The Development of a 'Magic Cane' for Mobility of the Blind in a Swampy Terrain

Imam Yuwono[1], Mirnawati[2], Evi Damastuti[3]
[1]Program of Special Education, Faculty of Education and Teacher Training, Universitas Lambung Mangkurat, Banjarmasin, South Kalimantan, Indonesia
Corresponding Author: Imam Yuwono, Email: imam.plb@ulm.ac.id

Abstract
Most visually impaired people greatly rely on a cane for Orientation and Mobility (OM).Canes so far in use may not effectively accommodate the needs of blind people, in particular for navigation in water body dominated terrainlike swamps and river basins. Thus, the aim of this research is to develop a 'magic cane' to assist in the orientation and mobility of blind people in swampy terrain. This research used the ADDIE R & D (Research and Development) design, which consisting of five stages, namely: Analysis, Design, Development, Implementation, and Evaluation. Research subjects composed of visually impaired people in The Barito river basin, of South Kalimantan in Indonesia. The data was collected by using action tests, questionnaires, and documentation. The data were analyzed using descriptive statistics to determine the effectiveness and practicality of developing the magic cane. This study produced a product dubbed the'magic cane'after its conceptualization by researchers and subsequently assembled by partners, the cane developed is equipped with audio features that can identify obstacles when being used in mobility such as potholes, puddles, and fire. The trial results showed that the magic cane's effectiveness reached 82% with a very effective criteria, but from a practical point of view it was only around 60%, bypractical criteria. Thus, it can be concluded that the development of themagic cane can be a vital mobilityaccessory for blind people in moving on terrain with water patches and swampy environment.
Keywords: Magic cane development; orientation and mobility, visually impaired

Introduction

Humans are born with different conditions, though it can be taken that most are born in good physical condition. However, it is also undeniable that some are born with impairments while others acquire them in their lifetime such as impaired vision, which for the affected presents obstacles and difficulties in carrying out their daily activities. A person who experiences problems with vision is ultimately called visually impaired (Amka, & Mirnawati, 2020).

As a result of experiencing obstacles in their vision, blind people cannot obtain complete information from the surrounding environment. Humans receive about 80% of information from the environment through vision. Therefore, for blind people, it is difficult to do well in natural life (Satam, Al-Hamadani & Ahmed, 2019). Because blind people experience limitations in their vision, their daily activities will also be hampered, especially with mobility such as walking, finding doors, recognizing someone who is coming or detecting their foothold when walking. Blind people need special techniques when get to mobility activities or moving places. Some of the techniques commonly used by the blind in orientation and mobility are the alert companion technique, self-protection technique, and cane technique (Azzahro and Kurniadi, 2017). The use of canes can affect the orientation and mobility skills of blind people (Rahmawati & Sunandar, 2018; Mirnawati & Damastuti,

2018). Blind people often rely on external assistance that can be provided by humans, trained dogs, canes or special electronic devices as a decision support system (Sheth., Et.al, 2014; Pruthvi., Et.al, 2019).

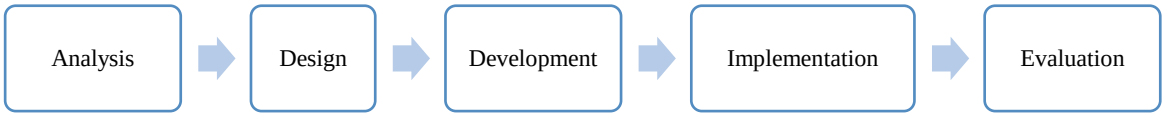
Moving through an unfamiliar environment is a real challenge for people with visual impairments. Those who go out of the house with a white cane often use the old route and have difficulty with the new route (Kiruba., Et.al, 2018). Often blind people face several problems on the road such as human obstacles, animals or walls, holes or stairs, muddy surfaces, fire and many others that can create problems such as accidents or injuries even though they have been assisted by a regular white cane (Pawaskar., Et.al, 2018). The white cane used by blind people is currently considered unable to identify objects found on the street if they are distracted by sound from a noisy surrounding environment, on the other hand, blind people cannot carry out their own mobility when it rains (Johnson, et.al, 2017). ; Amilya, 2019; Sahoo, Wei Lin, & Hwa Chang, 2019).

This problem is also faced by blind people in South Kalimantan. The condition of the soil in South Kalimantan, especially the Banjarmasin area, is wetland or also known as peatland. This area is inundated by water, both permanently and seasonally and is overgrown with vegetation, so it is the largest swamp area in Indonesia (Tavinayati, et al: 2016). Banjarmasin area geographically is a basin, it is in the lowlands so that it is inundated by river overflows and rainwater during the rainy season, but receding water in the dry seasonleaves behind puddlesand dried up potholes (Soendjoto: 2015).

