Bluetooth and IOT - Enabled Voice Activated Hospital Bed Control, Monitoring and Alerting System for Patients

Savita Mamadapur
Department of Electronics and Communication Engineering
Jain Institute of Technology, Davanagere, India

Chaitra J E, Chaitra S, Divya Jyothi G, Latha A
Department of Electronics and Communication Engineering
Jain Institute of Technology, Davanagere, India

***Abstract*: Medical beds were offered under sophisticated technology in the late twentieth century, especially in the sphere of improving patient care. The notion of smart-bed technology has evolved over the last fifteen years, however there is no official documentation of project existence it has been demonstrated. To execute different communication and control abilities, these and preceding systems typically use a single pressure button or switch-sensitive type switches. The intended goal is to develop a model bed that can respond to simple commands and aid the user in reversing, tilting, and other similar actions and ordering the dining table while also monitoring the minimal space required to fold or sit the bed in a convenient manner professional voice keywords in which the user will issue commands to perform any such actions slope, backward, up, down etc. Work such as bedroom requirements, appliances and various other activities can be done as an extended activity.**

Keywords: Arduino UNO based Voice Actuacted Hospital Bed, Smart Med-Bed , Voice Recognition (VR3) Module.

I. INTRODUCTION

The majority of patients spend their time in hospital beds. a significant portion of their time, necessitating a strong understanding of patient care, as well as the ability to be safe while attendants study data and enhance patient care. The specific purpose is to empower patients with self-sufficiency, allowing them to perform some essential tasks when nurses or caregivers are late or unavailable. As a result, such solutions assist the vast majority of patients in their condition, which is unavoidable and necessitates a quick shift in mobility. Access to quality medical care in hospitals turns out to be a This is a crucial issue. The expanding cost of therapeutic consideration and the reduction of the quantity of guardians are the two main motivations behind this (for example: health care providers). If the patient is confined and has lock-in issues, this becomes even more of a problem. ,Dealing with those patients needs a great deal of effort and consideration. In this way, it's critical to provide customised replies to caregivers of In nursing homes or hospitals, patients. It is suggested that you use a hospital bed. in this study for patients who are unable to move and are suffering from the effects of a severe disorder, such as Long-term coma, quadriplegia, clinical death, and so on are all possible outcomes. Because they are unable to move any extension of thinking, these patients require special attention. Furthermore, each exchange of a few hours implies that one must be regularly available to work; this includes during the night The project's purpose is to develop a smart city. It is primarily focused on a small prototype that can be measured in considerable part if it is proven to be effective, and it responds quickly to user commands utilising voice commands to deliver the desired result. The proposed framework's major goal is to make a way for It's a lot easier to cope with a patient who can't move while sitting in bed.Long periods of bed rest can cause a variety of problems.

II. LITERATURE REVIEW

[1], This report gives a detailed picture of as part of the intensive care unit, "smart beds" are used. A motor driver circuit is used by the IOT that is connected to the stepper motor and is transmitted via audio input. It has been discovered that receiving voice commands with accuracy is difficult. For the sufferer, wireless communication can be a hindrance.

[2], The automatic wheelchair of the voice control system utilising Arduino is discussed in this study. The structure consists of a sound system that allows a person with a physical impairment to steer a wheelchair in the direction of a voice that has difficulties developing closely owing to loss of mobility or wheelchair-controlled wheelchairs. The suggested speech system can only be modified by recognising an integrated voice module (VR3), which removes the need for any large complex modules. Furthermore, the proposed system is simple enough and inexpensive enough to be accessible via electronic ubiquitous gadgets and other existing structures in poor countries.

[3], The proposed model's major The idea is to make dealing with a patient who is unable to move as simple as possible. in bed. The suggested medical bed is self-contained when needed, with a revolving bed that rotates every several hours. The movable pieces as well as the pre-arranged places are controlled by the electric bed buttons.

[4], This paper describes how a tiny solar-powered wheelchair project for people with disabilities was planned and implemented. Tissue uses the surface Electromyography (sEMG) architecture was used to obtain the signal required for wheelchair movement. SEMG signals from the upper body muscles in their raw form leg are gathered, analysed, characterised, and isolated to get the basic aspects of making automatic motion control signals in a medical bed.

[5], Donation may be a contributing factor in a patient's recovery and may result in significant reactions to irreversible outcomes in large medical clinics. MedBed is a sophisticated digital bed that uses time, location, and the end of common sense to select the most significant and helpful analyses. The goal is to provide patients some autonomy through these connections, allowing them to assess emergency situations. when assistance is either delayed or difficult to obtain. This framework has the advantage of being able to be adopted in hospitals and medical institutions with minimal infrastructure upgrades.

