CHAPTER III

METHODOLOGY

The selection of the subjects, rationale used for the selection of subjects, selection of variables, justification of the variable selection, experimental design, orientation of the subjects, construction of the computer oriented electronic device, administration of the test, establishment of scientific authenticity, and statistical analysis have been described in this chapter.

3.1 SELECTION OF THE SUBJECTS

The purpose of the study is to construct a computer oriented electronic device for accurate assessment of reaction time, 20m split time and speed of 100m sprinters. In order to achieve the purpose of the study, two hundred male athletes who participated in the Anna University Intercollegiate Athletic Meet held at Coimbatore were selected. Among them one hundred and twenty athletes were randomly selected as subjects by lot method and their age ranged between 18 to 25 years.

3.1.1 RATIONALE USED FOR THE SELECTION OF SUBJECTS

In any research, pursuit the prudential and careful selection of subjects is indispensible. Keeping this concept, one hundred and twenty subjects were selected on random basis. They were divided into fifteen equal groups, each consisting of eight members to assess the chosen variables. Extreme care was implemented in the selection of the subjects. These subjects were considered long enough and true representatives of the population. Above all these subjects are adequate to draw meaningful conclusions.

3.2 SELECTION OF THE VARIABLES

The investigator referred the available scientific literature pertaining to the electronic equipment such as books, journals and websites. Resorting from the review of literature, discussion with experts and considering the feasibility, the following variables are selected.

1. Reaction time from the sprint starting position on the track.
2. 20m split time
   a. Starting point to 20m
   b. 20m to 40m
   c. 40m to 60m
   d. 60m to 80m
   e. 80m to 100m
3. Speed.

3.2.1 JUSTIFICATION OF THE VARIABLES SELECTION

In sprinting events, 100m is the fastest event. The athlete's reaction time, acceleration ability and flying sprint are the most determinant variables of speed. Accurate assessment of reaction time, and 20m split time at different phases of 100m sprinters are indispensible for coaches and judges. Based on these factors the above mentioned variables have been selected for the present study, alienating the error possibilities.

3.2.2 REACTION TIME OF SPRINTERS

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

During the reaction phase the highly concentrated sprinter uses the resistance of the starting blocks to initially accelerate from a complete rest position. An explosive force production of the legs in a very short time is vital for a successful start. The time between the start signals to the first movement of the sprinter is of relatively small importance to the overall result. However, the desired psychological advantages at the beginning of the race can last right through, to the finish. Knowledge on reaction time of sprinters from starting position on the track is most essential for physical educationist and coaches.

3.2.3 20m SPLIT TIME AT DIFFERENT PHASES

The 20m split time of 100m race was recorded:

a) starting point to 20m

b) 20m to 40m

c) 40m to 60m

d) 60m to 80m

e) 80m to 100m

These timings of every 20m were assessed and recorded in 1/1000 split seconds by computer oriented electronic device. The time taken between the starting and reaching of maximum speed is called as acceleration time and it plays a major role in sprinting events.

3.2.4 SPEED

At the 100m finishing point, the 100m race timing was measured using computer oriented electronic device and score was recorded in 1/1000 split seconds and which is the 100m sprinters performance. Assessing the speed of eight sprinters at a time by using electronic device is an advantage.

3.3 EXPERIMENTAL DESIGN

One hundred and twenty subjects were randomly selected by lot method and divided into fifteen equal groups, each consisting of eight members. To all the 120 subject's the reaction time from starting position on the track, 20m split time at different five phases and speed performance were assessed simultaneously for eight athletes by using the newly constructed computer oriented electronic device. Hence, random group design was followed in this study.

3.4 ORIENTATION OF THE SUBJECTS

The investigator conducted a meeting with the subjects prior to the administration of 100m race. The purpose, testing procedure and significance of the study were explained to them in detail so that there was no ambiguity in their minds. Further, all the subjects were motivated to perform better during the test. All the subjects were enthusiastic and co- operative throughout the study.

3.5 STEPS INVOLVED IN CONSTRUCTION OF THE COMPUTER ORIENTED ELECTRONIC DEVICE

A computer oriented electronic device was constructed to assess the reaction time, 20m split time at various five phases and speed of the 100m sprinters. The computer oriented electronic device is equipped with the following core parts.

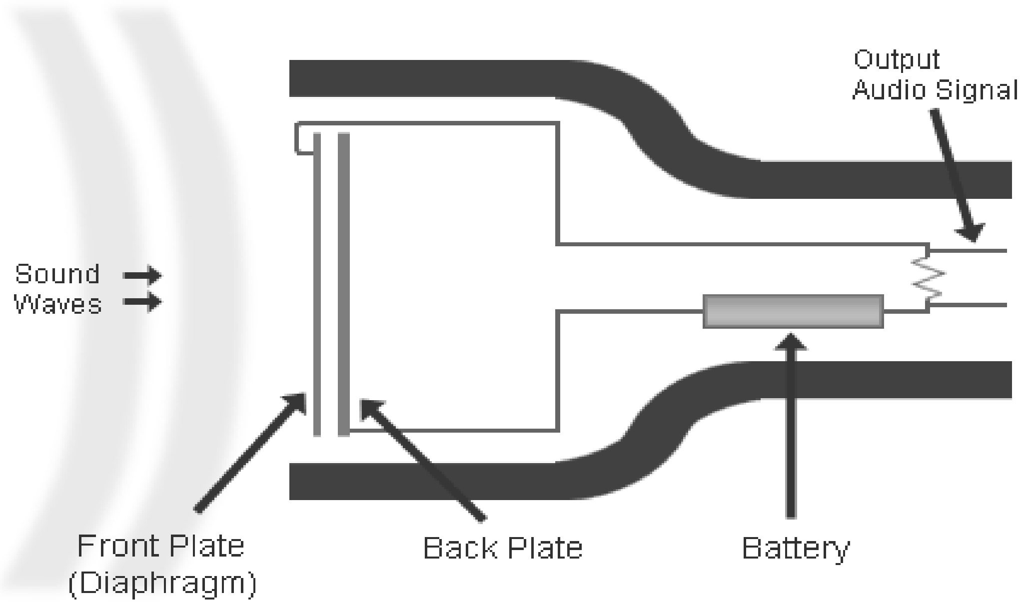
a. Condenser Microphone
b. Micro Switches
c. IR Transmitters
d. IR Receivers
e. Peripheral Integrated Circuits
f. Interfacing unit
g. Computer

3.5.1 CONDENSER MICROPHONE

Condenser microphone is a small electronic unit, which is attached with starting gun. It is character is adjustable to receive low decibel to high decibel sound and tuned appropriately to receive the gun sound. Its output terminal is connected with the interfacing unit via PIC microcontroller through wires. When power fed, it was observe the sound waves and converts it to its equivalent electrical signals. While gun firing, the sound is observed and transmitted to the interfacing unit to start all the timers in computer monitor simultaneously and instantly. The cut section view and parts of the condenser microphone is shown in figure 12.

