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Review Paper on Transforming Care for Paralysis Patients through IOT Innovation

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Abstract: The integration of Internet of Things (IoT) technology is revolutionizing care for paralysis patients, significantly enhancing their quality of life, autonomy, and independence. By harnessing the power of wearable sensors, smart home automation, Artificial Intelligence (AI)-powered predictive analytics, telemedicine platforms, and mobile apps, this innovative approach provides real-time monitoring of vital signs, movement patterns, and environmental factors. The IoT-based system enables personalized therapy plans, tailored rehabilitation programs, and timely interventions, empowering patients to take control of their condition. Moreover, AI-driven predictive analytics identify potential complications, allowing for proactive measures to prevent hospitalizations and reduce healthcare costs. Telemedicine platforms facilitate seamless communication between patients, caregivers, and healthcare professionals, ensuring continuous support and guidance. Additionally, mobile apps provide patients with accessible resources, educational materials, and community support networks. Preliminary results demonstrate remarkable improvements in patient outcomes, including enhanced mobility, reduced complications, and increased autonomy. Caregivers also benefit from reduced burden, improved quality of life, and enhanced support. With its potential to transform the lives of millions affected by paralysis worldwide, this groundbreaking IoT-based care model is poised to redefine the future of neurological rehabilitation.
***Keywords**: IOT, AI, Telemedicine, Paralysis, Mobility, Mobile App*

I. INTRODUCTION

The main aim of this project is to design and construct a head movement controlled device switching and health monitoring system for physically challenged. The user can wear this device to head and with the simple head movement's he can request the basic needs like water, food or medicine by using MEMS (Micro Electro-Mechanical Systems) technology. User can also control the electrical devices like light, fan etc. with the help of head movements. The SpO2 sensor and temperature sensor is used to monitor the health and upload this data to website using IoT technology. MEMS is a Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of detecting the tilt. This sensor finds the tilt and operates the electrical devices and announces the basic needs depending on tilt. For example, if the tilt is to the forward, then the device will be "ON" for the first time then next time it will be "OFF". In the same way, if the tilt is to the left side, then another device is going to be controlled. The tilt is in left side or right-side direction the related need will be announced. This device is very helpful for paralysis and physically challenged persons.

II. LITERATURE REVIEW

A. Dr. S.P.S. Saini and Diksha Goyal [1]

Described the work in gesture reorganisation use as application as a wheelchair in the presentation "Accelerometer based hand gesture-controlled wheelchair". In this instance, a gesture was recognised using a three-axis accelerometer sensor.

Sensors are used by a system to identify hand or gesture movements. The MEMS accelerometer sensor (Micro Electro Mechanical device) in this device recognises gesture. A gadget called an accelerometer uses electromechanical principles to measure acceleration forces. This accelerometer sensor has three axes and will be connected to the back of the hand and fingertips. It is a moving object. When it moves, the gesture is recognised, and the wheelchair will function in accordance with the sensor's movement.

One learns the system is entirely dependent on sensor after analysing the design of a "Accelerometer based hand gesture controlled wheelchair." This method is not very user-friendly because it cannot function if the sensor cannot move in an inclined position or direction. This method does not offer trustworthy assistance to people who are handicapped or impaired.

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B. Chin-Ming Fu, Chung-Lin Huang, and Feng-sheng Chen [2]

Presented a paper titled "Hand Gesture Reorganization using a real time tracking method and Hidden Markov Models" that outlines the development of a system for hand gesture recognition against stationary backgrounds.

The item's motion in this system provides crucial and practical information for object localisation and extraction. The overall system consists of four modules: real-time tracking, extraction, feature extraction, and training for hidden Markov models (HMM). when using the real-time hand tracking and extraction technique, to monitor the moving hand and extract the hand region. Use a Fourier Descriptor (FD) to describe the spatial feature and motion analysis to describe the temporal feature. As our feature vector, combine the spatial and temporal information from the input image sequences. Next, apply the HMM model to identify the input gesture. After looking at the "Hand Gesture Reorganisation using a real time tracking method and Hidden Markov Models" architecture, we can see that this system depends on the HMM model to identify the gesture. Because it is more difficult and less accurate to recognise gestures, it is neither helpful nor compatible with the user.

