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# Advanced Smart Bed for Bedridden Patients Care at Home

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**ABSTRACT:** Automation plays a vital role in our daily life. Hand gesture recognition is the main implementation in an automation field. This project states that a problem of adjusting the position of the bed with the help of hand gesture and home automation. We need inter mutual application for hand gesture recognition for implementing this work in a real-time system. For this real-time system, webcams are used to enable the hand gesture for human-computer interaction. It is proposed to demonstrate a real-time system to change the position of bed by hand gesture signs using webcams and simple hardware components. In this society the number of disabled patients is increasing and there is no one to take care of them. A patient required a caretaker to continuously monitor which is not always possible due to social or financial circumstances. So, to minimize care takers requirement and increase the comfort level of the patients here, we have proposed an automatic bed position control system for disabled patients. The bed positioning is also controlled by different hand gestures. The system also contains a continuous patient monitoring system that monitors various parameters such as temperature and pulse rate. If any of these any parameter crosses safe minimal level, this unit sends an alert signal to the doctor by sending an SMS. Automation plays a vital role in our daily life. Hand gesture recognition is the main implementation in an automation field. This project states a problem of adjusting the position of the bed with the help of hand gestures and home automation. We need inter mutual application for hand gesture recognition for implementing this work in a real-time system. For this real-time system, webcams are used to enable hand gestures for human-computer interaction. In this society the number of disabled patients is increasing and there is no one to take care of them. A patient required a caretaker to continuously monitor which is not always possible due to social or financial circumstances. So, to minimize care takers requirement and increase the comfort level of the patients here, we have proposed an automatic bed position control system for disabled patients. The bed positioning is also controlled by different hand gestures. It is proposed to demonstrate a real-time system to change the position of bed by hand gesture signs using webcams and simple hardware components.

**KEYWORDS:** Arduino uno, Python, Open CV,LCD, Pulse Sensor, Temperature senso, Ldr sensor, Gesture/mems sensor.

## I. INTRODUCTION

Our project targets individuals who have been discharged from hospitals but still require ongoing care due to physical weakness, such as ulcer patients, elderly individuals, or women post-delivery. Prolonged immobility during sleep can lead to pressure sores and ulcers, necessitating regular repositioning by healthcare staff to prevent these complications. Recognizing that prevention is more effective and economical than treatment, our project aims to assist healthcare providers in monitoring and addressing this issue.

Currently, one common practice to prevent pressure sores is to rotate patients every two hours. Our project proposes a solution where the bed itself automatically adjusts its position based on the patient's needs, utilizing hand gesture recognition technology. Wireless Sensor Networks (WSNs) play a crucial role in this setup, comprising sensors distributed across the bed to collect vital information about the patient's condition. This data is then transmitted in text format to designated caregivers for analysis and intervention.

Additionally, our system includes a medication reminder feature, ensuring timely administration of prescribed drugs. By addressing these challenges, we aim to introduce the concept of smart beds equipped with WSN technology into

healthcare settings, thereby improving patient care and reducing the incidence of pressure ulcers and related complications.

## II. OBJETIVS

- To Design an Automatic Bed System can be controlle by mems sensor.
- Monitor the patient’s conditions using HB and Temperature.
- Automated medication alert system.
- Automatic room appliances control.
- Hand Gestures detection using image processing.
- In case of Emergency send intimation message to doctor or caretaker.

## III.SYSTEM DESIGN

### A. Hardware Setup:

- Assemble the physical components, including Arduino Uno, LCD, heartbeat sensor, temperature sensor, DC motor, and emergency switch, following the specifications provided by the manufacturers.

### B. Arduino Uno Programming:

- Develop code for the Arduino Uno to initialize and retrieve data from sensors (heartbeat and temperature).
- Implement logic to control the DC motor based on user input or sensor data.
- Integrate functionality for the emergency switch to deactivate motorized operations during emergencies.

### C. LCD Display Integration:

- Write code to present relevant information on the LCD screen.
- Display real-time data such as heartbeat, temperature, and bed position.
- Ensure the LCD interface is user-friendly and informative for easy understanding.