FIGURE 12

MICROPHONE



3.5.2 MICRO SWITCH

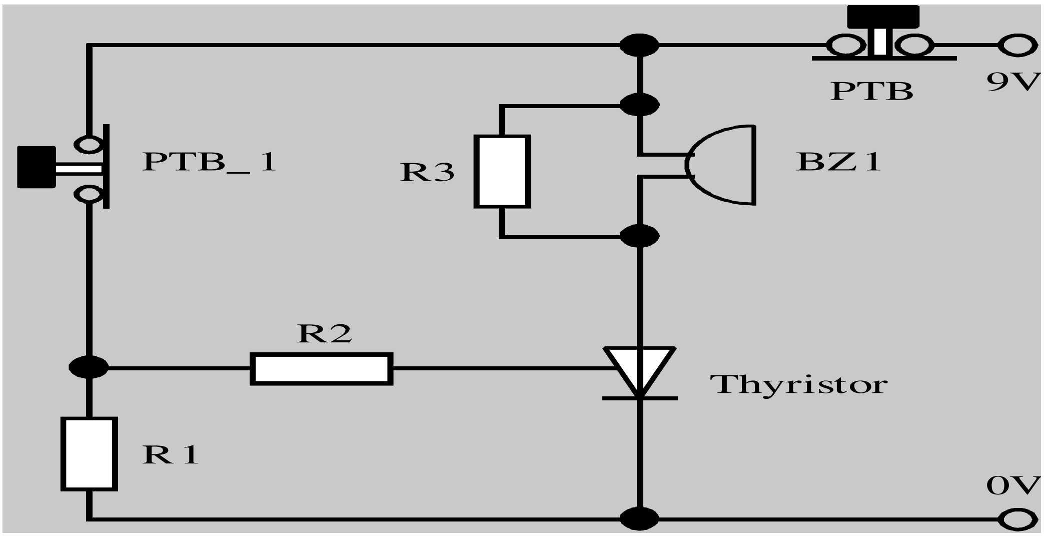
It is a special type of switch fed by the appropriate power supply to activate the switch. The output signal is very low when the switch is at normal condition. If the switch *g*ets operated the output signal of micro switch is high, which signal induces the timer to stop and record the timings and the switch is shown in figure 13 and its circuit diagram is shown in figure 14.

FIGURE 13

MICRO SWITCH

FIGURE 14

CIRCUIT DIAGRAM OF MICRO SWITCH



Components

PTB = Push type micro-switch (normally closed)

PTB_1 = Push type micro-switch (normally closed)

Thyristor = TIC106D, BZ1 = Buzzer, R1 = 10k ohm

3.5.3. INFRARED SENSORS

Infrared radiation (**IR**) is electromagnetic radiation with a wavelength between 0.7 and 300 micrometers, which equates to a frequency range between 1 and 430 THz. Its wavelength is longer (and the frequency lower) than that of visible light, but the wavelength is shorter (and the frequency higher) than that of terahertz radiation microwaves. Bright sunlight provides an irradiance of just over 1 kilowatt per square meter at sea level. Of this energy, 527 watts is infrared radiation, 445 watts is visible light, and 32 watts is ultraviolet radiation

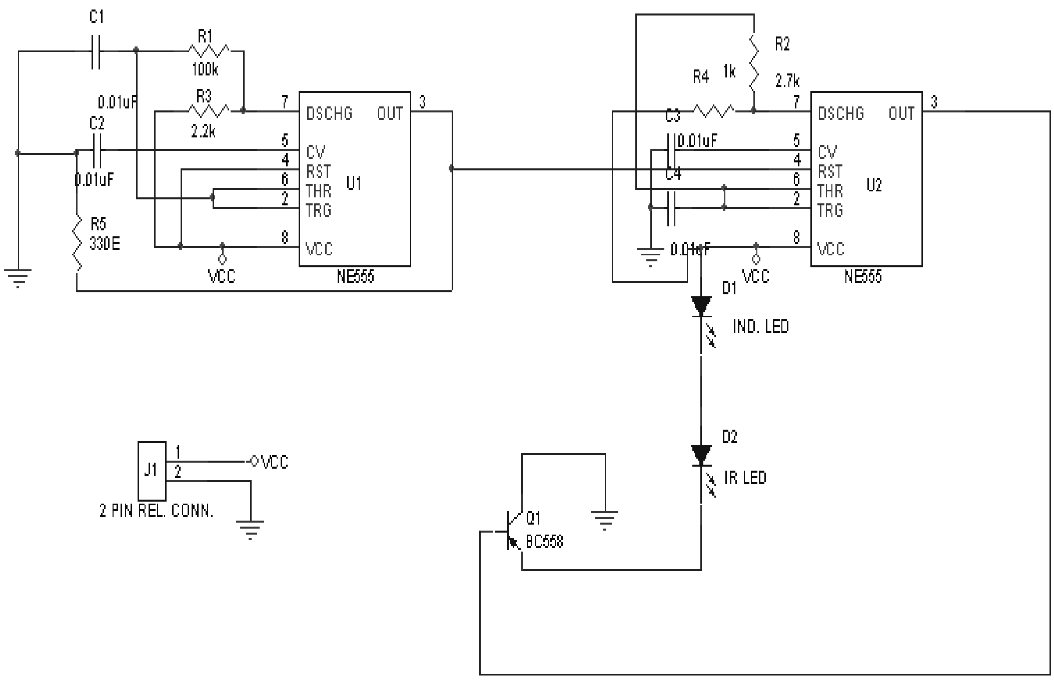
This is the most important part of the electronic device, which is the signal acquisition part while the device is functioning. In this area mainly two core parts are combined together and plays an important role in gathering and analyzing the data of the race and they are detailed below: a) Infrared Transmitter and 2) Infrared Receiver.

3.5.3.1 INFRARED TRANSMITTER

Infrared Transmitter is one of the core units of this electronic device. While power is fed to this unit, it produces two types of signals namely the data signals and the carrier signals. The carrier signals carry the data signal to the amplifier and these two amplified signals are transmitted towards the IR receiver. In this application, the data signals are produced using IC 555 in the astable mode. The astable mode can produce the signal continuously. The IC 555 produces square waves, which can be produced with variable frequency and it can be adjustable to the required application. The circuit diagram is shown in figure 15.

