A Smart Wheelchair for Aged People with Health-Monitoring System

Dr. P N Sudha[1], Suraj V Ghorpade[2], Thanushree D[3], Vaishnavi G[4], Vrindha Sham Bhatt[5]
[1]*Head of the Department, ECE, K S Institute of Technology, Bangalore, Karnataka, India*
[2,3,4,5] *Dept of ECE, K S Institute of Technology, Bangalore, Karnataka, India*

***Abstract*—The differently abled and aged individuals face difficulty when it comes to their locomotion in an independent manner. They are mostly dependent on other individuals. The paper defines a mechanism which makes them independent to move around carefully providing multiple controls which can be used in different scenarios. The E-Health monitoring system, monitors their health in real-time with the help of different wearable sensors and provides this data to the intended caretaker in regular intervals of time. The database of the individuals is also stored in a database, as it will be helpful in analyzing their health in long-term.**

***Index Terms*—Health Monitoring, IoT, Joystick, Voice Controlled.**

I. INTRODUCTION

The major aim of this paper is to design a smart wheelchair that will assist the elderly and physically weak patients with minimal effort for locomotion and also to monitor the general health constantly throughwearable device with implanted sensors in it along with an APP designed to access the data to keeptrack of all the health variations. A mechanism has been designed to move with ease without getting affected in different climatic conditions. This enables impaired people to carry out dailytasks with least dependency. The design and execution of a voice-controlled smart wheelchair for disabledpeople is done in this paper.

II. LITERATURE REVIEW

[1] In this paper titled, "Smart Wheelchair Using Medical IoT" is based on an android app and a manual joystick-controlled wheelchair. The app and the wheelchair are connected via WIFI or Bluetooth technology. Input to the wheelchairis given by the app, the manual joystick can be used to control the left, right, forward, backward moments along with stop. Infrared sensors are used to detect the obstacles from all 4 directions. It willallow the patient to move around anywhere without any help with least dependency by avoiding pushing the wheelchairand constant monitoring by the nurse along with ergonomics to provide comfort for back rest toencourageagoodposture. The main drawback of this design concepts was the high maintenance and repair cost. The smart wheelchair will cost much more than a normal wheelchair. Using the joystick to move around maybe tiring after sometime for the patient.

[2] In this paper titled, "Smart Wheelchair with inbuilt Health Monitoring System", the wheelchair includes 4 DPDT switches that allow the user to easily move the chair in anydirection.The Bluetooth module attached to the wheelchair is connected with the DC Motorsthrough an Arduino UNO. Both the wired and the wireless controls can function simultaneously.It has a heartbeat sensor attached tothe wheelchair. This sensor is constantly measuring the pulsevalues from the patient with a delay of 30 Seconds. A GSM module sends a notification messageto the doctor in charge, keeping them updated on the patient's health state 24X7. If an emergency occurs,a notification will be sent to all of the contacts listed in the database, allowing them to takeimmediateaction to savethe patient. This designed model relies on 12V rechargeable batteries to power the motors, which must be charged after a short period of time.

[3] In this paper titled, "Wheelchair For physically disabled people with voice", ultrasonic and infrared sensor control: The system provides joystick control, voice control, and autonomous driving modes. The integration of IR and Ultrasonic sensors in the proposed system helps to avoid obstacles, including stairs and holes. The drawback is that gridlines are common in residences, and the

sensors arehighly sensitive to the extent that these grids are mistaken for holes. The cost of the system willincreasesignificantly. Thecost of thesystem will increasesignificantly.

