IoT-ENABLED SMART THERAPY CHAIR-CUM-BED WITH REALTIME HEALTH MONITORING & WIFI CONTROL FOR STROKE REHABILITATION

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Abstract—This project deals with the fabrication of the mobile controlled stroke therapy wheel chair. Stroke is usually the sudden death of brain cells due to lack of oxygen, caused by blockage of blood flow or rupture of an artery to the brain. A stroke occurs when part of the brain loses its blood supply and stops working. This causes the part of the body that it controls to stop working as well. There are several treatments for the stroke like endovascular treatments, surgical treatments etc. But the best treatment for the paralysis, strokes, is the physiotherapy. Usually, the therapy is done manually with an assistant. We propose a method in which the physiotherapy is done automatically with the help of simple mechanisms. Our project consists of a chair setup in which the patients are made to sit and the arms and the legs of the chair is given motion, so that the patients arms and legs move at a relative speed so that the treatment is done effectively. Stroke theory chair is converted into bed by using mobile phone IOT. Wheel chair movement is also control by IOT control. This project describes the design of a simple, low-cost controller-based patient health monitoring system. Heart rate of the subject is measured from the thumb finger using IRD (Infra-Red Device sensors).

Temperature and heart beat values will be taken and updated in the web server about the condition of the patient using IoT module interfaced to the controller. GSM modem also used to notification message send to the doctors and relatives.

Keywords—Mobile-Controlled Wheelchair, Rehabilitation Therapy, IoT (Internet of Things).

I. INTRODUCTION

If a stroke causes damage to the part of your brain that controls movement, one may experience weakness or paralysis on one side of the body and the problems with moving and carrying out everyday activities. Physiotherapy is an important part of the rehabilitation. Techniques such as exercise, manipulation, massage, skills training and electrical treatment are used to help to heal and recover the movement. The main focus of physiotherapy after the stroke is to help one to learn to use both sides of your body again and regain as much strength and movement as possible. After a stroke, our brains cannot grow new cells to replace the ones that have been damaged, so your recovery depends on your brain & ability to reorganize its undamaged cells and make up for what has been lost. This is called neuroplasticity. Physiotherapy can provide expert practical guidance to help. Physiotherapists often work with other members of the stroke team to make sure they can help with the range of problems that stroke can cause. The main aim of our project is to provide the physiotherapy treatment automatically to the patients with less involvement of the attendee.

II. EXISTING SYSTEM

Several existing systems aim to provide automated stroke rehabilitation through IoT-

based smart therapy chairs and beds. These systems integrate motorized movements, health monitoring sensors, and remote control features to assist patients in regaining mobility.

A. IoT-Enabled Smart Therapy Chairs IoT-enabled smart therapy chairs are designed to assist stroke patients by providing guided limb movements, posture correction, and muscle stimulation. These chairs integrate sensors to monitor body posture, pressure points, and rehabilitation progress. Some advanced models include motorized seat adjustments and predefined therapy modes to help patients regain mobility.

Limitations: Despite their benefits, these chairs have limitations. Most systems follow fixed therapy routines, making them less adaptable to an individual's recovery progress. Additionally, they primarily focus on lower body movements, neglecting upper body rehabilitation. The high cost of motors and actuators also makes these chairs expensive, limiting their accessibility for home- based Mtherapy.

B. Smart Rehabilitation Beds with IoT Monitoring

Smart rehabilitation beds are used in hospitals and rehabilitation centers to help stroke patients with automated repositioning, muscle stimulation, and health monitoring.

These beds integrate IoT technology to track vital signs and adjust patient positions automatically, reducing the need for caregiver intervention.

Limitations: One major drawback of smart rehabilitation beds is their bulky and non-portable design, making them impractical for home use. Additionally, while they assist with positioning, they do not actively engage patients in movement-based therapy. Their high implementation costs, including the integration of sensors and motorized adjustments, also make them an expensive option for widespread use.

C. Bluetooth-Controlled Therapy Chairs

Bluetooth-controlled therapy chairs allow patients or caregivers to adjust position, recline, and movement settings using a mobile app. These chairs provide basic physiotherapy modes and make therapy sessions more accessible without requiring manual effort.

Limitations: Although Bluetooth control adds convenience, these chairs still require manual intervention, limiting automation. They also lack AI-driven real-time adjustments, meaning therapy exercises do not adapt to a patient's progress. Another limitation is the absence of cloud-based monitoring, which prevents healthcare professionals from remotely tracking a patient's rehabilitation progress.