FIGURE 15

INFRARED TRANSMITTER CIRCUIT DIAGRAM



As per the circuit diagram given above, the circuit uses two IC 555. One of the IC 555 is used to producing data signal and the other is used to produce the carrier signal which carries the data signals. The two square waves form data signals are modulated and passed to the amplifiers. The amplified signal is transmitted to the transistor to invert the modulated signal and passes it to the Infrared Light Emitting Diode to convert the electrical modulated signal to infrared pulses and this is transmitted in air. The signal which is transmitted is equal to the light frequency, hence there is no interference by any means.

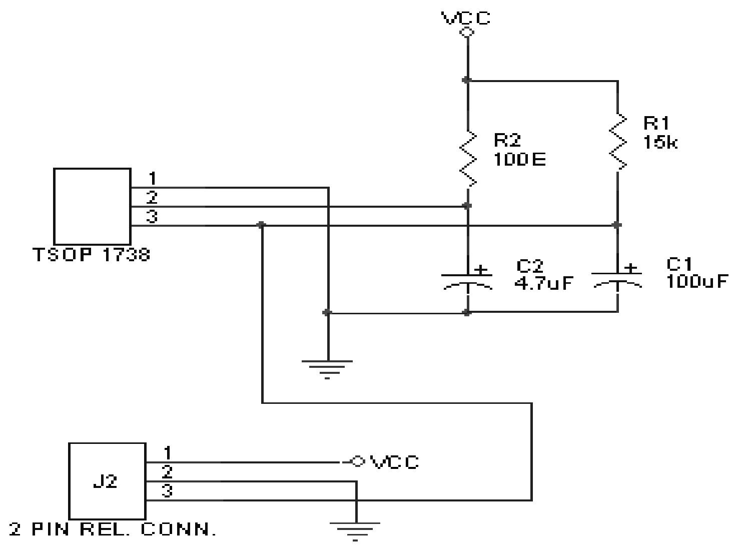
The IC LM555/NE555/SA555 is a highly stable controller capable of reducing accurate timing pulses. With mono stable operation, the time delay is controlled by one external resistor and one capacitor. With astable operation, the frequency and duty cycle are accurately controlled with two external resistors and one capacitor.

3.5.3.2 INFRARED RECEIVER

In this section the working method of circuits is explained. The receiver section uses the Infrared LED receivers, which is a general purpose receiver. The receiver has a wide range of receiving frequency, which enables to receive a wide bandwidth of frequency signals and it can be easily interfaced with micro controller and computer. The IR receiver circuit diagram is given in figure 16.

FIGURE 16

INFRARED RECEIVER CIRCUIT DIAGRAM



IR LED and receiver module in the proximity detector are shown in the above Figure 16, the proximity detectors are LED type miniaturized receivers using an infrared detector and used in various equipment like remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal is directly decoded by a microprocessor. LED receiver is the standard IR remote control receiver series, supporting all major transmission codes. The receivers use a sharp IR module when the IR beam from the transmitter falls on the IR module the output is activated.

As shown in circuit diagram, the data is received from the receiver, which can be directly encoded to micro controller and it will be given to a computer to compare the input voltage received and given to micro controller data.

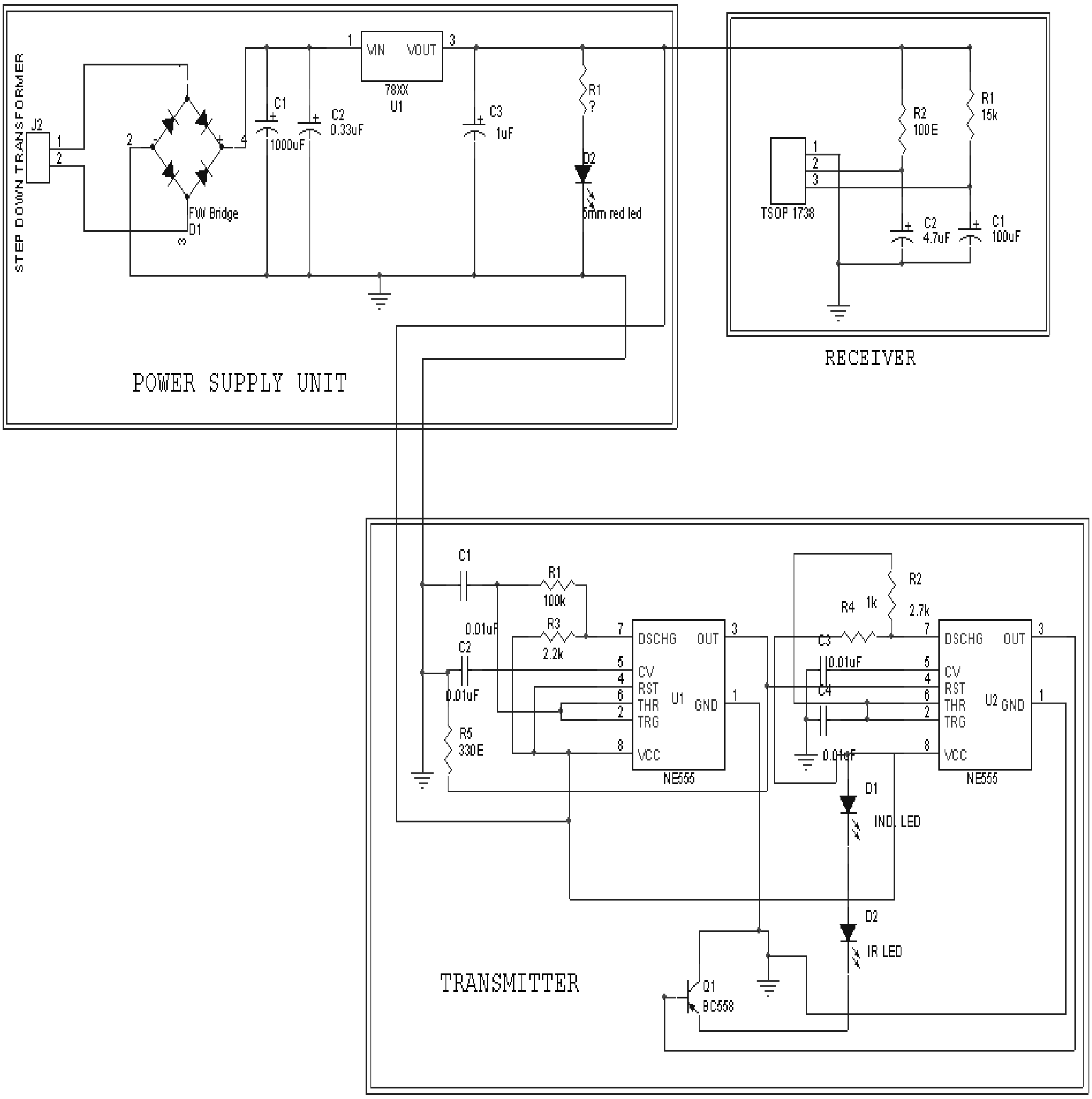
There is continuous transmission and receiving of the signals are possible only when there is no element in between the IR receiver and IR Transmitter, when there is any interruption between the two, there is a failure of the transmitter signal to receiver. Hence, there is no continues signal between the IR transmitter and IR Receiver, which interruption is encoded by the microcontroller.