The Swamp terrain in the Banjarmasin area is a problem in itself for blind people, because the canes that have long been used by the blind so far are not sufficient to accommodate the needs of blind people, for example in identifying puddles, swampy areas and overgrown grass or foliage. Thus, the aim of this research is to develop what researchers in this study are referring to as the*magic cane* to assist the blind with orientation and mobility this watery terrain. The caneis developed based on Arduino and sensors provides an audio effect in identifying various obstacles on the road that is being traversed, including water puddles, air temperature detectors, fire heat, obstacles and objects in front, heights and ground levels, and locations with holes, which will be experienced by blind people. The use of an ultrasonic sensor is able to detect water and various other obstacles using ultrasonic waves (Sathya., Et.al, 2018).

Methodology

This research is a R & D (Research and Development) research type, which aims to produce a product in the form of the*magic cane* to facilitate the orientation and mobility of blind people in river basins. Research and development methods are used to produce a certain product and test the effectiveness of the product (Sugiyono, 2015). This research procedure adapted the ADDIE development model which consisted of five stages of Analysis, Design, Development, Implementation and Evaluation (Sugiyono, 2015).



The research subjects were blind people living in the wetland environment of the Barito river basin. The data collection techniques used were interviews, action tests, questionnaires, and observations. Interviews are used to find problems that must be researched, and to analyze the needs of blind people in orientation and mobility in the wetlands area, action tests were used to determine the effectiveness of using the developed magic cane in orientation and mobility of blind people inwetland environments, a questionnaire was used to find out the practicality of using themagic cane in orientation and mobility activities carried out by blind people in a wetland environment, and documentation was used to complement data on the results of the implementation of the cane, in the form of photos of research activities.

Data on the effectiveness and practicality of the cane were analyzed using descriptive statistics with the formula:

$N = \frac{f}{n}$ x 100

Explanation:

P = Percentage

f = The number of scores obtained

n = The highest number of scores

Making decisions about the effectiveness and practicality of developing themagic canewas conducted using the conversion level of achievement with a scale of five as shown in the following Table:

Table 1: Achievement Scale

No.	Achievement Level(%)	Qualification Effectiveness	Qualification Practicality
1.	81 – 100 %	Very effective	Very practical
2.	61 – 80 %	Effective	Practical
3.	41 – 60 %	Effective enough	Pretty practical
4.	21 – 40 %	Less effective	Less practical
5.	< 20 %	Very less effective	Very impractical

(Arikunto, 2010 with modifications)

Results

Magic cane development

The development of the magic cane began with the needs analysis stage, the results of the needs analysis become a reference for researchers in developing a magic cane development design concept that can accommodate the needs of blind people to carry out orientation and mobility in a wetland environment. The magic cane design that was conceptualized by the researcher was then submitted to partners carry out the assembly or manufacture of the magic cane. The stages carried out by partners in the process of developing this magic cane are as follows:

Design Tool

The design of the tool is divided into 2, namely designing hardware in the form of electronic components and designing software using the C language Arduino IDE application. The design is carried out based on the system flow process to get a match between the working principles of the tool as a whole with the working principles of each supporting component. The expected feature of the tool to be designed is that the smart cane is able to automatically notify several conditions in front of the user, such as there are objects / people, there are potholes, there is fire / residual heat from burning on the road and there is a puddle of water, through the media of human voice that is informs the user.

Electronic Hardware Design

From the description of the expected features, the component designs that can support the system's work are:

- Sensor Measuring object distance based on the sonar signal reflection
- Flame and temperature detection sensor
- Sensor detection if there is a pooled liquid.
- Sound file player with Micro SD storage

The main controller / processor which has small dimensions and has quite a lot of connection ports to the sensor.