[6], In this study, the patient is able to operate a wheelchair using voice commands and the patient's region may be followed, the emergence of a wise voice based on a clever wheelchair system for persons with physical limitations who cannot hold a wheelchair in their hand. uses the GPS module in a wheelchair to send information from a mobile application via Firebase techniques. The VR3 speech recognition module records and visualises the user's voice in order to conform to the patient bearings. This programme uses the whole Android app to give a voice-guided wheelchair, obstacle placement, and GPS tracking for the user.

[7], Recent technological advancements have resulted in the effective introduction of empowered medical devices with intelligent controls that have resulted in the creation of deep and embedded functionality. The last two decades have seen more than just theoretical system developments in terms of object structure and form compilation (steps), as well as patient care (ideas of patient care and availability). As part of the overall patient care environment, this introduces a review of the performance of smart medical beds, referring to what has been revealed as "smart beds."

[8], A voice recognition system, a control system, and a receiver designed to detect signal from the sender when the sender is close to the patient care module. system are all part of the patient care equipment integration. A voice recognition system, a control system, and a receiver designed to detect signals from the sender when the sender is close to the patient care module. system are all part of the patient care equipment integration.

[9], A voice recognition system, a control system, and a receiver designed to detect signal from the sender when the sender is close to the patient care module. system are all part of the patient care equipment integration. By constructing a sit-down sign and utilizing visual algorithms to assess if the patient is attempting to stop and tell caretakers, GRiT chair users can benefit from a pressure sensor and proximity sensor. The GRiT system integrates the existing hospital wifi network to notify and find the patient with the nurse's call plans.

[10], A diagram depicts the development the voice input unit with the Patient Data Management System (PDMS) For real-time patient information, PDMS uses an IBM PS / 2 connected to the LAN. Promising application of voice output and recognition in the intensive care unit by providing continuous access to physical access information. It will result in a successful programme for persons with impairments all around the world.

III. SYSTEM ENGINEERING APPOACH FOR SYSTEM DEVELOPMENT

Smart Bed is built using a Systems Engineering (SE) methodology to meet certain specifications for a more balanced arrangement. The SE technique ensures that sub-systems are adequately chosen based on requirements and that no time or money is wasted in the process. It aids in the improvement of an exceptional system in terms of cost, system, and performance. It is in charge of recognizing the numerous sub-systems that are available during the conceptual evaluation phase of problem solving. Convergent thinking is then utilised to find the best subsystem and, as a result, a well-balanced solution The functional specifications are scribbled on a piece of paper.as well as requirements for hardware, software, and equipment

Hardware Requirements

The sections below must be completed in order to perform the required functions.

- REES52 Speech Processing Chip
- Microcontroller - for use control, an Arduino UNO board.
- L298N dual H-bridge motor driver circuit for twin engine control
- Motors powered by DC - 12V, 10 RPM, 11.25 kg/cm
- 3000 mAH 12V battery
- 5V/2A Arduino UNO adapter
- LEDs
- Jumping ropes between males, females, and males and females jumping roles
- Various types of data resistors

Software Requirements

- Embedded C logic is used to control several motors at the same time with a microcontroller
- Fusion 360, Solidworks, and AutoCAD are all available. utilised to design a mechanical bed.
- Proteus and Fritzing are used to simulate electronic components.
- Voice command training, The terms access port and UNO are used.

A. Mechanical Requirements

This bed must meet three mechanical design standards. The most important structure to consider is to envision and design.

- With the smart bed's unrestricted movement, the wiper mechanism was created so that the rod rotated according to the needs of the user by frame, and the foundation is made in the back to conduct the necessary analysis utilising a variety of analytical techniques
- When it comes to ensuring loading capacity, good configuration procedures are made during the design process.
- Accurate recording of mechanical designs ensures quality inspection.

IV. ELECTRONIC SYSTEM LEVEL BLOCK DIAGRAM

The figure shows a diagram of the electronic system level block.

The user's speech is collected using a microphone to voice recognition chip, such as the REES52, and a port accessible through Set the baud rate to 9600 on the USB to UART converter. The speech commands are subsequently converted into ASCII characters. This voice recognition chip will provide data to a microcontroller. The motor driver circuit will then send a signal to the motor, allowing the engine circuit pins to enter the appropriate mode of operation for the driver circuit. terminal to rotate in the desired direction.

