



## **AN ELECTRONIC EQUIPMENT TO ASSESS THE REACTION TIME AND ACCELERATION OF SPRINTERS – A STUDY**

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### **Abstract:**

We are living in modern world, in this world each and every field was computerized which are added accurate and consistent to bring out the work effectively. The present study reveals about an attempt to create an electronic device to assess the reaction time and acceleration ability of athletes in sprinting events simultaneously. Presently reaction times and acceleration ability of the athletes are not taken in any sprinting events at elementary and state level meets due to unobtainability of relevant equipment. The reaction time and acceleration ability of sprinters will influence over the performance in high order. To obtain such things an Electronic Equipment has been invented with accurate starting and finishing technique using the following core parts 1. Microphone, 2. Micro switch, 3. IR Transmitters, 4. IR Receivers, 5. Interfacing Unit and 6. Computer. To attain scientific genuineness of the gadget 120 subjects were chosen from Hindusthan College of Engineering and Technology, Coimbatore and the appropriate data were collected using the newly invented equipment while the subjects were running in the 50m race. The collected data were treated with appropriate statistical techniques and obtained Reliability and objectivity of the device.

**Key Words:** Reaction Time, Acceleration, Microphone, IR modules, Interfacing Unit, Computer, Reliability and objectivity.

### **Introduction:**

Technical inventions and relevant studies have enhancing the world as incomparable proportions in all days. We remain enjoyably shocked and surprised by the progress in various fields. While all the fields gain the benefit of the scientific benedictions, the investigator taught to implement such innovations in the field of athletics. This idealistic thinking motivated him; consequently this device was raised to assess the reaction timings and acceleration ability of athletes in sprinting events. Presently the timings are taken for sprinting events by manually activated stop watches in preliminary and state level events, which will not be used to find out the reaction time as well as acceleration ability of sprinters accurately. Hence an Electronic Equipment was invented with accurate starting and finishing technique. So we can find out perfect reaction timings and acceleration ability of the sprinter.

### **Statement of the Problem:**

The purpose of the study was to construct an Electronic Equipment to obtain reaction time and acceleration ability of sprinters in selective sprinting events.

**Delimitations:** The Study was delimited in these following factors.

- An instrument was constructed as per the requirement of obtaining reaction time and acceleration timings of sprinting events.
- 120 subjects were used to establish reliability, Validity and Objectivity of the instrument.

**Limitations:** The following uncontrollable factors associated with the study was accounted as limitations of this study,

- Due to unavailability of affordable device to find out reaction time simultaneously along with newly device. Hence, the validity of the device was not able to assess as limitations.
- The quantum of physical life, Style, Physiological stress and reaction time, acceleration ability of the athletes were considered as limitations.

**Hypothesis:** It was hypothesized that the newly invented Electronic Equipment will be reliable and objective in assessing the reaction time of the subjects. It is also valid, reliable and objective in assessing the acceleration ability of sprinters in sprinting events.

### **Significance of the Study:**

- This study gives additional information to the area of research.
- The results of the study would be useful to coaches and administrators to assess the reaction time and acceleration ability of sprinters more accurately.
- This study will help the participants to know their accurate reaction time and acceleration capability.

**Methodology:**

**Details about Electronic Equipment:**

The following are the vital parts of the Electronic Equipment.

- Microphone
- Micro switch
- Interfacing Unit
- IR Modules (Transmitter and Receiver)
- Computer

**Micro Switch:**

This is a special type of switch, which was attached in the starting block. Whenever we feed appropriate power supply to the switch it will work accordingly. While the switch is at normal condition the output signal is very low. If the switch gets operated the output signal of micro switch is high, which signal induces the corresponding timer to stop and record the timings.

**Interfacing Unit:**

This is the intelligence part of the equipment. This unit contains a special micro controller which is programmed with appropriate timers. Whenever the switches get operated fitted with starting blocks, appropriate electrical signals passed to the micro controller and it encodes the unit and influencing over the timers. These encoded signals converted as data signals and sends it to the computer for displays.

**IR Transmitters:**

The Infra-red transmitter having two different kinds of IC 555, As soon as power fed, they are producing Infra-Red rays and it emitting through the infrared Light Emitting Diode (LED) continuously towards IR receiver in a straight line.

**IR Receivers:**

The IR receivers are having TSO P17 series ICs, which receives the IR rays from the corresponding transmitters continuously. Since the transmitters at various lanes are directly focused towards the corresponding receivers in straight line to transmit the IR signal. The IR receivers converting the received IR rays into data signals and sends it to the interfacing unit.

**Computer:**

This is a normal computer, which was installed with special software according to our programme. The computer receives the data signal from interfacing unit. It encodes the signals and displays the exact reaction and acceleration timings of every athlete with precision.

**Functioning Method:**

**Assessing the Reaction Time of Sprinters from Starting Position on the Track:**

To assess the sprinters reaction time eight starting blocks were used. All the starting block's rear side resisting pad was fixed with a special micro switch. The output terminals of each switch are connected with interfacing unit for appropriate function. Its photography is presented in the figure 1.

