Smart Stick for the Blind and Visually Impaired People

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Abstract—**There are many issues over which humans have no control blindness is one of such issues. It snatches the vivid visual beauty of the world from an individual's life. But missing the beauty of nature becomes one of the last worries of such people as they have to face numerous difficulties in order to perform even the most basics of tasks in their day to day life. One of their most dominant problems is of transport, such as crossing roads, traveling in trains, or other public places. They always require human assistance to do so. But sometimes they are rendered helpless when no such assistance is offered. Their dependencies deteriorate their confidence. Traditionally they have been using the conventional cane stick to guide themselves by touching/poking obstacles in their way. This causes a lot of accidents and hence is dangerous for them and others. As this is a technologically driven era we decided to aid these differently abled people by coming up with a technology utilizing solution. We call it the "Smart Stick". It is a device which guides the user by sensing obstacles in the range of stick. It will identify all obstacles in the path with the help of various sensors installed in it. The microcontroller will retrieve data and pass it on as vibrations which will notify the user about hurdles on the way. It is an efficient device and will prove to be a big boon for blind people.**

Keywords—Smart Stick; Sensors; GPS-GSM module; RF module; Microcontroller; User Notification Setup.

I. INTRODUCTION

Our main aim to work on this project is to focus the blind population of the world and to assist them in every walk of life through the aid of technology.

According to the procured data from World Health Organization (WHO) [1] and National Federation of the Blind [2], there are around 253 million people who are visually impaired out of which 36 million people are blind worldwide [3].

According to the report by Times of India, India is now home to the world's largest number of blind people. Of the 36 million people across the globe who are blind, over 15 million are from India [4]. On the other hand, while India needs 2.5 lakh donated eye every year, the country's 109 eye banks (five in Delhi) [5] manage to collect a maximum of just 25,000 eyes, 30% of which cannot be used.

According to a survey conducted by an NGO, 98% blind people have met with accidents while traveling. Also, there are no special facilities provided to blind people in local transports resulting in the high number of accidents involving blind people.

We found that the main aids that blind people use are trained dogs, but such dogs are very expensive and not very reliable. Some other products available in the market are the smart belt, smart ring, smart cane etc. But these devices have very limited usability and lack approach due to more cost. So blind people are not interested in buying such products. Some innovators also tried to assist the blind people [6] using IR sensor, but our research found that IR sensor cannot work in sunlight because it also contains some amount of infrared rays which can be detected by photodiode present in IR sensor, our device overcomes this limitation as well.

In order to address all above-defined problems and to empower 36 million blind people worldwide, we are introducing a solution of what is christened as "Smart Stick". The stick is integrated with various sensors like ultrasonic sensor, water sensor with GPS-GSM module and RF module and with microcontroller etc. Sensors serve as its eyes and the microcontroller as its brain, which will retrieve data from the surroundings and pass on commands to the user notification setup. GPS keeps on monitoring the location of the blind person. RF module will help the blind person to locate the stick easily.

The rest of the paper is arranged as follows: Section II describes the component of innovation followed by the block diagram in section III; features and working of the smart stick are covered in section IV and section V respectively; Section VI shows Innovation in the proposed work; Section VII shows the impact of smart stick; finally Section VIII wraps up the paper with brief conclusion.

II. COMPONENT OF THE INNOVATION

The various components involved in our innovation are as follows:

1. Water sensor: A water sensor in an electronic sensor that is designed to detect the presence of water in the path of blind people and provide an alert in time to avoid chances of

slipping and drenching of the blind people [7]. Fig. 1. Shows the water sensor used in our smart stick.

2. Ultrasonic sensor: An ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listing for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the ultrasonic sensor and the object [8]. We are using this sensor in our stick to detect the obstacles like pits, pebbles, and cars etc. Fig. 2. and Fig. 3. shows the ultrasonic sensor used and its working respectively.