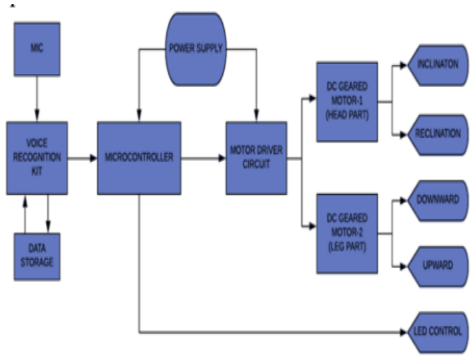

Figure 1: Electronic System Level Block Diagram

V. SOFTWARE DEVELOPMENT AND TESTING

A few low-Chaos tests were carried out at home and at school (for example, at the study hall and the research centre), and the planned system was found to work. three out of four times. a total of five In fact, it proved difficult to manage the bed at times while putting it through its paces in a typical sound environment (for instance, busy areas or traffic) limited zones). More research is being done to make the system work louder to the point of sobbing by using speed processing filters and classification separating methods. The user's command is received via a mic to speech chip, the REES52, as well as access port software, use a USB to UART converter with a 9600 baud rate. The voice command is then converted to an ASCII character, and the LED light indicator on the 16th GPIO is turned on if the ASCII character is retained. pin is turned on with a 4 second delay. If no ASCII character is received, i.e. there is no trained voice, the LED light on the 16th GPIO pin is turned off. The registers that are assigned to it store the trained data. To enable Johnson motors to set the bed by movement, voice commands key inputs. Because wireless technology is limited to a hospital setting, the notion It was born the idea of using a speech processing processor instead of wireless modules. In order for the equipment to function securely, the user begins vocal training. Input control is used to control the speed of a DC motor. The motor driver circuit is used to control the voltage. Bridge with two Hs The L298N motor driver is used to straighten and control the speed at the same time of two DC motors The circuit can handle DC voltages ranging from 5 to 35 volts and mains currents up to 2 amps.The DC car's speed is controlled by the pulse conversion process. By turning on the power and closing with fast prices, technology allows modifying the voltage value to the average of its value, which then goes to the driver's cycle. The activity cycle, or the average period when the signal is turned on, determines the average voltage value. on in comparison to the average time when the signal is turned off. When the signal is turned off in time, the average time is calculated. Giving patients the greatest possible care is still a hot topic, one that could improve the hospital's reputation if an effective model can be implemented. The major The project's goal is to develop a smart-Medbed that, in our case, aligns itself depending on voice input wor commands and can be expanded into a smart hospital room. employing strategic plans for electrical automation equipment, nurse call, and other user-based operational requirements. Most software fails to identify voice effectively due to misinterpretation of words, resulting in errors because most programmes do not grasp language in the same way that people do. Ok, in the current project, the faults are handled by creating a response system that compares voice input and activates the control output output based on the end user. The user determines the alignment angle, and specific commands are picked, making the device extremely intelligent device extremely intelligent.

