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Most of the information humans get from the surroundings is via sight. Going out independently is a challenge for the elderly and visually impaired. Designing aids for elderly and visually impaired has been challenging and difficult than expected. Before making an aid it is important to understand the requirements from past research. The aim of this paper is to develop an electronic walking aid for support, safe navigation and to build confidence. It provides assistance via warning signals of the obstacles with the help of ultrasonic sensors. GPS module is used to locate the exact location of the person. Voice alerts are provided through headphones. Wrist wearable biosensors provide health surveillance.

Keywords- ETA, GPS, Elderly, Visually impaired, Arduino, cane, walking stick, ultrasonic sensors

I. INTRODUCTION

It is very challenging for Elderly and visually less-abled persons to find their way in areas they have never visited before. [1] When it comes to travelling people who are blind or visually impaired need assistance. They are dependent on a human guide or a conventional cane. They identify and avoid objects by exploring the environment and obtaining tactile feedbacks through touch to identify the size and shape of the object. All this is done without any additional aid. [1][2] According to estimated statistics from WHO (2012), there are 285 million people across the globe who are visually impaired out of which 216 million have low vision and 39 million are blind.[3]

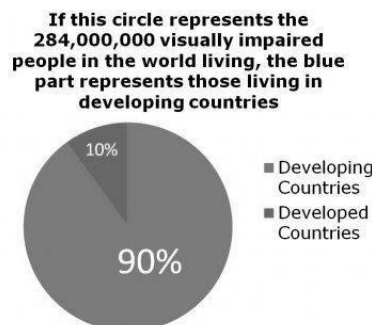


Fig.1.visually impaired population in developing countries

The outside world for elderly and visually impaired people is rife with dangers as they may injure themselves or stumble or fall or meet with an accident especially when they have to leave their dwelling place.

They receive tactile feedbacks to protect themselves from any danger. Perceiving features like texture, shape, size, weight, temperature through sensory organs helps them protect themselves and respond to the external stimuli accordingly but this is very difficult as they may come across various walking hazards like steps, depressions, holes, puddles, water logging, obstacle above knee and below knee levels and many other. [4]

The guide dogs and canes are the oldest and conventional mobility aids for people suffering from visual impairments. But they have drawbacks and limitations like acquiring training and special skills and little information about the surroundings is conveyed. With the advancement of technology different types of assistive aids (AT), electronic traveling aids (ETA) and electronic orientation aids (EOA) have come into existence and have been successful in enhancing the comfort, ease and mobility of elderly and visually impaired.

Providing solutions for orientation and mobility with increased confidence is the main task which includes optical recognition, enhanced vision, obstacle detection, obstacle avoidance, GPS, vision substitution and nano technology.[2][5] Along with advancements in circuit miniaturization the developments and enhancements in remote sensing after Second World War has lead to the existence of ultrasounds which has directed research on obstacle detection and avoidance through remote sensing. This has resulted in development of portable mobility machines. Mawat Sensor, Sona, Sonic pathfinder, Sonic Guide were developed for providing obstacle free path. Elderly and visually impaired who want to go out without being guided and taken care can do so with the help of the electronic walking stick. This makes the user and his family relaxed. The electronic walking sticks makes the elderly and visually impaired become independent and provides safety and security. [6]

In case of accidents, hazards or health imbalances while navigation, the electronic walking sticks can take care of them informing their dear ones well in time.

II. PROPOSED WORK

This stick is a real time guiding system for elderly and visually impaired to navigate on roads, unfamiliar locations, office in different situations. In certain circumstances when elderly and visually impaired may get injured like slippery road, fire, puddles and water logging, poles, speed breakers, etc. The system provides obstacle detection and way-finding assistance to the elderly and visually impaired. It consists of specific sensors for obstacles and voice alert through headphones in order to avoid problematic circumstances.

Health surveillance facility is also provided especially for those suffering from high blood pressure and those who are at a high risk of heart attack or any other health issues. Monitoring of vital parameters is done through dual biosensors which are wrist wearable. ECG signal from the biosensors is amplified and filtered and changed from analogue to digital and then transmitted to the walking stick. The whole system remains wireless, giving user flexibility to move around freely.

The microcontroller embedded in the stick detects symptoms of heart with the help of a heart attack algorithm. The level of the risk raises, in case any symptom of heart attack is observed. A call to emergency number is made by the user's cell phone, through Bluetooth module if the risk level reaches above the threshold. User is located with the help of GPS.[3]

III. DESIGN AND DEVELOPMENT

3.1. Design Process

The design process is architecture based. The proposed design has far more added features than the conventional old canes. The electronic cane is equipped with ultrasonic sensor for obstacle detection, biosensors for heart rate measurement. The ergonomic design and the cost have been taken into consideration. The weight of the stick makes it comfortable to carry and the cost makes it affordable.

3.2 Development Process

The electronic aid is developed in 2 stages. The source code development stage and the physical installation stage. In the physical installation stage first a virtual schematic is prepared and simulated.

The proposed system consists of various subsystems. The object detector circuit consists of ultrasonic sensors. Voice alarms through headphones. Microcontroller (arduino), GPS module and the power system are the major subsystems. Microcontroller used is ARDUINO. It consists of a GPS signal receiver and a GSM. GPS and GSM module used (808) are interfaced with the microcontroller to detect the person's location.

3.2.1 Object Detection

The system emits ultrasonics in a particular range which are reflected back by the obstacle. Ultrasonic sensor HC-SR04 is employed. The time lapse between the reflected signal and received signal is used to calculate the distance of the object from the user. Grey scale method is used to calculate the distance.

3.2.2 GPS And GSM

Global Positioning System is used to accurately determine a location in the form of longitude and latitude. Data logging through an SD card can be done. GPS interfacing is done with arduino to detect the exact location of the elderly or blind. The family may send a simple message and will get the exact location of the user on their mobile phone.

3.2.3 Microcontroller

The microcontroller used is AVR Atmega328 ARDUINO NANO 32 KB. It is open source community. The GPS and GSM are connected to the microcontroller. It features a USB interface, analog and digital I/O pins which allows to attach various extension boards. Works on 5V supply.

3.2.4 Bluetooth And Power Supply

The headphone is used in this project for guiding the visually impaired persons to navigate independently by amplifying the predefined voice signals. Since all electronic circuit work only with low dc voltage. We need a power supply unit to provide the appropriate voltage supply. A simple power bank with 7.4V is used. It consists of a comparator circuit which produces low battery indication.

3.2.5 Biosensors For Heart Rate Monitoring

The wrist wearable sensors will continuously monitor the ECG and transmit it to the microcontroller on the stick. The data transmission is wireless from wrist to stick to avoid inconvenience. Microcontroller receives digital data from the wrist and checks for heart attack symptoms with the help of a heart attack algorithm. In case of any danger detected the microcontroller produces alerts with the help of Bluetooth.

IV. CONCLUSION

The proposed system is a device that examines the path and sends an alerts in the event of any danger. An arduino algorithm with android interfacing is used to inform the user. This is done with the help of a Bluetooth headset. The stick is light in weight and affordable. It is comfortable to carry and enhances the independent mobility thus improving lifestyle of the less abled.

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