CHAPTER ONE

INTRODUCTION

1.1 Background

Radar (Radio Detection and Ranging) is a system by which electromagnetic waves are used to locate targets and determine target characteristics such as elevation, range, speed, azimuth, and size. Radar does this with greater accuracy, flexibility, and range than optical techniques, and thus has great applicability in a wide variety of situations. Most radars that operate today utilize frequencies greater than 300 MHz; however, it is sometimes desirable to have a system that operates in the high frequency (HF) band. This paper examines the history, theory, and current usage of HF radar systems.

Many advances had taken place since radio was first discovered in the late nineteenth century, and radar took full advantage of these developments. Many radio communications systems in the 1920s and 1930s operated using HF equipment. The HF band is the range of radio frequency that extends from 3 to 30 MHz that became a viable method of worldwide communication at this time. This is because HF waves can travel beyond the horizon due to reflection and refraction from the ionosphere, a region of ionized gas in the upper atmosphere. This method of communication was less expensive and easier to deploy than long distance telegraph cables, and therefore became widespread in usage. HF radio equipment and parts became readily available, which engineers adapted for use in early radar designs.

Numerous countries had radar development programs during the early twentieth century, including the United States and the United Kingdom. Many of the original radar designs operated in the HF range. In the United States, radar development was initially conducted at the Naval Research Laboratory. Albert Taylor and Leo Young began working on radar design in 1922 during routine communication experiments. Robert Page and Leo Young furthered radar technology by developing pulse radar, which was demonstrated in 1934.

1.2 Problem Statement

The objective for this master research is to make simulation for Over The Horizon Radar and show how it work and detect all targets over the horizon based on mobile GSM network interfaced with PC , this simulation can be done theoretical and practical through mobile GSM network and software language Turbo (c++).

1.3 Objectives

The goal of this master research is to:

- Get General understanding of radar system and over horizon radar in details.
- Get general understanding of GSM network and GSM intelligent alarm system.
- Give simple simulation for over horizon radar operation by using GSM intelligent alarm system interfaced to computer through D25 connector with turbo c++ programming language.
- Detect Targets which it integrated with GSM network mobile and display it on the computer monitor in real time.

1.4 Methodology

This research divided to two levels, hardware level and software level. The hardware level includes GSM intelligent alarm system interfaced with computer through D25 connector and the software level is implementing with turbo C++ language.

GSM intelligent alarm module is used to generate different targets which we need to detected. Host pc used to display this target on the computer monitor.

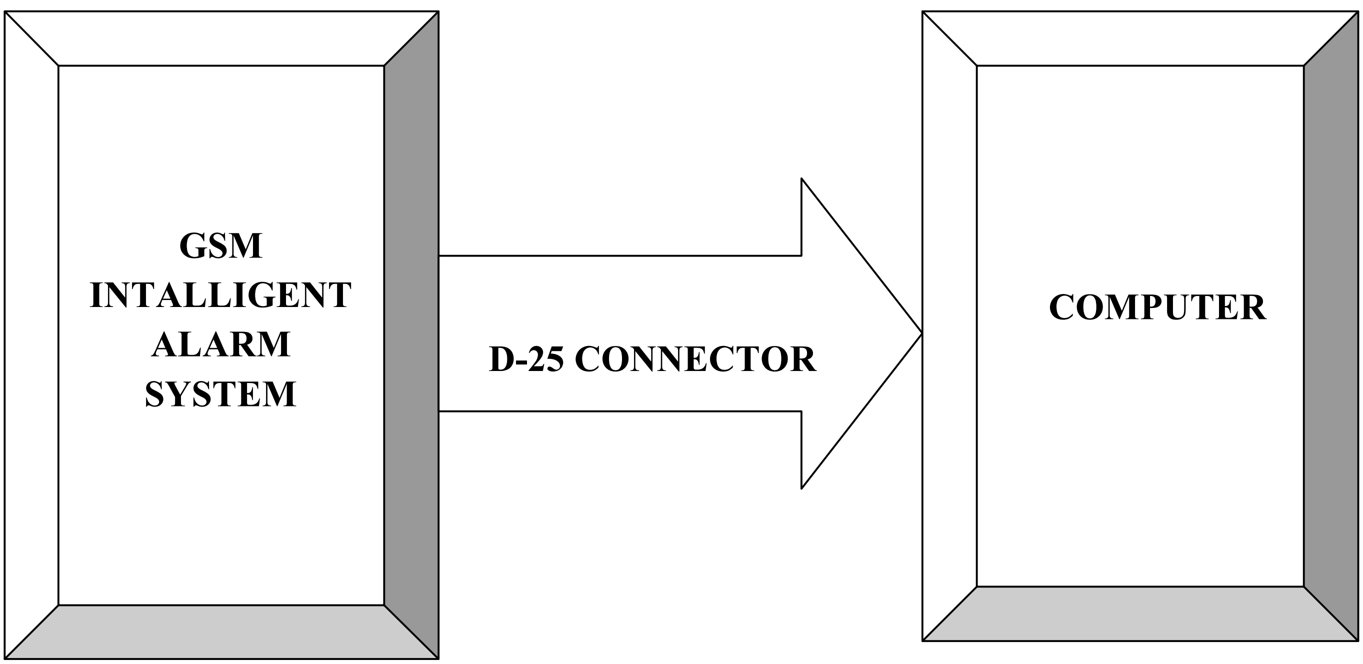

Figure (1.1): Block diagram of the system design

1.5 Research Plan

The Research consists of six chapters:-

Chapter one: An Introduction:-

It consists of the Background of research, problem statement, objective, methodology, research outline.

Chapter two: literature review

It contains radar system concepts, over the horizon radar function, Overview for global system for mobile communication system (GSM).

Chapter three: system design

It contains GSM intelligent alarm system, D-25 connector and computer.

Chapter four: software

The software level is the programming by turbo C++ language.

Chapter five: Results and discussion.

Chapter six: Conclusion and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2-1 RADAR SYSTEM PRINCIPLES

The word radar is a contraction of Radio detecting and ranging, the electronic principle on which radar operates is very similar to the principle of sound-wave reflection. If you shout in the direction of a sound-reflecting object (like a rocky canyon or cave), you will hear an echo. If you know the speed of sound in air, you can then estimate the distance and general direction of the object. The time required for an echo to return can be roughly converted to distance if the speed of sound is known.

Radar uses electromagnetic energy pulses in much the same way, as shown in Figure 3. The radio-frequency (RF) energy is transmitted to and reflected from the reflecting object. A small portion of the reflected energy returns to the radar set. This returned energy is called an ECHO, just as it is in sound terminology. Radar sets use the echo to determine the direction and distance of the reflecting object. Radars are used to detect the presence of an aim (as object of detection) and to determine its location. The contraction implies that the quantity measured is range. While this is correct, modern radars are also used to measure range and angle. The following figure shows the operating principle of primary radar. The radar antenna illuminates the target with a microwave signal, which is then reflected and picked up by a receiving device. The electrical signal picked up by the receiving antenna is called echo or return. The radar signal is generated by a powerful transmitter and received by a highly sensitive receiver.

The following figure shows the operating principle of a primary radar set. The radar antenna illuminates the target with a microwave signal, which is then reflected and picked up by a receiving device. The electrical signal picked up by the receiving antenna is called echo or return. The radar signal is generated by a powerful transmitter and received by a highly sensitive receiver.

