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Wearable Blind People's Guidance Devices as Obstacles Detection System Based on Stabilizer System and Multiple Sensors

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ABSTRACT

Global health studies forecast that 61 million people will be suffering from blindness by 2050. Blind people's guidance devices are important for blind people to move in an unknown environment because they cannot obtain surrounding information through vision which causes their mobility and independence to be hampered significantly. However, the existing blind people's guidance devices could not provide accurate and reliable obstacle detection data to blind users in different environments and conditions. This is because, in common, they do not have a stabilizer system to maintain the viewing angles of obstacle detection sensors when they are tilted to different angles, and they do not have a sensor layout that can detect obstacles at different levels and directions simultaneously. In this paper, wearable blind people's guidance devices (WBPGD) were developed to provide accurate and reliable obstacle detection data in different environments and conditions to improve blind users' mobility and independence effectively based on a stabilizer, object detection, and human detection systems. The performance of the stabilizer and object detection systems had a low percentage of errors up to 10.376%. The human detection system has a measuring range of at least 90° cone to detect humans, while the vibration motors and light-emitting diodes (LEDs) on wristbands responded correctly according to the collected obstacle detection data. Hence, the WBPGD can provide accurate and reliable obstacle detection data in different environments and conditions to prevent users from being hurt by obstacles and allow them to approach humans around them for help independently when necessary.

Keywords: Wearable blind people guidance services; obstacle detection system; multiple obstacle detection sensors; stabilizer system; wireless communication protocol

INTRODUCTION

Blindness is recognized as a kind of disability that has limitations in vision (Fathoni et al. 2020). Recent global health studies approximated at least 217 million people are suffering from visual impairment, of whom 36 million people are suffering from blindness (Real and Araujo 2019). In general, a person obtains at least 80% of information through vision in daily life (Li et al. 2021). However, blind people are unable to access information through vision and face the problem of their mobility and independence being hampered significantly due to the inability to obtain surrounding information through vision. Besides, the problem of obstacle detection sensors such as ultrasonic or infrared (IR) sensors are attached to existing blind people's guidance devices at fixed angles, which results in the sensors providing unreliable, inaccurate, and misleading data to blind users when the devices are tilted to different angles. This is because the sensors attached to the devices will detect obstacles at a new viewing angle instead of being kept at the initial viewing angle to detect obstacles when the devices are titled to different angles. Moreover, the problem of the existing blind people's guidance devices which only utilize ultrasonic or IR sensors to detect obstacles could not detect head, body, and knee-level obstacles simultaneously, which also causes the sensors to provide unreliable, inaccurate, and misleading data to blind users when they are moving in different environments and conditions. Since the problems put blind people at high risk of being hurt by obstacles, it is required to develop blind people's guidance devices that provide reliable and accurate obstacle detection data in different environments and conditions to improve blind users' mobility and independence effectively.

This paper mainly focuses on developing wearable blind people's guidance devices (WBGPD) that provide accurate and reliable obstacle detection data in different environments and real conditions based on a stabilizer system and multiple obstacle detection sensors to improve blind people's mobility and independence effectively. (Kang C.C et al. 2023). This also creates opportunities that could greatly enhance the ability to apply science and technology in support of sustainability (Kang C.C et al. 2022). The WBPGD consist of a chest strap that blind users wear on the body and two wristbands that blind users wear on both hands respectively. The essence of the WBPGD is the vibration motors on both wristbands provide correct tactile feedback to improve blind users' mobility and independence effectively, based on the reliable and accurate data collected by sensors on the chest strap and transmitted to respective wristbands wirelessly. On the chest strap, the obstacle detection sensors viewing angles are maintained by a stabilizer system. Thus, the stabilizer system is introduced to solve the problem of obstacle detection sensors attached to existing blind people's guidance devices at fixed angles. An object detection system is deployed on the WBPGD to detect objects at different levels and directions simultaneously by relying on multiple ultrasonic sensors. Hence, the system is deployed to solve the problems of blind people's mobility and independence being hampered significantly due to the inability to obtain surrounding information through vision, as well as the existing blind people's guidance devices which only utilize ultrasonic or IR sensors to detect obstacles could not detect head, body, and knee-level obstacles simultaneously. Besides, a human detection system is deployed on the WBPGD to solve the problem of blind people's mobility and independence being hampered significantly due to the inability to obtain surrounding information through vision, by relying on a PIR sensor to detect humans in front of blind users so they can approach the humans for help independently when necessary. All systems operate together to ensure blind users receive accurate and reliable obstacle detection data in different environments and conditions so that the users' mobility and independence can be improved effectively.