C. Anooda Geethu Mohan, M.S. Sajana, Smitha Paulose, M.P. Fathima, and K.A. Anupama [3]

Using a MEMS Accelerometer sensor, the author demonstrated "Automatic Wheelchair Using Gesture Reorganisation Along with Room Automation." With this system, real-time detection is approaching. tracking and reorganisation of hand direction for interaction between intelligent wheelchair and human robot. This device was designed to use the accelerometer sensor to translate hand and finger motions into signals that a computer could understand. In order to detect gestures or finger reorganisation, the accelerometer data is calibrated and filtered. We employ a three-axis accelerometer for wheelchair control, which successfully converts hand and finger motions into signals that a computer can understand. Patients cannot afford to utilise this system; hence it is not very user-friendly.

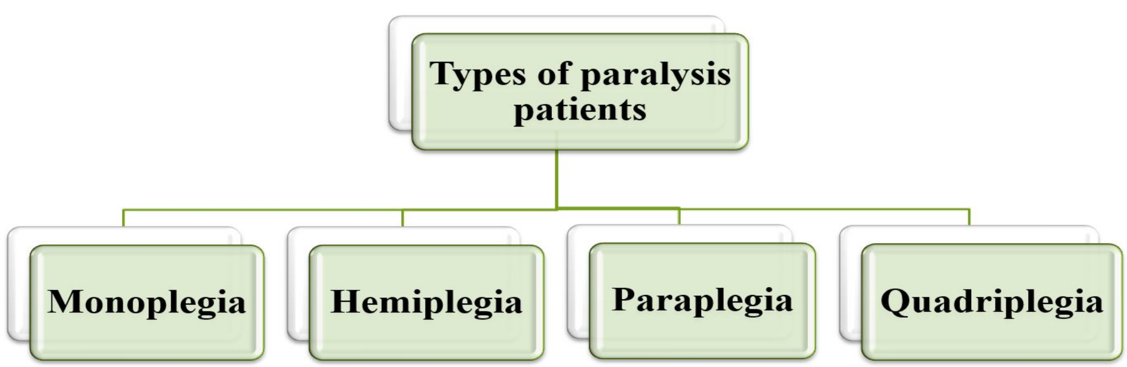
D. Varalakshmi B.D. and Devikarani Patil [4]

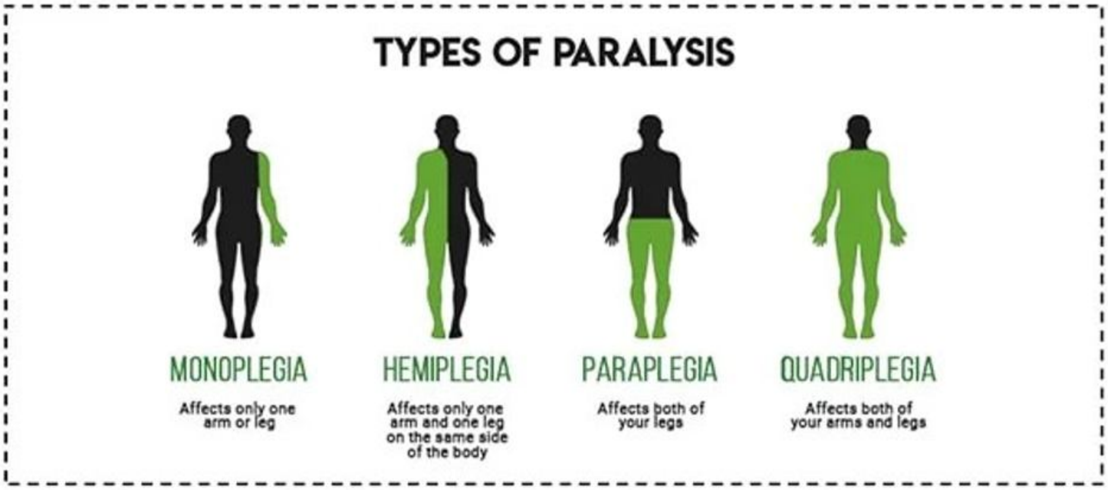
The "Hand Gesture Recognition for MP3player Using Image Processing Technique and PIC16F8779" presented explains the hand gesture recognition utilising an image processing web camera. This solution suggested that the gesture image be captured using a web camera and processed using a remote interface and a MATLAB controller. The (x, y, and z) readings of certain objects are used to connect the database when a captured image is sent to MATLAB. When an object moves in any direction, the accelerometer records the readings. When the accelerometer moves in a certain set of directions, it can identify gestures or a specific way to use an application. Through image processing, this system recognised purpose using the K-L Transform. One issue with this method is that, when the image is varied or noisy, it is always trying to figure out how to separate multiple sources of images, making it less effective.

