Smart Walking System based on Artificial Intelligence

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Abstract : This paper involves the smart assistance system for outwardly debilitated individuals. As per the research, there are roughly 37 million individuals over the world who are visually impaired as indicated by the World Health Organization. Individuals with visual inabilities are regularly in need of the outer help which can be provided by people, trained dogs, or electronic gadgets as supportive system for basic assistance .The already existing systems are not cost affective and are being unaffordable for the visually impaired to but and use it. Not only being expensive but also those supporting systems are difficult to carry . Thus, this played the motivation for the development of a smart cane white stick to survive these restrictions which includes ultrasonic sensors at particular positions on the stick that gives the data about obstacle to the client by initiating the signal sound or vibrations. We proposed minimal effort and light weight framework structured with micro controller that processes signal and alerts the visually impaired person over any obstacle, water or dark areas through beeping sounds or vibrations. The system comprises of obstacle detection sensors for process of receiving, processing and sending signals to the alarm system which finally alerts the user for prompt action. The system was designed, programmed using Python language and tried for exactness by the visually impaired. Our gadget can recognize obstacle inside the separation of around 2m from the client. So, basically our system will be an assistance system which will be able to take the decision based on the précised readings collected and hence the user will be guided accordingly.

Index Terms :Artificial intelligence, Ultrasonic sensor, Arduino board, Microcontroller, Mobility aid, Visually Impaired Person, Alarm system

I. INTRODUCTION

Visually impaired individuals are the general population who thinks that its hard to perceive the finest detail with solid eyes. The individuals who have the visual intensity of 6/60 or the flat scope of the visual field with the two eyes open have not exactly or equivalent to 20 degrees. These individuals are viewed as visually impaired and hence, they need the regular assistance. An overview by WHO (World Health Association) did in 2011 appraisals that on the planet, around 1% of the human population is outwardly disabled (around 70 million individuals) and among them, around 10% are completely visually impaired (around 7 million individuals) and 90% (around 63 million individuals) with low vision as per analysis. The major issue with visually impaired individuals is the medium with which they explore their navigation. Such individuals require help from others with great vision. As portrayed by WHO, 10% of the outwardly hindered have no practical vision at all to enable them to move around securely without help. This examination proposes another system for structuring a keen stick to help outwardly disabled individuals that will give them route. The traditional route helps for people with visual weaknesses are the strolling stick (additionally called white stick or stick) and guide mutts which are portrayed by the numerous defects. The most basic deficiencies of these guides include: fundamental abilities and preparing stage, scope of Movement, and exceptionally unimportant data conveyed been imparted.

System would be made by using Artificial Intelligence. As Artificial Intelligence is training a system to work in such a way that which at a moment a human can do better. Using Artificial intelligence the system will be trained in such a way that it would assist the visually impaired to navigate their way independently if not in highly traffic area but at least in the areas like garden or anywhere indoor.

Our methodology changed this stick with some hardware segments and sensors, the electronic helping gadgets are intended to explain such issues. The ultrasonic sensors, are utilized to record data about the nearness of obstacle out and about. Ultrasonic sensor have the ability to recognize any impediment inside the separate scope of 2cm-450cm. Along these lines at whatever point there is an obstruction in this range it will caution the client. Most visually impaired direction frameworks utilize ultrasound in light of the fact that of its in susceptibility. With the advances of present day innovation both in equipment and programming it has turned out to be simpler to give smart route framework to the outwardly impeded.

II LITERATURE REVIEW

In paper [1] To investigate the prevalence and causes of visual impairment and blindness. Visual impairment was defined as distance visual acuity 20/40 in the worse-seeing eye. Retinal diseases represented the major cause of no correctable visual impairment and accounted for more than half of causes of blindness. Retinal diseases are a major cause of no correctable visual impairment and blindness.

In survey [2] the main problem for visually impaired person is to find the route whenever the person has to move from one place to another. To overcome this problem a smart white cane was developed in that ultrasonic sensors are used to detect the obstacle within 2cm to 450cm which provide information about the environment to the user by activating the buzzer sound.

