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A Review on Electronic Components Used for Automated Physiotherapy Framework

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ABSTRACT: In this paper we are doing the review on different components which can be used for automation. There are different types of sensor available for sensing the notion of human body. Microcontrollers are necessary for programming purpose. Here I will try to suggest these components for making the automated structure for neck movement. Human head is supported by the neck which contains seven vertebrae. These bones are stacked on one another from top to bottom .We are commonly facing the problem of neck and shoulder pain in our daily life due to bad posture which can cause misalignment of our neck, head and spine. I am introducing the detail about designing the automated neck framework/structure for the neck movement.

KEYWORDS: physiotherapy, neck movement, motors and sensors

I. INTRODUCTION

Physiotherapy led rehabilitation is a clinically and cost effective intervention for those patients whose life has been adversely changed by injury, illness or disease[2].Physical therapy is the science of blending physiology with exercises and applying these principles to the body when any injury is sustained. Physical therapy provides services to individuals and populations to develop, maintain and restore maximum movement and functional ability throughout the lifespan. This includes providing services in circumstances where movement and function are threatened by ageing, injury, disease or environmental factors. Functional movement is central to what it means to be healthy.

Physiotherapy rehabilitation aims to optimize patient function and well-being, it helps the patient get back to daily activities, work and leisure. Rehab focuses on reducing disability and lifestyle restrictions. Rehabilitation can be used for recovery from injury or disease and also for management of long term conditions. Rehabilitation should start as soon as possible to speed recovery. Rehabilitation is important forimproving mobility and activity levels, shorter length of stay in hospital, significantly improved quality of life [20]. Now a days Neck pain is a very common epidemiological problem found in humans; it is not possible that any individual has not suffered from neck pain. We can design frame work structure which could be automated, portable, light weight, comfortable, wearable structure. By using this the patient itself can take the advantages of physiotherapy without any need of physiotherapist. It can be easily operated by the patient itself.

Types of neck movements

The human neck makes essentially six movements. All movements of the neck are combinations and varying percentages of these six movements. These gently performed movements are [23]:

1. Flexion—the movement in which the chin is lowered down toward the chest.
2. Extension—the neck is extended, as in looking upward toward the ceiling.
3. and 4. Lateral rotation to the left and to the right—these are simply direct lateral rotation to either side.
5. and 6.lateral flexion may be best described as trying to place the ear upon the shoulder through a sideways movement of the neck, directing the ear toward the shoulder tip on both sides.

These six movements may be **s**lowly performed occasionally to stretch the neck ligaments if they tend to feel tight. The movements can be performed at any time by patients who have not had fusions. If you have had a fusion, your surgeon will discuss with you when you can start them. It is important that the patient himself or herself initiate these movements.

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II. RELATED WORK

As we all know when the patient is in COMA state, which is a state of unconsciousness, the person fails to respond normally to painful stimuli, light, or sound and does not initiate voluntary actions. In this situation the regular movement of body part is required otherwise the body parts become stiff by using this exoskeleton the patient's relative can also give the movement to the patient's body parts. This would be same for the bed rest patient which cannot be able to stand from the bed by any mean of injury. If his/her hand is working it can also use this by its own. This project is surely become beneficial for hospital purposes, for physiotherapist, for rehabilitatison centres etc. This would be same for the bed rest patient which cannot be able to stand from the bed by any mean of injury. If his/her hand is working it can also use this by its own.

In this paper I suggested different motors for controlling the required movement, sensors for sensing the motion of body parts and controllers for programming purpose.

III. ELECTRONIC COMPONENTS PART

A. MOTORS

Now for the head movement generally we all use stepper/servo motor.

1. Stepper motor

Stepper Motors are generally operated under open-loop control. Commands determine the specified movement of the Stepper Motor. In rare instances, Stepper Motors can stall or lose steps, due to resonance issues or unexpected force. While it is a rare occurrence, the possibility is a drawback for Stepper Motor technology. Stepper Motors can operate in a closed-loop configuration. However, this results in a costly system design. At high speeds, Stepper Motors typically have poor torque characteristics. Through micro stepping, torque can be improved. However, unless Stepper Motors are used in closed loop mode, they do not perform as well as Servo Motors. Stepper Motors generally produce 200 full steps, 400 half steps, and up to 25,000 micro steps per revolution. The specified location is not always achieved, due to the Stepper Motor's open loop nature, especially when operating under a load. To attain a smooth motion, micro stepping is often used; however, it often results in less positional accuracy. Stepper Motors are commonly recommended for applications that are cost-sensitive and low maintenance. Steppers provide stability and flexibility; they do not fluctuate in positioning, especially under dynamic loads, and can be run in open or closed-loop configurations. If run within their specifications, no encoders are needed [19].

