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Smart Bed with Voice Command and Integrated Health Monitoring

Dr.V. Dooslin Mercy Bai
Professor, Department of Biomedical Engineering,
Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamil Nadu, India.

Brintha L, Jeyasree Bala S,
Naveen Kumar M, Arul Pandiyan A
Final Year Students, Department of Biomedical Engineering,
Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamil Nadu, India

ABSTRACT

Manually adjusting hospital beds presents significant challenges for healthcare professionals, impacting both their workflow and patient care outcomes. These manual adjustments are time-consuming, leaving nurses with less time to attend to other important tasks. As a result, patient needs may be delayed, and the overall quality of care may decrease. Moreover, manually adjusting the bed to ensure safety and comfort can be risky, potentially leading to improper positioning that exacerbates existing medical conditions or causes discomfort and pressure sores. Additionally, the demand for frequent and accurate bed adjustments throughout the day increases the pressure on nurses, especially in high-turnover or complex care settings. This project aims to address these issues by developing a hospital bed that responds to voice commands, enhancing patient care and monitoring. The bed's voice recognition technology allows patients to adjust their positions independently, improving comfort and accessibility, particularly for those with mobility challenges. Equipped with sensors to monitor heart rate and temperature in real time, the bed enables prompt detection of irregularities and facilitates immediate medical intervention. By combining voice control with continuous health monitoring, this innovative bed improves patient autonomy, raises the standard of care, and reduces the workload on healthcare staff. Ultimately, it seeks to create a more responsive and efficient healthcare environment, leading to better patient outcomes and overall hospital efficiency.

Keywords: **Voice recognition input, Heartrate sensor, Temperature sensor, Position detection sensor**

INTRODUCTION

There are approximately 1.19 million accident cases worldwide, and our target is to focus on individuals who have become physically disabled due to these accidents. Our idea aims to reach patients aged between 12 and 75 years, based on their health fitness and the effectiveness of their voice command in operating the devices. This project seeks to develop a smart hospital bed that responds to voice commands, allowing patients to adjust the bed's position, control nearby medical equipment, and communicate with healthcare professionals without needing physical assistance.

This innovation will significantly benefit patients with limited mobility or those recovering from surgery, as it reduces the need for manual adjustments and nurse interventions. The design focuses on safety, and ease of use, ensuring that both patients and healthcare providers find it reliable and efficient.

The advancement of technology in healthcare has led to numerous innovations focused on enhancing patient care, safety, and operational efficiency. One notable development in this area is the integration of real-time monitoring features into voice-activated hospital bed management systems. This cutting-edge system, which combines voice control with sensors for temperature and heart rate monitoring, offers a comprehensive solution for patient management, representing a significant leap forward in hospital bed technology.

The primary objective of this project is to enhance patient care by combining comfort, convenience, and comprehensive health monitoring in a single, cohesive system. The Smart Bed is designed to address the needs of patients, caregivers, and healthcare professionals by providing real-time data on various health metrics and enabling intuitive control through voice commands.

The Smart Bed is a suite of advanced sensors, including temperature sensors, heart rate monitors, and position detectors. These sensors work in tandem to continuously monitor the patient's vital signs and physical state, providing valuable insights into their health. By capturing and analysing data such as body temperature, heart rate, and sleep position, the bed offers a holistic view of the patient’s well-being.

The integration of these technologies offers numerous advantages. Voice-activated controls reduce the need for manual adjustments, allowing patients to feel more comfortable and receive personalized care. Continuous monitoring of vital signs enhances patient safety by enabling early detection of health issues. The automatic alarm system quickly notifies medical staff of any significant changes, ensuring better management of patient conditions and faster responses. Additionally, this technology boosts operational efficiency by simplifying bed management and alleviating the workload of healthcare professionals.

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LITERATURE SURVEY

1. Akshata Chavan .et.al "Voice Actuated Hospital Bed Control, Monitoring And Alerting System Using Bluetooth And Iot". Now a days due to increasing in medical problems, so the patient expects so many advance facilities in hospital. The patient should feel comfortable in hospital. So, concentrating on patient's asset and safety we have designed this system. The main aim of this system is the movement of bed according to patient requirement. To give the command system has used UART Bluetooth module to connect speech recognition system and microcontroller. The speech recognition system is installed in mobile. The system makes use of the speech recognition system, servo motors, a microcontroller (Arduino UNO), temperature sensor and heartbeat sensor.

