International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Automatic and Portable Physiotherapy Hardware Device for Legs Authors

Mr. Pawan Kamdi[1], Janhvi Lonare[2], Aishwarya Mankar[3], Anagha Bhongade[4], Yash Kale[5]

[1]Assistant Professor, GHRCEM Nagpur
[2,3,4,5]Student, GHRCEM Nagpur

Abstract
This Project is to Design and fabricate a cheaper Continuous Passive Motion [CPM] Machine than what is available commercially and with more versatile features. In the tendency, continuous passive motion (CPM) was proposed as an orthopedic treatment and a physiotherapy method that promotes recovery from the injuries after surgery of joints. The CPM is intended to accelerate the regeneration of periarticular tissues, to prevent contracture, and to correct range of motion (ROM) and is more effective than conventional treatment method.

INTRODUCTION

Modern devices are being used in advanced mechanical, electrical, and computer systems for various applications, and to assist in research. Continuous passive motion (CPM) is a widely used postoperative treatment method that is designed to aid recovery after joint surgery or injury. It can lead to a reduction in both hospital stay and analgesic requirement and accelerates the recovery process. In many physiotherapies centre's the use of CPM is limited by the cost of the equipment. In the present work, we have design and develop the project of Low-Cost Shoulder CPM Machine with the energy conservation point of view & with advanced heating and cooling effect which was not in old CPM Machine.
The cost of the machine has been reduced by 70 %, without compromising the functionality and accuracy of the machine. The machine is tested at one of the renowned Hospital in Nagpur
-India. Shoulder joint is observed to be enhanced to normal Range of Motion (ROM) and the patients' pain level has been abridged. Scientific studies have determined that patients who have troubled achieving the normal range of motion can be benefited using CPM Machine and the recovery is accelerated.
A KNEE surgery has come a long way in the past fifty years. However, orthopedic surgeons are always looking into ways to improve their results. One persistent problem following joint surgery is stiffness of the joint. In 1926, Von Riemke stated that, after the
surgery all the joints should be moved. The movement should be from the first day, should be very slow, as much as possible it should be slow and continuous. Based on a series of
experimental investigation, in 1960 Robert Salter, MD, experimented on a Knee joint under continuous compression, and invented the concept of CPM. Salter hypothesized that CPM would accelerate the healing of articular cartilage and particularly structures, such as the joint capsule, ligaments and tendons. Passive motion following injury or surgery has long been the topic of controversy and debate. Early

practitioners such as Hugh Owen Thomas vehemently opposed the use of passive motion. However, at the beginning of the 20th century, observations of cardiac surgery wherein the heart muscle heals properly in the presence of constant motion, led the inventor to pursue CPM development till date. Also, the short-term efficacy of CPM has been established by numerous clinical studies. When compared with physical therapy alone, the addition of CPM increases active flexion in the weeks after arthroplasty. Low-cost CPM for Ankle joint and in Low-cost CPM for knee joint was successfully developed and tested.

The lofty cost of machine is a big concern for its use in the rehabilitation centres in India. By using latest cost-effective control method, the labor, the machining, and material cost in India are comparatively low. The cost of the machine has been reduced by 60% without

compromising the functionality and accuracy of the machine. "Automatic And Portable Physiotherapy Hardware Device for legs" will be aim of our project.

PROBLEM STATEMENT

Total joint replacement is the removal and replacement of a damaged joint. In the last decades, total knee replacement (TKR) surgery procedures have continued to increase, with the most pronounced rate among younger patients. Most of the the machine focuses mainly on range-of-motion exercise rather than resistance or functional training which requires different therapies. In existing machines all the motions do not perform automatically, some are automatic, and some must be carried out by physiotherapist. Currently One physiotherapist can handle only one patient at a time with personal assistance.