3.5.4 TOTAL INFRARED MODULE CIRCUIT

The circuit primarily consists of an infrared transmitter and an infrared receiver. The transmitter section consists of a 555 timer IC functioning in astable mode. It is wired as shown in the figure 17. The output from astable is fed to an infrared LED, which limits its operating current. This circuit provides a frequency output of 38 kHz at 50 per cent duty cycle, which is required for the infrared detector/receiver module.

FIGURE 17

TOTAL IR MODULE CIRCUIT'S DIAGRAM



Both the transmitter and the receiver parts are placed in a straight line to the infrared LED to avoid false indication due to infrared leakage. While an object crosses the infrared rays emitted by the infrared LED, the infrared receiver gets special signal, hence when the receiver part is triggered, the output signal is used in any desired way.

The sensitivity of the detector depends on current-limiting resistor in series with the infrared LED. The circuit is used as a proximity sensor, i.e. to detect objects obstructing an IR beam. The LEDs are pointed in the same direction as the IR module and at the same level. The suggested arrangement is shown in the circuit diagram. The LEDs are properly covered with a reflective material like glass or aluminum foils on the sides to avoid the spreading of the IR beam and to get a sharp focus of the beam. When there is nothing in front of them, the IR beam is not interrupted hence the circuit is not activated. When an object crosses the device, the IR light from the LEDs is destructed by the object and the circuit gets activated to produce the appropriate signal.

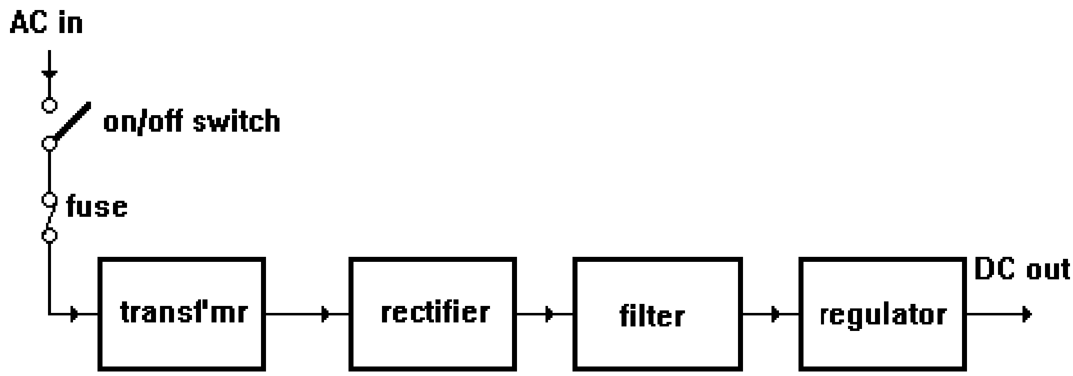
The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/EIA-232-F inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept □30-V inputs. Each driver converts TTL/CMOS input levels into TIA/EIA-232-F levels.

3.5.5 POWER SUPPLY UNIT

Most of the electronic circuits need a DC supply such as a battery to power them. Since the main supply is AC, it has to be converted to DC to useful in electronics. This is what a power supply does and the diagram is presented in figure 18.

FIGURE 18

POWER SUPPLY UNIT'S DIAGRAM



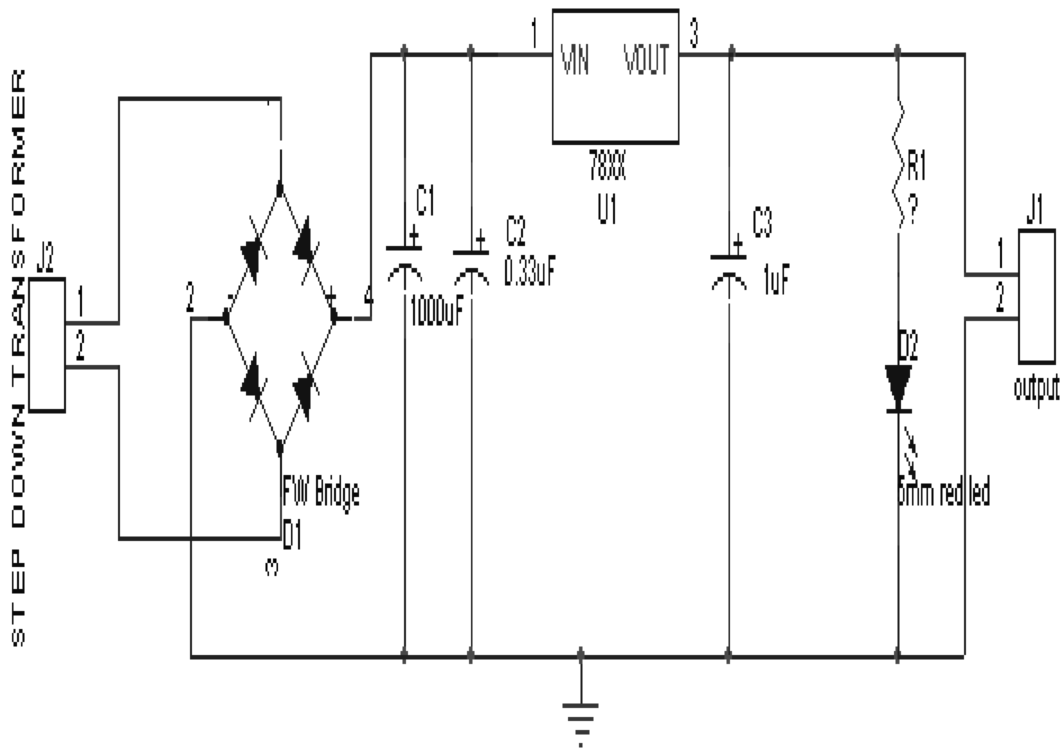
First the AC supply passes through an isolating switch and safety fuse before it enters the power supply unit. In most cases the high voltage mains supply is too high for the electronic circuitry. It is therefore stepped down to a lower value by means of a transformer. The mains voltage is stepped down where high DC voltages are required. From the transformer the AC voltage is fed to a rectifier circuit consisting of one or more diodes. The rectifier converts AC voltage into DC voltage. This DC is not steady as from a battery. It is pulsating;

the pulsations are smoothed out by passing them through a smoothing circuit called a filter. In its simplest form the filter is a capacitor and resistor.

Any remaining small variations can, if necessary, be removed by a regulator circuit which gives out a very steady voltage. This regulator also removes any variations in the DC voltage output caused by the AC mains voltage changing in value. Regulators are available in the form of Integrated Circuits with only three connections and the circuit diagram is shown in figure 19.