[4] In this paper titled, "Voice Controlled Wheelchair", The objective is to make it easier for individuals with physical limitations to move around independently, as well as to provide a level of ease for those who lack the ability to handle a joystick by using a microphone. The software implementation uses the CMU Sphinx Toolkit and the Pocket sphinx library to implement voice recognition on an Ubuntu system. The voice recognition code is written in Python. Key phrase Spotting, and Sliding Match Filter, are employed in this study and tested in various test environments. In a loud environment, the Key technique delivers a mean accuracy of up to 75 percent and a maximum of 90 percent when tested in varied environments with fine-tuning. They have used visual processing to detect obstructions and edges, and ultrasonic sensors to avoid them. The python suite running on the laptop then searches for any of the 5 different voice commands using key phrase spotting, and if it is recognized, the necessary command is transmitted to the Arduino via UART, and then the required Control signal is given to the motor driver to drive the wheelchair in the direction specified in the voice command. The disadvantage of the key spotting model is noise susceptibility, which can be overcome by using unidirectional microphones and positioning them such that they record only the driver's voice. In the future, the model couldbe improved by adding ultrasonic sensors to the wheelchair's contour to avoid obstacles andcrashes.

[5] In this paper titled "IoT Based Smart Wheelchair for HealthCare", it uses Arduino and an IoT cloud platform to provide remote health monitoring services. Doctors can access the online services to record and monitor their patients' healthregularly, and patients can connect directly with their doctors in case of an emergency. Thetargeted sensors are placed at the armrest. Pulse rate and blood oxygen levels are detected by sensors, processed by Arduino and sent to the cloud that initiates a SMS update just in case of any abnormality. Because disabled individuals cannot afford to travel, this system helps them access healthcare remotely.

[6] In this paper titled, "Development of Electric Wheelchair for Smart Navigation and Health Monitoring System", the system creates a framework for a smart, low-cost wheelchair for people with disabilities thatcan be transformed into a stretcher using an Arduino UNO and a Raspberry Pi to offer live broadcasting. The prototype connects Pi to the Android app bluedot, which analyses the disabled person's pulse rate, heart rate, temperature, and ECG and stores the data in the cloud. An alarm SMS will be sent to the caretaker in the event of unusual health situations. To build and administer the health database. The Thing Speak platform is used to store and retain health monitoring data to construct and manage the health database. One of the most typical issues is the cost is high.

[7] In this paper titled, "Design ofVoice ControlledSmart Wheelchair", the objective here is about Arduino-based speaker-dependent voice-controlled navigation systems, the voice recognizing capability is tested in noisy as well as silent environments and good accuracy is obtained. As the objective revolves around the voice recognition, it is ideal to train the model in both noisy and asilent environment.

[8] In this paper titled, "A Novel Design of Gesture and Voice Controlled Solar-Powered Smart Wheel Chair with Obstacle Detection", the methodology to control the movement was defined. The two modes of controls are incorporated. The movement of the wheelchair was controlled by hand gestures and was also controlled by gestures of hand. In worst scenarios, the person might not be able to even lift their hand or to speak, in these scenarios, there is a need for another control. The motors andtheir drivers were driven by solar energy. It is ideal to store the charge as well when it comes to solar energy driven applications.

[9] In this paper titled, "Design and Development of Voice Controlled Wheelchair", the voice input is given through an android device and is made to reach the Arduino UNOthrough the Bluetooth module which is the HC-05 Bluetooth module. In this case, the range of the Bluetooth module and the clarity of the voice from the microphone of the android device are the area of interest.

[10] In this paper titled, "Design of an Arduino Based Voice-Controlled Automated Wheelchair",

Arduino Mega, VR3 module and SIM900A GSM module-based motor-controlled wheelchair.The application of the VR3 module is a good inclusion as the speech processing complexity isminimized. The incorporation of the GSM module is used to send a message to the caretaker or the doctor if there is any emergency with respect to the patient using the wheelchair. The Arduino Mega is used in this paper as it offers more memory storage than the Arduino UNO, however the clock speeds are the same with respect to the two development boards.

[11] In this paper titled, "Smart Electronic Wheelchair Using Arduinoand Bluetooth Module", the design of a smart, motorized, voice-controlled wheelchair using an embedded system basedon Arduino Uno board, a Bluetooth Module, Motor Driver and an Android phone is shown in this proposed model. The processing units are directly attached to the wheelchair in one package. The speech recognizer proved a recognition rate of above 90%. As the processing units are attached as a package, there pair or maintenance would result in the removal of the whole package in order to troubleshoot the issue.

