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Smart Walking Stick

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***Abstract*—The main aim is to make a smart stick to avoid leg weakness, balance loss and improper navigation of indoors and outdoors. These are the reason for fall accidents occur which might be dangerous and harmful. A suitable device is needed to help the blind and elderly people to walk outside or inside with full confident and independently. The project aims at designing robot cane which will monitor normally the events that will occur and also to improvised navigation of outdoors and indoor by detecting obstacle at different heights on flat road. The cane is also modeled to consider real-time movements of person walking or their different style of walking by counting the each step they are heading to and how much they travelled. A threshold level is set for acceleration value when person walks. Combination of ultrasonic sensor and force sensor placed in the tip of shoe which will help to measure the distance between stick and leg. If a person tend to fall his hand's pressure will be more than usual one and pressure sensor will sense that pressure and force will be exerted to the shoe. When output will be more than threshold value then alarm is activated.**

Keywords—Arduino Uno board, Force sensor, Ultrasonic sensor, Pressure Sensor.

I. INTRODUCTION

Robotics is a branch of engineering that involves science and technology of robots, manufacture, their design, and application. Robots are used in many different fields and for different purposes that can be useful for agriculture, safety purpose, navigating blind people and medical facility, etc. As it is used for different purpose they have different structure, construction, frame to achieve particular task. The mechanical aspect came into picture for completing the assigned task so that it can interact with environment. All robots contain some level of computer programming code. A program will give some sense to robot about what to do and when to do and how to do. Good constructed programs are core essence for robots and if there is any fault or error in program the performance can relatively be poor as well. The cane is most simplest and affordable device that can be used by any person across the world. It can be cost effective. But using these devices we cannot give the assurance that it will give sufficient information and also safe mobility, which are available to the people with senses. Visually impaired persons have difficulty to interact with their environment because of lack of eye sight and also they may have less contact with surroundings. Due to this visually impaired persons may face the difficulty in comparing obstacles appearing in front of them, and they are not able to move from one place to another. Also for elderly people who suffer from leg weakness and loss balance due to muscle fatigue, which can affect their mobility and walking style. Walking Stick is mainly designed to detect and avoid obstacles when blind people are walking on the ground. When user holding the cane or he /she hold the cane which is centered at the body and moves, the cane that has little distance between ground and tip of the stick. The tip of the cane should always at the front of leg that is lifted first and it is not necessary that it should maintain some distance between ground and tip; the tip of cane can touch the ground elsewhere. According to advance technologies, these canes are designed in such a way that user can put less effort to find the path or obstacle in front of them or became easy to navigate outside comfortably. This project aims at designing improvised navigation system and fall detection .This will be useful for blind people and elderly people.

II. RELATED WORKS

A number of walking-aid robots were design which were helpful for blind people to navigate from one place to another and also to roam outdoors and indoor. All robots were designed mainly to detect the obstacles that are present in front the user at the time of travelling but these devices only detect objects that are at the ground or those which are not touching the ground. Such assistant devices may solve one part of problem but they face problem at other level. So the devices should have solution considering in all perceptive which may help them when they walking outside or inside at least at the flat surface. Some of the devices are also implemented to detect fall of the persons which may help both blind and elderly people and prevent them from dangerous fall. The devices that are design are not accurate and complex or in some battery life is less. The exiting devices have some drawbacks that may motivate to make efficient and simpler device by overcoming the limitations.

G. Prabhakar Reddy, K. Sathish Babu proposed Intelligent Cane Robot for walking Assistance of Elder and Handicapped People in which S3C2400 was developed using an ARM920T core, with new bus architecture AMBA method was used. The cane robot was developed in which it can move in any direction for elderly and handicapped people. It determines walking intension of the person and controls the motion according to that. By using sensors like IR sensors, ultrasonic sensors interfacing with microcontroller which supports elder and handicapped people which will help them to avoid lower limbs problems. The main drawback was using many sonar sensors which may confuse robot due to similar frequency of sensors and also cause wrong reading that leads to less accuracy.