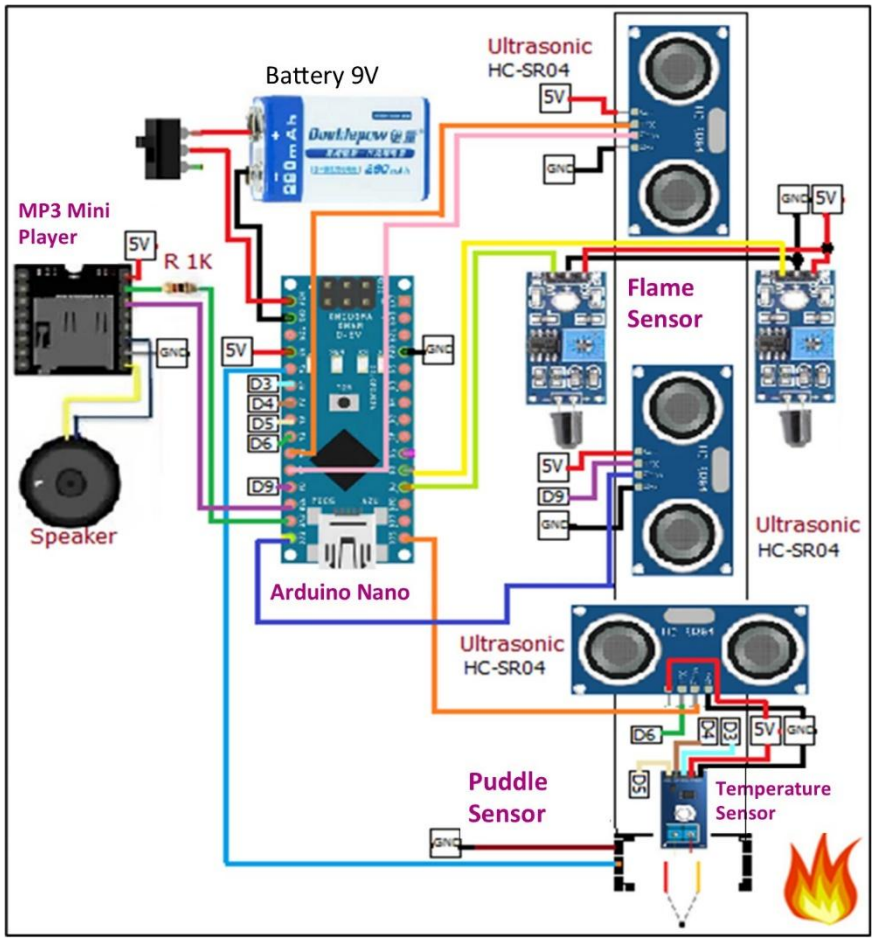


Figure1: Controller/Processor

The main controller uses the Arduino Nano which has 13 digital pins and 8 analog pins. Components using digital pins and analog pins are as follows:

Digital Pin
Temperature Sensor - Thermocouple Type K Max6675
Pin data SO = pin 5;
Pin CS = pin 4;
Pin CLK = pin 3;
MP3 Mini Player: Pin 10 RX and Pin 11 TX
Proximity Sensor 1, Ultrasonic SR-HC04
Triger Pin = 7;
Echo Pin = 8;
Proximity Sensor 2, Ultrasonic SR-HC04
Triger Pin = 9;
Echo Pin = 12;
Perforated Road Sensor, Ultrasonic SR-HC04
Triger Pin = 13;
Echo Pin = 6;
Puddle Sensor: Pin 2. Analog Pin
sensorApi1 = A0;
sensorApi2 = A1;

Software Design

The flow of the software design system follows the work principle flow, as shown in the following figure:

