CHAPTER I

INTRODUCTION

In today's world, sports play an important role and millions of people participate in it. Many countries have recognized the importance of an effective sports training program in a wide range of activities not only for the success in major international competitions but also for the development of healthy participation. Research has revamped the whole concept of sports. The field of sports is currently undergoing remarkable scientific changes. Highly technological innovations through contributions from various disciplines made the sports field more authentic, glamour and appealing.

Today, world is with computer and space ships. As civilization advances men's desire to compete with counterpart also increases. He wants to excel in his chosen field. As a result such desire leads to scientific discoveries and their application for excellence. In modern times, transfer and integration of knowledge from a wide range of disciplines and industries has generated rapid technological changes in sports. New technologies have made sports faster and enjoyable in many ways. Sports technologies have the capacity to enhance performance, prevent injuries and provide overall wellbeing to the athletes **(Fuss, 2008).**

The present century is rightly technological due to the influence of advancements in the field of science and technology on the varied aspects of life, resulting in its modernization. The impact of scientific and technological advancements in sports is so great and which has given rise to the new discipline called sports technology.

The path of science and innovations has under gone remarkable changes during the past couple of decades and has caused the growth of science based industries such as information technology, space technology, biotechnology, sports technology etc. Coaches and sports scientists are more dependent on modern and scientific technology to derive top quality performance from their athletes. Technology has revolutionized coaching and training. It has come to the stage, that the enrichment in using technology and its process has attained a multidimensional approach, using ultra technological devices. The influence can be felt in selecting suitable strategy and positions of players before and during the game.

1.1 METHOD OF RUNNING RACE

Running events prove that the athletes are the fastest and have the greatest endurance. An outdoor athletic track made up of mud or synthetic material has eight lanes, and the races are run in counter clockwise. Starter initiates races with gunshot, all races proceed in the lanes, and each sprinter keeps himself within his allocated lane from start to finish. This also applies to any portion of a race run in lanes. If an athlete leaves the track or steps on the line demarking the track, he/she is disqualified. Also, any athlete who jostles or obstructs another athlete in a way that impedes his progress also is disqualified from that event. However, if an athlete is pushed or forced by another person to run outside his lane, and if no material advantage is gained, the athlete is not disqualified. Stop watches or automatic timers are used to find out the performance of athletes, the winner crosses the finish line in the shortest time. Races of different distances start at different places on the track, but all races end at the same finish line, and following are several types of running events, sprints, relays, and distance races.

1.2 SPRINTS

Sprinting events are 100 meter, 200 meter, and 400 meter races. In all sprint races, athletes can use starting blocks to enable to start the race. The 100 m and 200 m sprints are demonstrating speed of individuals, while the 400 m race is a combination of speed and endurance. The 100 meters race is on the straightaway, the 200 meters race starts on the curve, and the 400 meters race is one full lap around the track. The ability to sprint is an important weapon in an athlete's armory for many track and field events and many sports. Sprinting performance of athletes are determined by start, reaction time, acceleration, locomotion, and stride frequency.

1.3 START

The start of a sprint race is that part of the race from the firing of the gun to the leaving from the starting blocks and the term usually includes the first strides out of the blocks **(Martin Lynch, 2003).**

"At the starter's command 'on your marks' the athlete moves forward and adopts a position with his hands just behind the starting line, the feet on the starting blocks and the knee of the back leg resting on the ground. On the 'set' the athlete lifts the knee of the back leg off the ground, thereby elevating the hips and shifting the center of gravity forward. Finally, when the gun is fired, the athlete lifts his hands from the track, swings the arms vigorously (one forward and one backwards), and with a forceful extension of both legs drives the body forward away from the blocks and into the running strides **(James, 1994).**

1.3.1 TYPES OF STARTS

There are three main types of starting positions for sprint start. The principle difference between these starts is basically the horizontal distance between the front and back feet of the athlete.

1.3.1.1 BUNCH START

The Bunch start sometimes referred to as Bullet start. In this crouch start the feet are close together with the toes of the back foot opposite the heel of the front foot. Sometimes the feet are even closer together. This would usually involve a block spacing of less than 30cm.

1.3.1.2 MEDIUM START

In this crouch start position, the feet are further apart. The knee of the back leg is placed opposite a point towards the toes of the front foot. The inter-block distance of this start has been described as approximately shin length apart. **(Arnold, 1992)** describes a position many athletes use these days which is slightly less than shin length apart, but not so close as to call a Bunch or Bullet start. This position could be referred to as a 'Short Medium Position'. An inter-block distance of somewhere between 30 to 50cm could be described as a medium start.

1.3.1.3 ELONGATED START

In this crouch start position, the knee of the back leg is placed at the level or slightly behind the heel of the front foot. It has been described as a position where the inter-block distance is well in excess of shin length. An inter-block distance in excess of 50cm could be described as an elongated start.

The medium start offers the most advantage to the sprinter. While compared the medium start to the other two starts, it allows the sprinter to exert a higher force against the blocks for the longest practicable time, which in turn produces the maximum impulse so that the athlete leaves the blocks with the greatest possible velocity **(Henry, 1952 and Sigerseth, 1963)**.

1.4 FALSE START

An athlete, on final set position, may not commence his starting motion until he receives the sound of the gun, or approved starting apparatus. If, in the judgment of the starter or re callers, he does so any earlier, it is considered as a false start. It is deemed a false start if, in the judgment of the starter an athlete fails to comply with the commands "on your marks" or "set" as appropriate after a reasonable time; or an athlete after the command "on your marks" disturbs other athletes in the race through sound or otherwise. Any athlete making a false start must be warned.

