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VIRTUAL REALITY BASED BALANCE TRAINING FOR ENHANCING BODY BALANCE

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Abstract:

Stroke is very major cause of body disability which also leads to death.There are impairments in body movements, sensory activities, and motor activities in stroke patients.2 off 10 people are getting affected by motor skill disability due to stroke and this rate increasing every year.Diabetes and high blood pressure are the major cause for stroke.In some cases, bleeding from the brain only causes a temporary disruption, known as a transient ischemic attack.The main objective of this paper is to cure patients experiencing stroke through Balance training based Virtual Reality.Considering the advancement in electronics and computer applications, Virtual reality medicine and 3D-technology enhance health care in many-way.Which aslo include surgery,physiotherapy,rehab. During balance training,patient can able to control the voluntary body movements by giving proper actions to disabled location of bone and muscle.This helps to learn more about the application of psychiatry, rehabilitation, stroke recovery for future purposes.

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Keywords: VR, Stroke ,Motor activities,coordination exercises,psychiatry,impairments,3-D technologies,rehabilitation,MSP430,Unity.

I.INTRODUCTION:

Virtual reality is a machine - human brain interface using computer,which gives visual environment to the individuals whom using it.Nowadays,virtual reality has been using in various fields of medical application.Most importantly,it is more beneficial in stroke rehabilitation.Virtual reality compiles the 3D objects designed and lights of the output,which represent through VR box shows augmented models and environments to be more real.It is clinically proven that Virtual reality brings focus to the patients during balance training of stroke recovery which enables consistent recovery.Rather than this, our idea also useful for people in their body balance training.A board made of any fibre or wood material is going to be the balance board for this project.we can place one or more board based on the balance factors and types of exercise.

Before, learning about the techniques of body balance,we should know some basic things related to human body locomotion. Generally, the study of human body locomotion or study of walking is called as gait-cycle.It is used as assessment for patients who are unable to walk known as Gait analysis.It is useful in analyzing patients who are affected by stroke causes risk in body movements.

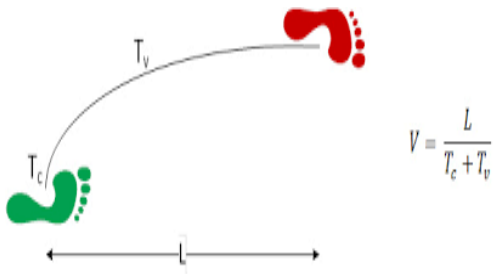


Figure 1: Gait analysis technique**.**

II.CONCEPTS OF BIO MECHANICS:

Centre of pressure:

In a surface, at any point the total vector forces of human body acts to provide necessary support is called as Centre of pressure in human body.

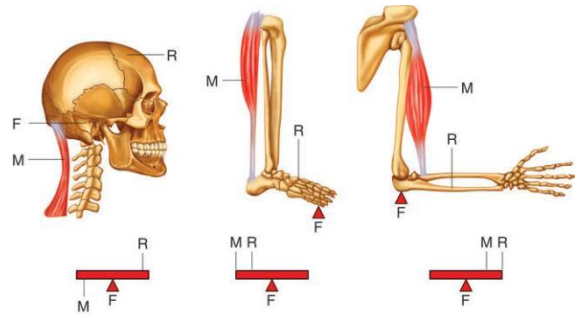


Figure 2: Body pressure points**.**

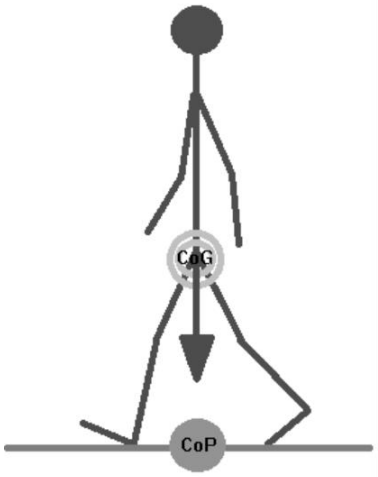


Figure 3: Centre of pressure of human body**.**

Stride:
While walking, when we take a long step is said as stride.