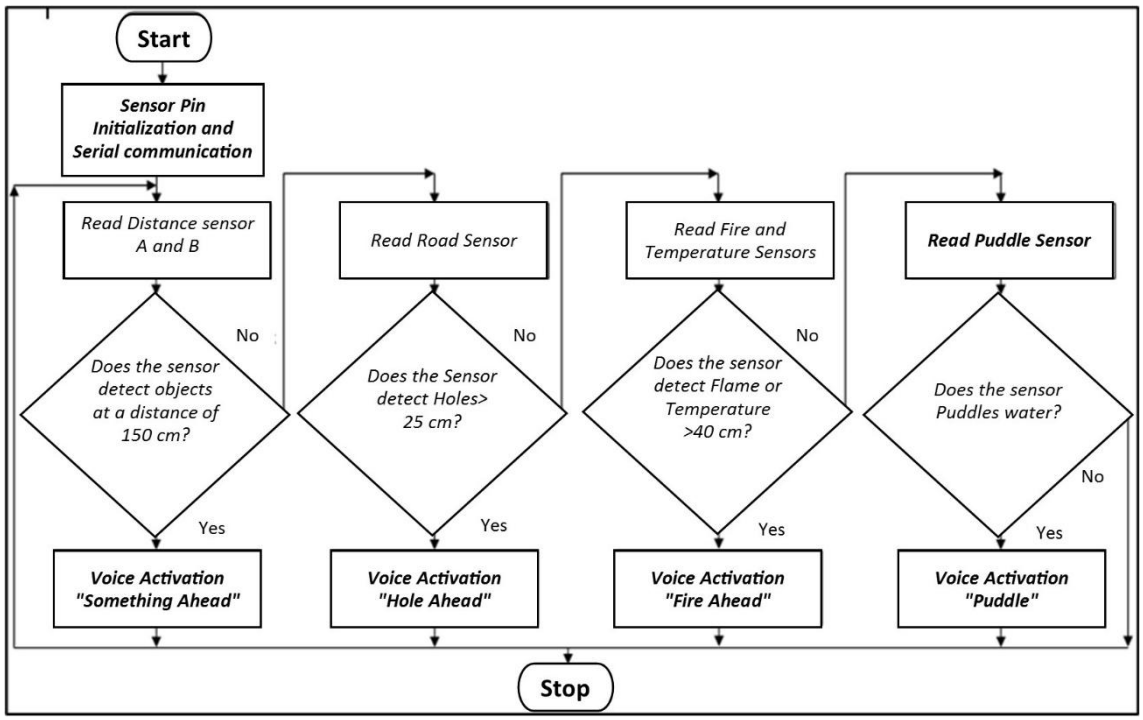


Figure 2: Design Flow

System Description

Initialization of Pins, Sensors and Serial Communications, is the stage for declaring the sensor pins that are used as Input or Output, serial communication with the MP3 Mini Player.

Read Distance Sensor A and Distance B, is a specification for detecting objects / people in front with an angle range of 30^0 to the right and to the left. There are 2 ultrasonic sensors SR-HC04 for this distance detection, at the top and bottom of the cane, such as shown in Figure 9. If one or both of these sensors read objects / people at a distance below 150 cm, then Arduino will activate the MP3 Mini Player, to run the MP3 file with the sound "There is something in front"

Figure 3: Reading Distance

Read Perforated Road Sensor, is a specification for detecting potholes that are in front with an angle of 30 to the right and to the left. There is 1 ultrasonic sensor SR-HC04 for distance detection on potholes, as shown in Figure 10. If the sensor reads the reflected signal from the road at a distance below 25 cm, then Arduino will activate the MP3 Mini Player, to run MP3 files with sound " There is a Hole in the Way "

Figure 4: Hole in the Way "

The next specification is to detect fire and hot temperature detected by the cane. There are 2 flame sensors and 1 temperature sensor using Thermocouple Type K max6675. If the Flame Sensor reads the wavelength of the flame over a range, the Arduino will activate the MP3 Mini Player, to run the MP3 file with the sound "There is Fire Ahead". Meanwhile, if the end of the cane where the temperature sensor is on a hot road is above 40 C, Arduino will also activate the MP3 Mini Player, to run the MP3 file with the sound "There is a Fire in Front". The placement of this fire sensor is as shown in the Figure 4:

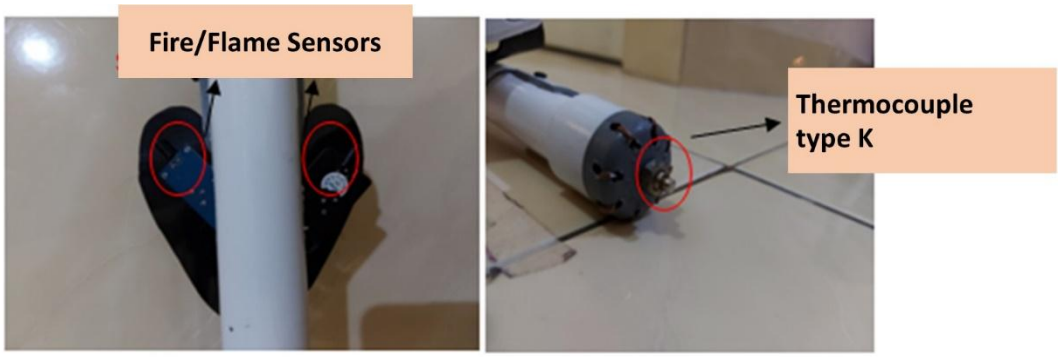


Figure 5. Fire Detection Sensor

To detect standing water in front, a puddle sensor is used. The 2 sensor cables are connected to the Ground pin and the Arduino pin respectively. If the sensor is in a pool of water, then pin D2 will be worth LOW, and Arduino will activate the MP3 Mini Player, to run MP3 files with the sound "There is a puddle of water". The placement of this fire sensor is as shown in the following figure:

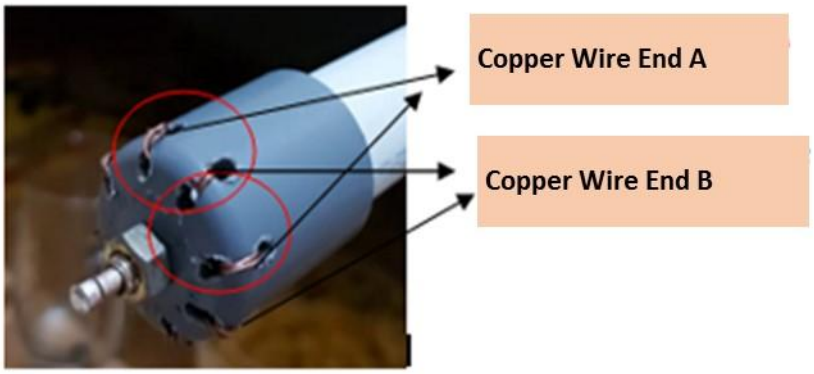


Figure 6: Fire Sensor

Magic cane Development Product

The magic cane is a tool for the visually impaired orientation and mobility, as shown in Figure 13, with a length of 1.5 m and placement of several sensors.

