GPS and GSM based Steered navigation and location tracking device for Visionless

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Abstract—This paper gives a conceptual perception about a device which helps the visionless or partly sighted for navigation and tracks them in case of emergencies. It is a robotics centered hurdle evading device. The device consists of a Microcontroller and obstacle sensors that avoids collision and GPS which provides location information of the visionless person. This device is capable of moving in specific direction depending upon command received by sensor input and can change the direction before hitting the obstacle. The overall concept of this paper is the result of numerous present concepts and focusing on tracking of the blind individual.

Key words: GPS, GSM, HMI, Steered Navigation

I. INTRODUCTION

It is very difficult for vision less people to move inside the home and also outdoors. As many of these people have difficulty knowing where they are or where they are going, frequently feeling totally disorientated or even isolated. Therefore supplemental navigational guidance is very important for them. Navigation involves updating one's position and orientation while he or she is traveling an intended route, and in the event the person becomes lost, reorienting and reestablishing a route to the destination. Guiding people is about augmenting them with contextual information, which usually includes obstacle prompting and optimal routing. There are some existing solutions but it is tough to use new equipment, as these devices have complex interfaces and are not user friendly.

This paper provides a concept for developing a low cost, user friendly robotic device based on independent navigation for obstacle avoidance, useful for visually disabled person. Moreover the device helps in tracking the user in case of emergencies using the GSM and GPS interfaced with the Microcontroller. GPS and GSM play significant role for outdoor navigation.

The wheel attached to the stick helps in free movement of the device when pushed forward by the user. When the obstacle sensor detects an obstacle the device changes the direction away from the obstacle. The user straightaway senses this piloting action and can follow the device's new track effortlessly without any difficulty. The device also has two buttons at the handle, one to turn ON the device and other to send SMS in case of emergencies. The overall perception of the device is described in the following sections.

II. PROPOSED HMI-MODEL

Blind and visually impaired people are at a disadvantage when they travel because they do not receive enough information about their location and orientation with respect to traffic and obstacles on the way and things that can easily be seen by people without visual disabilities. Navigation systems usually consist of three parts to help people travel with a greater degree of psychological comfort and independence: sensing the immediate environment for obstacles and hazards, providing information about location and orientation during travel and providing optimal routes towards the desired destination.

Human Machine Interface (HMI) Model assists the Visionless user for navigation and location Identification. The steering navigation stick is shown in figure 1. The model consists of a stick which makes easy for the user to hold the device. The wheel attached to the stick helps in free movement of the device. There is no power supply provided to the wheel. It moves when it is pushed forward by the user. Microcontroller is present in between the wheel and the stick, which performs all control operations of the device. All the important components of the device are interfaced with the microcontroller. The obstacle sensors are placed at the front position of the device. They are placed in such an angle that they detect obstacles in the navigating path. Depending on the information received by the obstacle sensor, the microcontroller will steer the wheel away from the obstacle.

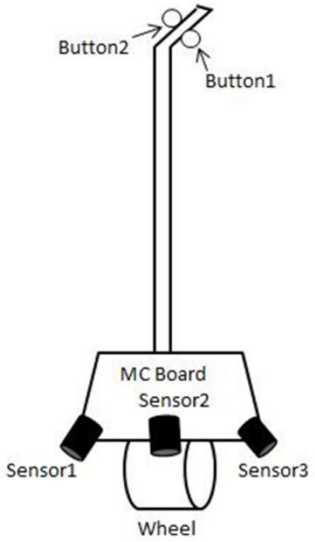

Fig. 1: Steering navigation stick for visionless person

Most important units are the two buttons that are present at the handle of the stick. Button1 is used to turn ON/OFF the micro controller. Button2 is used to send the SMS at the time of emergencies to the pre-stored number(s) of family members or guardian of the user, which consists of Location information of the user. For this purpose, GSM and GPS modules are interfaced with the Microcontroller.

