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# Fabrication of a Locally Designed Dual Power Supply Hand – Eye Coordination Tester with a Micro controller IC Interface.

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**Abstract**
High rate of instability in our environment today including other stressors have led to increase in stress and other health related issues, which together with other life challenges affect the ability of our central nervous system to focus and coordinate the external activities we engage in, leading to most Hand-Eye Coordination impairment. Testing and engaging in routine exercise have been reported to improve Hand-Eye Coordination. In this study, we presented a simple user friendly device made with locally sourced materials, using micro controller IC as interface that served a dual purpose of testing the coordination and stability level of an individual and also enhance the progress of recuperating patients while playing it routinely as a simple game. Random Hand-Eye Coordination test was conducted among 60 persons within the age range of 40 – 65 years. 10 persons were selected among the sample size with hand-eye coordination impairment and were subjected to the use of our device for 10 days after which they were tested for coordination level. The result showed great improvement on 8 persons, as they score above 7 points, representing 80% of those who used the device while only 2 persons representing 20% scored below 7 points, indicating that, the use of the device was effective in improving the level of coordination of the individuals tested, implying that the device is satisfactory.
**Key words: Hand-Eye, Coordination, Tester, Stress, Fabrication, Device.**

## I. INTRODUCTION

The nervous system**,** one of the most important and complex systems of our body, is primarily concerned with responses to external and internal stimuli. Hand-eye coordination (HEC) is a fine motor skill in which one's hands and sight work together [1, 2] to be able to do things that require speed and accuracy, [3, 4]. The eyes direct attention (gaze) and the hands execute the task[5, 6, 7]. It is a complex neurological process that begins when the eyes send visual information to the brain, which in turn integrates the data and turns them into a three-dimensional image.

In biomechanics, balance is an ability to maintain the line of gravity of a body within the base of support with minimal postural sway [8]. Maintaining balance, however, requires coordination of input from multiple sensory systems [9]. The senses must detect changes of spatial orientation with respect to the base of support, regardless of whether the body moves or the base is altered. Although, some environmental factors such as light conditions and floor surface changes can affect balance [10]. Balance impairments is known to associate with aging [11], due to Age-related decline in the ability of the sensory systems to receive and integrate information, hence, the elderly are at an increased risk of falls. In the case of an individual standing quietly upright, the limit of stability is defined as the amount of postural sway at which balance is lost and corrective action is required [11].

The HEC Tester, therefore, provides means for individuals, both young and old to access their HEC levels [12]. The device is also capable of detecting the slightest tremor in the individual. This design involves steady passage of a sensor rod electrode, through arranged sets of circular rings, sized from the biggest to the smallest, all through until, it gets to a target point. The exercise will be termed successful if there is no contact made between the sensor-rod electrode and the metallic rings but in the event of a contact to any of the rings, an oscillatory signal alarm is instantly generated to create awareness. The individual's level of stability or coordination can thereafter be established based on how many of the rings the electrode successfully passed through.This process can be very useful in testing and enhancing the recovery rates of stroke survivors or those suffering from progressive tremors as well as withdrawal syndrome. The device can also increase positive mental attitude in individuals overcoming challenges and anxiety by building in them emotional self-control and balance, towards any set target.

## II. DESIGN METHODOLOGY

### 2.1 Materials

♦Resistors
♦Diodes
♦Capacitors
♦Transistors
♦555 timers IC
♦Transformers
♦Voltage Regulating ICs
♦Programmed micro-controller IC
♦Set of Metallic Rings
♦12V Buzzer
♦Crystal Oscillator

### 2.2 Design Specification

#### 2.2.1 The Mechanical Part

METALLIC BOX
It involves a smooth, rectangular, metallic box of dimension 45cm by 10cm.
RINGS
This part will involve arranging a set of five circular Aluminum rings of different diameters : 5cm, 4cm, 3cm, 2cm and 1cm in sizes and mounted on the rectangular box from the biggest in size to the smallest, forming a cone - like shape.
SENSOR ROD
On the side of the box is a sensor rod electrode that will be flexibly connected to the base of the rectangular box so as to ensure easy movement.

#### 2.2.2 The Programmed Electronic Part

Each of the rings will be electrically connected as input to a multi vibrator oscillator circuit which will in turn produce corresponding digital signals. These signals will be programmed into a Peripheral Interface Microcontroller IC for activation of audio alert and visual display. The alert will happen when there is a contact with the rings and the display will show the very ring which the electrode came in contact with.

