical autonomy is a key problem among the visually impaired. They don't even have faith in their own abilities. Blind persons can now go on their own adventures with the use of ultrasonic sensors and a voice-based technology developed by the authors of [26]. The study consists of six main modules: initialization, interface, address query translation, route query, route traversal, and obstacle detection. The initialization of the system library is performed in the initialization module. The second module, User Interface, is responsible for gathering the final destination via user-supplied microphone input. Text-to-Speech is used for voice outputs, and the Google Voice Recognizer API is used for voice recognition in this speech interface. Address query translate, the third module, translates latitude and longitude into a set of coordinates.

According to Author in [27], there are various methods for determining the barrier's distance in order to construct a mobility aid for the visually impaired. One such technology is ultrasonic. A pair of shoes outfitted with ultrasonic sensors around the sole were used to guide the visually impaired person. The sensors are activated by a custom circuit that is tucked away in the wearer's footwear.

Nassih et al. [6] state that a smart cane use Radio Frequency Identification (RFID) technology to detect RFID tags placed in different areas to direct users and to identify obstructions in the user's path. The cane-like gadget has a backpack attached to the back of the user. Power is supplied

electrically by the bag, and sound is played back to the user via in-bag speakers. However, the range of this technology is restricted to the areas where RFID tags have been installed. Otherwise, when no tags are present, it will operate as if it were a regular stick.

The blind cane is one of the most important tools for the visually impaired, as stated by [7]. The purpose of the Guide Cane is to provide stability for the sight impaired while they travel. The Guide Cane is held in front of the user in the same way as a traditional white cane would be. The Guide Cane is considerably heavier than its white counterpart.

Author in [8] describes a Smart Cane as a technological advancement that takes the form of a conventional blind cane but also incorporates a sensor system. Guide Cane, which is equipped with numerous ultrasonic sensors and servo motors, is conceptually similar to this notion. The primary audience for this product is blind people who need help finding their way around. The ultrasonic sensor can detect and avoid things that have been placed in its path. This architecture has a number of shortcomings, as discussed by the authors of [9], such as its inflexibility and instability. Water-detection sensors are also absent from this concept.

According to [10], a white cane is supposed to be able to detect obstacles between 2 and 3 feet away, at a height of up to the knee. (0.91 m). When the cane detects an obstacle, it either vibrates or makes a noise to alert the user. The battery in the cane lasts for 10 hours and powers the sensor and controller. The delay can be calculated by adding the outbound and return travel times for the waves encountering the barrier. The user is informed of their current distance via a buzzer.

Using an Arduino board, a voice recognition module, and a GPS module, the authors of [11] developed a speech-based solution for the visually impaired. In this setup, the blind man will enter the destination's name into the speech recognition module. The GPS receiver constantly receives data on where the user is in relation to their destination, including the location's latitude

and longitude.

One of the most useful tools for the visually impaired is the blind hat, as stated in [12]. Herman [13] argues that the loss of physical autonomy experienced by the sight impaired is one of the greatest challenges they face. They don't even have faith in their own abilities. The authors of [14], who conducted the experiment known as "Project Prakash," did so on the basis of this idea. It was developed to test whether or not blind people could mentally identify a series of objects. Several applications are suggested by Chang and Song [15], [16], [17], [18], [19], [20]. When entering a new space, it can be challenging for people with visual impairments to remember the exact location of furniture and obstructions. These examples illustrate the challenges faced by the visually impaired [21-27] [21], [22].

### III. MATERIAL AND METHODS

An analysis of the published research on aids for the visually impaired during the past decade is presented here. Based on that, we designed and built a smart cap to help the blind and visually impaired avoid potential hazards. There is an ultrasonic sensor, an Arduino microcontroller, a buzzer, a battery, a switch, an LED, a regulator, several filter capacitors (C1C2s), a resistor, and some cables.

Fig.1 is a schematic of the entire project, detailing the placement of its primary components such as the Arduino microcontroller, its sensors, and its buzzer.

The smart cap for the blind is a navigational aid that helps the sight impaired reach their destinations safely. It uses two HC SR 04 ultrasonic sensors to find obstacles and measure depth. Additionally, Arduino is used as the main controller. When an obstacle is in the way, the sensor will pick up on how far away it is and report that information to the controller. When a problem is detected, the controller switches to audio mode and a buzzer starts making warning noises.