1.5 REACTION TIME IN SPRINTING EVENTS

Reaction time has been described as the time elapsed between the firing of the starter’s gun, and the first reaction of the athlete. When automatic blocks are used in major championships it is deemed an athlete cannot react faster than 0.1 of a second. The reaction time as the time between the sound of the starter's gun and the moment the athlete is able to exert a certain pressure against the starting blocks **(Mero, Komi & Gregor, 1992)**. Reaction time measurement currently includes the time it takes for the sound of the gun to reach the athlete, the time it takes for an athlete to react to the sound and the mechanical delay of measurements, inherent in the starting blocks.

Reaction time can be divided into premotor time and motor time. Premotor time is the time from the gun until the onset of EMG activity in skeletal muscle. Motor time is delay between the onset of electrical activity and force production by the muscle.

An average reaction time about 0.09 seconds from the sound of the gun and the first rise by the force trace - this time was considerably faster than reaction time of the same athletes obtained by conventional methods, Possibly indicating a measurement of ' Pre-motor ' period of total reaction time **(Payne & Blader, 1971)**.

This theory was supported by the fact that this first rise in the trace did not coincide with perceptible movement of the athlete. Various conclusions have been made regarding reaction times, they are detailed below:

a. In all sprint events, reaction times of best athletes is less than 0.2 m seconds.

b. In the same events, reaction times of female is greater than those of male.

c. Reaction times grow in proportion to the length of the race and

d. Reaction time plays only a very small part in the overall performance of any race.

1.5.1 TYPES OF REACTION TIME

1.5.1.1 SIMPLE REACTION TIME

Simple reaction time is the time required for an observer to respond to the presence of a stimulus. For example, a subject might be asked to press a button as soon as a light or sound appears. Mean RT for college-age individuals is about 160 milliseconds to detect an auditory stimulus, and approximately 190 milliseconds to detect visual stimulus.

1.5.1.2 CHOICE REACTION TIME

Choice reaction time tasks require distinct responses for each possible class of stimulus. For example, the subject might be asked to press one button if a red light appears and a different button if a yellow light appears. The Jensen Box is an example of an instrument designed to measure choice reaction time.

Reaction time is the sum of all the event-durations that occur between the presentation of a stimulus and the evocation of a response. It depends on the length of the neural path between the receptor organ (e.g. eye or ear) and the responding muscles (e.g. in the leg of runner) together with delays incurred when the information is processed centrally. Reaction times of 14-16 hundredths of a second for acoustic stimuli and 16-18-hundredths of a second for optical stimuli are generally regarded as good.

In choice reaction time, the user must give a response that corresponds to the stimulus, such as pressing a key corresponding to a letter if the letter appears on the screen. The Reaction Time program does not use this type of experiment because the response is always pressing the spacebar **(Luce, 1986 & Welford, 1980)**. The pioneer reaction time study was showed that a simple reaction time is shorter than the choice reaction time, which is longest of all **(Donders, 1868)**.

Laming, (1968) concluded that simple reaction times averaged 220m sec but recognition reaction times averaged 384 msec. This is in line with many studies concluding that a complex stimulus (e.g., several letters in symbol recognition vs. one letter) elicits a slower reaction time **(Brebner & Welford 1980, Teichner & Krebs 1974, Luce 1986)**. An example very much like an experiment was reported by **(Surwillo, 1973)**. In which reaction was faster when a single tone sounded than when either a high or a low tone sounded or the subject was supposed to react only when the high tone sounded.

1.6 FACTORS INFLUENCING REACTION TIME

If variation caused by the type of reaction time experiment, type of stimulus, and stimulus intensity are ignored, there are still many factors affecting reaction time.

1.6.1 AROUSAL

One of the most investigated factors affecting reaction time is 'arousal' or state of attention, including muscular tension. Reaction time is fastest with an intermediate level of arousal and slowdown when the subject is either too relaxed or too tense **(Welford 1980, Broadbent 1971 & Freeman, 1933).**

1.6.2 AGE

Simple reaction time shortens from infancy into the late 20s, then increases slowly until the 50s and 60s, and then lengthens faster as the person gets into his 70s and beyond **(Der & Deary 2006). Luchies et. al. (2002)** also reported that this age effect was more marked for complex reaction time tasks.

Reaction time also becomes more variable with age **(Hultsch et.al. 2002 & Gorus et.al. 2008)** and with Alzheimer's disease. **(MacDonald et.al. 2008)** found that reaction time variability in older adults was usually associated with slower reaction times and worse recognition of stimuli, and suggested that variability might be a useful measure of general neural integrity, speculates on the reason for slowing reaction time with age. He maintains it is not just simple mechanical factors like the speed of nervous **(Welford, 1980).**

1.6.3 GENDER

At the risk of being politically incorrect, in almost every age group, male have faster reaction time than female, and female disadvantage is not reduced by practice **(Der and Deary, 2006).**

The last study is remarkable because it included over 7400 subjects. **(Bellis, 1933)** reported that mean time to press a key in response to a light was 220 msec for males and 260 msec for females, the sound difference was 190 msec for males and 200 msec for females **(Enge, 1972).** In comparison reported a reaction time to sound for male 227 msec and female for 242 msec. However, **(Silverman, 2006)** reported evidence that the male advantage in visual reaction time is getting smaller, possibly because more women are participating in driving and fast-action sports.