[12] In this paper titled, "Arduino based voice-controlled wheelchair", it is to aid patients with both upper and lower limb limitations, avoice-controlled wheelchair prototype was constructed utilizing a commercially available manual wheelchair. The spoken command from the speech recognition module is processed byan Arduino microcontroller, which controls the wheelchair's motor movement. The prototype ofan Arduino-based voice-controlled wheelchair was created and proven successfully to respond to voice instructions. The motors used in this project regularly stalls, and the wheelchair struggles to move after coming to a complete stop or zero speed while carrying a load of more than 65kg.

III. OVERVIEW OF THE MODEL

As per the previous references, the following are the obtained inferences:

- There is always a need of multiple modes of control for a smart wheelchair considering the different types of disabilities which are seen at older ages.
- Aged individuals need continuous monitoring and hence, the wearable sensors have to interfaced with the smart wheelchair where the health parameters of the individual are been monitoring in real-time and there is a need to store these data too.
- The efficient storage of these data is required and hence, a web application with unique username is dedicated to each of them and their caretaker can have an access to the same.
- On the basis of the data, the reports are generated at different periods which helps the doctor to diagnose and come to accurate conclusions.
- The smart wheelchair has to have a mechanism to protect the individual in case of harsh weather conditions and is defined in this paper.

Analyzing the above technicalities, we put forward our methodology wherein, the there is a facility of a rain proof roof in order to prevent the individual if it rains. The health is monitored at all times and if any of the variations occur, the same will be notified to the surrounding and as well as to the caretaker and to the doctor. This data is a part of the periodic report which is generated and the same will be available on the dashboard of their account which is a web application.

IV. PROPOSED METHODOLOGY

This project work is about the implementation of Smart Wheelchair using the controls of Arduino UNO board. The system methodology mainly focuses on continuous health monitoring, managing the data obtained from the wearable sensors, protection from harsh weather conditions and the multiple ways to control the motion of the wheelchair.

Overall Functioning of the Smart Wheelchair with respect to Arduino UNO developmental board

- The Arduino UNO developmental board which comprises of the Atmega328P processor acts as the heart of the system which controls the whole system. The Joystick is a hardware which is one of the modes of the three to control the motion of the wheelchair.
- The wearable sensors which are used to capture the health parameters of the individual using the wheelchair are heart beat pulse sensor, Body temperature sensor – LM35 and the ECG sensor.
- On the other side, the motor driver is interfaced with the Arduino UNO developmental board which takes the input from any one of the inputs and drives the motors through a specific direction.

- The water sensor activates the rain proof roof if in case it starts to rain. The Web application gets the sensor values and they are stored in the database through a Wi-Fi module interfaced with the Arduino UNO.

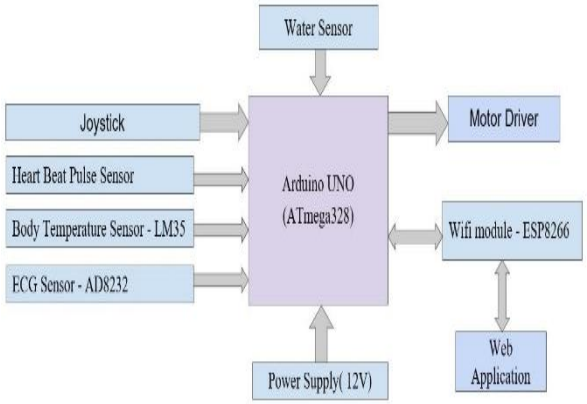

Fig 4.1: Overall functioning with respect to Arduino UNO

Health Monitoring System

- The health of an individual is monitoring continuously, it is too much of data to be stored if the system keeps on the storing all the values. Hence, few values are considered and the duplicates at the same instant of time is discarded.
- The system starts and the set of wearable sensors starts to capture the data and if the value of any of the health parameter is beyond the normal values or if the values are out of range, then the buzzer starts to buzz, so that the surroundings are aware of the scenario the individual is undergoing.
- Simultaneously, a message is sent to the care taker and the doctor about the unpleasant health variation experienced by the individual.
- If the values are in range, then the values are just recorded by the system into the dashboard considering some of them to generate the report.
- In either of the two cases, the values be it normal or abnormal, they are considered to generate the report.