2. Meenatchi.et.al "Systemic Review on Voice Actuated Smart Hospital Bed". The past fifteen years have brought various changes in the concept of smart bed technology, but no definitive evidence of the project's existence has been presented. These and previous systems typically use at least one push button or pressure-sensitive type switch to implement various control and articulation capabilities. Smart beds are designed to assist patients with mobility issue as it will allow them to control bed movement by themself and help them return to normal movement more quickly, with the presence of a monitoring system that alerts nursing staff when patients move and leave the bed with side rails. This type of high-end bed contributes greatly to the recovery of the patient's physical condition, health and activity because it is the main factor in achieving this goal, according to studies that have confirmed that the patient's movement during hospital stay as contributed to his quick recovery and early discharge from the hospital.

3.M.N.Mohammed.et.al"A New Design of Multi-Functional Portable Patient Bed". A new method in a rehabilitation bed for transporting a bedridden patient is developed and applied to avoid staying at hospital with costly medical treatment and such obstacles, therefore to conquer these problems, the proposed design of the bed is formulated based on literature survey as well as consult the medical staff. This paper discusses the specification, mechanism design and evaluating healthcare activities for development of a new style of active bed that provides high mobility with comfortable sleeping for bedridden persons and it also can meet the demands of those who may be required to take hospital beds to use at home particularly in a case of nursing disabled persons.

4.Lam meng chun.et.al "Mobile-based Hospital Bed Management with Near Field Communication Technology". A desktop-based (PC) information technology system has been widely adopted to assist this operation. The fixed location and the limited amount of available PCs shared among staff for different routine tasks can cause delays in bed information updating and therefore delays to the bed management processes. With the penetration of smartphones, a mobile-based application becomes a reliable alternative solution for bed management to complement the existing system. Smartphones offer a few benefits, especially mobility because users can update the information from any place and at any time. Our aim was to study the applicability of a mobile-based application for assisting bed management operation. The application consisted of ward-based bed information visualization, bed information updating, and ward information updating modules. Observation and interviews with expert users were performed to outline the required functions of the application. On a Likert 1-5 scale, the mobile application achieved a mean score of 3.45 for usefulness, 3.40 for ease of use, and 3.42 for satisfaction. Meanwhile, the respondents were also concerned about the mobile data consumption of the app, which took up 45.8% of the negative feedback. On the positive side, the respondents agree that the mobile application helps them in the bed management operation

5. Choudhari .et.al "Design and development of smart system for providing services to bedridden patients". This project research work has been carried out and the smart system has been designed and developed for providing essential services to bedridden patients. Recognizing the challenges faced by individual patients who are confined to their beds and often feel helpless and dependent, we have been motivated to contribute by developing a system to address their needs. Our goal was to alleviate their sense of unhappiness and dependence by creating a solution that offers assistance and support. The system autonomously transmit message to the mobile devices of concerned relatives or nurses based on the patient's needs, using flex sensors activated by finger movements. The flex sensors detect gestures made by the user, and Arduino processes this information to generate corresponding voice output through a mobile device in the desired language. This innovative project holds significant potential to greatly benefit society by enhancing the quality of life for bedridden patients and providing them with a sense of autonomy and assistance.

6.Development of voice actuated Wasted controlled smart surgical bed Wasted time in the operating room results in higher operating costs and greater post-operative complications. One effective way to reduce operation time is automating basic processes that occur during surgery. Given the rise of smart-home devices, implementation of virtual assistants became a feasible solution in many medical settings. With a consumer smart-home device and off-the-shelf components, we engineered a voice-controlled smart surgical bed that adjusts the bed configuration via a voice input. The resulting device is expected to optimize human resources and reduce surgical site infection by eliminating the need of a traditional touch control mechanism.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 11, November 2024

