AIM

TO ACQUAINT THE CLASS ABOUT WIRELESS COMMUNICATION

1. **Introduction** **A wireless network refers to a computer network that makes use of Radio Frequency (RF) connections between nodes in the network**. Wireless networks are a popular solution for homes, businesses, and telecommunications networks.

2. **Wireless Communication**

(a) Definition: Wireless communication refers to the transmission of data between devices without the use of physical cables or wires.

(b) One of the medium of communication

(c) Transfer of information without any electrical conductor

(d) Used for both long & short distances

(e) Radio frequency, Infrared light, Laser light etc

(f) Wireless communication offers flexibility, mobility, and scalability, making it ideal for various applications ranging from personal devices to industrial systems.

3. **Components of a Wireless Communication Setup**

(a) **Transmitter**: The transmitter is the device responsible for converting information into electromagnetic signals suitable for transmission over the air. It modulates the carrier wave with the information to be transmitted. The transmitter may include components such as a modulator, amplifier, and antenna.

(b) **Receiver**: The receiver is the device that captures and processes the electromagnetic signals transmitted over the air. It demodulates the received signals to extract the original information. The receiver may include components such as a demodulator, amplifier, and antenna.

(c) **Transceiver**: In many wireless communication systems, the transmitter and receiver functions are combined into a single device called a transceiver. The transceiver handles both transmission and reception tasks, simplifying system design and reducing hardware complexity.

(d) **Modulation and Demodulation Circuitry**: Modulation is the process of impressing the information to be transmitted onto a carrier wave, while demodulation is the process of extracting the information from the received modulated signal. Modulation and demodulation circuitry are essential

components in wireless communication systems for encoding and decoding data.

4. **Applications of Wireless Communication**

(a) **Personal Area Networks (WPANs)**: Bluetooth-enabled devices for short-range communication (e.g., wireless headphones, keyboards).

(i) **Personal area networking**: Connecting personal devices such as smartphones, tablets, and wearable devices.

(ii) **Home automation**: Controlling smart home devices such as lights, thermostats, and security systems.

(iii) **Healthcare**: Monitoring and tracking medical devices, wearable health trackers, and patient monitoring systems.

(iv) **Entertainment**: Streaming audio or video content between devices such as smartphones, speakers, and TVs.

(aa) Technologies used in WPAN :-

(i) Bluetooth
(ii) ZigBee
(iii) Infrared
(iv) Z-wave

(ab) Features of WPAN :

(i) Low cost, Little or No infrastructure setup
(ii) Short range communication
(iii) Small personal network , use anywhere
(iv) Wide range of devices
(v) Low power consumption
(vi) No complex connectivity

(ac) Advantages of WPAN :

(i) Security
(ii) Portability
(iii) Easy Connectivity
(iv) Stability

(ad) Disadvantages of WPAN :

(i) Short range
(ii) Transfer speed

(b) **Local Area Networks (LANs)**:

WLAN stands for Wireless Local Area Network. It is a type of wireless communication network that allows devices within a limited area, such as a home, office, or campus, to connect to each other and to the internet without the need for wired connections.

Wi-Fi allows devices like smartphones, laptops, tablets, and other Wi-Fi-enabled devices to connect to a local network access point (wireless router or access point) to gain access to resources such as the internet, printers, file servers, and other devices on the same network.

(c) **Wide Area Networks (WANs)**: Cellular networks for long-range communication, enabling mobile phones and IoT devices to connect to the internet.

WWAN stands for Wireless Wide Area Network. It is a type of wireless communication network that covers a large geographic area, typically spanning several kilometres or miles. WWAN technology enables devices such as laptops, tablets, and smartphones to connect to the internet and other networks without the need for a wired connection.

5. **Types of wireless communication**

(a) **Radio Transmission** Easily generated, Omni-directional, travel long distance, easily penetrates buildings

Radio transmission in wireless communication involves the use of radio frequency (RF) electromagnetic waves to transmit data wirelessly between devices.