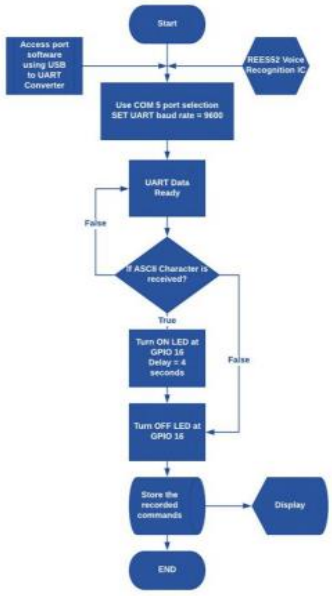

Figure 2: Main control algorithm flow chart

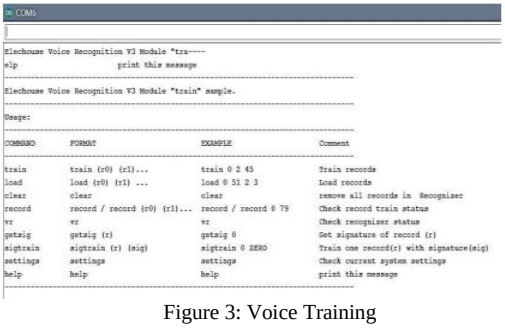

Figure 3: Voice Training

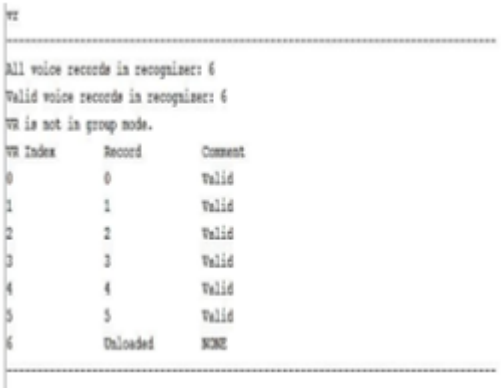

Figure 4: Voice Recognition Status

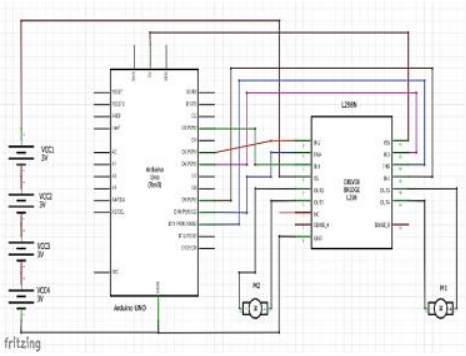

Figure 5: Simulation of Arduino Uno with L298N and Johnson motors

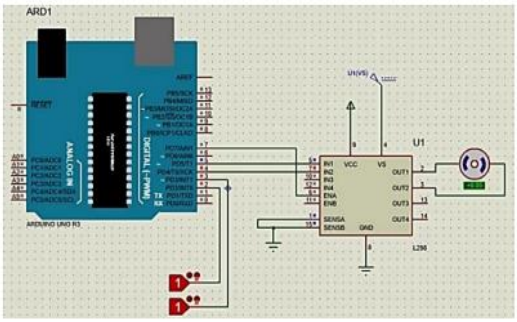

Figure 6: Simulation using Proteus

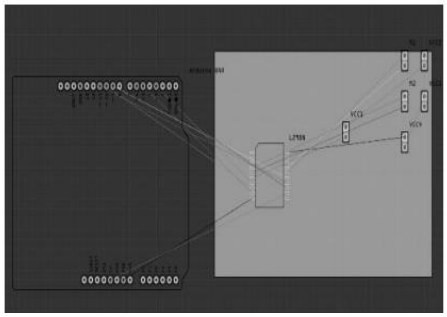

Figure 7: PCB Layout of the Developed System

VI.MECHANICAL SUBSYSTEM CONCEPTUALIZATION

On the mechanical side, the X Y Z Johnson motor base was present.was meant to see if a product concept works. Because the controller selected can only support two motors, the concept was created with two engines. Figures 8 and 9 demonstrate the idea design in Fusion 360, respectively.

Figure 8: Assembled Structure 1

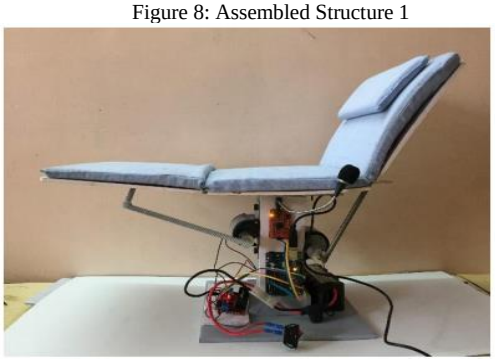

Figure 9: Assembled Structure – Head Inclination

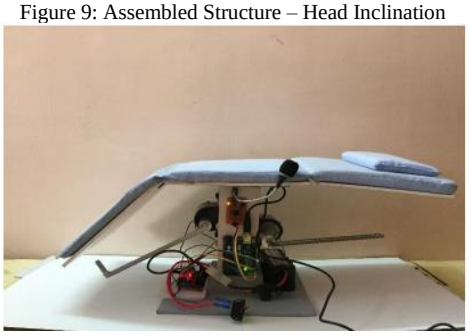

Figure 10: Assembled Structure – Leg Reclination

A. Voice Module Design

The major input that activates Johnson's engines to keep the bed rolling is voice commands. Because wireless technology was limited to the hospital setting, the notion instead of wireless modules, a speech processing chip was born. To function safely, the user must first train his or her voice to activate the system. The VR3 module, which employs the HM2007 microprocessor, allows us to access the Human-Machine Interface by optimising the surroundings and environment. The following instructions were written to meet our requirements:

- Incline (movement of the head)
- Take a seat (head movement)
- Lights on
- Aiming higher (leg movement)
- Leg movement (downward)
- Light (led on)
- Lights off (led off)

Figure 11: Voice Module Chip

B. Hospital Bed and controlling the motion desgin

The mechanised bed was created in Fusion 360, and all safety precautions were taken. The weight after stress analysis, making load placement simple. To keep the project simple, the entire system is built of metal. The above design was chosen because it ensures robust support and extends the space where the rods travel, resulting in the desired output The H-Bridge l298N transmission is the driver utilised in this application. It is a circuit that uses 12V to regulate the Power conduction in both directions enables bidirectional operation of the bed. Cars that raise the hospital bed and retain it at the proper angle using a DC designed motor. The excellent torque-to-speed ratio and compact compactness of Johnson Geared Motors are well-known and they function well at 10 RPM speeds with voltages ranging from 6 to 18 V DC at 12V. At 10 RPM, this automobile produces 11.7 kg-cm of torque.

