International Journal of Research in Engineering, Science and Management
Volume-1, Issue-11, November-2018
www.ijresm.com | ISSN (Online): 2581-5792

Design and Construction of Navguide for Visually Impaired People

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***Abstract*: With the scope of electronics increasing day by day, the need for utilizing these advanced technologies to make human lives simpler is becoming more and more necessary. The demand for using these technologies to make lives easier for disabled people is also growing. This has encouraged many new areas of research and one of the areas is electronic mobility aid for blind. There are a few smart systems available in the market which uses electronic sensors mounted on the cane but those systems also have certain disadvantages. The Nav Guide is a novel electronic device to aid outwardly debilitated individuals with obstacle in freeway finding. The importance of the Nav Guide system is that it provides easy information on the surrounding environment and deduces priority information without causing information overload. The priority information is provided to the user via vibration and audio feedback mechanisms. The proof-of-concept device comprises of an Arduino with ultrasonic sensors, vibration motors, and a battery. The assessment results display that NavGuide is a valuable guide in the location of impediments, wet floors and ascending staircases. The proposed system guides the blind to detect fire and current passing and it also gives the line following guidance.**

***Keywords*: — Blind people, NavGuide, Obstacle detection, visually impaired people.**

1. Introduction

People with disabilities, especially blinds and partially sighted, are every day confronted with plenty of problems while performing routine activities and moving through unfamiliar areas. Current society guarantees freedom of movement and access to a preferred goal under the same conditions to all the people. In order to meet the desires of a person with disabilities in the Republic of Croatia, traditional building measures such as curbs lowering, ramps construction and platforms lifting have been mostly in use. The possibilities provided by advanced information and communication technology, planning for the people's orientation in space, determining the position where a person is located (locating), tracking, leading to the goal (navigation), etc., have been under-utilized. Till now there was no advanced technology to help the Blind. They utilized for the most part mechanical (normally material) approaches to navigate in space. An electronic solution has been developed for the detection of obstacles and dangers on the way and they were used as a replacement for a walking stick which is a basic tool of the blind people. That way the variants of sticks with laser or ultrasonic sensors were developed, but they have not entered into widespread use blind and visually impaired are in need and depends on some stuffs because they lack information about the obstacles and dangers, they have little information about the visual markings in space, they have no sense of direction and speed, essential to the people who can see for navigation through familiar, as well as through the unfamiliar Environments using maps or instructions. The idea is based on the way of NavGuide obstacle detector that consists of components is the detection of the immediate environment which includes finding obstacles like solid part and dangers like fire and hazards. The alerting system consists of intimates the current position and positioning the direction of movement along the requested route using voice alert and the vibration mode. In this paper, we are proposing the NavGuide with additional features which is an electronic device to assist visually impaired people with obstacle free path-finding. The emphasis of the NavGuide system is that it provides easy information on the surrounding environment and deduces priority information without causing information overload. The priority information is provided to the user via vibration and audio feedback mechanisms. It also guide for fire detection, current passing and line following guidance.

2. Related work

The first set of technologies that could be used to locate the users within the enclosed areas is those that are already available and should not be built, such as mobile technology (GSM) and wireless networks [1] (WLAN). Public services (police, emergency services) use the mobile network to locate users, but that locating is too rough for this application. Depending on the distribution of the transmitter, it can achieve an accuracy of about 100 m. In a similar way, one can use the current WLAN network, so that the signal strength is read, and compared to the database in order to determine the distance from the transmitter [5]. Using a trilateration technique, the location of the user can be determined from multiple signal sources. The problem is that WLAN should have enough points, which is not possible everywhere, and especially not in outdoor areas. The accuracy varies, as well, depending on the conditions, reflections and propagation and it can be from 1 to 3 m. Radio-frequency identification (RFID) belongs to these