BLOCK DIAGRAM

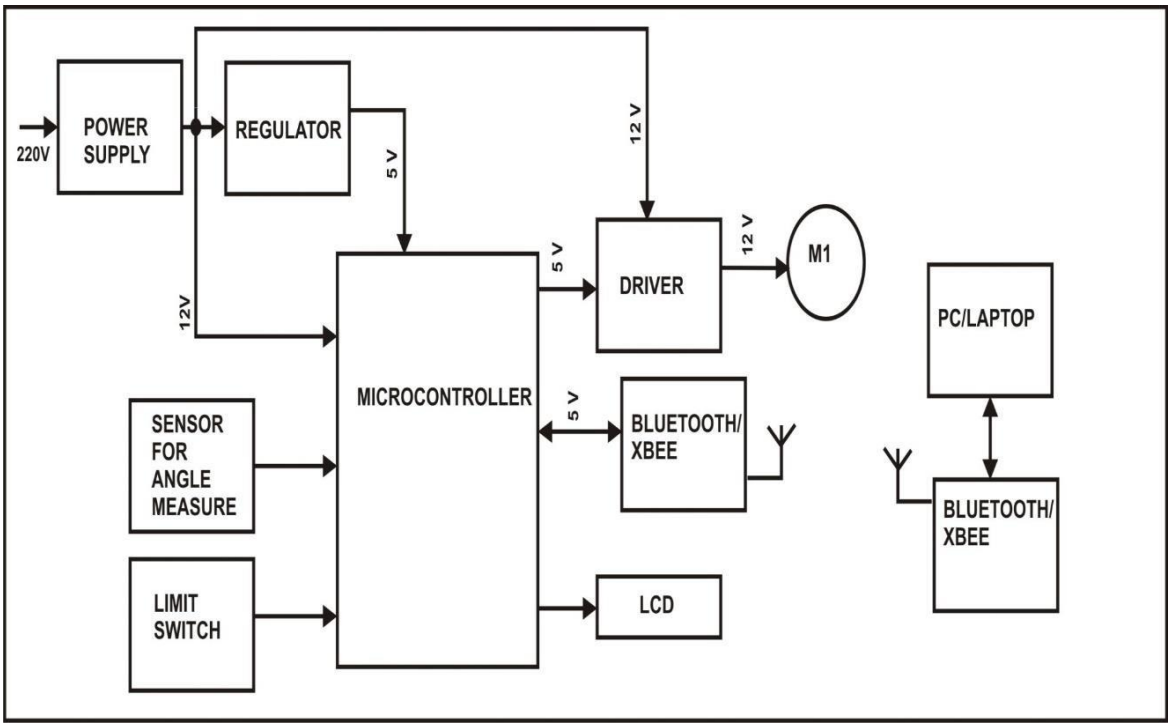

Figure no 1.1 Block Diagram for Physiotherapy Machine

CIRCUIT DIAGRAM-

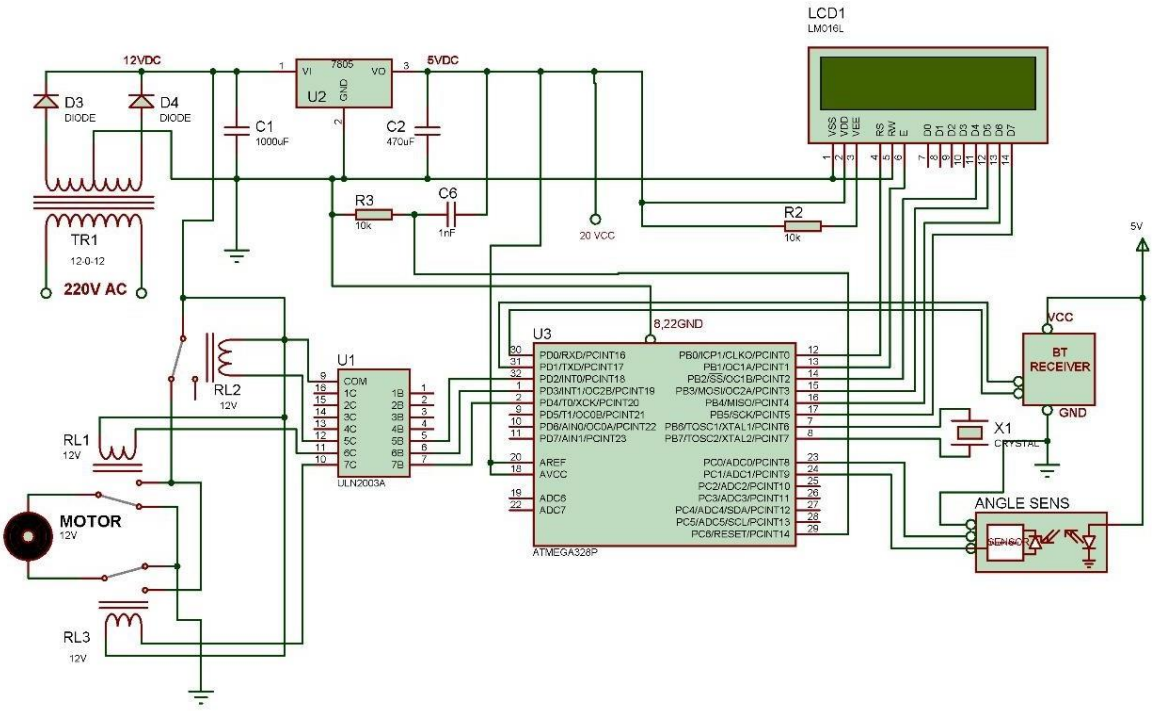

Figure no 1.2 Circuit Diagram for Physiotherapy machine

OPERATION OF CIRCUIT

In the above circuit, a step-down transformer is used to convert 220v ac to 12v ac. in the circuit some components are work on 12vdc, and some on 5vdc, hence rectifier is used to convert a 12v AC t 12vDC which Is required to drive 12v motor and relays. A regulator IC 7805 of 5v is used to convert 12v to constant 5v which will be used by PIC, Angle Sensor, LCD and Bluetooth module. Capacitor C1 and C2 used here as a filter.

After getting power supply ON, microcontroller reset the internal RAM memory for which resistance R3 and Capacitor C6 is used as a Powe- ON-Reset. Further microcontroller displays all the parameters like Realtime Angle, Number of counts to be set, Maximum angle to be set, status of motor whether it is stopped/running, also shows direction arrows in upward/downward.

Once microcontroller receives a command from Bluetooth module regarding settings of parameters, it saves it into its internal EEPROM and acknowledge by sending received data to Bluetooth application on mobile device. As soon as the start command received microcontroller gives command to relays. In our project a 12v relays are used which cannot directly drive by PIC uC, hence a driver IC ULN2003 is used, which increases the level of 5v coming from microcontroller to a 12v.

In our project an accelerometer is used as angle sensor, which gives analog voltage between 0-5v for X and Y direction. Further these analog values are read and convert to digital vlues with the help of 10-bit internal ADC (Analog to Digital Converter).

Bluetooth module works on 5v and having communication range of 30mts,

SPST Relay Rly2 is used to Start/Stop the motor, where as Rly1 and Rly3 is used to decide whether the motor run in clockwise of anticlockwise direction. 8

- **Transformer [220/12 V]:** It is used to the step-down voltage i.e. 220/ 12 V and supply it to Microcontroller 12F 683

- **Microcontroller pic:** It is used to control all the automatic activities which are required for the controlling of the project. Once the program is fed in Microcontroller it is used to work manually.
