A MIDTERM REPORT ON

ELECTRIC KNEE

SUBMITTED BY

VAIBHAV UPPAL 2009A3PS116G

PRIYANK DEVPURA 2009A8PS187P

UNDER SUPERVISION OF

DR. AMOD KUMAR (SCIENTIST 'G' AND H.O.D FOR DU-2)

MR. NEELESH KUMAR (SCIENTIST 'E1')

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CENTRAL SCIENTIFIC INSTRUMENTS ORGANISATION (C.S.I.O)
CHANDIGARH

A PRACTICE SCHOOL STATION OF
BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

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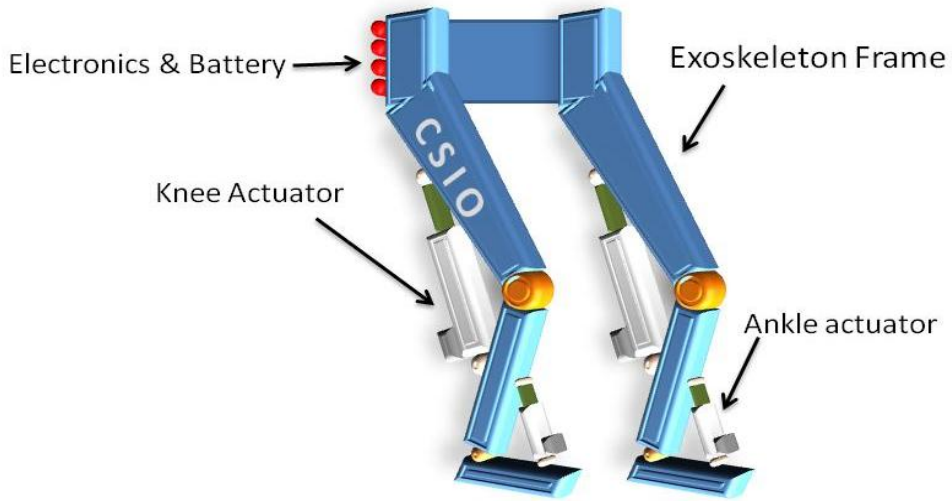
ABSTRACT

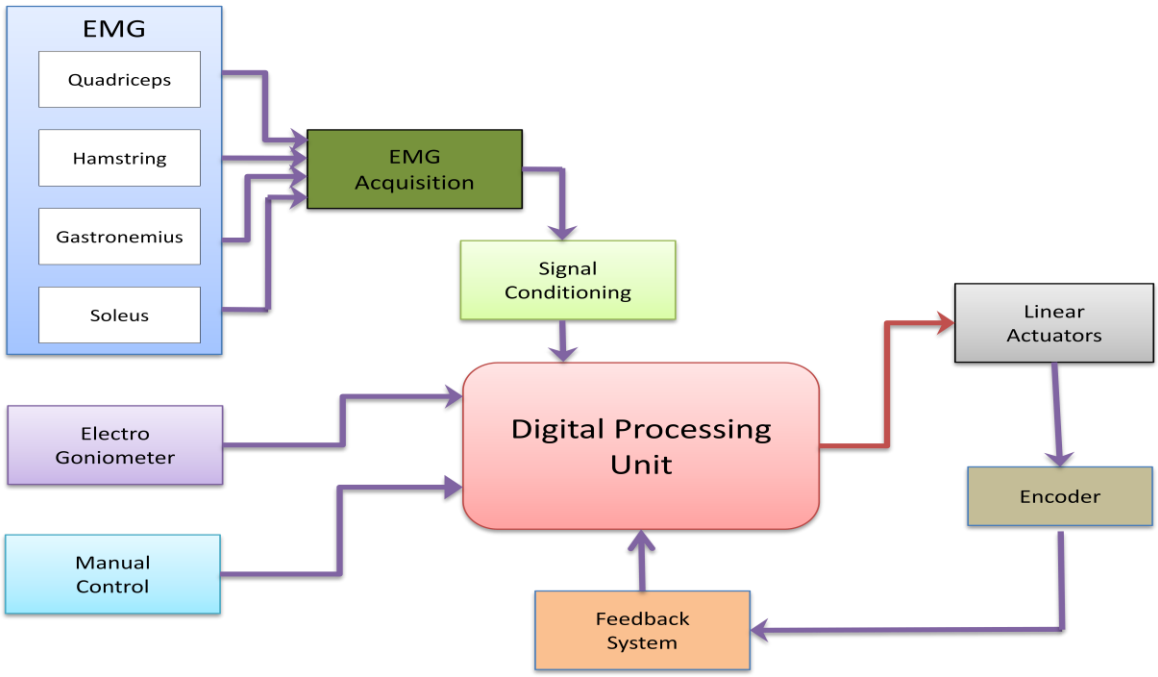
Full or partial loss of function in the lower limb is an increasingly common ailment associated with a wide range of injuries, disease processes, and other conditions including sports, occupational, spinal cord injuries, and strokes. Some people are even born with disabilities. To treat such abnormalities, large number of physiotherapy exercises is used which are labour intensive requiring high levels of one to one attention from highly skilled medical personnel. Prior to the introduction of machine assistance, physical therapists have had to manually move the patient's limbs. This leads to two problems, repetition and strain. The physical therapist is not able to precisely duplicate the movements each time. The machines are capable of doing so, leading to a superior rehabilitation for the patient. The therapists experience strain from having to move the patient's limbs. To solve the above problems, a device has been developed that helps the disabled ones to perform flexion and extension of lower limbs. It is a framework made up of aluminum, with knee joints and an actuator attached to it, which has to be worn. The complete setup weighs not more than 2 kg. The aim of the project is to generate walking mechanism using PSOC microcontroller.