As can be seen in Fig.2, a 9V DC battery is utilized in conjunction with a switch that activates the flow of voltage before the user leaves. Then, a

1000uF capacitor, C1, is used to filter this voltage. One such form of capacitor is the "Filter Capacitor." It is built in a way that prevents a certain range of frequencies from penetrating to another system. It is typically employed for low-frequency signal filtering. Most capacitors are of the parallel plate variety. In this case, the capacitor is connected to the right circuit, filtering out unwanted impulses while keeping the ones that are useful. Then the voltage is transferred to a regulator, which converts the input voltage (in this example 9V) into a stable +5V output. Then, a second 100uF capacitor, C2, filters the voltage once again. Now a 220-ohm resistor is employed to limit current to the LED that serves as a current indication in the circuit. This resistor does double duty by reducing voltage and current in circuits. The Ultrasonic sensors are linked to the Arduino, which is powered by a direct connection to the battery. A molten glue gun and connecting wires were used to make all the connections on a brown board.[31-34]

### IV. RESULTS AND DISCUSSION

The aforementioned strategy would help blind persons achieve independence in the long run. With this method, they will have less need for a cane and be able to avoid the challenges associated with using one. They will be able to interact with others without any help from outside sources thanks to the technology available to them. This method can be used to lessen the effects of other, more frustrating forms of assistance and participation. Since it requires less effort from the user, the cap outperforms smart canes. After the circuit board was developed, the entire system was intended to work together and was successfully tested.

The cap's actual appearance is depicted in Figures 3 and

4. The black cylinder in Fig.3 represents the buzzer, which emits a beeping sound to warn the user of potential danger. In Fig.4, the blue board represents the Arduino, and the two metallic cylinders in the front represent the ultrasonic sensors that detect the barrier.

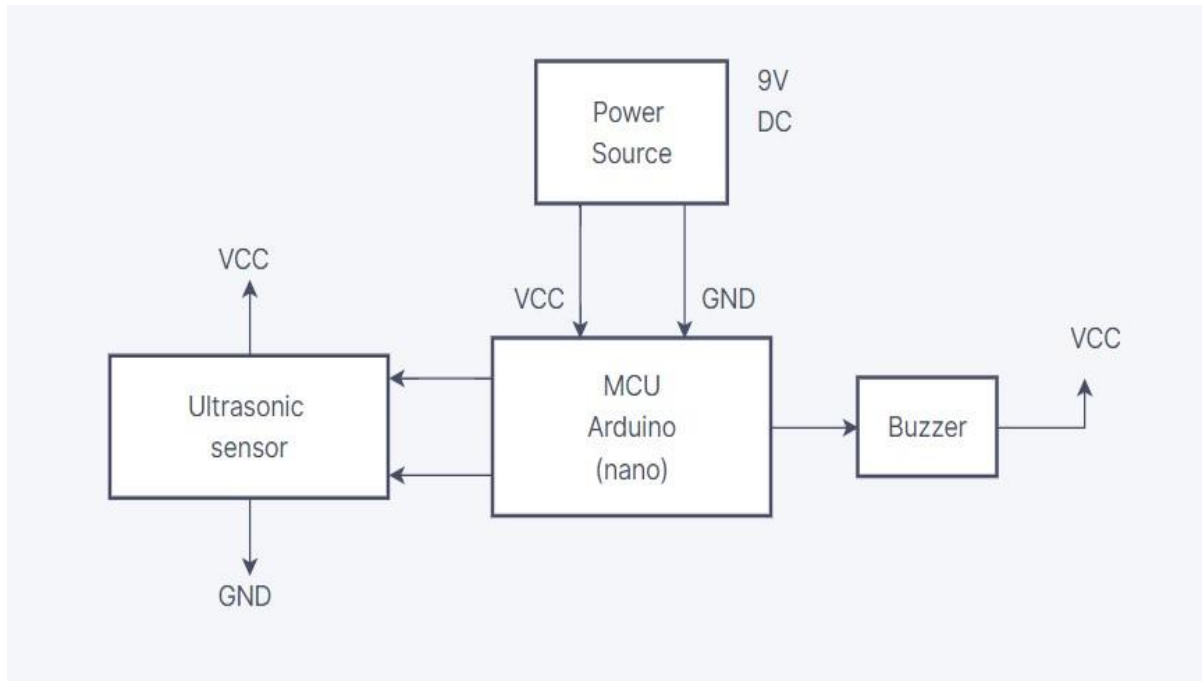


Fig. 1. Flow Chart of the system.