Several studies related to blind people's guidance devices are referred. In common, the blind people's guidance devices proposed in the studies consist of sensors to detect obstacles, modules to inform users regarding obstacles, and microcontrollers to coordinate the components of the devices (Hong S.Y. et al. 2023). The summary of the blind people's guidance devices proposed in the studies is shown in Table 1. According to Table 1, the majority of the studies utilized the ultrasonic sensor as the obstacle detection sensor and both tactile and auditory feedback to inform blind users regarding the obstacles. The PIR sensor was deployed by (Krishnakumar et al. 2017) to detect dynamic obstacles within 3 m from blind users in the left, right, and front directions of the blind users. The red, green, and blue (RGB) sensor was deployed by Lakde and Prasad (2015) to inform blind users about the type of floor they are walking on, while three studies deployed water sensors to detect water on the floor. Buzzers and vibration motors were commonly used to inform blind users about obstacles. The summary of drawbacks found on the blind people's guidance devices proposed in the studies is illustrated in Table 2. According to Table 2, all studies encountered the problem of no stabilizer system available to maintain the sensors' viewing angles to prevent the sensors from providing unreliable, inaccurate, and misleading information to blind users when the devices are tilted to different angles. All studies also faced the problem of being unable to detect head, body, and knee-level obstacles simultaneously. Both problems not only hamper blind users' mobility and independence significantly but also put the users at high risk of being hurt by obstacles such that their safety is threatened.

TABLE 1. Summary of the blind people's guidance devices proposed in the studies

No	Reference	Obstacle detection sensor					Type of feedback	
		Ultrasonic Sensor	PIR Sensor	IR Sensor	RGB Sensor	Water Sensor	Tactile	Auditory
1	Abusukhon (2023)	X						X
2	Anuar Mohamed Kassim et al. (2015)	X					X	X
3	Dey et al. (2018)	X						X
4	Krishnakumar et al. (2017)	X	X					X
5	L. Shashitha and Babu (2021)	X						X

continue ...

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6	Lakde and Prasad (2015)		X	X		X	X
7	M. Arun Kumar et al. (2022)	X				X	X
8	Pragathi Lk et al. (2018)		X		X	X	X
9	Ram Mude et al. (2022)	X				X	X
10	S. Divya et al. (2019)	X			X	X	X
11	Shaikh, Vishal Kuvar, and Mohd. Abbas Meghani (2017)	X				X	X
12	Sharma et al. (2018)	X			X	X	X
13	Singh et al. (2025)	X				X	X
14	Suraj et al. (2019)	X				X	X
15	Uddin and Suny (2015)	X					X

TABLE 2. Summary of drawbacks found on the blind people's guidance devices proposed in the studies

No	References	Drawback	
		No stabilizer system is available to maintain the sensors' viewing angles	Blind people's guidance devices are unable to detect head, body, and knee-level obstacles simultaneously
1	Abusukhon (2023)	X	X
2	Anuar Mohamed Kassim et al. (2015)	X	X
3	Dey et al. (2018)	X	X
4	Krishnakumar et al. (2017)	X	X
5	L. Shashitha and Babu (2021)	X	X
6	Lakde and Prasad (2015)	X	X
7	M. Arun Kumar et al. (2022)	X	X
8	Pragathi Lk et al. (2018)	X	X
9	Ram Mude et al. (2022)	X	X
10	S. Divya et al. (2019)	X	X
11	Shaikh, Vishal Kuvar, and Mohd. Abbas Meghani (2017)	X	X
12	Sharma et al. (2018)	X	X
13	Singh et al. (2025)	X	X
14	Suraj et al. (2019)	X	X
15	Uddin and Suny (2015)	X	X