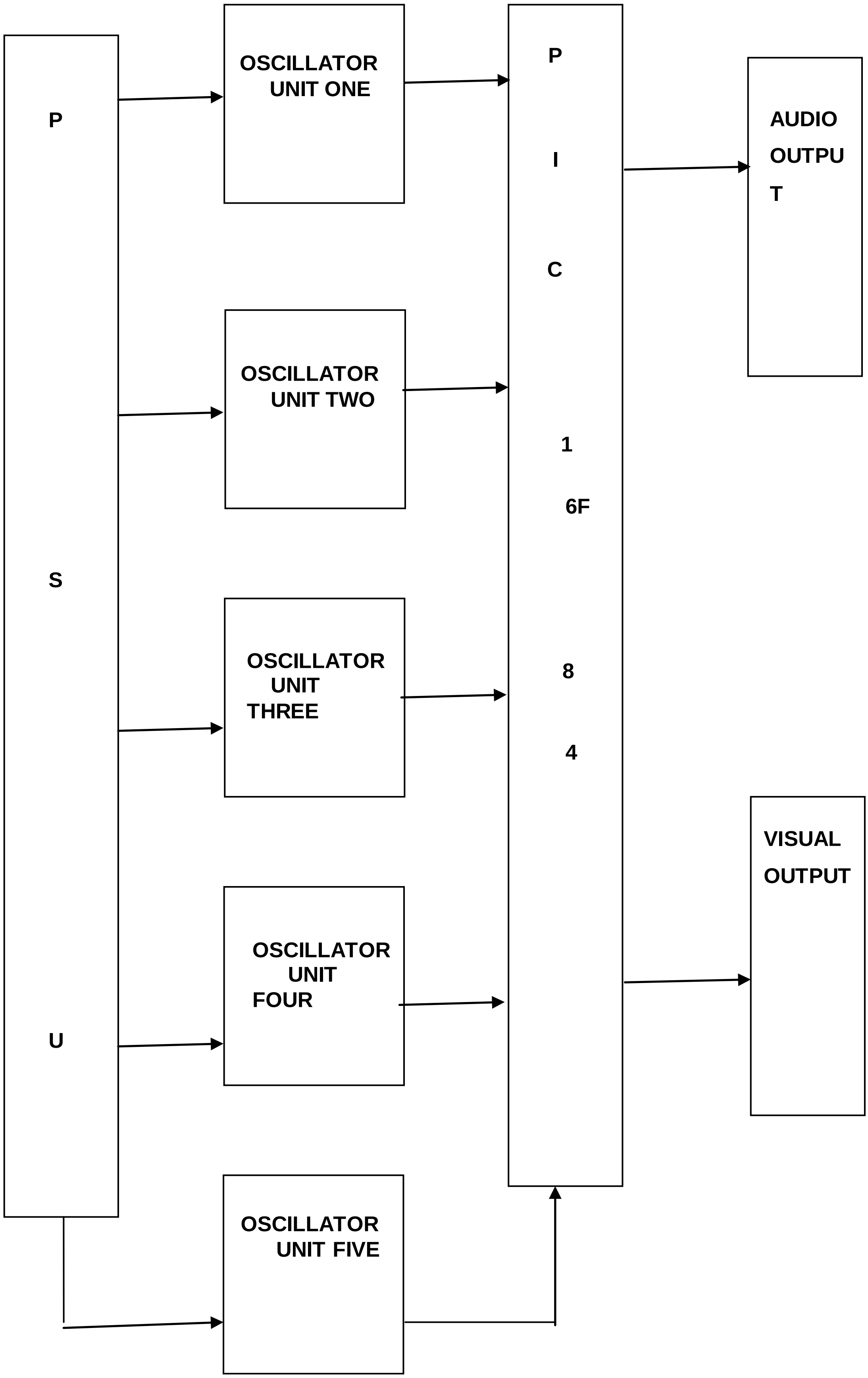


**Fig 1: Block Diagram of the Design**

**2.4 Calculations**
For the power diodes:
Solving from the formular,
$V_p = V_{rms} \times \sqrt{2}$
but $V_{rms} = 12$
$V_p = 12 \times \sqrt{2}$
$= 17\ V$