III. MICROCONTROLLER BOARD DESCRIPTION

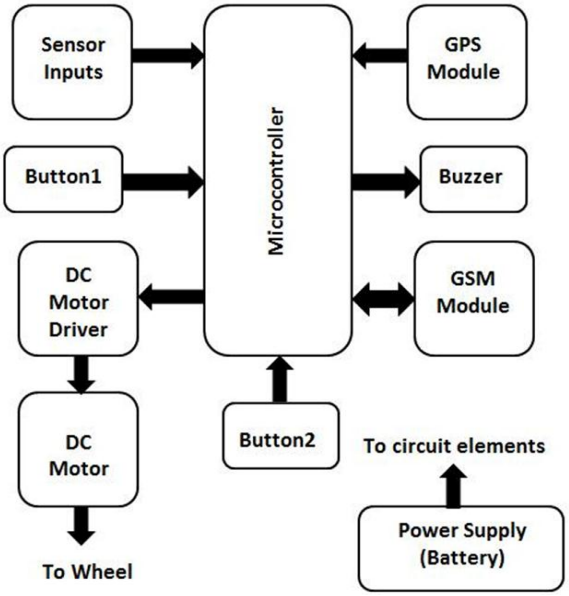

Fig. 2: Block diagram of microcontroller board elements

This section provides detail description of Microcontroller used in the proposed model. The block diagram of Microcontroller board and its important elements are shown in figure 2. The elements of microcontroller board are explained as follows:

Microcontroller:

The Microcontroller acts as the heart of the system. It is programmed for control applications. It receives the obstacle information form the sensors and gives signal to the DC motor to change the direction away from the obstacle. Once the obstacle is detected, the Microcontroller indicates the buzzer so that it produces buzzing sound alerting the user regarding the obstacle. Microcontroller also controls applications of Buttons, GPS, GSM and DC motor which are interfaced to it.

Obstacle sensors:

Designed for obstacle detection, the Device can be mounted with three sensors. To identify a desired direction of motion, the Microcontroller takes the input from the sensors and decides where to move subsequently and turn the wheels consequently.

DC motor and DC motor driver:

The DC motor, functioning in the control of the Microcontroller, can steer the wheels left and right relative to the obstacle detected. DC motor driver is used to drive the DC motor.

GPS and GSM module:

GPS module helps in the location tracking and GSM module is used to send/receive Short messages from/to the device. For the help of the user, two buttons are provided at the handle of the stick. Button1 is used to turn ON/OFF the device. Button2 is used to send the SMS at the time of emergencies to the pre-stored number(s) of family members or guardian of the user, which consists of Location information of the user. User's family members or guardian can also be sent SMS to the device and track the location of the user.

IV. SENSOR OPERATION AND WHEEL MOVEMENT

When the user drives the device forward, the wheel will move in the direction of movement of the user until the obstacle is detected. Once the obstacle is detected, the wheel rotates away from the obstacle. If the obstacle is detected in front of moving path, then the wheel can rotate left or right depending on the priority programmed in the Microcontroller as shown in figure3. If the obstacle is right portion of the device, then the wheel will rotate in left side as shown in figure4. If the obstacle is detected at the left portion of the device, then the wheel rotates in left side as shown in the figure5.

