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PHYSDROID

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Abstract: Physical therapy is used to improve a patient's physical functions through physical examination, diagnosis, prognosis, patient education, and health promotion. It is practiced by physical therapists, usually at a clinic or at the patient's suitable place. Even though physiotherapists are efficient and effective, there are some difficulties faced by patients. Robotic technology designed to assist physiotherapy can potentially increase the efficiency of and accessibility to therapy. It helps to assist therapists to provide consistent training for extended periods of time, and collecting data to assess progress. Robotic devices also offer flexibility in their operation, as feedback of the user's performance based on the data from the sensors can be used to provide appropriate movements and forces during training. It enables consistent training of the prescribed intensity for extended periods of time. It has the potential to completely change the way physiotherapists deliver treatment to patients in the future.

INTRODUCTION:

Physiotherapy treats acute or chronic pain, movement and physical impairments resulting from injury, trauma or illness. Physical therapy is used to improve a patient's physical functions through physical examination, diagnosis, prognosis, patient education, and health promotion. It is practiced by physical therapists, usually at a clinic or at the patient's suitable place. Even though physiotherapists are efficient and effective, there are some difficulties faced by patients. For people moving from place to place, maintaining a proper physiotherapist on a regular basis is not practical. Physical therapy is used to improve a patient's physical functions through physical examination, diagnosis, prognosis, patient education, and health promotion. It is practiced by physical therapists, usually at a clinic or at the patient's suitable place.

Even though physiotherapists are efficient and effective, there are some difficulties faced by patients. Robotic technology designed to assist physiotherapy can potentially increase the efficiency of and accessibility to therapy. It helps to assist therapists to provide consistent training for extended periods of time, and collecting data to assess progress. Robotic devices also offer flexibility in their operation, as feedback of the user's performance based on the data from the sensors can be used to provide appropriate movements and forces during training.

It enables consistent training of the prescribed intensity for extended periods of time. It has the potential to completely change the way physiotherapists deliver treatment to patients in the future. As the potential benefits to using robotics for rehabilitation are apparent, there still are many challenges which need to be overcome and require further research. As of now the main limitations are high costs of acquiring and using robotic systems, lack of high clinical evidence for patient improvement, and the need for standardized measures for therapy protocol and assessment. Other limitations are their bulky size and lack of internal power supply duration with mobile units. Patients who have spasticity can have it triggered by the robotic movement and the greater walking durations can lead to some adverse effects such as increased risk for fractures, abrasions, pressure sores and falls. Due to a combination of demographic changes and the lack of resources in the field of public health and technology improvement, the development of new rehabilitative practices seems mandatory to build sustainable models for rehabilitation from the clinical, organizational, and economic perspectives.

Massage therapy has become one of the most popular complementary and alternative medical (CAM) therapies for back pain, the condition for which CAM therapies are most commonly used. A massage is defined as "a mechanical manipulation of body tissues with rhythmical pressure and stroking for the purpose of promoting health and wellbeing". Despite the availability of novel mechanical support tools for back massage intervention, for example, massage therapy is still provided in a traditional way, where both the patient and the therapist need to be in the same place.

PROPOSED SYSTEM:

Robotic technology designed to assist physiotherapy can potentially increase the efficiency of and accessibility to therapy. It helps to assist therapists to provide consistent training for extended periods of time, and collecting data to assess progress. Robotic devices also offer flexibility in their operation, as feedback of the user's performance based on the data from the sensors can be used to provide appropriate movements and forces during training. It enables