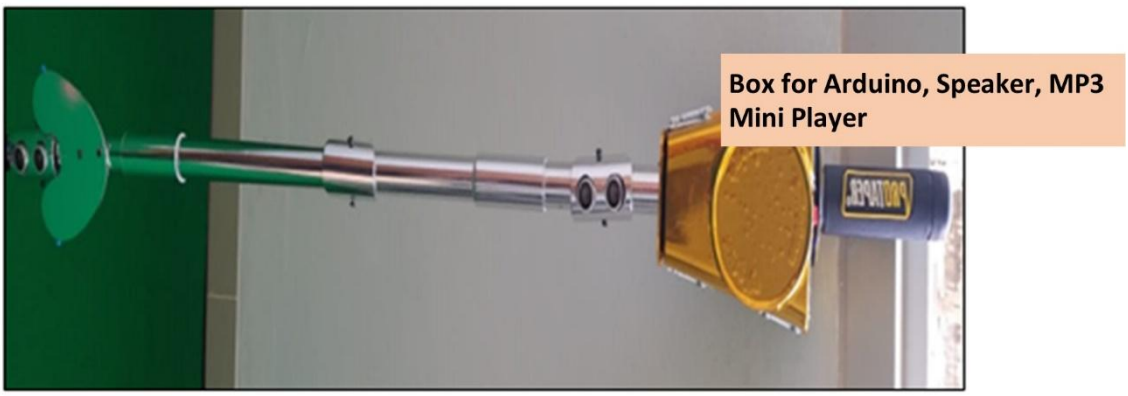


Figure 7: Magic Cane

After producing a product in the form of a magic cane as a tool for orientation and mobility for the visually impaired, the next step is to test the use of the magic cane in orientation and

mobility in a wetland environment to evaluate the effectiveness and practicality of the magic cane being developed.

Effectiveness and Practicality of the Magic Cane

The effectiveness of the magic cane can be seen in the trial implementation by comparing the ability of blind people to perform mobility from one place to another by conditioning several obstacles when using an ordinary white cane and when using a developed magic cane. As for some of the conditioned obstacles, including: 1) The road is rocky; 2) Potholes; 3) Residual heat of combustion; 4) The road inclines; 5) slope; 6) Speed bump; 7) Stagnant water; 8) Meeting someone on the street; 9) Meeting an object on the road. As for the results of testing the effectiveness of the magic cane, it is shown in the following diagram:

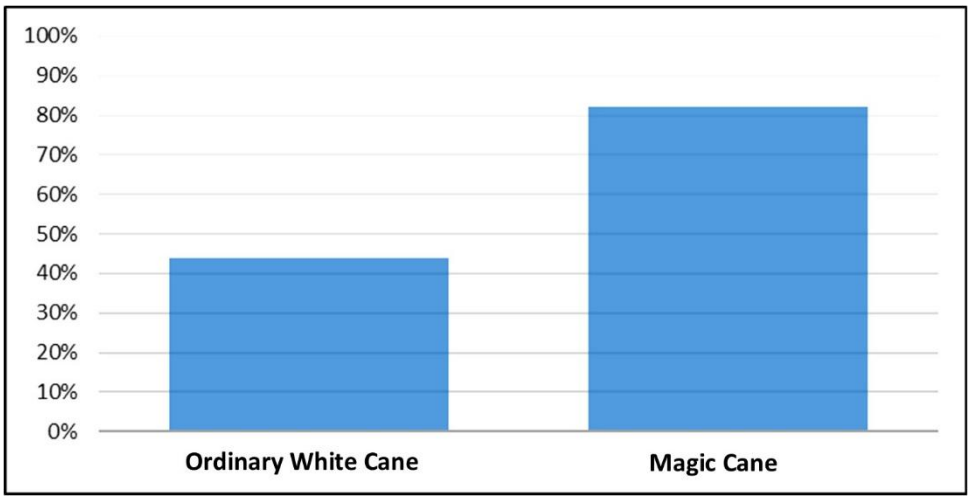


Figure 8: Illustration of Effective Magic Cane

The graph above shows that the effectiveness of using ordinary white canes in mobile in wetland environments by blind people is around 44% with the criteria of "quite effective" while the use of the magic cane by blind people for mobility in wetlands reaches a percentage of 82% with the criteria "very effective". The results of the practicality test for using the cane are as follows:

Table 2: Using Ordinary White Cane

No	Statement	Response	
		Yes (1)	No (0)
1	The stick is easy to use	v	
2	The cane is safe to use when walking	v	
3	The audio on the stick was clear	v	
4	The device in the wand does not interfere with use		v
5	Light stick		v
6	The young stick was brought		v
7	The stick can detect standing water	v	

8	The stick can detect fire	v	
9	The stick can detect potholes	v	
10	The size of the stick is not too big so it is comfortable to use		V
Percentage of effectiveness		60%	
Criteria		**Quite Practical**	

Based on the results of the questionnaire above, the magic cane that was developed was still in the "practical enough" category. Blind people considered that the magic cane that was developed was still not easy to carry anywhere because the size and device contained in the cane were still quite large and disturbing.