INTRODUCTION

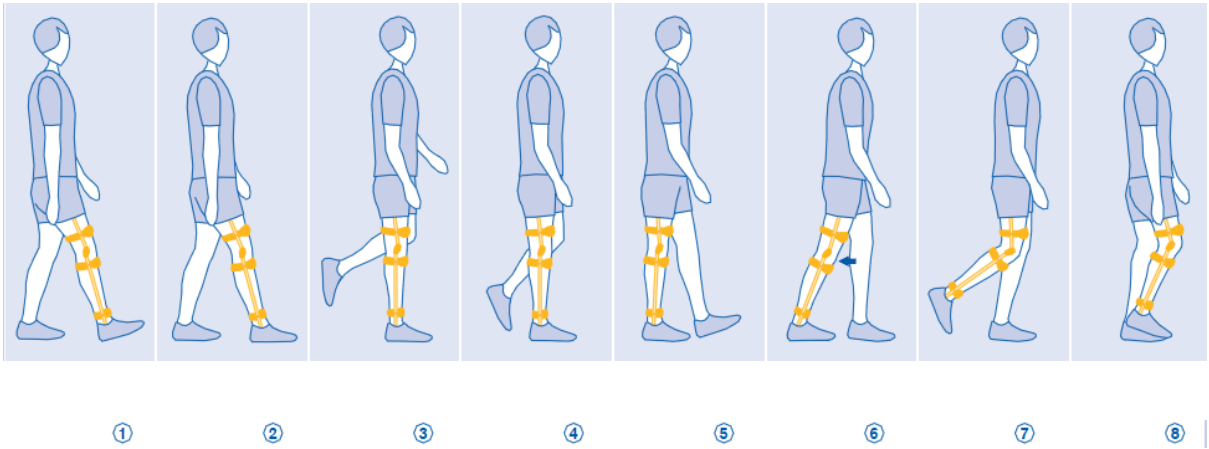
An exoskeleton is an external structural mechanism with joints and links corresponding to those of the human body. The word ‘exoskeleton’ has been taken from the outer cover present in insects that provides them protection and are shed periodically. Exoskeleton devices have got a large number of applications like in rehabilitation medicine where it can be used to help a stroke patient restore walking or it can also be used for physiotherapy purpose, in virtual reality simulation etc. Exoskeletons offer benefits for both disabled and healthy populations. Exoskeleton can be used as a capability magnifier or assisting device. It is used as capability magnifier in case of soldiers and mountaineers where this device help them carry loads much more than their body weight. It is used as assisting device for people who have lost their limbs or have become paralyzed. This exoskeleton design not only assists a person but also tries to improve its GAIT. The twin wearable legs are powered by Actuators, all controlled by a microprocessor. Main purpose for development in robotic exoskeletons is augmenting human performance, assisting people with disabilities, studying human physiology, or re-training motor deficiencies. Basically an exoskeleton consists of a metal frame, sensors, actuators and control electronics. Hip knee and ankle joint actuators are designed in order to enable shank and thigh lift the foot clear of the ground during the swing phase because exoskeleton walks in synchronization with Human.