FIGURE 19

POWER SUPPLY UNIT CIRCUIT DIAGRAM



3.5.6 PERIPHERAL INTEGRATED CIRCUITS

Peripheral Integrated Micro controller is one of the core functioning units of the electronic device, which is fixed at interfacing unit of the device.

3.5.6.1 CONCEPTS OF MICROCONTROLLER

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. The microcontroller combines on to the same microchip of The CPU core, Memory (both ROM and RAM), some parallel digital ICs.

The microcontrollers combine other devices also such as.

a. A timer module to allow the microcontroller to perform tasks for certain time periods.
b. A serial I/O port to allow data to flow between the controller and other devices such as a PIC or another microcontroller.
c. An ADC to allow the microcontroller to accept analogue input data for processing.

3.5.6.2 SPECIAL FEATURES OF MICROCONTROLLERS

a. Smaller in size
b. Consumes less power and Inexpensive

Micro controller is a standalone unit, which perform functions on its own without any requirement for additional hardware like i/o ports and external memory. The heart of the microcontroller is the CPU core. In the past, this has traditionally been based on an 8-bit microprocessor unit. In the recent years, microcontrollers have been developed around specifically designed CPU cores.

3.5.6.3 PIC 16F877 MICROCONTROLLERS

Various microcontrollers offer different kinds of memories like EEPROM, EPROM, and FLASH etc. Among which FLASH is the most recently developed technology that is used in pic16F877 microcontrollers.

3.5.6.4 ARCHITECTURE OF PIC 16 F877

The complete architecture of PIC 16F877 is shown in the table III and it gives details about the specifications of PIC 16F877.

TABLE III

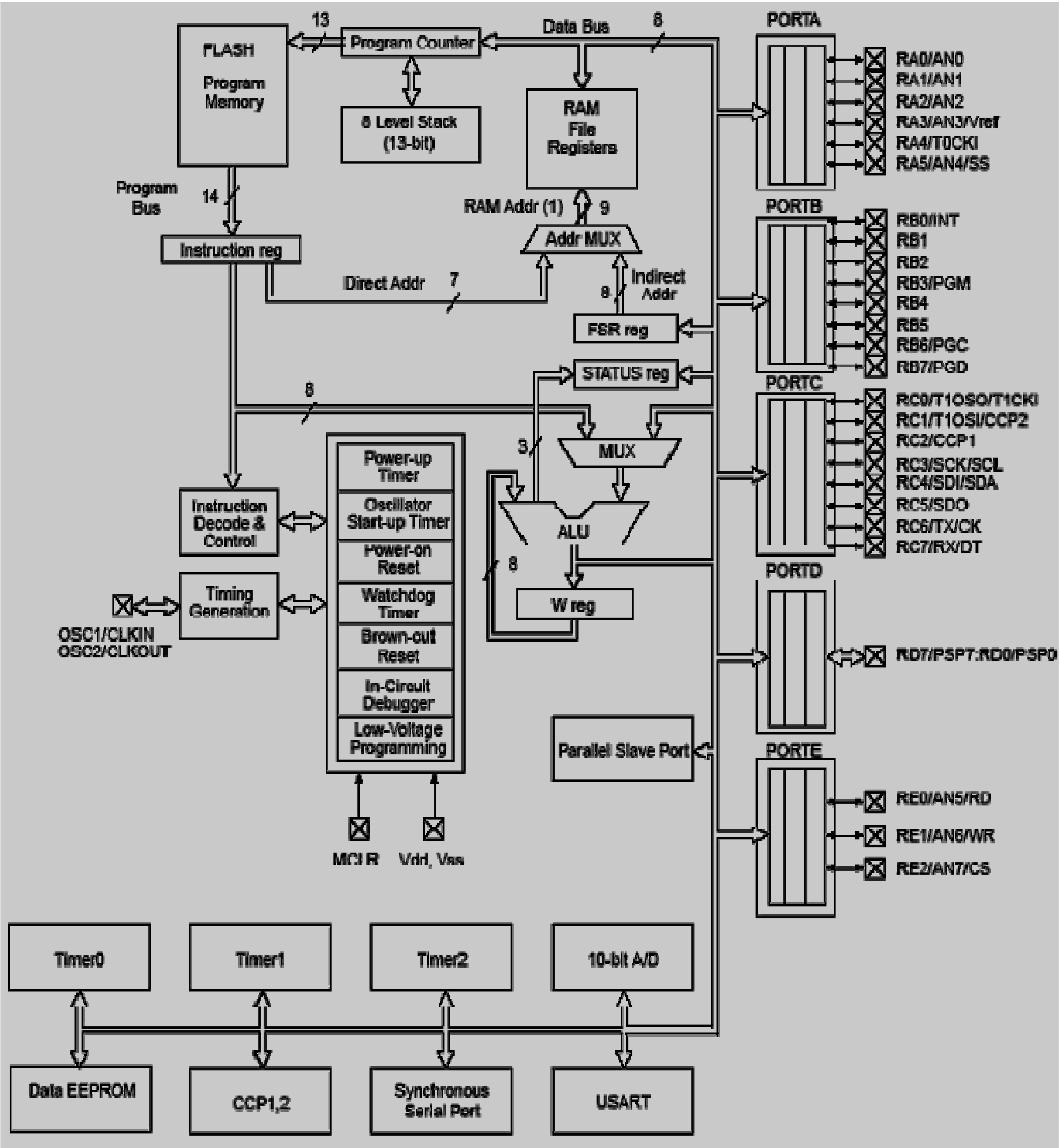
ARCHITECTURE OF PIC 16 F877 MICROCONTROLLERS