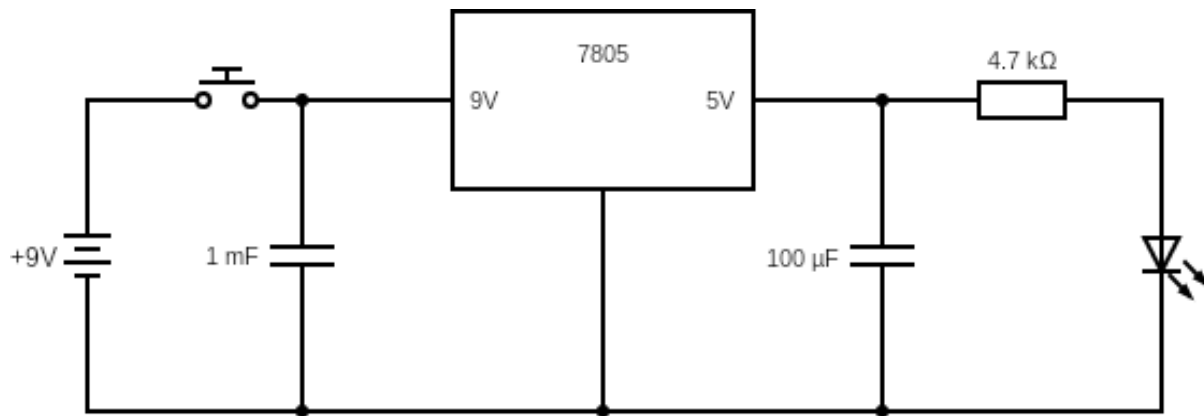


Fig. 2. Circuit diagram of the system



Fig. 3. Assistive cap without arduino



Fig. 4. Assistive cap with arduino

V.

#### CONCLUSION AND FUTURE SCOPE

In this work, we describe the search and system that can be of tremendous use to the visually impaired. The proposed design will make it possible for blind people to go around without help. If such a system can be created, it will pave the way for cheaper, more efficient medical equipment for the injured. This project is particularly well-suited for developing countries due to its effective cost. The evaluations concluded that the product functions best when used internally. Currently unavailable on the market, but a future upgrade to the auxiliary movement's functionality using accessible, affordable technology stands to open up a sizable new customer base in emerging economies.

The visually handicapped will benefit from this specially designed cap because of the audio output that will guide them through their everyday tasks. The disabled will be less reliant on caretakers as a result. The ability to quickly and easily notify others of a crisis is a valuable asset. All of this will be accomplished in a more streamlined and technologically advanced fashion because to the camera's ability to provide real-time visualization via image processing.

Human effort was greatly reduced by the suggested devices, but they could be even more useful if integrated with the user's cell phone. Possible future enhancements to the proposed gadget include expanding its ability to provide spoken output for higher levels of user involvement and enabling two-way spoken conversation between the gadget and its user. Some potential improvements and future goals include increasing the range of the ultrasonic

sensor, decreasing the size and weight, improving the weight distribution, increasing the ergonomic maturity, conducting a test move item, and using a smaller ultrasonic and control circuit.

#### REFERENCES

- [1] I. Batra, S. Verma and K. Janjua, "Performance Analysis of Data Mining Techniques in IoT," 2018 4th International Conference on Computing Sciences (ICCS), Jalandhar, India, 2018, pp. 194-199, doi: 10.1109/ICCS.2018.00039.
- [2] Ghosh, G.; Kavita; Verma, S.; Talib, M.N.; Shah, M.H. A Systematic Review on Image Encryption Techniques. *Turk. J. Comput. Math. Educ.* 2021, 12, 3055–3059.
- [3] Puneeta, S.; Sahil, V. Analysis on Different Strategies Used in Blockchain Technology. *J. Comput. Theor. Nanosci.* 2019, 16, 4350–4355.
- [4] V. Bhoge and S. Y. Chinchulikar, "Review on GPS Navigation System for Blind People," *International Journal of Engineering Sciences & Research Technology*, 2006.
- [5] Das, S. R., Jhanjhi, N. Z., Asirvatham, D., Ashfaq, F., & Abdulhussain, Z. N. (2023, February). Proposing a Model to Enhance the IoMT-Based EHR Storage System Security. In *International Conference on Mathematical Modeling and Computational Science* (pp. 503-512). Singapore: Springer Nature Singapore.
- [6] H. G. Lele, V. V. Lonkar, V. V. Marathe, and M. M. Modak, "Electronic path guidance for visually impaired people," *The International Journal of Engineering and Science (IJES)*, pp. 9–14, 2013.
- [7] T. Kumar, B. Pandey, S. H. A. Mussavi, and N. Zaman, "CTHS based energy efficient thermal