- **Limit Switches**: A limit switch is an electromechanical device that consists of an actuator mechanically linked to a set of contacts. When an object meets the actuator, the device operates the contacts to make or break an electrical connection.
- **Geared Motor:** It has sturdy construction with gear box built to handle stall torque produced by the motor. Drive shaft is supported from both sides with metal bushes. Motor runs smoothly from 4V to 12V and gives 30 RPM at 12V. Motor has 6mm diameter, 22mm length drive shaft with D shape for excellent coupling.
- **Screw Drive:** It is used to lift the one part smoothly according to the command given by the Micro Controller.

Result

The Oscillations of leg can be adjusted. And the machine will bend joint for according to angle settings. The Physiotherapist may program the CPM machine to increase the amount that the joint is flexed over time. Oscillations may prevent scar tissue from forming. This may also prevent pain and stiffness in the knee. Muscles may get stronger more quickly.

The CPM machine will gently exercise leg muscles to prevent them from getting weak. Tendons and ligaments, the tissue that connects to the muscles and bones, may also get stronger by using a CPM. You may have increased blood flow in your arm or leg. Increased blood flow to your tissues will help you heal faster.

Patients may have less pain. This CPM machine will elevate leg and decrease swelling. Patient may have less pain if your swelling is decreased.

Conclusion

This physiotherapy machines in leg rehabilitation, particularly after knee surgeries like total knee arthroplasty, can yield significant clinical benefits, including improved range of motion, reduced pain, and enhanced recovery times. The real-life example underscores the potential of CPM machines to facilitate effective rehabilitation, leading to better surgical outcomes and improved patient satisfaction. Ultimately, while individual results may vary, the overall evidence supports their role as an asset in rehabilitation protocols**.**

This project is especially useful for strengthening the Knee muscles. It produces same effect as produced by manual work (By physiotherapist) and it saves the valuable time of physiotherapist.