DEVICE	PROGRAM FLASH	DATA MEMORY	DATA EEPROM
PIC 16F877	8K	368 Bytes	256 Bytes

3.5.6.5 ARCHITECTURE

FIGURE 20

ARCHITECTURE OF PIC 16F877

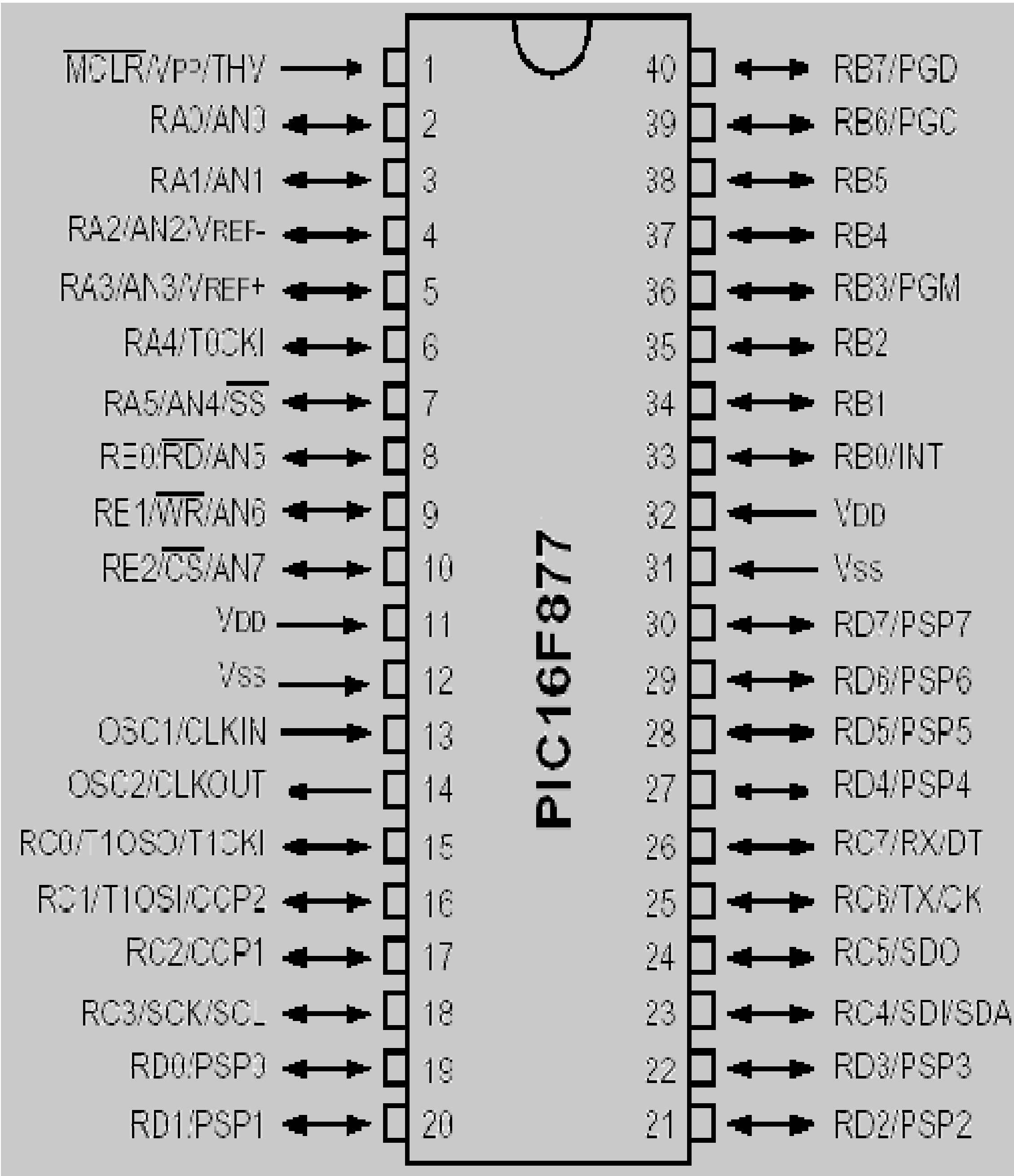


Note 1: Higher order bits are from the STATUS register.

3.5.6.6 PIN DIAGRAM

FIGURE 21

PIN DIAGRAM OF IC16F877



In this application, a timer program in visual basic dot net is used. When the starting gun is operated to commence the race, the gun's sound is absorbed and encoded by the PIC, and the encoded signal sends to the interfacing unit to start timer instantly in the computer. When the subject passes through the finishing line, the infrared sensors receive the interruption and it sends the signals to PIC microcontroller.

The micro controller gets signal from all the IR receivers of the 8 tracks and changes in to alphabet code and transmits the signal to the interfacing unit.

3.5.7 INTERFACING UNIT

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

3.5.8 PERSONAL COMPUTER

This is an ordinary computer yet one of the major functioning units. A special software program from visual basic is installed, which contains the timer and sprinters performance recording options. All timers instantly and simultaneously start when it receives signal from the starting gun. All the timers will stop and record the timings based on the signals received from infrared sensors while athletes cross the corresponding lines, finally the computer analyze the result and display the results in position wise.

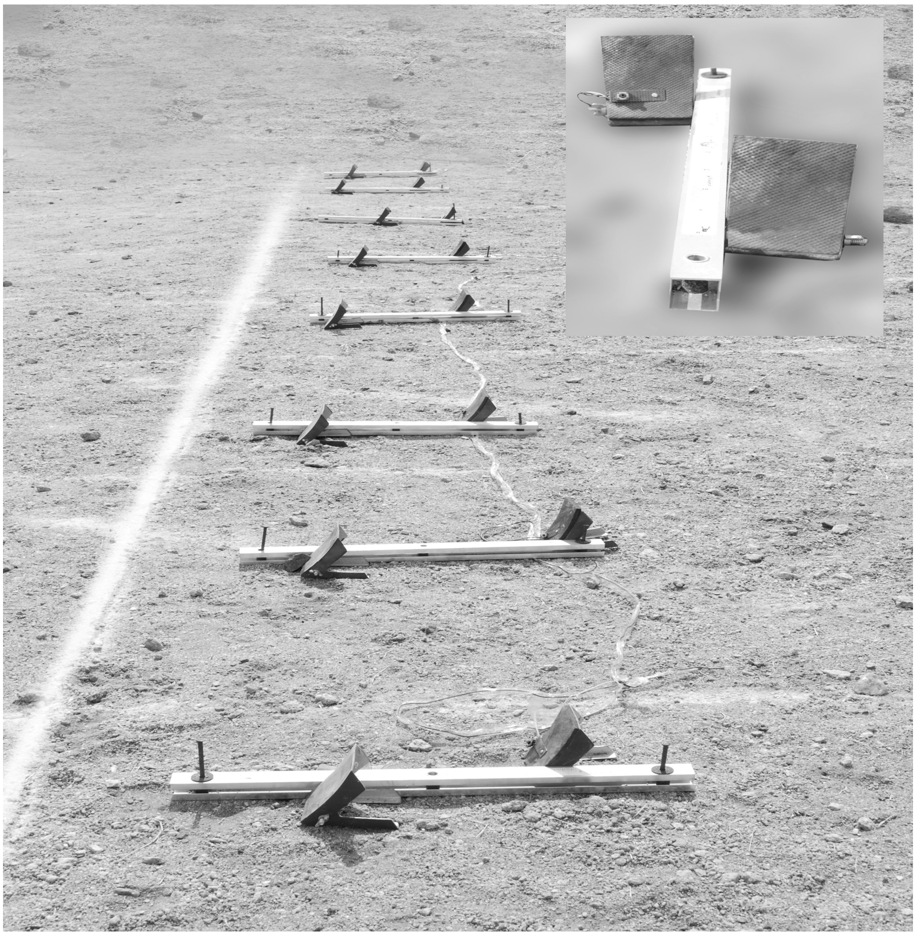
3.6 ADMINISTRATION OF THE TEST

3.6.1 ASSESSING THE REACTION TIME OF 100m SPRINTERS FROM STARTING POSITION ON THE TRACK

To assess the 100m sprinters reaction time, eight starting blocks were used. All the starting block's rear side is fixed with a special micro switch and its output terminals of each switches are connected with the computer via interfacing unit for appropriate function. Its photography is presented in the figure 22.