The implementation of a smart stick that assists a visually impaired person to his destination safe and secure. We make use of various sensors to detect the obstacles ahead and warn the blind person about the obstacle through beep sound. The intensity of the beep sound increases as the person nears the obstacle which aid him to move aside of the obstacle.[3]

In [4] the proposed technique is a straightforward strolling stick outfitted with sensors to give data about the earth. GPS innovation incorporated with pre-modified areas enables the client to pick the ideal course to be taken. In the framework, ultrasonic sensor, pit sensor, water sensor, GPS beneficiary, level converter, driver, vibrator, voice synthesizer, keypad, speaker or earphone, PIC16F877A microcontroller and battery were utilized. The proposed framework planned to give ease and effective route help for the visually impaired which gives a feeling of fake vision by giving data about the natural situation of articles around them while giving continuous help by means of GPS.

In [5] the Voice Enabled Smart Walking Stick for Visually Impaired people was developed. The proposed framework utilized two Ultrasonic locators which are Pit sensor and Water sensor; GPS beneficiary, GSM module, Voice synthesizer, ATmega328/P micro-controller, transfer, speaker and battery. Ultrasonic sensors works on a principle that generate high frequency sound waves and evaluate the echo which is received back by the sensor. GPS receiver is used to track the current position of the human. The voice synthesizer and speaker are used to produce voice messages if the human goes out of the desired path. The pit sensor is used to detect any pit or dents present in the way. The GSM module and relay are for the equipment switching purpose. The data with respect to obstructions is given through voice alarms that destroy the issue of understanding vibration designs which was utilized in past frameworks

In survey paper [6] A variety of versatile or wearable route frameworks have been created to help outwardly debilitated individuals amid route in known or obscure, indoor or out entryway situations. This paper exhibits a near overview among compact/wearable obstruction detection/evasion frameworks (a subcategory of ETAs) with an end goal to advise the examination network and clients about the capacities of these frameworks and about the advancement in assistive innovation for visually impaired people.

A versatile robot obstacle avoidance system has been changed over effectively to a route help for the visually impaired. Rather than transmitting electronic signs to the robot movement controllers, the impediment shirking framework transfers data to the client by transmitting electronic signals. These signals give spatial data about the area of articles in space, or managing data for the prescribed travel heading and speed. The technique is executed in another movement help for the visually impaired, the Navbelt. Normal voyaging speed on the Navbelt test system in the direction mode was 0.76 m/sec.[7]

In [8] paper presents a navigation device to help visually impaired people move indoor efficiently. The solution for indoor localization problem was provided by SLAM algorithm. To find a shortest virtual-blind-road a Pol-graph was designed using A* algorithm. The dynamic sub-goal selecting based route following algorithm was proposed to help the blind follow the shortest virtual-blind-road as closely as possible and meanwhile avoid obstacles.

In proposed paper [9] is concerned with independent mobility for the visually impaired in indoor environments.
An indoor situation for the most part has a higher obstruction detection chances than an open outside space and frequently contains overhanging objects. In this way, 3D recognition is required for object location. To address the difficulties and exploit indoor route, we present a RNA with a client server design for on-going way finding in this paper. The RNA is a computer vision improved white stick that utilizes a 3D camera-Swiss Ranger SR4000-for observation. It gives two navigational capacity way finding and 3D object identification to its client. This paper will concentrate itself on the way finding capacity that utilizes another Pose Estimation (PE) strategy to find the client in a floor plan and aides the client to the goal. The PE issue is otherwise called Simultaneous Localization and Mapping (SLAM).

