

TRACKING BIRDS MIGRATION USING PYTHON 3

Submitted in partial fulfilment of the requirements for the award of
Bachelor of degree in Computer science.

By

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BONAFIDE CERTIFICATE

This is to certify that this project Report is the Bonafide work of **NISHA.D(Reg. No. 38290057)** and **THEIVANA.I.N(Reg. No. 38290097)** who carried out the project entitled “ **TRACKING BIRDS MIGRATION USING PYTHON 3**” under our supervision from **November 2020 to April 2021.**

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I, **NISHA.D(Reg. No. 38290057)** hereby declare that the project reported entitled “TRACKING BIRDS MIGRATION USING PYTHON 3” done by me under the guidance of Dr.MAHESWARI.M , is submitted in partial fulfilment of the requirements for the award of Bachelor of science degree in computer science.

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ABSTRACT

Here we are making a project which just traces the Birds location in terms of its precise latitude and longitude and then send it to a mobile number(as per our requirements).This project consist of three main devices which are (i) Arduino UNO,(ii) GPS Module(Neo – 6M) and (iii) GSM-900A. These all the three devices will be going to be fixed in the Bird to which we want to trace. Initially what happened that we make a program in arduino (in c language) regarding interfacing the GSM devices and GPS devices .And we also set a mobile number in the program as per our need, on which we get the info regarding its location(Bird's).First of all we want to make a call to the mobile number which has been installed in the GSM Module and then after some specific dealy.(as per mentioned in the program) we get a SMS regarding the exact latitude and longitude of the Birds. It is done in a way that GPS device is continuously receiving the location of the birds from satellite and then transferring to the arduino board, from where we sent it to the required mobile number. And hence in this way we can easily get info regarding the exact location of the birds. Once the message has been sent to the predefined mobile number GSM gets deactivated and the GPS get activated. Thus we can easily track our Bird's.

TABLE OF CONTENTS

Chapter No.	TITLE	Page No.
	ABSTRACT	V
	LIST OF FIGURES	
	LIST OF ABBREVIATIONS	
1	INTRODUCTION	1
	1.1 OVERVIEW OF PROJECT	1
2	LITERATURE SURVEY	3
3	AIM AND SCOPE OF THE PROJECT	4
	3.1 AIM OF THE PROJECT	4
	3.2. SCOPE OF THE PROJECT	4
	3.2 SYSTEM REQUIREMENTS	4
	3.3.1. HARDWARE REQUIRMENTS	5
	3.3.3. SOFTWARE REQUIREMENTS	5
4	EXPERIMENTAL OR MATERIAL METHODS	6
	4.1.DESIGN METHODOLOGY	
	4.1.1 EXISTING SYSTEM	6

4.1.2. PROPOSED SYSTEM

5	MODULES DESCRIPTION	7
5.1	GSM Module	7
5.1.1	GSM history	7
5.1.2	Service provided by GSM	8
5.1.3	Mobile station	9
5.1.4	Base station subsystem	11
5.1.4.1	Base station controller	12
5.1.5	Architecture of the GSM network	14
5.1.6	Radio link aspects	15
5.1.7	Multiple access and channel structure	15
5.1.8	Frequency hopping	16
5.1.9	Discontinuous Reception	17
5.1.10	Power control	17
5.1.11	Network Aspects	18
5.1.12	Radio Resource Management	19
5.1.13	Handover	19
5.1.14	Mobility Management	21
5.1.15	Location Updating	21
5.1.16	Communication Management	22

5.1.17 Call routing	23
5.2 GPS Receiver	24
5.2.1 GPS History	24
5.2.1.1 Working and Operation	25
5.2.2 Data Decoding	26
5.3 Arduino UNO	26
5.4 ARCHITECTURE	28
5.5 ARCHITECTURE EXPLANATION	29
5.5.1 GSM MODULE	29
5.5.2 ARDUINO UNO	30
5.5.3 GPS MODULE	31
5.6 WORKING PROCEDURE	32
 6 HARDWARE CONNECTIONS	 33
6.1 CONNECTION OF ARDUINO WITH GSM SIM 900A	33
6.2 CONNECTION OF ARDUINO WITH GPS	33
MODULE NEO-6m	
 7 RESULTS AND PERFORMANCE ANALYSIS	 34
 8 CONCLUSION AND FUTURE SCOPE	
8.1 CONCLUSION	37
8.2 FUTURE SCOPE	37

REFERENCES	38
-------------------	----

APPENDIX

A. Source Code	39
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B. Publication	
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LIST OF FIGURES

FIGURE NO.	FIGURE NAME	PAGE NO.
5.1.3	Mobile station SIM port	11
5.1.4	Siemens base station	12
5.1.4.1	Siemens base station	14
5.1.4.1	Siemens TRAU	14
5.1.5	General Architecture of GSM Network	15
5.1.16	Call routing for a mobile terminating call	23
5.4	Architecture of Birds Tracking System	29
5.5.2	GSM and Arduino	30
5.5.3	GPS	31

LIST OF ABBREVIATIONS

GPS	-	Global Positioning System
GSM	-	Global System for Mobile communication
IDE	-	Integrated Development Environment
ICSP	-	In Circuit System Programming
USB	-	Universal Serial Bus
SMS	-	Short Message Service

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW OF PROJECT

Birds play an important role in the natural ecosystem. Many bird species have been affected and some are on the verge of extinction. The Indian vulture and the whiterumped vulture species have suffered a 99%-97% population decrease in Bangladesh , Pakistan and India. Numerous bird species migrate to certain areas during specific seasons every year.

Animal movement and migration has long fascinated man. Due to its scale, birds migration is one of the most striking. The number of birds involved is in the billions, the annual round trips of some birds species reach 70000 km and some of the birds known to perform non-stop flights of 10000 km. Discoveries such as these are in part due to the use of tracking technology, which is of interest of multiple reasons.

Firstly, Tracking is an important to better understand and protect migrating species. second , migrant birds are indicators of change . Human activity is having a impact on the planet and migrant animals modify their behaviour due to human caused changes and stressors. Birds being the most mobile of all animals , are of particular interest in this regard

Birds are sighted at particular locations but their routes of migration remain largely unknown. As compared to other animals , tracking birds is a difficult task as there are stringent tracker constraints like size, weight and power sources. It is also extremely difficult to recapture birds for data retrieval. We propose a system **TRACKING BIRDS MIGRATION USING PYTHON 3** which will monitor these migratory birds and which will eliminate the need for bird recapture.

Birds tracking system is used to determine the location of birds using different methods like GPS and other radio navigation systems operating through satellites and ground based stations. This system is an important for tracking birds at a given period of time.

CHAPTER 2

LITERATURE SURVEY

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CHAPTER 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM OF THE PROJECT

To find latitude, longitude, location and to track birds without recapture is the main aim of this project. These can be resolved by our application “**TRACKING BIRDS MIGRATION USING PYTHON 3**”. We are going to track birds by using Global system for mobile communication (GSM) services.