The peak inverse voltage of the diodes is given as
$PIV \geq VP$

From the semiconductor data book, power diode IN4001 has a peak inverse voltage of 50V. Hence it was taken for diodes $D_1 – D_4$.
Using ripple factor formular for full wave, rectifier,
$V_r \geq {}^{1}/_{4\sqrt{3} \times f_o \times R_L \times c}$
Where $V_r$ = ripple voltage (5mv)
Fo = output frequency
= 2 x input frequency
= 2 x 50 = 10H~~z~~
$R_L = 500\Omega$ (assumed)
$\therefore C \geq {}^{1}/_{4\sqrt{3} \times 100 \times 500 \times 0.05}$
$= {}^{1}/_{1732/05}$
= 577 x 10-6 farad
= 577µF

Choice value for the capacitor, $C_1 = 1000\mu F$, for better filtration.
For the indicator circuit
$V_T = V_{R1} + V_{D5}$
but $V_{D5} = 2_V$
$12 = V_{R1} + 2_V$
$V_{R1} = 10v$
But $V_{R1} = I_{D5} \times R_1$
$I_{D5} = 10mA$
$10 = 10mA \times R_1$
$R_1 = {}^{10 \times 1000}/_{10}$
$= 1000\Omega$
$R_1 = 1K\Omega$

Taking the ON period to be 60 seconds
i.e. T = 60
With choice values of the charging capacitor to be 1000µF,
Using the formular:
T = 0.693 RC
Substituting the values
$60 = 0.693 \times R \times 1000 \times 10^{-6}$
$R = {}^{60 \times 10^{-6}}/_{0.693 \times 1000}$
$R = {}^{60 \times 10}/_{693}$
$= 86.580K\Omega$
Standard value chosen was 100KΩ
Summary
$R_2 = R_4 = R_6 = R_8 = R_{10} = 100K\Omega$
$C_2 = C_3 = C_4 = C_5 = C_6 = 1000\mu F$
$R_3 = R_5 = R_7 = R_9 = R11 = 10K\Omega$