FIGURE 22

MICRO SWITCHE FITTED WITH STARTING BLOCKS



At the starting point of each lane, 8 athletes were directed to run 100m straight sprint in a 400m mud track with crouch starting position. To start the race, starting gun attached with condenser microphone was used, when the gun was triggered the sound was observed by the microphone and sent the signal to microcontroller instantly to start all the 8 timers in the computer and it was flashed in the computer monitor. On hearing the gun sound, the athletes kicked the starting block to commence the race, while the special micro switches observe the movement and sent a signal to interfacing unit to stop the timer. Every athlete's response, corresponding timer unit seized and it was recorded in microseconds. These recorded times are the reaction time of sprinters from starting position on the track and which are shown in figures 23 and 24.

FIGURE 23

SPRINT STARTING POSITION TO ASSESS

THE REACTION TIME

FIGURE 24

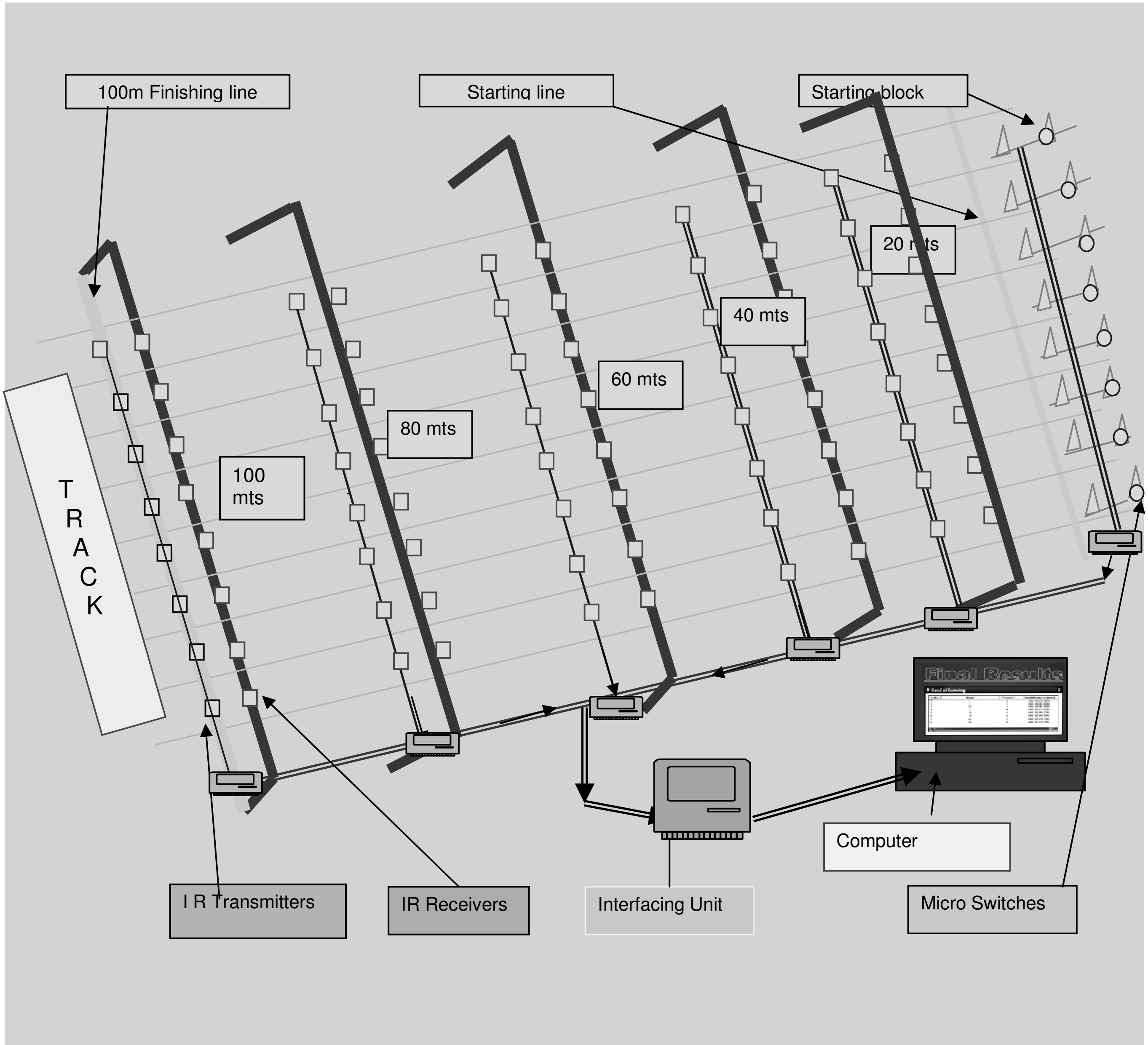
ASSESSING REACTION TIME OF 100M SPRINTERS IN STARTING POSITION ON THE TRACK

3.6.2 ASSESSING 20m SPLIT TIME OF 100m SPRINT AT DIFFERENT FIVE PHASES

The Infrared transmitters of the electronic device were placed at 20m, 40m, 60m, 80m and 100m of the track in every lane. The IR receivers also fixed over the IR transmitter in a straight line, at eight feet height. The power fed to IR module, the IR rays emitted in a straight line from IR transmitter to the corresponding IR receiver with streamlined injection. The gathered rays by the IR receivers are converted as electrical signals and constantly transmitted to the interfacing unit. The interfacing unit encoded the received signals and sent them to the computer to coordinate with the corresponding timer to analyze and record the result. These results had shown the 20m split time at various five phases and which is presented in figure 25.

