A Smart Wheelchair System with Social Media update

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Abstract

Objective: To develop a smart wheelchair for blind and disabled persons. **Methods and Analysis:** The wheelchairs being used patients are not user friendly. In modern days, it is difficult for a person to attend a patient throughout the day. The proposed wheelchair can be self-manoeuvred easily by the patient using hand or head gestures. Apart from it, the wheelchair is aided by a voice guided indoor positioning system. **Findings:** We incorporated an IOT service device so that the status of the patient is regularly updated on a web server. This smart wheelchair is connected to the cell-phone of the guardian as well as the social media profile of the patient so that the patient can get help as soon as there's a mishap. **Improvement:** The wheelchair has ability to detect obstacles across the path of the patient and it can divert its path from the obstacle so as to avoid collision.

Keywords: Gesture Control, Internet of Things, Indoor Positioning, Obstacle Avoidance, Voice Guidance

1. Introduction

Wheelchair has become the most used device for people with physical disabilities and poor health. Surprisingly, the number of wheelchair users in underdeveloped countries is more than that of the users in the developed nations when we talk in terms of percentage. As per the study done[1,2] wheelchairs are playing an important role for elder people with limited mobility in order to participate in day to day routine feasible for them.

Wheelchair helps the users with physical disability in independent locomotion and provides them with self-sufficiency. We are proposing a design of a wheelchair which can help elder people, physically challenged and visually impaired persons to do their works more effectively with minimal aid from the others. A lot of research work has been undergoing in this area. In[3] proposed a system which could be used in vehicles and wheelchairs. The wheelchair would detect obstacles and accordingly control its speed[4]. The vehicle was also capable of traffic light detection and sign board detection. In[5] proposed a wheelchair which would be operated by the head gestures given by the user.

But it did not have an obstacle detection system. In[6] proposed a gaze and head gesture based interface system. The user can look in the direction where he wants to go and then nod or shake his head, based on this movement accelerometer senses the signal and the wheelchair can able to move in that particular direction desired by the user. However, the system was very bulky as it requires a PC at the back. There was no provision for obstacle avoidance and hence the device is not preferable to use by the blind person. In[7] proposed a method in which the movement of the wheelchair is controlled by the direction of the user's face. IR sensors are used to avoid obstacles and wall following. But the wheelchair is quite bulky and its performance is easily affected by change in lighting conditions, background environment etc.

From the last few years various prototypes of smart wheelchairs devices have been proposed and implemented. As a result, we can say that smart wheelchairs are having the facility of a range of devices like joystick, mouse, voice interaction, camera based interface, other sensor based interfaces like pressure, temperature, pulse rate, automatic navigation systems with more emphasis on

safety of the user[8,9]. And also proposed[10,11] new techniques which is used to control a wheelchair based on sensor readings which are generated by speech recognition and vision system. There are also developments in imaginative wheelchair which can assist physically handicapped in their daily activities, along with the people with limited or poor vision as well as senior citizens. The wheelchair is equipped with accelerometer sensor which will be helpful in detection of movement of the chair and IR sensors which are used for obstacle detection. The device is also equipped with voice guidance system which can easily be able to guide the users through the way at each and every instant. Halting of the wheelchair is performed at present places settled by Infrared Sensors[12]. The smart wheel chair is designed to help indoor safety for physically challenged people[13].

Here the wheelchair proposed is a multi-purpose wheelchair and it can be used by people with physical disability and visual imparity. It also has a system to send the location details on a web-server which can be used later by the physician to get the information about patient's daily activity. Also there is a provision, to alert the user's guardian if he falls down and also use the social media profile of the person to ask for help.

2. System Description

The complete equipment of the wheelchair is further classified into various subsystems:

- Navigation System.
- Indoor Positioning System.
- Voice Guidance System.
- Obstacle Detection System.
- Data Sharing System.

2.1 Navigation System

We have designed two different methods to control the robot. One is through head gesture while the other is through hand gesture. The physically disabled people can use the hand gesture unit to guide the wheelchair throughout. But it might prove difficult for the visually impaired person to operate the wheelchair because they will not be able to keep the accelerometer module in correct orientation. Such people can guide the wheelchair by using special rings worn on their fingers. The problem with accelerometer and magnetometer is that it should be kept in proper direction and orientation. It is difficult for a blind person to do this routine act again and again.

