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Smart Walking Stick for Visually Impaired Persons

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Abstract **– The common disability among different age groups of peoples across different countries in the globe is blindness, either totally or partially. As per the statistics provided by World Health Organization (WHO), worldwide about 285 million people are affected by this blindness. 246 million people of both the genders are totally blind and about 39 million people are partially blind. Either partially or totally impaired visually, these persons under go great difficulty in daily life and their woes are more if there is an obstacle in their path of movement. A walking stick for such persons is of great help for such persons. In this work assembly and testing of a smart walking stick for visually impaired persons is done. This device identifies the obstacles and hindrances in the path of the people's low or zero in eyesight. This stick is a low-cost unit and effectively helps in having an artificial vision for visually impaired persons. It also provides a navigational information about the environment static or moving by identifying the environment and estimating the distance of the obstacles or hindrances around them. A series of beep sounds caution the blind persons about these obstacles and hindrances.**

Keywords **– Blindness, Walking stick, Artificial vision, Radio frequency transmitter, Global System for Mobile Communications.**

I. INTRODUCTION

Important organ for any human being is an Eye and good visibility in both the eyes of a person is the primary requirement as interpreting any visual information and transferring it to the brain is essential. Eyes receive, process and provide people with 83% of the information about the environment and play an important role in human life. Blindness is identified as a condition of losing the ability to see light and blind persons have with poor or no eyesight rely on other senses like touch and hear to compensate this disability. Based on the information provided by World Health Organization (WHO), approximately 285 million people worldwide are affected by this blindness, either partially or totally impaired visually. 246 million people of both the genders are totally blind and about 39 million people are partially blind [1]. A blind person needs to overcome obstacles like steps, objects or water spilled, a wall etc. A person who is visually impaired is either entirely or partially blind. Various types of difficulties are faced by the visually challenged persons while navigating and their movement is limited making them depend on their family members for mobility.

A walking stick for blind persons is of great help and assembly and testing of a smart walking stick for visually impaired persons is done in this work. A smart walking stick purpose is to identify the obstacles like steps, walls etc. and hindrances like water on floor, shallow surfaces in the path of the people's low or zero in eyesight. This stick is a low-cost unit and effectively helps in having an artificial vision for visually impaired persons. This design of a portable stick includes various sensors like ultrasonic, light, and water sensors suitable for navigation in open or public places. The sensors included in the built of this smart stick are useful in detecting obstructions and water in the path of navigation. The sensors and other circuitry elements used in the assembly of this smart stick are cost affective, resulting in a low-cost device and easily affordable by millions of blind individuals around the world.

II. LITERATURE REVIEW

In their work on smart walking stick for visually impaired Shravan Mohite et al [1], came up with a device that supports the blind people in identifying the surroundings and detect hazards and obstacles while walking. This device functions as an artificial vision and alarm system. With this device, blind persons can identify unfamiliar locations with the help of Global Positioning System (GPS) navigation enabled in the device. Details of smart walking stick, an electronic aid to identify obstructions in the path was given Mohammad Hazzaz Mahmud et al [2]. Different sensors like, ping sonar sensor, proximity sensor, wet detector, and tiny pager motor are used for simple and safe movement of the visually impaired persons. In the design of the smart walking stick designed by Apurv Shaha et al [3], global positioning system (GPS) integrated with a smartphone useful to detect obstacles and provide real time location tracking is

incorporated. The design results in high power-saving in addition to precise guidance and navigation. In their design of compact smart walking stick for visually challenged persons, Odong Sam et al [4] used ultrasonic and water sensors to identify obstacles and water in their path of navigation. As and when this smart stick is misplaced or stolen, the radio frequency transmitter incorporated in the stick design sets off an alarm with a wild beep. In their work Premarajan Akhil et al [5], gave the design of the smart walking stick with an ultrasonic sensor, GPS, and Global System for Mobile Communications (GSM), to identify impediments, locate the shortest and safe path to the destination, and trigger alarm in case of emergency using a vibrator and a speaker on the walking stick. This design is suitable for both indoor and outdoor conditions. In their work of an intelligent stick for walking, Shalini Singh et al [6] gave details of design which are useful for both elderly and blind persons in navigating and keeping a track of their health condition. Different types of sensors used in the design are useful in locating shallow pits, obstacles, water pools in the path, and record body temperature and pulse rate of the person holding the stick. A message is sent to caution others in case of emergency. Additional feature to be included is monitoring diabetic level and blood pressure while moving. In the design of smart blind walking stick for visually challenged people, Nilima Sahoo et al, [7] described the design features which include ultrasonic sensor, water level sensor, vibrator, buzzer, and a GPS module to enhance the functional features of the stick. As suggested by these authors, one of the points for future scope is employing a neural network learning algorithm to anticipate potentially dangerous circumstances for blind or aged persons. In our work a similar stick with all low-cost sensors with maximum features like locating obstacles, pits, walls and water in their path of navigation needed for a smart walking stick is explained and the same is assembled and tested for functionalities.