SCOPE OF THE PROJECT :

- i. The system consists of modern hardware and software components enabling one to track their vehicle online or offline. Any vehicle tracking system consists of mainly three parts: mobile vehicle unit, fixed based station and, database and software system.
- ii. It is the hardware component attached to the Bird having either a GPS/GSM modem. The unit is configured around a primary modem that functions with the tracking software by receiving signals from GPS satellites or radio station points with the help of antenna. The controller modem converts the data and sends the Bird location data to the server.

CHAPTER 4

EXPERIMENTAL OR MATERIAL METHODS

4.1 DESIGN METHODOLOGY

4.1.1 Existing System

The University of Amsterdam Birds Tracking System (UVA-BITS) was developed by Edwin baaij of the technology center and willem Bouten and Judy Shamoun of the institute for biodiversity and Ecosystem Dynamics, all of the university of Amsterdam. It has been designed to answer the needs of people with diverse research aim and interested in tracking Birds. This is a Bird Tracking System characterized by light weight, solar powered, high energy efficient GPS devices, with two way wireless Zigbee(2.4 GHz) data communication to a groundstation network. The system condits of one base station, one or more relay station.

- (1) The Existing System does not show the latitude and longitude and also they did not track without recapturing.
- (2) It require 4Mb for data storage.

4.1.2 Proposed System:

In our proposed method the tracker device mounted on the birds including arduino UNO , GSM and GPS. When the code is sent from the mobile the GSM read the code and send it to the arduino and then the arduino get the latitude and longitude with the help of GPS and then it send to the specified mobile number through SMS.

PROPOSED SYSTEM ADVANTAGES:

- (1) High Accuracy
- (2) Easy to use
- (3) Track Birds without Recapture

CHAPTER 5

MODULE DESCRIPTION

5.1 GSM Module

5.1.1 GSM History:

The acronym for GSM is Global System for Mobile communication. During the early 1980s, analog cellular telephone system 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 is 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 Groupe 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
- Ability to support handheld terminals
- Support for range of new services and facilities
- Spectral efficiency
- ISDN compatibility

Pan-European means European-wide. ISDN throughput at 64Kbps was never envisioned, indeed, the highest rate a normal GSM network can achieve is 9.6Kbps.

Europe saw a cellular service introduced in 1981, when the Nordic Mobile Telephone System or NMT450 began operating in Denmark, Sweden, Finland, and Norway in the 450MHz range. It was the first multinational cellular system. In 1985 Great Britain started using the total access communication System or TACS at 900MHz. later, the West German C-Netz, the French Radio COM 2000, and the

Italian RTMI/RTMS helped make up European's nine analog incompatible radio telephone systems. Plans were afoot during the 1980s, however, to create a single wide digital mobile services 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. 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. 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, 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. 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 networking 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.

5.1.2 Service provided by GSM:

From the beginning, the planners of GSM wanted ISDN compatibility in terms of the services offered and the control signaling used. However, radio transmission limitations, in terms of bandwidth and cost, do not allow the standard ISDN Bchannel bit rate of 64 kbps to be practically achieved.

Telecommunication services can be divided into bearer services, teleservices, and supplementary services. The most basic teleservice supported by GSM is telephony. As with all other communications, speech is digitally encoded and transmitted through the GSM network as a digital stream. There is also an

emergency service, where the nearest emergency-service provider is notified by dialing three digits.

- a) Bearer services: Typically data transmission instead of voice. Fax and SMS are examples.
- b) Teleservices: Voice oriented traffic.
- c) Supplementary services: Call forwarding, caller ID, call waiting and the like.

A variety of data services is offered. GSM users can send and receive data, at rates up to 9600 bps, to users on POTS (Plain Old Telephone Service), ISDN, Packet Switched Public Data Networks, and Circuit Switched Public Data Networks using a variety of access methods and protocols, such as X.25 or X.32. Since GSM is a digital network, a modem is not required between the user and GSM network, although an audio modem is required inside the GSM network to interwork with POTS.

Other data services include Group 3 facsimile, as described in ITU-T recommendation T.30, which is supported by use of an appropriate fax adaptor. A unique feature of GSM, not found in older analog systems, is the Short Message Service (SMS). SMS is a bidirectional service for short alphanumeric (up to 160 bytes) messages. Messages are transported in a store-and-forward fashion. For point-to-point SMS, a message can be sent to another subscriber to the service, and an acknowledgement of receipt is provided to the sender. SMS can also be used in a cell-broadcast mode, for sending messages such as traffic updates or news updates. Messages can also be stored in the SIM card for later retrieval.

Supplementary services are provided on top of teleservices or bearer services. In the current (Phase I) specifications, they include several forms of call forward (such as call forwarding when the mobile subscriber is unreachable by the network), and call barring of outgoing or incoming calls, for example when roaming in another country. Many additional supplementary services will be provided in the Phase 2 specifications, such as caller identification, call waiting, multi-party conversations.

5.1.3 Mobile Station:

The mobile station (MS) consists of the mobile equipment (the terminal) and a smart card called the Subscriber Identity Module (SIM). The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive calls at that terminal, make calls from that terminal, and receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains the International Mobile Subscriber Identity (IMSI) used to identify the subscriber to the system, a secret key for authentication, and other information. The IMEI and the IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or personal identity number.

GSM phones use SIM cards, or Subscriber information or identity modules. They're the biggest difference a user sees between a GSM phone or handset and a conventional cellular telephone. With the SIM card and its memory the GSM handset is a smart phone, doing many things a conventional cellular telephone cannot. Like keeping a built in phone book or allowing different ring tones to be downloaded and then stored. Conventional cellular telephones either lack the features GSM phones have built in, or they must rely on resources from the cellular system itself to provide them. Let me make another, important point.

With a SIM card your account can be shared from mobile to mobile, at least in theory. Want to try out your neighbour's brand new mobile? You should be able to put your SIM card into that GSM handset and have it work. The GSM network cares only that a valid account exists, not that you are using a different device. You get billed, not the neighbour who loaned you the phone.

This flexibility is completely different than AMPS technology, which enables one device per account. No switching around. Conventional cellular telephones have their electronic serial number burned into a chipset which is permanently attached to the phone. No way to change out that chipset or trade with another phone. SIM card technology, by comparison, is meant to make sharing phones and other GSM devices quick and easy.

On the left above: Front of a Pacific Bell GSM phone. In the middle above: Same phone, showing the back. The SIM card is the white plastic square. It fits into the grey colored holder next to it.

On the right above: A new and different idea, a holder for two SIM cards, allowing one phone to access either of two wireless carriers. Provided you have an account with both. The SIM card is to the left of the body.



5.1.3 Mobile station SIM port

5.1.4 Base station subsystem:

The Base Station Subsystem is composed of two parts, the Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the standardized Abis interface, allowing (as in the rest of the system) operation between components made by different suppliers.