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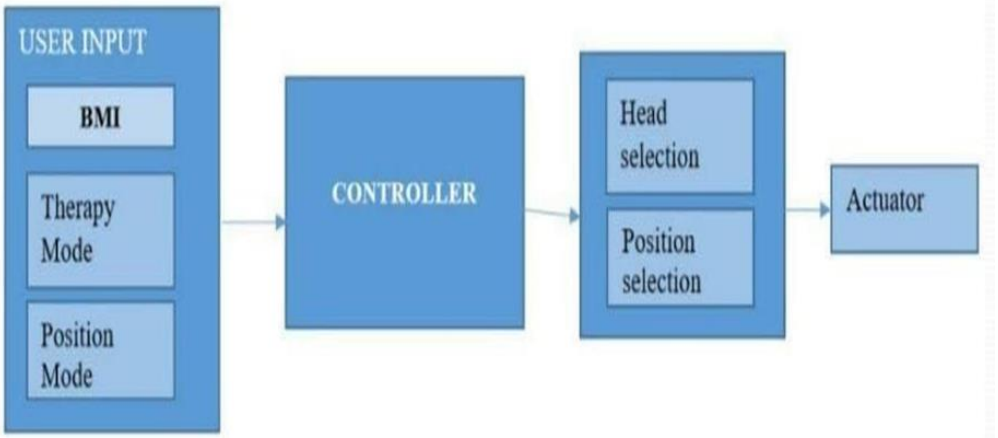
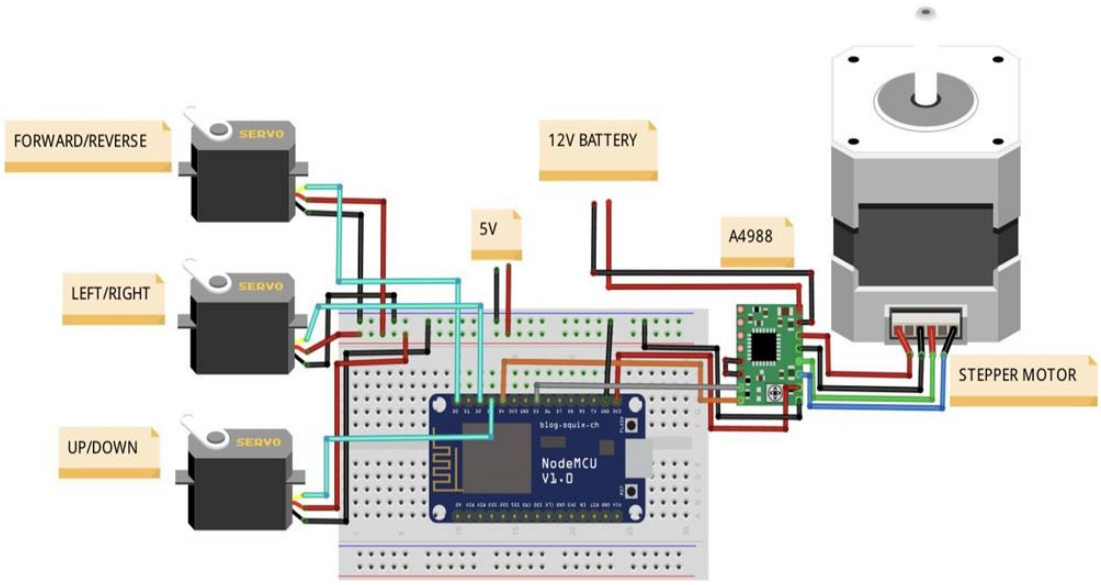
consistent training of the prescribed intensity for extended periods of time.
Replacing human labor with automation is a growing trend across multiple industries, and Physiotherapy is no exception. A Physdroid is a robotic device deployed for multiple purposes. Physdroid provides the function of a massage therapist, physiotherapist and can also be used for applying ointments and lotions. This multipurpose Physdroid is achieved by changing the tip of the Robotic Arm for the required purpose. Physdroid also allow to be controlled remotely either by using Bluetooth or through Internet. In this way, the patient doesn't necessarily need to be with the Physiotherapist for the therapy. While the demand for increased dosage continues to grow, contextual and job-related demands remain the same. That makes the problem of meeting intensity demand without increasing physical strain on therapists. There comes the need for portability, which is another feature to be considered as it is easier to carry if the patient is travelling. Physdroid is portable and possible to use remotely.
Physdroid has been proposed as a means of physical rehabilitation and relaxation for muscles. The physiotherapy sessions are still done under the care of certified physiotherapists and enables them to alter the pressure variations on the tip of the device.