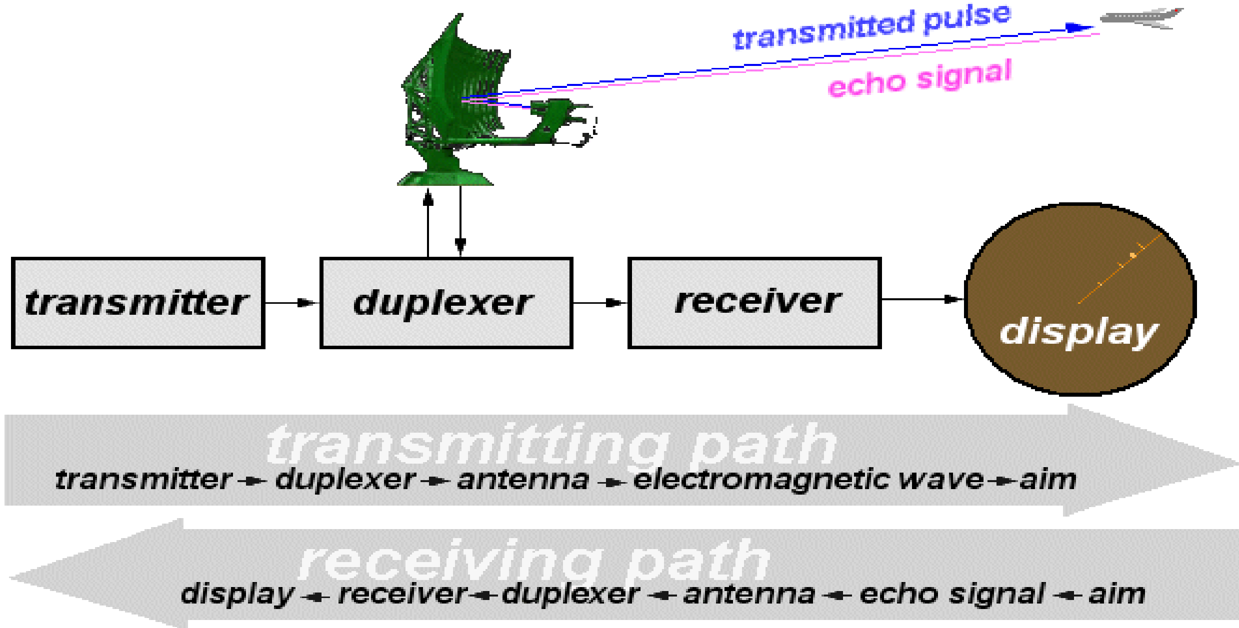

Figure 2.1 : Block diagram of a primary radar

All targets produce a diffuse reflection i.e. it is reflected in a wide number of directions. The reflected signal is also called scattering. Backscatter is the term given to reflections in the opposite direction to the incident rays.

Radar signals can be displayed on the traditional plan position indicator (PPI) or other more advanced radar display systems. A PPI has a rotating vector with the radar at the origin, which indicates the pointing direction of the antenna and hence the bearing of targets.

2.1.1Transmitter

The radar transmitter produces the short duration high-power RF pulses of energy that are into space by the antenna.

2.1.2Duplexer

The duplexer alternately switches the antenna between the transmitter and receiver so that only one antenna need be used. This switching is necessary because the high-power pulses of the transmitter would destroy the receiver if energy were allowed to enter the receiver.

2.1.3Receiver

The receivers amplify and demodulate the received RF-signals. The receiver provides video signals on the output.

2.1.4 Radar Antenna

The Antenna transfers the transmitter energy to signals in space with the required distribution and efficiency. This process is applied in an identical way on reception.

2.1.5Indicator

The indicator should present to the observer a continuous, easily understandable, graphic picture of the relative position of radar targets.

The radar screen (in this case a PPI-scope) displays the produced from the echo signals bright blibs. The longer the pulses were delayed by the runtime, the further away from the center of this radar scope they are displayed. The direction of the deflection on this screen is that in which the antenna is currently pointing.

2.2 Radar Equation

The power P_r returning to the receiving antenna is given by the equation:

$$P_r = \frac{P_t G_t A_r \sigma F^4}{(4\pi)^2 R_t^2 R_r^2} \qquad (2.1)$$

where

- P_t = transmitter power
- G_t = gain of the transmitting antenna
- A_r = effective aperture (area) of the receiving antenna
- σ = radar cross section or scattering coefficient, of the target
- F = pattern propagation factor
- R_t = distance from the transmitter to the target
- R_r = distance from the target to the receiver.

In the common case where the transmitter and the receiver are at the same location, $R_t = R_r$ and the term $R_t^2 R_r^2$ can be replaced by R^4, where R is the range. These yields:

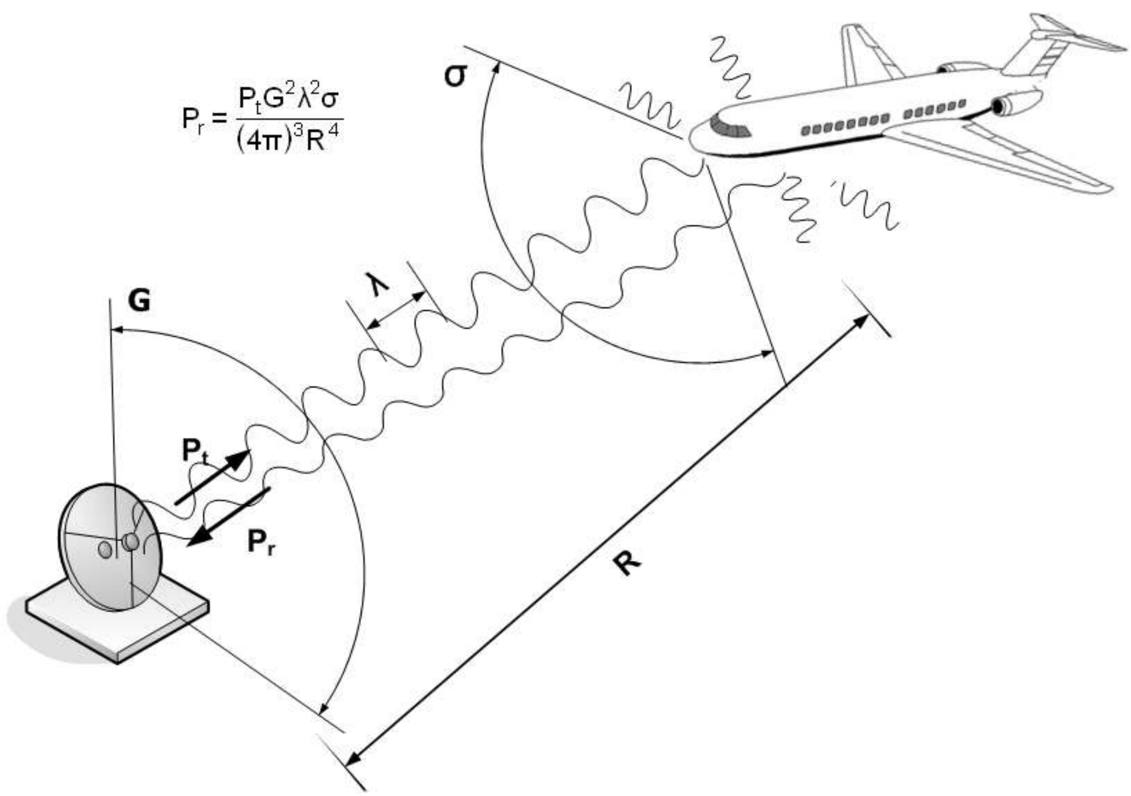

Figure 2.2 : radar Equation parameters

This shows that the received power declines as the fourth power of the range, which means that the received power from distant targets is relatively very small. Additional filtering and pulse integration modifies the radar equation slightly for pulse-Doppler radar performance, which can be used to increase detection range and reduce transmit power.The equation above with $F = 1$ is a simplification for transmission in a vacuum without interference. The propagation factor accounts for the effects of multipath and shadowing and depends on the details of the environment. In a real-world situation, pathloss effects should also be considered.

2.3 Radar Frequency Bands

The International Telecommunications Union (ITU) assigns specific frequency bands for radiolocation (radar) use. Each frequency band has its own particular characteristics that make it better for certain applications than for others. In the following, the characteristics of the various portions of the electromagnetic spectrum at which radars have been or could be operated are described. The divisions between the frequency regions are not as sharp in practice as the precise nature of the nomenclature. HF (3 to 30 MHz). Although the first operational radars installed by the electromagnetic waves at HF have the important property of being refracted by the ionosphere so as to return to the earth at ranges from about 500 to 2000 nmi, depending on the actual condition of the ionosphere. This allows the over the horizon detection of aircraft and other targets.

So there are many typies of radar bands :

2.3.1 Very High Frequency VHF (30 to 300 MHz)

Like the high frequency HF region, the very high frequency VHF region is crowded, bandwidths are narrow, external noise can be high, and beam widths are broad. The rang of this band is between (30 to 300 MHz). It is a good frequency for lower cost radars and for long-range radars such as those for the detection of satellites. There have not been many applications of radar in this frequency range because its limitations do not always counterbalance its advantages.

2.3.2 Ultra High Frequency UHF (300 to 1000 MHz)

Much of what has been said regarding VHF applies to UHF. However, natural external noise is much less of a problem, and beam widths are narrower than at VHF. Weather effects usually are not a bother. With a suitably large antenna, it is a good frequency for reliable long range surveillance radar, especially for extraterrestrial targets such as spacecraft and ballistic missiles. It is well suited for AEW (airborne early warning), e.g., airborne radar that uses AMTI for the detection of aircraft. Solid-state transmitters can generate high power at UHF as well as offer the
advantages of maintainability and wide bandwidth.