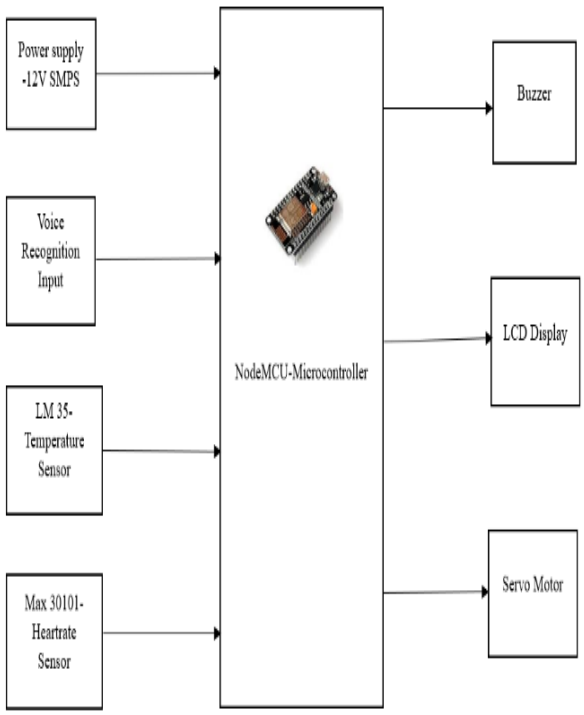
7. SUN Qi-feng .et.al "Mechanism Design and Debugging of an Intelligent Rehabilitation nursing bed".With the improvement of medical standards and the increase of the people's requirements for medical devices, it is a certain necessity to design and develop an intelligent rehabilitation nursing bed with high intelligence and integrated functions for the elderly, the paralyzed and the disabled. Taking into account the actual needs of patients, we design the mechanisms of supporting back, curving legs and side turning-over. With six dofs screw-slider-link mechanisms, we achieve the 90° side turning-over district nursing function. And we analyse the problems of the debugging process. Practical application shows that the bed runs smoothly, and the parameters of design is reasonable. With the state of side turning-over, we can scrub and massage the patient's back, buttock and legs.

8. Mya Thandar Phyu .et.al "Temperature monitoring system using lm35 and pic microcontroller".Automatic control using embedded systems is an efficient technique that is crucial in recent times. This paper discusses the implementation of a temperature sensor in an electric motor to monitor the temperature, and provide automatic safety mechanisms by controlling various components, to ensure the safety and longevity of the motor. An LM35 temperature sensor is interfaced with microcontroller PIC16F877A, and the sensor input is processed, governed by safe motor temperature limits, to provide intimation and automatic PWM-based speed control of a fan-based cooling system, as well as the speed of the motor, to ensure motor safety as well as better energy efficiency. The system is simulated in Proteus and verified.

9.Poonam.et.al "Remote Temperature Monitoring Using LM35 sensor and Intimate Android user via C2DM Service". This paper presents an embedded wireless sensor network prototype for remote room temperature monitoring. This network will be used for management of fire rescue operations. It will give the Android registered user freedom to continuously monitor the remote room temperature and in this way it provides better fire controlling technique. The proposed system provides an android user interface for registered user to access the current temperature and a flash/beep message in case of fire. LM35 sensor sense the remote room temperature and temperature status is transmitted to the smart phone via GPRS. Remote room temperature data transfer between the smart phone and application server that is connected to temperature sensor via USB cable is done using Google's C2DM service. The application server which analyses the temperature data, then inform registered user for taking proper action in case of fire. This work aims at monitoring of remote room temperature. Thus provides opportunity to quickly respond to fire emergencies.

10. Rajesh Pandey .et.al "Advance Smart Bed for Patients". The design, modeling, and experimental testing of a smart hospital bed that is mechanically operated to avoid pressure ulcers in hospital patients are described in data, then inform registered user for taking proper action in case of fire. This work aims at monitoring of remote room temperature. Thus provides opportunity to quickly respond to fire emergencies.

BLOCK DIAGRAM



HARDWARE SETUP

1.NodeMCU: NodeMCU is an open-source firmware. The name "NodeMCU" combines "node" and "MCU" (microcontroller unit). It's based on the ESP8266 or ESP32 microcontroller, which allows it to perform more than just connect to WiFi networks. NodeMCU is the preferred platform for wireless projects, home automation, and Internet of Things (IoT) applications. The prototyping hardware typically used is a circuit board functioning as a dual in line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna.

Fig 1.1 Node MCU

2.LCD DISPLAY

It Stands for "Liquid Crystal Display." LCD is a flat panel display technology commonly used in TVs and computer monitors. It is also used in screens for mobile devices, such as laptops, tablets, and smartphone. LCD provides better picture quality and support for large resolutions. Light is projected from a lens on a layer of liquid crystal.