### D. Machine Learning Integration:

- Select and configure a machine learning library, such as MediaPipe, for gesture recognition.
- Gather a dataset for training the machine learning model, encompassing various hand gestures for bed control.
- Train the machine learning model using the acquired dataset.
- Integrate the trained model into the Python code for gesture recognition, enabling the system to interpret and respond to user hand gestures effectively.

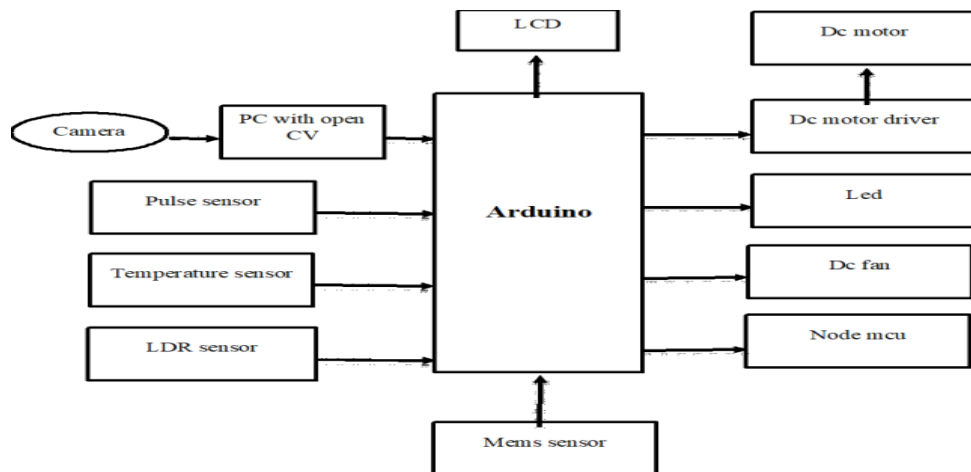


Fig 1: Block Diagram

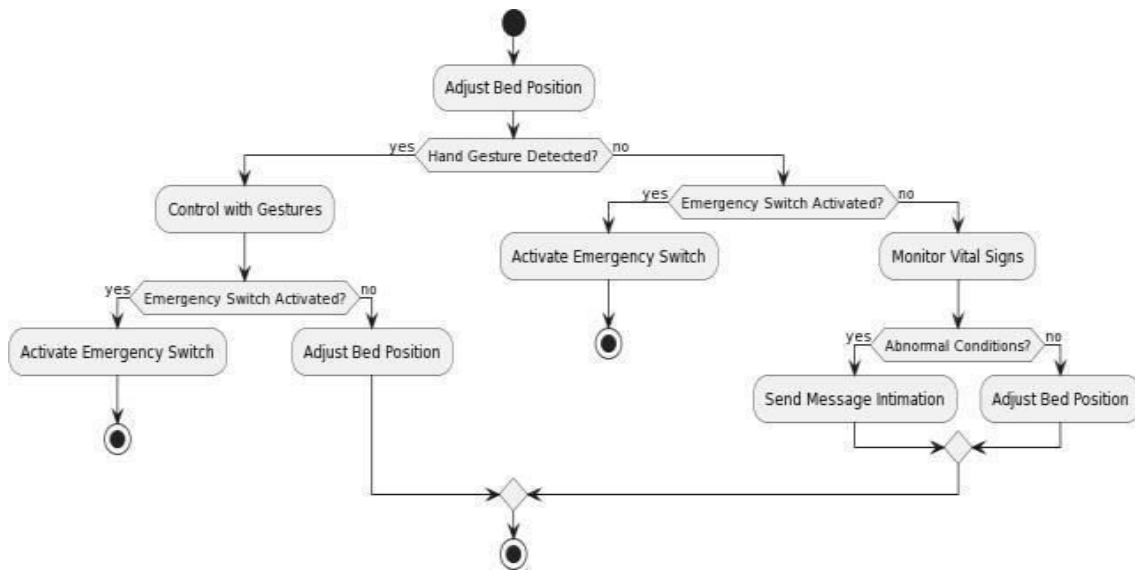


Figure 2: Flow Chart

- Users have the capability to adjust their bed's position, such as raising or lowering the head or foot of the bed, through simple hand gestures, eliminating the need for physical buttons or remote controls.
- This feature significantly enhances convenience for individuals with limited mobility or those who prefer to make adjustments without having to leave the bed.
- The system's functionality makes beds more accessible to individuals with disabilities or mobility impairments, empowering them to independently manage their bed's position, thereby improving their quality of life and reducing dependency on caregivers.
- Home automation systems offer a high degree of convenience by enabling users to effortlessly control various devices and systems within their homes.
- Users can optimize their energy consumption by scheduling and automating the usage of devices based on occupancy patterns and environmental conditions.