The Base Transceiver Station houses the radio transceivers that define a cell and handles the radio-link protocols with the Mobile Station. In a large urban area, there will potentially be a large number of BTSs deployed, thus the requirements for a BTS are ruggedness, reliability, portability, and minimum cost

The BTS or Base Transceiver Station is also called an RBS or Remote Base station. Whatever the name, this is the radio gear that passes all calls coming in and going out of a cell site. The base station is under direction of a base station controller so traffic gets sent there first. The base station controller, described below, gathers the calls from many base stations and passes them on to a mobile telephone switch. From that switch come and go the calls from the regular telephone network. Some base stations are quite small; the one pictured here is a large outdoor unit. The large number of base stations and their attendant controllers are a big difference between GSM and IS-136.

5.1.4 Siemens base station



5.1.4.1 Base station controller:

The Base Station Controller manages the radio resources for one or more BTSs. It handles radio-channel setup, frequency hopping, and handovers, as described below. The BSC is the connection between the mobile station and the Mobile service Switching Center (MSC).

Another difference between conventional cellular and GSM is the base station controller. It's an intermediate step between the base station transceiver and the mobile switch. GSM designers thought this a better approach for high density cellular networks. As one anonymous writer penned, "If every base station talked directly to the MSC, traffic would become too congested. To ensure quality communications via traffic management, the wireless infrastructure network uses Base Station Controllers as a way to segment the network and control congestion.

The result is that MSCs route their circuits to BSCs which in turn are responsible for connectivity and routing of calls for 50 to 100 wireless base stations."

Many GSM descriptions picture equipment called a TRAU, which stands for Transcoding Rate and Adaptation Unit. Of course also known as a Trans-Coding Unit or TCU, the TRAU is a compressor and converter. It first compresses traffic coming from the mobiles through the base station controllers. That's quite an achievement because voice and data have already been compressed by the voice coders in the handset. Anyway, it crunches that data down even further. It then puts the traffic into a format the Mobile Switch can understand. This is the TransCoding part of its name, where code in one format is converted to another. The TRAU is not required but apparently it saves quite a bit of money to install one. Here's how Nortel Networks sells their unit: "Reduce transmission resources and realize up to 75% transmission cost savings with the TCU."

"The Trans-Coding Unit (TCU), inserted between the BSC and MSC, enables speech compression and data rate adaptation within the radio cellular network. The TCU is designed to reduce transmission costs by minimizing transmission resources between the BSC and MSC. This is achieved by reducing the number of PCM links going to the BSC, since four traffic channels (data or speech) can be handled by one PCM time slot. Additionally, the modular architecture of the TCU supports all three GSM vocoders (Full Rate, Enhanced Full Rate, and Half Rate) in the same cabinet, providing you with a complete range of deployment options.

"Voice coders or vocoders are built into the handsets a cellular carrier distributes. They're the circuitry that turns speech into digital. The carrier specifies which rate they want traffic compressed, either a great deal or just a little. The cellular system is designed this way, with handset vocoders working in league with the equipment of the base station



5.1.4.1 Siemens BS



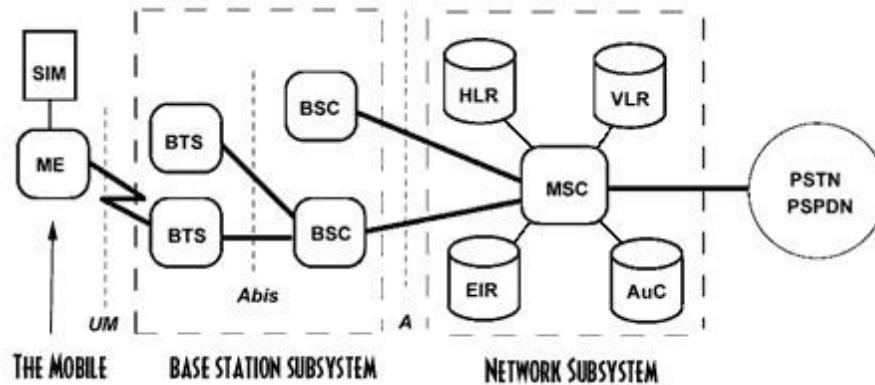
5.1.4.1 Siemens TRAU

5.1.5 Architecture of the GSM network:

A GSM network is composed of several functional entities, whose functions and interfaces are specified. The GSM network can be divided into three broad parts. The Mobile Station is carried by the subscriber. The Base Station Subsystem controls the radio link with the Mobile Station. The Network Subsystem, the main part of which is the Mobile services Switching Center (MSC), performs the switching of calls between the mobile users, and between mobile and fixed network users. The MSC also handles the mobility management operations. Not shown is the Operations and Maintenance Center, which oversees the proper operation and setup of the network. The Mobile Station and the Base Station Subsystem communicate across the Um interface, also known as the air interface or radio link. The Base Station Subsystem communicates with the Mobile services Switching Center across the A interface.

As John states, he presents a generic GSM architecture. Lucent, Ericsson, Nokia, and others feature their own vision in their own diagrams.

Lucent GSM architecture/ Ericsson GSM architecture /Nokia GSM architecture / Siemens's GSM architecture



5.1.5 General architecture of a GSM network

5.1.6 Radio link aspects:

The International Telecommunication Union (ITU), which manages the international allocation of radio spectrum (among many other functions), allocated the bands 890-915 MHz for the uplink (mobile station to base station) and 935-960 MHz for the downlink (base station to mobile station) for mobile networks in Europe. Since this range was already being used in the early 1980s by the analog systems of the day, the CEPT had the foresight to reserve the top 10 MHz of each band for the GSM network that was still being developed. Eventually, GSM will be allocated the entire 2x25 MHz bandwidth.

5.1.7 Multiple Access and channel structure:

Since radio spectrum is a limited resource shared by all users, a method must be devised to divide up the bandwidth among as many users as possible. The method chosen by GSM is a combination of Time- and Frequency-Division Multiple Access (TDMA/FDMA). The FDMA part involves the division by frequency of the (maximum) 25 MHz bandwidth into 124 carrier frequencies spaced 200 kHz apart. One or more carrier frequencies are assigned to each base station. Each of these carrier frequencies is then divided in time, using a TDMA scheme. The fundamental unit of time in this TDMA scheme is called a burst period and it lasts 15/26 ms (or approx. 0.577 ms). Eight burst periods are grouped into a TDMA frame (120/26 ms, or approx. 4.615 ms), which forms the basic unit for the definition of logical channels. One physical channel is one burst period per TDMA frame.

i) Traffic channels

A traffic channel (TCH) is used to carry speech and data traffic. Traffic channels are defined using a 26-frame multi-frame, or group of 26 TDMA frames. The length of a 26-frame multi-frame is 120 ms, which is how the length of a burst period is defined (120 ms divided by 26 frames divided by 8 burst periods per frame). Out of the 26 frames, 24 are used for traffic, 1 is used for the Slow Associated Control Channel (SACCH) and 1 is currently unused (see Figure 2). TCHs for the uplink and downlink are separated in time by 3 burst periods, so that the mobile station does not have to transmit and receive simultaneously, thus simplifying the electronics.

ii) Control channels

Common channels can be accessed both by idle mode and dedicated mode mobiles. The common channels are used by idle mode mobiles to exchange the signaling information required to change to dedicated mode. Mobiles already in dedicated mode monitor the surrounding base stations for handover and other information. Dedicated mode means a mobile is in use.