VII.CONCLUSON

A smart advanced bed that responds to voice commands tilts and arranges the bed at precise angles in response to the user's voice. All of the operations used in the building of this bed are detailed, including their methodologies and techniques. Component requirements were identified but the concept had to be refined before it could be implemented, with the application of stress and load analysis.The ATmega328 microcontroller was utilised to control the LEDs. The system's sensitivity, which was operating the motor driver circuit based on all user voice input, was turned on. The required angles have already been specified in this project, making it simple to build an idea that can be altered according to the user's preferences The entire system operated on C logic, which was Arduino compatible. Because the HM2007 chip is Arduino compatible, the entire system is significantly easier to put together. This method decreases the project's complexity, lowering expenses and enhancing efficiency. During the launch of the Smart Bed, which combined hardware and electronic components, elements, disruptions and troubleshooting were regular issues. We were able to get the intended result by meeting software requirements with minimal team effort. Because of the unique technology we developed to make the bed less problematic and difficult, the load analysis of the complete underground system takes a long time. We were able to overcome around 80% of the issues encountered during the bed modification due to the hurdles we experienced. A smart bed is expected to cost around Rs.8000/- on average. Because it is simple, straightforward, and low-cost, most patients will benefit from implementing this paradigm. The growth of the same concept will substantially improve it and assist us in combating the ills we are confronted with. Overall, our proposed Hospital Bed prototype is environmentally friendly, emitting no hazardous signals into the hospital environment even after the device has been wirelessly installed.

APPENDIX – FUTURE SCOPE

1. Improve the bed's gradual movement precision. Motion engines.
2. To control bed movement, we use neural networks and fuzzy logic.
3. Introduce Artificial Intelligence-based systems to avoid total electronic objects, which is a dangerous situation. area that contributes to the module's drawbacks
4. Instead of using a speech processing chip, mind-ware controls that overcome speech impairment and other unique problems can be built.
5. Robots and other in patient care, complex control systems can be deployed.

ACKNOWLEDGMENT

The authors would like to thank all of the members of the Ramaiah University of Applied Science in Bangalore for their continuous assistance and advise in assisting us in successfully completing our research.

REFERENCES

[1] Ignacio Ghersi, Mario Marino and Monica Teresita Miralles, Smart medical beds in patient -care environments, Ghersi et al. BMC Medical informatics and Decision Making(2018) 18:63. IEEE'
[2] G.Panik, K.Benki and B.Breko, Voice Operated Intelligent Wheelchair -VOIC,IEEE ISIE 2005,June 20-23,2005,Dubrovnik, Croatia.
[3] Tawfik, Ahmed Hamdan, Abdulrahman Azzam and Yahya Ibrahim Published Online on 2018.
[4] M.S. Kaiser, Z.Chowdhury, S.Al Mamun, A.Hussain, M.Mahmud.(2016).A Neuro-Fuzzy Control System Based on Feature Extraction of Surface Electromyogram Signal for Solar-Powered Wheelcchair. Cogn.Comput.,8(5): 946-954. doi: 10.1007/s12559-016-9398-4.
[5] Abdallah Kassem, Mustapha Hamad and Chady El
[6] Moucary, MedBed: Smart Medical Bed, 2017 Fourth International Conference on Advances in Biomedical Engineering (ICABME).
[7] Guin and B. B. Baishya, "Brain Controlled Wheelchair using LabVIEW",Jan. 2013.
[8] Huster KA, Tellent DR et al. (2012) Patent : Hospital bed with graphical using interface having advanced functionality.
[9] Dixon SA (2009) Patent:Proximity Activation of Voice Operation of Hospital Bed. Andrienko K (2012) Patent: Biometric Bed Configuration.
[10] H.Knight, J.K. Lee and H.Ma, "Chair Alarm for patient fall prevention based on Gesture Recognition and Interactivity," 2008 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Vancouver, BC, 2008, pp.3698-3701.
[11] M. Petroni et al., "An automatic speech recognition system for bedside data entry in an intensive care unit," Computer-Based Medical Systems,1991. Proceedings of the Fouth Annual IEEE Symposium, Baltimore, MD, 1991, pp. 358-365.