2.3.3 L Band (1.0 to 2.0 GHz)

This is the preferred frequency band for land based long-range air surveillance radars, It is possible to achieve good MTI performance at these frequencies and to obtain high power with narrow-beam width antennas. External noise is low. L band is also suitable for large radars that must detect extraterrestrial targets at long range.

2.3.4 S Band (2.0 to 4.0 GHz)

Air surveillance radars can be of long range at S band, but long range usually is more difficult to achieve than at lower frequencies. The narrower beamwidths at this frequency can provide good angular accuracy and resolution and make it easier to reduce the effects of hostile main-beam jamming that might be encountered by military radars. Generally, frequencies lower than S band are well suited for air surveillance. Frequencies above S band are better for information gathering, such as high-data rate precision tracking and the recognition of individual targets.

2.3.5 C Band (4.0 to 8.0 GHz)

This band lies between the S and X bands and Can be described as a compromise between the two. It is difficult, however, to
achieve long-range air surveillance radars at this or higher frequencies. It is the Frequency where one can find long-range precision instrumentation radars used For the accurate tracking of missiles. This frequency band has also been used for multifunction phased array air defense radars and for medium-range Weather radars.

2.3.6 X Band (8 to 12.5 GHz)

This is a popular frequency band for military weapon control (tracking) radar and for civil applications. Shipboard navigation and piloting, weather avoidance, Doppler navigation, An X-band radar may be small enough to hold in one's hand or as large as the MIT Lincoln Laboratory Haystack Hill radar with its 120-ft-diameter antenna and average radiated power of about 500 kW. Rain, however, can be debilitating to X-band radar.

2.3.7 Ku, K, and Ka Bands (12.5 to 40 GHz)

The original K-band radars developed during World War II were centered at a wavelength of 1.25 cm (24 GHz). This proved to be a poor choice since it is too close to the resonance wavelength of water vapor (22.2 GHz), where absorption can reduce the range of radar. Later this band was subdivided into two bands on either side of the water-vapor absorption frequency. The lower frequency band was designated K11, and the upper band was designated Ka. These frequencies are of interest because of the wide bandwidths and the narrow beam widths that can be achieved with small apertures. However, it is difficult to generate and radiate high power. Limitations due to rain clutter and attenuation are increasingly difficult at the higher frequencies. Thus not many radar applications are found at these frequencies. However, the airport surface detection radar for the location and control of ground traffic at airports is at Ku band because of the need for high resolution.

2.3.8 Millimeter Wavelengths (above 40 GHz)

Although the wavelength of Ka band is about 8.5 millimeters (a frequency of 35 GHz), the technology of Ka band radar is more like that of microwaves than that of millimeter waves and is seldom considered to be representative of the millimeter-wave region. Millimeter- wave radar, therefore, is taken to be the frequency region from 40 to 300 GHz. The exceptionally high attenuation caused by the atmospheric oxygen absorption line at 60 GHz precludes serious applications in the vicinity of this frequency within the atmosphere.
The table below shows radar frequency bands .

Table (2.1): radar bands

Radar Frequency Bands		
Band Designation	**Frequency Range**	**Typical Usage**
VHF	50-330 MHz.	Very long-range surveillance
UHF	300-1,000 MHz.	Very long-range surveillance
L	1-2 GHz.	Long-range surveillance, enroute traffic control
S	2-4 GHz.	Moderate-range surveillance, terminal traffic control, long-range weather
C	4-8 GHz.	Long-range tracking, airborne weather
X	8-12 GHz.	Short-range tracking, missile guidance, mapping, marine radar, airborne intercept
K_u	12-18 GHz.	High resolution mapping, satellite altimetry
K	18-27 GHz.	Little used (H_20 absorption)
K_a	27-40 GHz.	Very high resolution mapping, airport surveillance
mm	40-100+ GHz.	Experimental

2.4 Radar Types

There are two Types of Radar Detectors classified by waveform:

2.4.1 Pulse radar

It sends out signals in short (few millionths of a second) but powerful bursts or pulses. Pulse Radar determines distance (range) by measuring the time it takes a radar wave to get to the target object and to come back (time of flight) and then divides that time in two (distance to the target). Since all radio waves travel at the same speed of light, this known speed multiplied by the time of flight can be used to determine distance. By continuing to track an object with pulse radar the speed of the object can also be determined.

2.4.2 Continuous Wave Radar

It sends out a continuous signal instead of short bursts. There are two types of Continuous Wave Radar:

2.4.2.1 Doppler Radar

it is used mostly to make precise speed measurements and is most often utilized by police traffic radars . Doppler Radar transmits a continuous wave of a constant frequency. When this frequency strikes a moving object the frequency is changed and the new frequency returning to the radar is used to determine the speed of the moving target. Examples of Doppler Radar - Decatur Police Radar Guns. A lot of sports radar guns , such as Bushnell Velocity Speed Gun , are Doppler Radars as well.

2.4.2.2 Frequency Modulated (FM radar)

also transmits a continuous signal, but it rapidly increases or decreases the frequency of the signal at regular intervals. As a result FM Radar, unlike Doppler Radar, can determine distance (range) as well as velocity (speed).

2.5 Application of radar

Radar has been employed on the ground, in the air, on the sea, and in space. Ground-based radar has been applied chiefly to the detection, location, and tracking of aircraft or space targets. Shipboard radar is used as a navigation aid and safety device to locate buoys, shore lines, and other ships as well as for observing aircraft. Airborne radar may be used to detect other aircraft, ships, or land vehicles, or it may be used for mapping of land, storm avoidance, terrain avoidance, and navigation. In space, radar has assisted in the guidance of spacecraft and for the remote sensing of the land and sea.

The major user of radar, and contributor of the cost of almost all of its development, has been the military: although there have been increasingly important civil applications, chiefly for marine and air navigation. The major areas of radar application, in no particular order of importance, are described below.

2.5.1 Air Traffic Control (ATC)

Radars are employed throughout the world for the purpose of safely controlling air traffic en route and in the vicinity of airports. Aircraft and ground vehicular traffic at large airports are monitored by means of high-resolution radar. Radar has been used with GCA (ground-control approach) systems to guide aircraft to a safe landing in bad weather. In addition, the microwave landing system and the widely used ATC radar-beacon system are based in large part on radar technology.

2.5.2 Aircraft Navigation

The weather-avoidance radar used on aircraft to outline regions of precipitation to the pilot is a classical form of radar. Radar is also used for terrain avoidance and terrain following. Although they may not always be thought of as radars, the radio altimeter (either FM/CW or pulse) and the doppler navigator are also radars. Sometimes ground-mapping radars of moderately high resolution are used for aircraft navigation purposes.

2.5.3 Ship Safety

Radar is used for enhancing the safety of ship travel by warning of potential collision with other ships, and for detecting navigation buoys, especially in poor visibility. In terms of numbers, this is one of the larger applications of radar, but in terms of physical size and cost it is one of the smallest. It has also proven to be one of the most reliable radar systems. Automatic detection and tracking equipments (also called plot extractors) are commercially available for use with such radars for the purpose of collision avoidance. Shore-based radar of moderately high resolution is also used for the surveillance of harbors as an aid to navigation.

2.5.4 Space

Space vehicles have used radar for rendezvous and docking, and for landing on the moon. Some of the largest ground-based radars are for the detection and tracking of satellites. Satellite-borne radars have also been used for remote sensing as mentioned below.

2.5.5 Remote Sensing

All radars are remote sensors; however, as this term is used it implies the sensing of geophysical objects, or the "environment." For some time, radar has been used as a remote sensor of the weather. It was also used in the past to probe the moon and the planets (radar astronomy). The ionospheric sounder, an important adjunct for HF (short wave) communications, is a radar. Remote sensing with radar is also concerned with Earth resources, which includes the measurement and mapping of sea conditions, water resources, ice cover, agriculture, forestry conditions, geological formations, and environmental pollution. The platforms for such radars include satellites as well as aircraft.

2.5.6 Military

Many of the civilian applications of radar are also employed by the military. The traditional role of radar for military application has been for surveillance, navigation, and for the control and guidance of weapons. It represents, by far, the largest use of radar.

2.6 OVER THE HORIZON RADAR OVERVIEW

Over the horizon (OTH) radars operating in the HF band (3-30 MHz) exploit signal reflection from the ionosphere to detect and track airborne and surface targets at ranges an order of magnitude greater than conventional line-of-sight radars. A chief advantage of OTH radar systems is their ability to persistently monitor remote geographical regions where microwave radar coverage is either not feasible or convenient. For over four decades, OTH radars have been used to provide cost-effective early-warning surveillance over wide areas at ground distances of up to 3000 km.