aware image ALU design on FPGA,” *Wireless Personal Communications*, vol. 85, pp. 671–696, 2015.

[8] M. Shafiq, H. Ashraf, A. Ullah, M. Masud, M. Azeem, N. Jhanjhi, and

M. Humayun, “Robust cluster-based routing protocol for IoT-assisted smart devices in WSN,” *Computers, Materials & Continua*, vol. 67, no. 3, pp. 3505–3521, 2021.

[9] I. A. Shah, N. Z. Jhanjhi, M. Humayun, and U. Ghosh, “Health Care Digital Revolution During COVID-19,” in *How COVID-19 is Accelerating the Digital Revolution*. Springer, 2022, pp. 17–30.

[10] M. Lim, A. Abdullah, and N. Z. Jhanjhi, “Performance optimization of criminal network hidden link prediction model with deep reinforcement learning,” *Journal of King Saud University-Computer and Information Sciences*, vol. 33, no. 10, pp. 1202–1210, 2021.

[11] Ashraf, S.S., Verma, S., Tech, M.: A survey on sentiment analysis techniques on social media data. *Int. J. Recent Res. Asp.* 3(3), 65–68 (2016)

[12] Aski, V.J.; Dhaka, V.S.; Kumar, S.; Verma, S.; Rawat, D.B. *Advances on networked ehealth information access and sharing: Status, challenges and prospects. Comput. Netw.* 2022, 204, 108687.

[13] S. Gaba, R. Gupta, S. Verma, I. Taj, *Clustering in Wireless Sensor Networks Using Adaptive Neuro-Fuzzy Inference Logic Information Security Handbook*, CRC Press (2022), pp. 39-54

[14] Datta, D.; Dhull, K.; Verma, S. *UAV Environment in FANET: An Overview*. In *Applications of Cloud Computing*, 1st ed.; Chapman and Hall/CRC: Boca Raton, FL, USA, 2020; ISBN 9781003025696.

[15] C. C. Chang and K. T. Song, “Ultrasonic sensor data integrations and its Application to environment Perception,” *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, vol. 47, no. 3, pp. 651–660, 2000.

[16] P. Rani, Kavita, S. Verma, N. Kaur, M. Wozniak, J. Shafi, and M. F. Ijaz, “Robust and Secure Data Transmission Using Artificial Intelligence Techniques in Adhoc Networks,” *Sensors*, vol. 22, no. 1, pp. 251–251, 2022.

[17] V. E. Adeyemo, A. Abdullah, N. Z. Jhanjhi, M. Supramaniam, and A. O. Balogun, “Ensemble

and deep-learning methods for two-class and multi- attack anomaly intrusion detection: an empirical study,” *International Journal of Advanced Computer Science and Applications*, vol. 10, no. 9, 2019.

[18] S. H. Kok, A. Abdullah, and N. Z. Jhanjhi, “Early detection of crypto- ransomware using pre-encryption detection algorithm,” *Journal of King Saud University-Computer and Information Sciences*, vol. 34, no. 5, pp. 1984–1999, 2022.

[19] I. A. Shah, Q. Sial, N. Z. Jhanjhi, and L. Gaur, “The Role of the IoT and Digital Twin in the Healthcare Digitalization Process: IoT and Digital Twin in the Healthcare Digitalization Process,” *Digital Twins and Healthcare: Trends, Techniques, and Challenges*, pp. 20–34, 2023.

[20] N. Kaur and S. Singh, pp. 65–84, 2017.