Block Diagram



GAIT ANALYSIS



There are 8 phases of walking. These are as follows:

- In the first phase, there is heel strike with stabilized joint.
- In the second and third phase, exoskeleton assumes the load and knee joint is stabilised.
- The next step consists of Mid-Stance phase with stabilised knee joint.
- There is heel strike with the left foot in the fifth step.
- In the next two steps, body moves itself in front of the foot, complete extension of the knee joint when toes are lifted from the floor.
- The last phase is the pre-swing phase, leg is relieved of load. It can swing through with disengaged joint.

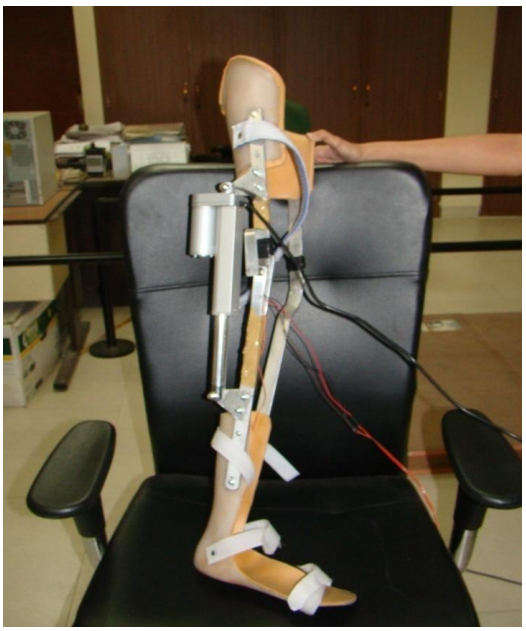
Project Completed So Far

A prototype was developed for the physiotherapy purpose with movable knee joint. The length and width of the prototype can be varied to fit the needs of the patient. A linear actuator has been fixed at the knee joint which is responsible for the flexion and extension of leg. A **Relay Board** is also used as shown in above figure. It has a H-bridge circuit. It has following terminals: Vcc, Gnd, An1, An2 and Reset. To Vcc, 12V is connected. The wires coming out from the actuator is connected to Vcc and Gnd terminals. To control the movement of knee, An1 and An2 terminals is used. The control signal is given by the PSOC Kit through programming. An1 is used for movement of knee in one direction and An2 is used for movement in other direction.

A **potentiometer** is attached at the knee joint which gives an analog signal which is then converted into digital output. The output is displayed on LCD but it is in hexadecimal. So it is then converted to decimal through programming. Now we need to calibrate it so that it can display the angles instead of arbitrary decimal values. Thus, it is then calibrated to calculate various angles at the knee joint. These angles

are then displayed on the LCD with their 8 phases as mentioned above. These angles are read by PSOC and compared with the standard angles for different phases. Different phases are achieved through this logic and control signal is given to An1 and An2.

A **uoled32028** is used for graphic display. It is used to display the buttons such as Start, Stop, Next, etc. It is connected to PSOC through serial communication. The RX terminal of this is connected to TX of PSOC and TX is connected to RX of PSOC. So whenever a button is pressed, it sends a signal to RX terminal of PSOC. Through this way communication is done. The program is stored in the flash memory of uoled32028.



Now our task is to generate a walking mechanism. For this, we will be using another prototype and with the use of PSOC kit walking mechanism will be generated.

References

1. PSOC datasheet
2. Uoled32028 datasheet
3. Electric actuator datasheet