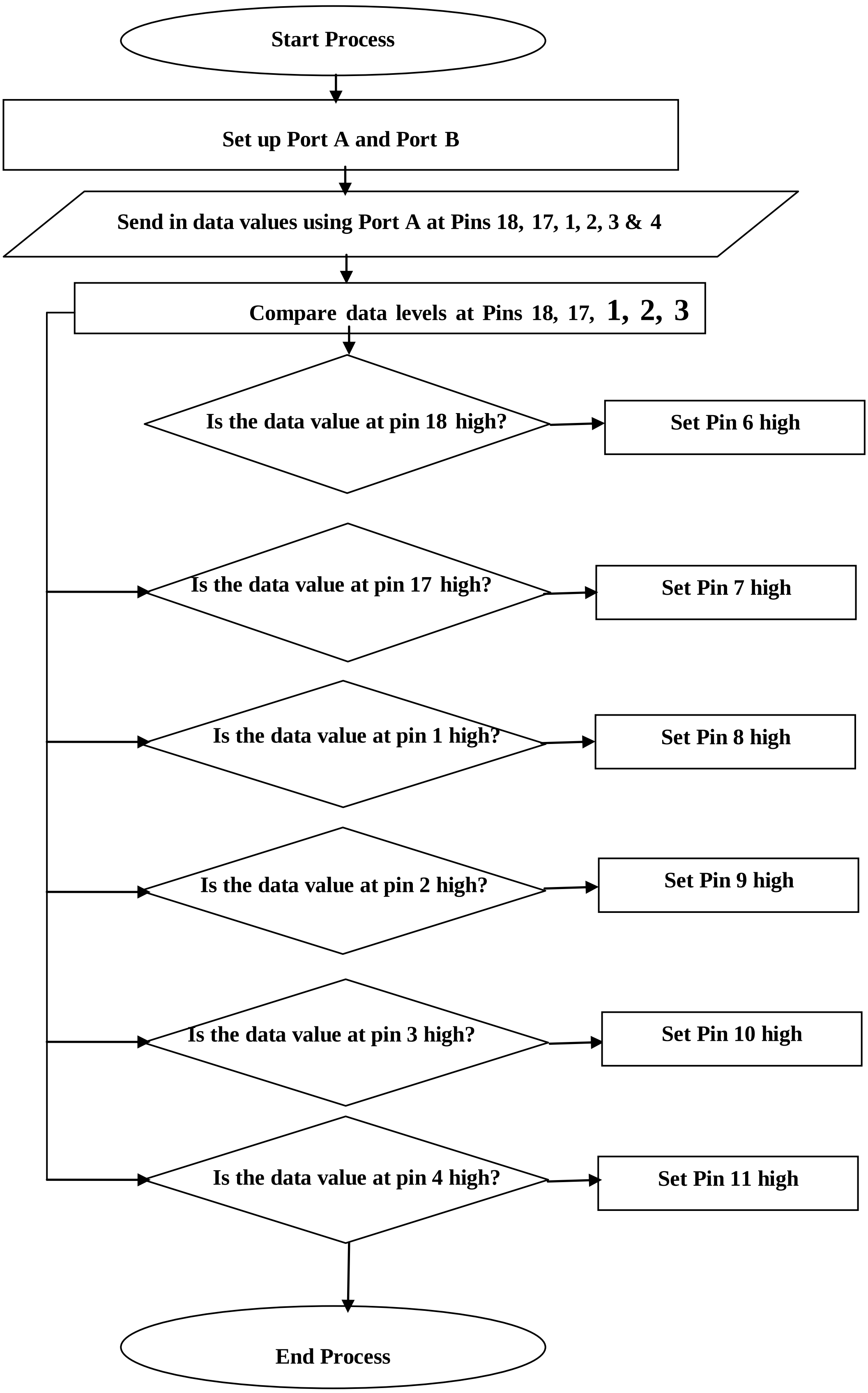


**Figure 2: Program Flowchart of the Microcontroller 16F84**

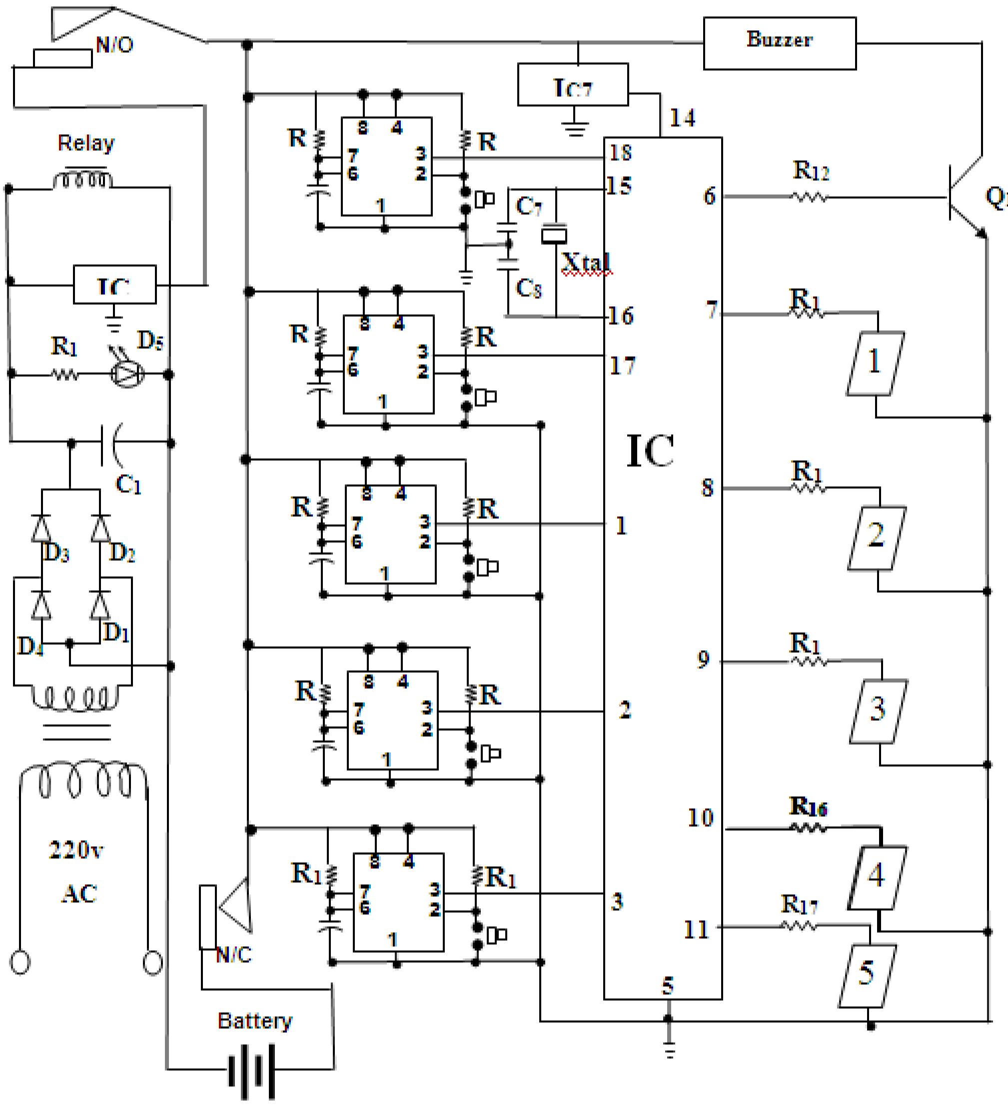


Figure 3: Complete Circuit Diagram of the Designed Work

***Table 1:** functional analysis*

| NOS | PROCEDURES | REMARKS | OBSERVATIONS |
|---|---|---|---|
| 1. | Power cable was plugged into a power supply outlet. | The power unit became activated. | The LED indicator came ON, showing that the power unit was activated. |
| 2. | The power switch was turned ON | This was to activate the rest of the circuitry with the various voltage requirements. | None of the output indicators – visual and audio, came ON. |
| 3. | The conductor stick was pulled out and carefully guided to pass through the circular rings all down to the terminal reference base. No contact was expected to be made to the rings. | The conductor rod successfully moving inwards and outwards, going through the rings to the target, without triggering off the alarm means an optimum HEC skill. | At this progress made, the visual output indicators will still remain inactive. But the audio output will be activated once the target contact at the base reference has been made. |