#### IV. METHODOLOGY

This section outlines the strategies and methodologies employed in designing and developing the hand gesture recognition system for adjusting the position of automatic adjustable beds in hospitals. For hand gesture recognition to control bed positions, various tools, libraries, and programming languages are utilized, including the Open-Source Computer Vision Library (OpenCV). OpenCV, implemented in Python language, serves as a powerful framework for recognizing hand gestures due to its extensive functionality and ease of use. The primary component of the system is the Arduino Uno microcontroller, which plays a pivotal role in receiving information from the patient. Based on the received commands, the Arduino Uno executes necessary actions to adjust the bed's movement accordingly. Furthermore, the system incorporates biomedical sensors such as temperature and pulse rate sensors. The pulse rate sensor assesses heart function by detecting blood flow through the finger, while the temperature sensor measures body temperature via external skin contact. The collected sensor data is processed by a microcontroller for further analysis. In addition to controlling bed movement, the system includes functionality for environmental monitoring. For instance, an LED light automatically activates in low-light conditions, while a fan starts operating if the room temperature exceeds a certain threshold. Moreover, the system maintains vigilant monitoring of vital physiological parameters measured by the sensors. In case of any abnormalities detected, such as irregular pulse rate or elevated temperature, an alert mechanism is triggered. This alert system utilizes a NodeMCU module to send SMS notifications to the attending doctor, ensuring timely intervention. Furthermore, the system provides real-time display of measured physiological parameters, including pulse rate and temperature, on an LCD screen for easy reference and monitoring.