Ankit Agarwal, Deepak Kumar, Abhishek Bhardwaj implemented Ultrasonic Stick for blind using pulse echo technique. In this system the pulse echo technique was used to detect the obstacle and give some alert sound once the object is detected while traveling. It will calculate the difference between transmit time and receiving time by which we estimate distance between the user and obstacle which is

3m away from person's body. The main drawback was it consumed lot of energy and power due to strong signal transmitting from one corner to another corner.

Alenjandro R. Garcia Ramirez and Renato Fonseca Livramento da Silvaetal designed Voice Aided electric stick by using voice based system that helps blind people to aware about surroundings more effectively. The main contribution of this system was to detect obstacles that do not touch the grounds using haptic sensor. After obstacle is detected, the vibration takes place at the electronic stick and buzzer is activated and emergency message is sent through the GPS. The main drawback was it can detect only obstacles above the waistlines not of stones, steps.

Sharada Murali Shrivatsan R, Sreenivas V, Srihaarika Vijjappu Joseph Gladwin S., Rajavel R. designed Smart walking cane for blind people where obstacle detection system was made with GPS and GSM technology. This walking stick was designed to find out obstacles for user who is walking on the ground by using multiple sensors and also providing the awareness of environment. When the obstacle is detected feedback is given through vibrating motors and voice feedback for other obstacle to differentiate between obstacles respectively that can be heard from earphones. GPS and GSM module is used to send the message that is considered to be urgent are conveyed to the specific person that is mentioned in the code. This module can detect multiple obstacles present simultaneously according to program loaded in the module. The main drawback is It cannot distinguish between stationary and moving objects.

Kabalan Chaccour, Rony Darazi, Amir Hajjam propsed Multi-sensor guided walker for visually impaired elderly people in which Assistant Living System is made where when the obstacle is detected, the message is conveyed through wireless communication using Zigbee and GPS for outdoor. The heart and oxygen rate is also measured using appropriate sensors. The main limitation is wheels are not there for proper movement of cane in all direction.

III. System Architecture

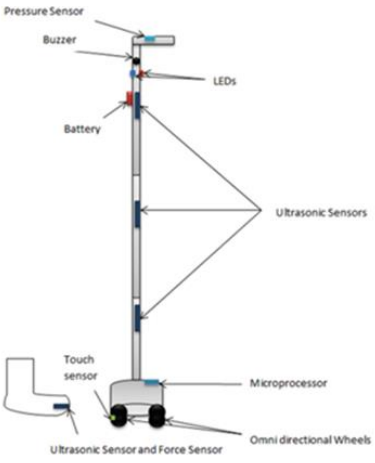

Fig. 1 Architecture Diagram of proposed system

The stick consists of three ultrasonic sensors are connected at specific height according to the total height of the stick as shown in Fig.1. Pressure sensor is placed at the handle of the stick to measure pressure exerted by hand of the user. It also consists of Omni-directional driven by the wheels which will help to move smoothly and properly. The ultrasonic sensor and force is kept inside the shoe of the person to measure the distance of the person's leg and stick. The buzzer and led gets activated when obstacle is placed in front of the sensor. The touch sensor is used to switch on-off the battery as per convenient. Buzzer will act as audible notification that will take user in correct direction and detect the obstacle accurately. This system is applicable only on flat surface. This system must be reliable, easy to use, robust and affordable. These sensors and devices are interfaced with Arduino. The input and output devices are connected to the pins of Arduino and according to the coding written in the Arduino IDE which is uploaded to the board.