1.6.4 LEFT AND RIGHT HAND

The hemispheres of the cerebrum are specialized for different tasks. The left hemisphere is associated with the verbal and logical brain, and the right hemisphere is with creativity, spatial relations, face recognition, and emotions, among other things. Also, the right hemisphere controls the left hand, and the left hemisphere controls the right hand. This has made researchers think that the left hand should be faster at reaction times involving spatial relationships such as pointing at a target **(Brebner & Welford 1980).**

1.6.5 DIRECT AND PERIPHERAL VISION

Brebner & and Welford (1980) cited in literature that shows that visual stimuli perceived by different portions of the eye produce different reaction times. The fastest reaction time comes when a stimulus is seen by the cones (when the person is looking right at the stimulus). If the stimulus is picked up by rods (around the edge of the eye), the reaction is slower.

(**Ando et. al. 2002)** found that practice on a visual stimulus in central vision shortened the reaction time to a stimulus in peripheral vision, and vice versa.

1.6.6 FATIGUE

Yet another observation by **(Welford, 1980)** is found that reaction time gets slower when the subject is fatigued. **(Singleton, 1953)** observed that this deterioration due to fatigue is more marked when the reaction time task is complicated than when it is simple. Mental fatigue, especially sleepiness, has the greatest effect. **(Kroll, 1973)** found no effect of purely muscular fatigue on reaction time.

1.6.7 BREATHING CYCLE

Buchsbaum & Calloway (1965), found to our surprise that reaction time was faster when the stimulus occurred during expiration than inspiration.

1.6.8 PERSONALITY TYPE

Brebner (1980), found that extroverted personality types had faster reaction times, and **(Welford, 1980 & Nettelbeck, 1973)** said that anxious personality types had faster reaction times. **(Lenzenweger, 2001)** found that the reaction times of schizophrenics were slower than those of normal people, but their error rates were the same. **(Robinson & Tamir, 2005)** found that neurotic college students had more variable reaction times than their more stable peers.

1.6.9 EXERCISE

Exercise has its direct effect with the reaction time. **(Welford, 1980)** found that physically fit subjects had faster reaction times. (**Levitt, Gutin 1971 & Sjoberg, 1975)** showed that subjects had the fastest reaction times, when they were exercising sufficiently to produce a heart rate of 115 beats per minute. **(Kashihara & Nakahara 2005)** found that vigorous exercise did improve choice reaction time, but only for the first 8 minutes after exercise. Exercise had no effect on the percent of correct choices related to the subjects.

1.6.10 INTELLIGENCE

The tenuous link between intelligence and reaction time is reviewed by **(Deary et. al. 2001)**. Serious mental retardation produces slower and more variable reaction times. Among people of normal intelligence, there is a slight tendency for more intelligent people has faster reaction times, but there is much variation between people of similar intelligence **(Nettelbeck, 1980).** The speed advantage of more intelligent people is greatest on tests requiring complex responses **(Schweitzer, 2001).**

1.7 ACCLERATION IN SPRINTING EVENTS

The rate of change of speed is defined as acceleration, which takes place between the starting and attainment of maximum speed. The time taken between the starting and reaching of maximum speed is called as acceleration time. It plays a major role in the final performance of the athlete.

1.7.1 BIOMECHANICS OF ACCELERATION PHASE

a. After the first two strides, the foot touches down in front of center of gravity.

b. The forward body lean begins to decrease until normal sprinting position is reached after about 22 yards (20 meters). Head is relaxed, eyes focused straight ahead.

c. Thee eyes focused on the track keep low, to allow the buildup of speed.

d. Forward lean of the whole body with a straight line through the head, spine and extended rear leg.

e. Face and neck muscles relaxed.

f. Shoulders held back and relaxed, square in the lane at all times.

g. Arms move with a smooth forward backward action - not across the body - drive back with elbows - hands move approximately from shoulder height to hips.

h. Elbows maintained at 90 degrees (angle between upper and lower arm).

i. Hands relaxed - fingers loosely curled - thumb uppermost.

j. Legs - fully extended, rear leg pushing off the track with the toes - drive the leg forward with a high knee action with the knee pointing forward and with the heel striking under the backside (not the back of the backside as the knee is low and pointing down to the ground) - extend lower leg forward of knee (rear leg drive will propel the foot forward of the knee) with toes turned up - drive the foot down in a claw action with a ball of foot / toe strike on the track vertically below the knee - pull the ground under you into a full rear leg extension - (elbow drive assisting the whole action).

k. On the ball of foot/toes at all times - feet pointing forward straight down.

l. The elbow drive commences just before rear leg drive.

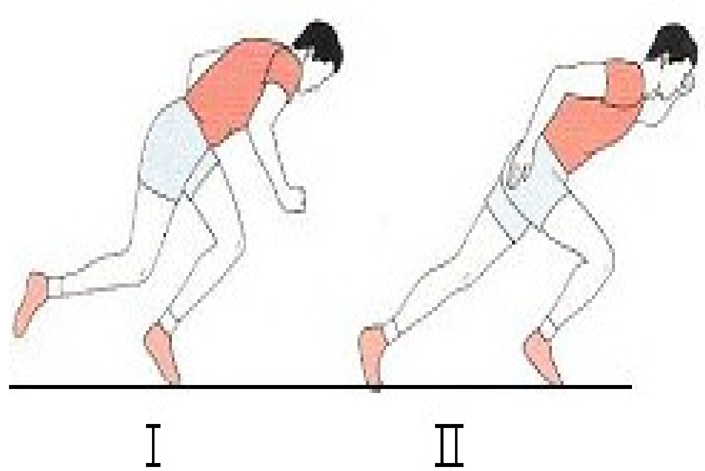
m. The fast leg action, and good stride length allowing continual acceleration.

n. Appearance of being smooth and relaxed but driving hard with elbows and legs.

o. The drive is maintained for approximately 20-30 meters and then the whole body slowly comes into a high tall action.