#### IV. HARDWARE AND SOFTWARE REQUIREMENTS

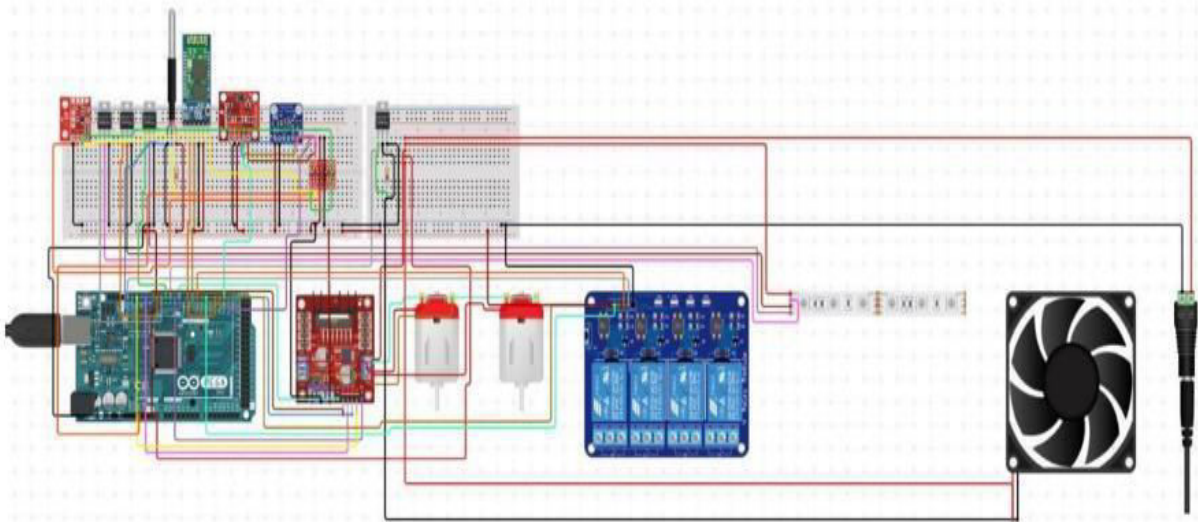


Figure 3: Electrical circuit Diagram

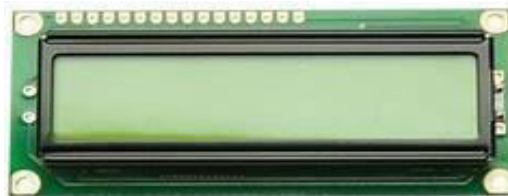
#### A. Hardware

##### 1. Arduino Uno

The NodeMCU (Node Microcontroller Unit) is a versatile open-source hardware and software development platform centered around the ESP8266 System-on-a-Chip (SoC). Developed by Expressive Systems, the ESP8266 integrates essential computing components, including a CPU, RAM, Wi-Fi networking capabilities, and a modern operating system and software development kit (SDK). Unlike traditional microcontrollers, which require external components for connectivity and functionality, the ESP8266 offers a comprehensive solution within a single chip. This level of integration simplifies the development process and reduces the complexity of hardware design. Despite its advanced features, the ESP8266 can be challenging to utilize directly due to its embedded nature. Therefore, platforms like NodeMCU provide a user-friendly interface and development environment, enabling easier access to the capabilities of the ESP8266. Overall, the ESP8266, when utilized in platforms like NodeMCU, facilitates rapid prototyping and development of IoT (Internet of Things) projects, offering a cost-effective and efficient solution for a wide range of applications.

##### 2. LCD display

A liquid-crystal display (LCD) is a type of flat-panel display or optical device that utilizes the light-modulating characteristics of liquid crystals. Unlike some display technologies, liquid crystals themselves do not emit light. Instead, LCDs rely on a backlight or reflector to illuminate and produce images, whether in color or monochrome. This property allows LCDs to efficiently generate clear and vibrant visuals for various applications, ranging from consumer electronics to industrial displays.



##### 3. DC Motor

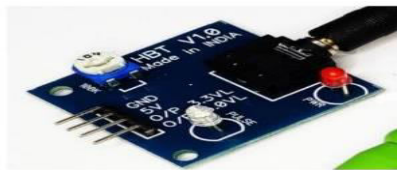
DC motors are devices that transform electrical energy into mechanical energy. They typically comprise permanent magnets and wire coils arranged within them. When an electric current is supplied to the motor, the coils generate a magnetic field. This magnetic field interacts with the static magnetic field produced by the permanent magnets, resulting in the generation of mechanical motion. This motion is typically observed as the rotation of the motor's shaft

or armature.



#### 4.Pulse Sensor

The Pulse Sensor is a device capable of measuring heart rate and related parameters such as cardiac arrhythmia, which refers to abnormal heart rhythms. By placing the sensor against an area of the skin near arteries, it can detect the pulsatile flow of blood. Each time the heart contracts, blood is ejected into the arteries, causing a detectable increase in blood volume. The Pulse Sensor translates this blood flow into electrical signals, typically resulting in an increase in output voltage proportional to the pulsatile activity. This enables the sensor to accurately measure heart rate and identify irregularities in heart rhythm.



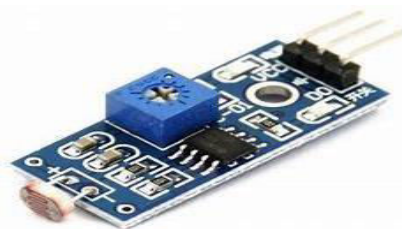
#### 5.Temperature Sensor

This version of the DS18B20 sensor is pre-wired and waterproofed, making it convenient for measuring temperatures in distant or wet conditions. Although the sensor itself can withstand temperatures of up to 125°C, the PVC jacketing of the cable limits its safe operating temperature to below 100°C. Being digital, these sensors maintain signal integrity even over extended distances, ensuring reliable temperature readings without signal degradation.