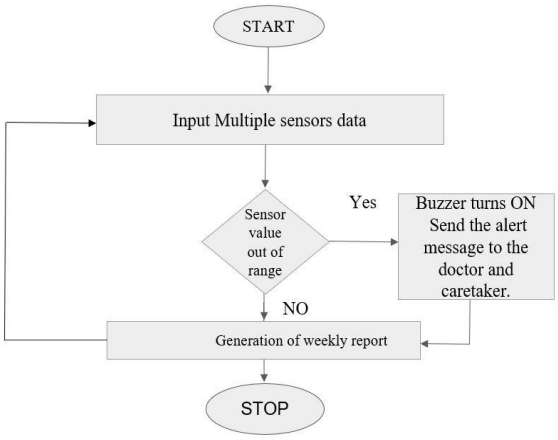

Fig 4.2: Block diagram for Health-Monitoring System

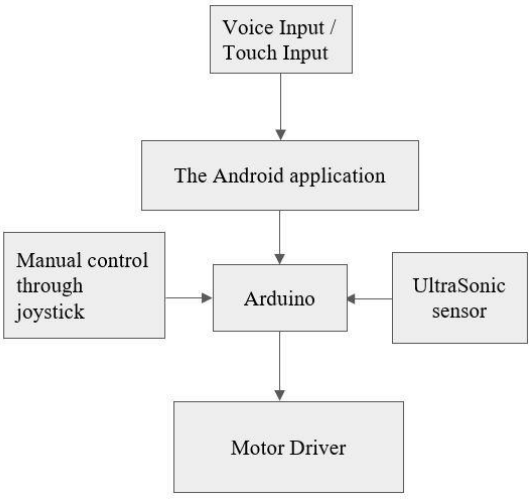

Fig 4.3: Overall functioning with respect to Arduino UNO

Modes of Control for Wheelchair Locomotion

- An android application is connected to the Web Application through Wi-Fi and it is feasible to use the same means to establish the connection with the Arduino. The voice input and the touch input can be given through an android application.
- The motion of the chair can be driven through a joystick controlled by the individual themselves, if they are able to.
- The third mode of control is using the ultrasonic sensor, this works even when the other two modes are operating as a mechanism which prevents to meet any obstacle on the way. If none of the controls are given, then the Ultrasonic sensor finds a way to move around without meeting any obstacle on its way.

- There are three different modes of control, which might create a cloud of fear in the minds of the individuals about the system failure. However, the priorities are given and hence, this prevents unwanted scenarios in case of system failure.

V. CONCLUSION

The proposed mechanism will provide three ways of control for the movement of the wheelchair which can be enabled based on different scenarios and the condition of the user. The voicecapturing aspects will be tested in a noisy as well as the pleasant backgrounds as the voice inputcan be given in either outdoor or indoor environment. The wheelchair constantly monitors the health variations through the wearable sensors and if any irregularities are found, the same will be notified to the caretaker and the buzzer will activated to make the people around the wheelchair be aware of the situation of the patient. The smart wheelchair is also facilitated by arain proof roof, in order to prevent the patient from not getting affected by the harsh climaticconditions. The reports of the health variations are generated and the periodic health reports arebeing stored on a web application where the care taker and the doctor can have an access based on which the effective diagnosis can be done. The smart wheelchair is proved to feasible in both domestic as well as commercial purposes.

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