III. Component Details

A stick available in market and useful for both aged persons and blind people is provided with ultrasonic sensor for estimating the obstacle distance as per pre decided value and in two directions like in the front and sides of the person using the stick. A water sensor used is useful for detecting presence of water on the floor of movement and the level of water and sudden rain fall. A light detecting sensor, viz., a light dependent resistor (LDR) is used in the design to detect light intensity and caution with a beep if the light intensity is very less leading to darkness or very poor visibility as the blind person or aged person may collide with other persons due to poor visibility conditions in navigating path. The high resistance offered by these LDRs vary with variations in light intensity and are inexpensive, simple in construction and easy to use. A voltage regulator is used in the circuitry to ensure a constant output voltage independent of certain fluctuations in the input voltage. A buzzer used in the circuit gets activated and emits a continuous beep for each of the variations in the environment. An infrared (IR) sensor also used in the stick assembly to detect proximity of a person. IR sensor is a radiation sensitive optoelectronic component with a sensitivity range of 780 nm to 50 µm. IR sensors are useful in motion detection. Two light emitting diodes (LEDs) are used to glow in different colors to caution the persons around, though these are not directly useful for the person holding the stick. These LEDs require very low voltage and consume very less power. Power source for the passive elements in the circuit is a battery of suitable voltage and compact in size. A micro controller is used to dump the instructions to activate various sensors and enable active and continuous interaction with environment. Arrangement of various components in the smart walking stick is shown in figure 1.

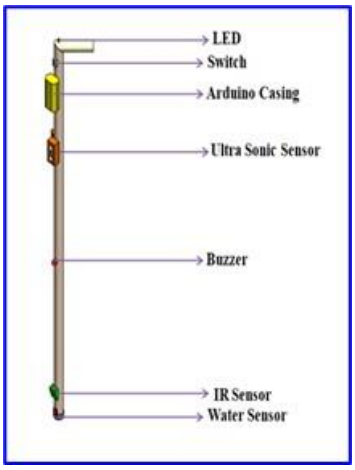

Fig.1. Smart Stick Assembly

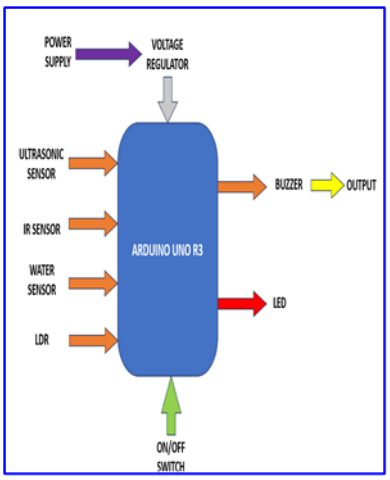

Fig.2. Block diagram of Smart Stick circuit

IV. IMPLEMENTATION

The smart walking stick is an integration of IR sensors, ultrasonic sensors, LDR sensors, and a water sensor and a buzzer along with a microcontroller. The IR sensor array is strategically positioned to detect obstacles in close proximity to the walking stick. It employs infrared rays to measure the distance between the stick position and an obstacle. The ultrasonic sensor using sound waves estimates the distance between obstacles and stick and range of detection is better compared to an IR sensor. LDR employed gauges the ambient light levels and this information is crucial for providing feedback on changes in lighting conditions. The water sensor is incorporated to detect water body or spilled water in order to alert the user about potential wet or slippery surface ahead. As and when obstacle is found in the path, variations in surrounding light intensities or/and a slippery surface is/are identified, the buzzer is activated and loud buzzer sound is given. Distinct tones of buzzer are used to alert in specific cases like an obstacle, variations in surrounding light intensities or presence of slippery surface. Block diagram of Smart Stick circuit is shown in figure 2. The assembled smart walking stick was test blind folded by a group of persons and with different variations in the environment like obstacle, steps, light intensities and slippery surface. The response of all the sensors is found to be good and very satisfactory. The future scope of work is to use a simple chip in place of all these components like sensors, controllers etc. Work is in progress in that direction.

V. RESULTS AND CONCLUSIONS

When tested the stick functioned well by identifying obstacles around the sensors and the buzzer is triggered accordingly and glowing of LED happened which is useful for cautioning other people around. The stick when put to use could easily identify obstacles whatever is the obstacle like a book or a box or a wall or a door. When tested near steps, the stick could identify the variation in height of the floor, indicating a presence of steps giving a different type of beep. Stick performance is found to be satisfactory. The design is compact and safe for the user. However, the functioning at present is affected by the battery life as it is the weak part of the stick and we are further working on improving its performance.

REFERENCES

[1] Mahmud, Mohammad Hazzaz & Saha, R & Islam, Sayemul, “Smart walking stick-an electronic approach to assist visually disabled persons”, International Journal of Scientific and Engineering Research, 2013.
[2] Mohite Shravan and Patel, Abhishek and Patel, Milan and Gaikwad (Mohite), Vaishali, “Smart Walking Stick for Visually Impaired People”, 2018.
[3] Shaha, Apurv & Rewari, Shubham & Gunasekharan, Sankaradithyan, “SWSVIP-Smart Walking Stick for the Visually Impaired People using Low Latency Communication”, International Conference on Smart City and Emerging Technology (ICSCET), 2018.
[4] Sam Odong & Niwareeba, Roland & Michael, Tumwijukye & Nobert, Ijotre & Martin, Maraka, “Design and Construction of a Smart Walking Stick for Visually Impaired Individuals”, 6th East African Healthcare Engineering Regional Conference and Exhibition, (EARC), 2018.
[5] Sahoo N, Lin H W, Chang Y H, “Design and Implementation of a Walking Stick Aid for Visually Challenged People”, Sensors 2019,. https://doi.org/10.3390/s19010130
[6] Shalini Singh, Dr. Balwinder Singh, “Intelligent Walking Stick for Elderly and Blind People”, International Journal of Engineering Research & Technology (IJERT) Volume 09, Issue 03, 2020.
[7] Akhil P., Akshara R, Athira R, Kamalesh Kumar S.P, Thamotharan M, Shobha Christila S, “Smart Blind Walking Stick with Integrated Sensor”, Materia. Proc. 2022, https://doi.org/10.3390/materproc2022010012