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Smart Room Identifier for Visually Impaired People

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Abstract *:This paper proposes the design and setup of a smart room identifier system for visually impaired peoples in our society. Based on the reflected light intensity, the color sensormounted on the mechanical-aid device identifies a room.The color sensor provides different output values,depending on the received reflected light intensity. To ensure safe movement of the physically challenged person- who is blind or having low vision,an ultrasonic sensor is fitted on the front part of the machine. This sensor identifies the obstacles in the path, and halts the machine,which enables the user to deviate from obstacle.To avoid random movement of the wheel chair and keep a predetermined safe distance from the wall, it follows wall-following technique;which works on the output of another ultrasonic sensor fixed onthe left side of the system.The motor driver and the DC motors connected to the wheel chair,drives the system in the desired direction.The entire system is coordinated and controlled by microcontroller.*

Keywords–*Colorsensor, room identifier, wall following, microcontroller,sensor****.***

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I. INTRODUCTION

According to WHO (2010), 285 million people are affected by visualimpairment [3]. For a visually impaired person, the most difficult challenge is mobility and navigation. Even in their own known environment, it is difficult for them to identify and move towards theirdesired destination. The situation worsens,as they age, or the physical challenges increases. Technological advancements can be used to provide devices which help the needy to orientate and navigate through an area or a space, especially indoors.

In the modern era, most of the commercial solutions for visually impaired localization and navigation assistance are based on the Global Positioning System (GPS). However, these solutions do not providemuch efficient results for the visually impaired community mainly due to low accuracy, signal loss and the impossibility to work indoors. Moreover, GPS cannot provide local information about the obstacles in front of or in the near vicinity of the person. Furthermore, other commercial products available in the market present limited functionalities having low scientific value and are not widely accepted by the users [4].

This paper is conceived as an idea to setup a prototype model of a wheelchair, which identifies the different rooms in the house based on the paint color. This hi-tech system iscapable of identifying the three primary colors (RGB)-Red, Blue and Green. We assign a specific color to eachroom door and by identifying thedoor color;the system recognizes the required destination. The user selects the desired room by pressing the pushbutton switches which have raised numbers, which allows the people who are blind or who have low vision to select the desired room. Based on the pushbutton status, the microcontroller sends signals for the robot movement. The pair of ultrasonic sensors mounted on the front and left side of the robot helps to identify the obstacles on its path as well as maintains a safe distance from wall to be followed based on output values of the later. The person on the wheel chair canmoves forward till it identifies the room by reading the specific color assigned to the room.

II. Related Works

In recent years,many works been published for improving the living status of vision impaired persons. Sujith B et al [4] discuss about the computer vision-based approach for visually impaired persons in their paper titled "Computer Vision-Based Aid for the Visually Impaired Persons- a Survey and Proposing New Framework". They have done a detailed survey regarding the assistive technologies like wearable navigation assistance.They proposed a systemframework having capabilities like obstacle detection, object identification, path and door detection, object features identification and reading contents of objects. "Ultrasonic stick for blind" by Ankit Agarwal et al [5] discuss about the use of ultrasonic sensor for identifying the objects in front. According to them, when the ultrasonic sensors attached to the system detect any objects or obstacles in 180 degree horizontal and 60 degree vertical, it will activate the buzzer and the vibration motor automatically. In

case of an emergency, the user of the stick will press the emergency button and the signal from the button will go to the microcontroller which will get the location from the GPS modem and transmit the location to the GSM modem which will send a SMS messages to the all saved numbers in the system.Wall-following Method for an Autonomous Mobile Robot using Two IR Sensors by Gavrilut et.al. [6] describes the wall following technique using ultrasonic sensors. Their robot is equipped with two IR sensors, for obstacle detection, each of them composed from an emitter and a receiver. The distance of area covered by the sensors can be set up on three levels: 30, 60 or 100 cm, respectively. Two independently controllable electric motors ensure highest mobility of the chassis. The robot uses the D/A convertersto switch the drive motor voltage, so that, the speed and direction of each track is freely controllable.

