Research Article

TruePath Smart Stick

Mira Qerul Barriah Muhamad[1,*], Nurhusna Hurrulain Mohd Nasruddin[2], Nurul Asyiqin Mohd Raflee[3], Nurul Atiyah Yahya[4], and Nurul Izzwanie Mohamat Shafie[5]

1 Universiti Teknologi MARA Kelantan; miraqerul@uitm.edu.my; ORCID ID (https://orcid.org/0000-0002-0652-082X)

2 Universiti Teknologi MARA; husnanasruddin@gmail.com

3 Universiti Teknologi MARA; nurulasyiqinraflee@gmail.com

4 Universiti Teknologi MARA; nurulatiyahyahya001@gmail.com

5 Universiti Teknologi MARA; izzwanieshafie@gmail.com

* Correspondence: miraqerul@uitm.edu.my; 013-6725339

Abstract: *The most critical challenge in creating a smart stick is cost management while ensuring durability, advanced features, and user-friendliness. Advanced technologies and materials, like GPS, automatic lighting, obstacle detection, and durable materials like stainless steel to avoid technical and safety issues, can make production costs go up by a lot. This means that many people, especially those with lower incomes, are unable to afford to buy the product. Also, advanced device features make people less comfortable using them, especially older people or people who are not used to technology. This challenge gives an opportunity to discover a way to develop a smart stick that is affordable, durable, and user-friendly. In order for everyone to be able to afford and use the smart stick, the material needs to be carefully picked so that advanced technologies can be included. To make the design light, portable, safe, and anti-rust, other materials besides stainless steel, like carbon fiber or aluminum, have been figured out. The TruePath app's interface is also made easy to use, practical demonstrations are provided, and Braille handbooks are available to help users learn smart sticks on their own and make their lives better.*

Keywords: smart stick; assistive device; advanced technology; obstacle detection.

1. INTRODUCTION

Visually impaired people face big challenges when trying to interact with their surroundings. Their inability to recognize changes in the environment often limits their movement and independence. Navigating and finding directions are especially hard for those who cannot see, forcing them to depend heavily on their sense of hearing or help from others. This dependence can lead to safety risks because relying only on hearing is not enough in areas with many obstacles or dangers. Because of this, creating a smart device to help visually impaired people move safely and freely has become an urgent need.

Recent research highlights the importance of using modern solutions for visually impaired individuals. Studies show that smart sticks equipped with advanced technologies, such as ultrasonic sensors, GPS, and LED lights, offer many benefits. For example, ultrasonic sensors can detect obstacles in real time and alert users to nearby objects and hazards. GPS integration provides accurate location information, helping users reach their destinations more easily. LED lights that automatically activate in low-light environments, making the user visible to others for added safety. Durability is also a key

consideration, with the stick being water-resistant to a standard suitable for all-weather use. A rechargeable battery system ensures the device remains functional for extended periods.

1.1 Public Awareness About Facilities for The Blind

Accessibility for visually impaired people is a big issue in many countries, even though there have been improvements in infrastructure and policies. Tactile pavement, also known as tactile tiles, plays an important role in helping visually impaired individuals move around safely in public spaces. However, as Moses Choo, a consultant for the National Council for the Blind Malaysia, has pointed out, many people do not understand how these tiles should be used or maintained. Choo stressed that tactile tiles must always remain clear so that blind people can walk safely and independently. Unfortunately, many people either ignore or misuse these paths, treating them as decorations instead of essential tools for accessibility.

This lack of understanding can have serious consequences. When tactile paths are blocked by things like parked cars, signs, or goods, visually impaired people are forced to take alternative routes. This increases their risk of accidents and makes navigating public spaces more dangerous and stressful. Public areas, especially in busy cities, often fail to meet the specific needs of blind pedestrians. This shows a lack of effort to create inclusive spaces and can make visually impaired people feel excluded from society. To address this problem, it is important to educate the public and raise awareness about keeping tactile paths clear. Governments, organizations, and communities must work together to solve this issue.

1.2 Statistics of Cases of Accidents Involving Visually Impaired People

Research shows that visually impaired people are more likely to experience accidents or serious life events than the general population. A study published in the International Journal of Environmental Research and Public Health found that people with visual impairments face a higher risk of accidents and injuries. This highlights how vulnerable visually impaired individuals are in environments that do not meet their needs. The lack of proper infrastructure, safety measures, and public understanding increases the risks they face in their daily lives.

