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Master Thesis

Title
System for Motion and Equilibrium Assessment

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Objective

Document

Master Thesis

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Major Information	1. Abstract 2. Introduction 3. Method of Study 4. Results
Content	1. Abstract 2. Purpose and Adjective 3.Introduction 4. Literature Review 5. Method of Study 6. Results

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Position	Name	Education	Signature

ABSTRACT

The main aim of this project is to create an augmented reality in the form of a rehabilitation program for people with neurological disorders such as Parkinson's disease, Multiple sclerosis, People affected by strokes etc; which is accompanied by imbalance in posture and developing balance rehabilitation methods for patients with vestibular mal functions. The most common diseases associated with Neurological disorder are Parkinson's disease (PD) and Multiple sclerosis. Parkinson's disease is a long term Neurological disorder that affects the central nervous system. Multiple sclerosis (MS) is generally referred to as demyelinising disease in which the myelin sheath of the neurons of the brain and the spinal cord are damaged. We have built this rehabilitation program using UNITY 3D software for creating 3D models. This involves three stages. At first a 3D model has been designed, which is nothing but a Markerless Motion Capturing system, where the subject is made to wear a virtual reality device **Shinegon** and their motion is monitored using **Kinect**. Secondly We create the software for assessing hand and finger motion using Leap **Motion Sensor** and **Epson BT 300** during Gorbov-Shulte test by using augmented reality and Thirdly a) Server application - it can register the motion data, save it in CSV file and send it to mobile device with using wi-fi network and b) Android application for augmented or virtual reality glasses. With using of this software patient can interact with virtual environment

CHAPTER 1

1.Purpose and adjectives

The purpose of work: Development of system for motion and equilibrium assessment, based on sensory dissociation.

Adjectives:

1) Formulating the demands for motion and equilibrium assessment;
2) Creating the program modules for software system;
3) Testing the system with group of volunteers.

CHAPTER 2

Introduction

The main aim of this project is to create an augmented reality in the form of a rehabilitation program for people with neurological disorders such as Parkinson's disease, Multiple sclerosis etc; which is accompanied by imbalance in posture and developing balance rehabilitation methods for patients with vestibular malfunctions. The Postural abnormalities are caused by functional or morphological variation of the equilibrioception system. These disorders weaken the Central Nervous system's ability to process vestibular, visual and proprioceptive signals which are responsible for maintaining balance in posture. Due to this the plasticity of the nervous system is reduced which leads to disfunctionality. The methods which are used currently for evaluating postural reflexes have low sensitivity and specificity. In this a system is a virtual environment is designed for motion and equilibrium assessment.

Every movement of our body from running, raising or folding hands to smiling and sleeping is controlled by a complex network which is the Central Nervous system (Brain, Spinal cord and Nerves).It is a lightning fast communication network that is responsible for controlling every aspect of your movement and sensation. The main role of the CNS is acting as a protective mechanism against the barriers. There are two protective mechanisms it is Pain and Startle reflex.

Startle response is nothing but an unconscious defensive mechanism against threatening or sudden stimuli such as sudden movement or sharp noise which is normally associated with negative effect against the body. The onset of Startle response is a Startle reflex reaction. The Startle reflex is associated with the Brainstem reflectory reaction that acts a protective mechanism for vulnerable parts such as back of the neck and the eye, which facilitates escape response from sudden stimuli.

If the nervous system is affected it causes changes in the response to stimuli functions. Which totally changes the activity of an individual. Those activities may include loss of sensation, Postural disorders, loss of movement Psychatric problems etc. Postural disorders may include diseases connected with various organs and tissues which affects the normal functioning of human being. Causes of the postural disorders may include injuries, birth defect, genetic factors, food factors and environmental related factors. All these disorders affect the Central nervous system and the musco skeletal system, thus disrupting the balance and posture of the individual. Most common causes of the balance disorder and movement instability are Parkinson's disease and Multiple sclerosis.

The most common diseases associated with Neurological disorder are Parkinson's disease (PD) and Multiple sclerosis. Parkinson's disease is a long term Neurological disorder that affects the central nervous system. It affects the nerve cells in the brain that produces Dopamine. In brain Dopamine functions as a neurotransmitter which is a chemical produced by nerve cells in order to send signals to other nerve cells. Dopamine acts as a chemical messenger and also plays a major role in Reward motivating behaviour, this helps in increasing the dopamine level in the brain. They are also involved in motor control and release of various hormones in the body.

The major cause of Parkinson's disease is unknown, but believed to be cause by Genetic and environmental factors. There is also an increased risk in people who are widely exposed to pesticides and among those who had prior head injuries. The most obvious symptoms include shaking, rigidity, slowness of movement, difficulty with walking, thinking and behavioural problems may also occur. Other symptoms may include sensory, sleep and emotional problems.

2.1 Parkinson's Disease:

There are five stages for Parkinson's disease which include:

- Stage 1: It the mildest. Noticable changes in posture, walk or facial expressions.
- Stage 2 : It is a moderate form of Parkinson's. It includes tremors, stiffness and trembling. Stage 2 does not impair balance.
- Stage 3 : Middle stage in Parkinson's. Visible signs are most likely to experience loss of balance and decreased reflexes. Falling becomes more common.
- Stage 4 : It is possible to stand without assistance but requires walker or any type of assistive device. Decrease in movement and reaction. Doing daily tasks become impossible and dangerous.
- Stage 5 : Advanced stage of Parkinson's. Total stiffness or freezing upon standing which becomes unable to walk or stand. People experience confusion, hallucination and delusion.

2.2 Multiple Sclerosis:

Multiple sclerosis (MS) is generally referred to as demyelinising disease in which the myelin sheath of the neurons of the brain and the spinal cord are damaged. This damage disrupts the conduction of signals, communication in the affected nerves. The symptoms may include mental, physical and even psychiatric problems may even occur. The most common symptoms include blindness in one eye, double vision, trouble with sensation, muscle weakness and trouble with coordination.

Nowadays application of modernized computer methods for medical diagnosis, research and education have become a common practice all over. Using modern automated data it is very easy to obtain research data at high level of precision . But due to the increase in volume of information to be processed in a short time, the quality of diagnosis and the level of precision is greatly affected. The processing of the obtained raw data from a multilevel complex biological system within a specified amount of time is a difficult process to be achieved.

2.3 Current Methods Used:

In the current scenario different techniques and methods are involved to evaluate postural control. The present technology used to monitor postural control can be quantitatively considered by measuring the movement of Centre of Pressure (COP) and Centre of Mass (COM) using wobble board. These techniques are mainly involved for sports training and balance restore mechanism. The main drawbacks of this technique are that, it does not provide directional Characteristics that are required for Postural assessment which is cyclic or recording of sudden transitional movements. It is based on integrated evaluation of condition and allows to consolidate multidimensional data into integrated data by characterizing the rate of system deviation from reference state. The COP method has some disadvantages, such as large size of equipment, which should be properly installed in stationary conditions and thoroughly calibrated before use. One more issue of the posturography is a requirement that all force platforms intended for clinical applications should satisfy the standards of the International society for posture and Gait research (ISPGR), it means that the devices must be able to measure movements and displacements with ±0.1mm accuracy and 0.05 mm resolution. Such a high level of metrological characteristics is achievable, but for a high price. As a result, the computerized posturography (CPG) is very useful but relatively expensive method, which can be used effectively to resolve some specific clinical issues rather than on a daily basis.

To overcome these problems we are proposing a convenient approach towards correlation of the biological system with the needed values. This system for motion and equilibrium assessment which is designed using virtual environment is used for assessing the state of equilibrium. This technology helps to diagnose the Neurological disorders beforehand. Posturology is a new trend in neurology. This

branch focuses on the development and approach for diagnosing the disorders of the human posture balance system.

Using a high performing Computational environment to create multi parametric system for movement quality and functional equilibrium state of a human system, that includes a set of techniques such as dynamic stabilometry, video capturing for detection of movements, Electroencephalography, Oculography, Myography etc. Whereas in recent times due to development of Computer graphics we are able to create a virtual three dimensional visual environment, which imitates an actual environment. The virtual environment can be controlled by using computer to stimulate desired motion and to carry out detailed examination of visual information and posture control. Postural control of the patient without vestibular disorder can be realized through the visual signals.

CHAPTER 3

Literature review

3.1. Mechanical and physiological aspects of postural orientation and equlibrium

FAY B. HORAK (Neurological sciences of Oregon health and Science University, Portland, OR, USA)

Postural control is not an easy way of summation of reflexes. It is rather a complicated process involving dynamic sensory motor processes. Postural orientation involves alignment of head and the foot with respect to gravity, support surfaces, visual of the surroundings and internal references. Understanding postural control involves considering a person's physiological system from standing, walking and to interact with the environment in a safe and efficient manner. This understanding helps us to analyze balance disorders in each individual. In many elderly people with balance disorders the cone of ability is very small or their central neural cone of stability is disrupted. Both of which affects their movement stratergies to maintain equilibrium. Sensory information from somato sensory, visual and vestibular system must be integrated to interrupt complex sensory environment. The ability to align the body parts with respect to gravity, the support surface, visual surrounding and internal references is a critical component of postural control. Thus a comprehensive evaluation by a skilled clinician by evaluating the impairments and stratergies underlying functional performance in postural stability is necessary for optimal balance, rehabilitation and fall prevention.

3.2. Sensory dissociation in vestibular function assessment :

The main aim of this project is to create a system for early diagnosis of neurodegenerative disorders which causes imbalance in posture and for developing rehabilitation methods for patients with vestibular disorders. . Posturology is a new trend in neurology. This branch focuses mainly towards the development and use of various assessment methods and approaches for the early diagnostics of disorders

related to human balance system. One method to evaluate the functional state of the vestibular system is to record the behaviour of the overall pressure centre on the surface with the help of a force platform. The main objective of this project is development and application of virtual environment for virtual reality devices which is Oculus Rift DK2 for the assessment of the impact of neurological tests in virtual reality systems to maintain balance of patients with Parkinson's and Multiple sclerosis. The movement of the body in virtual reality was recorded for 20 seconds. The study involved two groups. First group was 12 volunteers without disorders of the balance function; in the second group was 10 subjects with Parkinson's disease. Results of the study of neurological functional tests revealed that, with closed eyes and using a virtual reality in a group of healthy humans shows variation in the point corresponding to the centre of mass were significantly reduced in comparison with the right and left hands.

3. 3. Statistic data simulation by estimation of biological system state:

V.A. Fokin

HPE SEI Siberian state medical university, Tomsk

Analyzation of the obtained biomedical data for developing methods of data extraction from them. The formation of integral estimations of biosystem represents actively developing directions of modern information technologies in medical science and practice of public health. In mathematical formulation the problem comes to construction of algorithms and functional reflection of space characterizing bio system in one dimensional space for estimations of this state of the system determined by a value of specified integral test. Statistical data simulation may be considered as efficient method of studying the properties of the biosystem whose results, on one hand helps innumerically estimating the statistical properties of the test itself and, on the other hand, allows us for determining

conditions put on sample volume which is required for obtaining generalized state estimations. Estimation of statistic features of integral test suggested before representing nontrivial solution for the problem of which uses only analytical approaches is stipulated by significant difficulties and in some practical cases which is impossible. From the data obtained we can conclude that Statistic simulation of the data of the biological system is the effective method of forming samples with multidimensional data which can be used for estimation of system in conditions of low volumes of experimental data and volume of the sample is a signicant parameter for quantitative estimation of the biological system.

3.4. Computational approach to assess postural tests under microgravity conditions:

Konstantin Brazovskii, VasiliiFokin, Ivan Tolmachev, JacovPekker and David Hachaturyan

National Research Tomsk Polytechnic University, 634050 Tomsk, Russia

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Human vestibular system is substantially disturbed under microgravity conditions. Vestibular system is extremely fragile, it degrades significantly when the gravity is lower than the gravity of the earth. It should be constantly monitored during long term space travel. This paper describes distance based criterion to estimate multi dimensional measurements and its application for postural tests assessment. The general idea of conventional postural tests data processing methods is to estimate statistical parameters of movements under different conditions, and then validate the raw values into scores. The study was conducted in two groups: the first, reference group, consisted of 9 healthy subjects; the second group was comprised of 9 patients with minor neurological deficits and negative Romberg's test. Functional postural tests were used along with a video-based markerless motion capture technique. Data from the subjects were collected and the numerical data was analysed, calculated and tabulated. We can conclude that this method takes into

account small variations of the trajectory linked to individual physiological features of the vestibular system. A data gathering procedure does not involve the exact value of gravity, thus could be possible used under microgravity conditions.