FIGURE 1

BIOMECHANICS OF ACCELERATION PHASE



1.7.2 ACCELERATION MECHANICS AND CONSIDERATIONS

1.7.2.1 STRIDE LENGTH

While the beginning of race stride length is short and it consecutively increases until maximum velocity is reached.

1.7.2.2 GROUND CONTACT TIME

Ground Contact Time is the amount of time each foot spends on the ground. It is longest at the beginning as the body is trying to overcome inertia, and to try creating velocity through force application, this takes a great deal of strength accumulation.

1.7.2.3 SHIN ANGLE WITH GROUND

The shin angle determines the force application to the ground and the projection angle roughly 45 degree projection angle is ideal that the athlete is going to drive out. The shin angle opens up and increases throughout acceleration and into maximum velocity.

1.7.2.4 VELOCITY

Velocity is both the speed and direction that the body is moving. As the athlete accelerates, the rate and distance will increase with time.

1.7.2.5 STRIDE FREQUENCY

Like ground contact time, it starts off slower (though still quite high) and increases until stride frequency reaches optimal level at maximum velocity.

1.7.2.6 HEEL RECOVERY

Heels should recover quickly, with limited backside mechanics and should not involve large amplitudes of motion behind the hips. During acceleration, especially the first 6-8 steps, the athletes want to minimize their backside mechanics. Backside mechanics in sprinting are movements occurring behind the center of mass.

1.8 MAXIMUM SPEED PHASE

Maximum speed begins from the end of acceleration at approximately 40m of the 100m race, and the biomechanics of the race are as found below:

a. The Push-off angle from ground is approximately 50-55^{o}. Trunk is almost erect with approximately 5^{o} forward lean.

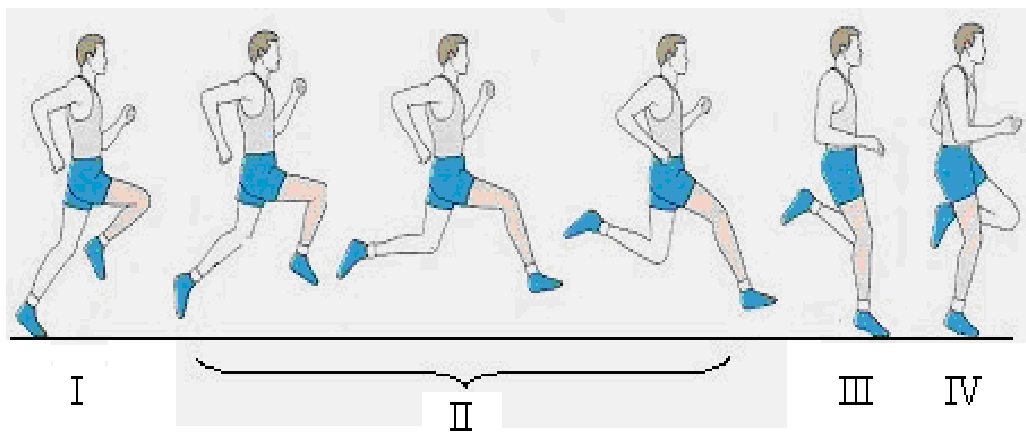
b. The Push-off leg folds tightly towards buttocks in a relaxed ‘heeling' motion. Front leg thrusts forward and upward at maximum speed (~44mph in elite sprinters). When front thigh reaches maximum possible knee lift, lower leg swings forward in a relaxed movement.

c. The Foot meets ground with ankle slightly extended (plantar flexion) directly under center of gravity. Bodyweight is balanced so that only the ball of the foot touches the ground.

d. The Shoulders remain steady, elbows flexed at ~90^{o}, kept close to body throughout all phases. Hands swing forward and up above shoulder height, down and past hips. Arms and hands should have an aggressive hammering action. Head aligns naturally with trunk and shoulders and facial/neck muscles are relaxed by keeping the mouth slightly open.

FIGURE 2

BIOMECHANICS OF MAXIMUM SPEED PHASE



1.9 STRIDE LENGTH

Distance between the strides is called as stride length. The total distance divided by total number of strides to cover it is known as average stride length. The initial foot strike out of the blocks should be around 50-60cm from the start line. The stride length should then progressively increase on each stride by 10-15cm until they reach their optimal stride length of around 2.30 meters.

If the athlete lands at 50cm from the start line and increases their stride length by 10cm/stride then they will reach their optimal stride length around their 19th stride - approximately 26m from the start line. If they were able to maintain their 2.30m stride length then they would cross the finish line on their 51st stride.

If the athlete lands at 60cm from the start line and increases their stride length by 15cm/stride then they will reach their optimal stride length around their 13th stride - approximately 20m from the start line. If they were able to maintain their 2.30m stride length then they would cross the finish line on their 49th stride.