METHODOLOGY

SYSTEM DESIGN

The WBPGD consists of a chest strap and two wristbands with total power consumption of 7.39W in fully active mode, and each of them has a ESP32 as the microcontroller, which is powered by an 18650 battery. ESP32 is a microcontroller that has series of system on chip and modules with low power consumption and low cost, and it supports ESP-NOW wireless communication protocol. The chest strap, Wristband 1, and Wristband 2 are depicted in Figure 1. The obstacle detection sensors mounted on the chest strap are five ultrasonic sensors and a PIR sensor, while three vibration motors and light-emitting diode (LED) pairs are available on each wristband to gather and combine substantial quantities of feedback based on the data collected by the sensors (Kang et al. 2023). The vibration motors are mounted inside the wristbands using the best configuration suggested by (Anuar Mohamed Kassim et al. 2015) to ease the identification of the vibration locations. The response classification for each vibration motor and LED pair is shown in Figure 2. The obstacle detection sensors collect data, followed by the data is transmitted to both wristbands wirelessly through ESP-NOW wireless communication protocol before the vibration motors and LED pairs on both wristbands provide a particular response according to the received data. A cycle of a sequence consists of eight beats that take 2 seconds. The WBPGD is designed to be wearable, with the 18650 batteries as the power source, to ensure the users' comfort and convenience such that their hands are free to carry other things when they are wearing the WBPGD and moving in different environments for long periods. The ESP-NOW wireless communication protocol allows reliable bidirectional data transmission between transmitter and receiver up to 220 m (Espressif Systems 2024). Healthcare services are undergoing digital transformation into so-called, digital healthcare (Kang et al. 2023). Instead of auditory feedback, tactile feedback is provided to alert the users regarding obstacles because it is affirmed as an effective method to alert the users regarding obstacles even in environments that consist of ambient noise, at the same time, prevent interfering with the users' awareness of environmental sounds which signal dangers or give cues for spatial orientation (Bharadwaj, Shaw, and Goldreich 2019).