3.5. Improvement of Arm Movement Patterns and Endpoint Control Depends on Type of Feedback During Practice in Stroke Survivors:

M. C. Cirstea, M.D, PhD, and M. F. Levin, PhD

One of the major challenge in stroke rehabilitation is restoration of arm motor function. The main objective was to determine that if manipulation of attentional focus by providing either knowledge of results feedback (KR), focusing on movement outcomes, or knowledge of performance (KP) feedback. A group of volunteers were assigned to this task. Twenty-eight chronic stroke survivors were randomly assigned to 2 groups that practiced 10 sessions of 75 pointing movements. During practice, groups received either 20% KR about movement precision or faded (26.6% average) KP about arm joint movements. A nondisabled control group (n = 5) practiced the same task with KR. The result observed were as follows, Motor patterns were recovered only in KP, as evidenced by immediate and long-term increase in joint range, better interjoint coordination in early movement phases, and generalization of gains. Improvements in clinical impairment and function were related to decreases in compensation (trunk rotation) and recovery of interjoint coordination in mid-movement phases. We can conclude that In stroke survivors, when the learners attention was directed to the movements themselves (KP), motor improvements reflect recovery compared to when attention was directed toward movement outcomes (KR).

3.6.The reach to grasp movement in children with autism spectrum disorder

Morena Mari, Umberto Castiello, Deborah Marks, Catherine Marraffa andMargot Prior

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This paper describes about Autism which is associated with a wide and complex array of neurological behavioural symptoms. The Examination of the motor nervous system offers a particularly appealing method for studying autism by providing information about this syndrome which is proved to be relatively immune to experimental influence. This Research which is reviewed, characterizes kinematically the reach-to-grasp movement in children with autism compared with age-matched 'controls'. Unlike the age-matched children, autistic children showed differences in movement, planning and execution, supporting the view that movement disturbances may play a part in the phenomenon of autism. We can conclude that differences in the reach-to-grasp patterning exhibited by autistic people confirm their dysfunctional ability to initiate, switch, efficiently perform or continue any ongoing action including those involved in communicating, interacting socially or performing useful daily living activities. Consequently, there is a shift in focus to a movement perspective may reveal a new route for investigating autistic behaviour that might be useful for rehabilitation and diagnostic purposes.

3.7. Relating Movement Control at 9 Upper Extremity Segments to Loss of Hand Function in People With Chronic Hemiparesis

Catherine E. Lang, PT, PhD, and Justin A. Beebe, MSPT

Loss of hand function in people with hemiparesis is a major contributor for disability post-stroke. To use the hand for functional activities, a person may need control of the more proximal upper extremity segments to position and orient the

hand with respect to the environment and may need control of the fingers to manipulate objects within the environment. 32 patients with hemiparesis were studied making isolated movements of shoulder flexion, elbow flexion, forearm pronation/supination, wrist flexion/extension, and individual finger flexion using 3D kinematic techniques. Hand function was measured with a battery of clinical tests, and principal components analysis was used to create a single hand function score for each patient from the test battery. Correlation and regression analyses were used to examine relationships between segmental movement control and hand function. Movement control at all 9 segments of the upper extremity was related to hand function. Of the 9 segments, the thumb tended to have the weakest relationship with hand function. Of the 3 measures of movement control, AROM had strong relationships with and predicted the most variance in hand function (73%).These data support the idea that loss of movement control covaries across segments and that loss of hand function is due to loss of movement control at all segments, not just at distal ones.

3.8.A Randomized Controlled Trial of Gravity-Supported, Computer-Enhanced Arm Exercise for Individuals With Severe Hemiparesis

Sarah J. Housman, MS, OTR/L, Kelly M. Scott, M.D, and David J. Reinkensmeyer, PhD

On previous discovery, a passive instrumented arm orthosis (Therapy Wilmington Robotic Exoskeleton was developed [T-WREX]) that enables individuals with hemiparesis to exercise the arm by playing computer games in a gravity supported environment. The purpose of this study was to compare semiautonomous training with T-WREX and conventional semiautonomous exercises that used a tabletop for gravity support. Twenty-eight chronic stroke survivors with moderate/severe hemiparesis were randomly assigned to experimental (T-WREX) or control

treatment. All subjects significantly improved ($P \leq .05$) upper extremity motor control (Fugl-Meyer), active reaching range of motion (ROM), and self-reported quality and amount of arm use (Motor Activity Log). Improvements were sustained at 6 months. We can conclude that Gravity-supported arm exercise, using the T-WREX or table top support, can improve arm movement ability after chronic severe hemiparesis with brief one-on-one assistance from a therapist (approximately 4 minutes per session).

3.9.Development and Control of a 'Soft-Actuated' Exoskeleton for Use in Physiotherapy and Training

N.G. TsagarakisAnd Darwin G. Caldwell

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Nowadays Full or partial loss of function in the upper limb is an increasingly common problem due to sports injuries, occupational injuries, spinal cord injuries, and strokes. Typically treatment for these conditions relies on manipulative physiotherapy procedures which are extremely labour intensive. Although mechanical assistive device exist for limbs which is very rare for the upper body. In this approach we describe the construction and testing of seven degree motion prototype which is upper arm training/ rehabilitation (exoskeleton) system. The work presented here shows how the system takes advantage of the inherent controllable compilance to produce a unit that is extremely powerful, providing a wide range of functionality (motion and forces over an extended range) in a manner that has high safety integrity for the patient. A training control scheme is introduced which is used to control the orthosis when used as exercise facility. The Results demonstrate that the potential of the device can be used as an exercise facility for

the joints of the upper limb a rehabilitation/power assist orthosis or as a joint power for those with loss/reduced power in the limb and a motion analysis system.

3.10.MovementVariability as a Clinical Measure for Locomotion

Bryan C. Heiderscheit

The very aim of this paper is to analyse the variability in human movement, which focuses on locomotion variability. By assessing the stride characteristics, movement variability has been closely associated with reduced gait stability and unsteadiness. However, based on the measure of joint coordination during locomotion, variability has been suggested to provide a source of adaptation. Therefore, it would appear that the assessment of movement coordination from either the task outcome of stride characteristics or the joint coordination patterns provide distinctly opposing views of variability. The use of the variability measures, specifically joint coordination variability, from a clinical perspective have been analysed in this paper. Investigations were presented in which a reduction in joint coordination variability has been associated with pathology. Finally, the clinical implications of these measures as well as treatment suggestions were discussed. Based on the information obtained, rehabilitation clinicians can incorporate measures of movement variability to aid in the design of appropriate treatment programs directed at these deficits.

3.11.Control of rapid limb movements for balance recovery: age-related changes and implications for fall prevention

Brian E. Maki, William E. Mcilroy

Department of Surgery and Institute of Medical Science, University of Toronto

Balancing reactions that involve rapid stepping or reaching movements are critical for preventing falls. These compensatory reactions are much more rapid than

volitional limb movements and can be very effective in decelerating the centre of mass motion induced by sudden unpredictable balance perturbation. The objective of this research was regarding age related changes in compensatory stepping and reaching reactions and the practical implications of these findings for fall prevention programmes. The result observed was that older adults appear to be more reliant on arm reactions than young adults but are less able to execute reach-to-grasp reactions rapidly. We can conclude that More effective use of stepping and reaching reactions can be promoted through improved design and appropriate use of sensory aids, mobility aids, footwear, handrails and grab bars and also to address the problems that are associated with the control of lateral stability because it is the lateral falls that are most likely to result in hip fracture.

3.12. Falls in Parkinson's disease: Kinematic evidence for impaired head and trunk control.

Michael H. Cole, Peter A. Silburn, Joanne M. Wood, Charles J. Worringham, Graham K. Kerr

School of Medicine, University of Queensland, Australia

This study involves Changes in stride characteristics and gait rhythmicity, which characterise gait in Parkinson's disease and are widely believed to contribute to falls in this population. Forty-nine patients clinically-diagnosed with idiopathic PD and 34 controls had their gait assessed using three-dimensional motion analysis. Of the PD patients, 32 (65%) reported at least one fall during the follow-up compared with 17 (50%) controls. The results observed was that PD patients had increased stride timing variability, reduced arm swing and walked with a more stooped posture than controls. Additionally, PD fallers took shorter strides, walked slower,

spent more time in double-support, had poor gait stability ratios and did not project their centre of mass as far forward of their base of support when compared with controls. These stride changes were accompanied by a reduced range of angular motion for the hip and knee joints. Therefore, head motion could exceed 'normal' limits, if patients increased their walking speed to match healthy individuals. This could be a limiting factor for improving gait in PD and emphasises the importance of clinically assessing gait to facilitate the early identification of PD patients with a higher risk of falling.

3.13. Evaluation of an instrumented glove for hand-movement acquisition

Laura Dipietro, PhD; Angelo M. Sabatini, PhD; Paolo Dario, PhD

Advanced Robotics Technology and Systems (ARTS) Laboratory; ScuolaSuperiore St-Anna, Piazza MartiridellaLiberta 33, Pisa

This paper demonstrates Quantitative assessment of a digit range of motion(ROM) which is often needed for monitoring effectiveness of rehabilitative treatments and assessing patient's functional impairment. The objective of this research was to investigate the feasibility of using the Humanware Humanglove, a 20 position sensors glove, to measure finger's ROM, with particular regard to measurement repeatability. A series of tests were performed on six normal subjects. Data obtained was based on statistical parameters and on the intraclass correlation coefficient (ICC). Sources of errors that could affect measurement repeatability were also analyzed. The results obtained demonstrated that, the glove could be used as goniometric device. The main advantage yielded by the use is reduction in the time needed to perform the whole measurement process, while maintaining process repeatability comparable to that achieved by traditional means of

assessment. It also allows for dynamic and simultaneous recording of hand joint movements.

3.14. Diagnosis and classification of chronic low back pain disorders: Maladaptive movement and motor control impairments as underlying mechanism

Peter O'Sullivan

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Low back pain (LBP) is a very common but largely self-limiting condition. Eighty five percent of chronic low back pain (CLBP) disorders have no known diagnosis leading us to a classification of 'non-specific CLBP' that leaves a diagnostic and management vacuum. CLBP pain disorders can be classified into sub-groups, based on the mechanism underlying the disorder, it is considered critical to ensure appropriate management. There are three broad sub-groups of CLBP disorders. The first group of disorders present where underlying pathological processes drive the pain, and the patients' motor responses in the disorder are adaptive. A second group of disorders present where psychological and/or social factors represent the primary mechanism underlying the disorder that centrally drives pain, and where the patient's coping and motor control strategies are mal-adaptive in nature. Finally it is proposed that there is a large group of CLBP disorders where patients present with either movement impairments (characterized by pain avoidance behaviour) or control impairments (characterized by pain provocation behaviour). For this group, physiotherapy interventions that are specifically directed and classification based,

have the potential to impact on both the physical and cognitive drivers of pain leading to resolution of the disorder.

3.15. The relationship between smooth pursuit performance, motion perception and sustained visual attention in patients with schizophrenia and normal controls

A. Stuve, L. Friedman, J. A. Jesberger, G. C. Gilmore, M. E. Straussand, H. Y. Meltzer

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In this study, we learnt that the test for hypothesis that low smooth pursuit gain in schizophrenia is related to an abnormality in motion perception. The method used was that, The subjects were 19 schizophrenics treated with clozapine and 19 controls. In addition to smooth pursuit and motion perception paradigms, sustained attention was also assessed using a continuous performance task (CPT). The results obtained was that, In this patient group there was a statistically significant negative correlation between smooth pursuit gain and motion perception threshold. This relationship was not secondary to attention deficit as assessed by the CPT. We can conclude that the results obtained were consistent with the notion that the smooth pursuit gain deficit is related to a deficit in motion perception rather than in attention. Brain area V5 (also referred to as MT in macaque), located in the parietal occipital region, is known to be critically important both for motion perception and gain. Thus, our results point to an abnormality in this area in schizophrenia.