Here are some examples:

Home Wi-Fi networks: Wi-Fi routers and access points provide wireless connectivity to devices within a home, allowing users to access the internet, stream media, and communicate wirelessly.

Public Wi-Fi hotspots: Wi-Fi hotspots in cafes, airports, hotels, and other public places offer internet access to users with Wi-Fi-enabled devices.

Satellite Communication: Satellite communication systems use radio transmission to establish communication links between ground stations, satellites in orbit, and other spacecraft.

Satellite television: Direct-to-home (DTH) satellite television services use radio signals to broadcast television programming to satellite dishes installed at subscribers' homes.

Satellite internet: Satellite internet services use radio transmission to provide high-speed internet access to users in remote or underserved areas where terrestrial infrastructure is limited.

(b) **Microwave Transmission** Widely used for long distance communication

Microwave transmission in wireless communication involves the use of electromagnetic waves with frequencies ranging from hundreds of megahertz (MHz) to tens of gigahertz (GHz) to transmit data wirelessly between devices. Microwave communication systems typically operate over longer distances compared to infrared or light wave communication and are commonly used in various applications.

(i) **Television broadcasting**: Direct-to-home (DTH) satellite television services use microwave links to broadcast television signals to satellite dishes installed at subscribers' homes.

(ii) **Telecommunications**: Satellites provide long-distance communication links for voice, data, and internet services, especially in remote or rural areas where terrestrial infrastructure is limited.

(iii) **Remote sensing and Earth observation**: Microwave signals are used in satellite-based remote sensing applications, such as weather forecasting, environmental monitoring, and agricultural analysis.

(iv) **Microwave Wireless Networks**: Microwave frequencies are also used in wireless networking technologies, providing high-speed data transmission over short to medium distances. Examples include:

(c) **Infrared** Widely used for short range communication unable to pass through solid objects, used for indoor wireless LANs, not for outdoors In wireless communication, infrared (IR) refers to the use of infrared light waves to transmit data wirelessly between devices. This technology is commonly used for short-range communication within a confined space, typically within a few

meters. Infrared communication relies on the modulation and transmission of infrared light signals to convey information between devices.

Sure, here are some common examples of infrared wireless communication:

(i) **Remote Controls**: Many electronic devices such as TVs, DVD players, air conditioners, and stereos use infrared remote controls for user interaction. When you press a button on the remote, it emits an infrared signal containing specific codes that are received by a sensor on the device, causing it to perform the corresponding action (e.g., changing channels, adjusting volume).

(ii) **Infrared Data Transfer**: Infrared ports on devices like laptops, smartphones, and PDAs allow for short-range data transfer. In the past, this was commonly used for activities such as transferring files between devices or syncing data. While less common now due to the prevalence of other wireless technologies like Bluetooth and Wi-Fi, some devices still include infrared ports for compatibility.

(iii) **Infrared Keyboards and Mice**: Some keyboards and mice use infrared technology to communicate wirelessly with a computer. The devices emit infrared signals that are received by a sensor connected to the computer, enabling users to interact with the system without the need for physical cables.

(iv) **TV Remote Extenders**: Infrared extenders are devices used to control electronic equipment from a distance. They consist of an infrared transmitter that is placed near the device to be controlled and an infrared receiver that picks up signals from the remote control and relays them to the transmitter using a wired or wireless connection, extending the range of the remote control.

(v) **Wireless Headphones**: Some wireless headphones utilize infrared technology to transmit audio signals from a base station to the headphones. The base station emits infrared signals containing the audio data, which are received by sensors on the headphones, allowing users to listen to audio without being tethered to the audio source by cables.

These are just a few examples of how infrared wireless communication is used in various consumer electronics and devices.

