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MULTIFUNCTIONAL BLIND STICK FOR VISUALLY IMPAIRED PEOPLE

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ABSTRACT

This paper presents the design, development and testing of Embedded multifunctional blind stick for visually impaired people. One of the biggest problems faced by the visually impaired is navigating from place to place, be it indoors or outdoors. Further, the adverse conditions of the roads make it even more difficult for them to walk outdoors. They have to be alert at all times to avoid consequences like colliding with stable or moving obstacles, ascending or descending staircases, slipping down wet terrain. Also, at times they may be in distress and might want to send an alert message to their relatives or friends about their whereabouts. These problems of blind people can be addressed with the intervention of technology. The proposed solution employs the Embedded system paradigm to provide a medium between the blind and the environment. Several sensors can be used to detect anomalies like obstacles, staircases and wet terrains respectively. The prototype discussed here is a simple, sophisticated and affordable multifunctional blind stick equipped with various sensors and modules. Also, this solution provides a way to send a message about the whereabouts of the user to the concerned people.

Keywords: visually impaired, multifunctional blind stick, object recognition, obstacle detection.

I.INTRODUCTION

According to the World Health Organization, almost 285 million people worldwide suffer from some sort of visual impairment, with 86 percent having impaired vision and 14 percent being blind. Human vision is one of the most vital senses for survival. Vision aids in establishing a connection with the environment. People who are blind rely on alternative resources, such as a modest walking cane or other people. They learn site directions, impediments on their way, and navigate according to them in familiar settings like the interiors of a house. However, relying on one's recollection to get from one place to another is not always safe for the blind. Especially when they're out in the open. Blind persons are not always afforded assistance there is a need for a device, such as a stick, that can assist visually impaired people in all aspects of their lives .The stick's main criteria for it to be useful to any visually impaired person are efficiency and cost effectiveness. People, vehicles, and stones in the outside, as well as stairs, walls, and impediments on the stick, there's a speaker. The stick can also detect moist or damp surfaces and provide the user a vibrational signal.

II. LITERATURE REVIEW

Efforts to enhance the quality of life for visually impaired (VI) individuals are gaining global traction, with a significant focus on assistive technologies (AT) that address challenges in mobility, education, and daily living [1]. Malaysia, a nation witnessing a rising number of VI individuals, is making strides in integrating technology to cater to this community [2]. With visual impairment among the most common disabilities in the country, targeted initiatives like Assistive Courseware (AC) and smart mobility aids are transforming accessibility and inclusivity for VI individuals. However, gaps persist, as AT remains underutilized, costly, and largely inaccessible to low-income groups [3].

The government of Malaysia, through its emphasis on Information Technology and Communication (ICT) as part of its economic growth strategy, has recognized the potential of creative content and AT [4]. Despite these efforts, education for VI learners still lags, with limited resources and innovative tools available to bridge the gap between them and sighted peers. AC prototypes developed for VI children demonstrate that interactive features such as audio, graphics, easy navigation, and multimedia elements can significantly enhance learning outcomes and foster critical skills like self-motivation, interpersonal engagement, and adaptability. These tools not only expose VI learners to technology but also help to break down barriers to their participation in education and society [5].

On the mobility front, innovations like smart walking sticks and canes integrate advanced sensors, GPS, and feedback systems to provide real-time obstacle detection, navigation assistance, and safety alerts. Devices such as the Smart Cane and ultrasonic sensor-based walking aids exemplify the potential of technology to empower VI individuals by enabling them to move independently and confidently in both indoor and outdoor environments [6]. These tools are designed to address practical needs, such as identifying stairs, water, and other potential hazards, while remaining lightweight and cost-effective.

Globally, the World Health Organization reports that over 285 million individuals are visually impaired, with 39 million categorized as blind. Developing countries account for 90% of these individuals, underscoring the urgency of affordable and accessible solutions [7]. Research highlights the role of AT in bridging societal gaps, as seen in Malaysia, where the number of registered VI individuals rose from 14,738 in 2002 to 23,378 in 2009. Yet, limited resources and the high cost of AT continue to hinder its widespread adoption.