3.16. Assessment of Motion of a Swing Leg and Gait Rehabilitation with a Gravity Balancing Exoskeleton

Sunil K. Agrawal, Sai K. Banala, Abbas Fattah, VivekSangwan, VijayaKrishnamoorthy, John P. Scholz, and Wei-Li Hsu

The gravity balancing exoskeleton consists of rigid links, joints and springs, which are adjustable to the geometry and inertia of the leg of a human subject wearing it. This passive exoskeleton does not use any motors but is designed to unload the human leg joints from the gravity load over its range of motion. The underlying principle of gravity balancing is to make the potential energy of the combined leg machine system invariant with configuration of the leg. The goal of the results reported in this paper was to provide preliminary quantitative assessment of the changes in kinematics and kinetics of the walking gait when a human subject wears such an exoskeleton. The data on kinematics and kinetics were collected on four healthy and three stroke patients who wore this exoskeleton. These data were computed from the joint encoders and interface torque sensors mounted on the exoskeleton. This exoskeleton was also recently used for a six-week training of a chronic stroke patient, where the gravity assistance was progressively reduced from 100% to 0%. The results show a significant improvement in gait of the stroke patient in terms of range-of-motion of the hip and knee, weight bearing on the hemiparetic leg, and speed of walking.

3.17. Research and Clinical Applications of assessing balance

Kevin M. Guskiewicz and David H. Perrin

In this research work, they have discussed about allowing athletes to return to competition following injury which often creates a dilemma for athletic trainers and team physicians. Most clinicians gather as much data as possible before deciding whether to allow an athlete to return to competition following injury. The status of the postural control system and balance is important for certain pathologies and

therefore should be considered in these clinical decisions. As more high tech balance systems become available, it is important for clinicians to understand not only what is available but what these devices measure. This paper reviews relationship between the postural control system and the kinetic chain, traditional and contemporary techniques for assessing balance, and ways in which clinicians can bridge the gap between balance research and clinical practice. We can conclude that balance assessment have been correlated with functional capacity in the elderly. Competition among manufacturers of the high-tech balance systems will hopefully reduce the cost of the units so they can find their way into more sports medicine settings for both clinical and research purposes.

3.18. Assessment of Gross Motor Development

Williams. H &Monsma. E. V

University of South Carolina

The process of Motor development can be defined as the gradual acquirement of control and or use of the large and small muscle masses of the body which is due to neuromuscular coordination. Motor development is also often referred to as Perceptual motor development in part because both the brain and the nervous system and the muscles interact in complex ways in order to allow the child to move the body skillfull manner in manipulating objects and exploring the physical world around them. An important function of the human nervous system is the coordinated control of movement. Coordination of motor responses enable the young child to explore the environment and to learn and visualise a variety of different sensory stimuli. This promotes brain development and perceptual function. Results of gross motor skill screening and evaluation of the preschool

child are most useful as a part of a comprehensive, multidimensional assessment of the young child. If the child has gross motor deficiencies, it is more likely that the motor development problems observed are temporary and simply reflect an uneven growth process that will be self corrected within time. If, on the other hand, gross motor deficits are accompanied by fine motor and or other sensory perceptual or cognitive difficulties, there may be underlying neurological problems.

3.19. Inverse relation between In vivo Amyloid Imaging load and Cerebrospinal fluid A42 in humans

Anne M. Fagan, PhD, Mark A. Mintun,M.D, Robert H. Mach, PhD, Sang Yoon Lee, PhD,Carmen S. Dence, MS, Aarti R. Shah, MS, Gina N. LaRossa, BS, Michael L. Spinner, MA, William E. Klunk, M.D, PhD, Chester A. Mathis, PhD, Steven T. DeKosky, M.D, John C. Morris, M.D,David M. Holtzman, M.D

The $Amyloid_{42}$(A42) appears to be central to Alzheimer's disease (AD) pathogenesis and is one of the major component of amyloid plaques, Which means cerebrospinal fluid (CSF) A42 is decreased in dementia of the Alzheimer's type. This decrease leads to plaques acting as an A42 'sink', which hinders the transport of soluble A42 between the brain and CSF. This hypothesis have been investigated. The method used were that by comparing the in vivo brain amyloid load with CSF A42 and other measures by ELISA (enzyme-linked immunosorbent assay) in clinically characterized research subjects. The result observed were that the Subjects fell into two non overlapping groups: those with positive PIB binding who had the lowest CSF A42 level, and those with negative PIB binding had the highest CSF A42 level, Three cognitively normal subjects were tested PIB-positive with low CSF A42, suggesting the presence of amyloid in the absence of cognitive

impairment These observations suggest that brain amyloid deposition results in low CSF A42.

3.20. Assessing muscle stiffness from standing quietly in Parkinson's disease

Michael Lauk,Msc, Carson C. Chow, PhD, James J. Collins, PhD, Lewis A. Lipsitz, M.D, Susan L. Mitchell, M.D

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From the previous studies conducted, A Postural stiffness measure has been developed, which is extracted from the foot Center of Pressure (COP) trajectories from individuals who are standing quietly, which is based on an analytical mechanical model of posture control. In this case we have applied this measure to patients with Parkinson's disease (PD). The Postural stiffness measures have been correlated with different clinical rating scales, obtained from patients. Out of all Kendall's rank correlation was highly significant between the stiffness measure and rigidity, Bradykinesia, posture impairment, gait, and leg agility, respectively, which was rated by the Unified Parkinson's Disease Rating Scale. The results obtained prove that higher intrinsic muscle stiffness may contribute to the above mentioned clinically defined symptoms. From the clinical point of view, this work indicates that the proposed postural stiffness measure may be useful as an assessment tool for the evaluation of PD patients subsequent to pharmacological and surgical treatment.

3.21. Scoliosis induced by Medullary damage: An experimental study in Rabbits

Carlos Barrios, M.D, Maria T. Tunon, M.D, Jose A. De Salis, M.D, Jose L. Beguiristain, M.D, Jose Canadell, M.D

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Until now there has been no reports about experiments that were designed to induce scoliosis by direct damage of different areas of the spinal cord. In an experiment conducted, a series of rabbits with medullary damage were taken, the researchers attempted selectively to interrupt the pathways that mediate proprioceptive input. Three different techniques were used to perform Unilateral lesion of the dorsal column and posterior horn of the spinal cord: Longitudinal electrocoagulation, Stereotaxic microcoagulation and Coagulation with laser were performed. Out of the 32 operated rabbits, 17 developed scoliosis, exhibiting clear pathologic damage of the spinal cord. Electrophysiologic study, including EMG and analysis of the tonic - vibratory reflex, was performed on 10 rabbits with medullary damage (scoliotic and nonscoliotic) and 12 matched controls. The results that were obtained suggested that, there was disturbance of the sensory afferences that control the postural tone and consequent muscular imbalance, which is expressed as reduced activity in the muscles of the convex side.

3.22. Adaptation to altered support and visual conditions during stance: Patients with vestibular deficits

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People who were diagnosed with vestibular disorders have been exposed to a number of alternated support surface and visual environments when they were

standing unsupported. A six degree of freedom platform which was equipped with movable support surfaces for each foot and a movable visual environment deprived from patients of normal inputs derived from a fixed level support surface and from an immobile environment. The most dramatic performance of patients was that they were unable to suppress the influence of visual and proprioceptive inputs appropriately whenever motions of external surface disturbed the orientation information provided by these inputs. We can conclude that the less affected patients dint experience not so much instability due to the loss of vestibular inputs which leads directly to posture but because of their responses which were not appropriate to proprioceptive inputs and vision. This discussion was focussed on the role of vestibular input as an internal reference system for orientation about which adaptive changes in proprioceptive and visual inputs are made.

3.23. Postural sensitivity to visual flow in aging adults with and without balance problems

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This work is based on testing the balance behaviour of young and older people with and without balance problems which in response to visual flow from a moving visual environment. The method used was that the Balance behaviour was marked by force plate measures of maximum anterior and posterior displacement of theCOP foot and horizontal shear forces. The sample included normal young adults (i = 13; mean age 23 years, ± 7.5), normal aging adults *(n* = 13; mean age 76 years, ± 6.5), and aging adults with balance problems not directly approached to a diagnosable neurological disease or dysfunction *(n* = 13; mean age 79 years, ± 5.8). The following results were obtained, The aging adults whose balance were affected

had statistically greater sway responses than the young group, when thestimulus was totally unexpected. Some individuals in each group had large responses that were statistical outliers from the group median. The group whose balance were affected had significantly greater shear forces than the young group. We can conclude that higher amount of sway responses rely too much on posture control as in balance affected age group. Visual sensitive posture control is due to several different processes. Greater shear forces leads to more usage of hip movement in addition to ankle movement.

3.24.Ontogenetic Development of Postural control in man: Adaptation to altered support and visual conditions during stance 1

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A group of Normal young children ranging from age group of 1 to 10 years were tested in a number of experimental procedures, by testing their ability to adapt quickly, their strategy of control in altered support system and visual conditions. This experimental procedure was done using a movable platform and visual environment, and the analytical techniques, using EMGs and measures of reaction forces and body motions. The structure of automated postural adjustments in young children has greater variability, similar to that of adult subjects studied previously. However, young children below the age of 7 years were unable to compress systematically the influence of inputs obtained from the support surface or from vision when these provided inappropriate orientation information due to the motion surfaces. We can conclude that the automatic postural adjustments and the

context dependent reweighting of support surface, are separate processes and that the hierarchically lower level automated process matures much before than the higher level adaptive processes.

3.25. First Transit and equilibrium radionuclide angiography in patients with Inferior Transmural myocardial infarction

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The radionuclide criteria can be defined as an element used for identifying hemo dynamically significant right ventricular infarction, A group of 33 men with consecutive inferior transmural infarction were evaluated. He-mo dynamically significant right ventricular infarction was present in 6 of the 33 patients (Group I); the remaining 27 patients did not respond to hemo dynamics characteristic of right ventricular infarction (Group II). A right ventricular ejection fraction of less than 40% separated Group I and Group II patients by equilibrium ($p = 0.003$). The presence of a right ventricular regional wall motion abnormality on first transit or equilibrium radionuclide angiograms separated Group I and II patients. We can conclude that patients with transmural myocardial infarction, a right ventricular regional wall motion abnormality have less than 40% first transit or equilibrium radionuclide angiography is a useful criterion for establishing the presence of hemo dynamically significant right ventricular infarction, while its absence argues against the diagnosis of right ventricular infarction.

3.26. A model for Multisystem evaluation treatment of individuals with Parkinson's disease

Margaret Schenkman, PhD, and R. B. Butler, M.D

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This paper describes a method for systematically making decisions regarding the evaluation and treatment of an individual with Parkinson's disease. The obvious signs of Parkinson's disease are rigidity, bradykinesia, tremor, and postural instability. The doctor who treats the patient with Parkinson's disease is faces difficulty in decision making regarding which of the patient's problems can be solved, which require compensation strategies, and who require physical therapy intervention. This system which have been presented for making decisions regarding evaluation and treatment of the patient with Parkinson's disease is based on a model that was recently developed for evaluation and treatment of individuals with nervous disorders.This paper firstly demonstrates the use of a model to interpret the underlying causes and symptoms of Parkinson's disease. Next it demonstrates how the model can be used for decision making regarding physiotherapy evaluation, monitoring, and treatment of the patient with Parkinson's disease. Lastly it demonstrates how the model can be used to focus on research related to the effect of physiotherapy intervention for the person with Parkinson's disease.

3.27. Clinical Measurement of Postural Control in Adults

Fay B. Horak

This paper briefs us about Postural control, which is nothing but the ability to maintain equilibrium and orientation in a gravitational environment. Numerous

approaches for clinical measurement of maintaining postural control have been developed. This paper describes the importance of neuro-physiological and clinical considerations in order to develop measurement tools to assess postural control in adults. The postural control system can be divided into three basic functional components for assessment: Biomechanical components, Motor Coordination Components, and Sensory Organization Components. The condition for postural performance in a particular equilibrium position must be taken into consideration that the movement strategy required to complete the task, because the amount and quality of body movement is independent of postural stability which is nothing but the centre of gravity. We can conclude that Postural control is very complex and cannot be evaluated with any global measure of balance.