This problem is rectified using rings, there is no condition of wearing rings in a particular direction and orientation. The rings can be worn on the fingers and each finger will have a single ring. Whenever a person closes hand, the wheelchair moves in a particular direction depending on the finger closes. This is an intuitive way to control the wheelchair.

2.2 Indoor Positioning System

RFID tags are installed at the entrance of every room so that we can get the location of the person inside the house using the RFID reader on the wheelchair. RFID (Radio Frequency Identification) was originally developed for military applications but these days it is used in many commercial applications like supply chains, transport services, personnel access, toll collection etc. The RFID tags which we use here are passive tags. They read only tags consist of a microchip attached to a radio antenna mounted on a substrate. The microchip stores 96 bits of data in it.

2.3 Voice Guidance System

In order to help visually impaired, we have used voice guidance system using a rerecording voice IC. APR9600 is a single-chip voice recording and playback device. Each voice sample that we store here can have a maximum duration of 60 seconds. The best thing about the voice guidance system is that we use flash memory to store the voice samples and so there is no requirement of battery backup.

2.4 Obstacle Detection System

This system is pledged for detecting and avoiding obstacles. An infrared sensor is used to detect obstacles in the prototype. The sensor works on the basis of IR transmitters, receivers and their control circuit. The IR transmitter keeps glowing but the receiver cannot detect these rays until an obstacle comes in. Whenever any obstacle appears, the receiver receives these rays and its resistance decreases, as a result of which it conducts more current. This change in current is used to trigger an npn transistor which serves CMOS level outputs to the microcontroller.

2.5 Data Sharing System

We are using a GPRS/GSM module, which posts data on web server using HTTP. The social media status update will also be done using HTTP protocol. The SMS will be

sent to the guardian of the user by using the same module. For using this service, the SIM card being used by the system should have internet connectivity.

3. Technology

3.1 Hardware Used

3.1.1 Accelerometer

The 3 axis accelerometer is shown in Figure 1 is an electromechanical device that will sense acceleration forces. Whenever the user moves the wheelchair, he has to exert acceleration on the module. The accelerometer senses change in capacitance whenever it is moved. We are using ADXL335 to detect the change in gestures. There is a need to calibrate this accelerometer and magnetometer. The sensitivity of the accelerometer is 300 mV/g. We use the mean of the first ten observations as the rest position for the gesture. Whenever an acceleration of 10 mg is found in any direction the wheelchair is moved in that particular direction.
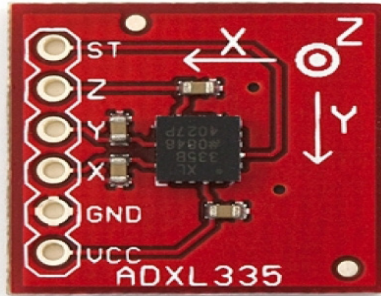

Figure 1. Accelerometer sensor.

3.1.2 Obstacle Sensor

Figure 2. IR sensor.

Figure 2 represents an IR sensor which is capable of detecting stationary objects (by the heat of the object) as well as a moving object. We use an IR LED which emits IR rays when properly biased. Because of any obstacles these rays fall on an IR photodiode. This changes the resistance and output voltage of the IR photodiode. This additional voltage is used to trigger the base of an NPN transistor.

3.1.3 RFID

Passive RFID tags are shown in Figure 3 and these passive RFID tags are attached to every room. These tags are made from a tiny tag chip that is connected to an antenna. The RFID reader on the wheelchair provides the connection between the tag data and the wheelchair.

Figure 3. RFID reader.

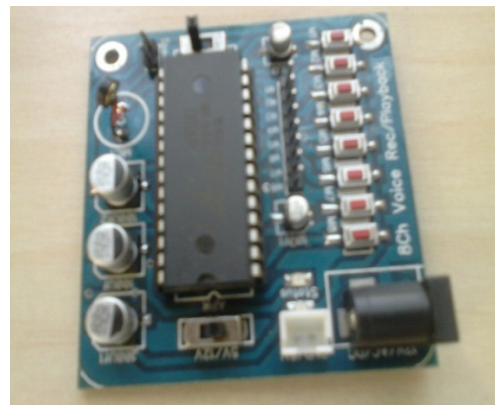### 3.1.4 Voice Rerecording and Playback

Figure 4. Voice recorder.