(d) **Light Wave Transmission** Unguided optical signal such as laser, unidirectional easy to install

6. **Advantages and Disadvantages of wireless communication**

(a) **Advantages**

(i) Access anywhere and anytime

(ii) A wireless communication network is solution in areas where cables are impossible to install

(iii) Wireless networks are cheaper to install and maintain

(b) **Disadvantages**

(i) High security vulnerabilities

(ii) High cost for setting the infrastructure

(iii) Unlike wired communication, wireless communication is influenced by physical obstructions, climatic conditions, interference from other wireless devices

7. **Full Form**

Ser No	Short Form	Full Form
1.	AP	Access Point
2.	ARP	Address Resolution Protocol
3.	AES	Advanced Encryption Standard
4.	CPE	Customer Premises Equipment
5.	CCQ	Client Connection Quality
6.	DHCP	Dynamic Host Configuration Protocol
7.	DNS	Domain Name System
8.	DDNS	Dynamic Domain Name Server
9.	GMT	Greenwich Mean Time
10.	IP	Internet Protocol
11.	ICMP	Internet Control Message Protocol
12.	LAN	Local Area Network
13.	MAC	Media Access Control
14.	PoE	Power over Ethernet
15.	P2MP	Point-to-Multi Point
16.	PVID	Port-based VLAN ID
17.	RADIUS	Remote Authentication Dial In User Service
18.	SSID	Service Set Identifier
19.	TCP	Transmission Control Protocol
20.	TKIP	Temporal Key Integrity Protocol
21.	VLAN	Virtual Local Area Network
22.	WEP	Wired Equivalent Privacy
23.	WLAN	Wireless Local Area Networks
24.	WMM	Wi-Fi multi-media
25.	WPAPSK	WPA-Pre shared Key
26.	WPA	Wi-Fi Protected Access

8. **Planning a Wireless Communication Setup**

(a) **Identify Requirements**: Define the range, data rate, reliability, and power consumption requirements of the communication system.

(b) **Select Frequency Band**: Choose an appropriate frequency band based on factors such as regulatory constraints, interference, and propagation characteristics.

(c) **Site Survey**: Conduct a site survey to assess environmental factors (e.g., obstacles, interference sources) that may affect signal propagation.

(d) **Antenna Placement**: Optimize antenna placement and orientation to maximize signal strength and coverage.

(e) **Security Measures**: Implement encryption, authentication, and access control mechanisms to secure wireless communication against unauthorized access and data breaches.

9. **IP Radio**

(a) This is light weight and portable equipment

(b) Broad band radio works on the basis of IP address

(c) It allows us to live streaming, chatting, voice calling and video conference

(d) It works on principle of Line of Sight

(e) There is a directional antenna which has the effect of screening

10. **Facility of IP Radio**

(a) High data rate

(b) Video can be configured

(c) Takes less time to establish

(d) The scene is convenient

(e) There is facility to see the signal strength

(f) There is no need to install software

(g) It can be used even in rainy/ snowfall season

11. **Necessary equipment for setup**

(a) Broad band radio

(b) ESPD (Electronic surge protection device)

(c) POE (Power over Ethernet)

(d) UTP cable with RJ 45 cable (as per requirement)