5.1.8 Frequency Hopping:

The mobile station already has to be frequency agile, meaning it can move between a transmit/ receive, and monitor time slot within one TDMA frame, which normally are on different frequencies. GSM makes use of this inherent frequency agility to implement slow frequency hopping, where the mobile and BTS transmit each TDMA frame on a different carrier frequency. The frequency hopping algorithm is broadcast on the Broadcast Control Channel. Since multipath fading is dependent on carrier frequency, slow frequency hopping helps alleviate the problem. In addition, co-channel interference is in effect randomized.

Here's a huge difference between conventional cellular (IS-136) and GSM: frequency hopping. When enabled, slots within frames can leapfrog from one frequency to another. In IS-136, by comparison, once assigned a channel your call stays on that pair of radio frequencies until the call is over or you have moved to another cell.

5.1.9 Discontinuous Reception:

Another method used to conserve power at the mobile station is discontinuous reception. The paging channel, used by the base station to signal an incoming call, is structured into sub-channels. Each mobile station needs to listen only to its own sub-channel. In the time between successive paging sub-channels, the mobile can go into sleep mode, when almost no power is used.

5.1.10 Power control:

There are five classes of mobile stations defined, according to their peak transmitter power, rated at 20, 8, 5, 2, and 0.8 watts. To minimize co-channel interference and to conserve power, both the mobiles and the Base Transceiver Stations operate at the lowest power level that will maintain an acceptable signal quality. Power levels can be stepped up or down in steps of 2 dB from the peak power for the class down to a minimum of 13 dBm (20 mill watts).

We need only enough power to make a connection. Any more is superfluous. If you can't make a connection using one watt then two watts won't help at these near microwave frequencies. Using less power means less interference or congestion among all the mobiles in a cell.

The mobile station measures the signal strength or signal quality (based on the Bit Error Ratio), and passes the information to the Base Station Controller, which ultimately decides if and when the power level should be changed. Power control should be handled carefully, since there is the possibility of instability. This arises from having mobiles in co-channel cells alternating increase their power in response to increased co-channel interference caused by the other mobile increasing its power. This is unlikely to occur in practice but it is (or was as of 1991) under study.

Two points: The first is that the base station can reach out to the mobile and turn down the transmitting power the handset is using, Very cool. The second point is that a digital signal will drop a call much more quickly than an analog signal. With an analog radio you can hear through static and fading. But with a digital radio the connection will be dropped, just like your landline modem, when too many 0s and 1s go missing. You need more base stations, consequently, to provide the same coverage as analog.

5.1.11 Network Aspects:

Ensuring the transmission of voice or data of a given quality over the radio link is only part of the function of a cellular mobile network. A GSM mobile can seamlessly roam nationally and internationally, which requires that registration, authentication, call routing and location updating functions exist and are standardized in GSM networks. In addition, the fact that the geographical area covered by the network is divided into cells necessitates the implementation of a handover mechanism. These functions are performed by the Network Subsystem, mainly using the Mobile Application Part (MAP) built on top of the Signaling.

The signaling protocol in GSM is structured into three general layers [1], [19], depending on the interface. Layer 1 is the physical layer, which uses the channel structures discussed above over the air interface. Layer 2 is the data link layer. Across the Um interface, the data link layer is a modified version of the LAPD protocol used in ISDN (external link), called LAPDm. Across the A interface, the Message Transfer Part layer 2 of Signaling System Number 7 is used. Layer 3 of the GSM signaling protocol is itself divided into 3 sub layers.

- ☐ Radio Resources Management
 - ☐ Controls the setup, maintenance, and termination of radio and fixed channels,
 - ☐ Including handovers.
- ☐ Mobility Management
 - ☐ Manages the location updating and registration procedures, as well as security and authentication.
- ☐ Connection Management
 - ☐ Handles general call control, similar to CCITT Recommendation Q.931, and manages Supplementary Services and the Short Message Service.

5.1.12 Radio Resources Management:

The radio resources management (RR) layer oversees the establishment of a link, both radio and fixed, between the mobile station and the MSC. The main functional components involved are the mobile station, and the Base Station Subsystem, as well as the MSC. The RR layer is concerned with the management of an RR-session [16], which is the time that a mobile is in dedicated mode, as well as the configuration of radio channels including the allocation of dedicated channels.

An RR-session is always initiated by a mobile station through the access procedure, either for an outgoing call, or in response to a paging message. The details of the access and paging procedures, such as when a dedicated channel is actually assigned to the mobile, and the paging sub-channel structure, are handled in the RR layer. In addition, it handles the management of radio features such as power control, discontinuous transmission and reception, and timing advance.

5.1.13 Handover:

In a cellular network, the radio and fixed links required are not permanently allocated for the duration of a call. Handover, or handoff as it is called in North America, is the switching of an on-going call to a different channel or cell. The execution and measurements required for handover form one of basic functions of the RR layer.

There are four different types of handover in the GSM system, which involve transferring a call between:

- ☐ Channels (time slots) in the same cell
- ☐ Cells (Base Transceiver Stations) under the control of the same Base Station Controller (BSC),
- ☐ Cells under the control of different BSCs, but belonging to the same Mobile services Switching Center (MSC), and
- ☐ Under the control of different MSCs.

The first two types of handover, called internal handovers, involve only one Base Station Controller (BSC). To save signaling bandwidth, they are managed by the BSC without involving the Mobile services Switching Center (MSC), except to

notify it at the completion of the handover. The last two types of handover, called external handovers, are handled by the MSCs involved. An important aspect of GSM is that the original MSC, the anchor MSC, remains responsible for most call-related functions, with the exception of subsequent inter-BSC handovers under the control of the new MSC, called the relay MSC.

Handovers can be initiated by either the mobile or the MSC (as a means of traffic load balancing). During its idle time slots, the mobile scans the Broadcast Control Channel of up to 16 neighboring cells, and forms a list of the six best candidates for possible handover, based on the received signal strength. This information is passed to the BSC and MSC, at least once per second, and is used by the handover algorithm.

The algorithm, for when a hand over decision should be taken is not specified in the GSM recommendations. There are two basic algorithms used, both closely tied in with power control. This is because the BSC usually does not know whether the poor signal quality is due to multipath fading or to the mobile having moved to another cell. This is especially true in small urban cells.

The 'minimum acceptable performance' algorithm gives precedence to power control over handover, so that when the signal degrades beyond a certain point, the power level of the mobile is increased. If further power increases do not improve the signal, then a handover is considered. This is the simpler and more common method, but it creates 'smeared' cell boundaries when a mobile transmitting at peak power goes some distance beyond its original cell boundaries into another cell.