III. PROPOSED MODEL

The smart room identifierincorporated in the wheel chair has two parts, namely; hardware and software. The hardware architecture comprises of an embedded system that is based on Arduino Mega board, Ultrasonic sensors, Color sensors and motor driver. The software part comprises of the set of instructions used for sensor data capture and its manipulation and control of the entire system based on the captured data.

Power for the control unit, connected ultrasonic sensors and color sensors is drawn from a voltage regulator that supplies 5 V. The power to the microcontroller board is provided using a 9V battery.

The block diagram for the hardware part is given in fig. 1 below.

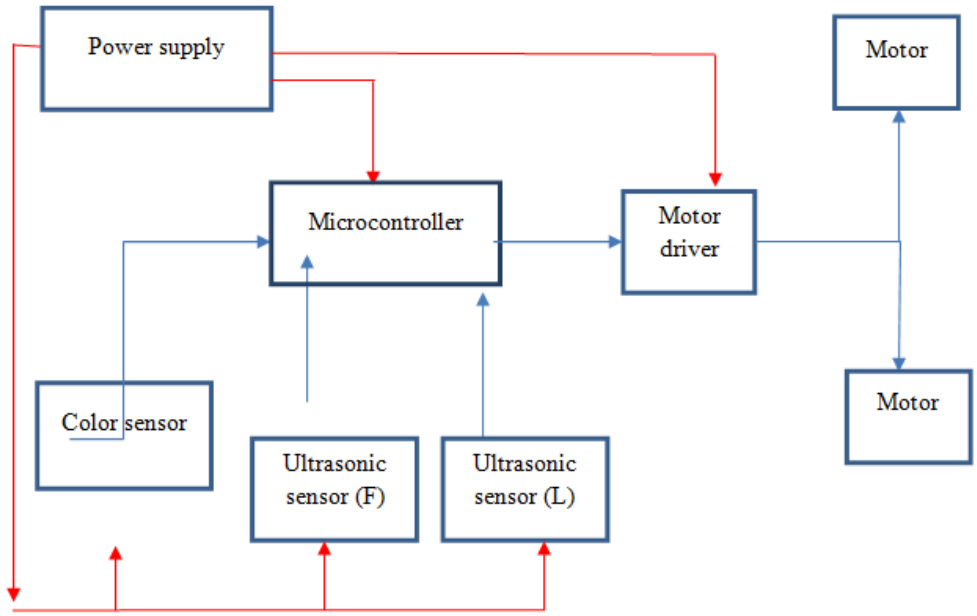

Figure 1. Smart room identifier block diagram

The smart room identifier prototype model is capable of identifying three rooms based on its color. We provide three different colors to the doors of the room like red for bed room, green for kitchen and blue for toilet. Selection of the room is done by pushbutton switch. These switches are interfaced to the microcontroller in the input mode. We assign each push button to a particular room. To make it more user friendly for the blind, we make use of the switches which has the raised numbers 1,2and 3. In our project, push button 1 is assigned for kitchen, 2 for bedroom and 3 for toilet. When the person presses switch 1, the microcontroller vehicle moves forward, till it sees green color.

Movement of the wheel chair is controlled by the microcontroller program. The motor driver connected to the front and rear wheels direct the motor based on the microcontroller command signals. Ultrasonic sensors attached to the front of the wheel chair, provides information regarding the obstacles in front and its distance from the sidewall. Ultrasonic Distance Sensor,HC-SR04, is a popular and low-cost solution for non-contact distance measurement function. It is able to measure distances from 2cm to 400cm with an accuracy of about 3mm [7]. The module contains a transmitter and receiver unit. To start the measurement, the trigger pin is set to be high for 10µs and then turned to low state. This action will trigger an ultrasonic wave at frequency of 40 KHz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after reflection by any obstacle, the echo pin goes high for a particular amount of time. This high state of the echo pin will be equal to the time taken for the wave to return back to the sensor.If there is an obstacle in-front of the module, it