Voice recorder and play back are shown in Figure 4 we are storing voice samples and again

Playing back in a single IC APR9600. It has a playback capability for 40 to 60 seconds. A 16-ohm speaker can be connected to the output of the IC.

3.1.5 GSM/GPRS Modem

Figure 5. GSM/GPRS modem.

A quad band GSM/GPRS Modem is shown in Figure 5 and these modems are used in the wheelchair. The four frequency bands are 850/900/1800/1900 MHz. It is interfaced to ARM processor using RS232 interface. The modem has internal TCP/IP stack so that the wheelchair can be connected directly to the Internet via GPRS.

3.2 Software Used

For programming the processor, KeiluVision IDE is used. The web server used here is Things peak and to tweet we use the platform of Thing tweet.

4. Results

Figure 6. Thing tweet.

Figure 6 depicts the presence of the user in two rooms with respect to time.

Figure 7 represents the status on Twitter account of the user which mentions the time at which he fell down.

This has been done through Thing Tweet API. The Wheel chair has a rescue system for its user. The Wheel chair has proved to be a cost effective solution
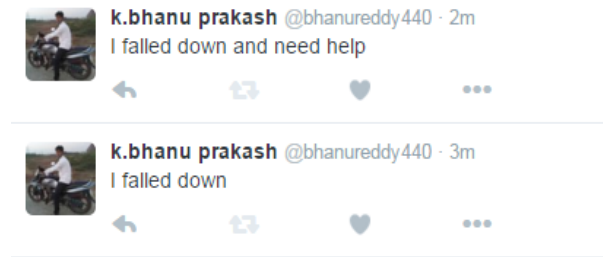

Figure 7. Twitter account results.

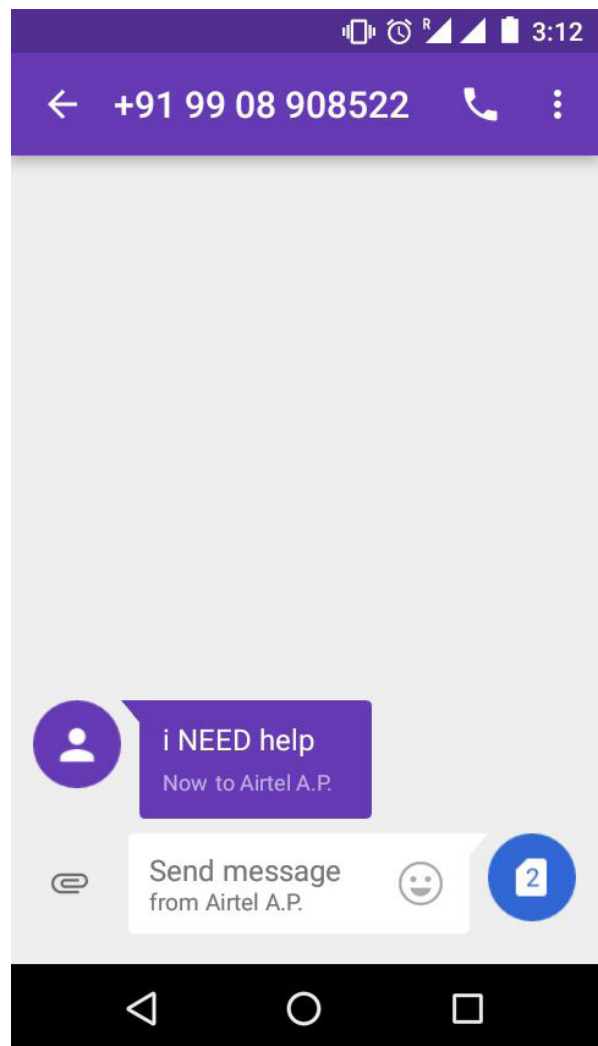Figure 8 represents the Snapshot of the message sent by the wheelchair to the guardian phone.

Figure 8. Snapshot of the message.

5. Conclusion and Future Work

Smart wheel chair system is designed for physically challenged and visually impaired persons. In future, we can also add vital parameter monitoring to the wheelchair. Using suitable sensors, the vital parameters of the user can be uploaded on a web server. Whenever the vital parameters cross a certain threshold, it will be updated on Twitter automatically using React API of Thing speak web server. We can also add GPS to the wheelchair in order to incorporate outdoor positioning system in the wheelchair.

6. Acknowledgements

7. References

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