The 'power budget' method uses handover to try to maintain or improve a certain level of signal quality at the same or lower power level. It thus gives precedence to handover over power control. It avoids the 'smeared' cell boundary problem and reduces co-channel interference, but it is quite complicated.

5.1.14 Mobility Management:

The Mobility Management layer (MM) is built on top of the RR layer (radio resources), and handles the functions that arise from the mobility of the subscriber, as well as the authentication and security aspects. Location management is

concerned with the procedures that enable the system to know the current location of a powered-on mobile station so that incoming call routing can be completed

5.1.15 Location Updating:

A powered-on mobile is informed of an incoming call by a paging message sent over the PAGCH channel of a cell. One extreme would be to page every cell in the network for each call, which is obviously a waste of radio bandwidth. The other extreme would be for the mobile to notify the system, via location updating messages, of its current location at the individual cell level. This would require paging messages to be sent to exactly one cell, but would be very wasteful due to the large number of location updating messages. A compromise solution used in GSM is to group cells into location areas. Updating messages are required when moving between location areas, and mobile stations are paged in the cells of their current location area.

In conventional cellular location messages are sent to the exact cell a mobile is in.

To review, the VLR Data Base, or Visited or Visitor Location Register, contains all the data needed to communicate with the mobile switch. Levine says this data includes:

- ☐ Equipment identity and authentication -related data
- ☐ Last known Location Area (LA)
- ☐ Power Class and other physical attributes of the mobile or handset
- ☐ List of special services available to this subscriber
- ☐ More data entered while engaged in a Call
- ☐ Current cell
- ☐ Encryption keys

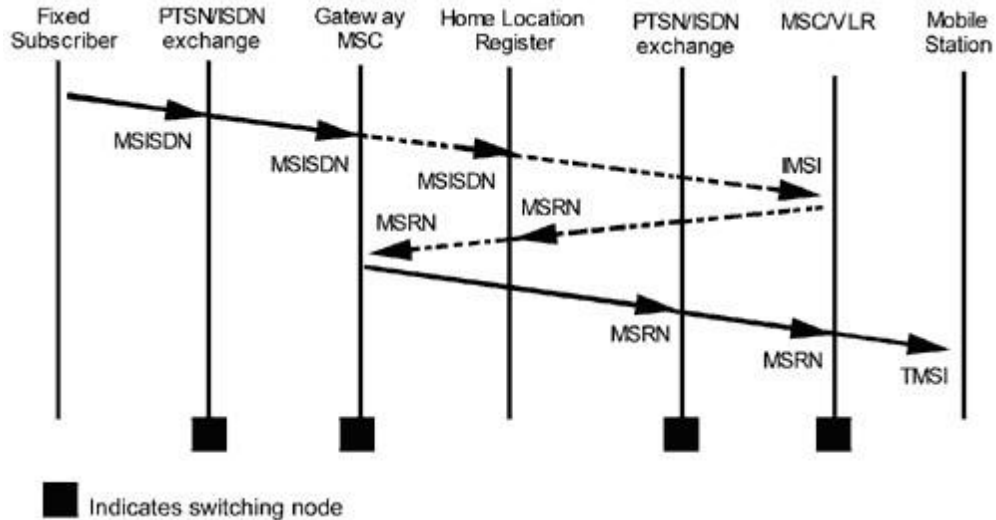
The location updating procedures, and subsequent call routing, use the MSC and two location registers: the Home Location Register (HLR) and the Visitor Location Register (VLR). When a mobile station is switched on in a new location area, or it moves to a new location area or different operator's PLMN, it must register with the network to indicate its current location. In the normal case, a location update

message is sent to the new MSC/VLR, which records the location area information, and then sends the location information to the subscriber's HLR. The information sent to the HLR is normally the SS7 address of the new VLR, although it may be a routing number. The reason a routing number is not normally assigned, even though it would reduce signaling, is that there is only a limited number of routing numbers available in the new MSC/VLR and they are allocated on demand for incoming calls. If the subscriber is entitled to service, the HLR sends a subset of the subscriber information, needed for call control, to the new MSC/VLR, and sends a message to the old MSC/VLR to cancel the old registration.

A procedure related to location updating is the IMSI (International Mobile Subscriber Identity) attach and detach. A detach lets the network know that the mobile station is unreachable, and avoids having to needlessly allocate channels and send paging messages. an attach is similar to a location update, and informs the system that the mobile is reachable again. The activation of IMSI attach/detach is up to the operator on an individual cell basis

5.1.16 Communication Management:

The Communication Management layer (CM) is responsible for Call Control (CC), supplementary service management, and short message service management. Each of these may be considered as a separate sub layer within the CM layer. Call control attempts to follow the ISDN procedures specified in Q.931, although routing to a roaming mobile subscriber is obviously unique to GSM. Other functions of the CC sub layer include call establishment, selection of the type of service (including alternating between services during a call), and call release.



5.1.16 Call routing for a mobile terminating call

5.1.17 Call Routing:

Unlike routing in the fixed network, where a terminal is semi-permanently wired to a central office, a GSM user can roam nationally and even internationally. (With, if needed, a properly enabled handset.) The directory number dialed to reach a mobile subscriber is called the Mobile Subscriber ISDN (MSISDN), which is defined by the E.164 numbering plan. This number includes a country code and a National Destination Code which identifies the subscriber's operator. The first few digits of the remaining subscriber number may identify the subscriber's HLR within the home PLMN.

An incoming mobile terminating call is directed to the Gateway MSC (GMSC) function. The GMSC is basically a switch which is able to interrogate the subscriber's HLR to obtain routing information, and thus contains a table linking MSISDNs to their corresponding HLR. A simplification is to have a GSC handle one specific PLMN. It should be noted that the GMSC function is distinct from the MSC function, but is usually implemented in an MSC.

PLMN: Public land mobile network. In this context a cellular telephone network. PLMN is chiefly a European usage.

The routing information that is returned to the GMSC is the Mobile Station Roaming Number (MSRN), which is also defined by the E.164 numbering plan.

MSRNs are related to the geographical numbering plan, and not assigned to subscribers, nor are they visible to subscribers.

The most general routing procedure begins with the GMSC querying the called subscriber's HLR for an MSRN. The HLR typically stores only the SS7 address of the subscriber's current VLR, and does not have the MSRN (see the location updating section). The HLR must therefore query the subscriber's current VLR, which will temporarily allocate an MSRN from its pool for the call. This MSRN is returned to the HLR and back to the GMSC, which can then route the call to the new MSC. At the new MSC, the IMSI corresponding to the MSRN is looked up, and the mobile is paged in its current location area.