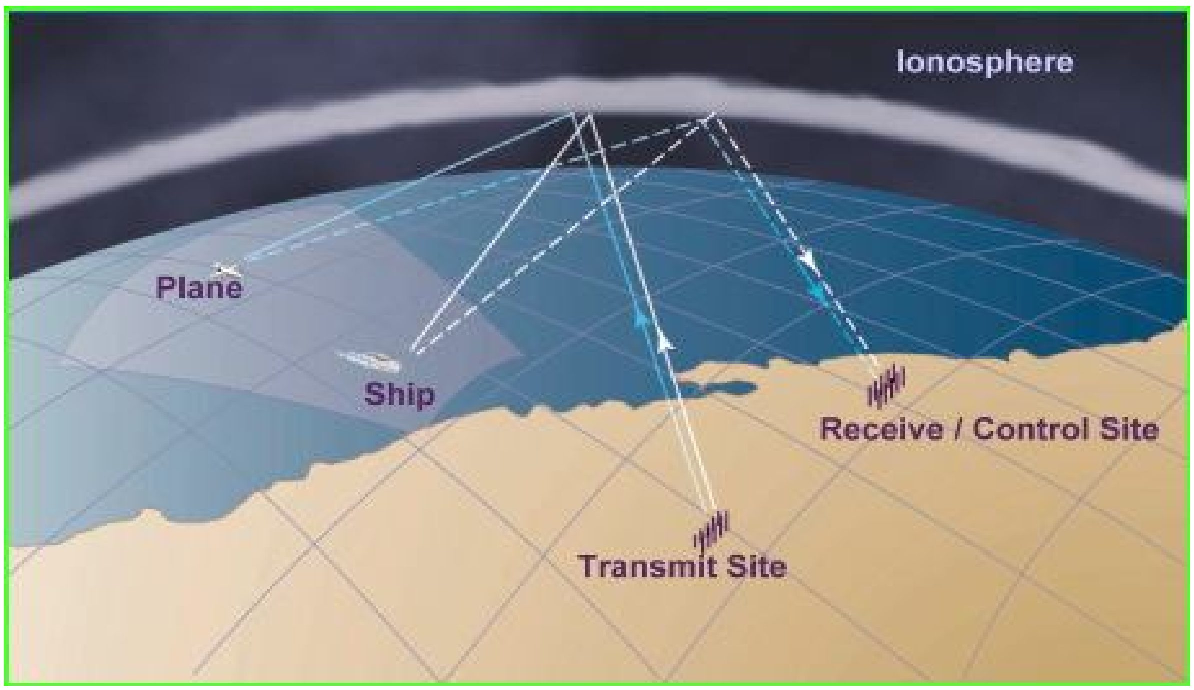

Figure (2.1) : shows Over the horizon radar

2.6.1 The Ionosphere

In a region extending from a height of about 50 km to over 500 km, most of the molecules of the atmosphere are ionised by radiation from the Sun. This region is called the ionosphere. The most important feature of the ionosphere in terms of radio communications is its ability to reflect radio waves. However, only those waves within a certain frequency range will be reflected. Various methods have been used to investigate the ionosphere, and the most widely used instrument for this purpose is the ionosonde, An ionosonde is a high frequency radar which sends very short pulses of radio energy vertically into the ionosphere. If the radio frequency is not too high, the pulses are reflected back towards the ground. The ionosonde records the time delay between transmission and reception of the pulses over a range of different frequencies .The performance of OTH radars vitally depends on the physical characteristics of the ionosphere, its stability and its predictability.

2.7 GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

During the early 1980s, analog cellular telephone systems were experiencing rapid growth in Europe, particularly in Scandinavia and the United Kingdom, but also in France and Germany. Each country developed its own system, which was incompatible with everyone else's in equipment and operation. This was an undesirable situation, because not only was the mobile equipment limited to operation within national boundaries, which in a unified Europe were increasingly unimportant, but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized.The Europeans realized this early on, and in 1982 the Conference of European Posts and Telegraphs (CEPT) formed a study group called the Group Special Mobile (GSM) to study and develop a pan-European public land mobile system. The proposed system had to meet certain criteria:

- Good subjective speech quality
- Low terminal and service cost
- Support for international roaming
- Ability to support handheld terminals
- Support for range of new services and facilities
- Spectral efficiency
- ISDN compatibility

Europe saw cellular service introduced in 1981, when the Nordic Mobile Telephone System or NMT450 began operating in Denmark, Sweden, Finland, and Norway in the 450 MHz range. It was the first multinational cellular system. In 1985 Great Britain started using the Total Access Communications System or TACS at 900 MHz. Later, the West German C-Netz, the French Radiocom 2000, and the Italian RTMI/RTMS helped make up Europe's nine analog incompatible radio telephone systems. Plans were afoot during the early 1980s, however, to create a single European wide digital mobile service with advanced features and easy roaming. While North American groups concentrated on building out their robust but increasingly fraud plagued and featureless analog network, Europe planned for a digital future. Link to my mobile telephone history series.

In 1989, GSM responsibility was transferred to the European Telecommunication Standards Institute (ETSI), and phase I of the GSM specifications were published in 1990. Commercial service was started in mid-1991, and by 1993 there were 36 GSM networks in 22 countries [6]. Although standardized in Europe, GSM is not only a European standard. Over 200 GSM networks (including DCS1800 and PCS1900) are operational in 110 countries around the world. In the beginning of 1994, there were 1.3 million subscribers worldwide [18], which had grown to more than 55 million by October 1997. With North America making a delayed entry into the GSM field with a derivative of GSM called PCS1900, GSM systems exist on every continent, and the acronym GSM now aptly stands for Global System for Mobile communications.

According to the GSM Association (external link) , here are the current GSM statistics:

- No. of Countries/Areas with GSM System (October 2001) - 172.
- GSM Total Subscribers - 590.3 million (to end of September 2001) .
- World Subscriber Growth - 800.4 million (to end of July 2001) .
- SMS messages sent per month - 23 Billion (to end of September 2001) .
- SMS forecast to end December 2001 - 30 Billion per month .
- GSM accounts for 70.7% of the World's digital market and 64.6% of the World's wireless market.

The developers of GSM chose an unproven (at the time) digital system, as opposed to the then-standard analog cellular systems like AMPS in the United States and TACS in the United Kingdom. They had faith that advancements in compression algorithms and digital signal processors would allow the fulfillment of the original criteria and the continual improvement of the system in terms of quality and cost. The over 8000 pages of GSM recommendations try to allow flexibility and competitive innovation among suppliers, but provide enough standardization to guarantee proper inter-working between the components of the system. This is done by providing functional and interface descriptions for each of the functional entities defined in the system.

The United States suffered no variety of incompatible systems as in the different countries of Europe. Roaming from one city or state to another wasn't difficult. Your mobile usually worked as long as there was coverage. Little desire existed to design an all digital system when the present one was working well and proving popular. To illustrate that point, the American cellular phone industry grew from less than 204,000 subscribers in 1985 to 1,600,000 in 1988. And with each analog based phone sold, chances dimmed for an all digital future. To keep those phones working (and producing money for the carriers) any technological system advance would have to accommodate them.

GSM was an all digital system that started new from the beginning. It did not have to accommodate older analog mobile telephones or their limitations. American digital cellular, first called IS-54 and then IS-136, still accepts the earliest analog phones. American cellular networks evolved, dragging a legacy of underperforming equipment with it. Advanced fraud prevention, for example, was designed in later for AMPS, whereas GSM had such measures built in from the start. GSM was a revolutionary system because it developed fully digital from the beginning.

3.2 GSM Network Components

The GSM network has is divided into three systems. Each of these systems is comprised of a number of functional units which are individual components of the mobile network. The three Subsystems are:

- Switching System (SS)
- Base Station System (BSS)
- Operation & Support System (OSS)

In addition, as with all telecommunications networks, GSM networks are operated, maintained and managed from computerized centers.