Figure 1: Micro Switches Fitted With Starting Blocks



At the starting point, 8 athletes were directed to do sprint in their respective track with crouch starting position. To start the race, starting gun was used which was attached with a condenser microphone. When the starting gun was fired to commence the race, the sound has been observed by the microphone and sends appropriate signal to the microcontroller instantly to start all the 8 lane timers which also flashed on the computer monitor instantly. On hearing the gun sound, the athletes kicked the starting block to commence the race, while the special micro switches observe the movement of athlete and sent a signal to interfacing unit to stop the timer. Based on every athlete's response, corresponding timer unit seized and it was recorded in microseconds. These recorded times are the reaction time of sprinters.



Figure 2: Assessing Reaction Time of Sprinters at Starting Position

**Functioning Method:**

**Assessing the Acceleration Performance of Sprinters:**

The IR transmitters and receivers were placed at the 20mts and 40 mts of every lane to find out split timings. The output of the IR receivers was connected with interfacing unit. When we fed the appropriate power to the IR modules, the IR transmitters emits IR rays and it injected into the corresponding IR receivers placed at the top. The IR receiver directed the signals getting from IR transmitters to the Interfacing unit. Thus the data signals were encoded by interfacing unit and sent it to the computer for appropriate function. During the race, while the athletes crossing the 20mts and 40mts, the continuously emitting IR rays getting interruption; this interruption is sensed by the corresponding IR receiver and sending it to the interfacing unit. The micro controller of the interfacing unit decodes the interruptions with the corresponding timer and the computer displayed the exact acceleration timings of the every athlete.

When the starting gun was fired to commence the race, the athletes were started the race simultaneously all the eight lane timers in the computer were started by the sound of starting gun. Consequently all 8 lane timers get operated simultaneously and flashed in the computer screen. During the race, the athletes while crossing 20mts and 40mts of every lane corresponding IR rays gets interruption, when the IR receivers sensing the interruption and stimulated in the interfacing unit to record the time of the athletes in every lane and it will displayed in the computer. Its photography is presented in the following figure.

**Results and Discussions:**

**Computation of Descriptive Statistics:**

**Mean and Standard Deviation on Reaction Time of Sprinters (Sec.)**

Trials	Mode of Assessment	Reaction Time	
		Mean	SD
1	New Device	Mean	0.27
		SD	0.04
2	New Device	Mean	0.29
		SD	0.05
3	New Device	Mean	0.24
		SD	0.03

The above table shows that the mean values of the subject's reaction during the 1 to 15 trials are 0.27, 0.29 and 0.24, and with standard deviations of 0.04, 0.05, and 0.03 respectively.

**Reliability of Reaction Time**

**Analysis of Variance with Repeated Measures for Reaction Time (sec.) Sprint Performance:**

VARIABLES	ANALYSIS OF VARIANCE WITH REPEATED MEASURES						
	Source	SS	df	MS	F	MS <sub>E</sub>	R
Reaction Time (sec.)							

	Subjects	0.555	119	0.005	3.59	0.002	0.96
	Trials	0.001	1	0.001			
	Residual	0.018	119	0.0002			
The table value is 4.78					The table value is		

The above table specifies that the obtained F ratio 3.59 is less than the table value of 4.78 required at 0.01 level of significant. This showed that there is no significant difference between the test and re-test scorers signifying that the process of testing of the reaction time is perfect and consistent. Hence intraclass correlation was obtained for reaction time, which indicates that the obtained intraclass (R) value 0.96 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the reaction time assessed by the device during the test and re-test are significantly related. The above results proved that the newly constructed electronic device is reliable to assess the reaction of sprinters on the track simultaneously for eight athletes.

**Objectivity of Reaction Time:**

**Analysis of Variance with Repeated Measures for Reaction Time (sec.):**

VARIABLES	ANALYSIS OF VARIANCE WITH REPEATED MEASURES						
	Source	SS	df	MS	F	MS <sub>E</sub>	R
Reaction Time (sec.)	Subjects	0.990	119	0.008	3.82	0.0002	0.98
	Trials	0.001	2	0.000			
	Residual	0.050	238	0.000			
The table value is 4.78					The table value is		

The above table indicates that the obtained F ratio 3.82 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that the process of testing the reaction time is perfect and consistent. Hence, Intraclass correlation was obtained and the (R) value 0.98 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the reaction time recorded by the three testers using the newly constructed electronic device at three different periods is significantly related. The above results strongly proved that the newly constructed electronic device possess objectivity to assess reaction time of sprinters.

**Reliability of Starting Point to 20m Split Time:**

**Analysis of Variance with Repeated Measures for Starting Point to 20m Split Time (sec.) Sprint Performance:**

Source	SS	df	MS	F	MS <sub>E</sub>	R
Subjects	2.947	119	0.024	1.54	0.003	0.90
Trials	0.004	1	0.004			
Residual	0.310	119	0.0026			
The table value is 4.78					The table value is 0.234	

The above table specifies that the obtained F ratio 1.54 is less than the table value of 4.78 required at 0.01 level of significant. This showed that there is no significant difference between the test and re-test scorers signifying that the process of testing of the 20mts split time is perfect and consistent. Hence intraclass correlation was obtained for 20mts split time, which indicates that the obtained intraclass (R) value 0.90 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the 20mts split time assessed by the device during the test and re-test are significantly related. The above results proved that the newly constructed electronic device is reliable to assess the 20mts split of sprinters.

