



Exoskeleton Robot for Diagnosis, Therapy and Tremor Stabilization

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Abstract: Parkinson's disease is a progressive disorder of the nervous system that affects movement. It develops gradually, sometimes starting with a barely noticeable tremor in just one hand. But while a tremor may be the most well known sign of Parkinson's disease, the disorder also commonly causes stiffness or slowing of movement. Parkinson's disease is the second most common neurodegenerative condition, affecting an estimated four to six million people worldwide. This aim of this project is to develop a supporting unit for the patients suffering from Parkinson's disease to help them carry out simple day to day activities without depending on any external help. The tremor stabilization unit uses the principle of a self balancing robot is made to assist the patients with Parkinson's disease. An upper limb exoskeleton robot, the intelligent arm, which can control the shoulder, elbow, and wrist, was developed; aiming to support clinicians and patients with continued monitoring. This project will be helpful for the patients who are suffering from these mentioned problems. The prototype has three modes of operation. In the first mode doctor can monitor and control the duration of exercise and also receive feedback from patients. In the second mode the patient can do therapy himself with help of our system and doctor can observe the patient via feedback data. By analyzing this data doctor can determine patient's health conditions as well as can give instructions according to the present condition of the patient. In the final mode, the tremor stabilization part is carried out.

Keywords: Parkinson's Disease, tremor, DOFs, exoskeleton, physiotherapy aid, Fuzzy Logic, Simulink, MATLAB.

I. INTRODUCTION

The aim of this project is to develop an intelligent arm which acts as a supporting unit for the patients suffering from Parkinson's disease to stabilize their tremor. It is also provided with an extension such that it acts as a physiotherapy aid too. Parkinson's disease (PD) is the second most prevalent neurodegenerative disease in the world. It starts with a slight tremor in one hand and in later stages may lead to motor impairments such as rigidity, shaking stiffness, unsteadiness and slowness in movement. PD is an incurable disease. This is because PD is characterised by the decrease in the secretion of the enzyme Dopamine in the brain, which is essential part of the circuitry that mediates motor and cognitive functions. Our project helps those people affected by this disease to carry out simple day to day activities without depending on external help, due to excessive shaking of their hands. The tremor stabilization unit included uses the principle of a self balancing robot which is made to assist the patients. Its main unit is an accelerometer which will detect the angle of tilt causes by the tremor and corrects it. It also makes use of a gripper at the other end of the unit, where the tremor is stabilised, to hold onto a particular object which in turn is controlled by a switch.

The extension of our project is an upper limb exoskeleton robot, the intelligent, which can control the shoulder elbow, and wrist, aiming to help clinicians and patients with continued monitoring. The current situation in the field of diagnosis and physiotherapy, the attendance of the instructor will not be available most of the time. So the incorrect ways of exercise may often cause serious problems.

Most of the people do not really know the proper way of therapy. Our prototype will have two modes of operation. In the first mode doctor can monitor and control the duration of exercise and also receive feedback from patients. In the second mode the patient can do therapy himself with help of our system and doctor can observe the patient via feedback data. By analyzing this data doctor can determine patient's health conditions as well as can give instructions according to the present condition of the patient.

II. EXISTING SYSTEM

The existing method only involves the detection of PD using speech analysis. Done by analyzing perceptual speech characteristics like reduced loudness, mono pitch, hoarseness, a breathy voice quality and/or imprecise articulation. Block diagram of the existing system is shown:

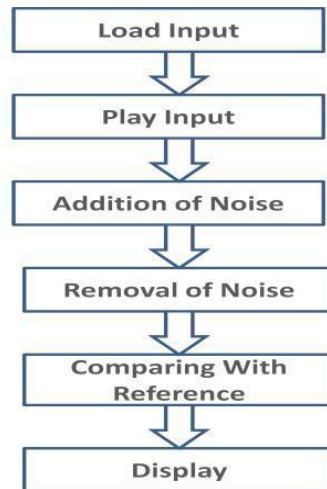


Fig no.1 Flow Diagram of existing system

III. PROPOSED SYSTEM

The first is that it can be used by Parkinson's syndrome patients as a viable tremor stabilization tool, the accelerometer present in the model will measure the tilt of the tremor in all the 3 axis and correct it by providing a opposite motion using the dc gear motor arrangement. The doctor will be able to receive these readings and give his/her expert opinion on the same, using IoT (via the TELEGRAM app). The second use is that it acts as an effective physiotherapy aid for arm impaired patients. Two modes are provide for the physiotherapy part: in the automatic mode the exoskeleton itself will lift the arm and perform the exercises. Once the arm as gained enough strength we can switch over to the manual mode and try lifting the arm very slowly on our own. User specific cards (RFID tags) will be provide to each of the patients, each containing the necessary personal and medical details of the specific patient. The block diagram of the prototype is shown. The prototype proposed by us have two principal use

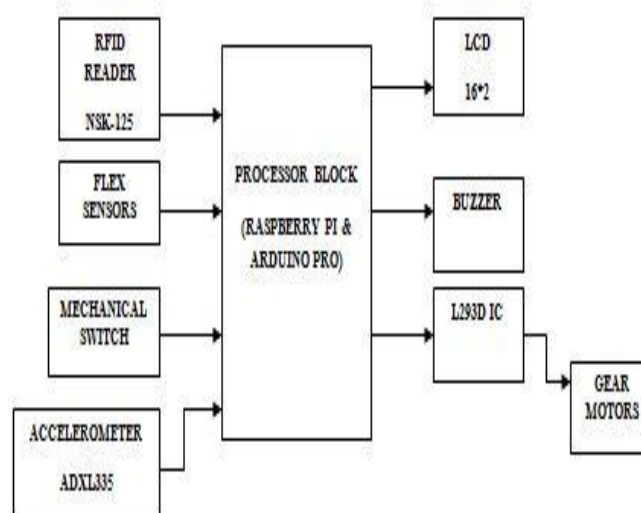


Fig no.2 Block Diagram

IV. OBJECTIVES

The main objectives of our project will be

- the project is helpful in the field of diagnostic field.
- to help patients suffering from PD to carry out their daily routines without help.
- acts as a cost effective physiotherapy aid.
- helps in reducing the tremor present in the upper limbs of PD patients or patients suffering from any such similar conditions



V. SOFTWARE DESCRIPTION

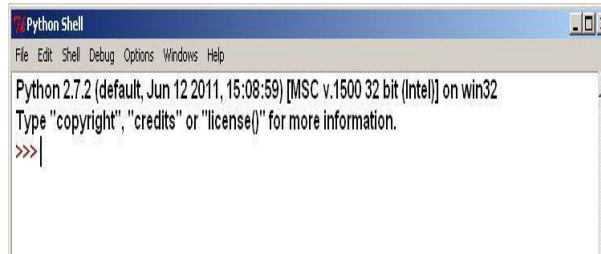


Fig no.3 Python Editor window

Python is a powerful modern computer programming language. It bears some similarities to Fortran, one of the earliest programming languages, but it is much more powerful than Fortran. Python allows you to use variables without declaring them (i.e., it determines types implicitly), and it relies on indentation as a control structure. You are not forced to define classes in Python (unlike Java) but you are free to do so when convenient. Python was developed by Guido van Rossum, and it is free software. Free as in “free beer,” in that you can obtain Python without spending any money. But Python is also free in other important ways, for example you are free to copy it as many times as you like, and free to study the source code, and make changes to it.