5.2 GPS RECEIVER:

5.2.1 GPS History:

The Global Positioning System (GPS) is a Global Navigation Satellite System (GNSS) developed by the United States Department of Defense. It is the only fully functional GNSS in the world. It uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals, which enable GPS receivers to determine their current location, the time, and their velocity. Its official name is NAVSTAR GPS. Although NAVSTAR is not an acronym, a few acronyms have been created for it. The GPS satellite constellation is managed by the United States Air Force 50th Space Wing. GPS is often used by civilians as a navigation system.

After Korean Air Lines Flight 007 was shot down in 1983 after straying into the USSR's prohibited airspace, President Ronald Reagan issued a directive making GPS freely available for civilian use as a common good. As suggested by physicist D. Fanelli.

A few years before, Since then, GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, and hobbies such as geo-caching. Also, the precise time reference is used in many applications including the scientific study of earthquakes. GPS is also a required key synchronization resource of cellular networks, such as the Qualcomm CDMA air interface used by many wireless carriers in a multitude of countries.

The first satellite navigation system, Transit, used by the United States Navy, was first successfully tested in 1960. Using a constellation of five satellites, it could provide a navigational fix approximately once per hour. In 1967, the U.S. Navy developed the Imation satellite which proved the ability to place accurate clocks in space, a technology that GPS relies upon. In the 1970s, the ground-based Omega Navigation System, based on signal phase comparison, became the first worldwide radio navigation system.

The design of GPS is based partly on similar ground-based radio navigation systems, such as LORAN and the Decca Navigator developed in the early 1940s, and used during World War II. Additional inspiration for the GPS came when the Soviet Union launched the first Sputnik in 1957. A team of U.S. scientists led by Dr. Richard B. Kershner were monitoring Sputnik's radio transmissions. They discovered that, because of the Doppler Effect, the frequency of the signal being transmitted by Sputnik was higher as the satellite approached, and lower as it continued away from them. They realized that since they knew their exact location on the globe, they could pinpoint where the satellite was along its orbit by measuring the Doppler distortion.

5.2.1.1 Working and Operation:

When people talk about "a GPS," they usually mean a GPS receiver. The Global Positioning System (GPS) is actually a constellation of 27 Earth-orbiting satellites (24 in operation and three extras in case one fails). The U.S. military developed and implemented this satellite network as a military navigation system, but soon opened it up to everybody else.

Each of these 3,000- to 4,000-pound solar-powered satellites circles the globe at about 12,000 miles (19,300 km), making two complete rotations every day. The orbits are arranged so that at anytime, anywhere on Earth, there are at least four satellites "visible" in the sky.

A GPS receiver's job is to locate four or more of these satellites, figure out the distance to each, and use this information to deduce its own location. This operation is based on a simple mathematical principle called trilateration. GPS receiver calculates its position on earth based on the information it receives from four located satellites. This system works pretty well, but inaccuracies do pop up.

For one thing, this method assumes the radio signals will make their way through the atmosphere at a consistent speed (the speed of light). In fact, the Earth's atmosphere slows the electromagnetic energy down somewhat, particularly as it goes through the ionosphere and troposphere. The delay varies depending on where you are on Earth, which means it's difficult to accurately factor this into the distance calculations. Problems can also occur when radio signals bounce off large objects, such as skyscrapers, giving a receiver the impression that a satellite is farther away than it actually is. On top of all that, satellites sometimes just send out bad almanac data, misreporting their own position.

Differential GPS (DGPS) helps correct these errors. The basic idea is to gauge GPS inaccuracy at a stationary receiver station with a known location. Since the DGPS hardware at the station already knows its own position, it can easily calculate its receiver's inaccuracy. The station then broadcasts a radio signal to all DGPS-equipped receivers in the area, providing signal correction information for that area. In general, access to this correction information makes DGPS receivers much more accurate than ordinary receivers.

5.2.2 GPS Data Decoding:

G.P.S receiver continuously sends data and the microcontroller receives the data whenever it requires. The data sent by the G.P.S is a string of characters which should be decoded to the standard format. This is done by the program which we implement in the controller.

5.3 ARDUINO UNO:

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the

reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Technical specifications:

Microcontroller: Microchip ATmega328P [7]

Operating Voltage: 5 Volts

Input Voltage: 7 to 20 Volts

Digital I/O Pins: 14 (of which 6 can provide PWM output)

UART: 1

I2C: 1

SPPI: 1

Analog Input Pins: 6

DC Current per I/O Pin: 20 mA

DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB of which 0.5 KB used by bootloader

SRAM: 2 KB

EEPROM: 1 KB

Clock Speed: 16 MHz

Length: 68.6 mm

Width: 53.4 mm

Weight: 25 g

General pin functions

LED: There is a built-in LED driven by digital pin 13. When the pin is high value, the LED is on, when the pin is low, it is off.

VIN: The input voltage to the Arduino/Genuino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.

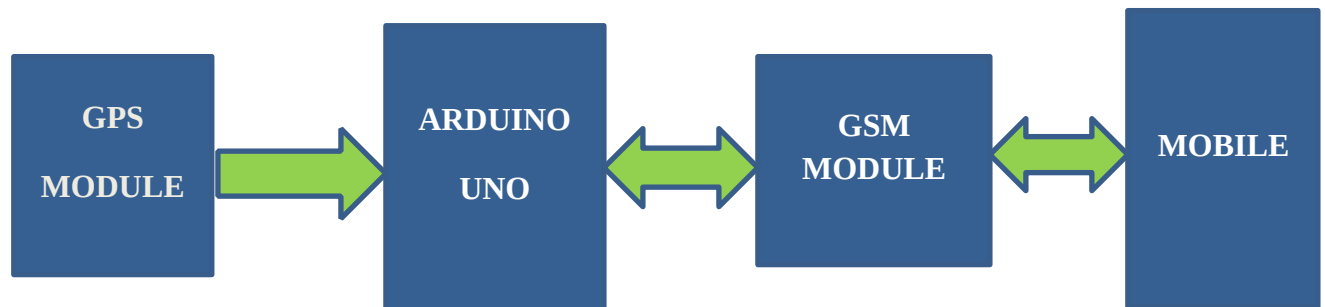
3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND: Ground pins.

IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work with the 5V or 3.3V.

Reset: Typically used to add a reset button to shields that block the one on the board.