BLOCKDIAGRAM



CIRCUIT DIAGRAM



The integral part of the circuit diagram is microcontroller, the microcontroller board like Node MCU which is based on ESP8266 microcontroller. It includes built in WiFicapabilities .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. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a TensilicaXtensa LX106 core, widely used in IoT applications shields which utilize these extra pins. NodeMCU

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provides access to the GPIO (General Purpose Input/Output) and a pin mapping table is part of the API documentation. Totally 16 GPIO pins is available for Executing in the Code and a Analog pin.D0 (GPIO16) can only be used for GPIO read/write. It does not support open-drain/interrupt/PWM/I²C or 1-Wire.
The next part is A4988 stepper motor driver which is a complete Microstepping Motor Driver with built-in translator for easy operation. The driver has a maximum output capacity of 35 V and ± 2 A. It can operate bipolar stepper motors in full-, half-, quarter-, eighth-, and sixteenth-step modes.A4988 has an inbuilt translator, so only two wires are required to connect it to controller board. two pins DIR and STEP of module is connected with Arduino. STEP pin used to control the steps while DIR pin is used to control direction. Micro-step pins (MS1, MS2 and MS3) are used to operate the driver module in different step functions. In the above circuit MS1, MS2, and MS3 pins left disconnected, that means the driver will operate in full-step mode. This motor driver has low-ESR ceramic capacitors on board, which makes it vulnerable to voltage spikes, so it is advised to use at least 47µf capacitor across motor power supply pins. Stepper Motor wires is connected with output pins (1A, 1B, 2A & 2B) of driver module. It is commonly used in controlling the NEMA series stepper motors like NEMA17, NEMA23, and NEMA34.

Next the actuating part which is used actuate the robotic arm is Servo motor which is a type of motor that can rotate with great precision. A servo consists of a Motor (DC or AC), a potentiometer, gear assembly, and a controlling circuit. First of all, we use gear assembly to reduce RPM and to increase torque of the motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer. Now an electrical signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from the potentiometer and another comes from other sources, will be processed in a feedback mechanism and output will be provided in terms of error signal. This error signal acts as the input for motor and motor starts rotating. Now motor shaft is connected with the potentiometer and as the motor rotates so the potentiometer and it will generate a signal. So as the potentiometer's angular position changes, its output feedback signal changes. After sometime the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.
Interfacing Servo motors.they have three wires coming out of them. Out of which two will be used for Supply (positive and negative) and one will be used for the signal that is to be sent from the MCU. An MG995 Metal Gear Servo Motor which is most commonly used for humanoid bots.
All servo motors work directly with your +5V supply rails but we have to be careful on the amount of current the motor would consume if you are planning to use more than two servo motors a proper servo shield should be designed.

The linear motion of the linear actuator is controlled with a stepper motor,which is also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.
The mechanism of a Stepper motor consists of Brushed DC motors rotate continuously when DC voltage is applied to their terminals. The stepper motor is known for its property of converting a train of input pulses (typically square waves) into a precisely defined increment in the shaft's rotational position. Each pulse rotates the shaft through a fixed angle.

Stepper motors effectively have multiple "toothed" electromagnets arranged as a stator around a central rotor, a gear shaped piece of iron. The electromagnets are energized by an external driver circuit or a micro controller. To make the motor shaft turn, first, one electromagnet is given power, which magnetically attracts the gear's teeth. When the gear's teeth are aligned to the first electromagnet, they are slightly offset from the next electromagnet. This means that when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one. From there the process is repeated. Each of those rotations is called a "step", with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

The circular arrangement of electromagnets is divided into groups, each group called a phase, and there is an equal number of electromagnets per group. The number of groups is chosen by the designer of the stepper motor. The electromagnets of each group are interleaved with the electromagnets of other groups to form a uniform pattern of arrangement. For example, if the stepper motor has two groups identified as A or B, and ten electromagnets in total, then the grouping pattern would be ABABABABAB.
Electromagnets within the same group are all energized together. Because of this, stepper motors with more phases typically have more wires (or leads) to control the motor.

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PROS AND CONS:

The major advantage of the system is easier and effective therapy with more precision and increased mobility, and reducing the work burden on Physiotherapists. To make the product cost effective and the clinical accuracy of the product is the main challenge and concern for developing the proposed system

CONCLUSION:

Robotic Physiotherapist has the potential to completely change the way physiotherapists deliver treatment to patients in the future. One of the main goals of current robotic development is to pair information technology with rehabilitation robotics to deliver assessment and treatment over the internet. The multipurpose of this Robotic Physiotherapist can be further developed as the technology advances.

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