will reflect the ultrasonic burst.If the signal is back, ECHO output of the sensor will be in HIGH state (5V) for duration of time taken for sending and receiving ultrasonic burst. The amount of time during which the Echo pin stays high is measured by the microcontroller board as it gives the information about the time taken for the wave to return back to the Sensor. If the signal received in the front sensor is more than the specific value, indicates the presence of an object and the automated wheel chair stops for a while. In our project we assigned, a distance of 20cm as the safe distance for obstacle identification. If the front sensor value is less than 20cm, the microcontroller sends signal to halt the motor. Ultrasonic sensor connected to the left sidereads the distance from the wall. Here we assigned a distance of 15cm from the wall as the safe wall distance to move forward. Whenever the vehicle comes closer to the wall, if the distance between the wall and the wheelchair become less than 15cm, the microcontroller sends signals to move to the right till the distance become more than 15cm.

For identifying the destination room, we interfaced color sensor TCS3200 with Adruino. TCS3200 is a programmable color light-to-frequency converter that contains an array of configurable silicon photodiodes and a current-to-frequency converter on a single monolithic CMOS integrated circuit. The chip contains provisions for selecting the frequency scaling. By selecting the values of S0and S1 pins, we can select 2%, 20% or 100%of frequency scaling [8]. In our project, we selected 20% by keeping S0 HIGH and S1 LOW. The control pins S2 and S3 are used for selecting the color to be read by the photodiode.By setting the S2 and S3 LOW and HIGH in different combinations, we could select different photodiodes for identifying our three different room destinations.

For selecting a particular room, we utilized three pushbutton switches. We interfaced these switches in input mode with the microcontroller. The movement of the system is carried out by interfacing dc motors with microcontroller using motor driver shield. The entire system is controlled and coordinated by programming the microcontroller. This system helps to enhance the self-dependency of blind and low vision people.

IV. Flowchart

Flowchart for the system is shown in fig.2. The system waits for an input from the pushbutton switch. When it receives a signal, first it identifies the source. Now based on the ultrasonic data it moves till it reaches the destination. For example, when the key 1 is pressed, based on the ultrasonic values, it proceeds to the predetermined destination which is the kitchen. While moving forward, it also checks the color sensor data. When the color sensor output matches with the color assigned for kitchen, the vehicle stop and wait for further commands from the user.