A system for Navigation Assistance for Visually Impaired (NAVI) is developed by implementing a stereo vision system to detect the obstacles of the scene. The RGB-D sensors are used which provides range information from active sensing by means of infrared sensor and intensity images from passive sensor such as standard camera. The main contribution, is the robust expansion of the range-based floor segmentation by using the RGB image. Range information is used to detect and classify the main structural elements of the scene.[10]

In [11] This study proposes another procedure for structuring a smart stick to help visually impaired people that will give them route. The regular and old route helps for people with visual disabilities are the strolling stick and guide dogs which are portrayed by a numerous defects. The ultrasonic sensors, water sensor, buzzer, and RF transmitter/Receiver are utilized to record data about the presence of obstacles. GPS innovation coordinated with pre modified areas enables the client to pick the ideal route to be taken. In the framework, ultrasonic sensor, pit sensor, water sensor, GPS collector, level converter, driver, vibrator, voice synthesizer, keypad, speaker or earphone, PIC16F877A microcontroller and battery were utilized. The proposed framework planned to give minimal effort and effective route help for the visually impaired which gives a feeling of fake vision by giving data about the natural situation of articles

In this reference [12] paper presents a system which detects objects/obstacle using ultrasonic sensor, Micromechanical system(MEMS) based gyroscope to measure angle or rate of rotation of stick, Piezoelectric beeper which acts as an alarm to the user cautioning him about his movement. The best part of this system is the language used for command can be any language in the world.

The proposed gadget can collaborate with the traditional white stick, particularly in spots brimming with moving objects (e.g., a train station amid a surge hour). The sensors mounted on the keen glove, to be sure, can distinguish obstacles on the way and give a feedback to the client before crashes. From an innovative viewpoint, the executed Zero Update algorithm conquers the issue of identifying wrist and hand turn, subsequently improving the client experience.[13]

In [14] paper outlines an obstacle acknowledgment framework for the visually impaired individuals utilizing the Radio frequency recognizable proof (RFID).The RFID reader gathers data of the environment (area, location) from the detached labels, and after that the information is conveyed to a control unit which deals with the showcase of the message in Braille through the electromechanical switches in the stick handle. This control unit is made of a microcontroller unit (MCU) that is customized to choose the specks utilizing decoders and supports that send electrical messages that lead to the raising or bringing down of pins, which permits showing the content in Braille.

III MATERIALS AND METHODS

3.1 Proposed System:

Our proposed framework is comprised of the Ultrasonic sensor was interfaced to the micro-controller, codes were composed with the Arduino outline and the physical sensor was associated with the micro-controller. The Arduino UNO is a micro-controller board dependent on the AT-mega328p (data sheet). It has 14 advanced yields and information sources pins of which 6 can be utilized as PMW yields, 6 simple sources of info, a USB association, a power jack.

The framework will enable the oblivious in regards to openly explore to their coveted goal. It is likewise easy to understand and simple. It is reasonable and accordingly can be mass created for utilization of the outwardly debilitated. The framework has the ability to distinguish snags that exist on the ground amid strolls indoor and outdoor route. A pair of ultrasonic sensors to detect obstacles in front of the blind from ground level height to head level height in the range of 400 cm a head. Ultrasonic sensors and water sensors take real time data and send it to the micro-controller. After processing this data, the micro-controller activates the buzzer. The water sensor detect water on the ground, and battery is used to power the circuits.

3.2 Hardware:

The choice procedure of fitting sensor relies upon a few factors, for example, cost, air condition, kind of obstruction to be distinguished, recognition extend, and the coveted accuracy of estimations gathered data and its transmission recurrence.The flowchart of the proposed system is presented below:

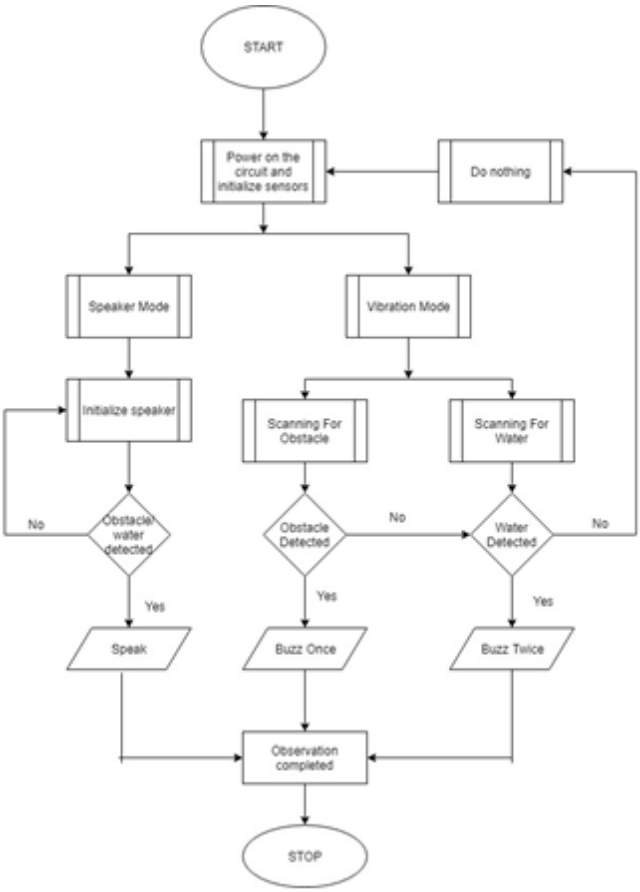

Fig. 1. proposed system flowchart

IV SYSTEM ARCHITECTURE

This system is basically made for visually impaired people for self-protection. This System can be used indoor or in the garden where the visually impaired people feel secure to move. Arduino plays the role of micro-controller. The Arduino gets initialized by switching it on. In the event that the visually impaired person needs to go to a specific place he/she will have to initially choose the mode between the two different modes provided i.e either the speaker mode or vibration mode. Ultrasonic sensors are being used for distance measurement and additionally for obstruction detection. For the same, majorly three ultrasonic sensors are being utilized. These three sensors covers all three directions (left, centre, right) of the individual. As indicated by the given figure, the separation between stick to street side (right half of the street) will be estimated by ultrasonic sensor 1, distance between stick to centre street will be estimated by ultrasonic sensor 2 and the distance between stick to street side (left half of the street) will be estimated by ultrasonic sensor 3. All the three different ultra-Sonics will going to read the three different distances of the obstacles. Then, it will compare all the three distances and the highest distance measured will the direction in which the individual will move . According to proposed framework, two modes are being utilizing that are vibrator mode and speaker mode. In case if there is more sound outside. than, disabled individual can utilize vibrator mode else he/she can utilize speaker mode with the goal that guidelines can get past through speaker. In the event that the individual picks the vibration mode, the impediment is identified with the ultrasonic sensor and the sensor will examine for an obstruction as an alert for the individual. At the point when the obstacle is detected then vibrator will vibrate once than the individual will move in left direction, vibrator will vibrates twice to move straight, vibrator will vibrate thrice to move right.

When the individual picks the speaker mode, with the assistance of speaker which obstacle is there is informed to the individual as an audio. Later the distance is calculated by the distance formula. The distance which is longest is chosen as the way for the individual to walk.

This system basically performs three tasks i.e. obstacle detection ,distance measurement from stick to obstacle and giving the decision whether the individual should move left, straight or right

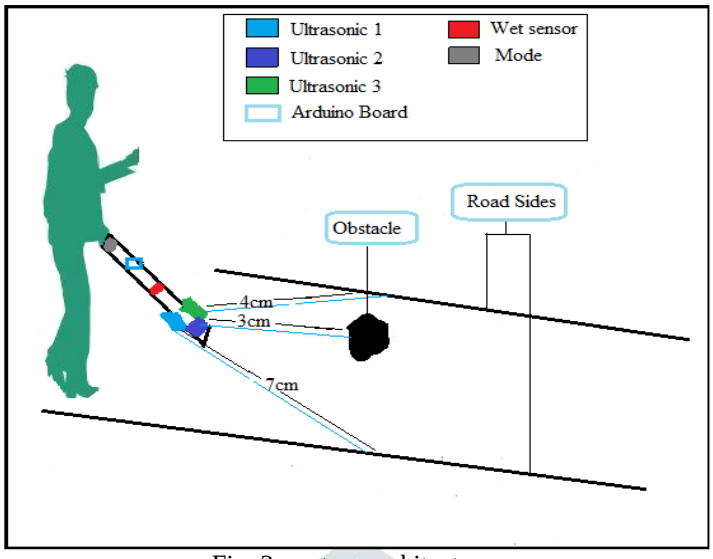

Fig. 2. system architecture

4.1 Hardware Configuration:

The proposed framework gives upgrades to the current framework structure. It tries to make the current framework convenient to use, efficient, helpful and easy to use. The implementation of the proposed design of the stick requires following hardware components:

A)Ultrasonic sensors
B)Arduino Uno
C)Speaker
D)Piezoelectric vibrator

A) Ultrasonic sensor:

In the proposed system we use 3 ultrasonic sensor. Each ultrasonic sensor detects the obstacles in a range of about 200 - 400 cm. The distance of the obstacle is determined based on the delay between the emission of sound and the arrival of an echo. The distance of the obstacle can be measured as, : Distance = (time*speed of sound in air)/2 (1) Where, time is the time duration for which the ultrasonic waves have travelled and Speed of sound in air is 340m/s. We divide the product of time and speed by 2 because the time is the total time it took to reach the obstacle and return.[2]

B) Arduino Sensors:

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

C) Speaker:

In the proposed system, as two different modes are provided, one of them is speaker mode. The decision taken by our system would be conveyed using speakers and hence the user would be able to listen or make the movements in the particular direction.

D) Piezoelectric vibrator:

This piezoelectric vibrator will provide the different vibration so user would be able to move in particular directions as per different patterns.

Fig. 3. Hardware Configuration

V RESULT AND DISCUSSION

This system basically performs two tasks i.e. distance measurement from stick to obstacle and obstacle detection. Obstacle detection identifies potholes and bumps on the ground in the user's route, guiding the user to avoid it. Firstly, the electrical circuit configuration was done on a breadboard. The connections on the breadboard comes out to be less efficient and hence, later it got replaced with Vero board. The main purpose of the proposed system is actually the working of ultrasonic sensors. The ultimate work of 3 ultrasonic sensors is to fetch 3 different distance measurements from the stick to different obstacles and then evaluate them. And after the evaluation, the user is instructed to follow in the resulted particular direction. The instructions will either be given by speaker mode or by vibration mode. This mode selection task will done by user to select one of the modes from the two modes provided. If the speaker mode is selected, the instructions will be given by audio whereas in case of vibration mode, different patterns would be stored for different instructions

Experiment 1: In the Garden

This particular experiment was performed while walking in the garden. It shows the frequent results by instructing the user with distinct instruction. Generally, on sidewalk the obstacles (trees, plants, benches etc) are mostly detected in any of the directions. So, for this particular experiment the result was generated as Move Straight.

Ultrasonic 1 (left)cm	Ultrasonic 2 (centre)cm	Ultrasonic 3 (right)cm	Result
3.89	14.9	9.98	Centre
10.47	19.97	12.58	Centre
18.85	16.37	7.9	Left
11.25	1.65	19.75	Right
7.25	24.6	5.24	Centre
4.51	27.95	15.24	Centre

Experiment 2: For the Indoors

Experiment 2 was performed in the indoor area i.e in house. So in this particular experiment, it was found out that our system could recognize the obstacles in various directions while giving out the various particular instructions to move.

Ultrasonic 1 (left)cm	Ultrasonic 2 (centre)cm	Ultrasonic 3 (right)cm	Result
23.1	17.94	89.98	Right
90.47	17.70	47.68	Left
63.87	26.28	17.89	Left
7.25	1.65	69.87	Right
17.56	44.69	15.84	Centre
14.25	27.9	35.24	Right

Experiment 3: On road side(on footpath)

This particular Experiment was performed during the walk on the footpath. Generally, there are less number of obstacles on the footpath. Our system could found those obstacles even when they were consistently in one particular direction.