3.28. Postural sway increase in low back pain subjects is not related to reduced spine range of motion

Alain Hamaoui, ManhCuong Do and Si Bouisset

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This paper puts up a question whether postural sway increase in low back pain subjects are related to spine mobility impairment, and especially which leads to a decrease in the range of motion, that was assumed leading to structural spine stiffness. A group of 10 low back pain subjects and other group of 10 healthy control subjects were allowed to perform spine flexion extension and spine side bending tests, and standing posturographic examination in different experimental conditions. Subjects with low back pain showed increased postural sway along the anterior-posterior axis and reduced side bending which is parameter being varied in opposite direction. Moreover, no correlation was found between these two types of

parameters. Although, the slight decrease in spine side bending did not seem to be sufficiently great to disturb the low amplitude movements that maintain postural equilibrium. We can conclude that postural sway increase in low back pain is not related to a reduced spine range of motion, but it might be linked to an increase in muscular active tension, which reduces dynamic mobility capacity.

3.29. Basic Gross Movement Assessment tool for Children having minor motor dysfunction

Jeanne E. Hughes, M.S and Ann Riley, M.A

This paper describes about Children who have minor motor dysfunction who are often referred for evaluation of these problems to physical therapists who work in educational environments. Certain Measures that are being used by therapists to assess seriously disabled children are often more inappropriate for these children. The Basic Gross Motor Assessment was developed after analyzing children with minor motor dysfunction. Standard procedures were outlined and a sample group of 1,260 children were randomly selected aged from 5 years 6 months to 12 years 5 months who have been served for norming purposes. Validity and reliability studies were completed with an additional 285 subjects. We may conclude that, The Basic Gross Motor Assessment is considered as a useful tool for evaluating minor motor problems in children and also useful for identifying those children who require further physical therapy assessment and access to direct treatment.

3.30. A Selective impairment of Motion Perception following lesions of the middle Temporal visual area (MT)

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This paper describes about the various Physiological experiments which indicate that the middle temporal Visual area (MT) of primates plays a major role in the cortical analysis of visual locomotion. Based on the investigation about the role of MT in visual perception by analysing the effectiveness of chemical lesions of MT on Psychophysical thresholds. In this experiment Rhesus monkeys have been trained to do Psychophysical tasks that enabled the researchers to assess their sensitivity to motion and against it. For Psychophysics involving motion, a dynamic random dot display was employed that permitted the researchers to vary the intensity of a motion signal in the midst of covering motion noise. The researchers measured the threshold intensity for which the monkey successfully completed a direction discrimination. In a task contrast to it, the researchers measured the threshold contrary to which the monkey were able to successfully discriminate the arrangement of stationary gratings. The results obtained indicated that neural activity in MT contributes selectively to the perception of motion.

3.31. Assessment by Multiple Gated Equilibrium Scintigraphy

JamshidMaddahi, M.D, Daniel S. Berman, M.D, Dale Matsuoka

This paper describes about the response of right ventricular ejection fraction (RVEF) during exercise and its connection to the location and extent of coronary artery disease has not been fully explained. Researchers have developed and validated a new method for scintigraphic evaluation of RVEF using rapid multiple gated equilibrium scintigraphy and multiple right ventricular regions of interest. This technique has been employed during bicycle exercise for a group of 10 normal

subjects and a group of 20 patients with coronary artery disease. Resting RVEF was not significantly different between the groups. In all 10 normal subjects RVEF rose at peak exercise. At peak exercise in coronary artery disease patients, the group RVEF remained unchanged, but the individual responses varied. Thus we can conclude that 1.In normal subjects RVEF increases during upright exercise and 2. Even though RVEF at rest and it is not necessarily affected by coronary artery disease, failure of RVEF to increase during exercise, in the absence of chronic obstructive pulmonary disease or valvular heart disease, may be related to the presence of significant right coronary artery stenosis.

3.32. Relationship between Cognitive Performance and Motor dysfunction in patients with Parkinson's disease

Valentina Varalta, Alessandro Picelli, Cristina Fonte and Camilla Melotti

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This paper explains about the pilot cross-sectional study for investigating the relationships between cognitive performance and motor dysfunction involving balance and gait ability in patients with Parkinson's disease. A group of 20 patients with Parkinson's disease underwent a cognitive and motor assessment. The analyses showed that balance skills are significantly connected with executive functions, cognitive impairment and the ability to switch attention between two tasks. And also, functional mobility showed a significant connection with cognitive impairment, verbal fluency, and ability to switch attention between two tasks. Additionally, the functional mobility which was evaluated under the dual task condition showed a significant correlation with cognitive impairment and ability to

switch attention between two tasks. We can conclude that these findings might help early identification of cognitive deficits or motor dysfunctions in patients with Parkinson's disease who may benefit from rehabilitative strategies. And also prospective large scale studies are needed to strengthen the results.

3.33. Visual Vestibular conflict induced by virtual reality in humans

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This paper describes about diverging inputs from visual and vestibular afferents which produce motion sickness and postural instability. However the relationship between visual and vestibular inputs to each other remains obscure. In this study, the researchers have examined the development of subjective sickness and balance related symptoms and objective equilibrium induced by visual vestibular conflict (VVC) stimulation by using virtual reality. The symptoms observed from the subjects were evaluated by Graybiel's and Hamilton's criteria, which gradually got worse during the VVC. The main objective of postural instability was not observed during the VVC, but it happen to have occurred immediately after the VVC. And also there was a time lag between the subjective symptoms and objective ataxia induced by VVC. We can conclude that, from the study that was done, we can suggest that the VVC inputs are processed in different pathways causing the subject autonomic symptoms and postural instability in humans.

3.34. Antioxidants, Oxidative stress and Degenerative Neurological Disorders

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In this study clinical trials of several neurodegenerative diseases have been increasingly targeted for the evaluation of the effectiveness of various antioxidants. The possible clinical effectiveness of antioxidants in several degenerative conditions has been rising out of the many years of basic science generally showing that reactive oxygen species (ROS) and oxidative damage are important factors in the processes involved. Aging is one of the most significant risk factors for degenerative neurological disorders. Specifically the results that were obtained on serendipitous findings prove that a neutron based free radical trap, a-phenyl-*tert*butylnitrone (PBN), has neuroprotective activity in several experimental neurodegenerative models. The demonstration of enhanced 3 nitro tyrosine formation in affected regions of the Alzheimer's brain, in comparison to age-matched controls, shows the importance of neuro inflammatory processes. iNOS induction involves activation by phosphorylation of the MAP kinase p38 and can be induced in cultured astrocytes by IL-1b or H2O2. We can conclude that the outcomes of clinical trials on antioxidants will become less confusing as more knowledge is present on the basic processes involved.

3.35. Motor Determinants of Gait in 100 ambulatory patients with Multiple sclerosis

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This study focuses on the prospective analysis of gait and strength parameters which was performed to a group of 100 patients who were diagnosed with MS and pyramidal involvement admitted in a rehabilitation unit. The patients were divided into two groups depending on their ability to walk in daily life which is with and without external support and further more into 4 clinical subgroups associated with involvements such as sensory loss or cerebellar ataxia. 20 healthy subjects were studied as a control group. Observed results showed that the average velocity and strength of the hamstring and quadriceps were strongly associated with each other and reduced in the MS group in comparison with the control, and in the cane assisted group compared with the non assisted group. We can conclude that the findings provide evidence that an association between strength reduction and gait impairment is obvious whatever the clinical form in patients with MS. This association was found to be higher with hamstrings but may change depending on the disability level and the clinical form. This may be taken into account for individual assessment of further rehabilitation programmes.

3.36. Assessment of Mal alignment of trunk and Pelvis in Stroke Patients

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This paper describes about the presence of scoliosis, which is one of the largest problems among people affected by stroke. Unequal weight distribution and muscle tightness become the main cause for Trunk and pelvis abnormalities. The position of scapula and pelvis is being affected due to the presence of scolosis which in turn causes of motor, sensory impairments and perceptual functions of the upper and lower extremities. The main aim is to assess trunk and pelvis mal alignment in stroke patients in relation to the duration of illness and degrees of spasticity. This study included 60 stroke patients, their age ranged from 45 to 65 years. Based on

the duration of illness, they were divided into 2 equal groups. Each group was subdivided into two subgroups according to the degree of spasticity. Clinical and neurological examination, brain CT and MR imaging, assessment of muscle tone, trunk control and trunk range of motion were performed to each patient. The result was that, There was a statistical significant difference for trunk side bending among all patients and also there was a significant correlation between the degree of spasticity and both lateral trunk deviation and lateral pelvis tilting as well as between duration of illness and abnormal trunk movements in all groups.

3.37. The effects of incremental speed dependent treadmill training on Postural instability and fear of falling in Parkinson's disease

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The main objective of this paper is to detect the effectiveness of incremental speed-dependent treadmill during training on postural instability, dynamic balance and fear of falling in patients with Parkinson's disease. This Design is based on Randomized Controlled trial. A group of 54 patients who were affected by idiopathic Parkinson's disease in stage 2 or 3 and 31 patients (21 training, 10 control) who were in starting stage were considered. The Postural instability of patients with Parkinson's disease was assessed using the motor component of the Unified Parkinson's Disease Rating Scale (UPDRS), Berg Balance Test, Dynamic Gait Index and Falls Efficacy Scale. 21 patients with Parkinson's disease participated in an 8 week exercise programme using incremental speed dependent treadmill training. The result obtained were, The speed of the treadmill was

gradually increased from initial to maximum tolerable speed. Scale scores of the training group were improved significantly after the training programme. We can conclude that Specific exercise programmes using incremental speed dependenttreadmill training may improve mobility and fear of falling in patients with Parkinson's disease.

3.38. Rehabilitation Management of Friedreich Ataxia: Lower Extremity Force Control Variability and Gait Performance

Michael O. Harris - Love, Karen Lohmann Siegel, Scott M. Paul and Kimberly Benson

This Paper describes about a rehabilitation management program for a period of 12 month for a 14 year old girl with Friedreich ataxia. She was asked to perform a series of task oriented bimanual reaching activities, functional strengthening, and gait training using a walker featuring tension controlled wheels. The physical status of the girl was analysed using Nine Hole Peg Test, single limb stance time, manual muscle testing, self reported falls, isometric force control testing and 3D gait analysis in a motion capture laboratory. The patient's Nine-Hole Peg Test, single limb stance time, and manual muscle testing reflected minimal changes while her gait speed decreased by 69.4%. However, the force control targeting her dominant knee extensors showed a 43.7% increase in force variability consequently following her decline in gait performance. The Walking Stabilizer fairly improved her gait performance, and her fall rates decreased from 10 to 3% per month. The observations suggested that the use of force control testing as proxy measures of ataxia and tension controlled gait kit shows control in the management of Friedreich ataxia and merit further investigation.

3.39. Toward a Narrower, More Pragmatic view of Development Dyspraxia

Kylie J. Stenman, M.D, M.A.S, Stewart H. Mostofsky, M.D and Martha B. Denckla, M.D

This paper describes about Apraxia, which is being traditionally referred to as an impaired ability to carry out skilled basic movements in the absence of fundamental sensory motor, language, or general cognitive impairment sufficient to preclude them. The child neurology literature which includes a much broader and different usage of the term developmental dyspraxia. It is being used to describe a wide range of motor symptoms, including clumsiness and general movement coordination difficulties, in various developmental disorders (including autistic spectrum disorders, developmental language disorders, and perinatal stroke). But many arguments have been imposed against the need to restrict the use of the term developmental dyspraxia to describe an impaired person's performance of skilled gestures, recognizing something, unlike acquired adult onset apraxia, coexisting sensory and motor problems can also be present in some people.

3.40. A Review of the different methods for assessing Balance

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This study is based on the review of the balance assessment methods which are currently used to evaluate the standing posture balance. Most of the Instrumentation which is available currently appears to be more suited to research laboratories than to routine clinical laboratories or situations. The Functional assessments for balance appear to be the quickest test to administer and they do not require expensive equipment. However only least distinct changes in balance can only be detected making them suitable as a screening tool for identifying the

subjects who need more of a thorough evaluation. Force platforms which appear to be most suited for the balance assessment instrumentation in the clinical situation since it produces a real time display and can also detect small changes in subject's ability to maintain their balance, by making them much more suitable for complete evaluation tool for balance assessment and for monitoring patient's progress.