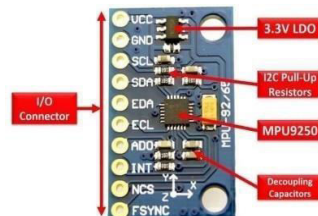
#### 6.LDR Sensor

The LDR sensor module serves as an economical option for measuring and detecting light intensity, functioning as both a digital and analog sensor. Commonly referred to as the Photoresistor sensor, it incorporates an onboard Light Dependent Resistor (LDR) to sense variations in light levels.



## 7.MEMS Sensor

Microelectromechanical systems (MEMS) sensors are versatile devices capable of detecting and measuring various parameters such as flow, pressure, acceleration, temperature, and even biological substances like blood. These sensors integrate both mechanical and electronic components to fulfill their functions effectively. The microelectronic elements are responsible for sensing and processing data, while the mechanical components provide physical feedback. One commonly used MEMS sensor is the MPU9250, known for its capabilities in measuring motion and orientation accurately.



## B. Software

### 1. PYTHON

It is an object-oriented programming language. The processing happens during the runtime, and this is interpreter. Python's simple to learn and easy to use is an advantage and thus makes it developer friendly. It is easier to read and understand as the syntax is conventional. The code can be executed line by line using the interpreter. Python can support multiple platforms like Linux, UNIX, windows, Macintosh, and so on.

### 2. OPEN CV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross platform and free for use under the open-source BSD license.

## V. RESULT AND DISCUSSIONS

The new generation of electric medical beds represents a significant advancement in patient care, incorporating functional, aesthetic, and interactive features. These beds are designed with a comprehensive, multidisciplinary approach, aiming to address the evolving needs of healthcare environments and patients. Global market analysis indicates a growing demand for medical beds, with increasing emphasis on compliance with relevant standards and regulations. This underscores the importance of ensuring safety, efficacy, and quality in medical device design and manufacturing. Smart medical beds, as part of this new generation, offer integrated solutions for patient care, assistance, and monitoring. They have the capability to detect patient movement, track vital signs, monitor breathing and heart rate, regulate temperature, and even detect falls or changes in condition. Technological innovations, such as continuous monitoring capabilities offered by devices like the Central Smart bed with Contact-free, Continuous Monitoring, provide efficient and patient-friendly methods for early detection and intervention, potentially saving lives. The implementation of a smart bed using Arduino Uno has shown promising results, particularly in monitoring sleep patterns and regulating bed temperature for enhanced comfort. Integration with sensors like accelerometers and temperature sensors, along with user-friendly interfaces such as mobile apps or voice commands, has facilitated seamless interaction with the system. Furthermore, integrating the smart bed with other devices within the smart home ecosystem allows for enhanced automation and personalization of the sleep environment. User feedback has been positive, highlighting the system's effectiveness and providing valuable insights for further refinement.

## VI. CONCLUSION

The proposed Gesture Controlled Bed movement system is designed to be user-friendly and cost-effective, enabling seamless interaction between individuals and the bed through hand gestures. The implementation utilizes a three-coin algorithm to analyze convex envelopes and detect key points, ensuring accurate recognition of hand gestures. Integration with other devices within the smart home ecosystem enhances automation and personalization of the sleep environment, as highlighted by positive user feedback. Additionally, the system's capabilities extend to assisting speech-impaired individuals, allowing them to express words effectively. Patients can also adjust the bed to their comfort level, while room appliances are automatically controlled for added convenience. The estimation of palm center position is achieved through the Skyum algorithm, while the Gram algorithm is utilized to detect fingertips. Machine learning algorithms are employed to interpret different hand gestures and adjust the bed position

accordingly. Furthermore, the wireless smart health monitoring system enhances healthcare service delivery by minimizing the need for constant manual patient monitoring. This system efficiently assists healthcare professionals, allowing them to allocate their time more effectively while still ensuring high-quality patient care.

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