IV. Implementation

Walking cane is one of the simplest and affordable assistive devices that is used to support visually impaired and elderly people to save them and enhance their lifestyle with more awareness. But using these devices we cannot give the assurance that it will give sufficient information and also safe mobility, which are available to the people with senses. Visually impaired persons have difficulty to interact with their environment because of lack of eye sight and also they may have less contact with surroundings. Due to this visually impaired persons may face the difficulty in comparing obstacles appearing in front of them, and they are not able to move from one place to another. And also elderly people suffer from leg weakness and loss balance due to muscle fatigue, which can affect their mobility and walking style. There are two parts that will involve in this system one is software and other hardware part.

A. Hardware

In this proposed system, it is designed in such a way that user can put less effort to find the path or obstacle in front of them or became easy to navigate outside comfortably and also prevent from dangerous fall. The hardware design have different module to make one electronic devices. Each individual module has specific functions: Obstacle detector, fall detector, alert notification.

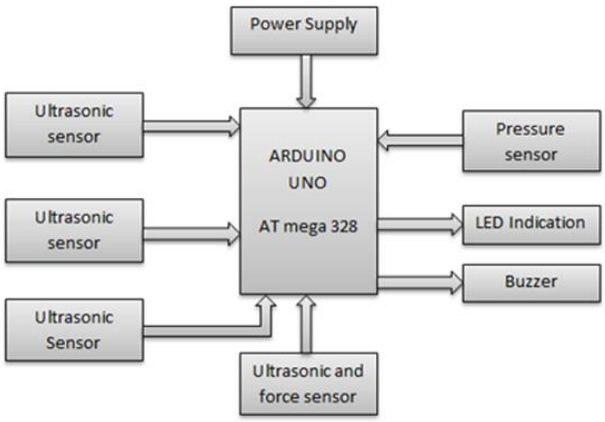

Fig. 2 Block Diagram of the System

The block diagram of the system consists of three ultrasonic sensors that is connected to the stick and pressure sensor at the handle of the stick force and ultrasonic sensor placed inside the shoe as shown in Fig. 2. The led and buzzer act as an output.

1) Obstacle Detector: It is very difficult for blind people to walk outside without suitable devices. They may face a

risk to hit with an obstacle or any other hurdle when they walk outside or inside the house. As they have very less contact with the environment as compare to people who are having senses obstacle detector system is very important. This system consists of three ultrasonic sensors that are connected at different levels of heights. This will help person who is walking with this stick can detect the obstacle on the ground, window or walls and also tree branches, etc. whenever it will detect the obstacle when placed in front of the sensor and it gives the alert notification.

2) Fall Detector: This system will help to detect a fall of the person. It will be very difficult for blind and elderly people who face risk of stumble and fall. It may happen when person walking and they tend to fall due to hole or carpet or may be due to muscle fatigue or leg weakness. In these situations the lower sensor cannot detect and person can fall. If a person tend to fall his hand's pressure will be more than usual one and pressure sensor will sense that pressure and force will be exerted to the shoe. The ultrasonic sensor that is placed in the shoe will calculate the distance between stick and person leg. By this method this system will monitor real time movements of person's walking style and also by counting and monitoring the style of steps and how much they travelled. The threshold level of acceleration is set when person's walk. When output will be more than threshold value then alarm is activated.

B. Software

The ARDUINO Integrated Development Environment is a piece of software that is available anywhere openly which can easily be download without any difficulty. It runs in any operating systems version like Windows, Mac OS X, and LINUX. It is platform where user writes the coding in the text editor or the space given in that software. This software can be for all types of Arduino boards. It consists of toolbar menus, messages area and many buttons mentioned below the menus.

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V. RESULTS

In this system, ultrasonic sensor will help blind people to navigate properly and effectively indoors and outdoors. The obstacle detector consists of three ultrasonic sensors that are placed at different heights on the stick. The ultrasonic are placed at the lower part near wheel and middle and top little bit below the handle of the stick. When the obstacle is detected on the ground, lower ultrasonic (S3) will sense the obstacle and buzzer is activated and led is on. If trees or braches come across the way, the middle sensor (S2) will detect obstacle and different tone is created and led is on. If the obstacle is at the height where top sensor (S1) is present then sensor will sense that obstacle also and alarm is activated. The distance is also measured between obstacle and sensor as per the program as shown in Fig. 4. If the obstacle is present within that distance then alert notification is activated otherwise it will not react.