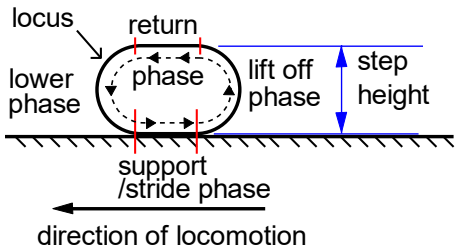


Figure 4: Long stride phase in gait cycle**.**

Stance:
Stance is defined as posture of body or contact of entire body against surface by foot.

III.LITERATURE REVIEW:

In this case,we have provided the related work for this paper. Jinhwa-jung, Jaehoyu, Hyung-kyukang were jointly proposed a paper related to VR based rehabilitation to stroke patients using treadmill for body-coordination.Their objective is to access patient through VR and provide walk training.This helps patients to recover from Stroke completely. Haruka motomatsu proposed an paper related to virtual reality in medical field and its application.In this paper author clearly explained the application of VR in stroke recovery using coordination-exercises.Chun-Chen,Tsai-Cheng,Shih-Ching,Chia-Ying Chung were jointly proposed a paper for hemiplegic stroke patients.The aim of this paper is used to increase the skills of inner organs of ear by giving exercises using VR and to support brain coordination.Astrid-zech,Markus-hubscher,Luts-vogt,Wintfried bazard were jointly proposed a paper related to neuro-muscular dysfunction and recover it by using balance training and walk training through virtual reality. They provided basic training to help Patient to recover from neuro-muscular disability.The training includes proper step walking,core-body muscle coordination exercises.

IV.PROPOSED MODEL:

Our proposed model is about providing necessary -
Training to patients via virtual reality and to identify the body balance reports that ensure patient's proper body posture.Basically, we made an balance board which enables patients to know their appropriate load distribution over it.This information can be processed during the training.so,
here we used Arduino UNO Micro controller which has 14 pin and enough sufficient to operate in low temperature without any struggle.We developed game using Virtual reality and 3D models in unity platform which employs major role in performing body balance training.Here we use electronic weighing scale sensor to know the patient load that is happened in stroke patient health aberrations.

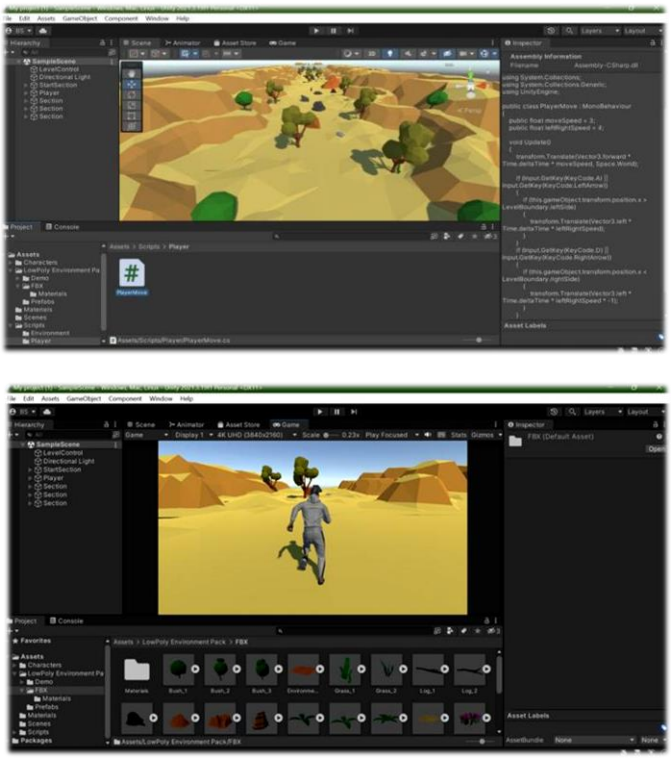


Figure 5: Images of our game in Unity

Apart from the Unity,patient can able to find their centre of pressure (COP).Systematically,there are two ways of finding body balance.Either we can set up array of load cells in unknown space or we can set up load cells based on the area of the shape.By taking total average values of load cells resulting values,it gives us an balance output values.

V.HARDWARE REQUIREMENTS:

- Arduino UNO -Micro controller.
- ESP32-Module
- Plywood - (3x3) feet
- Weighing sensor - 35/40 kg.
- Grh5yInstrumentation amplifier-INA 329 or INA 328 or INA 129

ARDUINO UNO:

Arduino UNO is a 14 pin micro controller.There are analog pins ranges from A0-A5 and digital pins ranges from 0-13.It requires 5V as power which is a regulated power supply for the controller and also other external components.