Ultrasonic 1 (left)cm	Ultrasonic 2 (centre)cm	Ultrasonic 3 (right)cm	Result
3.89	14.9	19.98	Right
22.47	19.70	19.58	Left
28.85	16.37	7.9	Left
10.25	3.75	17.78	Centre
7.57	14.19	7.74	Centre
4.51	27.9	15.24	Centre
5.7	24.36	4.65	Centre
14.37	37.55	26.4	Centre
34.51	77.9	14.26	Centre

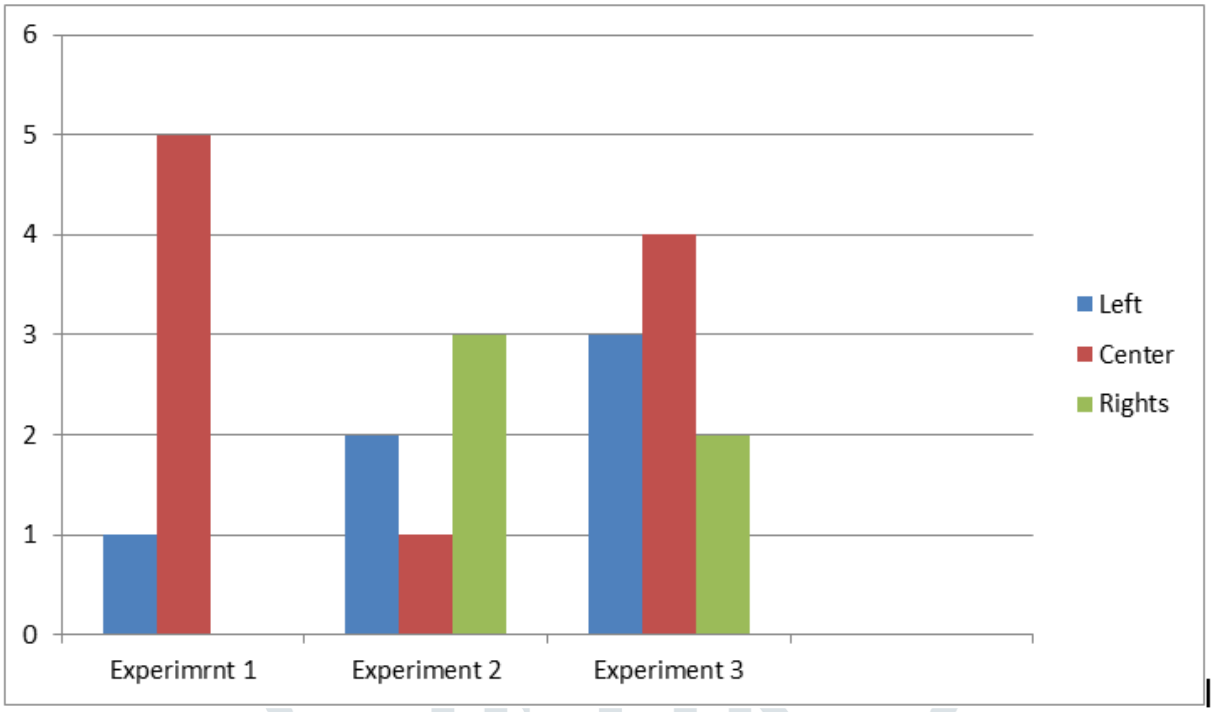

Fig. 4. Difference between Results

VI CONCLUSION

The Smart Stick goes about as an essential stage for the coming age of additionally supporting gadgets to the visually impaired to navigate safely both indoor and outdoor. It is effective and reasonable. It prompts great outcomes in recognizing the obstacles on the way of the user in the range of three meters. This framework offers a low-cost, reliable, portable, low power utilization and strong answer for route with clear short reaction time. A vibrator may likewise be included for usability and accommodation. In spite of the fact that the framework is hard wired with sensors and different components, it's light in weight. Further aspects of this system can be improved via wireless connectivity between the system components, thus, increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. Later on, advance changes to upgrade the execution of the framework will be included. These include: A worldwide situating technique to discover the situation of' the user utilizing the GPS. The ultimate aim of the project is to develop a low cost and convenient embedded personal guidance system dedicated to visually impaired users.

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