Discussion

Blindness is a general term that describes a condition of loss of vision function either partially or completely which affects other aspects of life (Rahmawati & Sunandar, 2018; Satam, Ahmed, & Al-Hamadani, 2019). Without the ability to see humans will have difficulty completing their tasks properly (Rithuan, Zain, & Nawawi, 2019). One of the difficulties faced by blind people is mobility activities or moving from one place to another. There are three limitations experienced by blind people, namely limitations in the scope of diversity of experience, limitations in interacting with the environment and limitations on moving places (Yudiastuti & Azizah, 2019; Setyaedh, Rusijono, & Hidayati, 2019).

The problem of moving places faced by blind people is an urgent problem because it will have an impact on the dependence of the blind on the family and the people around them. So that blind people will experience limitations in obtaining information, interacting with the surrounding environment, and in other fields. Humans receive about 80% of information from the environment through vision (Satam, Ahmed, & Al-Hamadani, 2019). If a blind person can move or move freely, one can interact with the environment and gain a lot of experience so that it can have a positive impact on various aspects of blind development (Rahmawati & Sunandar, 2018).

The magic cane development which is carried out is based on the results of the needs analysis carried out through the assessment activity. the assessment activity is a comprehensive collection of information to get and fully understand the potential, limitations and needs of the blind, including in terms of orientation and mobility (Yuwono., et. al., 2017). In order to accommodate the blind's need for mobility in a wetland environment, the development of a magic cane uses the power of Arduino and sensors. The use of Arduino technology in white cane construction can be used by blind people and help them overcome problems in moving (Almousa & Al-Haija, 2018; Orlando, 2019). Sensors and sound systems are designed to improve navigation for the visually impaired (Alam, Rabby & Islam, 2015; Nowshin., Et.al, 2017; Gbenga, Shani, & Adekunle, 2017).

The development of a magic cane using the power of Arduino and sensors and MP3 produces a wand that can detect obstacles that are encountered while walking, such as potholes, puddles, and fire. Obstacles detected by the cane are conveyed by the blind in the form of audio or sound, as we know that blind people use hearing and audio to access information. The combination of several of these devices acts as a smart system so that people with visual impairments are helped by navigation so that they are aware of the obstacles they will pass (Mahmud, Saha, & Islam, 2013; Hada., Et.al, 2018; Kumar., Et.al, 2019; Fauzi, Jamaluddin, & Razak, 2020).

The magic cane that has been developed is effective in assisting blind people in carrying out mobility, especially in wetland environments because the magic cane developed with Arduino and ultrasonic

devices provides several features on the wand that can provide navigation assistance to the visually impaired in detecting puddles, the presence of fire, and roads. hollow. The use of Arduino is equipped with an ultrasonic sensor that has a Receiver and Transmitter to help users find out or be aware of obstacles on the road in their path so they can avoid them (Purnomo, Jani, & Kridoyoni, 2018). as well as providing navigation assistance to the visually impaired in detecting puddles, holes and other obstacles so that they can move safely (Therib, 2017). Smart walking canes help blind people to navigate and do their work easily and comfortably (Adhe, et.al, 2015; Sathya, 2018; Yahaya, et.al, 2019; Budilaksiono, et.al, 2020).

Tests for the use of a magic cane by blind people are carried out by conditioning several obstacles, including rocky roads, potholes, residual burning heat, uphill roads, downhill roads, speed bumps, puddles, meeting someone on the road, meeting an object on the road. The trial results show that in the end the magic cane developed is able to detect most of the obstacles that have been conditioned, so that the effectiveness of the magic cane reaches 82% with very effective criteria. The percentage of reduction in the collision rate when using an ultrasonic walking cane developed with a normal white cane is 90.1, so the ultrasonic walking cane can be relied on for use by blind people (Sudakhar, 2018). However, the practicality of the cane is only around 60% with criteria that are quite practical. The specifications of the development of the magic cane are not easy to carry and are not comfortable to use by blind people because the size of the cane is still relatively large.