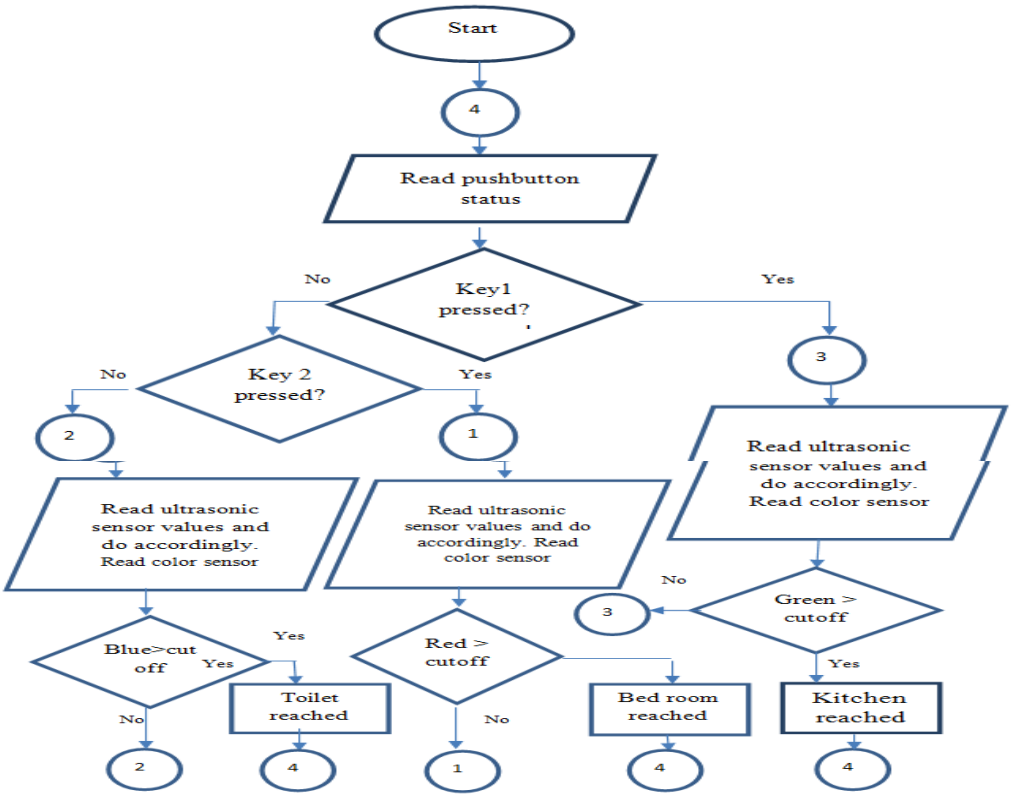

Figure 2. Smart room identifier-flowchart

V. Experimental Results

The performance of the system is evaluated based on three factors. The first factor is how effectively the system identifies the obstacle in its path. In this project we programmed the controller to stop its movement when it identifies an object at a distance less than 25cm. For 100% of test run the result was positive as shown in table 1.

Table 1. Obstacle identification result

Sl. No.	Distance from the foot rest (cm)	Obstacle identifying result
1	18	Identified
2	15	Identified
3	25	Identified
4	6	Identified

The second factor is when we press a particular switch for a specific room, the accuracy of identifying and reaching the destination. Here room selection is done by pressing push button switch and room is identified by utilizing color sensor output. The result was positive for 90% of test run.

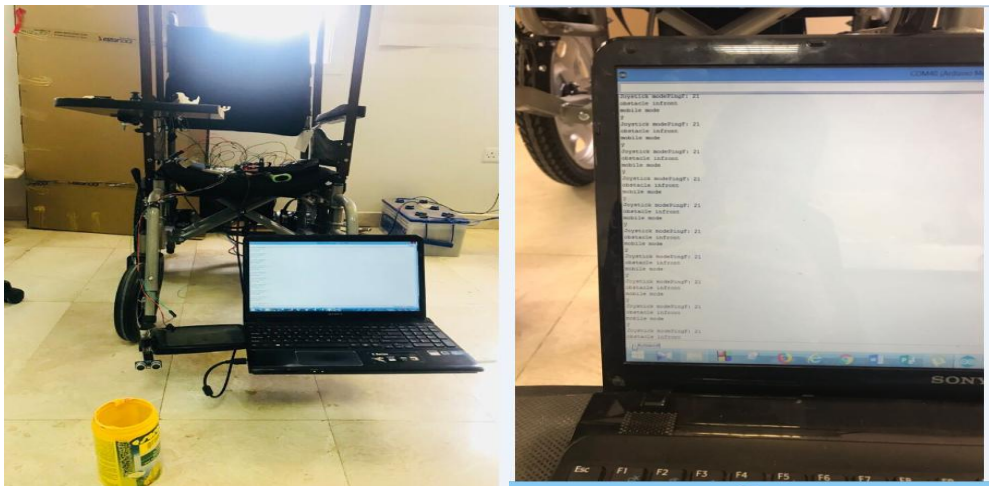

Figure 3. Obstacle identifying test result

The simulation for the system was done using Proteus software and it was perfectly working. Ultra sonic sensor output for wall following and obstacle identification is shown in figure 3. Based on the data from the color sensor, destination is decided according to the color assigned.

VI. Conclusion

This paper elaborates the design and construction of a smart room identifier for the visually impaired sect in our society by utilizing color sensor and micro controller board incorporated in a wheel chair. The ultrasonic sensors attached to the front part of the system help to identify obstacles in its path and the one in its left side help for the safe maneuver. By using push button switches, the destination to be reached is selected and the destination is identified based on the color sensor output. The system can be modified by providing provisions for identifying pits and steps ahead on its way. This proposed system enhances the self-dependency of blind, low vision and aged sect in our society.

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