One major reason for these dangers is the absence of safe and accessible public spaces. For example, many visually impaired individuals struggle in areas with heavy traffic because there are no audible signals or properly designed pedestrian crossings. Crossing a road or walking on a sidewalk can become dangerous if the infrastructure is not built to support their needs. Along with this, drivers and pedestrians often lack awareness about the challenges faced by visually impaired people, which further increases the chances of accidents.

2. PROJECT OUTCOMES

The ultimate objective of the Smart Stick (TruePath) innovation is to improve the mobility and freedom of blind and visually impaired people by integrating innovative technologies. The innovation of the Smart Stick will produce three key outcomes with a Braille user guide, an innovative smart stick and a companion mobile application to support the Smart Stick features.

The first outcome is a Braille user handbook that will act as a thorough instruction manual to assist those with visual impairments in comprehending and using the smart stick. Providing detailed instructions on how to utilize the stick's capabilities, such as its navigation system, obstacle detection, and Bluetooth connectivity, this guide will be created in an accessible way. It will also provide comprehensive instructions on safety precautions, common problem-solving techniques, and

maintenance advice to guarantee long-term usability. Testimonials and first-hand accounts from people with vision impairments may also be included in the guide to help new users comprehend the usefulness of the smart stick. This paper, which provides information on mobility options for the blind and visually impaired, may be developed into a book or series of guidelines.

The second outcome is the development of the smart stick itself, which will use the latest innovations to enhance safety and navigation. The stick will have advanced obstacle detection sensors, like ultrasonic and LIDAR, to detect moving and immovable dangers. Users will be notified or beeped to warn them of these dangers. In order to give users trust when going somewhere, a GPS navigation system will be integrated to offer real-time location guidance and route tracking. A Bluetooth connector will also be included in the smart stick, allowing it to connect with other devices for improved functionality. Other features include an integrated speaker for audio feedback, LED lights which switch on automatically in low light to improve visibility for the user and others, and a water-resistant design to guarantee longevity in all weather. Lastly, a rechargeable battery system will offer dependable assistance, guaranteeing that the gadget continues to work for a long period of time.

3. PROJECT CHALLENGES

Cost management is a significant challenge when creating a smart stick. The materials used to make the product durable and long-lasting, such as stainless steel for the cane, can be expensive. Additionally, including advanced technologies like sensors, and GPS increases the cost. These technologies require sophisticated components, such as solar charging capabilities, and user-friendly interfaces. The high price of the product could make it less accessible to visually impaired people, especially those who cannot afford high-tech solutions. Balancing production costs with product affordability is a major challenge. Careful selection of materials, technology, and manufacturing methods is necessary to keep the product within a reasonable price range while still meeting the users' needs.

The use of electronics in assistive devices, such as the smart stick or cane, also raises safety concerns. Since the smart stick will include sensors, GPS systems, and possibly other electronics, it is essential to ensure that these components are safely integrated into the cane without endangering the user. Water, dirt, or physical impact could cause the electronics to malfunction or be damaged. The last thing a visually impaired person needs is a failure in their assistive device while navigating busy streets or unfamiliar places. Additionally, the device must be lightweight and portable while containing the necessary technology. Ensuring that the sensors or GPS do not make the cane too heavy or cumbersome requires careful design and material selection. The device must also be durable enough to withstand daily wear and tear, especially when used outdoors in tough environments.

4. PROJECT SUCCESS INDICATORS

The first potential success indicator for smart cane innovation is receiving a lot of positive feedback from users, caregivers and professionals. Positive feedback indicates that the device meets the needs and expectations of its target audience by addressing real-world challenges. This feedback serves as a critical validation point, demonstrating the effectiveness of smart sticks in improving mobility and independence for blind individuals. Comments from users about the ease of use, reliability and overall experience of the device can indicate its practicality and usefulness in everyday life. Likewise, professionals, such as rehabilitation specialists, can provide insight into how devices support training and integration into various environments.

Additionally, specific feedback from caregivers and family members adds depth to this validation by highlighting the broader impact of the device. For example, caregivers may see a significant increase in the user's confidence and independence, reducing their need for ongoing assistance. Testimonials about the seamless integration of the device into the daily routine are of great importance, as they demonstrate practicality and user-friendliness. If blind individuals report feeling safer and more empowered to navigate their environment, this confirms the product's effectiveness and potential for widespread adoption. Collectively, this positive feedback builds trust in the product, ensuring it truly meets the needs of its users and inspiring further development and innovation.