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Fig 2.1 LCD Display

3. SERVO MOTOR

A servo motor is defined as an electric motor that provides precise control of angular or linear position, speed, and torque using a feedback loop system. A servo motor is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision.

Fig 3.1 Servo Motor

4. BUZZER

A buzzer is an electrical device that is used to make a buzzing sound for example, to attract someone's attention. It is an extremely small & solid two-pin device thus it can be simply utilized on breadboard or PCB. The working principle of this is similar to magnetic and electromagnetic.

Fig 4.1 Buzzer

5. LM 35 TEMPERATURE SENSOR

The LM35 is a precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius. It provides a simple and reliable method for measuring temperature with an accuracy of ±0.5°C at room temperature and a typical accuracy of ±0.25°C over a wider range. The LM35 is designed to operate over a range of -55°C to +150°C, making it suitable for a variety of medical and industrial applications.

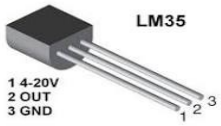

Fig 5.1 LM 35 Temperature sensors

6. HEARTRATE SENSOR

The MAX30102 is a highly integrated pulse oximetry and heart-rate sensor module designed for wearable and medical applications. It combines two LEDs, a photodetector, an optical element, and low-noise electronics with ambient light rejection, all in a single package. This sensor is capable of measuring oxygen saturation (SpO2) and pulse rate through a non-invasive method by detecting the absorption of light in the blood.

Fig 6.1 Heartrate Sensor

7. POSITION DETECTOR SENSOR

It is a sensor that is used to detect the object's movement & convert it into signals which are suitable for transmission, control, or processing. These sensors are normally used for measuring the distance of the body from the reference position. So it detects how far the body has moved from one position to another and this output is frequently used as feedback to the control system to take appropriate action.

SOFTWARE SETUP

Thonny is an integrated development environment (IDE) designed specifically for beginners learning Python. Its intuitive interface makes coding easier by offering features such as syntax highlighting, code completion, and quick access to documentation. Thonny includes a built-in debugger that enables users to step through their code and inspect variables, which helps in understanding program flow and troubleshooting. With a built-in Python interpreter, it allows

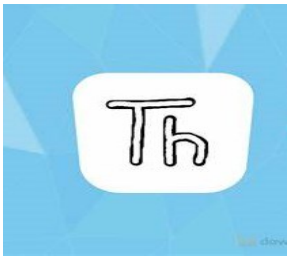

Fig 7.1 Thonny Software

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users to run Python code without needing external setup or configuration. Thonny also offers a straightforward project management system and a clean, distraction-free layout, making it an ideal choice for novice programmers who want to learn Python in a supportive and user-friendly environment

RESULT & DISCUSSION

The primary objective was to enhance patient care and monitoring by creating a voice-activated hospital bed. Using voice recognition technology, this innovative bed allows patients to request assistance and adjust their position with simple voice commands. Equipped with sensors to monitor vital signs, the bed can alert medical staff in case of an emergency. The development process focused on a user-friendly interface, accurate voice recognition, and seamless integration with the hospital's existing patient monitoring systems. Ultimately, the research led to a prototype that improved patient comfort and independence, while responding precisely to voice commands. This solution shows great potential in reducing the workload on healthcare staff and improving response times, contributing to a safer and more efficient healthcare environment.

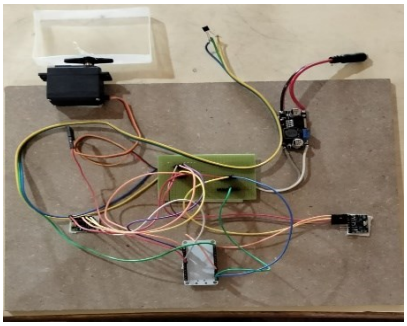

Fig 8.1 Prototype

CONCLUSION

This hospital bed significantly improves patient care by incorporating voice recognition technology alongside sensors that monitor heart rate, temperature, and position. Patients can now independently control their bed and track their vital signs, enhancing both comfort and autonomy while reducing reliance on caregivers. By integrating these functions into a single device, the solution simplifies healthcare operations, reduces the need for extra equipment, and lowers overall costs. This innovative approach not only boosts efficiency but also facilitates timely interventions, leading to better patient outcomes and more streamlined caregiver workflows in contemporary healthcare environments.

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