Conclusion

The process of developing themagic cane began with a need’s analysis, which was then carried out by the researcher's conceptual design based on a need’s analysis, the conceptual design is then submitted to partners for assembly or product development, the finished product is then tested on blind people for further evaluation. The trial results showed that the effectiveness of the magic cane that was developed reached 82% effectiveness. Meanwhile, the practicality of the magic cane that was developed was only around 60% effectiveness categorized as quite practical.Due to limited funds improving the cane's practicability to a higher level of effectiveness was not carried out.Thus, the developed magic cane being quite practical can be a useful tool for blind people in enhancing their mobility in an environment with water patches in the terrain like swampy areas and river basin regions.

References

1. Almousa, M.T., & Al-Haija, Q.A. (2018). Enhanced White Cane for Visually Impaired People. Journal of Applied Computer Science & Mathematics. January 2018 DOI: 10.4316/JACSM.201802001
2. Adhe, S., Kunthewad, S., Shinde, P., & Kulkarni, V.S. (2015). Ultrasonic Smart Cane for Visually Impaired People. IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), e-ISSN: 2278-2834,p- ISSN: 2278-8735. PP 11-15
3. Alam, U.K., Rabby, F., & Islam, M.T. (2015). Development of a Technical Device Named GPS Based Walking Cane for the Blind. Journal of Science & Engineering. Vol. 43: 73-80, 2015.
4. Amka., & Mirnawati. (2020). Social Participation of Deaf Students within Inclusive Higher Education. International Journal of Innovation, Creativity and Change. Volume 11, Issue 6, 2020
5. Azzahro, A., & Kurniadi, D. (2017). Penggunaan Tongkat pada Siswa Tunanetra SMALB dalam Melakukan Mobilitas. JASSI_anakku. Volume 18 Nomor 1, Juni 2017

6. Amilya, W. (2019).Tongkat Pintar Bagi Penyandang Tunanetra. https://www.uny.ac.id/berita/tongkat-pintar-bagi-penyandang-tunanetra (diakses: Rabu, 06 November 2019)
7. Budilaksono, S., Bertino, B., Suwartane, I.G.A., Rosadi, A., Suwarno, M.A., ..., Riyadi, A.A. (2020). Designing an Ultrasonic Sensor Cane Prototype for Blind People. 1st Bukittinggi International Conference on Education IOP Conf. Series: Journal of Physics: Conf. Series 1471. doi:10.1088/1742-6596/1471/1/012020
8. Fauzi, S.S.M., Jamaluddin, M.N.F., & Razak, T.R. (2020). Smart Cane for Visually Impaired with Obstacle, Water Detection and GPS. International Journal of Computing and Digital Systems. http://journals.uob.edu.bh
9. Gbenga, D.E., Shani, A.I., & Adekunle, A.L. (2017). Smart Walking Cane for Visually Impaired People Using Ultrasonic Sensors and Arduino. International Journal of Engineering and Technology (IJET).Vol 9 No 5 Oct-Nov 2017. DOI: 10.21817/ijet/2017/v9i5/170905302
10. Hada, D.S., Gautam, H., Rathore, J., Bhopani, K., Vishnoi, L., & Nawaz, S. (2018). Smart Walking Cane for Visually Impaired Person. International Journal of Scientific Research in Science and Technology. Volume 4, Issue 5
11. Johnson, J., Rajan, N., Thomas, N.V., Rakendh, C.S., & Sijo, T. (2017). Smart Walking CaneFor Blind. nternational Journal of Engineering Science Invention Research & Development; Vol. III, Issue IX, March 2017
12. Kiruba, G.J.P.j., Kumar, T.C.M., Kavithrashree, S., & Kumar, G.A. (2018). Smart Electronic Walking Cane for Blind People. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. Vol. 7, Issue 3, March 2018
13. Purnomo, J.B., Jani, M.A., &Kridoyono, A. (2018). TongkatPendeteksiHalanganUntukPenderitaTunanetraDengan Sensor UltrasonikMenggunakan Tenaga Surya. KONVERGENSI. Volume 14, Nomor 2, Juli 2018
14. Kumar, D.S., Anand, M.P., Raj, K.D., Raj, P.T., Yaswanth, R., & Yogesh, S. (2019). Electronic Cane for Visually Impaired People With buzzer alert. International Journal of Recent Technology and Engineering (IJRTE). ISSN: 2277-3878, Volume-7, Issue-6S5, April 2019
15. Mahmud, M.H., Saha, R., & Islam, S. (2013). Smart walking cane - an electronic approach to assist visually disabled persons. International Journal of Scientific & Engineering Research, Volume 4, Issue 10, October-2013. ISSN 2229-5518
16. Mirnawati & Damastuti, E. (2018). MemaksimalkanPenggunaanTongkatUntuk Meningkatkan Kemampuan Mobilitas Siswa Tunanetra Di SLB-A Fajar Harapan Martapura. Eprint.ulm.ac.id. (diakses pada harirabu, 06 November 2019)
17. Nowshin, N., Shadman, S., Shadman, S., Joy, S., Joy, S., Aninda, S., … Minhajul, I. M. (2017). An Intelligent Walking Cane for the Visually-Impaired People. International Journal of Online Engineering (iJOE), 13(11), 94. doi:10.3991/ijoe.v13i11.7565
18. Orlando, F. (2019). Development of an Intelligent Cane for Visually Impaired Human Subjects. Conference Paper · October 2019. DOI: 10.1109/RO-MAN46459.2019.8956328
19. Pruthvi., Nihal, P.S., Menon, R.R., Kumar, S.S., & Tiwari, S. (2019). Smart Blind Cane using Artificial Intelligence. International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8, Issue-5S, May, 2019