5.4 ARCHITECTURE



5.4 Architecture of Birds tracking system

5.5 ARCHITECTURE EXPLANATION

5.5.1 Arduino :

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

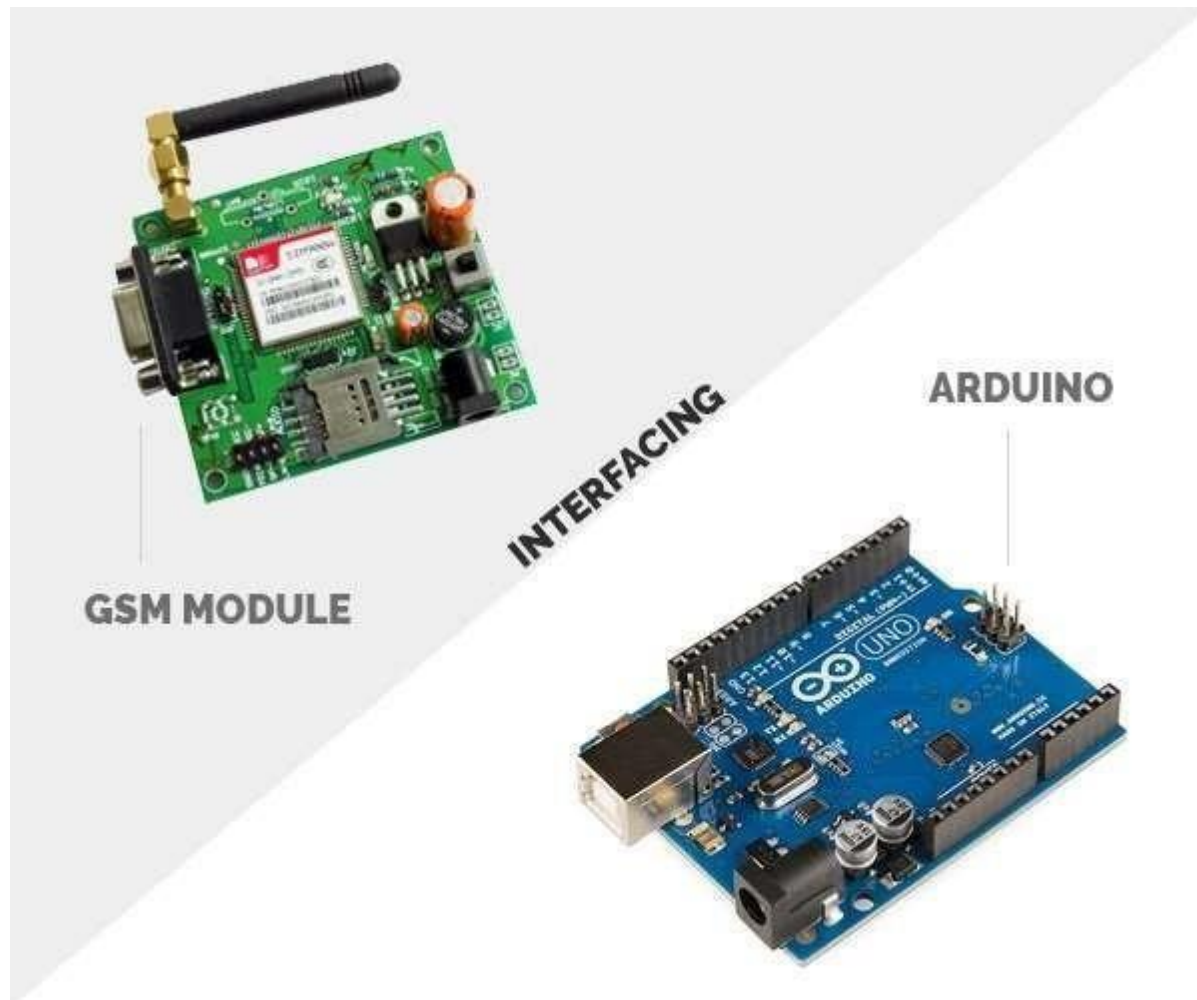
The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package

The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer

(or appropriate wall power adapter) with a USB cable or power it with a AC-to-DC adapter or battery to get started.

5.5.2 GSM:

GSM (or Global System for Mobile Communications) was developed in 1990. The first GSM operator has subscribers in 1991, the beginning of 1994 the network based on the standard, already had 1.3 million subscribers, and the end of 1995 their number had increased to 10 million! There were first generation mobile phones in the 70's, there are 2nd generation mobile phones in the 80's and 90's, and now there are 3rd gen phones which are about to enter the Indian market. GSM is called a 2nd generation, or 2G communications technology. In this project it acts as a SMS Receiver and SMS sender. The GSM technical specifications define the different entities that form the GSM network by defining their functions and interface requirements



5.5.2 GSM and ARDUINO

5.5.3 GPS:

The Global Positioning System (GPS) is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather conditions, anywhere in the world, 24 hours a day, with no subscription fees or setup charges.

How GPS works

GPS satellites circle the Earth twice a day in a precise orbit. Each satellite transmits a unique signal and orbital parameters that allow GPS devices to decode and compute the precise location of the satellite. GPS receivers use this information and trilateration to calculate a user's exact location. Essentially, the GPS receiver measures the distance to each satellite by the amount of time it takes

to receive a transmitted signal. With distance measurements from a few more satellites, the receiver can determine a user's position and display it.



5.5.3 GPS

Once your position has been determined, the GPS unit can calculate other information, such as:

- ☐ Speed
- ☐ Position
- ☐ Track

5.6 Working Procedure:

Devices will be going to be fixed in the Bird to which we want to trace. Initially what happened that we make a program in arduino (in c language) regarding interfacing the GSM devices and GPS devices .And we also set a mobile number in the program as per our need, on which we get the info regarding its location(Bird's).First of all we want to make a call to the mobile number which has

been installed in the GSM Module and then after some specific delay.(as per mentioned in the program) we get a SMS regarding the exact latitude and longitude of the Birds. It is done in a way that GPS device is continuously receiving the location of the birds from satellite and then transferring to the arduino board, from where we sent it to the required mobile number. And hence in this way we can easily get info regarding the exact location of the birds. Once the message has been sent to the predefined mobile number GSM gets deactivated and the GPS get activated. Thus we can easily track our Bird's.

CHAPTER 6

HARDWARE REQUIREMENTS

6.1 CONNECTION OF ARDUINO WITH GSM SIM 900A :

It is very easy to interface gsm with arduinouno.we have to connect it in following way :

- Connect Tx pin of GSM to receiver pin 2 of arduino (due to Software Serial Library).
- Connect Rx pin of GSM to transmitter pin 3 of arduino
- Connect GND of arduino to GND of GSM.
- Supply power to GSM and arduino using 12 V,1A adapter

6.2. CONNECTION OF ARDUINO WITH GPS MODULE – 6M :

- Connect TS pin of GPS to receiver pin 0 of Arduino (due to software serial library).
- Connect RX pin of GPS to transmitter pin 1 of Arduino.
- Connect GND of Arduino to GND of GSM.
- Supply power to GPS from Arduino VCC +3.3V.