3.41. A study of Labyrinthine function in Patients with Adolescent idiopathic Scoliosis

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This study involved an Electro-nystagmographic analysis of labyrinthine function, which was performed in 56 patients with adolescent idiopathic scoliosis (AIS) aged from 10 to 16 years. Among which 47 patients had major structural single curvatures, and 9 patients who had double primary scoliosis and were analysed separately. Based on this analysis, it was found that Treatment was required in 36 cases while 20 were only being observed. A control group was also formed constituting of 30 healthy children of the same age group. Based on the analysis Spontaneous nystagmus (SN) and positional nystagmus (PN) were found in 24 out of the 47 patients with single curvatures and was found in only one subject in the control group. Neither did the frequency of SN or PN differ significantly between patients requiring treatment and patients submitted to observation only. A dysrhythmicnystagmus occurred in the scoliotic patients with significantly increased frequency. There wasn't a definite conclusion as to whether the findings

may indicate a causative factor in relation to the idiopathic curvature or whether they might be a feedback effect from the deformed spine.

3.42. A method for evaluating motion sickness induced by matching stereoscopic images on a Head – mounted display

Hiroki Takada and Kazuhiro Fujikake

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This paper is based on the reports that even users of virtual environments and entertainment systems experience motion sickness. This type of visually induced motion sickness (VIMS) is caused by sensory conflict, for instance, there is a disagreement between vergence and visual accommodation while viewing stereoscopic images. In this study they have used the SSQ and also quantitatively measured the head acceleration and sway of the center of gravity of the human body before and while during the exposure to stereoscopic images on a head mounted display. During the process of measurement, the subjects were given in structions to maintain the Romberg posture for the first 60 seconds and a wide stance (with the midline of heels 20 cm apart) for the next 60 seconds. Another method was proposed to obtain stochastic differential equations (SDEs) as a mathematical model of the body sway on the basis of the stabilogram. While there were many minimal points for time averaged potential function in the SDEs, the exposure decreased the gradient of the potential function. It can be conclude that the Researchers have succeeded in estimating the decrease in the gradient potential of the function by using an index called sparse density.

3.43. Parkinson's disease Assessment using Fuzzy Expert system and Non Linear Dynamics

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This study describes about a newly proposed screening system used for quantitative evaluation and analysis, mainly designed for the detection of Parkinson's disease at an early stage. This experiment has been carried out in the view of improving the diagnosis which is currently established upon a basis of subjective scores. Parkinson's disease (PD) is caused due to the result of dopamine loss, a chemical mediator that is responsible for the body's ability to control movements. The symptoms reflect that the loss of nerve cells, due to an unknown cause. The input parameters of the system are represented by frequency, amplitude, the spectral characteristic and trembling localization. The main symptoms of Parkinson's disease include trembling of hand, arms, difficulty in movement, postural instability, disturbance in coordination and equilibrium, sleep disturbance, difficulty in speaking, reduction of voice volume. The medical knowledge in PD field is characterized by imprecision, uncertainty and vagueness. We can conclude that the proposed system (fuzzy expert systems) is non-invasive and, easy to use by both physicians and patients at home.

3.44. Vestibular Rehabilitation for Dizziness and Balance disorders after Concussion

Bara Abdel Majid Alsalaheen

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This paper describes about those individuals who acquire a concussion are sent for vestibular rehabilitation. This study describes about prescribed exercises and the outcomes of vestibular rehabilitation. The purpose of this dissertation is to provide normative data to be used in vestibular rehabilitation, and to describe the exercises and the outcomes of a vestibular physical therapy program. In this case a cross sectional design was used to establish the normative reference values; a group of 91 participants were assigned certain activities which was, Specific Balance Confidence scale, Dynamic Gait Index, Functional Gait Assessment, Timed Up and Go, 5 times Sit to Stand test, tests of gait speed and the Balance Error Scoring System. Percentile scores were computed for all measures. Normative reference values for balance were provided. An improvement was observed in all measures at the time of discharge from vestibular rehabilitation. We can conclude that the Individuals who received vestibular physical therapy after concussion had favorable outcomes, but it was impossible to determine if the outcomes were solely due to the therapy. And also the interventions provided by physical therapists were consistent across patients.

3.45. Evaluation of Patients with Gait Abnormalities in Physical and Rehabilitation Medicine settings

Laurent Bensoussan, M.D, Jean Michel Viton, M.D, PhD, and Alain Delarque, M.D

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This study is based on the assessment of patients with gait abnormalities in Physical and Rehabilitation medicine settings which is nothing but a clinical examination based on the International Classification of Functioning, Disabilities

and Health. In this study, Mainly the Body structure, activities and participation, and environmental factors which is both the Physical and Human factors were all assessed. Qualitative and Quantitative assessments of gait were a part of the activity and evaluated based on the participation. Scales were also used to assess the gait activities. Gait assessment tools can also be used in laboratory environments for kinematic, kinetic, electromyography and energy consumption analysis and other tools, such as video recording and walkways, can be used in clinical practice, while ambulatory assessment tools can be used to analyse the patient's everyday activities. We can conclude that instrumental gait assessment were used to understand the underlying mechanisms and the aetiology of the disorders, in order to obtain quantified gait parameters, and also to define suitable therapeutic methods for following the course of the disease.

3.46. Assessment and Quantification of head Motion in Neuropsychiatric functional imaging research as applied to Schizophrenia

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This paper focuses on the varying degrees of head motion that have been recognized as a potential confound in functional Neuro imaging studies. By comparing neuropsychiatric populations to healthy normal volunteers, and studies show excessive head motion as a possible reason for the differential patterns of functional activation frequently observed between groups. The degree of Head Motion was also tested in 16 patients with chronic schizophrenia and education matched controls during the acquisition of functional magnetic resonance imaging

data. The degree of Motion that were examined across 3 different indices during a complex task and the effect of entering the motion parameters as additional repressors' in a general linear model analysis. The results that were obtained indicated that individuals with schizophrenia did not exhibit more task correlated or total motion compared with controls. We can conclude that the current results suggested that stable patients with schizophrenia are capable of controlling head motion compared with matched normal controls.

3.47. Neurological assessment Skills for the Acute Medical Surgical Nurse

Janet T. Crimlisk and Margaret M. Grande

This article describes about the Practical and efficient neurologic assessment skills which are absolutely necessary for critical care unit nurses. During an acute neurologic event, the nurse very much needs a focused assessment for the precise history and the analysis of the symptoms and an immediate head to toe survey, any potential abnormalities to identify and correctly report the medical problem. When a patient requires routine monitoring of neurologic signs, the nurse's role includes a series of neurologic assessment, collecting and assimilating the data that were obtained, interpreting the patient's problem, notifying the physician when it is very much required, and documenting that data. We can conclude that this article presented an overview of a staff nurse's neurologic assessment, explained common neurologic tests performed at the bedside, identification of an efficient way to perform the assessment, and also indicated what to include and when the Neuro signs should be documented.

4.48. Temporal Fourier Analysis applied to equilibrium Radionuclide Cineangiography

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This paper describes about the Regional and global left ventricular wall motion which was assessed in a group of 120 patients using radionuclide cine angiography (RCA) and contrast angiography. The Functional imaging procedures based on a temporal Fourier analysis of dynamic image sequences were carried out for the study of cardiac contractility. From the study two images were constructed by taking the phase and amplitude values of the first harmonic in the Fourier transform for each pixel. This technique increased the sensitivity of RCA for determining segmental abnormalities especially in the left anterior oblique view (LAO). In this study Coronary artery disease were only be able to assessed for segmental contraction abnormalities only. Contrast ventriculographic studies were performed 24 hours after the equilibrium gated radionuclide evaluation. From the observation we can conclude that Each frame contained 500,000 counts. The superimposing of cardiac cycles was synchronized using the peak of the R wave which were followed by cycles presenting a deviation of 10% from the mean were rejected.

3.49. Response to stimulant Drug treatment in Hyperactive Children: Prediction from EEG and Neurological Findings

James H. Satterfield, Dennis P. Cantwell, Ronald E. Saul, Leonard I. Lesser and Robert L. Podosin

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This study is based on the neurological examinations, EEG findings, and behavioural responses to methylphenidate treatment which was conducted for a group of 57 hyperactive boys, between the age group of 5 to 10 years, whose results were reported and discussed. The results that were obtained indicated that the subjects with minor neurological abnormalities in 4 or more categories significantly responded with more improvement ($p < .01$) to methylphenidate treatment than the other subjects who were without abnormalities. Subjects with abnormal levels of EEGs significantly had more improvement ($p < .001$) than those with normal EEGs. A significant correlation was found between the degree of evidence of brain dysfunction (obtained from EEG and neurological examinations) and the probability of response to methylphenidate treatment. We can conclude that both the neurological and the EEG examinations played a significant role in the assessment of hyperactive children.

3.50. Assessment with Equilibrium Gated Blood Pool imaging

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This paper describes about oral effect of propranolol on left ventricular ejection fraction. The Left ventricular volumes, cardiac output, and segmental wall motion was assessed with the help of multigated blood pool imaging technique used both at rest and during exercise for a group of 15 patients with angina pectoris. It was found that Propranolol had no effect on resting left ventricular ejection fractions. More specifically, left ventricular end diastolic volume index, end systolic volume index, stroke volume index, and cardiac index were not altered significantly at rest

or during exercise by propranolol. Those patients with increases in left ventricular ejection fractions had a greater change in left ventricular end-diastolic volume indices and a greater change in left ventricular end-systolic volume indices during exercise while on propranolol. Thus we can conclude that 1. Left ventricular function majorly responded to propranolol during exercise and cannot be easily predicted; 2. Propranolol causes no consistent decrease in exercise left ventricular ejection fraction; 3. An increased exercise left ventricular ejection fraction with propranolol is contributed to have significant increases in end diastolic volume during exercise; and 4. Gated blood pool imaging is a useful method for characterising rest and exercise left ventricular ejection fractions and left ventricular volumes during propranolol therapy.

3.51. Design and Validation of Rehabilitation Robotic Exoskeleton for Tremor Assessment and Suppression

E. Rocon, J. M. Belda Lois, A. F. Ruiz, M. Manto, J. C. Morenoand J. L. Pons

This paper describes about the Mechanism of Exoskeletons which are nothing but mechatronic systems worn by a person in such a way that the physical interface permits a direct transfer of mechanical power and information can also be exchanged. Upper limb robotic exoskeletons may be helpful for people with disabilities or limb weakness or injury. In Neurological practice, the most common movement disorder is Tremor. In addition to medication, rehabilitation programs and deep brain stimulation, biomechanical loading has appeared as a potential tremor suppression alternative. This Paper gives an introduction torobotic exoskeleton called WOTAS (Wearable orthosis for tremor assessment and suppression) which is used for testing and validating nongrounded control strategies for orthotic tremor suppression. In this paper there are two strategies

based on biomechanical loading and notch filtering the tremor by application of internal forces. The results that were obtained from clinical trials were presented, which indicated the feasibility of ambulatory mechanical suppression of tremor.

3.52. Disequilibrium and its Management in Elderly Patients

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This Paper describes about Dizziness, which is being one of the frequent occurrence in elderly people, carries substantial health hazards and quality of life for patients of patients is being affected. Disequilibrium in movement for the elderly refers to dizziness or ataxia, sometimes both without apparent localizing signs and is majorly contributed to the aging process. In many cases, disequilibrium is multifactorial and may be worsened or triggered by multiple medications and complications resulting from treatment. This review provides an update of the literature concerning elderly multifactorial imbalance and discusses factors that triggers fall movement. The author reviewed the underlying pathology of disequilibrium along with an assessment of how the current evaluation methods and exercise protocols are used to help prevent falling movement in elderly people. Patients must be induced to perform customized physical exercises under safe conditions. We can conclude that the main objectives of current programs were to encourage patients to develop an efficient personalized strategy of equilibrium and to increase their level of physical activity to prevent fall.