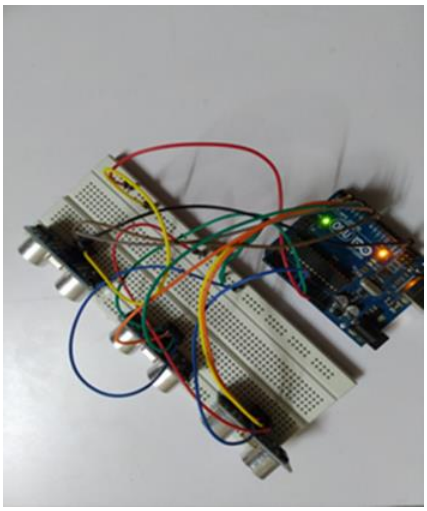

Fig. 3 Circuit Diagram of the obstacle Detector

Sensor are placed at different distance horizontally to the breadboard where left corner is considered as S3 and middle one is S2 and right corner is S1. This is circuit diagram of obstacle detector where it can detect and measure the distance between obstacle and sensor when placed in front of sensor as shown in Fig 4.

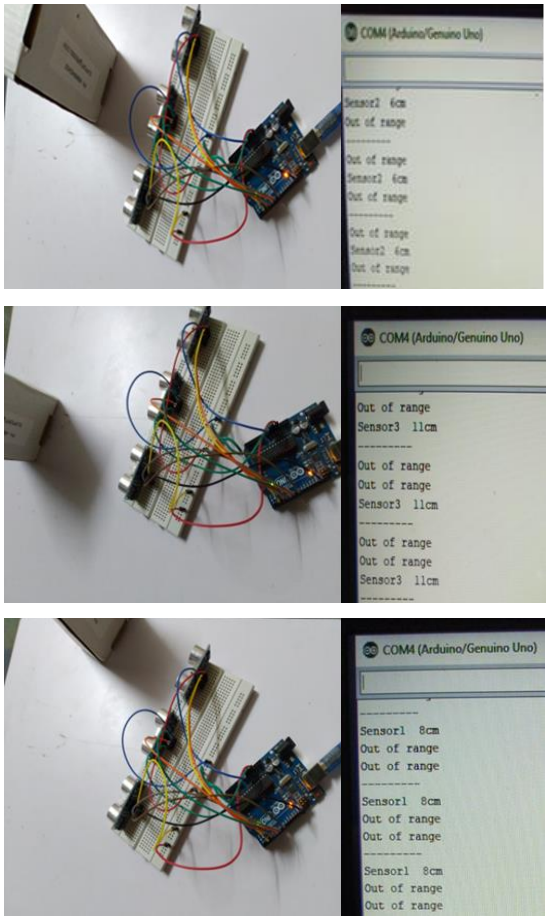

Fig. 4 placing obstacle in front of sensors and measuring distance

VI. CONCLUSION

Smart walking cane is one of the simplest and affordable assistive devices that are used to support visually impaired and elderly people to save them and enhance their lifestyle with more awareness. Visually impaired persons have difficulty to interact with their environment because of lack of eye sight and also they may have less contact with surroundings. In this project the simple cane will have all facilities which will help them to navigate outdoors and indoors and also control the movement. It will consist of group of sensors that will detect the obstacles at different heights on the flat surface with Omni- directional wheels that are used for proper movement of cane robot. In future work, this cane will be modeled with feature that will detect fall of the person. This will be useful for both blind people and elder people who suffer from muscle fatigue or leg weakness. This system will consider real time movements and also monitor the persons style, counting steps and distance travelled. It will also set the threshold for pressure and if the output value exceeds that threshold it will give alert notification. This system will be useful for both blind and elderly people whenever they go out of the house and they will feel more independent.

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