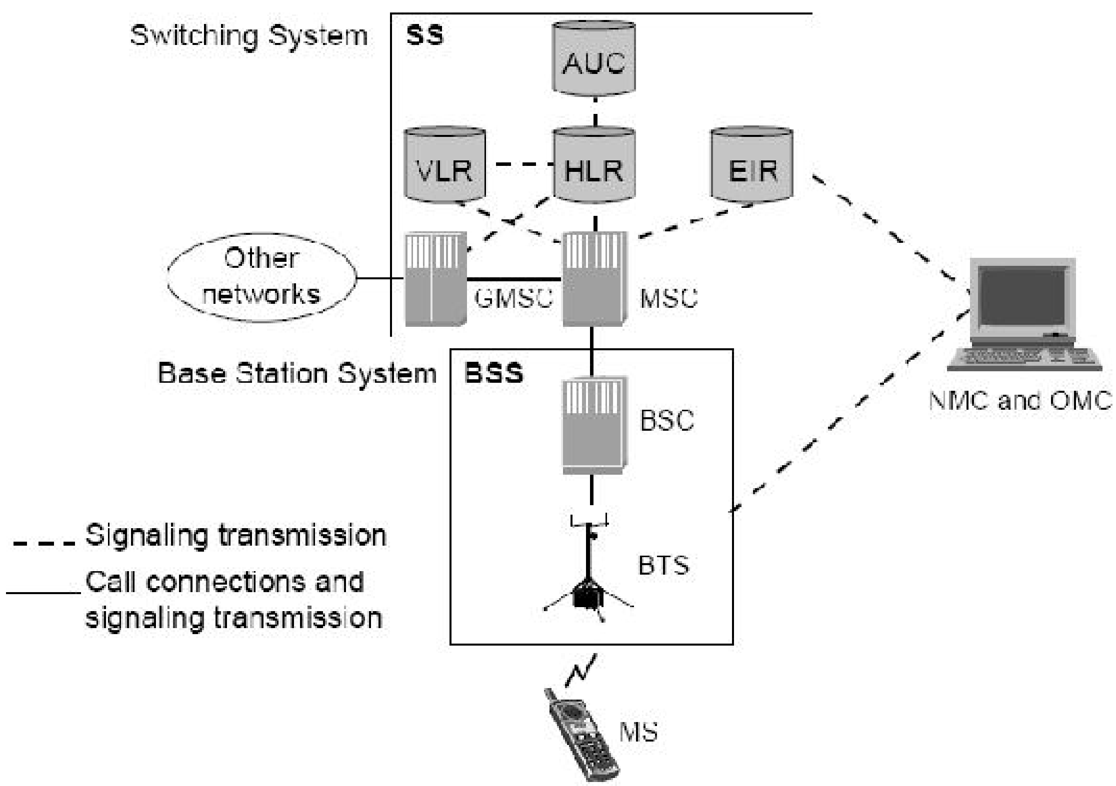

Figure (2.3): GSM System Model

3.2.1 Switching System (SS) Components

3.2.1.1 Mobile services Switching Center (MSC)

The MSC performs the telephony switching functions for the mobile network. It controls calls to and from other telephony and data systems, such as the Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), public data networks, private networks and other mobile networks.

3.2.1.2 Home Location Register (HLR)

The HLR is a centralized network database that stores and manages all mobile subscriptions belonging to a specific operator. It acts as a permanent store for a person's subscription information until that subscription is canceled. The information stored includes :

- Subscriber identity
- Subscriber supplementary services
- Subscriber location information
- Subscriber authentication information

3.2.1.3 Visitor Location Register (VLR)

The VLR database contains information about all the mobile subscribers currently located in an MSC service area. Thus, there is one VLR for each MSC in a network. The VLR temporarily stores subscription information so that the MSC can service all the subscribers currently visiting that MSC service area. The VLR can be regarded as a distributed HLR as it holds a copy of the HLR information stored about the subscriber. When a subscriber roams into a new MSC service area, the VLR connected to that MSC requests information about the subscriber from the subscriber's HLR. The HLR sends a copy of the information to the VLR and updates its own location information. When the subscriber makes a call, the VLR will already have the information required for call set-up.

3.2.1.4 Authentication Center (AUC)

The main function of the AUC is to authenticate the subscribers attempting to use a network. In this way, it is used to protect network operators against fraud. The AUC is a database connected to the HLR which provides it with the authentication parameters and ciphering keys used to ensure network security.

3.2.1.5 Equipment Identity Register (EIR)

The EIR is a database containing mobile equipment identity information which helps to block calls from stolen, unauthorized, or defective MS. It should be noted that due to subscriber-equipment separation in GSM, the barring of MS equipment does not result in automatic barring of a subscriber.

3.2.2 Base Station Subsystem (BSS) Components

3.2.2.1 Base Station Controller (BSC)

The BSC manages all the radio-related functions of a GSM network. It is a high capacity switch that provides functions such as MS handover, radio channel assignment and the collection of cell configuration data. A number of BSCs may be controlled by each MSC.

3.2.2.2 Base Transceiver Station (BTS)

The BTS controls the radio interface to the MS. The BTS comprises the radio equipment such as transceivers and antennas which are needed to serve each cell in the network. A group of BTSs are controlled by a BSC.

3.2.2.3 Mobile Station (MS)

An MS is used by a mobile subscriber to communicate with the mobile network. Several types of MSs exist, each allowing the subscriber to make and receive calls. Manufacturers of MSs offer a variety of designs and features to meet the needs of different markets.

GSM MSs consist of:

- A mobile terminal
- A Subscriber Identity Module (SIM)

3.2.3 Operation & Support System (OSS)

3.2.3.1 Operation and Maintenance Center (OMC)

An OMC is a computerized monitoring center which is connected to other network components such as MSCs and BSCs via X.25 data network links. In the OMC, staff are presented with information about the status of the network and can monitor and control a variety of system parameters. There may be one or several OMCs within a network depending on the network size.

3.3 GSM Frequency Bands

As GSM has grown worldwide, it has expanded to operate at three frequency bands: 900, 1800 and 1900.

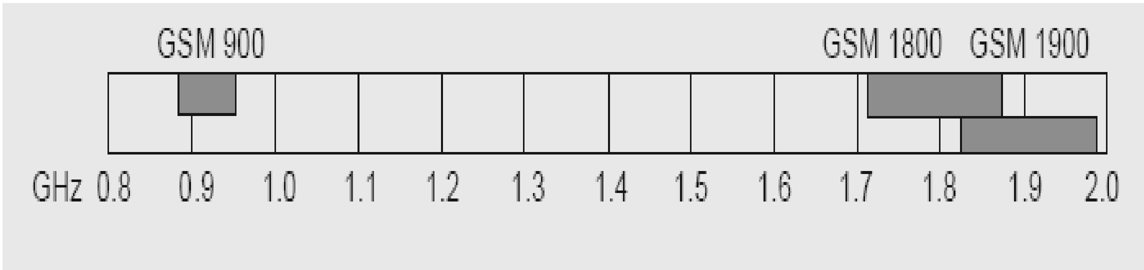

Figure (2.4): GSM frequency bands

3.3.1 GSM 900

The original frequency band specified for GSM was 900 MHz. Most GSM networks worldwide use this band. In some countries and extended version of GSM 900 can be used, which provides extra network capacity. This extended version of GSM is called E-GSM, while the primary version is called P-GSM.

3.3.2 GSM 1800

In 1990, in order to increase competition between operators, the United Kingdom requested the start of a new version of GSM adapted to the 1800 MHz frequency band. Licenses have been issued in several countries and networks are in full operation. By granting licenses for GSM 1800 in addition to GSM 900, a country can increase the number of operators. In this way, due to increased competition, the service to subscribers is improved.

3.3.3 GSM 1900

In 1995, the Personal Communications Services (PCS) concept was specified in the United States. The basic idea is to enable "person-to-person" communication rather than "station-to station". PCS does not require that such services be implemented using cellular technology, but this has proven to be the most effective method. The frequencies available for PCS are around 1900 MHz. As GSM 900 could not be used in North America due to prior allocation of the 900 MHz frequencies, GSM 1900 MHz is seen as an opportunity to bridge this gap. The main difference between the American GSM 1900 standard and GSM 900 is that it supports ANSI signaling.

CHAPTER THREE

SYSTEM DESIGN

Before beginning the design steps we are going to give a brief idea about the system design it consist of GSM intelligent alarm system connected to computer through D25 connector .

We used GSM intelligent alarm system to generate signal and send it to computer through D-25 connector. Computer work as the detector and monitor it display all the targets which it received from GSM alarm system.

The figure (3.1) below is showing block diagram of the system.