3.53. Bone Density and Metabolism in Children and Adolescents with Moderate to Severe Cerebral Palsy

Richard C. Henderson, M.D, PhD, Robert K. Lark, M.S, Richard D. Stevenson, M.D, and Mark Conaway, PhD

The main objective of this paper is about the diminishing bone density and a natural inclination to fracture with minimal trauma is common in children and adolescents with moderate to severe cerebral palsy. The purpose of this study was to provide a detailed evaluation of bone mineral density. A group 117 children from an age group of 2 to 19 years with moderate to severe CP as defined by the Gross Motor Functional Classification scale. The evaluation method included measures of BMD, a detailed anthropometric assessment of growth and nutritional status, medical and surgical history. The results obtained was that Osteopenia (BMD *z* score<2.0) was found in the femur of 77% of the population and 97% of all study participants who were unable to stand and were older than 9 years. Fractures had occurred in 26% of the children who were older than 10 years. In stepwise regression analysis, it was found that severity increases the difficulty in feeding the child. We can conclude that Low BMD is prevalent in children withmoderate to severe CP and is associated with significant fracture risk. The underlying pathology is complex, with multiple factors contributing to the problem and significant variation between different regions of the skeleton.

3.54.Upper Limb Motion Analysis using Haptic Interface

Marco Muhihand Anton Zupan

University of Ljubljana, University of Rehabilitation Institute

The main objective of this paper was evaluating the functional studies of the upper limbs in patients with neurological diseases. This method allows assessment of kinematic and dynamic motor abilities of upper limb. This methodology is based on creating a virtual environment, using a computer display for visual information and a PHANTOM touch interface. In virtual environment, a labyrinth in patient's frontal plane was created at the start of each test. By moving the touch interface with the help of a control stick the patient was able to move the pointer through the labyrinth in 3dimensions and to feel the reactive forces of the wall. The patient's primary task was to pass the labyrinth as quickly as possible, with as few collisions with the walls as possible. The test made various degrees of complexity possible; by choosing labyrinths with various track width and length, and by changing wall friction. The new test offers a wide range of numerical and graphic results. It has so far been applied to 13 subjects with various forms of ND as well as to healthy subjects. We can conclude that the comparison in performance between right and left UL has been carried out in healthy subjects.

3.55. Progressive Ideomotor Apraxia: Evidence for a selective Impairment of the Action Production System

Steven Z. Rapcsak, Cynthia Ochipa, Kathleen C. Anderson and Howard Poizner

Department of Neurology, University of Arizona, Arizona, Center for Molecular and Behavioural Neuroscience, Rutgers University, New Jersey, James A. Haley Veterans Hospital, Tampa, Florida

This paper describes about a patient with slowly progressive bilateral limb apraxia associated with an asymmetrical focal degenerative progress of the parietal lobes. A Clinical assessment of the praxis suggested that a striking deficit in controlling the spatiotemporal attributes for the purposeful skilled limb movements which was

consistent with ideomotor apraxia. This precise nature of the action production impairment leads to the Main objective, which is three dimensional computerographic analysis of transitive movements which demonstrated significant kinematic deficits in spatial accuracy, timing and joint coordination. A detailed evaluation of the praxis system revealed that despite almost complete inability to perform transitive movements, Abstract knowledge of the tool function was present in was remarkably well preserved. The complex dissociation between intact conceptual knowledge of action and impaired movement documented in this cases provides support for cognitive models of practice. We can conclude that apraxia is interpreted to represent a selective disruption of the action production system

CHAPTER 4

Method of study

4.1. Experimental Method:

The method of study involves understanding of the Physiological mechanism of human body to maintain equilibrium and orientation in space. The main aim of this approach is to develop a system based prior diagnostic method for Neurological disorders and balance control. Balance control can be of two types (1) Sensory control and (2) Motor control.

4.1.1. Sensory Control:

Sensory control is determination of position of body depending on the environmental conditions. It depends on visual system, vestibular system and somato system, whereas Motor control is ultimately the choice of body movement. It depends on the muscle contractile patterns i.e ankle and thigh, trunk and neck, eye and head etc.

The main purpose of this experiment is to

- Use the distance based method for analysis of multidimensional data.
- To analyze the interaction of visual and vestibular analyzers.
- Study the various methods of accessing vestibular function.

This experimental mainly focuses on the following criteria

- Stabilometry – Movement tracking of Centre of Pressure
- Markerless movement capturing system, Multiparametric assessment of Postural tests.
- To use the virtual reality to access the interaction of visual and vestibular analyzers.
- Oculometry – Using biofeedback for controlling Vestibular function.

4.1.2. Stabilometry:

It is the study of postural equilibrium under the presence of gravity. It is mainly used for movement tracking of centre of pressure. The basic indicators used for the above are

- Statokinesigram : It is a layout of line connecting the successive positions of the centre of pressure during the recording, it is not necessarily a geometric figure. It is used for quantifying the dispersion of successive positions related to the centre of pressure.
- Vector Statokinesigram : It is a graphic record of magnitude and direction of electronic voltage of the body converted through A/D converter. This is used for comparative study of direction of body sway of healthy young adults and elderly patients.
- Function of balance.
- Dynamic Postural stability index.

The tests undertaken for stabilometry involves Romberg's test which involves test for turning of head correlation stabilogram and breaths.

4.1.3. Markerless movement capturing system:

Markerless movement capturing system involves multiparametric assessment of postural tests. It allows full body 3D motion capture and analysis without any markers.

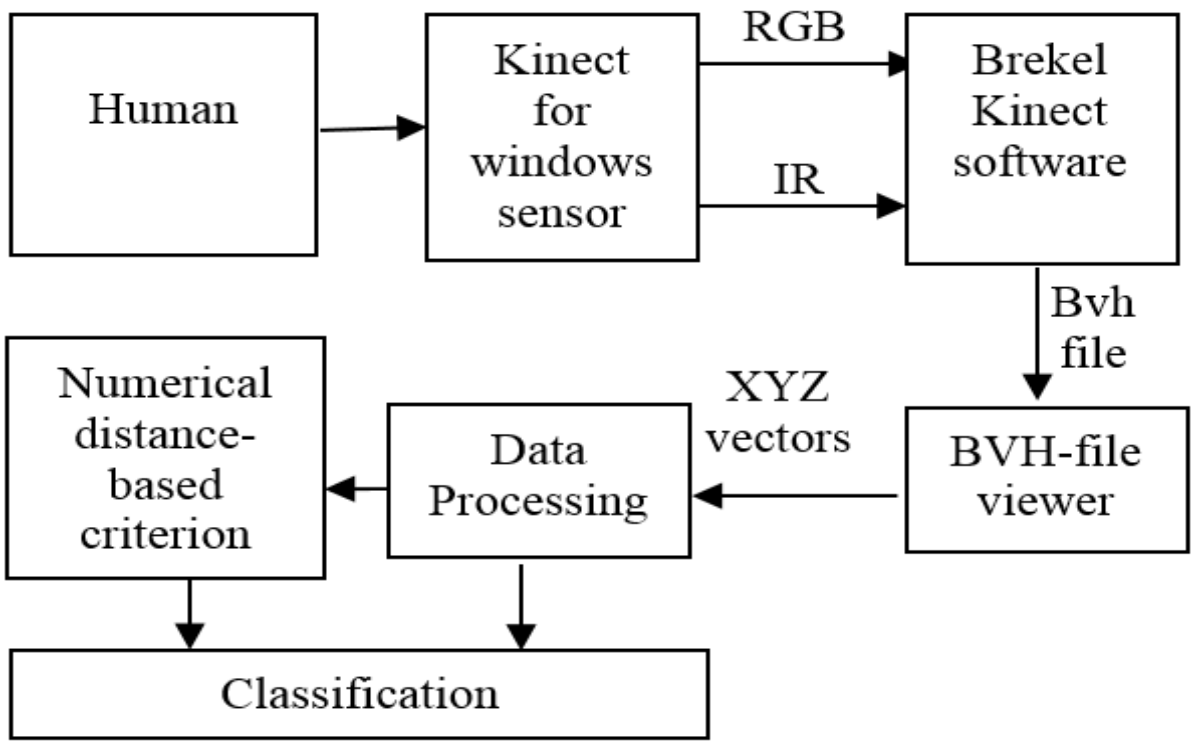

Fig 4.1

Using virtual reality systems to access the interaction of visual and vestibular analysers. It is analysed by Balance Evaluation system test using virtual reality. The development and application of virtual environment for virtual reality device VR Shinekon, for assessment of the impact of neurological tests in a virtual reality system to maintain balance of patients with Parkinson's disease.Virtual three-dimensional visual environment is a room decorated in neutral black with bright orange lines and boundaries between floor-wall-ceiling . This design does not have any distraction, which allows for assessment of the functional state of the system to maintain the equilibrium of the human body.

Fig 4.2

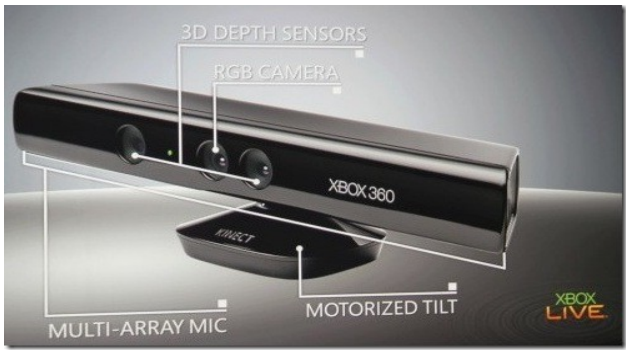

Fig 4.3

4.2 Unity 3d:

3D formats

Unity supports importing meshes from two different types of files:

- **Exported 3D file formats**, such as .fbx or .obj. You can export files from 3D modeling software in generic formats that can be imported and edited by a wide variety of different software.
- **Proprietary 3D or DCC (Digital Content Creation) application files**, such as .max and .blend file formats from 3D studio max or blender, for example. You

can only edit proprietary files in the software that created them. Proprietary files are generally not directly editable by other software without first being converted and imported. An exception to this is sketch up .skp files, which both by Sketch Up and Unity can read.

Advantages:

- Instead of importing the whole model into Unity, you can import only the parts of the model you need.
- Exported generic files are often smaller than the proprietary equivalent.
- Using exported generic files encourages a modular approach (for example, using different components for collision types or interactivity).
- You can import these files from software that Unity does not directly support.
- Exported 3D files (.fbx, .obj) can be reimported into 3D modeling software after exporting, to ensure that all of the information has been exported correctly.

4.3. VR Shinecon:

The VR Shinecon is a virtual reality headset with smartphone iside. The VR Shinecon has a OLED display, 1080×1200 resolution, a 90 Hz refresh rate, and 110° field of view. It has integrated in smart phone headphones which provide a 3D audio effect, rotational and positional tracking. This creates 3D space, allowing for the user to use the Rift while sitting, standing, or walking around the same room.

4.4. Epson Moverio BT-300:

The Moverio BT-300 spots a transparent display that projects images on an 80 inches floating screen 5 meters in front of your eyes. There is also a 5 Megapixel camera located at the front of the glasses along with the motion and ambient light sensors.

While not the most stylish glasses that you would wear around, it is definitely a much improvement from its predecessor with an almost “Google”-like design.

The Moverio BT-300 is connected to an Android controller that has a track pad and basic Android buttons through a wire. This provides a familiar interface to existing Android user although an improvement would be welcome in the form of wireless or swipe/gesture control.

Fig 4.4

4.5. Kinect:

Released in November 2010, Kinect is a relatively low-cost (about $149) device developed by Microsoft that provides joystick-free gaming just using body

gestures recognition. The device provides a color camera, microphones, accelerometers, and a motorized tilt; however, the most important and novel component is a depth camera.

The depth sensing is provided by an infrared (IR) projector that projects a fixed structured light (consisting of a pattern with millions of small dots), and an infrared camera captures the reflections of this pattern and provides an 11-bit single-band image (i.e., from 0 to 2,048). The microprocessor inside Kinect performs stereo triangulation between the image captured by the infrared camera and the original pattern, obtaining the depth information for each point on the field of view. The output of this triangulation is the depth image, which is a gray-scale image, where the intensity of each pixel is proportional to the depth, which is the distance from the device to the object on the scene in the corresponding pixel position.

Fig 4.5

All the cognitive features like players and gesture recognition are not really performed by Kinect. The device itself just provides the cameras, leaving the recognition itself to be executed by software that implements state-of-art computer vision methods based on depth images.

Advantages:

- The ability to use different methods of instrumental and objective assessment of balance function.
- Skills of multidimensional data analysis applied to real medical data.