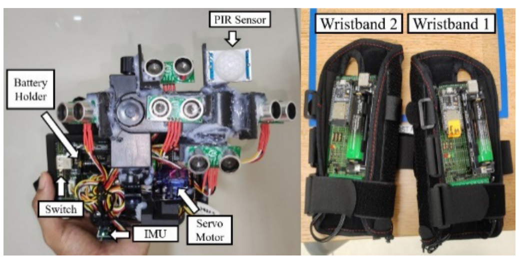

FIGURE 1. Chest strap, Wristband 1 and Wristband 2

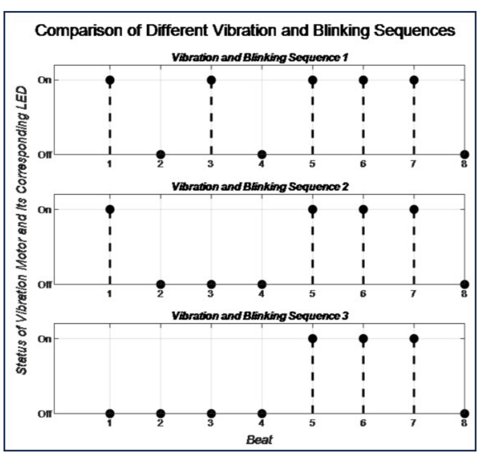

FIGURE 2. Response classification for each vibration motor and LED pair

The object detection system involves five ultrasonic sensors on the chest strap, three vibration motors and LED pairs on Wristband 1, and two vibration motors and LED pairs on Wristband 2. The ultrasonic sensor layout is depicted in Figure 3. An ultrasonic sensor sends and receives ultrasonic pulses using a transducer to provide us with information about an object proximity. The ultrasonic sensor 1, 2, and 3 are responsible for detecting body-level objects at the front, right, and left of the users respectively, while the ultrasonic sensor 4 and 5 are responsible for detecting head and knee-level objects in front of the users respectively. The viewing angles of ultrasonic sensor 2 and 3 are 36° away from ultrasonic sensor 1, as suggested (Anuar Mohamed Kassim et al. 2015). The viewing angles of ultrasonic sensor 4 and 5 are 11° and 27° away from ultrasonic sensor 1 respectively, with the assumption that the target users are Malaysian who have an average height of 162 cm (Hakim 2021). Hence, ultrasonic sensor 4 and 5 can detect head and knee-level objects located at 2 m in front of the users based on the trigonometrical function. The RCWL-1601 ultrasonic sensor can detect objects located at a distance up to 4.5 m and it also offers the advantage of providing accurate and reliable data to the users regardless of the presence of dust or dirt as well as transparency, colour, and shape of objects. Each vibration motor and LED pair on both wristbands, which is involved in the object detection system, corresponds to an ultrasonic sensor and it provides a particular vibration and blinking sequence based on the data collected by its corresponding sensor. The pseudocode of the object detection system is illustrated in Figure 4. For each wristband, it begins with the ESP32 receiving the data collected by ultrasonic sensors which are transmitted from the chest strap. Then, based on each received measured distance, the ESP32 classifies the object as located in either the very close, close, or safe region. The corresponding vibration motor and LED pair will then respond to sequence 1, 2, and 3 for the object located in very close, close, and safe regions respectively before a new iteration begins.

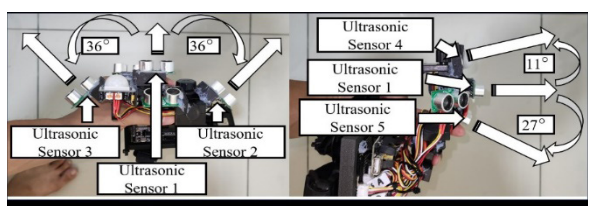

FIGURE 3. Ultrasonic sensor layout

```
ESP32 on the wristband receives data collected by ultrasonic sensors and
        transmitted from the chest strap
FOR each received data
    IF the measured distance < 100 cm THEN
            Classify the object is located in the very close region. The
            corresponding vibration motor and LED pair respond Sequence 1
        ELSEIF
    IF 100 cm <= the measured distance < 200 cm THEN
            Classify the object is located in the close region. The corresponding
            vibration motor and LED pair respond Sequence 2
        ELSEIF
    IF the measured distance >= 200 cm THEN
            Classify the object is located in the safe region. The corresponding
            vibration motor and LED pair respond Sequence 3
        ENDIF
ENDFOR
```

FIGURE 4. Pseudocode of object detection system

The human detection system involves a PIR sensor on the chest strap and a vibration motor and LED pair on Wristband 2. A PIR sensor detects the human's movement by detecting the changes in infrared radiation released by them when they move within the detection range. The PIR sensor is responsible for detecting the presence of humans in front of the users. The HC-SR501 PIR sensor offers the feature of detecting heat-generated moving obstacles such as humans within about 120° cones and up to 7 m. The vibration motor and LED pair on Wristband 2 provide a particular vibration and blinking sequence based on the data collected by the PIR sensor. The pseudocode of the human detection system is illustrated in Figure 5. It begins with the ESP32 receiving the data collected by the PIR sensor which is transmitted from the chest strap. Then, the ESP32 classifies a human is present in front of the users if the received data states human motion is detected, and vice versa. The vibration motor and LED pair will then respond Sequence 1 and 3 for the cases a human is present and not present in front of the users respectively before a new iteration begins.

```
ESP32 on the wristband receives data collected by the PIR sensor and transmitted from
        the chest strap
    IF the human motion is detected THEN
            Classify a human is presence in front of the users. The corresponding
            vibration motor and LED pair respond Sequence 1
        ELSEIF
    IF the human motion is not detected THEN
            Classify no human is presence in front of the users. The corresponding
            vibration motor and LED pair respond Sequence 3
ENDIF
```