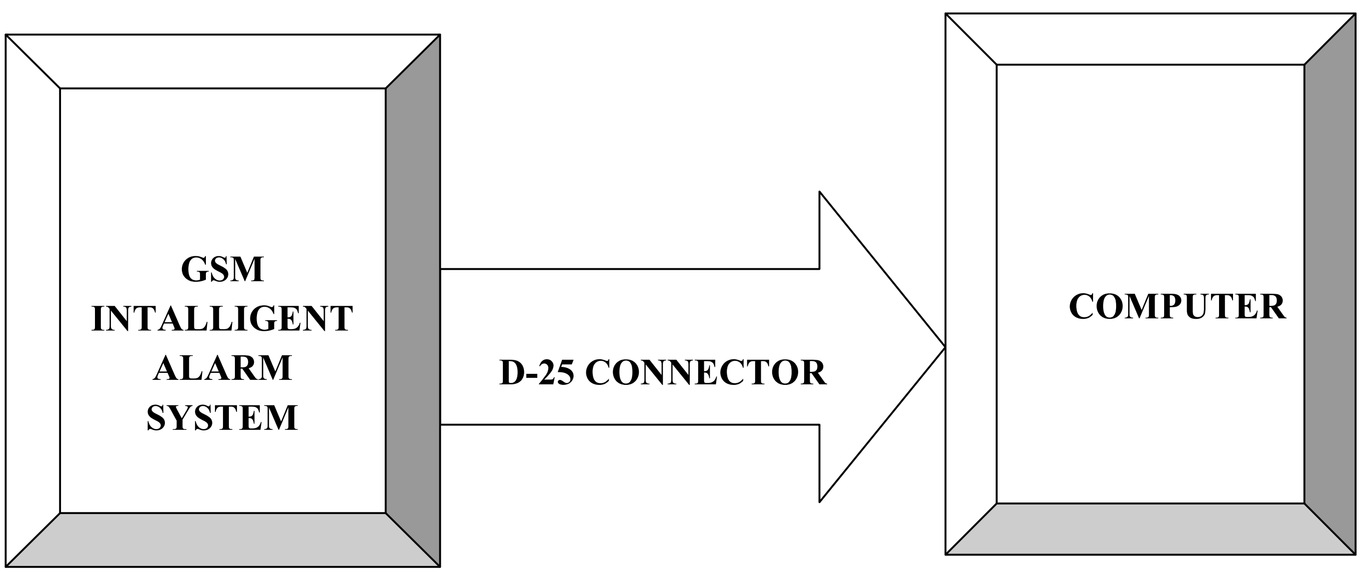

Figure (3.1) block diagram of system design

3-1 GSM Intelligent Alarm System

GSM intelligent alarm system, has all the function of traditional telephone alarm system, moreover it takes the advantage of GSM network and short text message, it would be used more convenient, reliable, and efficient. The figure (3.1) is showing the system.

Figure (3.1) is showing GSM intelligent alarm system

3.1.1 Function of the base

It has a lot of functions**:**

- Support by GSM network 900/1800/1900 bands.
- Full duplex communication with base.
- Voice and message alert.
- Monitor living surrounding.
- Easley to set ON or OFF every wire or wireless direction.
- 3 zone for wire director.
- 16 zone for wireless director.
- Wireless distance is 100 meter.
- In put power is 9- 12 v dc.
- Easley to connect to computer or other device.

3.1.2 Configuration The Base

There are ten connector outside the back of base (GND; SIREN; RELAY1; RELAY2; SPEAKER; O2; O1; I3; I2; I1):

I1; I2; I3, this 3 point for line input, every one point can be connected with ground or open to make alarm out.

O1; O2; these 2 point for output, you can call in or send the SMS to set it . If this point output go high, the lamp of OUT 1 or OUT 2 will light in the panel.

SPEAKER; this point for voice output, it connect to the speaker .the other point of speaker connect to ground.

RELAY1; RELAY2, this two point will close 3 minute when alarm happened .

SIREN, this point can output siren tone alarm, this connect to the siren .the other point of siren connect to ground.

GND, power ground.

3.2 D25 Connector

D25 connectors are Serial cables used for older computers or older thermal printers / industrial equipment that require a D type 9 pin to 25 pin configuration. The pin outs are configured straight through. A 9 pin male coupler can be used with this cable to convert the D9 pin back to male if needed. We used this serial cable in our system as interface between GSM intelligent alarm system and computer .the figure (3.2) below is showing D25 connector .

Figure (3.2) shows D25 connector

3.2.1 D25 Connector Features

- Fully Moulded Cable
- All lines connected
- D25 Pin Male to D9 Pin Female cable

3.2.2 PINs Signals

The original pin layout for RS232 was developed for a 25 pins D sub connector. In this pin-out provisions were made for a secondary communication channel. In practice, only one communication channel with accompanying handshaking is present. For that reason the smaller 9 pin version is more commonly used today.

The figure (3.3) shows D25 PINs signal distribution.

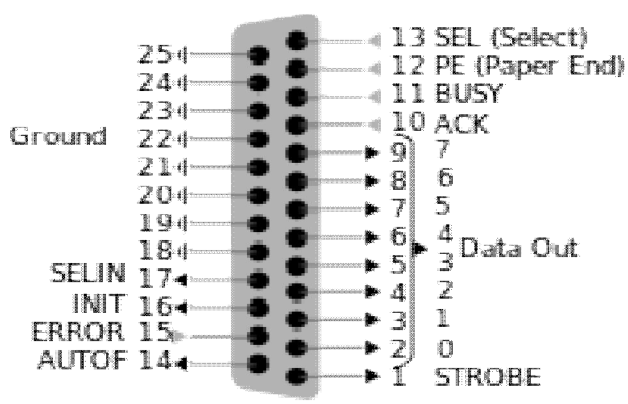

Figure (3.3) shows D25 PINs signal

3.3 **Computer and Programming Language**

A computer system is an electronic device it made up of both hardware and software. Software is another term for computer program. Software controls the computer and makes it do useful work. Without software a computer is useless, Hardware refers to the physical components that make up a computer system. These include the computer's processor, memory, monitor, keyboard, mouse, disk drive, printer and so on. In these notes we take a brief look at the functions of the different hardware components. In addition we describe the some of the essential software required for the operation of a computer system.

3.3.1 Hardware

The hardware of a computer system is made up of a number of electronic devices connected together. Figures 1 and 1A are block diagrams of a typical computer system.

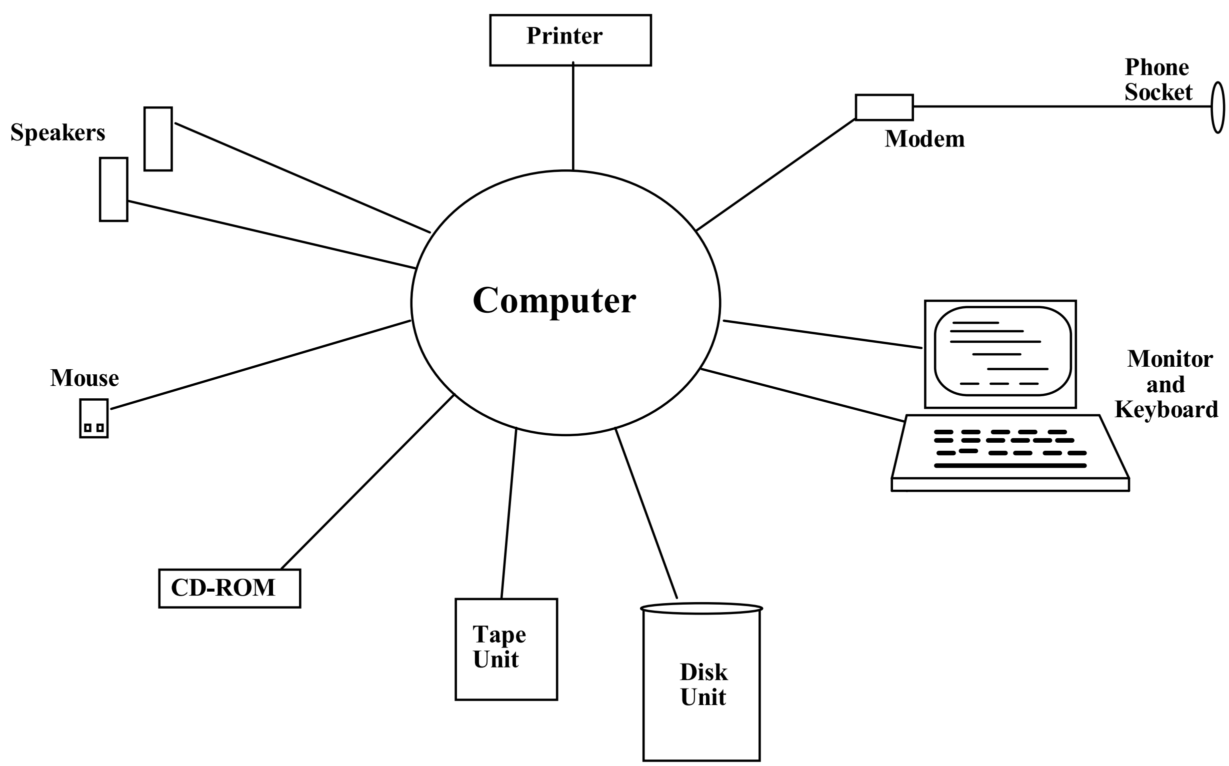

Figure (3.4) typical computer system

3.3.1.1 The Processor

The processor as its name suggests is the unit that does the work of the computer system i.e. it executes computer programs. Software is composed of instructions, which are executed (obeyed) by the processor. These instructions tell the processor when and what to read from a keyboard; what to display on a screen; what to store and retrieve from a disk drive and so on. A computer program is a set of such instructions that carries out a meaningful task. It is worth remembering at this stage that the processor can only perform a limited range of operations. It can do arithmetic, compare numbers and perform input/output (read information and display or store it). It has no magical powers. It is instructive to bear in mind that all computer programs are constructed from sequences of instructions based on such primitive operations.