2. Servo motor

Servo Motors offer constant positional feedback. Constant feedback eliminates the potential for stalling, and allows the motor to correct any positioning discrepancies. The closed-loop configuration that Servo Motors offer allows the motor to generate faster speeds and up to three times the torque than their Stepper counterparts. Servo Motors can generate speeds and power anywhere between two and four times the speed of a Stepper Motor. Servo Motors operate under constant position feedback (closed-loop), allowing for higher speed and greater reliability. Servo Motors perform under a closed-loop system, allowing the Servo Motor to attain higher peak torque capabilities. Servo Motor resolution is dependent upon the type of encoder used. Most encoders produce between 2,000 and 4,000 pulses per revolution, while some can produce up to 10,000 pulses per revolution. Servo Motors can maintain positional accuracy due to their closed-loop operation. Servo Motors are recommended for high-speed (typically greater than 2,000 RPM) and high torque applications requiring dynamic load changes. Servo Motors require higher maintenance and a more complex setup, but do not create vibration and/or resonance issues like Stepper Motors may [19].

B. SENSORS

Here as a feedback sensor we use accelerometer sensor and any force sensor.

Accelerometer sensor is use for measuring the angle of rotation and it can be used as a feedback so that if there will be any unpredictable situation occur the whole system must be stop. Force sensor will sense the applied force on the desirable point. There are different types of accelerometer is available in the market. We can choose any one of them according to our need. Motion sensing is a critical sensing modality that plays an important role in medical practice.

1. Cantilever Based Accelerometers

The use of cantilever based accelerometers for assessing human body movement was first proposed in the 1950s, although the devices in the early stage were somewhat unreliable, large and expensive [11]. Thanks to the revolutionary

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advancement of microfabrication technologies, state-of-the-art micro-accelerometers have become more accurate,reliable, smaller and cost effective [12-13]. Their applications in biomedical areas have been extensively explored, significantly changing this field of body motion measurement.

2. Capacitive Accelerometer

Capacitive accelerometers are one of the most widely used solid-state motion sensors on the market [14, 15]. The relative displacement between the proof mass and the supporting frame is derived from the change of electrical capacitance when the movable electrode plate displaces either in-plane or out-of-plane with the stationary supporting frame. In practice, the movable electrodes and the stationary frame are often in the form of interdigitated electrode fingers. The overlapping area of the movable fingers and the stationary fingers and the gap distance between the fingers are important parameters determining the measuring sensitivity.

3. Piezoresistive and Piezoelectric Accelerometers

Micro machined piezo resistive accelerometers were first described by Roy lance and Angell [16], and are currently used in various industrial applications. The configuration of the cantilever structures in piezoresistive accelerometers is similar to those in capacitive accelerometers [17], while their electrical measuring mechanisms are different. In piezoresistive accelerometers, a piezoresistor is often patterned on a thin suspending cantilever which connects the proof mass and the supporting frame. Due to the mechanical flexibility of the cantilever, a large mechanical strain occurs as the external acceleration displaces the proof mass. The strain is derived from the electrical resistance change in the piezoresistor.

4. Gyroscopes

Gyroscopes refer to the sensors that measure the rotary rate of an object. A micro machined gyroscope utilizes the Coriolis Effect to convert the rotary motion of the subject into a measurable linear motion. The rotary rate can therefore be determined using the above described sensing mechanisms of measuring linear accelerations [18].

C. MICRO-CONTROLLERS

For programming purpose we can use different types of Microcontroller available in markets like, 8051MC, PIC microcontroller, Arduino, ATmega, etc. According to our need we can use any one of them for programming purpose.

1. PIC microcontroller

PIC microcontroller are somewhat advanced and has lots of peripherals on chip. So for most of the applications one hardly needs extra hardware to attach to this microcontroller for proper output. Whereas 8051 is a basic microcontroller which is mainly used by beginners and it gives very reliable outputs in systems but mostly needs a bit extra circuit

2. Arduino

The Arduino is a complete development platform with its own standards, integrated development environment (IDE).The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. If you are new to microcontrollers, the Arduino platform is certainly worth considering for educational purposes.

3. ATmega

Atmel® megaAVR® microcontrollers (MCUs) are the ideal choice for designs that need some extra muscle. For applications requiring large amounts of code, megaAVR devices offer substantial program and data memories with performance up to 20 MIPS. Meanwhile, innovative Atmel picoPower® technology minimizes power consumption. All megaAVR devices offer self-programmability for fast, secure, cost-effective in-circuit upgrades. You can even upgrade the Flash memory while running your application. Normal range of motion for human neck movement is 40 degree for full lateral bending and 70 degree for full flexion bending in this case. According to the need of application we can select the desired component to full fill our requirement.

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VI. CONCLUSION

In case of motors servo motors are generally more preferable because the position of servo motors can be controlled more precisely than those of standard DC motors. Servo motors are fast, high torque, accurate rotation with in a limited angle but more complicated setup with PWM tuning. For the new comer, the Arduino platform is certainly worth considering for educational purposes. It's very easy to get up and running, with very well equipped libraries and many code examples. It may be a very good way to start programming, since things will pretty much just 'work'. Gyroscopes uses Earth's gravity to help determine orientation while accelerometer designed to measure non-gravitational acceleration. The main difference between the two devices is simple: one can sense rotation whereas the other cannot. The intended use of each device ultimately influences their practicality in each platform used. Depending on the type of information you need to collect each device will provide different results.

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