1.10 STRIDE FREQUENCY

The total number of strides to be made to cover the prescribed distance is called as stride frequency, Stride frequency and average stride lengths are in negative proportionate, if stride length is increased the stride frequency will less an in numbers.

1.11 THE FINISH

The finish of a race is marked by a white line 5 cm wide. The athletes must be placed in the order in which any part of their torso (as distinguished from the head, neck, arms, legs, hands or feet) reaches the vertical plane of the nearer edge of the finish line.

1.12 SPEED PERFORMANCE

Speed is the ultimate result of every sprinting event, especially in sprinting events, timing is the final result. The elapsed time between the starting points to finishing point is known as performance.

1.12.1 FACTORS INFLUENCING SPEED

The key determinant of foot speed in sprinting is the predominance of one distinct type of muscle fiber over another, specifically the ratio of fast-twitch muscles to slow-twitch muscles in a sprinter's physical makeup. Though fast-twitch muscles produce no more energy than slow-twitch muscles when they contract, they do so more rapidly through a process of anaerobic metabolism, though at the cost of inferior efficiency over longer periods of firing. The average human has an almost-equal ratio of fast-twitch to slow-twitch fibers, but top sprinters may have as much as 80% fast-twitch fibers, while top long-distance runners may have only 20%. This ratio is believed to have genetic origins, though some assert that it can be achieved by muscle training. "Speed camps", which purport to provide fractional increases in maximum foot speed, are popular among budding professional athletes, and some sources estimate that 17% to 19% of speed can be trained.

Though good running form is useful in increasing speed, fast and slow runners have been shown to move their legs at nearly the same rate, it is the force exerted by the leg on the ground that separates fast sprinters from slow. Top short-distance runners exert as much as four times their body weight in pressure on the running surface. For this reason, muscle mass in the legs, relative to total body weight, is a key factor in maximizing foot speed. Being able to accelerate quickly and powerfully is probably the most important skill that needs to be improved in all athletes. Athletes in every sport need to be able to run as fast as possible or as quickly as possible.

1.13 SPEED PERFORMANCE MEASURING TECHNIQUES

1.13.1 ASSESSING THE PERFORMANCE OF SPRINTING EVENTS USING STOPWATCHES

Olympic timing technology has come a long way since the last time the Olympic Games were held in Athens and Greece. More than 100 years later, the site of the first Modern Olympics is trading stopwatches for a selection of athlete's position by timings. Still such methods are used in National, State, University and District level events.

FIGURE 3

ASSESSING THE PERFORMANCE USING STOPWATCHES.

1.13.2 ASSESSING THE PERFORMANCE OF SPRINTING EVENTS USING ADVANCED TECHNOLOGY

Thanks to today's advanced timing technology, Olympic athletes can win or lose by a margin of only 1,000th of a second which is 40 times faster than the blink of an eye. Such accuracy requires first-rate technology and currently only two companies in the world meet the standards of the Olympic Committee. Omega is Official Timekeeper of the 2006 Winter Games in Torino, Italy. This title means the company provides technology and personnel for the timing of more than 150 events during the biennial competitions. The other company, Seiko, held the title during the 2002 Winter Games in Salt Lake City, Utah.

Timing and measurements are crucial to racing contest. Only a few hundredths of a second or centimeters separates the finishers in many events. Events can be timed with basic methods such as a stopwatch or more advanced timing systems that incorporate cameras and computers. They used Finish lynx cameras and Hy-Tek Meet Manager software, used by major conference championships and professional racing events to provide the most accurate and precise timing. The real benefit of using this was to get the Perfect Timing, data handling and fast accurate results with score. All running events are recorded with photos in the computer for retrieval if needed and eliminating any discrepancy.

In sprint races like the 100-meter dash, which can last as few as 10 seconds, timing is the essence. Therefore, every aspect of timekeeping is electronic, even from the starting gun. Once the runners are crouched with both feet on the pads on their starting blocks, a timing official pulls the gun's trigger, sending an electrical current through the attached copper wire to the starting blocks and a separate timing console. The current sets off a quartz oscillator in the timing console, while the sound of the gun is simultaneously amplified through speakers on each runner's starting block to hear every competitors at the same time.

At the other end of the race, a laser is projected from one end of the finish line to the other, where a light sensor, also known as a photoelectric cell or electric eye, receives the beam. As a runner crosses the line, the beam is blocked, and the electric eye sends a signal to the timing console to record the runner's time. Meanwhile, a high-speed digital video camera aligned with the finish line scans an image through a thin slit up to 2,000 times a second. When the leading edge of each runner's torso crosses the line, the camera sends an electric signal to the timing console to record the time. The timing console sends the times to the judges' consoles and an electronic scoreboard. The images themselves are sent to a computer, which synchronizes them with the time clock and lays them side-by-side on a horizontal time scale, forming a complete image. The computer also draws a vertical cursor down the leading edge of each runner's torso at the time the finish line was crossed. This composite image can then be broadcast on a video display within 30 seconds of the race's end to help make a decision on a close finish.

1.13.3 ASSESSING THE PERFORMANCE OF LONG DISTANCE EVENTS USING RFID

In longer races, such as the marathon, the clock is still started with an electric gun. However, the large number of competitors makes it impossible for all the runners to leave the starting line simultaneously, and dozens of runners can cross the finish line at a time. Because of these considerations, marathons require a more individual system of timing.