Malaysia’s national plans, including the Ninth and Tenth Malaysia Plans, emphasize the development of creative content and AT as a means of fostering inclusive growth [8]. Future efforts should prioritize affordability, scalability, and interactivity in AT solutions, enabling broader adoption across socioeconomic strata. By integrating multimedia elements, user-centric designs, and personalized learning approaches, AT can revolutionize access to education, mobility, and employment for VI individuals, contributing to a more inclusive society [9]. Furthermore, global collaboration in research, funding, and technological innovation is crucial to addressing the challenges faced by VI communities worldwide. Through these efforts, the vision of equitable access and participation for VI individuals can become a tangible reality [10].

III. SYSTEM MODEL

The Block Diagram of our prototype is as shown below,

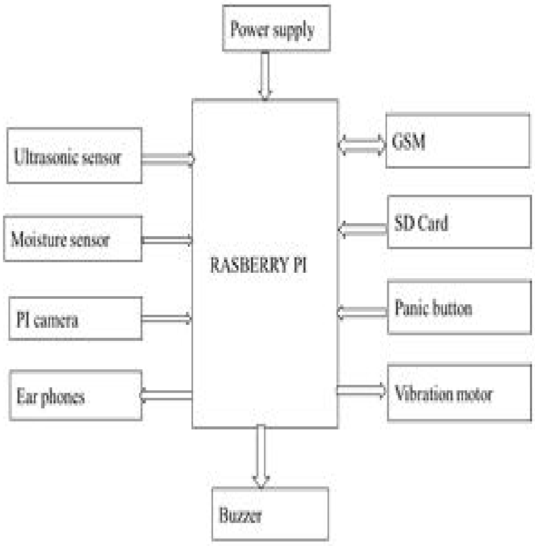

Figure1: Block diagram of the proposed system

Arduino: The Arduino board serves as the central controller for the system. It processes data from sensors, communicates with the mobile app, and controls the watering mechanism.

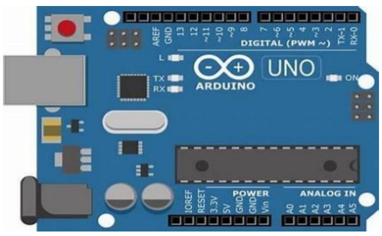

Figure 2: Arduino

Power Supply: You'll need a suitable power supply to provide power to the Arduino, water pump, and other components. Ensure it can provide the necessary voltage and current.

LCD (Liquid Crystal Display): The LCD screen can display essential information about plant hydration levels, system status, and more.

Figure 3: LCD Display

Ultrasonic Sensor: An **ultrasonic sensor** is a device that measures distance by emitting ultrasonic sound waves and analyzing the time it takes for the echoes to return. These sensors are widely used in various technologies, including robotics, automotive systems, and assistive devices, due to their reliability and precision.

Figure 4: Ultrasonic Sensor

Buzzer: A **buzzer** is a small electronic component that generates sound as an alert or feedback mechanism. It is commonly used in assistive technologies for visually impaired (VI) individuals, providing audio cues to navigate safely and interact with their environment.

Figure 5: Buzzer

Below is the design flow of the operation of the walking stick, The process begins. Check if the obstacle is moving. If **no**, proceed to "Obstacle not found". If **yes**,

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proceed to "Get obstacle data using sensor". Collect data about the obstacle using a sensor. Process the collected obstacle data with the database.