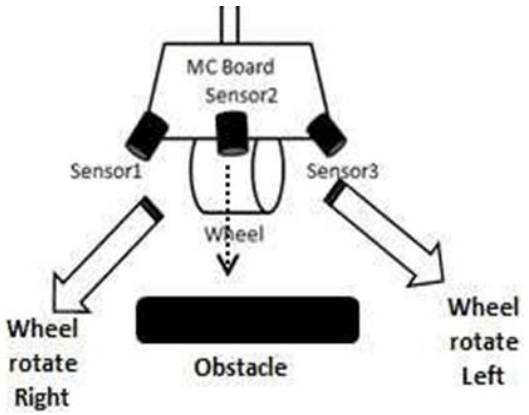

Fig. 3: Wheel rotating left/right for front obstacle

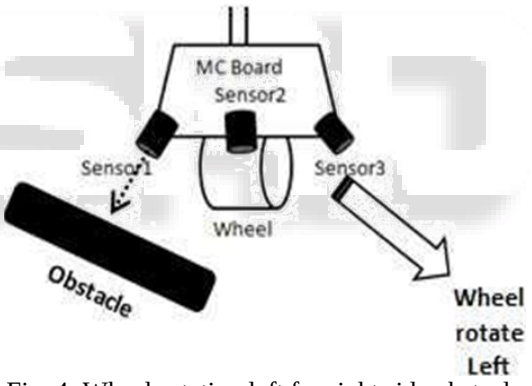

Fig. 4: Wheel rotating left for right side obstacle

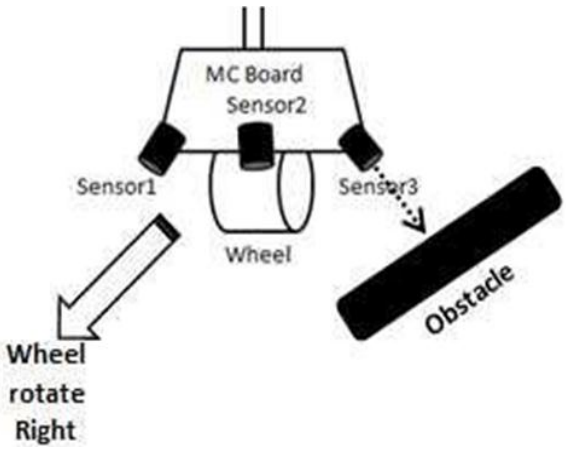

Fig. 5: Wheel rotating right for left side obstacle

The Microcontroller uses the sensor information to immediately control a suitable direction of travel. The Microcontroller has to be programed with a suitable Algorithm such that it provides an alternative direction to turn away from the obstacle and then continue in the chosen

path. Once the wheels begin to steer sideways to avoid the obstacles, the user can sense the subsequent rotation of the stick. Henceforth, the user modifies user's orientation with that of stick rotation. As soon as obstacle is cleared, the wheels steer back to the preferred direction of movement. Hardware required for proposed design are Microcontroller, Obstacle sensor like ultrasonic sensor, GSM and GPS module, DC motor and driver, Buzzer, metal stick with handle, a wheel and a batter for power supply. Softwares required are keil-vision tool, Embedded C programming and Flash magic to load program into Microcontroller.

V. ADVANTAGES AND DISADVANTAGES

A. Advantages:

Reduced complexity of the device than any other present device makes it easy to operate. It has only three sensors. It uses single wheel which helps in movement in narrow path. GPS and GSM help in identifying the location of the user during emergencies. Buzzer alerts the user regarding the obstacle. Since the user has to push the wheel for movement, the user can stop when obstacle is detected and move in the direction of wheel movement. This avoids collision with the obstacles.

B. Disadvantages:

It is designed to detect only the obstacles, any potholes in the path cannot be detected. Also, it cannot detect hanging objects.

VI. CONCLUSION AND FUTURE ENHANCEMENT

The proposed device is perception to develop a device which helps the visionless or partly sighted for navigation and tracks them in case of emergencies with the help of GPS and GSM. It is a robotics centered hurdle evading device. GPS provides location information of the visionless person. GSM helps in sending the messages to find the whereabouts of the user. This device is capable of moving specific direction depending upon command received by sensor input and can change the direction before hitting the obstacle. The overall concept of this paper is the result of numerous present concepts and focusing on tracking of the blind individual. With the proposed concept, the Device will not be able to detect hanging objects and pot holes in the path; this can be overcome by mechanical adjustment of used sensors and usage of additional sensors.

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