FIGURE 25

METHOD OF ASSESSING THE 20m SPLIT TIME OF 100m SPRINTERS AT DIFFERENT PHASES



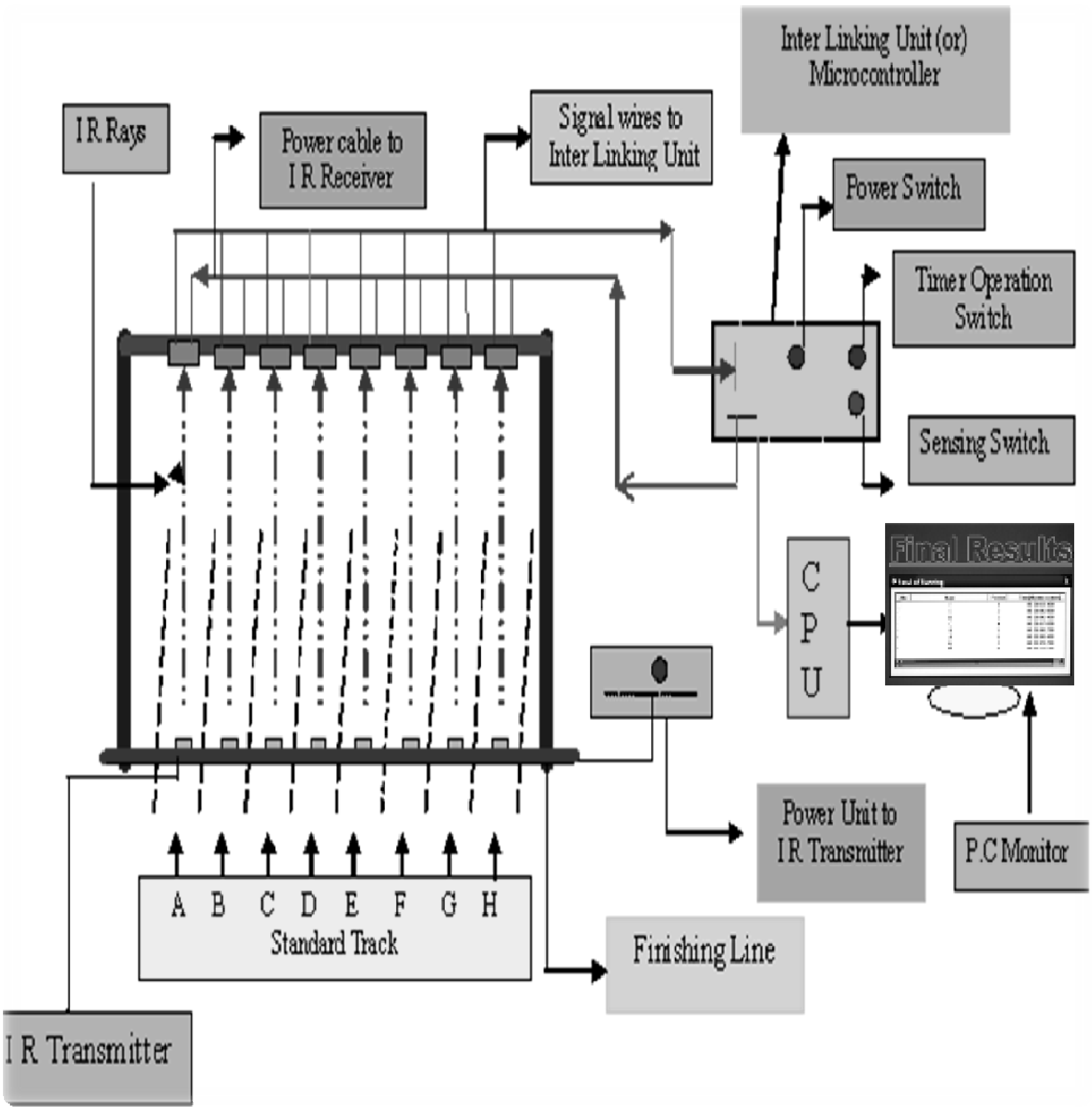
On hearing the gun sound the athletes started 100m and instantly timer of electronic device started in all eight tracks and flashed in the computer monitor. When the athletes crossed the 20m, 40m, 60m, 80m and 100m, the constantly emitted IR rays got interrupted. The interruption instantly got converted as data signals by IR receivers and these signals were gathered by the micro control at interfacing unit and it sent them to the computer in the form of a special computer code language, to coordinate with special software which is already installed in the computer. Hence, the timer in the computer also instomatically stops, so does for every athlete also. By the above said method the athlete's 20m split time for five phases were assessed. These recorded times are the 20m split time of starting to 20m, 20m to 40m, 40m to 60m, 60m to 80m and 80m to 100m, of 100m sprint.

3.6.3 ASSESSING THE SPEED OF 100m SPRINT

On hearing the gun sound, the athletes started the 100m race and instantly timer of the electronic device started in all eight tracks and flashed in the computer monitor. While they crossed at 100m finishing line, the constantly emitted IR rays got interrupted. The interruption instantly got converted as data signals by IR receivers and these signals were sent to the computer in the form of a special computer code language. This signal stops the timer in the computer instomatically, so does for every athlete also. By the above said method the athlete's 100m performance was assessed simultaneously for eight athletes and which is shown diagrammatically in figure 26.

FIGURE 26

DIAGRAM OF THE ELECTRONIC DEVICE WORKING METHODOLOGY AT 100m FINISHING POINT



3.6.4 COLLETION OF DATA

In this study, at a time eight athletes were directed to run 100m straight sprint on a 400m mud track in crouch starting position. In the same way 15 batches of each eight athletes, (15x 8=120) completed 100m sprinting. Further, at the interval of two days for recovery, the athletes were directed to run 100m second time by following the same procedure.

When the athletes ran 100m for the first time, the first tester assessed reaction time, 20m split time at various phases of , a) from starting point to 20m, b) 20m to 40m, c) 40m to 60m, d) 60m to 80m and 80m to 100m and 100m sprint performance of atheletes using the newly constructed electronic device. Simultaneously all the above said variables were also assessed by adequate number of timers using stopwatches.

Howere, the timers were unable to assess the reaction of atheletes as it is not possible to record the same using the stop watches.

When the athletes ran 100m for the second time the same first tester was collected the data for above said variables using the device. When the atheletes ran 100m for third and fourth time all the above said variables were assessed separetly by second and third testers using the newly constructed electronic device by following same procedure. During second, third and forth testing periods all the data were assessed by using the new device alone.

The data were collected from the atheletes during different four testing periods. Further, reliability, validity and objectivity were establised by using the appropriate data.

3.7 STASTICAL TECHNIQUES

To establish reliability, test re-test were conducted by using the newly constructed electronic device. ANOVA and Intraclass Correlation(R) was computed separetely for each variables as suggested by **Thomas and Nelson (1996).**

In order to establish valididy,tests were conducted by using the newly constructed electronic device and stop watches simultaniously. The collected data were treated by calculating Peasrson Product Moment Correlation separately for each variables.

With a view to establish objectivity, three testers were used to assess the variables by using the newly constructed electronic device at three different periods. ANOVA and Intraclass Correlation(R) was computed separetely for each variables as suggested by **Thomas and *Nelson (*1996).** In all cases, the level of significance was fixed as 0.01.

The results and discussions are presented in the next chapter.