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DEVELOPMENT OF LOW COST STICK FOR BLINDS USING SMART SENSORS GIVING PROTECTION FROM WATER PITS AND FIRE

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***Abstract*— The sticks currently available for the blinds to navigate are based on physical contact and thus are not suitable for protection against other obstacles like water pits and fire. The sticks having these features (available in advanced counties) are very closely and not affordable by common man in India. Therefore, there was a need to develop a stick giving these features at very low cost. Our paper outlines the developmental process, working principle of a stick using a smart sensor developed by us at a very low cost of Rs 200. The stick has been tested in the actual environment for more than six months and has proved successful.**

Keywords— **Blind stick, smart sensor, water pits, bi-metallic strips, thermistor, Buzzer and conductivity**

I. INTRODUCTION

A human being gets approximately 83% of information through sight thus seeing is an important sensing organ. Unfortunately, as per the recent WHO study, there are 285 million people in the world are visually impaired. Out of which 39 million are blind and 246 million have low vision. Out of these more than 90% people are in low income group who are deprived of this critical aid to do their normal day to day working.82% people are old and have slow reactions. The blind people while walking require protection not only from solid obstacles but also from accidently entering a water pit or fire. It is known that most of the blind people in India are still using sticks which can give them warning of only physical obstacles. Blind people in advanced countries are now using sticks which give them protection against entering water bodies as well as fire.

However, these sticks are costly and beyond the financial affordability of common man in India. Therefore, a need was felt to develop a stick which should not only be light but should also be cheap so that common people in India can afford it. The stick designed by us is based on the operation of a smart sensor which senses water and fire and warns the person with the help of a buzzer. The cost of the stick has been kept very low by integrating it with a single smart sensor which senses both water pit and fire. The paper presents a practical, theoretical and system concept to provide a smart electronic aid for blind people.

II. CHALLENGES FACED

Following challenges were faced to develop a stick fulfilling the prescribed specifications:

I. The stick should give a warning in case there are physical obstacles in front as being done conventionally.
II. The stick should also give warning in case there is a water pit in front where the blind person can enter accidently.
III. The stick should also provide a warning in case there is fire in front and this should be provided at least from a distance of 2 meters.
IV. As the sensors are to be mounted at the bottom portion of the stick and would be hitting many objects, their mounting should be very strong and the sensors should be very light.
V. Since the place at the lower end of the stick is limited, it is necessary to develop one sensor performing all functions instead of individual sensors.
VI. The electronic circuitry should consume very low power otherwise the maintenance cost would increase
VII. The electronics and other systems should be reliable and light so that the person is able to carry it conveniently.
VIII. The cost of the circuitry should be very low, preferably less than Rupees 200 so that a common man can afford it.

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III. DEVELOPMENT OF SMART SENSOR

Normally to detect fire, a thermistor detector is used and for water detection a water moisture controller sensor is used. However we have designed a smart sensor based on bi-metallic strips which are capable of detecting both water pit and fire. In this design very thin alloy strips made of carbon are used. These thin carbon strips are not only compact but have high composition to increase their thermal coefficient.
High thermal coefficient results in high current and increases the sensitivity of the smart sensors. The contacts of the bi-metallic strips are kept in the "open" condition in the absence of water pits and fire. The contacts of sensor would close in case of water and fire causing buzzer to come on thus alerting the blind person.

IV. PRINCIPLE OF SENSOR OPERATION

This sensor is very effective, useful and operates on basic principles. This sensor is also very different from the other costly sensors available in the market. The principles of sensor operation are as follows:

i) **Electrical Conductivity of Water**

The ability of water to conduct electricity through it causes the contacts to close when submerged in water. In water and ionic materials or fluids a net motion of charged ions occurs.
This phenomenon produces an electric current called ionic conduction. This causes the bi-metallic contacts to close resulting in flow of current through the buzzer which beeps and alerts the blind person from entering the water.

ii) **Expansion of Metal on Heating**

Temperature is a monotonic function of the average molecular kinetic energy of a substance. When a substance is heated, the kinetic energy of its molecules increases and the molecules begin to move more and usually maintain a greater average separation resulting in expansion and closing of the contacts and sounding of the Buzzer. Thus this smart sensor performs the functions of two individual sensors.

A. Sensing Water Pit

We have developed a sensor based on bi-metallic thermistor principle. The strip contacts are normally open due to which current from a light 9 Volt battery does not reach the buzzer and the buzzer is OFF as shown in Fig 1 (a). A blind person always keeps his stick 2 steps in front to sense the danger, keeping this in mind; the sensor has been positioned at the lower end of the stick.

On encountering a water pit, the sensor will get submerged into water and due to the conducting properties of the water the contacts of the bi-metallic strip would close causing the buzzer to ring alerting the blind person as shown in Fig.1(b).