Hence, Radio-frequency tags are used to measure the timings of every athlete, a small Radio-frequency tags RFID transponders are attached to each runner's shoe, sending out a unique radio frequency, it contains loops of copper wire to function as an antenna which picking up each runner's signal and sending the identification code and start time to the timing console. Mats are placed at 5-kilometer intervals to track each runner's progress, automatically displaying the best times on the score board. Another mat is placed at the finish line to record each runner's finish time. Each competitor's time is then compared with the time clock, which was initiated by the starting gun and stopped running when the first runner crossed the finish line. This technology is also used at the Boston, New York City and Los Angeles marathons, provided by companies such as Texas Instruments.

1.14 100m PERFORMANCE ASSED BY ADVANCE TECHNOLOGY

The Reaction Time and 20 meters split times for the men's 100m final of the Barcelona Olympics is presented in the table I.

TABLE I

REACTION TIME AND 20m SPLIT TIMES OF THE MEN'S OLYMPICS 100m (sec.) SPRINT

Name/Country	Reaction	20m	40m	60m	80m	100m
Christie (UK)	0.139	2.93	4.74	6.48	8.22	9.96
Fredericks (NAM)	0.138	2.91	4.74	6.50	8.26	10.02
Mitchell (USA)	0.143	2.93	4.76	6.52	8.28	10.04
Surin (Can)	0.124	2.89	4.72	6.50	8.28	10.09
Burrell (USA)	0.165	2.99	4.82	6.58	8.32	10.10
Adeniken (NGR)	0.183	3.01	4.84	6.58	8.34	10.12
Stewart (JAM)	0.154	2.95	4.78	6.56	8.36	10.22
Ezinwa (NGR)	0.172	2.99	4.84	6.62	8.42	10.26

1.14.1 INTERNATIONAL 100m SPRINTING PERFORMANCE ANALYSIS

The performance analyses vide Reaction time, Acceleration, maximum speed and deceleration of various international athletes of Barcelona Olympics is presented in the table II.

TABLE II

INTERNATIONAL ATHLETE'S 100m (sec.) SPRINTING PERFORMANCE ANALYSIS

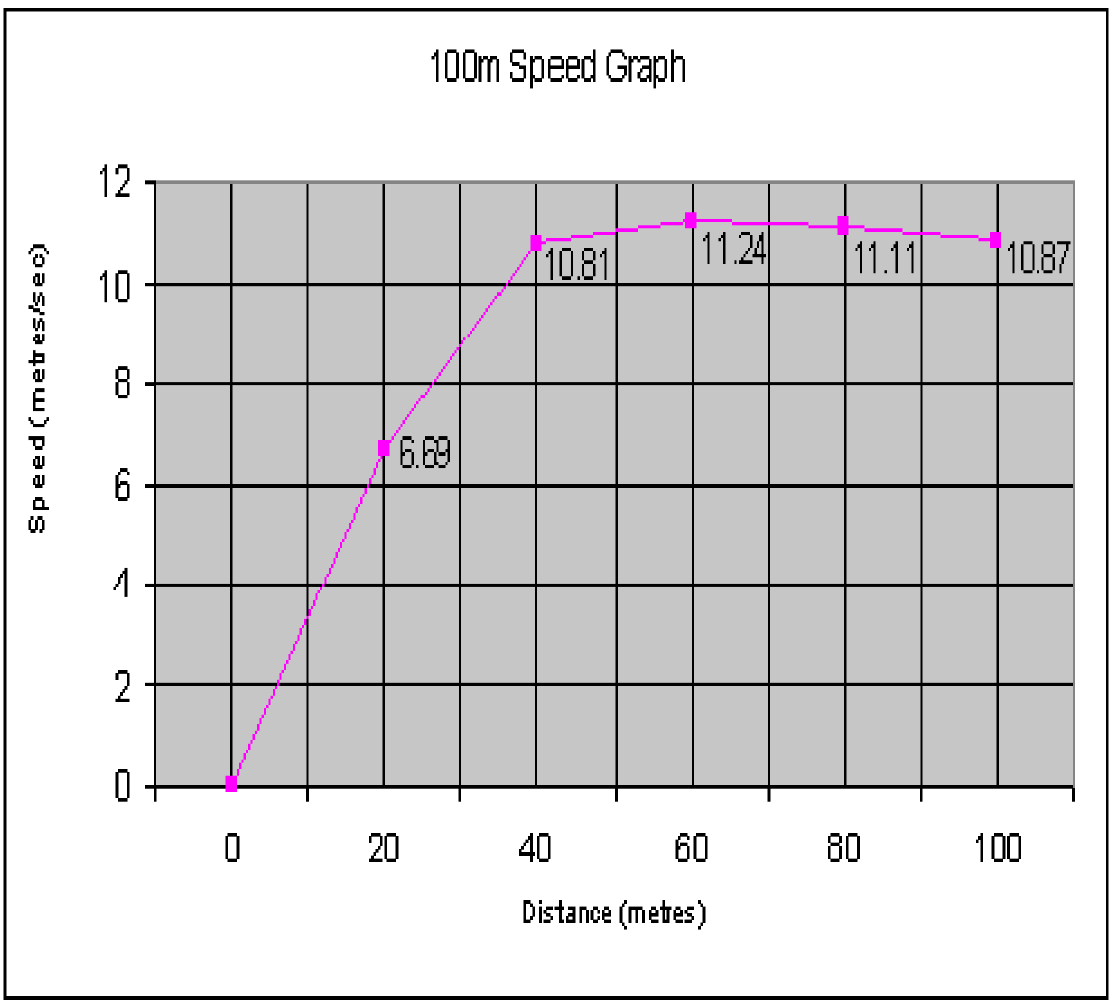
Name & Country	Reaction Time	20m	40m	60m	80m	100m	Up to 20m	20m to40m	40m to60m	60m to80m	80m to100m
Christie (UK)	0.139	2.93	4.74	6.48	8.22	9.96	2.93	1.81	1.74	1.74	1.74
Fredericks (NAM)	0.138	2.91	4.74	6.50	8.26	10.02	2.91	1.83	1.76	1.76	1.76
Mitchell (USA)	0.143	2.93	4.76	6.52	8.28	10.04	2.93	1.83	1.76	1.76	1.76
Surin (Can)	0.124	2.89	4.72	6.50	8.28	10.09	2.89	1.83	1.78	1.78	1.81
Burrell (USA)	0.165	2.99	4.82	6.58	8.32	10.10	2.99	1.83	1.76	1.74	1.78
Adeniken (NGR)	0.183	3.01	4.84	6.58	8.34	10.12	3.01	1.83	1.74	1.76	1.78
Stewart (JAM)	0.154	2.95	4.78	6.56	8.36	10.22	2.95	1.83	1.78	1.80	1.86
Ezinwa (NGR)	0.172	2.99	4.84	6.62	8.42	10.26	2.99	1.85	1.78	1.80	1.84