III. PROBLEM STATEMENT

Patients with paralysis face significant challenges in independently performing daily tasks and managing their health. Also they have muscle movement problem or need external help, which may not be possible for patients with severe impairments. Additionally, regular health monitoring is crucial for paralysis patients, as they are more prone to secondary health issues such as pressure sores, cardiovascular problems, and respiratory difficulties.

IV. TYPES OF PARALYSIS PATIENTS





V. OBJECTIVES

1) We construct this system for Monoplegia (i.e. It affects only one arm or leg), hemiplegia(i.e. it affects half part of our body), paraplegia(i.e. it affects both of your legs) and quadriplegia(i.e.it affects both of your arms and legs).
2) The system to read oxygen level, heart rate, temperature, blood pressure, pulses.
3) The IoT system to upload the all the parameters to the webpage.
4) To design a system to detect the head movement.

VI. RELEVANCE

Transforming care for paralysis patients with IoT technology is life-changing. It helps patients gain independence, personalized care, and improved quality of life. IoT devices monitor patients' health in real-time, alerting doctors to potential problems. Smart home automation makes daily tasks easier. AI-driven analytics provide tailored treatment plans. Caregivers get support, reduced stress, and better communication with healthcare professionals. This technology also benefits healthcare systems by reducing hospitalizations, streamlining care, and saving costs. Patients can return to work and social activities, boosting productivity and well-being. Families and caregivers get emotional support and resources.

VII. SYSTEM BLOCK DIAGRAM

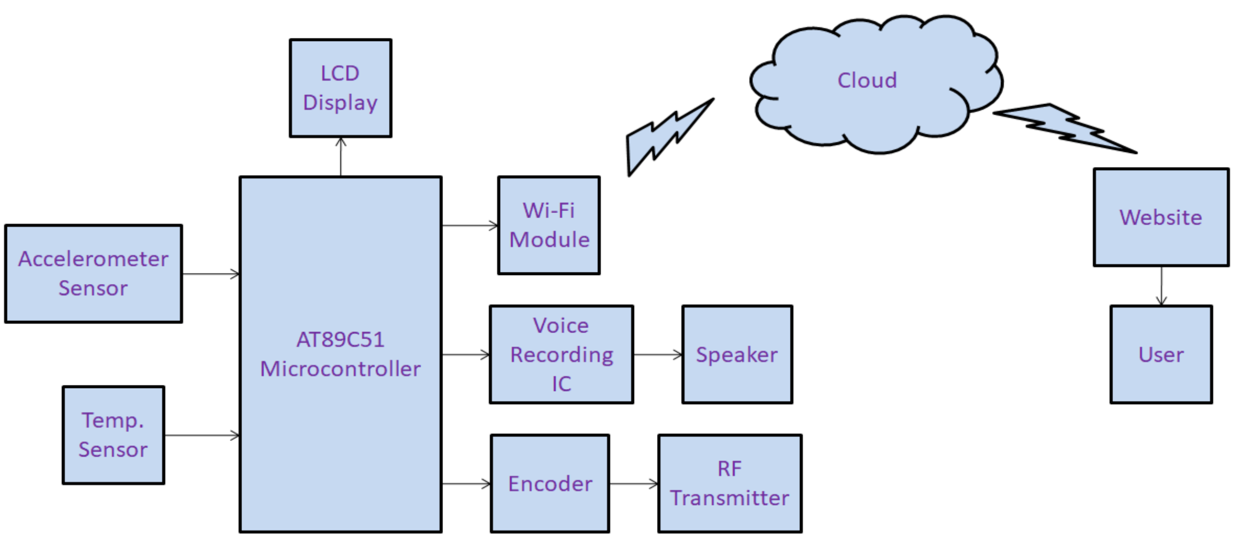


Fig. 1 Transmitter System

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The system is built around AT89C51 microcontroller. It is used as main controller board. The accelerometer is used to detect head movement. Its output is given to microcontroller. The Temperature sensor is used to read body temperature of the person. Its output is connected to microcontroller. Wi-Fi module is used to provide internet access to the system. Using this system will send the Oxygen level, heart rate and body temperature to the website using IoT. Voice recording IC is used to announce pre-recorded messages. For this speaker is connected to the output of the IC. Encoder is used to encode the data from Arduino to send the data to receiver to control the devices. RF transmitter is used to send the encoded data from Arduino to RF receiver. So at the receiver it can control the devices.