FIGURE 5. Pseudocode of human detection system

The stabilizer system involves an inertial measurement unit (IMU) and a servo motor on the chest strap. The IMU is responsible for detecting the vertical orientation of the chest strap, while the servo motor is responsible for changing the viewing directions of the obstacle detection sensors in response to the IMU output. The MPU6050 IMU is a Micro-Electro-Mechanical System (MEMS) that realizes the orientation measurements through measuring the gravitational acceleration using a 3-axis accelerometer and rotational velocity using a 3-axis gyroscope sensor. The SG90R servo motor has a rated torque of 2 kg/cm and it provides 180° rotation to change the viewing directions of obstacle detection sensors. The pseudocode of the stabilizer system is illustrated in Figure 6. It begins with the IMU being calibrated when the ESP32 is reset manually. After that, the IMU measures the vertical orientation of the chest strap. The servo motor will then move its horn tip to an angular position 100° greater than the vertical orientation of the chest strap before a new iteration begins.

```
IF the ESP32 is manually reset THEN
        IMU is calibrated
    ENDIF
IMU measures the vertical orientation of the chest strap
Servo motor moves its horn tip to an angular position 100 degrees greater than the
        vertical orientation of the chest strap
```

FIGURE 6. Pseudocode of the stabilizer system

EXPERIMENT DESIGN

The object detection system experiment setting is illustrated in Figure 7. The responses of Ultrasonic Sensor 1 and its corresponding vibration motor and LED pair are assumed as the representation of responses of the remaining ultrasonic sensors and their corresponding vibration motors and LED pairs because all of them operate based on the same principle. Vibration Motor 1 and the yellow LED on Wristband 1 correspond to Ultrasonic Sensor 1. The Wristband 1, an object, and the chest strap were fixed on tables such that the ultrasonic sensor 1 faced the object's surface perpendicularly. The experiment was conducted with the actual distance between the object and Ultrasonic Sensor 1 of 50 cm, 80 cm, 140 cm, 180 cm, 230 cm, and 250 cm respectively. The measured distance and responses of Vibration Motor 1 and the yellow LED were observed and analyzed for each actual distance.

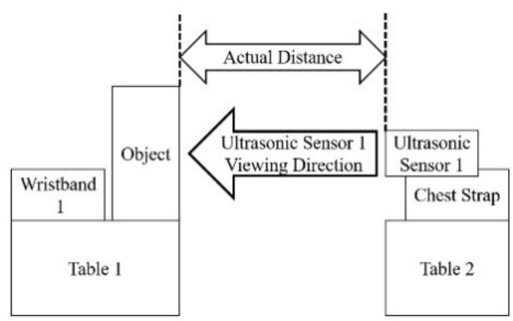

FIGURE 7. Object detection system experiment setting

The human detection system experiment setting is illustrated in Figure 8. The PIR sensor output for the human standing locations at 80 cm away from it is assumed as the output for the same location but for a distance up to 7 m because the PIR sensor has a maximum measuring range of 7 m as specification. Vibration Motor 5 and the green LED on Wristband 2 correspond to the PIR Sensor. Before the experiment was conducted, a human was standing in front of and at 80 cm away from the Fresnel Lens, while the Wristband 2 and chest strap were fixed on a table such that the Fresnel Lens faced the human perpendicularly. The experiment was conducted by changing the human standing location from 0° to 315° with a 45° interval, with 80 cm between the human and Fresnel Lens. The PIR sensor output generated on the chest strap and responses of Vibration Motor 5 and the green LED were observed and analyzed for each location.