| 4. | While going in and out of the rings any contact made will instantly be captured. | The point at which this occurs shows the HEC level | The visual output will display the number of the corresponding ring which the rod came in contact with, there will be audio alerting. |

**2.7 Eye-Hand Coordination Test**

Random Hand-Eye Coordination test was conducted among the given population within the age range of 40 – 65 years.

10 persons were selected among the sample size with hand- eye coordination impairment. They were subjected to the use of our device for 10 days and the result is presented on the table below. Score 7 and above in the test is represented by the sign (+) while score below 7 is represented by the sign (-).

## III. RESULT

**3.1 Result of the Eye-Hand Coordination Test**

The result of the Eye-Hand Coordination Test on the ten selected individuals with coordination impairment is presented on Table 2 below.

***Table 2:*** *Result of Eye-Hand Coordination Test*

| No of people tested | HEC result above 7 | HEC result below 7 |
|---|---|---|
| 1 | | - |
| 2 | + | |
| 3 | + | |
| 4 | + | |
| 5 | | - |
| 6 | + | |
| 7 | + | |
| 8 | + | |
| 9 | + | |
| 10 | + | |

$\sum f = 10$

Hand/Eye coordination level $= \frac{f}{\sum f} \times 100$ - - - - - - - - - - - - - - - equation 1