Fig. 1. Water Sensor   Fig. 2. Ultrasonic Sensor

3. RF module: An RF module is a small electronic device used to transmit and/or receive signals between two devices. It consists of RF transmitter and receiver. The wireless communication can be accomplished through radio frequency communication [9]. We are using it on our stick to identify the stick when the stick gets misplaced. Fig. 4. Shows the RF module used in our smart stick.
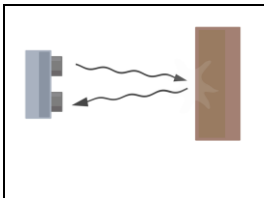

Fig. 3. Ultrasonic Working   Fig. 4. RF Module

4. GPS-GSM module: We are using the SIM808 module in our stick to get the real-time location of blind people. SIM808 is a GSM and GPS two-in-one function module. It is based on the latest GPS-GSM module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation [10]. This is a cheaper solution than a two-way GPS communication system wherein communication is done in both ways with GPS satellites. This project uses only one GPS device and two-way communication is achieved using a GSM modem. GSM modem with a SIM card used here implements the same communication technique as in a regular cellphone [11]. Fig. 5. Shows the SIM808 GPS-GSM module used.

5. Microcontroller: In this project, we are using Texas-Instruments' MSP430G2553 microcontroller. It acts as a brain for our stick. The MSP430 is a mixed signal microcontroller family built around a 16-bit CPU, the MSP430 is designed for low cost and specifically low power consumption embedded

applications. The current drowns in idle mode can be less than 1μA. The top CPU speed is 25 MHz [12]. Fig. 6. Shows the MSP430 microcontroller used in stick.
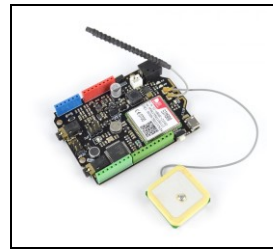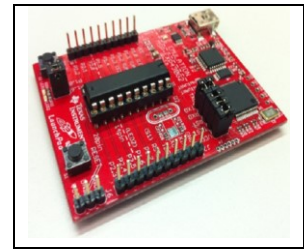

Fig. 5. SIM808 Module   Fig. 6. MSP430 Microcontroller

6. Battery: We are using 12 V rechargeable Li-ion battery. It is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Li-ion battery uses an intercalated lithium compound as an electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery [13].

7. Buzzer and Vibrator: To notify the user about the hurdle arriving on his path we are using buzzer and vibrator which is operated by motor driver L293D.

III. BLOCK DIAGRAM

The block diagram of Smart Stick shown in Fig. 7 is shown in Fig. 8. It shows all the important component embedded in the smart stick. Water sensor will detect the presence of water and will send the information to the microcontroller in digital form, the microcontroller will analyze this data/information and will send the command to the user notification setup i.e. buzzer and vibrator according to our program to alert the blind person. Ultrasonic sensor will detect the nearby obstacles that can cause an accident of blind people and the blind person will get informed about the same in a similar fashion as in case of water sensor. Suppose in case blind person forgot his/her stick by placing it somewhere else then he/she just have to press a button present in provided keypad the data will be sent to RF receiver present in the stick using RF transmitter, RF receiver will send this data to the microcontroller, microcontroller will activate the buzzer present in the stick so that blind person can search the stick easily. One of the main features of our stick is to track the real-time location of blind people this is done using SIM808 GPS-GSM module. We have also provided a panic button to help the blind person in case of an emergency.
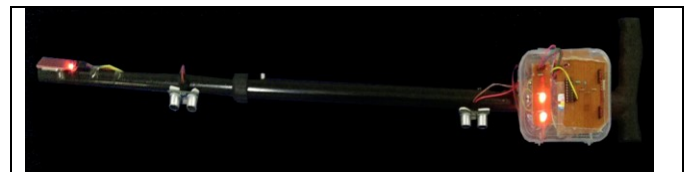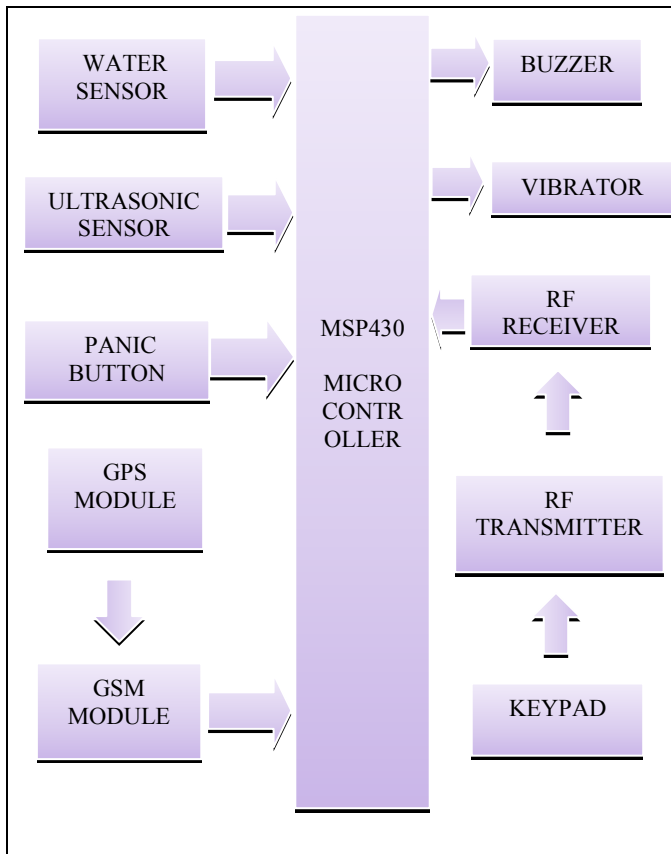