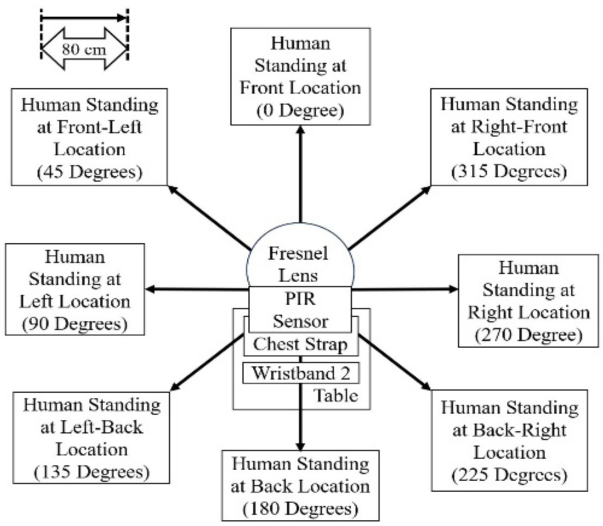

FIGURE 8. Human detection system experiment setting

The stabilizer system experiment setting is illustrated in Figure 9. The chest strap viewing direction represents the users' body posture. A change in ultrasonic sensor 1 viewing direction represents a change in the viewing directions of all obstacle detection sensors available on the chest strap. The experiment was conducted by holding the chest strap constant and calibrating the IMU such that the initial Ultrasonic Sensor 1 viewing direction as the wall, followed by tilting the chest strap vertically such that the viewing direction of the chest strap changed from downward to the calibrated position before upward. For each chest strap viewing direction, three IMU x-axis orientation measurements and the corresponding servo horn tip angular positions were observed from the Arduino integrated development environment (IDE) serial monitor and analyzed, while the corresponding ultrasonic sensor 1 viewing directions were also observed and analyzed.

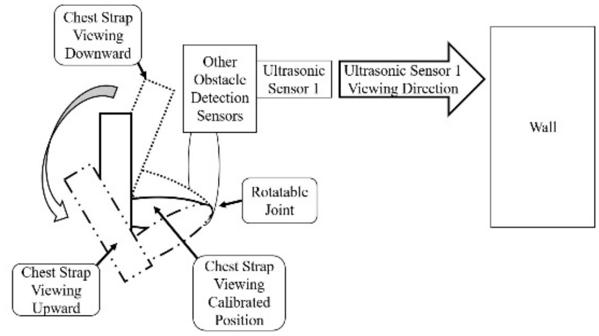

FIGURE 9. Stabilizer system experiment setting

RESULTS AND DISCUSSION

OBJECT DETECTION SYSTEM

The results of the object detection system experiment are shown in Table 3. According to Table 3, the measured distance provided by the system was less than the actual distance ranging from - 6.824 cm to - 5.122 cm with percentage errors ranging from 2.352% to 10.376% respectively. The responses of Vibration Motor 1 and yellow LED were correct based on the measured distances provided by the system throughout the experiment. Hence, the system can operate as intended to provide accurate obstacle detection data to the users such that they get informed about the objects located at different levels and directions simultaneously and make the correct movements to avoid the objects. The analysis of the object detection system experiment results is depicted in Figure 10. The actual and measured distances had the same trend such that the measured distance increased with the actual distance. The difference between actual and measured distances converged throughout the experiment. At the same time, the percentage error was low enough to be about a horizontal line throughout the experiment and this shows the system performance is reliable for objects located at different distances. The system design, in which the duration of a cycle of a sequence was designed as 2 s and the minimum threshold of distance between the object and the users for the vibration motors and LED pairs to inform the users regarding obstacles is 2 m, is the improvements over Anuar Mohamed Kassim et al. (2015) to allow the users having enough time to identify the locations of vibrations and obstacles.