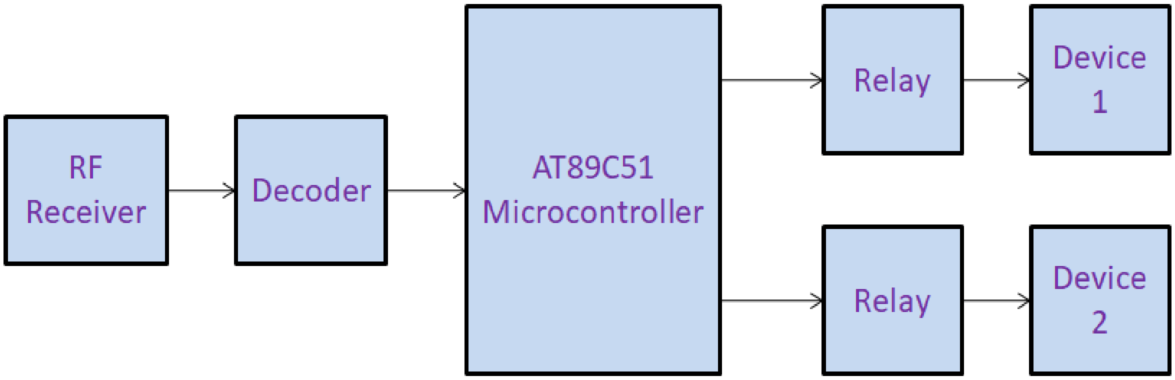
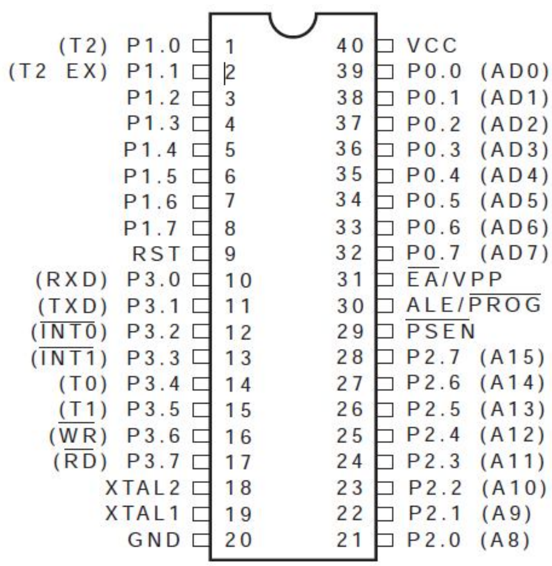


Fig. 2 Receiver System

The Receiver system is also built around microcontroller AT89C51. The RF receiver is used to receive the transmitted data by the main system. It gives the received signal to the decoder. Decoder decodes the received data and provides it to the microcontroller. microcontroller read the data from decoder and turn on or off the relay according the received command. Further relay switches devices on or off.

VIII. COMPONENTS

A. AT89C51 Microcontroller



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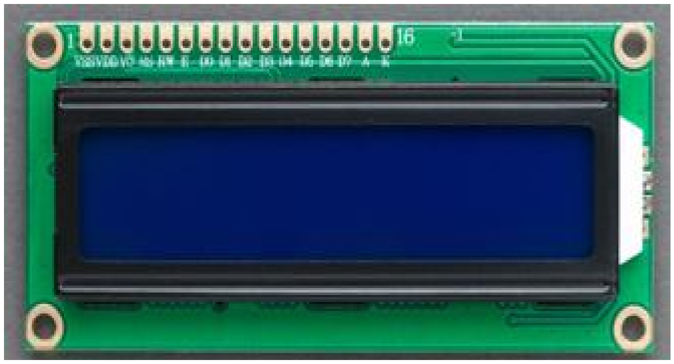
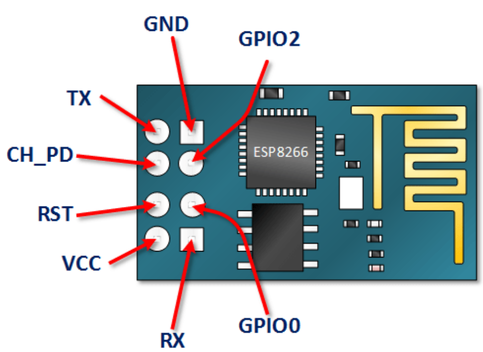
The 89C51RB2/RC2/RD2 device contains a non-volatile 16kB/32kB/64kB Flash program memory that is both parallel programmable and serial In-System and In-Application Programmable. In-System Programming (ISP) allows the user to download new code while the microcontroller sits in the application. In-Application Programming (IAP) means that the microcontroller fetches new program code and reprograms itself while in the system. This allows for remote programming over a modem link. A default serial loader (boot loader) program in ROM allows serial In-System programming of the Flash memory via the UART without the need for a loader in the Flash code. For In-Application Programming, the user program erases and reprograms the Flash memory by use of standard routines contained in ROM.