REFERENCE

1. Bahrani H, Hayes W, Hyatt J, Blackwell M, Eminan M. The cutting edge in sports medicine. Texas: Texas Orthopedics and Sport Medicine. [cited 2017 Apr 15]. Available from: www.hneos.com/ Resources/TRHTexOrthSport.pdf
2. Cottage Health, Cottage Center for Orthopedics, Goleta Valley Cottage Hospital. Orthopedics, orthopedic surgery, joint replacement, sports medicine, spine, knee, arm, shoulder, foot, hip, hand surgery. [cited 2017 May 2]. Available from: www.cottagehealth.org/services/orthopedics/
3. Mehrotra C, Remington PL, Naimi TS, Washington W, Miller R. Trends in total knee replacement surgeries and implications for public health, 1990–2000. Public Health Rep. 2005 May–Jun; 120(3):

278-82. 14
4. Pabinger C, Lothaller H, Geissler A. Utilization rates of knee-arthroplasty in OECD countries. Osteoarthr Cartil. 2015 Oct; 23(10): 1664-73. doi: 10.1016/j.joca.2015.05.008 116
5. JHR 33,2
6. Wendelboe AM, Hegmann KT, Biggs JJ, Cox CM, Portmann AJ, Gildea JH, et al. Relationships between body mass indices and surgical replacements of knee and hip joints. Am J Prev Med. 2003 Nov; 25(4): 290-5.
7. Harms S, Larson R, Sahmoun AE, Beal JR. Obesity increases the likelihood of total joint replacement surgery among younger adults. Int Orthop. 2007 Feb; 31(1): 23-6.
8. Suwanmaneepong S, Panitpracha P. National Science and Technology Development Agency (NSTDA). Status and opportunity for the knee arthroplasty manufacturer in Thailand. Technology Promotion. 2012; 39(223): 73-7. (in Thai). Available from: www.tpa.or.th/publisher/ pdfFileDownloadS/tn223A_p73-77.pdf
9. Ruiz D, Koenig L, Dall TM, Gallo P, Narzikul A, Parvizi J, et al. The direct and indirect costs to society of treatment for end-stage knee osteoarthritis. J Bone Joint Surg Am. 2013 Aug 21; 95(16): 1473-80. doi: 10.2106/JBJS.L.01488
10. Engstrom A, Bostrom J, Karlsson A. Women's experiences of undergoing total knee joint replacement surgery. J Perianesth Nurs. 2017 Apr; 32(2): 86-95. doi: 10.1016/j.jopan.2015.11.00
11. Annual Statistic Book of Chulalongkorn Hospital, Bangkok; 2016.
12. Bade MJ, Kohrt WM, Stevens-Lapsley JE. Outcomes before and after total knee arthroplasty compared to healthy adults. J Orthop Sports Phys Ther. 2010 Sep; 40(9): 559-67. doi: 10.2519/ jospt.2010.331
13. Chimentt C, Ingersoll G. Comparison of home health care physical therapy outcomes following total knee replacement with and without subacute rehabilitation. J Geriatr Phys Ther. 2007; 30(3): 102-8
14. Hospital for Special Surgery. Patients who go home after knee replacement do as well as those discharged to rehab facility. Annual Meeting of the American College of Orthopaedic 15 Surgeons (AAOS): Las Vegas, Nevada, 2015 24 Mar. [cited 2017 Jul 6]. Available from: www.hss.edu/ newsroom_study-patients-who-go-home-after-knee-replacement-do-as-well as- those-discharged-torehab-facility.asp
15. Changsuphan S, Kongvattananon P, Somprasert C. Patient readiness for discharge after total hip replacement: an integrative review. J Health Res. 2018; 32(2): 164-71.
16. Gawron VJ, Drury CG, Fairbanks RJ, Berger RC. Medical error and human factors engineering: where are we now? Am J Med Qual. 2006 Jan–Feb; 21(1): 57-67.
17. Southwick F. 6 Factors that lead to human error. [cited 2017 Feb 10]. Available from: www. fiercehealthcare.com/hospitals/6-factors-lead-to-human-error. 16

Figure no 1.3 Model

Figure no 1.4