1.14.2 EVALUATION OF SPEED

If plot the speed at the 20 meter marks, it shows the maximum speed is achieved around 60 meters and from this point speed declines to the 100 meter point when it is approximately the same speed as that achieved at 40 meters, which is presented as graphical representation in the figure 4.

FIGURE 4

GRAPHICAL REPRESENTATION OF EVALUATION OF SPEED



The objective for coaches and athletes is to reduce this decline in speed between 60 and 100 meters.

The Anaerobic (ATP-CP) Energy System provides energy for 5 to 7 seconds - the point at which maximum speed is achieved. The primary source of energy between 60 and 100 meters is the Anaerobic Lactate (Glycolytic) System. Note that the aerobic pathway also provides a small amount of energy.

1.15 THE TECHNIQUES TO CRACK 100 METERS WITH IN 10 SECONDS

To achieve a less then10 second in 100 meters race, we need to focus on the following split times

a. 0 to 10 meters in 2 seconds

b. 0 to 20 meters in 3 seconds

c. From 20 meters to 100 meters aim for 0.87 seconds per 10 meters

If manage this, it will lead to achieve 9.96 seconds for 100 meters race. Bear in mind that maximum speed is achieved at 60 meters and that speed then declines from 60 to 100 meters.

1.16 Olympic Timing History

Although the history of the Olympic Games stretches back as far as 776 B.C.., the history of Olympic timing technology began just over 100 years ago, from 1896 Olympics to 1908 Olympics.

In First "modern" Olympic Games during **1896 at Athens, Greece** the Stopwatches were used to assess the performances of athletes in all track events, after that digital stopwatch were found due to the revaluations of science Electrical timing technology and simple photo finish methods were used in first at

1912 Stockholm, Sweden Olympics. Officials process the timing data of athletes were recorded first time in **1988 Seoul Olympics, Korea.** Because of the scientific evaluation Radio transponders were first used in long-distance events on **2002 Olympics at Salt Lake City, Utah** and the Photo-finish device takes 1,000 pictures per second that was used from **2004 Athens, Greece Olympics,** after that the technology improved so much in assessment of performance, currently more advanced Photo finishing methods were introduced to find out precise timings of athletes in Olympics and major international events.

1.17 NEED OF THE STUDY

Now a day's mostly timings are recorded for track events in national, state, university and district level meets by manually operated stop watches. It may not be very accurate, as watches are operated by human beings. The accuracy is based on the operating ability, reaction time, observation sensitiveness, environmental factors and Psychological aspects of the timer. Every individual is not having same operating ability and it will reflect on the time recorded too. To avoid such error electronic device can be used, to ensure starting and finishing technique, time accuracy and precision tendency to measure the timings of athletes. This motivated the investigator to construct and standardize a computer oriented electronic device to record the performance and its related variables of the sprinters.

1.18 OBJECTIVES OF THE STUDY

1. To assess the reaction time of athletes from starting position on the track for eight sprinters simultaneously.
2. To record the 20m split time of 100m sprinters at different five phases, from starting point to 20m, 20m to 40m, 40m to 60m, 60m to 80m, 80 to 100m simultaneously.
3. To record the speed performance of 100m sprinters.
4. To record the reaction time, 20m split time at different phases and speed performance of eight 100m sprinters simultaneously by using single electronic device.
5. To record these timings of 100m sprinters more precisely in 1/1000 seconds
6. To standardize the newly constructed computer oriented electronic device by establishing reliability, validity and objectivity.
7. To overcome the unfavorable psychological conditions, physical discomforts and environmental impact of the judges on the result precision.

1.19 STATEMENT OF THE PROBLEM

The purpose of this study was to construct and standardize a computer oriented electronic device for the assessment of performance and related variables of sprinting event.

1.20 HYPOTHESES

1. It was hypothesized that the newly designed computer oriented electronic device would be accurate, reliable, valid and objective in assessing the reaction time of 100m sprinters from starting position on the track.
2. It was also hypothesized that the newly constructed electronic device would be accurate, reliable, valid and objective in recording the 20m split time at different five phases.
3. It was further hypothesized that the newly designed electronic device would be accurate, reliable, valid and objective in assessing the speed of 100m sprinters.