[21] T. Kaur, N. Kaur, and G. Sidhu, “Optimized Energy Efficient and QoS Aware Routing Protocol For WBAN,” *Recent Patents on Engineering*, vol. 14, no. 3, pp. 286–293, 2020.

[22] M. Kaur, N. Kaur, and R. Bajaj, “Effect of Data Rate on Performance of the Wireless Body Area Network,” *2021 2nd Global Conference for Advancement in Technology (GCAT)*, pp. 1–7, 2021.

[23] M. Kaur, R. Bajaj, and N. Kaur, “Wireless Body Area Network: Performance Analysis of Polling Access MAC Protocol,” *2021 2nd Global Conference for Advancement in Technology (GCAT)*, pp. 1–7, 2021.

[24] T. Puri, R. K. Challa, and N. K. Sehgal, “Energy-efficient Delay-aware Preemptive Variable-length Time Slot Allocation Scheme for WBASN (eDPVT),” in *Fourth International Conference on Advances in Computing, Communications & Informatics (ICACCI) Special Session on Energy Efficient Wireless Communications and Networking*, 2015, pp. 966–972.

[25] A. Harsur and M. Chitra, “Voice-based Navigation System for Blind People Using Ultrasonic Sensor,” *International Journal on Recent and Innovation Trends in Computing and Communication*, vol. 3, no. 6, pp. 4117–4122.

[26] C. K. Lakde and P. S. Prasad, “Review Paper on Navigation System for Visually Impaired

People,” *International Journal of Advanced Research in Computer and Communication Engineering*, vol. 4, no. 1, pp. 166– 168, 2015.

[27] R. Tapu, B. Mocanu, and E. Tapu, “A survey on wearable devices used to Guide navigating in outdoor locations for visually impaired users,” in *Proceedings of the 2014 11th International Symposium on Electronics and Telecommunications (ISETC)*, 2014, pp. 14–15.

[28] Piyush Kumar Shukla, Natural Disaster Detection for Smart IoT Communication using LoRA model, *International Journal of Wireless and Ad Hoc Communication*, Vol. 6 , No. 1 , (2023) : 19-29 (Doi : <https://doi.org/10.54216/IJWAC.060102>)

[29] Abedallah abualkishik , Rasha Almajed , Watson Thompson, Improving the performance of Fog-assisted Internet of Things Networks using Bipolar Trapezoidal Neutrosophic sets, *International Journal of Wireless and Ad Hoc Communication*, Vol. 6 , No. 1 , (2023) : 30-37 (Doi : <https://doi.org/10.54216/IJWAC.060103>)

[30] Gopal Chaudhary , Smriti Srivastava , Manju Khari, Generative Edge Intelligence for Securing IoT-assisted Smart Grid against Cyber-Threats, *International Journal of Wireless and Ad Hoc Communication*, Vol. 6 , No. 1 , (2023) : 38-49 (Doi : <https://doi.org/10.54216/IJWAC.060104>)

[31] Abedallah Z. Abualkishik , Rasha Almajed , William Thompson, Trustworthy Federated Graph Learning Framework for Wireless Internet of Things, *International Journal of Wireless and Ad Hoc Communication*, Vol. 6 , No. 1 , (2023) : 50-62 (Doi : <https://doi.org/10.54216/IJWAC.060105>)

[32] Reem Atassi , Aditi Sharma, An Efficient and Secured Triple-Layered Wireless Sensor Network with Machine Learning Techniques, *International Journal of Wireless and Ad Hoc Communication*, Vol. 6 , No. 2 , (2023) : 08-17 (Doi : <https://doi.org/10.54216/IJWAC.060201>)

[33] Hussain, K., Hussain, S. J., Jhanjhi, N. Z., & Humayun, M. (2019, April). SYN Eedetection based on bayes estimator (SFADBE) for MANET. In 2019 International Conference on Computer and Information Sciences (ICCIS) (pp. 1-4). IEEE.

[34] Sennan, S., Somula, R., Luhach, A. K., Deverajan, G. G., Alnumay, W., Jhanjhi, N. Z., ... & Sharma, P. (2021). Energy efficient optimal parent

selection based routing protocol for Internet of Things using firefly optimization algorithm. *Transactions on Emerging Telecommunications Technologies*, 32(8), e4171.