D. Wearable IoT-Based Rehabilitation Devices

Wearable rehabilitation devices, such as smart exoskeletons and motion-tracking sensors, provide real-time feedback on muscle activity and movement patterns. Some systems also integrate electromyography (EMG) sensors to measure muscle engagement, helping therapists track recovery progress.

Limitations: Despite their effectiveness, wearable IoT devices can be uncomfortable for long-term use, especially for elderly stroke patients. These devices also tend to be expensive due to the advanced sensors they incorporate.

Moreover, they often require professional supervision, making them less practical for independent use at home.

E. AI-Powered Robotic Therapy Chairs

AI-powered robotic therapy chairs use advanced actuators and AI algorithms to assist with limb exercises, muscle strengthening, and movement rehabilitation. These chairs adapt therapy sessions based on real-time patient progress, making rehabilitation more personalized and effective.

Limitations: While AI-powered robotic therapy chairs offer significant advantages, they are extremely costly, making them inaccessible for most individuals and rehabilitation centres. Their complex operation requires specialized training, adding to the difficulty of widespread adoption. Additionally, this technology is still in its early stages, meaning it is not yet widely available for general use.

III. PROPOSED METHODOLOGY

The proposed smart therapy chair-cum-bed integrates IoT, AI, and sensor-based automation to create an advanced rehabilitation system for stroke patients. This system focuses on real-time health monitoring, AI-driven therapy adjustments, and wireless control to enhance the recovery process. By combining these technologies, the system ensures that stroke patients receive personalized therapy, continuous monitoring, and remote

accessibility, making rehabilitation more effective and convenient.

The system design of the IoT-enabled therapy chair-cum- bed focuses on creating an efficient, automated rehabilitation solution with real-time health monitoring and remote accessibility. The architecture consists of multiple interconnected modules, including mechanical, electronic, and software components, working together to provide a seamless rehabilitation experience for stroke patients.

The chair-cum-bed mechanism is designed with motorized adjustments that allow smooth transitions between sitting and reclining positions. This flexibility helps patients perform various therapy exercises while ensuring comfort and support.

The system includes pre-programmed therapy modes that adjust the chair-bed position based on the rehabilitation needs of the patient.

A microcontroller-based control unit serves as the system's processing core. It collects real-time data from health monitoring sensors, processes commands from the mobile application, and controls the actuators accordingly. The control unit is programmed to automate therapy sessions based on the patient's progress while allowing manual intervention when needed

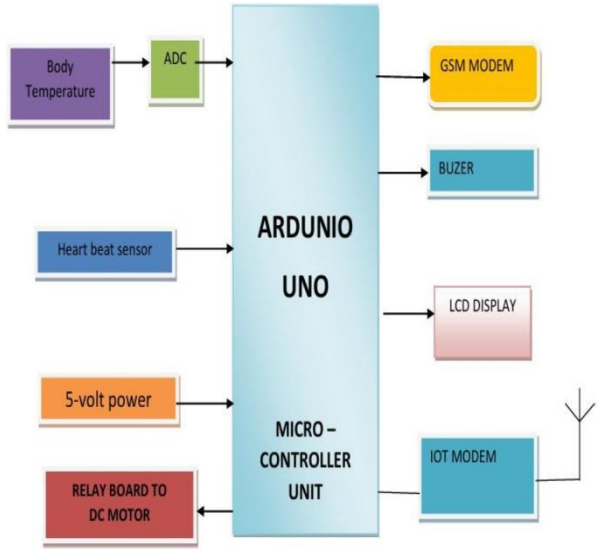


Figure:Block Diagram

Simplified block diagram of MICRO-CONTROLLER based temperature and respiration display system is shown in figure. With this system the parameters of our body can be mentioned and it is viewed by various doctors where ever required. The signals from the patients are picked up by the sensors. The sensors used here is "Thermistor".

The different signals obtained from various combinations are given to the amplifier section where AC Signals picked up with this signals are eliminated. This signal is given to the MICRO-CONTROLLER 7447 with ADC. In this analog signal is converted to digital. This digital signal is displayed in seven segment display as per the hardware program. Hence, the peak in the waveform of the received signal indicates the heart beat rate. The sensed heart rate is continuously compared with the threshold value which is provided in the microcontroller.

When the continuously sensed heart rate falls below or above the given limit, the microcontroller sends an automated message to the patient's doctor or relatives using the standard

GSM module which is interfaced to the controller unit. Also, the doctors can access the updated patient's record from the database using which the required treatments can be provided to the patient.

IV. WORKING

The experimental setup of our project consists of a chair setup in which the arms of the chair are fixed to the chair by suitable joints so that the arms can be moved independently.