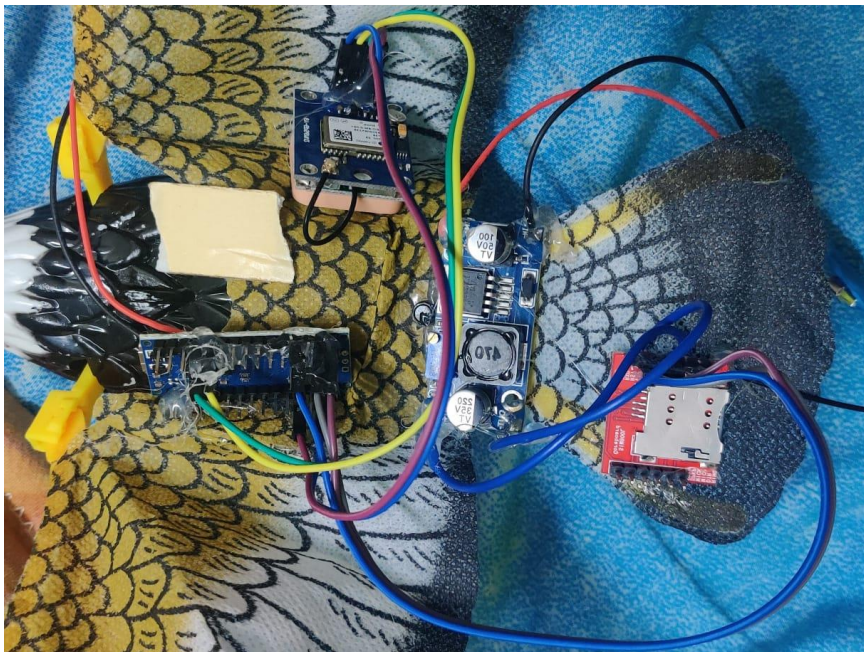
CHAPTER 7

RESULTS AND PERFORMANCE ANALYSIS

We a team of 2 members have successfully completed our Project on Tracking Birds Migration using Python 3.

We first tried to understand the working of our project through the schematic and then we proceeded to build the circuit as per the schematic. Initially we faced few problems with the GPS modem, as it won't work efficiently inside buildings. And also the GSM modem suffered problems with the coverage area of the Mobile Service Provider. So, we used Airtel as it has maximum coverage area. In order to solve this problem we can use dedicated servers and purchasing satellite space so that we can track birds location anytime and anywhere.

The overall developed circuit looks as in the following figure :



The above circuit works mainly by receiving messages from a mobile phone. There are three messages/commands by which we can track and control the vehicle. They are :

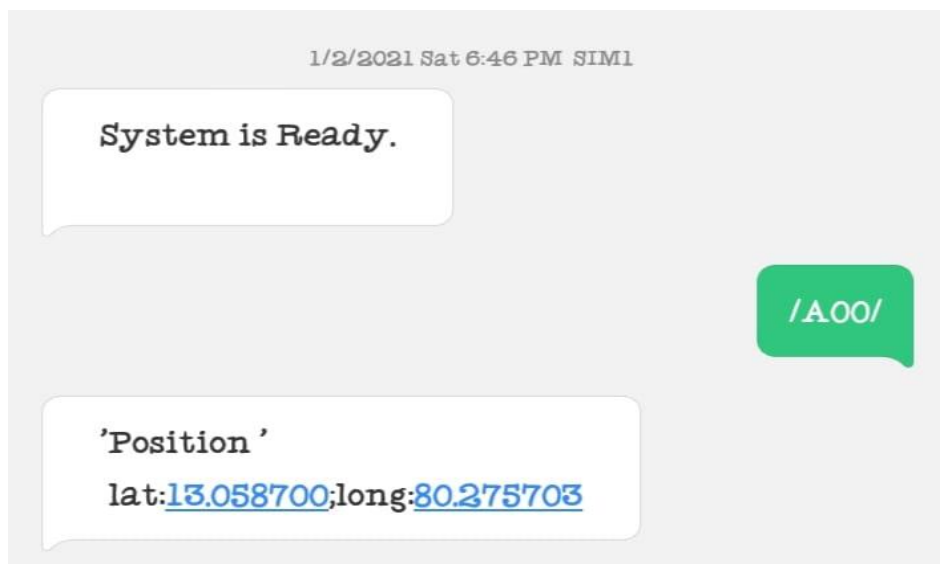
- i) TRACK
- ii) LOCKD
- iii) NLOCK

i) **TRACK:** Initiates the GPS modem and receives the Latitude and Longitude position and this information will be sent to the mobile from which it received the message.

ii) **LOCKD:** When this message is sent, then the Microcontroller initiates that which is located in between the passage to stop and which in turn stops the bird.

iii) **NLOCK:** This command makes the to start again so that the bird starts moving.

This project can further be crafted by restricting the usage of limited mobile numbers to get access to the device. This can be made by altering the program. The message which is sent to the mobile will be as shown in the following figure.



With the knowledge in Electronics and Communications we have successfully completed our project with perfect results.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 CONCLUSION :

The project titled “tracking Birds Migration using GSM and satellite communication” is a model for Birds tracking unit with the help of GPS receivers and GSM modem. Birds Tracking System resulted in improving overall productivity with better fleet management that in turn offers better return on your investments. Better scheduling or route planning can enable you handle larger jobs loads within a particular time. Birds tracking both in case of personal as well as business purpose improves safety and security, communication medium, performance monitoring and increases productivity. So in the coming year, it is going to play a major role in our day-to-day living.

We have completed the project as per the requirements of our project. Finally the aim of the project i.e. to trace the Birds is successfully achieved.

8.2 FUTURE SCOPE :

- i.** We can reduce the size of the kit by using GPS+GSM on the same module.
- ii.** We can increase the accuracy up to 3m by increasing the cost of the GPS receivers.

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- [3]. Chen Peijiang, Jiang Xuehua, “Design and Implementation of Remote monitoring system based on GSM,” vol.42, pp.167-175. 2008.
- [4]. V.Ramya, B. Palaniappan, K. Karthick, “Embedded Controller for Vehicle In-Front Obstacle Detection and Cabin Safety Alert System”, International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 2, April 2012.

APENDIX

A. SOURCE PROGRAM :

```
#include<Tiny++.h>3
#include<SoftwareSerial.h>
String distnumber="+919789944523";
floataltitude,longitude;
TinyGPSPlus gps;
SoftwareSerialgsm(2,3)
void setup()
{
  serial.begin(9600);
  gsm.begin(9600);
}
void loop() }
if(gps.encode(serial.read()})
{
  collectInfo();})}
voidcollectInfo()
{
  if(gps.location.isValid())
  {
    latitude=gps.location.lat();
    logitude=gps.location.lng();
    if(gsm.available())
    {
      char a=char(gsm.read());
      if(a=='R')
      {
        delay(2000);
        gsm.println("ATH");
```

```

delay(1000);
message();
}
}
delay(10000);
}
else
{
latitude=00;
longitude=00;
}
}
void message()
{
gsm.print("AT+CMGF=1\r");
delay(1000);
gsm.println("AT+CMGS=\"" + distnumber + "\"");
delay(1000);
gsm.println("My Location is");
gsm.print("Latitude:");
gsm.println(latitude,6);
gsm.print("Longitude:");

gsm.println(longitude,6);
delay(1000);
gsm.write((char)26);
delay(1000);
gsm.print("AT+CLTS=1");
gsm.println("AT+CCLK?");
)

```