20. Pawaskar, P.S., Chougule, D.G., & Mali, A.S. (2018). Smart Cane for Blind Person Assisted with Android Application and Save Our Souls Transmission. International Journal of Engineering and Management Research. Volume-8, Issue-3, June 2018. Page Number: 235-240. DOI: doi.org/10.31033/ijemr.8.3.31
21. Rahmawati, R.Y., & Sunandar, A. (2018). PeningkatanKeterampilanOrientasi dan Mobilitas melalui Penggunaan Tongkat bagi Penyandang Tunanetra. JurnalOrtopedagogia, Volume 4 Nomor 2 November 2018: 100-103
22. Soendjoto, M A. (2015). Sekilastentanglahan-basah dan lingkungannya. Conference: Prosiding Seminar Universitas Lambung Mangkurat, At Banjarmasin, Indonesia, Volume: 2015
23. Sugiyono (2015). MetodePenelitianKombinasi (Mix Methods). Bandung: Alfabeta.
24. Sudakhar, S. (2018). Smart Cane for Visually Impaired. International Journal of Engineering Science and Computing, August 2018. Volume 8 Issue No.8
25. Sahoo, N., Wei Lin, H., & Hwa Chang, Y. (2019). Design and Implementation of a Walking Cane Aidfor Visually Challenged People. Sensors, 19, 130; doi:10.3390/s19010130. www.mdpi.com/journal/sensors
26. Sathya, D., Nithyaroopa, S., Betty, P., Santhoshni, G., Sabharinath, S., &Ahanaa, M.J. (2018). Smart Walking CaneFor Blind Person. International Journal of Pure and Applied Mathematics. Volume 118 No. 20 2018, 4531-4536
27. Sheth, R., Rajandekar, S., Laddha, S., & Chaudhari, R. (2014). Smart White Cane – An Elegant and Economic Walking Aid. American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-03, Issue-10, pp-84-89
28. Satam, I.A., Al-Hamadani, M.N.A., & Ahmed, A.H. (2019). Design and Implement Smart Blind Cane. Journal of Adv Research in Dynamical & Control Systems, Vol. 11, No. 8, 2019.
29. Setyaedhi, H.S., Rusijono., & Hidayati. 2019. Problem-Based Learning Model in Practice-Oriented Student Work Sheets for Integrated Social Sciences. International Journal of Innovation, Creativity and Change. Volume 5, Issue 5, Special Edition: ICET Malang City, 2019
30. Tavinayati., Effendy, M., Zakiyah., & Hidayat, M T. (2016). PerlindunganIndikasiGeografisbagiProdusen Hasil PertanianLahanBasah di Propinsi Kalimantan Selatan. Lambung Mangkurat Law Journal Vol 1 Issue 1, March (2016)
31. Therib, M.A. (2017). mart Blinding Cane with Holes,Obstacles and Ponds Detector Based on Microcontroller. Journal of Babylon University/Engineering Sciences. No.(5)/ Vol. (25): 2017
32. Yuwono, I., Kamil, M., Rahardja, D., & Abdu, W. J. (2017). The effects of guidance and counseling programs on the learning processes of visually impaired high school students. International Journal of Special Education. vol 32, No 4 tahun 2017.
33. Yudhiastuti, A., & Azizah, N. (2019). Pembelajaran Program KhususOrientasiMobilitasBagiPeserta Didik Tunanetra di Sekolah Luar Biasa. PEMBELAJAR Jurnal Ilmu Pendidikan Keguruan dan Pembelajaran 3(1):1. DOI: 10.26858/pembelajar.v3i1.5778
34. Yahaya, S.A., Jilantikiri, L.J., Oyinloye, G.S., Zaccheus, E.J., Ajiboye, J.O., & Akande, K.A. (2019). Development of Obstacle and Pit-Detecting Ultrasonic Walking Cane for the Blind. FUOYE Journal of Engineering and Technology, Volume 4, Issue 2, September 2019.