4.6. Leap motion Sensor:

The Leap Motion controller is a small USB peripheral device which is designed to be placed on a physical desktop, facing upward. It can also be mounted onto a virtual reality headset. Using two monochromatic IR cameras and three infrared LEDs, the device observes a roughly hemispherical area, to a distance of about 1 meter. The LEDs generate pattern-less IR light and the cameras generate almost 200 frames per second of reflected data. This is then sent through a USB cable to the host computer, where it is analyzed by the Leap Motion software using "complex maths" in a way that has not been disclosed by the company, in some way synthesizing 3D position data by comparing the 2D frames generated by the two cameras. In a 2013 study, the overall average accuracy of the controller was shown to be 0.7 millimeters.

Fig 4.6

The smaller observation area and higher resolution of the device differentiates the product from the Kinect, which is more suitable for whole-body tracking in a space the size of a living room. In a demonstration to CNET, the controller was shown to perform tasks such as navigating a website, using pinch-to-zoom gestures on maps, high-precision drawing, and manipulating complex 3D data visualizations.

Leap Motion initially distributed thousands of units to developers who are interested in creating applications for the device. The Leap Motion controller was first shipped in July 2013. In February 2016, Leap Motion released a major beta update to its core software. Dubbed Orion, the software is designed for hand tracking in virtual reality.

CHAPTER 5

Results

From the results obtained from our study, we have created three software oriented programs for assessment and rehabilitation of motor disabilities.

5.1. Equilibrium and Walking Assessment:

The first program was developed for the purpose of equilibrium assessment by using virtual and augmented reality. During the study patients were advised to imagine as they were climbing steps and video capture system registers X,Y,Z coordinates of 20 segmented body model. The process takes 5 minutes. In first

stage patient need to stay in Romberg pose during first 15 seconds. Then in second stage, he/she is marching on the same place and sometimes they have to overstep the obstacles. In the third stage, they were also asked to stay still for 15 seconds in Romberg pose.

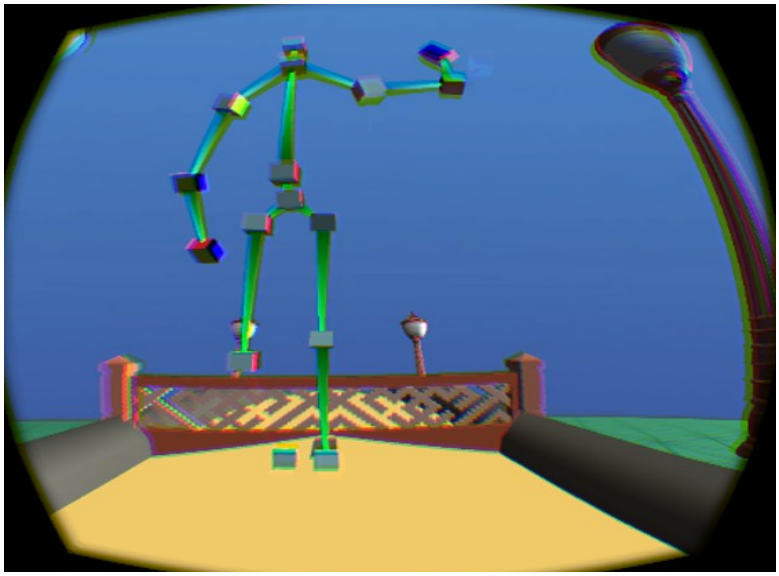

Fig 5.1. Interface of user for virtual environment

During the test we recorded the data in the form of CSV file. The discretization of data is 50 points per second for 20 segments of body. As a result we can build the graphs for each segment of body in time scale.

time	joint	pos_x	pos_y	poz_z
6.726	3	-0.212	1.695	2.576
6.785	3	-0.212	1.695	2.576
6.839	3	-0.212	1.695	2.576
6.908	3	-0.211	1.696	2.578
6.963	3	-0.210	1.698	2.581
7.025	3	-0.208	1.699	2.583
7.094	3	-0.207	1.699	2.585
7.147	3	-0.205	1.699	2.588
7.221	3	-0.202	1.698	2.589
7.276	3	-0.200	1.698	2.592
7.337	3	-0.198	1.698	2.595
7.409	3	-0.197	1.698	2.597
7.466	3	-0.196	1.697	2.599
7.533	3	-0.195	1.696	2.600
7.589	3	-0.194	1.696	2.601
7.660	3	-0.194	1.696	2.603
7.717	3	-0.195	1.696	2.605
7.783	3	-0.195	1.696	2.606
7.844	3	-0.195	1.696	2.607
7.898	3	-0.195	1.696	2.608
7.973	3	-0.195	1.696	2.608
8.052	3	-0.195	1.697	2.609

Fig 5.2. Structure of data file for registering motion.

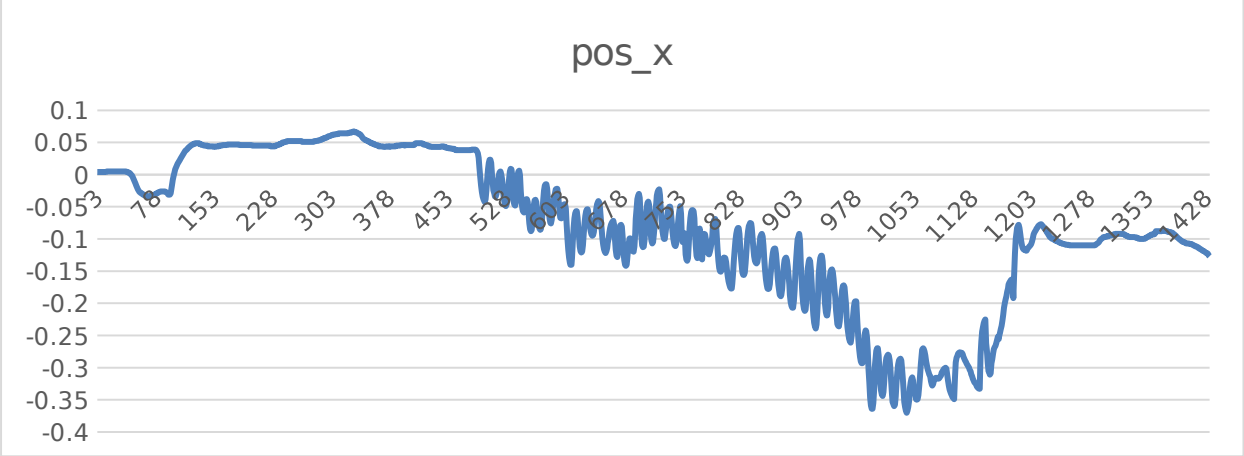

Fig 5.3. X-coordinate center of spine during the study

5.2. Hand Motion and Tremor Assessment:

We create the software for assessing hand and finger motion during Gorbov-Shulte test by using augmented reality. The main idea of this methodology that we could

use simple tasks to record information about tremor during rest and tremor during movement. When the test starts patient need to stretch out their arms for 15 seconds, then after pressing space bar half of cubes become red. Patient need to press it one by one, firstly red ones, then black. As a result all of cubes become green. During this process we record the data of movement for palm and every finger in CSV structured file. Then we can process the data and check out frequency and amplitude of the tremor in rest and during the movement.

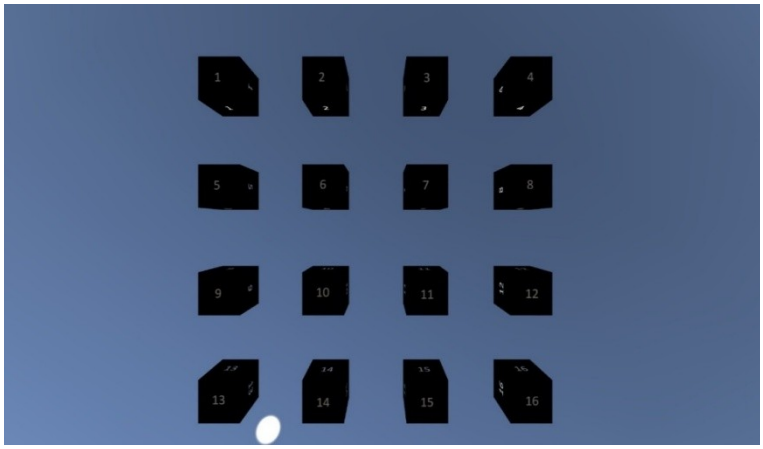

Fig 5.3. Initial view of virtual reality

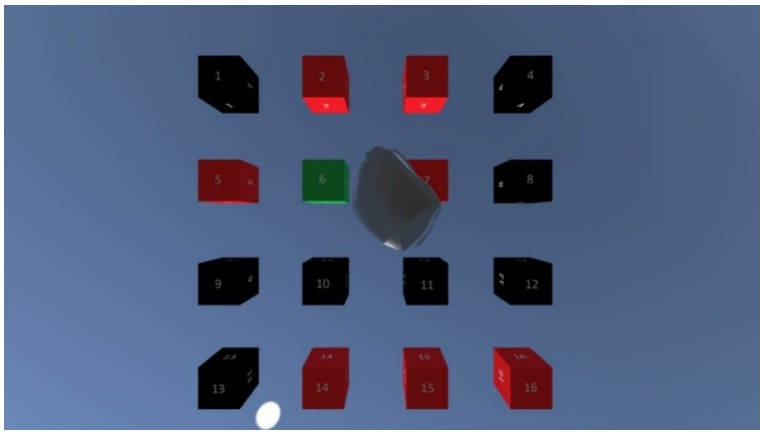

Fig 5.4. Start of Gorbod-Shulte test

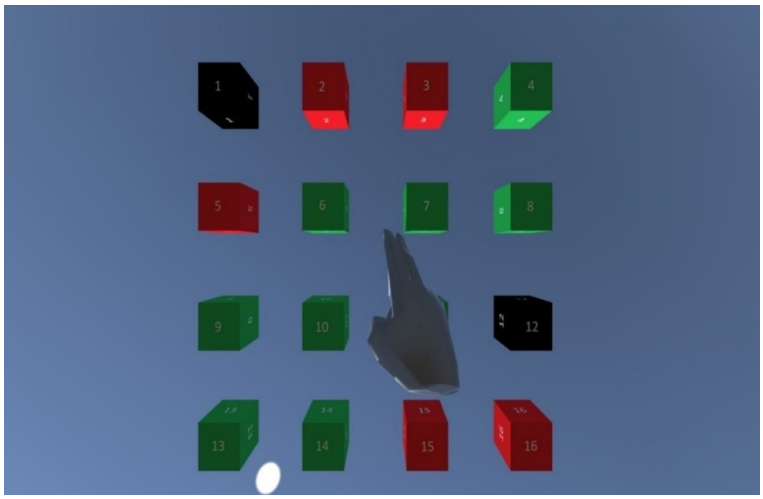

Fig 5.5. Interaction of patient with virtual object

5.3. Hand Motion and Tremor Assessment – Augmented Reality Version

To improve previous program we create software complex that consist of two parts

- Server application - it can register the motion data, save it in CSV file and send it to mobile device with using wi-fi network

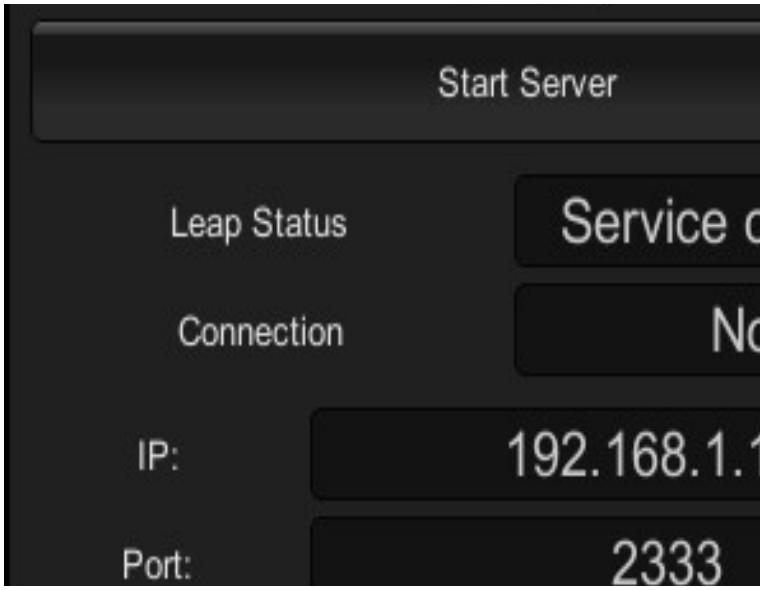

Fig 5.6

- Android application for augmented or virtual reality glasses. With using of this software patient can interact with virtual environment. The main idea that android device support feedback for movement of head and also get data from the desktop to provide interaction with virtual objects by using motion capture sensor