A second potential success indicator for smart stick innovation is market demand, which is characterized by a high level of interest from individual users and organizations. This demand reflects the product's ability to address a recognized gap in the market, confirming that it is solving an urgent need for blind individuals and their support systems. Expressions of interest, such as pre-orders, inquiries or commitments from rehabilitation centers and schools for the blind, show that the innovation resonates with its intended audience. Such requests also confirm the practicality and relevance of smart canes in both personal and institutional settings, ensuring that they have a broad and meaningful impact.

5. CONCLUSION

In conclusion, for this innovation project, the TruePath Smart Stick is an advanced assistive device designed to increase the mobility and independence of visually impaired individuals through advanced features such as ultrasonic obstacle detection, GPS navigation, voice guidance and waterproof durability. Created through in-depth research, user feedback and collaboration with experts, it addresses accessibility challenges by providing reliable and user-friendly solutions that empower users, improve safety, reduce navigation risks and foster social inclusion. While the project offers a cost-effective and adaptable tool for diverse environments, it also acknowledges limitations such as affordability challenges, user customization difficulties and the need for extensive testing. Future developments aim to reduce costs by exploring alternative materials, improving user training programs, and integrating AI-powered features for more accurate obstacle detection and navigation, demonstrating the transformative potential of technology in promoting inclusion and addressing societal challenges.

Acknowledgments: We would like to express our gratitude to God Almighty for His blessings and guidance throughout this project. We extend our deepest appreciation to our lecturer, Dr. Ayu Kamareenna binti Abdullah Thani, for her invaluable support, guidance, and feedback during this project and for ensuring its success. Our heartfelt thanks also go to our classmates and friends who shared their ideas and provided constant support throughout this journey. Their contributions and encouragement have been invaluable in overcoming challenges and refining the project. Additionally, we are deeply thankful to our parents and siblings for their love, prayers, and unwavering belief in us, which has been a constant source of motivation and strength. Again, we want to thank everyone who has helped us on this journey, directly and indirectly.

References

Attia, I., & Asamoah, D. (2020, May 1). The White Cane, its effectiveness, challenges and suggestions for effective use: A case of Akropong School for the blind. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4434876

Brunes, A., & Heir, T. (2021). Serious life events in people with visual impairment versus the general population. *International Journal of Environmental Research and Public Health*, 18(21), 11536. https://doi.org/10.3390/ijerph182111536

Chua, S. (2022, August 16). Time for the public to keep an eye out for the blind. *Free Malaysia Today.* Retrieved from https://www.freemalaysiatoday.com/category/leisure/2022/08/16/time-for-the-public-to-keep-an-eye-out-for-the-blind/

Elsonbaty, A. A. (2021). Smart blind stick design and implementation. *International Journal of Engineering and Advanced Technology (IJEAT),* 10(5), 17-20.

Hashim, Y., & Alaa Ghazi Abdulbaqi. (2023). Smart stick for blind people with wireless emergency notification. *Telkomnika,* 22(1), 175–175. https://doi.org/10.12928/telkomnika.v22i1.24972

Mmaniyarasi Munusamy, Tamil Moli Loganathan, & Ramakrishna, A. (2024). An invention of a smart blind stick using IOT. *Malaysian Journal of Innovation in Engineering and Applied Social Sciences (MyJIEAS),* 4(01), 173–178. http://myjieas.psa.edu.my/index.php/myjieas/article/view/88

Vision Australia. . (2025). *New report reveals 1 in 12 pedestrians, being hit by motor vehicles and cyclists* | Blindness and low vision services. Visionaustralia.org. Retrieved from https://www.visionaustralia.org/news/2019-08-23/new-report-reveals-1-12-pedestrians-being-hit-motor-vehicles-and-cyclists

Romadhon, A. S., & Husein, A. K. (2020, July). Smart stick for the blind using Arduino. *In Journal of Physics: Conference Series,* 1569 (3), p. 032088. IOP Publishing.

Salama, R., & Ayoub, A. (2019). Design of smart stick for visually impaired people using Arduino. *New Trends and Issues Proceedings on Humanities and Social Sciences*, 6(6), 58–71. https://doi.org/10.18844/prosoc.v6i6.4468

Shah, S., Baraka, J., & Abdulkareem, A. (2021). Smart stick for blind people.

Yunan, R., Junzhe, H., Yixuan, W., Haohan, Z., Zhiyu, L., & Jin, H. (2021). The design of an improved intelligent guide stick for the blind. *Journal of Physics: Conference Series*, 1939(1), 012069. https://doi.org/10.1088/1742-6596/1939/1/012069