3.3.1.2 Memory

Memory is used to store the information (programs and data) that the computer is currently using. It is sometimes called main or primary memory. One form of memory is called RAM - random access memory. This means that any location in memory may be accessed in the same amount of time as any other location. Memory access means one of two things, either the CPU is reading from a memory location or the CPU is writing to a memory location. When the CPU reads from a memory location, the contents of the memory location are copied to a CPU register. When the CPU writes to a memory location, the CPU copies the contents of a CPU register to the memory location, overwriting the previous contents of the location. The CPU cannot carry out any other operations on memory locations.

3.3.2 Input Devices

The keyboard and mouse are the most widely used input devices at the moment Another input device is called a light pen which can be used to point at a monitor, serving a similar function to a mouse. A touch sensitive screen is a method of input based on touching a specially designed screen in particular places. It is typically used in an application such as a tourist information system, where information can be obtained by touching menu options displayed on the screen.

3.3.3 Output Devices

Monitors are the commonest output device for a computer system. They range from the lowly dumb terminal screen to the high quality bit-mapped colour screen of workstations. A basic monitor displays up to 24 lines of 80 columns of standard characters. Advanced monitors range from monochrome to full colour and are bit-mapped which means that each point (usually called pixel which stands for picture element) on the screen corresponds to at least one bit in memory. By modifying the bits in memory, the image on the screen is modified. A colour screen may have up to 24-bits in memory corresponding to each pixel, since the colour of the pixel must be recorded. Such monitors vary in size and in the number of colours they support. Printers are the commonest hardcopy output device. They range from cheap low quality dot-matrix to high speed, high quality laser printers with a variety of intermediate quality devices available.

3.3.4 Turbo C++ Programming Language

C++ is an extension of C, developed by Bjarne Stroustrup at Bell Labs during 1983-1985. C++ added a number of features that improved the C language. Most importantly, it added the support of using classes for object-oriented programming. To compile and run C++ programs on a computer, you need a C++ compiler for the computer. The compiler generates the machine code for the computer. The input is the C++ source code and the output is the machine code (if compiled successfully).

CHAPTER FOUR

SOFTWARE

4.1 Turbo C++ Over view

Turbo C++ is one of programming language it was developed at the Bell laboratories in the mid of 1980's. C++ designed to support:

- Procedural programming
- Modular programming
- Data abstraction
- Object-oriented programming

C++ supports all the fundamental data types of C as well as all of the control constructs of C:

```
Char, short, int, long, float, double, long double
For { }
If () { } else if () { } else { }
Do { } while ()
While () { }
Switch () {case ......}
```

4.2 Flow chart of the program

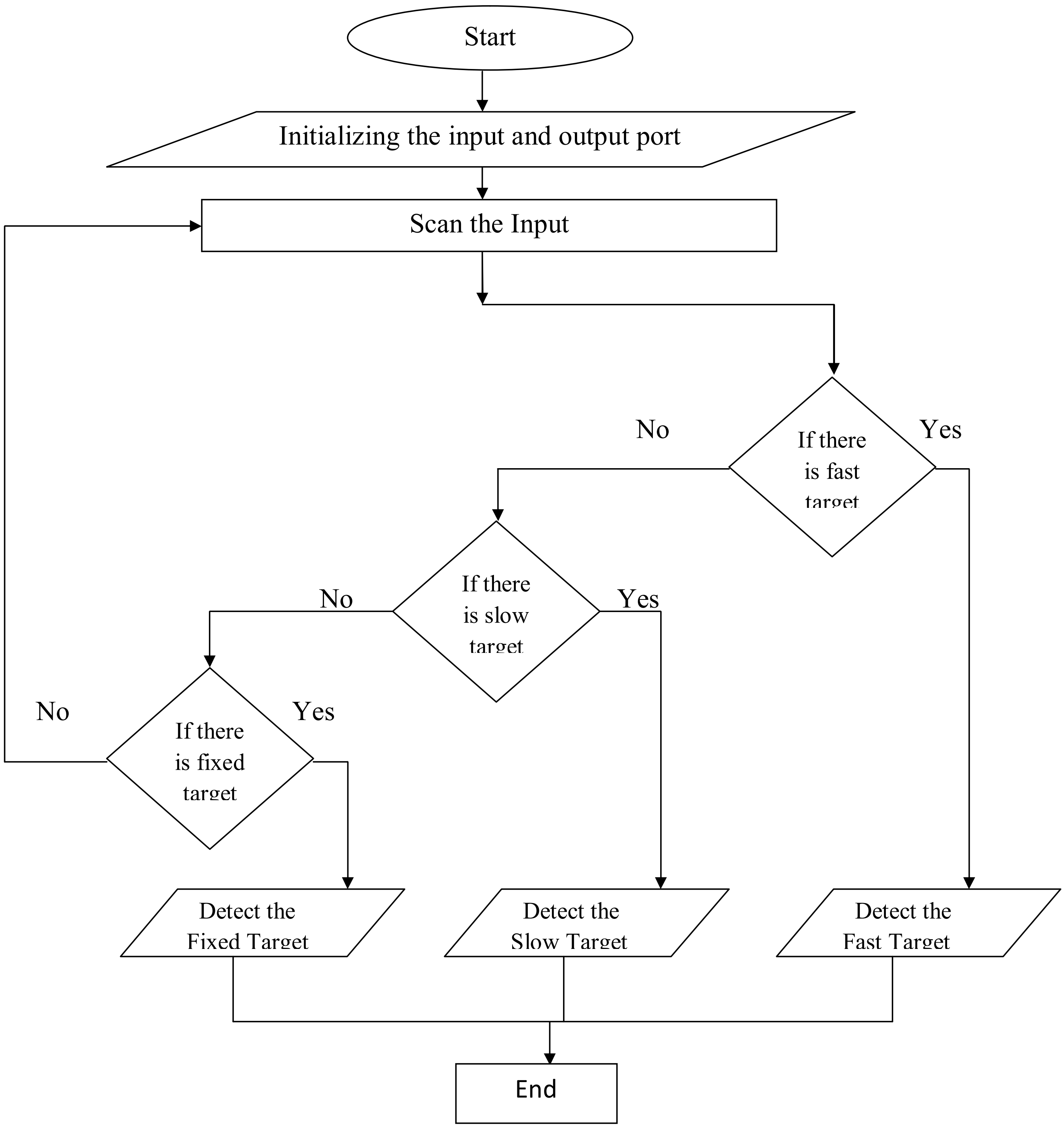

Figure (4.1): Show flow chart of the program

4-3 The program

```
#include <graphics.h>
#include <stdlib.h>
#include <stdio.h>
#include <conio.h>
#include <dos.h>
int main(void)
{
   /* request auto detection */
   int gdriver = DETECT, gmode, errorcode;
   int skip,ff,color;
   /* initialize graphics and local variables */
   initgraph(&gdriver, &gmode, "");
   /* read result of initialization */
   errorcode = graphresult();
   if (errorcode != grOk)  /* an error occurred */
   {
      printf("Graphics error: %s\n", grapherrormsg(errorcode));
      printf("Press any key to halt:");
      getch();
```

```
    exit(1); /* terminate with an error code */
  }
  setlinestyle(0,0,3);
  int speed=10;
  setcolor(BLUE);
  line(320,0,320,479);
  line(80,240,560,240);
  circle(320,240,240);
  int c=550,d=264; /*start co-ordinates of target */
  /* set fill style and draw a pie slice */
beg1:
  color=getcolor();
  printf("/n the color is %d",color);
  setcolor(YELLOW);
  pieslice(c,d,0,15,3);  /* display the target */
  c=c-3;
  d=d-3;
  setcolor(BLUE);
  int b=359; /* init. the max. degree */
beg2:
  setcolor(BLUE);
  if (b ==270) goto skip;
  if (b ==180) goto skip;
```

```
  if (b ==90) goto skip;


  setfillstyle(EMPTY_FILL, getmaxcolor());
  setcolor(RED);
  pieslice(320, 240, 0, b, 239);
  delay(speed);
  setcolor(BLACK);
  pieslice(320, 240, 0, b, 239);
skip:
  if(kbhit()) goto finish;
  b=b-1;
  if (b==1) goto beg1;
  goto beg2;
  /* clean up */
finish:
  getch();
  closegraph();
  return 0;
}
```

CHAPTER FIVE
RESULTS AND DISCUSSION

5.1 The Results

The main value of the radar in general is detecting the targets by send signal to the target and received an echo from the target directly. Over the horizon radar (OTHR) takes advantage of ionosphere refraction properties, allowing the radar to see far beyond the optical horizon.