Fig. 7. Smart Stick

Fig. 8. Block Diagram of smart stick

IV. FEATURES

The various features of smart stick are:

1. It can sense obstacles like pebbles, pits, rocks etc.

2. It can sense water in the path to avoid slipping or drenching.

3. It can trace the location of the blind person and sends the data to their relatives to avoid any misfortunes from befalling them.

4. It can be easily located if misplaced.

5. It is also having a panic button, blind persons can immediately inform their relatives in case of an emergency.

6. It is cheap hence easy to afford by all potential beneficiaries.

V. WORKING

When the stick encounters different obstacles in the path of blind person then depending upon the type of obstacles data is sent to the microcontroller. Retrieved data is analyzed by microcontroller based upon judgment command is sent to the output. Vibrations occur in predefined sequences set up during software implementation. No two vibration sequences will seem similar. Data sent by the microcontroller to the output is in electrical form and this electrical data is converted into vibrations and alerts the blind.

VI. INNOVATION IN THE PROPOSED APPROACH

This device of ours utilizes the latest available sensors to aid the people with visual disability. The main innovative aspect of our project is the traffic detector. The stick vibrates in relation to the closeness of the incoming vehicle hence allowing the user to determine the location of the traffic around him. Some important aspects of our project are:

1. Size: It is a decently sized stick as it has so many features, but still is practical to use and would not limit the user's movement.

2. Power: It utilizes a rechargeable Li-ion battery which has the ability to last for at least 12 hrs.

3. Cost: It is a very cost-effective product and provides all these features at a reasonable price. We have made it considering the poor income of typical Indian families and hence it will be affordable.

VII. IMPACT

We are hoping to greatly impact the lives of blind people and console the general differently-abled population that even if we cannot medically heal them, we still can vastly improve their daily lives by utilizing advanced technology. This shows a new start in developing devices which can aid not only people with disabilities but even normal people in their day to day lives. Allowing humans to become much more efficient in their work.

VIII. CONCLUSION

This gadget is a very practical creation which helps blind users by acting as his auxiliary senses. It has no-nonsense design which is purely focused on general usage. Even for mass production, it does not require heavy machinery. Based on the above facts we can confidently conclude that:

1. The smart stick is a simple, cheap, easy to handle electronic guidance device, which is proposed to provide constructive assistant and support for blind and visually impaired persons.

2. The device is efficient and unique in its capability in specifying the source and distance of the objects that may be encounter by the blind. It is able to scan areas left, right, and in front of the blind person regardless of its height or depth.

3. It is a user-friendly device and can serve the purpose of potential beneficiaries.

ACKNOWLEDGMENT

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