1.21 SIGNIFICANCE OF THE PROBLEM

1. The contribution of the present study is construction and standardization of computer oriented electronic device to assess the performance and related variables of sprinters.
2. The newly constructed electronic device would be useful to record and provide accurate reaction time of 100m sprinters from starting position on the track.
3. The newly designed electronic device would be helpful to record and provide accurate 20m split time at different five phases during training and competition.
4. The device would be useful to record the speed performance of 100m sprinters.

5. From the point of view of coaches, this equipment would be of great value to assess the performance related variables of sprinters, accurately and to design the training schedule accordingly.
6. The judges of sprinting events can use this electronic device for officiating in standard sports meet for precision assurance.
7. It can minimize the use of officials and stopwatches while officiating sprinting events.
8. It educates and enables the sprinters to know their sprinting ability at various phases and modify their training program to the requirements felt.
9. The findings of the study would motivate the sports technology experts to construct a sophisticated computer oriented electronic device to assess the performance variables of athletes participating in running, jumping, and throwing events.
10. The newly constructed electronic device possesses the scientific authenticity such as reliability, validity, objectivity, administrative feasibility, and educational applications. Hence, the new device can be used to collect the data for research purposes in addition to training, testing and officiating. Hence, this device is possessing research applications too.
11. The results of the study would be of great significance to the body of knowledge in the field of sports technology in general and technology for s printers in specific.

1.22 DELIMITATIONS

The study has been delimited in the following aspects.

1. An electronic instrument was constructed as per the requirement of assessing the sprinting performance and related variables.
2. Reaction time, 20m split time and speed of 100m sprinters were assessed accurately by using the newly devised electronic instrument.
3. One hundred and twenty Athletes were engaged as subjects to establish reliability, validity and objectivity of the instrument.
4. Reliability was established by conducting test and re-test method under identical condition by means of the same subjects, instrument and testers.
5. Validity was established through collecting data using the presently designed instrument and stopwatches.
6. Objectivity was established by collecting data using three different testers.

1.23 LIMITATIONS

The following uncontrollable factors associated with the study were accounted as limitations of the study,

1. The reaction time of sprinters from starting position on the track could not assess by using other than newly devised equipment. Hence, validity was unable to establish for reaction time.
2. The Psychological stress and other similar factors of the subjects and testers were unable to control.

3. The uncontrollable changes in climatic conditions such as atmospheric temperature, humidity and other meteorological factors during the period of testing and its possible influence on the test items, has been considered as limitations.

1.24 MEANING AND DEFINITION OF THE TERMS

1.24.1 REACTION TIME

The reaction time is the time lapse between stimulus and response (**Mero, 1992).**

1.24.2 REACTION TIME OF SPRINTERS

The reaction time of sprinters is the time between the sound of starter's gun and the moment the athlete is able to exert a pressure against the starting blocks **(Komi & Gregor, 1992)**.

1.24.3 20m SPLIT TIME OF VARIOUS PHASES

The 20m split time of various phases are the time lapse between a.) Starting to 20m, b), 20m to 40m, c), 40m to 60m, d), 60m to 80m, e) 80m to100m of the 100m sprint, with regard to present study is concerned.

1.24.4 SPEED

Speed is the capacity of the individual to perform successive movement of the same pattern at a faster rate **(Barrow, 1979).**

Speed is defined as the ability to move a part or the whole body as fast as possible over a given distance **(Vanhees, et. al. 2005).**

1.24.5 CONDENSER MICROPHONE

Condenser microphone is a small electronic unit, its character is adjustable to receive low decibel to high decibel sound and tuned appropriately to receive the sound. When power fed, it is ready to observe the sound waves and converts it to its equivalent electrical signals.

1.24.6 MICRO SWITCHES

It is a special type of switch and when the switch is at normal condition, the strength of output signal is very low. If the switch gets operated, the output signal of micro switch is high and which induces the action required felt.

1.24.7 IR TRANSMITTERS

Infrared Transmitter is an electronic device. While power is fed to this unit, it produces two types of signals namely carrier and data signals. These signals amplified and transmitted towards the IR receiver.

1.24.8 IR RECEIVERS

Infrared LED receivers are general purpose receivers. It has a wide range of receiving frequency. This enables to receive a wide bandwidth of frequency signals, and it can be easily interfaced with micro controller and computer.

1.24.9 PERIPHERAL INTEGRATED CIRCUITS

Peripheral Integrated Micro controller is one of the core functioning units of the electronic device. Microcontroller is a general purpose device, which integrates a number of the components of a microprocessor system on to single chip. It has inbuilt CPU, memory and peripherals to make it as a mini computer.

1.24.10 INTERFACING UNIT

Interfacing unit is also one of the core functioning unit. This consists of a special microcontroller, which receives the signals from all PIC microcontrollers and the signals are encoded and sent to the computer for appropriate functioning.

1.24.11 COMPUTER

Computer is an electronic device, which can automatically accept and store input data, process them, and produce output results by interpreting and executing programmed instruction **(Peter, 2006).**

A computer is a data processing device based upon the instruction provided and generates the desired output. A system is defined as a set of components that work together to accomplish one or more common goals. Computation are accomplishing in the computer by programming. Programing is a sequence of instructions **(Peter, 2006).**

The review of literature is presented in next chapter.