The leg part of the chair consists of pedal. The pedals are actuated by a DC motor operated by a battery. The power from the DC motor is transmitted to the pedals through a set of spur gears. The spur gears are used to increase or decrease the rotational speed of the motor.The stroke patients are made to sit on the chair and the hands and the legs of the patients are made to rest on the arms and the pedal of the chair respectively. Then the compressed air from the compressor is made to reach the solenoid valve. The solenoid valve is actuated by a toggle switch. When the solenoid valve is actuated, the air is allowed to reach the pneumatic cylinder.

The pneumatic cylinder reciprocates and the arm of the chair is moved thus tending to move the arms of the patients.

The motion to the pedal is given by the motor operated by a battery. The power from the battery is transmitted to the pedals through the spur gears. As the pedal rotates, the legs also rotate.

Thus, the physiotherapy treatment to the stroke patients is done with simple mechanisms. Stroke theory chair is converted into bed by using mobile phone IOT. Wheel chair movement is also control by IOT control. In our project lead- acid battery is used. The lead- acid batteries output is given to the IOT circuit. IOT board having six relays, they are connected to the 3 D.C motor.

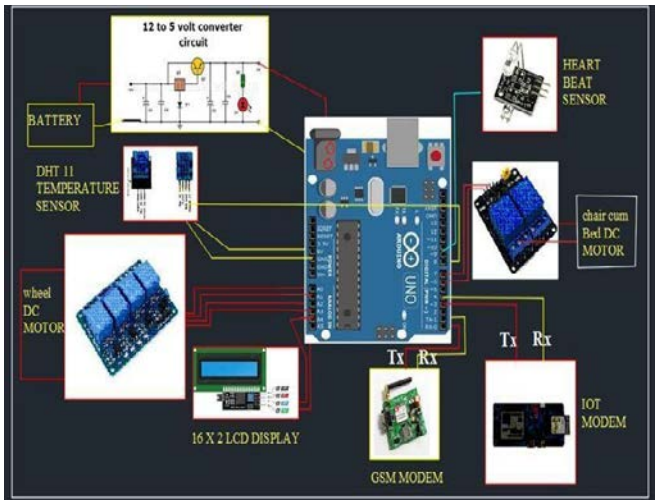
- Relay 1,3 - Forward Direction
- Relay 2,4 - Reverse Direction
- Relay 1,4 - Left Direction
- Relay 2,3 - Right Direction
- Relay 5 - Convert chair into bed
- Relay 6 - Convert bed into chair

The wheel chair path is controlled by the IOT WIFI control. The IOT circuit board is used for this wheel chair. The IOT circuit is fitted in the wheel chair. The mobile phone is used as the IOT transmitter circuit is used for this project. The IOT receiver circuit is having 6 relays.

The normal range of heartbeat is 60 to 100 beats per minute. Tachycardia is a heart rate faster than 100 beats per minute and bradycardia is a heart rate slower than 60 beats per minute. A slow rate in a healthy person can be caused due to being physically fit, sleep or a health condition such as propranolol or metoprolol. A faster heart can be caused due to exercise, pregnancy, a stimulus, nervous or excited. A slow rate can occur in diseased people due to reasons like heart attack, infections, and high potassium levels in the blood or an underactive thyroid gland. A faster heart rate can occur in diseased people due to reasons like infections, overactive thyroid gland, heart problems, etc.

Abnormal heart rhythms are called arrhythmias. This condition occurs in most of the people they are mainly harmless but some of them can be due to serious heart issues or other health problems. A faster heart can be caused due to exercise, pregnancy, a stimulus, nervous or excited. A slow rate can occur in diseased people due to reasons like heart attack, infections, and high potassium levels in the blood or an underactive thyroid gland. A faster heart rate can occur in diseased people due to reasons like infections, overactive thyroid gland, heart problems, etc. Abnormal heart rhythms are called arrhythmias. This condition occurs in most of the people they are mainly harmless but some of them can be due to serious heart issues or other health problems.

V. CIRCUIT DIAGRAM



VI.OUTPUT

Figure: Final Prototype

The final output of the IoT-enabled therapy chair-cum-bed is a fully functional, smart rehabilitation system that seamlessly integrates automated positioning, real-time health monitoring, and remote control capabilities. The chair-cum-bed can transition between different therapy modes, assisting stroke patients in mobility exercises and recovery. Equipped with sensors for tracking vital health parameters such as muscle activity, heart rate, oxygen levels, and movement, the system provides continuous monitoring and feedback. The Bluetooth and IoT-based connectivity enable caregivers and therapists to control the device remotely via a mobile or web application, ensuring personalized therapy adjustments.

Additionally, cloud- based data storage allows for long-term tracking of patient

progress, helping medical professionals refine rehabilitation strategies.

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