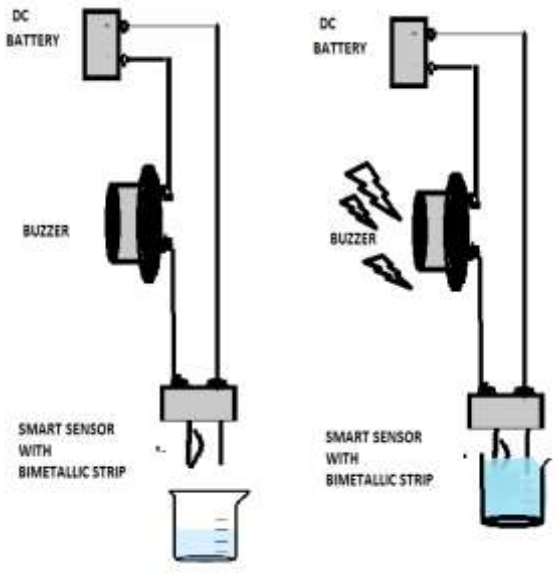

Figure-1: Principle of Water Pit Sensing

B. Sensing Fire:

For developing the sensing part of heat from a distance of 2 meters, a bi-metallic carbon strip of high thermal coefficient α=10.8 at 20 degree Celsius has been used to sense the fire from a safe distance. Whenever the bimetallic strips came in contact with the fire, both the contacts will expand and come in contact with each other closing the contact. As soon as they touch each other, the buzzer will start buzzing to alarm the blind person from the danger.

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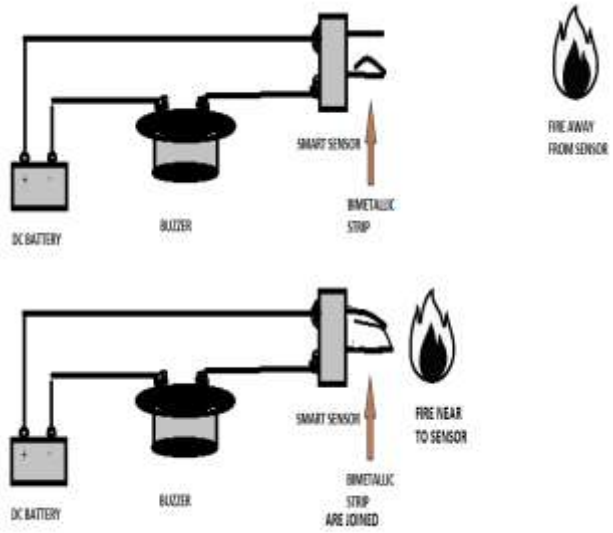

Figure-2: Principle of Fire Sensing

V. MATERIAL AND COST INVOLVED

The details of components used for designing this stick along with their costs are shown in the table below:

Components	Quantity	Cost
Sensor	1	20
9Volt Mallory Cell	1	40
Buzzer	1	20
Normal stick	1	110
Wires etc,	-	10
Total cost (with Stick) = Rs 200, Without Stick =Rs 90		
Developmental cost was Rs 1000		
Period of testing: six months by two blind people in actual conditions		

Table.1. Material and Cost Details

VI. EXPERIMENTAL RESULTS

Initially two sticks were prepared and given to two people from a blind school in Greater Noida. The people had volunteered to take part in the trial. They were explained that using mechanism of this stick was absolutely same as other sticks except that these sticks are not foldable. They need to switch OFF the battery when not using the stick to enhance the life of the cell.

It was found that during normal operations, the sensor and other circuitry worked reliably and battery lasted for more than the trial period of six months. Both le experienced no weight difference due to additional sensors and were comfortable in using this stick. Their confidence in walking during rains had also increased. Due to this success, a school in Noida has agreed to finance supplying these sticks to another 20 blind people as social cause.

VII. FUTURE DEVELOPMENTS

The stick developed by us can be further modified by adding an Ultra sonic sensor which can warn the person from a greater distance (3 to 7meters) as shown in Fig.3

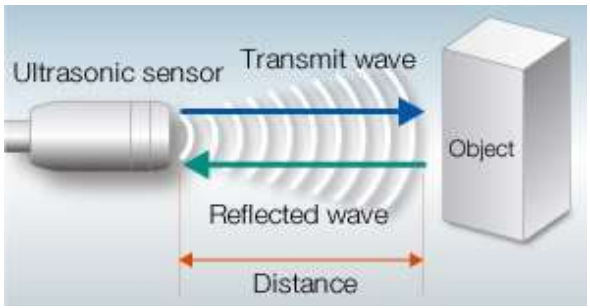

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Figure-3: Ultrasonic Sensor Developed for the Stick

With increased range, a blind person will get more reaction time to protect him which is essential as the person becomes older. When the ultrasonic sensors detects any objects or obstacles in 180 degree horizontal and 60 degree vertical, it will activate the buzzer and the vibration motor automatically alerting the blind person as shown in Fig 4 below.

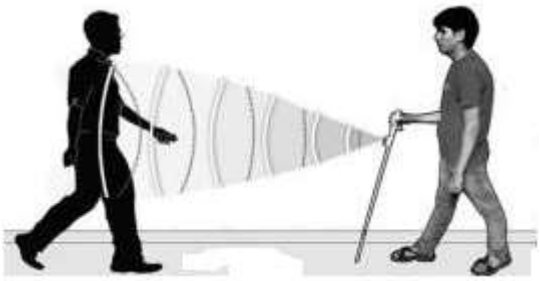

Figure-4: Working of Ultra sonic Sensor

However such a system would require the use of a microcontroller which would be the central part and would control the total working of all sub systems. This controller and ultra sonic sensor will not add appreciable weight to the stick but as they are costly (a general purpose microcontroller may cost between

Rupees 500 to 3500 which a common man may not be able to afford.

VIII. CONCLUSION

This paper has proposed the design and architecture of smart electronic stick for use by the blind people with additional protection against water pits and fire. The advantages of this system lie in the fact that it is very light, cheap and reliable and can be cost effective solution to millions of blind people worldwide.

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