radio technologies. This technology has a lot of potential and there are projects which are used for navigation and for locating. There is a whole system of guidance of the blind, developed using RFID technology. SESAMONET [3] system was installed at several points in northern Italy and it consists of a cane for the blind with an embedded RFID reader, that is connected wirelessly to a mobile device. Navigation software in a mobile device sends voice instructions to the user, and data are drawn from a central database to which it is connected via mobile network. The cane [6] reads the RFID passive tags that are embedded in the tactile floor and on each turning point or crossing, the device signalizes in which direction one should continue in order to reach the goal. This system is efficient, but it is not easy to install it on new terrain, because it needs a lot of work and installation of expensive tactile paths with RFID tags. In the end, there are passive technologies using MEMS (Micro Electrical Mechanical Systems) sensors [4] to determine the displacement and orientation of the user from the decoded values of acceleration, rotation, magnetic field and pressure. Digital accelerometers, gyroscopes, magnetometers, compasses, barometers, thermometers (temperature compensation) have been used to do that. The simplest such devices as pedometers, [6] which count steps and based on the number of steps and the average step length, they can determine the distance travelled, but they cannot determine the information about direction. More advanced category of the system are dead reckoning systems that contain some or all of the above sensors and calculate the shift of the user based on the data measured. There are two types of such devices: The first are those in which is acceleration sensor is placed on the shoe, and in the second, the sensor is attached to the belt. In both types, it is important that the fastening device is securely connected to the body so that it transmits all its movements accurately[8]. Then the software evaluates user's behaviour from the data on the sensor (walking forward, backward, sideways, running, standing). This technique is known as Pedestrian Dead Reckoning (PDR).

3. Proposed system

A. Preliminary

This section describes the design and structure of the NavGuide, electronic device to assist visually impaired people in obstacle free path-finding. Fig. 1 shows an overview of the NavGuide obstacle detection and navigation assistance system for visually impaired people. The main goal of the NavGuide is to create a logical map of the surrounding and provide suitable feedback to the user about the obstacles in the surrounding. The NavGuide consists of six ultrasonic sensors, a wet floor detector sensor, and a step down button, microcontroller circuits, four vibration motors, and a battery for power supply. An ultrasonic sensor is used to send out high frequency sound waves and record the time it takes for the reflected sound waves to return. The total of six ultrasonic sensorsare divided in two groups, i.e., group 1 and group 2. Group 1 sensors (S1, S2, S3) detect floor level obstacles while group 2 sensors (S4, S5, S6) detect knee level obstacles. Sensors S1 and S4 are front facing, S2 and S5 are left facing and S3 and S6 face towards the right side. All six ultrasonic sensors are wide beam ping sensors. An ultrasonic sensor uses high frequency sound waves to find the distance of an object from the NavGuide. When a sound wave hits an object, it is reflected off the object. An object may be directly in the front of the transmitter or at an angle for the signal to be reflected and received by the ultrasonic sensor.

B. Proposed naveguide methodology

The block diagram shows the proposed an efficient modified NavGuide obstacle detection and navigation assistance system for visually impaired people. From the existing NavGuide detector, we are implementing the some of the features for the welfare of visually challenged peoples. The extra features are added with the NavGuide detector is the vibration sensor, water sensor, temperature sensor and voice alert. Here in the modified NavGuide system the vibration sensor (i.e)., the piezoelectric sensor is used to alert the individual by vibration when it senses the obstacles or any other stuffs infront of the blind. Then the temperature sensor(LM35) is used to sense and detect the fire alert or some other precautions from the overheated elements is before the person then it should be alert the person by vibrating mode and instruct with the voice alert. And we also adding important feature is water sensor. The water sensor is used to detect the water on the floor which may cause the blind people to fall down, and causes some danger health issues. A voice alert is used in the system to instruct the blind, when if the obstacles are detected then the person need to be taken some actions to avoid the obstacles. So the voice alert used to give some instructions like take right, left, move behind etc. An arduino controller fetches the input from all the sensors like temperature, water, ultrasonic and IR sensor, when it exceeds the limit then the controller take actions to alert the person through the vibration sensor and the voice alert. So the precautions can be taken and followed by the person very easy and quick. This type of modified NavGuide