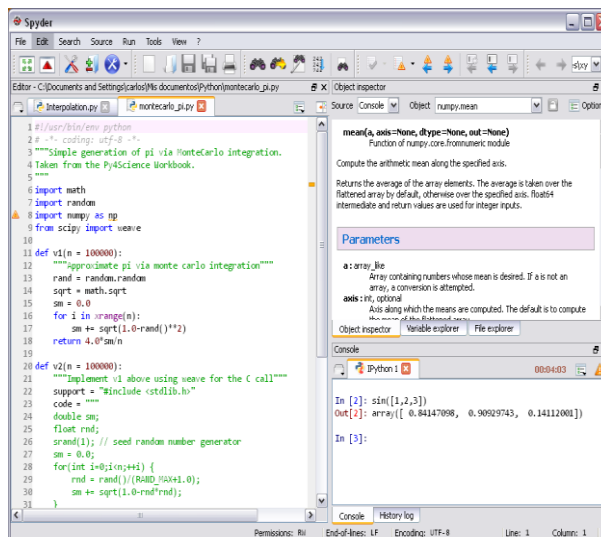


Fig 4 Python programming window

The “Python library” contains several different kinds of components. It contains data types that would normally be considered part of the “core” of a language, such as numbers and lists. For these types, the Python language core defines the form of literals and places some constraints on their semantics, but does not fully define the semantics. (On the other hand, the language core does define syntactic properties like the spelling and priorities of operators.) The library also contains built-in functions and exceptions— objects that can be used by all Python code without the need of an import statement. Some of these are defined by the core language, but many are not essential for the core semantics and are only described here. The bulk of the library, however, consists of a collection of modules.

VI. INTERNET OF THINGS (IoT)

The Internet of Things (IoTs) can be described as connecting everyday objects like smart-phones, Internet TVs, sensors and actuators to the World Wide Web where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Building IoTs has advanced significantly in the last couple of years since it has added a new dimension to the world of information and communication technologies. According to , in 2008, the number of connected devices surpassed connected people and it has been estimated by Cisco that by 2020 there will be 50 billion connected devices which is seven times the world population. Now anyone, from anytime and anywhere can have connectivity for anything and it is expected that these connections will extend and create an entirely advanced dynamic network of IoTs.



The development of the Internet of Things will revolutionize a number of sectors, from wireless sensors to nanotechnology. In fact, one of the most important elements in the Internet of Things paradigm is wireless sensor networks (WSNs).



Fig 5 The overall picture of IoT emphasizing the vertical markets and the horizontal integration between them.

WSNs consist of smart sensing nodes with embedded CPUs, low power radios and sensors which are used to monitor environmental conditions such as temperature, pressure, humidity, vibration and energy consumption. In short, the purpose of the WSN is to provide sensing services to the users. Since, the number of users of the Internet is increasing therefore; it is wise to provide WSN services to this ever growing community. Here IoT is used to send the analysis of the patient's condition to the doctor for feedback purposes and to get expert medical opinion

VII. RESULT & CONCLUTIONS

We successfully implemented our project which proves to work as an effective physiotherapy aid. A fully working model is shown below:



Fig no. 6 Final Prototype



For arm impaired patients, who experience reduced degrees of motion due to stiffness of the joints, are able to overcome this problem by using this exoskeleton. It is also very cost effective when compared to the hoards of money we pay the physiotherapist. The exercises can be done when the patient feels comfortable, without undergoing any further difficulty. The prototype is designed to have 2 movements one at the elbow and the other at the wrist. It works in 3 modes: the automatic mode and the manual mod are the first 2 modes; in the former mode the device will perform the physiotherapy procedure and in the latter the patient can do so by themselves. The third mode: the PD mode, which will help the people affected people to do the basic day to day activities freely, without depending on external help. It helps in stabilizing the tremor in the upper limbs of such patients which will allow them to do activities like turning the pages of a book, or to write on a paper, or even to hold objects firmly without it falling out from their hands. The extension of our project will truly be a boon to the diagnostic field. by using it in the physiotherapy process, it will considerably reduce the effort exerted by the doctor to a certain extent. Moreover it will also allow the patients to conduct exercises on their own and further send the feedback to the physician, in the absence of their availability.

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