B. 16x2 LCD Display



Use the 16x2 standard alphanumeric LCD display, they are extremely common and is a fast way to have your project show status messages. An LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.

C. Wi-Fi Module ESP8266



Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

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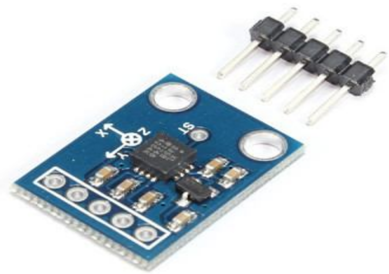
D. ADXL335 - Triple Axis Linear Accelerometer



ADXL335 is a Breakout board based on 3 axis ADXL335 IC from Analog Devices. The Accelerometer Module require no external devices and works on 5V power supply. It can be directly interfaced to ADC of a microcontroller without any external components. This module can be used to sense motion or tilt (in case of non-moving) in 3 axes. This is the latest in a long, proven line of Analog Sensors- the holy grail of accelerometers. The ADXL335 is a triple axis MEMS accelerometer with extremely low noise and power consumption - only 320uA! The sensor has a full sensing range of +/-3g the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated.

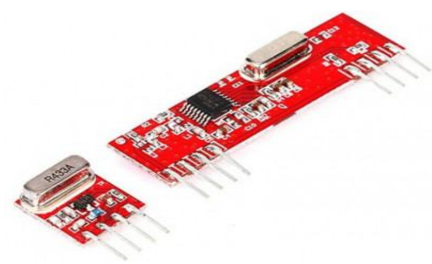
E. HT12E Encoder IC

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. HT12E has a transmission enable pin which is active low. When a trigger signal is received on TE pin, the programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

*F. **HT12D Decoder IC***

HT12D is a decoder integrated circuit that belongs to 212 series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 212 series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format. In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin. HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

G. 433MHz RF Transmitter Receiver Wireless Module



This hybrid RF Transceiver Module provides a complete RF transmitter and receiver module solution which can be used to transmit data at up to 3KHz from any standard CMOS/TTL source. The transmitter module is very simple to operate and offers low current consumption (typical. 11mA). Data can be supplied directly from a microprocessor or encoding device, thus keeping the component count down and ensuring a low hardware cost. The RX – ASK is an ASK Hybrid receiver module. The RF Transmitter Receiver Module is an effective low-cost solution for using 433MHz. The TX-ASK is an ASK hybrid transmitter module. TX-ASK is designed by the saw resonator, with an effective low cost, small size and simple to use for designing.

H. DS18B20 Water Proof Temperature Probe

This is DS18B20 Water Proof Temperature Probe – Black (1m) Original Chip which is based on the DS18B20 sensor. These 1-wire digital temperature sensors are fairly precise (±0.5°C over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them. Usable with 3.0-5.0V systems. When using with microcontroller put a 4.7k resistor to sensing pin, which is required as a pull-up from the DATA to VCC line.

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IX. CONCLUSION

Transforming care for paralysis patients through IoT innovation has revolutionized the healthcare landscape, significantly improving the quality of life for those affected. By leveraging IoT technologies such as wearable sensors, smart prosthetics, and real-time monitoring systems, patients can now receive personalized and proactive care. IoT-enabled devices facilitate seamless communication between patients, caregivers, and healthcare providers, ensuring timely interventions and enhanced rehabilitation outcomes. Advanced analytics and machine learning algorithms enable predictive insights, detecting potential complications and preventing hospitalizations. Furthermore, IoT-powered assistive technologies promote independence, autonomy, and dignity for paralysis patients, empowering them to participate fully in daily activities.

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