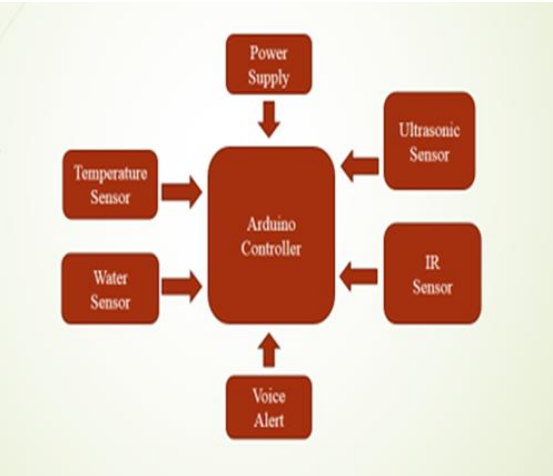

Fig. 1. Block diagram of proposed system

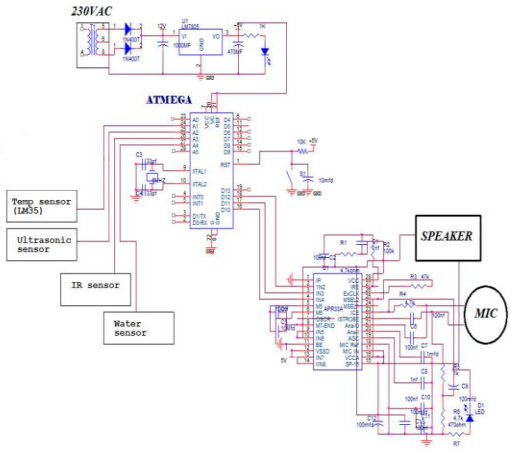

Fig. 2. Circuit diagram

4. Hardware specification

A. *Arduino controller*

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

B. *Temperature sensor*

The advantage of this sensor has more memory, processing and communication capabilities than other sensor nodes. The LM35 series are precision integrated – circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

C. *Water sensor*

The Water in Fuel Sensor or WiF sensor indicates the presence of water in the fuel. It is installed in the fuel filter and when the water level in the water separator reaches the warning level, the WiF sends an electrical signal to the ECU or to dashboard (lamp). The WiF is used especially in the Common Rail engines to avoid the Fuel injector damage. The WiF sensor uses the difference of electric conductivity through water and diesel fuel by 2 electrodes.

D. *IR sensor*

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor.

E. *UV sensors*

UV sensors measure the power or intensity of incident ultraviolet (UV) radiation. UV sensors are used for defining exposure to ultraviolet radiation in environmental settings. They are transmitters that react to one type of energy signal by producing energy signals of a different type. Generally, these output signals are electrical signals that are routed directly to an electrical meter for observation and recording. The generated electrical signals from UV sensors can also be sent to an analog-to-digital converter (ADC), and then to a computer with software for generating graphs and reports.

5. Simulation result

To implement our methodology in the simulation, we are going for the proteus ISIS schematic software tool. The Proteus Isis' circuit was implemented as in the below fig 3. The circuits are connected as per the block diagram and also implemented in the proteus software as shown in the fig.3. in the figure 4, the output measurement unit of LCD display are showing the results of sensing parameters (i.e)., D-distance of obstacles, T-output of temperature, IR- output of IR sensor, CD-conductivity result of water sensor, VIB- vibration alert mode output.

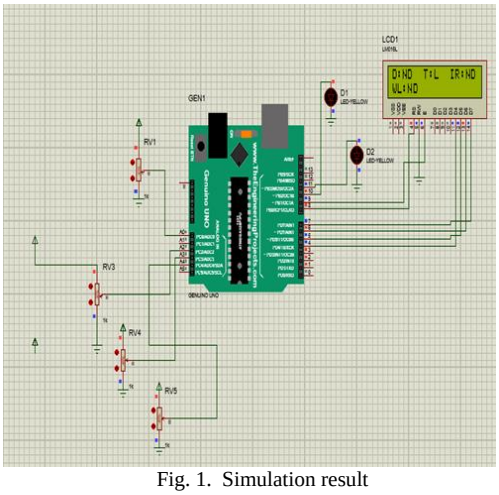

Fig. 1. Simulation result

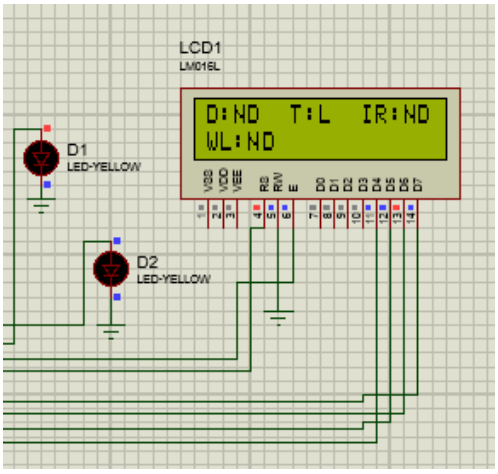

Fig. 2. Output display

6. Conclusion

In our proposed system, it can be applied in the straight path, right angle path and the curved path. The broad beam angle ultrasonic sensors enable wide range obstacle information. The vibrator used to alert the person in a quick manner and voice alert gives the proper instructions. The main functions of this

system are the clear path indication and the environment recognition. With the help of electronic NavGuide detector, blind people can improve their travel speed, reduce minor collision, do not lose their way, and increase safety from the fire, down fall and an accident as compare to unaided equipments. It also guide for fire detection, current passing and line following guidance. Future work includes installation of GPS system along with additional sensors like accelerometers, PIR motion detector and digital compass which tell the exact location of the user.

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