Figure 6: Arduino UNO

Analog pins which contains various range of pins used to work with different accessories.Power connecting supporter helps to provide very lower value power that supports LED.

INSTRUMENTATION AMPLIFIER:

Figure 7: INA 125P - Texas Instruments

Here we took INA125P for this project which supports maximum power supply of 36 voltage in reduced amplification.It's standard operating heat will be balance around the temperature of 45 to 80 degree.We can adjust baud rate to transmit easily.It
can produce higher value frequency to access the desirable ranges of frequency.

HX711:

HX711- Weighing sensor amplifier or IC in common used in amplifying the variable baud rate of load cell values which is mainly employs to rectifies the values and ease in measuring weight or load applies on Load cell.We can use this as alternation of INA 125P.It is also similar in application in cases to measuring load values.It is directly interfaces to the arduino uno and loadcell using power of 5V input through UNO.

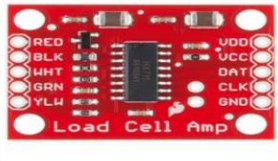


Figure 8: HX711

WEIGHING SENSOR:

For the concept of calculating the load distribution of patient during exercises,we can able to access the load using load cell which is otherwise called as weighing sensor.35 or 40 kg load cell-total of 4 pieces can be taken and at set up in the (3X3) plywood corners which is square in shape.A load cell is a wide bar which can able to identify the tension applies or pressure applies on the are calibrated with it.This is the purpose we learns concept of human biomechanics previously.

Figure 9 : Load cell

Specifications of Loadcell:

- It is a 40 kg Load cell.
- It is supported by Input power of minimum of 5 voltage to 12 voltage .
- It has precision value of 0.02%.
- Non linearity upto 0.017%.

VI.SOFTWARE REQUIREMENTS:

Unity is a game development engine,through which we had compiled our required game in application of VR that you seen already with our model concept above.The total software size is about 6gb with everything included such resources,textures,etc...PC which we are work must have 8 - 12 gb of ram to access game compiler quick as possible.Minimum of radeon graphics and windows 10 is preferable for hassle free process.

ARDUINIO IDE:

Arduino IDE is the official software which is used to code the board in order to perform the commands given to the port and its components functions.

UNO has 14 pins digital and 6 analog pins to interr-
upt and interface multiple functions.For IDE,we can use C++ programming language codes to command.
Although Arduino IDE has serial monitor and serial plotter which is used to view the real time results in numerically and also as graphical representation.

UNITY ENGINE:

Using Unity platform we can compiled a game which is used in Virtual reality.Basically we can use C# programming language to code and get required game environment.Further code for signal amplifications can also applies here to sense motions.

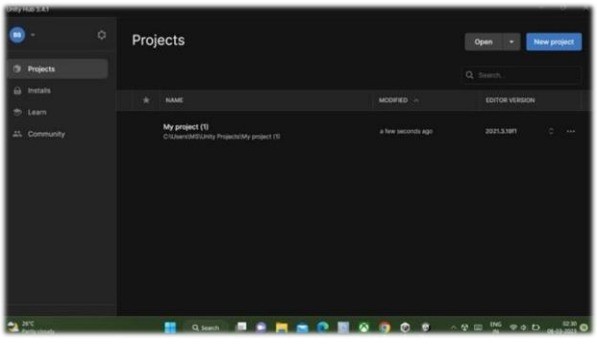
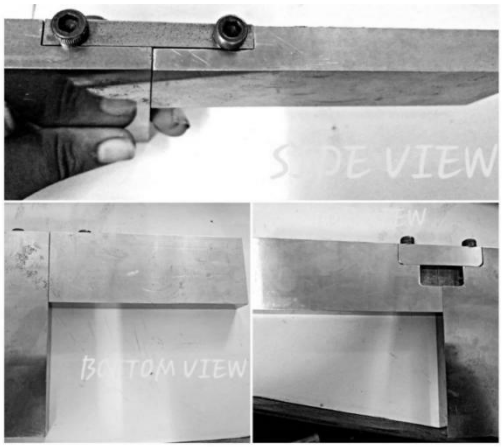
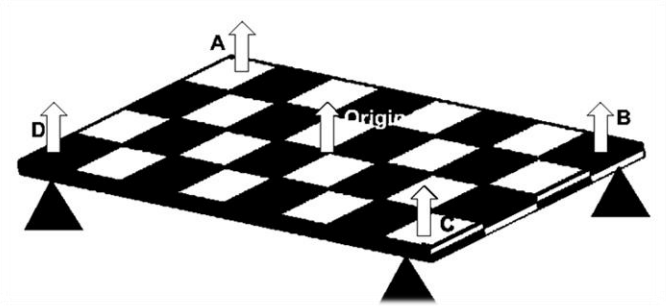