Over the horizon radar simulation was done successfully by using GSM intelligent alarm system and computer through D-25 connector.

Programmed Computer had three functions:

- I connected GSM intelligent alarm system with programmed computer through D-25 connector.
- Before initialization nothing happens, but when programmed computer gave orders to GSM intelligent alarm system to send signal, GSM intelligent alarm system will send signal, then computer will search to detect target.
- If programmed computer detect target it displayed it on the screen.
- If programmed computer not detect target it scan the GSM intelligent alarm system.

5.2 Discussion

Firstly a study to discuss the radar fundamentals , over the horizon radar (OTHR) , global system for mobile communication (GSM) ,DC-25 connector , computer and turbo c++ programming language .

Secondly implementation of detection system.

Finally the software to display on the computer monitor, hence the research shows the simulation of the operation of over the horizon radar.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

- Radar word is (Radio Detecting and Ranging) is an electromagnetic system it use for the detection and location of objects, it operates by transmitting signals and detect the nature of the signals reflected back from objects.
- Radar consists of transmitter unit, antenna, duplexer, receiver unit and display monitor.
- OTHR (Over The Horizon Radar) is one type of radars , it is along rang system that typically used high frequency radio waves propagating using ionosphere skip , it used to detect over the horizon targets , it operate in high frequency band (3-30 MHz) and exploit signal reflection from ionosphere to detect targets .
- There are a lot of an applications of over the horizon radar like air traffic control, ship safety, aircraft navigation, space , remote sensing and military purpose.
- The main idea of this research is to give simple simulation of over horizon radar.
- In this simulation we used GSM intelligent alarm system as transmitter and programmed computer as processor and monitor display.

6.2 RECOMMENDATION

- Today over the horizon radar became one of the very important radar, so the continuation of this research is very important.
- This research can be very useful in many practical applications especially in military and security purpose.

- In order to benefit from researches experiences, countries should provide the needs that help in such researches. If the needs are not available, the research will be stopped and there will be a great loss.
- In order to develop this research we can use advance software and programming language.
- Finally, the benefit of this research is excellent and met the search aims.

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APPENDICES A

Table (A-1) shows the specification for GSM intelligent alarm system

Static current	20mA
Power	9V-12V DC
Working temperature	-20⍰ +85⍰
GSM band	900/1800/1900MHz
Receiving code	ASK
Frequencies	315/433/868/915MHZ
wireless distance	100 M
wireless detectors	16
wire detectors	3
Back Up Battery	1000mAh 7.2V
Related Voltage of the Output Relay	2A/250V AC
Relative humidity	10-90%
Storage temperature	-20°C~+60°C

Table (A.2) shows PINs signal and specifications of D25 connector

Pin	Name	Direction	Description
1	GND		Shield Ground
2	TXD	—»	Transmit Data
3	RXD	«—	Receive Data
4	RTS	—»	Request to Send
5	CTS	«—	Clear to Send
6	DSR	«—	Data Set Ready
7	GND		System Ground
8	CD	«—	Carrier Detect
9	-	-	RESERVED
10	-	-	RESERVED
11	STF	—»	Select Transmit Channel
12	S.CD	«—	Secondary Carrier Detect
13	S.CTS	«—	Secondary Clear to Send
14	S.TXD	—»	Secondary Transmit Data
15	TCK	«—	Transmission Signal Element Timing
16	S.RXD	«—	Secondary Receive Data
17	RCK	«—	Receiver Signal Element Timing
18	LL	—»	Local Loop Control
19	S.RTS	—»	Secondary Request to Send
20	DTR	—»	Data Terminal Ready
21	RL	—»	Remote Loop Control
22	RI	«—	Ring Indicator
23	DSR	—»	Data Signal Rate Selector
24	XCK	—»	Transmit Signal Element Timing
25	TI	«—	Test Indicator

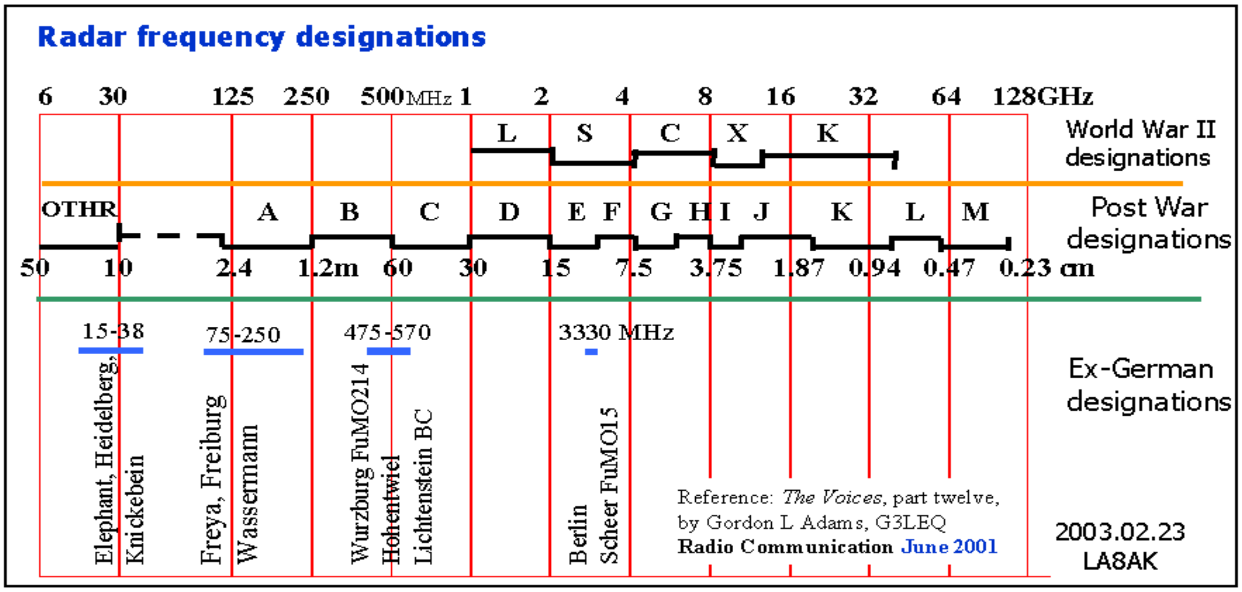

Figure (A-1) shows radar frequency designations

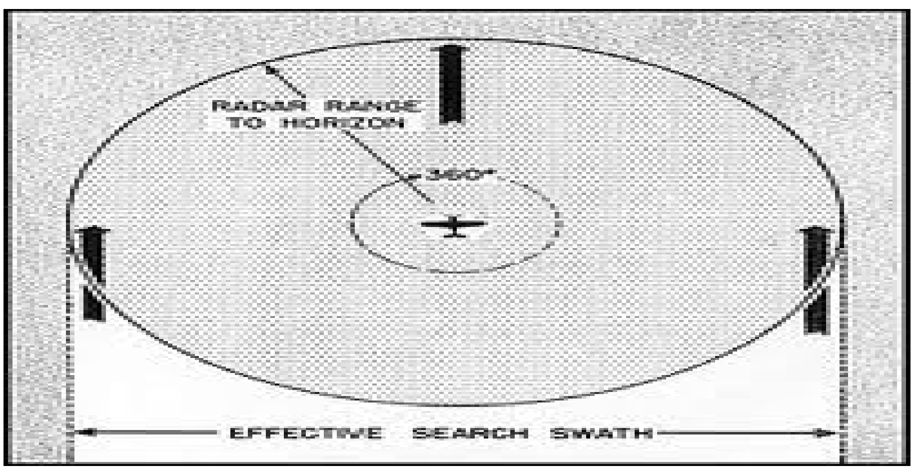

Figure (A-2) shows over the horizon radar display