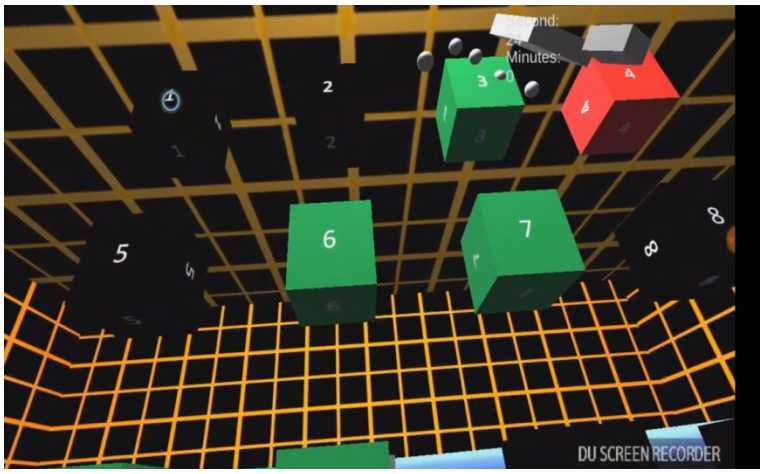

Fig 5.7. Virtual environment android application

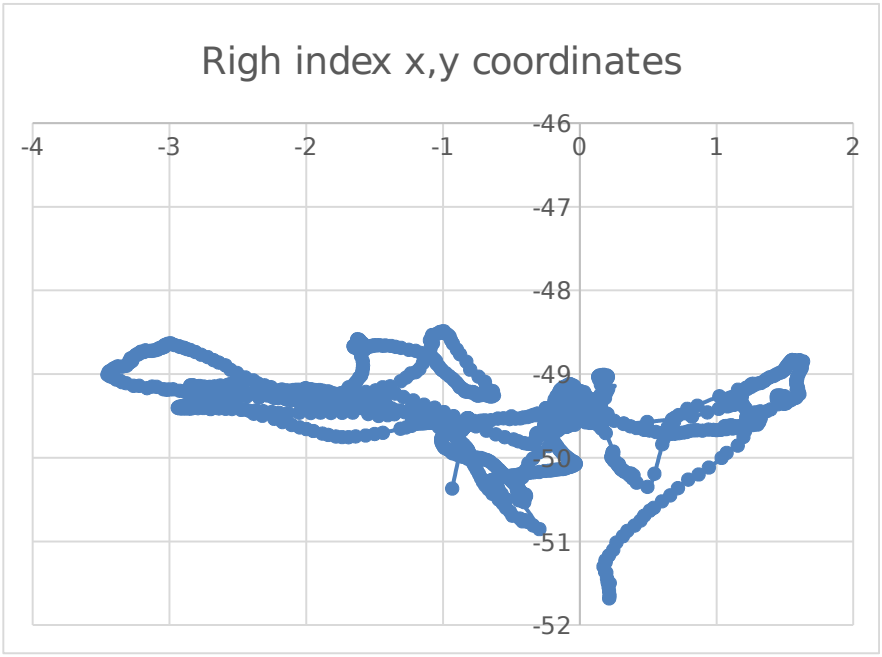

Fig 5.8. Trajectory of |right index during the test

CHAPTER 6

FINANCIAL DEPARTMENT

6.1. Theme of the Project:

The main aim of this project is to create an augmented reality in the form of a rehabilitation program for people with neurological disorders such as Parkinson's disease, Multiple sclerosis, People affected by strokes etc; which is accompanied by imbalance in posture and developing balance rehabilitation methods for patients with vestibular malfunctions. The Postural abnormalities are caused by functional or morphological variation of the equilibrioception system. These disorders weaken the Central Nervous system's ability to process vestibular, visual and proprioceptive signals which are responsible for maintaining balance in posture. Due to this the plasticity of the nervous system is reduced which leads to disfunctionality. The methods which are used currently for evaluating postural reflexes have low sensitivity and specificity. In this system, a virtual environment is designed for motion and equilibrium assessment.

The most common diseases associated with Neurological disorder are Parkinson's disease (PD) and Multiple sclerosis. Parkinson's disease is a long term Neurological disorder that affects the central nervous system. It affects the nerve cells in the brain that produces Dopamine. In brain Dopamine functions as a neurotransmitter which is a chemical produced by nerve cells in order to send signals to other nerve cells. Dopamine acts as a chemical messenger and also plays a major role in Reward motivating behaviour, this helps in increasing the dopamine level in the brain. They are also involved in motor control and release of various hormones in the body.

Multiple sclerosis (MS) is generally referred to as demyelinising disease in which the myelin sheath of the neurons of the brain and the spinal cord are damaged. This

damage disrupts the conduction of signals, communication in the affected nerves. The symptoms may include mental, physical and even psychiatric problems may even occur. The most common symptoms include blindness in one eye, double vision, trouble with sensation, muscle weakness and trouble with coordination.

We have built this rehabilitation program using UNITY 3D software for creating 3D models. This involves three stages. At first a 3D model has been designed, which is nothing but a Markerless Motion Capturing system, where the subject is made to wear a virtual reality device **Shinegon** and their motion is monitored using **Kinect**. The subject is instructed to perform certain body movements like Walking, Jumping etc and the data which is obtained is being recorded.

Secondly a 4*4 matrix cubes have been designed. The cubes are assigned numbers and three different colours which are black, red and green. In this case the subject is instructed to touch the boxes using augmented reality glasses which is **Epson 300**. The finger movement is monitored using **Leap Motion** Sensor. Intially the boxes will be black, when comes in contact with the hand it changes to red and when the subject takes off their hand from the boxes it changes to green. The obtained data has been collected and recorded.

Thirdly, in order to improve previous program we create software complex that consist of two parts

- Server application - it can register the motion data, save it in CSV file and send it to mobile device with using wi-fi network.
- Android application for augmented or virtual reality glasses. With using of this software patient can interact with virtual environment. The main idea that android device support feedback for movement of head and also get data from the desktop to provide interaction with virtual objects by using motion capture sensor.

6.2. Resources Required:

- VR Shinecon
- Epson Moverio BT 300
- Kinect
- Leap Motion Sensor
- Computer

6.3. Cost of the Resources:

- VR Shinecon – 1,500 Rubles
- Epson Moverio BT 300 – 60,000 Rubles
- Kinect – 3000 Rubles
- Leap Motion Sensor – 4,500 Rubles
- Computer – 20,000 Rubles

6.4. SWOT Analysis

6.4.1. Strength:

- The main advantage of this project is that it serves as a rehabilitation tool for people affected by Parkinson's disease, Multiple sclerosis and also people who were affected by stroke and have movement impairment.
- This program mainly serves as a confident booster for the affected people. Their stress level will be much higher than that of the normal person and it

will be very difficult for them to cope up with our day to day lifestyle. It will be a great way to improve their ability to boost their confidence.

- It suits according to the latest technology and Development going on in the field of medicine, it can be used in the form of a mobile application.
- It analyses and measures each and every movement of the subject from all the directions. Even the minute of movement can be recorded. Unlike the old technology, movement is not restricted up to certain distance and Imbalance in posture and tremor can be recorded within fraction of seconds.

6.4.2. Weakness:

- The Challenges faces are that this Research is now subjected only for Scientific Trials and not undergone any Clinical trials.
- When undergoing Clinical trials it should be approved by the Ministry of Health and Science, Russia and also should pass all the Ethical clearance tests.
- This is mainly a software oriented approach which does not affect the subjects mentally or physically, but necessary precautions were taken before the start of the experiment.
- The softwares are regularly updated with newer features, hence the current programming has to be changed to make it suitable for the newer versions of the software.

6.4.3. Opportunities:

- This is an entirely new approach which serves as a rehabilitation program for people who have movement disabilities.
- This will open higher amount of employment for fresher students who are knowledgeable with softwares like Unity 3D.
- This also can provide opportunities for cross platform projects for further improved systems.
- It creates numerous employment opportunities in various fields as the project can be applied in various fields.

6.4.4. Threats:

- It is still under scientific trial and has to undergo Clinical trials.
- Even though this is a very modern approach in medicine, Doctors must agree to proceed with this program for the patients.

CHAPTER 7

SOCIAL RESPONSIBILITY

7.1.OCCUPATIONAL SAFETY:

The main concern for occupational safety in this project is electrical shock from the working equipment.

7.1.1. Identification and analysis of workplace hazards, which the research object can create for people:

The main workplace hazard which arises from this project for people using the system is the electrical shock hazards that may occur due to poor wiring and insulation. Therefore all the connections have to be thoroughly inspected and checked before the operation of the system. Mainly we need power backup. With thoughtful system design that targets clinical and research applications which are well matched to current technology assets and limitations, it is predicted that VR rehabilitation will continue to gradually grow and gain acceptance as a mainstream tool.

7.1.2. Identification and analysis of workplace hazards, which may influence a researcher during the research process:

Most of the time spent during the research process by the researcher is coding and working on the computer. Care has to be taken while working and safety equipment had to be always worn by the researcher for safety precautions. Also the data which is used for research is important, it has to be safely stored in a secured database.

7.1.3. Protection methods to mitigate the potential damage:

Safety checks has to be done periodically to avoid any potential damage from the shock and other electrical factors associated with the system.

7.2. ENVIRONMENTAL SAFETY:

The main purpose of this thesis was to design a 3D model image viewer for augmented reality and it was successfully done. The current implementation of the application is a rough development preview but it has met all the main requirements which were set in the beginning. We found that the greatest **s**trength of this kind of display is that the viewer can study a fixed 3D image from different directions, simply by walking around it. So this project does not have any kind hazardous emissions or components that affect the environment. Care has to be taken during the disposal of the waste products which includes wiring and other electrical components used during the experimental trails.

7.2.1. Impact analysis of research object on environment:

A weakness is a limitation, fault, or defect in the entity that impedes progress toward defined goals (e.g., the limited field of view and resolution in a head-mounted display can limit usability and perceptual realism). Electrical wastes are the only problem associated with the project on environment, hence the waste products that arise during the project trails has to be safely disposed.

7.2.2. Impact analysis of research process on environment:

There is not much impact by the research process on the environment as it is mostly done by a software on a computer. This approach can be used in clinical practice for people with movement disabilities.

7.2.3. Protection methods to mitigate the potential damage:

The project is dependent on fast computers to perform the data processing and imaging .The electrical wastes had to be disposed accordingly to prevent its potential damage on the environment.

7.3. SAFETY IN EMERGENCY:

Safety is a critical issue for the construction industry. Literature argues that human error contributes to more than half of occupational incidents and could be directly impacted by effective training programs. A safe working environment where users can effectively rehearse tasks with electrical hazards and ultimately promote their abilities for electrical hazard cognition and intervention. Its visualisation and simulation can also remove the training barriers caused by electricity's features of invisibility and dangerousness

7.3.1. Identification and analysis of emergency situations, which the research object can create:

The main emergency situation that arises is fire due to short circuits and electrical shock by physical contact. Proper isolation of the power supply unit and insulation of the wires can prevent these emergency situations.

7.3.2. Identification and analysis of emergency situations, which may occur during the research process:

Programming in the software is a difficult task, each simulations has to be programmed separately and precisely.

3.3. Protection methods to mitigate the potential damage:

Proper backups and antivirus and antimalware software's has to be installed to protect the data during the research process.

7.4. WORKPLACE DESIGN:

Do not use electrical equipment or appliances near water or wet surfaces. Never use electrical equipment when your hands or the equipment is wet. The workplace should be neat and dry, as a moist working place can cause problems to the electrical components of the project. Use extension cords temporarily. If you need the extra length more often, speak to a certified electrician to install additional electrical outlets.

CHAPTER 8

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