Figure 10: Unity project console

VII.WORKING SYSTEM:





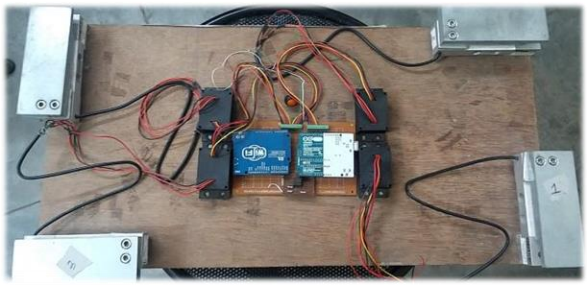


Figure 11: Load cell Integration

In a plywood of measurement 3X3 feet, we had placed 4 loadcells in which each load cell weighs upto 40Kg.We took this in basis of formula area of square which covers along the base of board equally ,which ensures no partial distribution of area undertaken with this.Hence, now board can cover its measuring spaces upto all the board square.Then we had attached our loadcells and arduino on board and interfaces the arduino to loadcells using C++ codes.Before installing components into the board, we should need to calibrate our load cell to check whether its works properly or not and then

we use to interface through separate codes for arduino - loadcells and VR game codes to arduino.Finally,the board is now ready to equip for games and coordination exercises.Though it will gives us exciting results through arduino serial monitor and serial plotter by setting appropriate baud rate.

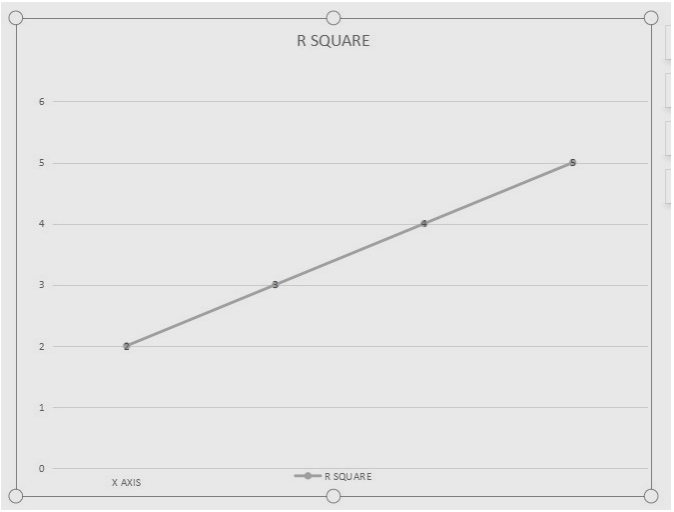


Figure 12 : Root Mean Square Value

RESULTS:

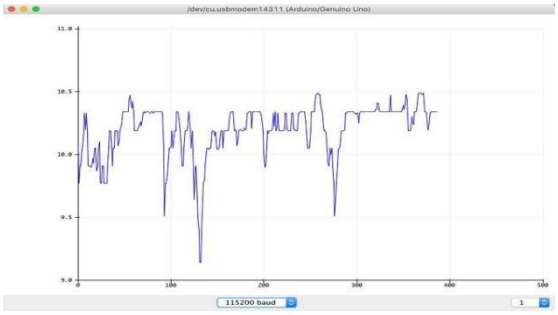


Figure 13: Calibrated-Loadcell representation - Serial plotter

CONCLUSION:

So, here we are in our final stage that is we have our working prototype with us.Our arduino works
well and it sends commands in desired manner.
We are trying to design the same prototype with different micro controllers in order to implement our project to next level and its processing efficiency is very much important in this case to perform in long period without any errors.Already we had started regarding this and we hope,very soon we hit market with affordable prototype for patient care.
We sincerely wants to express our thanks to our guide for his support to do this prototype.

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