TABLE 3. Results of the object detection system experiment

Actual distance between the object and Ultrasonic Sensor 1 (cm)	Measured distance between the object and Ultrasonic Sensor 1 (cm)	Difference between actual and measured distances (cm)	Percentage error (%)	Response of Vibration Motor 1 and yellow LED on Wristband 1 (Sequence)
50	44.812	- 5.188	10.376	1
80	74.528	- 5.472	6.840	1
140	134.878	- 5.122	3.659	2
180	174.182	- 5.818	3.232	2
230	223.176	- 6.824	2.967	3
250	244.120	- 5.880	2.352	3

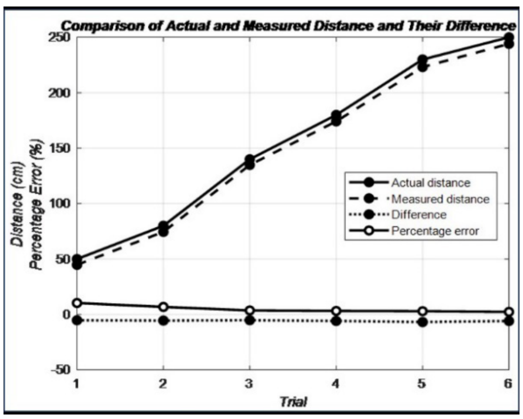

FIGURE 10. Analysis of the object detection system experiment results

HUMAN DETECTION SYSTEM

The results of the human detection system experiment are shown in Table 4. Based on Table 4, the PIR sensor outputs generated on the chest strap were "Motion detected" for the human standing locations of front, front-left, and right-front which are equivalent to 0°, 45°, and 315° with respect to the Fresnel Lens. This shows the PIR sensor detected humans at these three locations. The sensor could not detect humans at the remaining locations because the sensor has a measuring angle of about 120° cone as specification while those locations are outside the measuring angle of the sensor. The responses of Vibration Motor 5 and green LED were correct based on the PIR sensor outputs throughout the experiment. Hence, the system can perform as intended to provide accurate obstacle detection data to the users such that they get informed about the presence of humans and can approach the humans for help independently when necessary. The analysis of the human detection system experiment results is depicted in Figure 11. The PIR sensor has at least 90° cone to detect human motion, as depicted in Figure 11, which agrees with its specification. With the correct responses of Vibration Motor 5 and green LED on Wristband 2 throughout the experiment, the system performance is concluded as reliable and accurate.

TABLE 4. Results of the human detection system experiment

Human standing location with respect to the PIR sensor Fresnel Lens	The angle of human standing location with respect to the PIR sensor Fresnel Lens (°)	PIR sensor outputs generated on the chest strap	Response of Vibration Motor 5 and green LED on Wristband 2 (Sequence)
Front	0	Motion detected	1
Front-left	45	Motion detected	1
Left	90	Motion stopped	3

continue ...

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Left-back	135	Motion stopped	3
Back	180	Motion stopped	3
Back-right	225	Motion stopped	3
Right	270	Motion stopped	3
Right-front	315	Motion detected	1