HEC result above 7 = $\frac{8}{10} \times 100 = 80\ \%$

HEC result below 7 = $\frac{2}{10} \times 20 = 20\ \%$

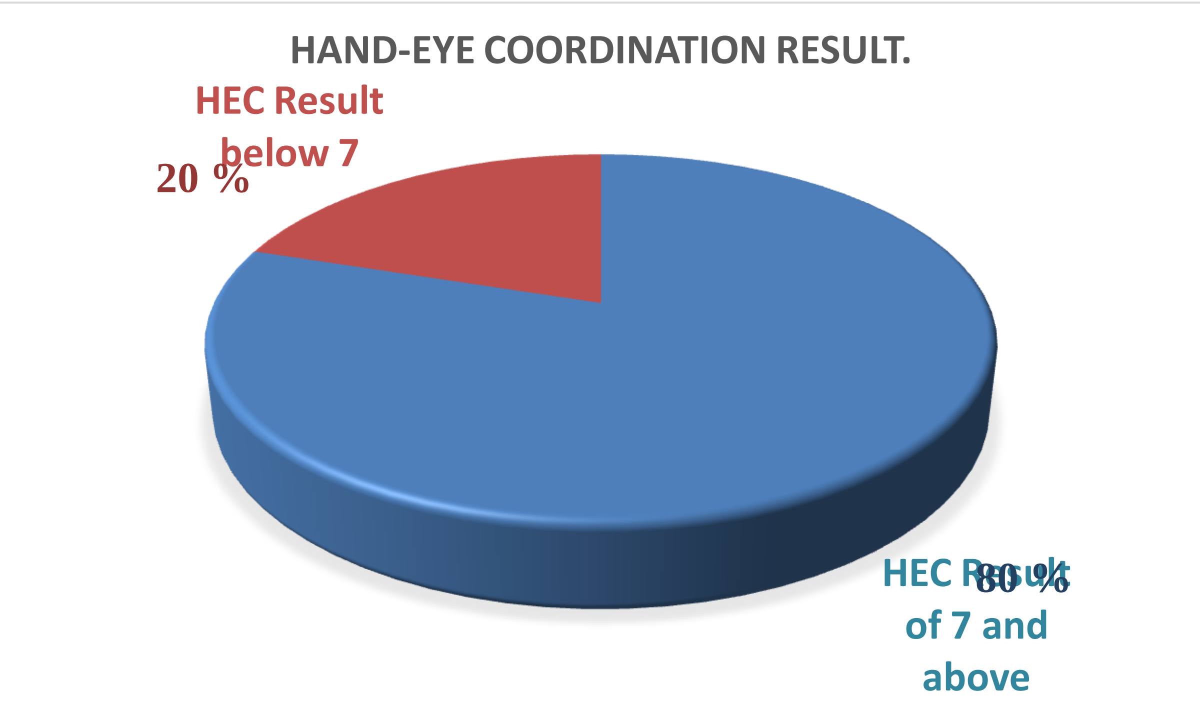


Figure 4: graph of Variable Frequency of the Hand-Eye coordination test

### 3.2 Test Result Analysis

From the testing exercises carried out above, the level of Hand-Eye Coordination in relation with contacts made with rings can be concluded as follows:

*Table 3: Test Result Analysis*

| Extremely Unstable | Very Unstable | Unstable | Fairly stable | Very Stable |
|---|---|---|---|---|
| **Ring 1** | **Ring 2** | **Ring 3** | **Ring 4** | **Ring 5** |

### 3.3 Discussion

This design is HEC tester with microcontroller interface based. It is powered from a DC sourced voltage converted from a high voltage (240V at 50Hz) AC Public Supply. Any contact with each of the circular rings triggers on an attached, self latching oscillator circuit that produces an output value of high voltage that is converted into a digit, making it unique when compared to other HEC testers. It is made from locally sourced materials, thus making it affordable, while its dual power supply unit, makes it a perfect use in the developing countries where power outage is a regular occurrence.

The device converted output voltage would be fed as inputs to a micro-controller based IC, programmed to control some connected audio and visual output devices. The entire device packaging was built to be compact; with all attached external accessories streamlined, and all functions working efficiently. The default stage of the latching oscillator is at open loop mode. Once contact is made from the electronic stick with any of the circular rings, the loop is completed to activate the attached oscillator circuit. All the oscillators are built as one touch mono stable multivibrator circuits.

Their generated outputs are one shot trigger, expected to remain high once activated. There are five of such oscillator based circuits in the building up of the hardware. Furthermore, the respective outputs of the latching oscillator were coupled directly to an interfaced micro-controller IC (PIC16F84) which was carefully programmed to activate output-connected audio and visual displays, corresponding to how the various input contacts were made. The devise was used by 10 persons with extremely unstable coordination, for 10 days, after which it was used to test their coordination .

## IV. CONCLUSION AND RECOMMENDATION

This study has been successfully achieved with a tested and working dual power supply unit. The micro controller based device, although built on a prototype level, has been tested on several individuals including the elderly. It gave a range of results on different occasions as intended. The principle and mode of operation of the device was made as simple as possible for easy use, while the use of the device improved the coordination level of the individuals tested, implying that the device is satisfactory.

It has been reported that HEC reduces with age; therefore, this device will be very useful to the middle aged population to enable them not only test their coordination level, but also enhance their coordination as they age. Furthermore, hospitals and health practitioners may find tremendous use of this device. Since it can also be played as a game, we recommend that the prototype be mass produced to serve our increasing aged population and those recuperating from stroke and Parkinson disease (PD).

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