**Reliability of Split Time from 20m to 40m:**

**Analysis of Variance with Repeated Measures for Split Time from (sec.) Sprint Performance:**

Source	SS	df	MS	F	MS <sub>E</sub>	R
Subjects	19.533	119	0.164	0.92	0.008	0.95
Trials	0.006	1	0.006			
Residual	0.840	119	0.007			
The table value is 4.78					The table value is 0.234	

Table indicates that the obtained F ratio 0.92 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the test and re-test scorers indicating that the process of testing of split time from 20m to 40m is perfect and consistent. Hence intraclass correlation was obtained which indicates that the obtained intraclass correlation (R) value 0.95 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from 20m to 40m recorded by the device during testing and re-testing periods are significantly related. The above results proved that the newly constructed electronic device is reliable to assess the acceleration performance from 20m to 40m of sprinters.



**Validity of Split Time from Starting Point TO 20m :**

**Pearson Product Moment Correlation for Split Time from Starting Point to 20m (sec.):**

Mode of Assessment	Mean	SD	r
New Device	3.12	0.11	0.97
Stopwatch	3.26	0.12	

The table value required for 2 & 118 degrees of freedom at 0.01 level of Significant is 0.236

Table indicates that the obtained correlation value 0.97 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from starting point to 20m by using the newly invented electronic device and stopwatches simultaneously are significantly related.

**Validity of Split Time from 20m to 40m:**

**Pearson Product Moment Correlation for Split Time from 20m to 40m (sec.):**

Mode of Assessment	Mean	SD	r
New Device	2.13	0.19	0.95
Stopwatch	2.32	0.30	

The table value required for 2 & 118 degrees of freedom at 0.01 level of Significant is 0.236

The table indicates that the obtained correlation value 0.95 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from 20m to 40m using the newly constructed electronic device and stopwatches simultaneously are significantly related. The above results proved that the newly constructed electronic device is valid in assessing the acceleration performance from starting point to 20mts and 20mts to 40mts of sprinters on the track simultaneously for eight athletes.

**Objectivity Starting Point to 20m Split Time:**

**Analysis of Variance with Repeated Measures for Starting Point to 20m split Time (sec.):**

Source	SS	df	MS	F	MS <sub>E</sub>	R
Subjects	2.87	119	0.024	1.80	0.009	0.62
Trials	0.30	2	0.15			
Residual	1.82	238	0.008			
				The table value is 4.78		The table value is

The table indicates that the obtained F ratio 1.80 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that, the process of testing the acceleration from starting point to 20m is perfect and consistent. Hence intraclass correlation was obtained which indicates that the obtained intraclass (R) value 0.62 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the acceleration from starting point to 20m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

**Objectivity of Split Time from 20m TO 40m:**

**Analysis of Variance with Repeated Measures for Split Time from 20m to 40m (sec.):**

Source	SS	df	MS	F	MS <sub>E</sub>	R
Subjects	32.66	119	0.271	0.98	0.011	0.95
Trials	0.007	2	0.003			
Residual	2.703	238	0.011			
				The table value is 4.78		The table value is

Above table indicates that the obtained F ratio 0.98 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there are no significant differences among three different testers. It reveals that the process of testing the acceleration performance 20m to 40m is perfect and consistent. Hence intraclass correlation was obtained which indicates that the obtained intraclass (R) value 0.95 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from 20m to 40m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related. The above results strongly proved that the newly constructed electronic device possess objectivity to assess the acceleration performance from starting point to 20m and 20m to 40m of sprinters simultaneously for eight athletes.

**Analysis of Data and Interpretation of the Study:**

The main purpose of the study was to construct an electronic equipment to assess the reaction time and acceleration performance of the sprinters consequently and also to establish scientific authenticity of the instrument. The setting up of scientific authenticity involves establishment of reliability, objectivity and validity. Reliability was established by test and retest method. In this procedure data were collected on two occasions with a gap of two days using the newly designed instrument, the same subjects, providing similar conditions

data were collected again. The obtained two sets of scores were subjected to univariate correlation procedure which resulted in a coefficient of correlation of 0.95 indicating that 92% association between these scores. Objectivity was established by collecting data using the same subjects, and same instrument, similar conditions were provided but two different testers were used. Thus two sets of scores were obtained and they were subjected to univariate correlation procedure which resulted in a coefficient of correlation of 0.98 indicating that 97% association between these scores.

**Conclusion:**

It is concluded that the device is more reliable and objective to assess the reaction time and acceleration performance of sprinter in sprinting event.

**Recommendation:**

- Device may be designed to measure the reading of track and field events.
- Similar gadget may be designed to measure various motor fitness components of athletes.

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