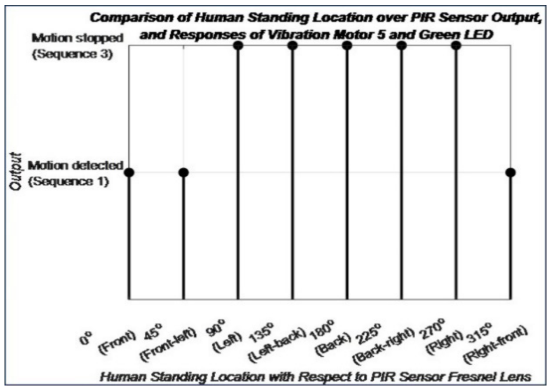

FIGURE 11. Analysis of the human detection system experiment results

STABILIZER SYSTEM

The results of the stabilizer system experiment are shown in Table 5. According to Table 5, the servo horn tip angular position was ranging from 85° to 120° to maintain the Ultrasonic Sensor 1 viewing direction as the wall throughout the experiment. The important concept that makes the stabilizer system perform as intended is the IMU output must be 100° smaller than the servo horn tip angular position. Although the IMU output was less than the servo horn tip angular position at the range from - 101° to - 99.37°, with percentage error ranging from 0.03% to 1%, during the experiment due to the limited resolution of the servo motor, the Ultrasonic Sensor 1 viewing direction was still maintained as the wall reliably with extremely low deviation. Thus, the system can operate as intended to maintain the viewing directions of all obstacle detection sensors to provide accurate and reliable obstacle detection data when the devices are tilted to different angles. The analysis of the stabilizer system experiment results is depicted in Figure 12. As illustrated in Figure 12, the IMU output had the same trend as the servo horn tip angular position such that the servo horn tip angular position decreased and remained constant with the IMU output. Hence, the difference between the IMU output and servo horn tip angular position was observed as a horizontal line on the graph.

TABLE 5. Results of the stabilizer system experiment

IMU output (°)	Servo horn tip angular position (°)	Difference between IMU output and servo horn tip angular position (°)	Ultrasonic Sensor 1 viewing direction
20.40	120.00	- 99.60	Wall
15.63	115.00	- 99.37	Wall
10.33	110.00	- 99.67	Wall
0.29	100.00	- 99.71	Wall
- 0.13	100.00	- 100.13	Wall
- 0.31	100.00	- 100.31	Wall
- 5.00	96.00	- 101.00	Wall
- 10.08	90.00	- 100.08	Wall
- 15.03	85.00	- 100.03	Wall

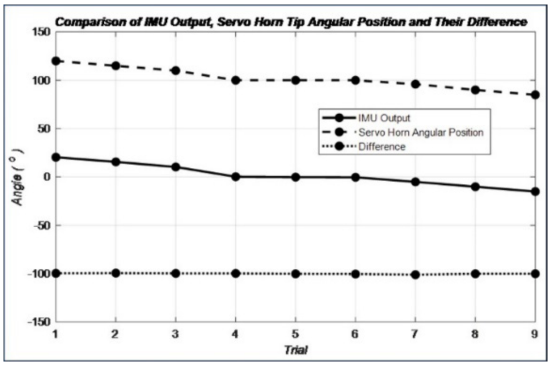

FIGURE 12. Analysis of the stabilizer system experiment results

CONCLUSION

Blind people are unable to receive surrounding information through vision, as opposed to ordinary people who receive a minimum of 80% of information through vision in their daily lives. Thus, blind people have extremely poor mobility and independence in travelling. The common drawbacks found on the existing blind people's guidance devices are they do not have a stabilizer system to maintain the viewing angles of obstacle detection sensors when they are tilted to different angles, as well as they do not have a sensor layout that can detect obstacles at different levels and directions simultaneously. As a result, blind users are still at high risk of being hurt by obstacles in their daily lives. The WBPGD proposed in this paper consists of a chest strap and two wristbands that operate together to provide accurate and reliable obstacle detection data in different environments and conditions to improve blind users' mobility and independence effectively based on a stabilizer system and multiple obstacle detection sensors. The object detection, human detection, and stabilizer systems were evaluated and they operated as intended. The performance of the stabilizer and object detection systems had low percentage errors, ranging from 0.03% to 1% and 2.352% to 10.376% respectively. The human detection system has a measuring range of at least 90° cone to detect human, while the vibration motor and LED pairs on wristbands respond the correct sequence based on the data collected by their corresponding obstacle detection sensors respectively. The duration of a cycle of a sequence was designed as 2 s and the minimum threshold of distance between the object and the users for the vibration motors and LED pairs to inform the users regarding obstacles is 2 m are the improvements over existing blind people's guidance devices to allow the users having enough time to identify the locations of vibrations and obstacles.

The WBPGD can be improved in the future by deploying obstacle detection sensors that are lighter and smaller to reduce the load applied on the users and servo motor in the stabilizer system. The WBPGD can also be improved in the future by introducing green energy source harvesting technology to charge the batteries that power up the systems to make them sustainable without polluting environments.

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DECLARATION OF COMPETING INTEREST

None.

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