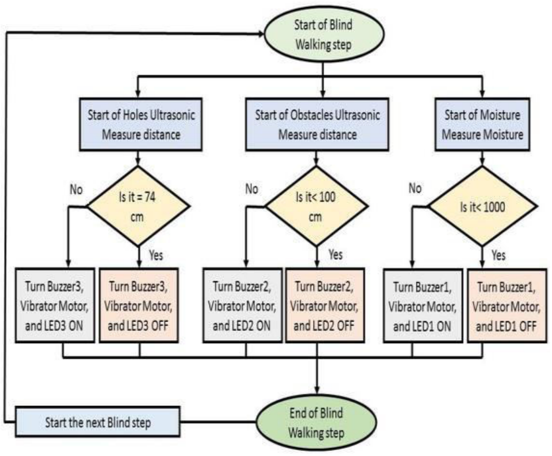

Figure 6: Design flow of the proposed system

Check if the processed data matches the database. If **yes**, proceed to "Alarm sound, vibrating motor activated". If **no**, proceed to "Obstacle is unknown". The obstacle is not recognized. The obstacle is not detected. Then, move along. If object is detected Activate the alarm sound and vibrating motor. The process ends.

The system uses ultrasonic sensors to detect obstacles. These sensors emit ultrasonic waves and measure the time it takes for the echoes to return, determining the distance to the obstacle.

Obstacle Detection: When an obstacle is detected within a certain range, the microcontroller processes this information and triggers the appropriate response.

Feedback Mechanisms: The system provides feedback to the user through various means:

Buzzer: Emits a sound to alert the user of an obstacle.

LCD Display: Displays information about the obstacle and system status.

Power Supply: The system is powered by a suitable power supply, ensuring all components receive the necessary voltage and current.

Additional Features: Some advanced systems may include features like GPS for location tracking, Bluetooth for connectivity with mobile apps, and cameras for more detailed obstacle recognition.

IV. RESULT

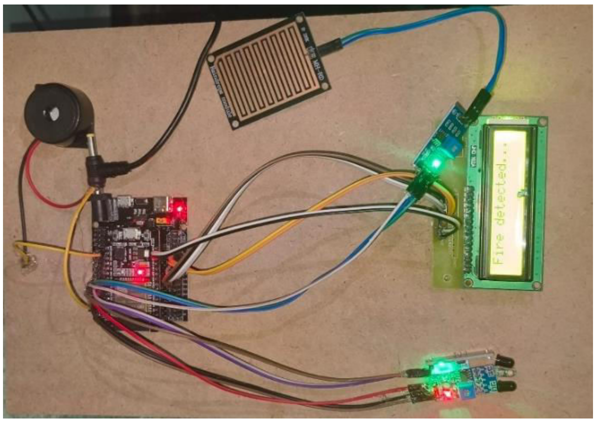

Figure 7: result of the proposed system

This work was successfully tested and implemented in tinder cad and partially implemented in the hardware model. In the software model, whenever the object came nearby to the sensor it got detected by the distance (dist1 = dur1 * 0.034 / 2) which was the default. The potentiometer was provided to change the distance accordingly and it give successful results for detecting objects and the alarms the buzzer. The vibration motor was also implemented successfully according to their object's direction it vibrated. In the hardware model prototype of the stick was made and one side detection was successfully tested.

V.CONCLUSION

The blind stick proposed in this project can aid the visually impaired user by helping him/her navigate through different terrains and obstacles. The Stick is also able to inform the users location to their caretakers depending on the button pressed in case of emergency or distress. The new feature braille keypad is added which helps to send messages to different concerned people according to the different situation. The remaining keypad can be used for different function as per the need. In the event of an emergency or trouble, the stick can also notify the user's caretakers of their whereabouts. The stick can also be found with the use of an RF remote control.

This can be improved further by adding tiny scale and high performing sensors, which will improve the design while also reducing the amount of space taken up on the stick. A few adjustments to the sensor angle placement can be made to have them adjust according to the angle of the stick relative to the ground so that they always point straight rather than being mounted at a static angle. It can also be improved by adopting a better material for the stick's body, such as carbon fibre, to make it lighter and more flexible to use.

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