(e) Laptop/ PC

(f) Antenna

(g) Power source

12. **Method of setup**

(a) Fit the clamp on the broad band radio

(b) Connect the (UTP) RJ 45 connector cable in BBR

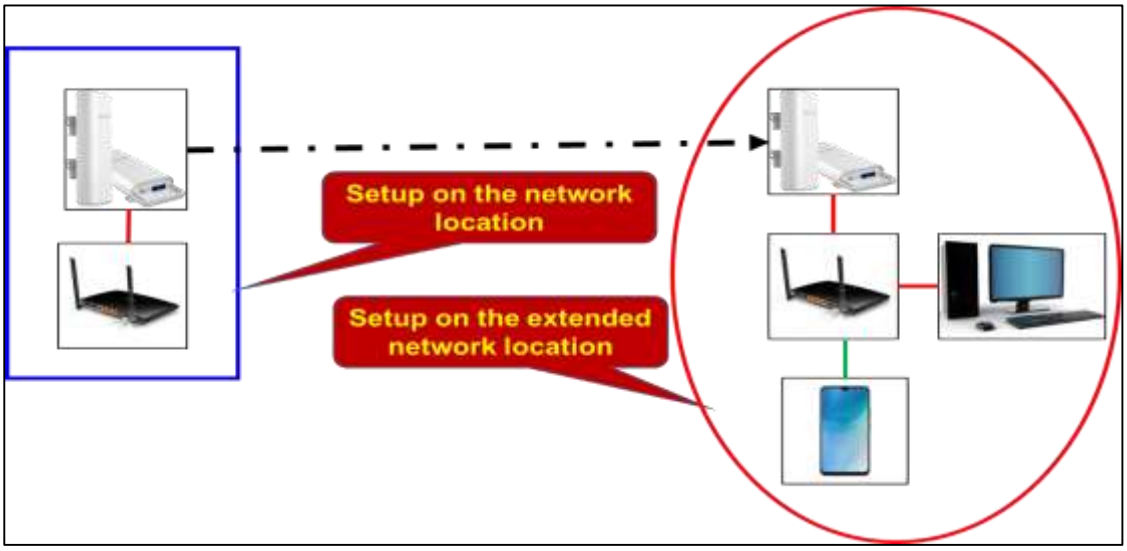
(c) Us RJ 45 connector at the other end of the cable into the ESPDs in port and connect the other end into out port of ESPD

(d) After clamping in mast, rotate it in the direction in which the communication is to be done

(e) Line of sight should be clear

(f) Connect the cable coming from out port (UTP) and connect the USB cable to the elite power source to the PC/ Laptop

(g) **Connectivity**

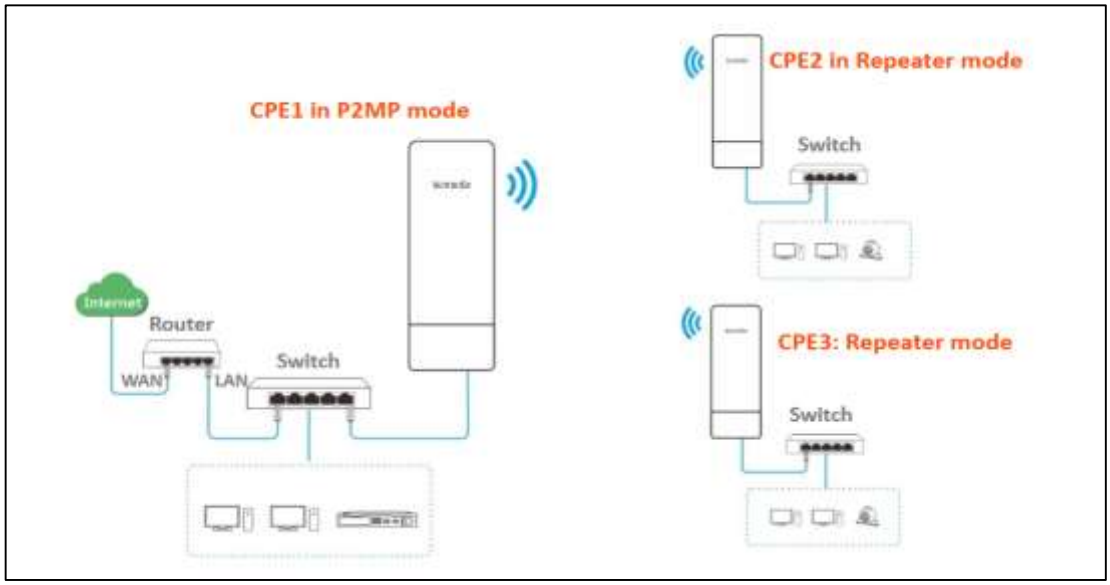


13. **How to operate**

(a) Get the broad band radio connected to the computer

(b) Click on internet explorer icon

(c) The web page given in its setting will open



14. **Set up the CPE**

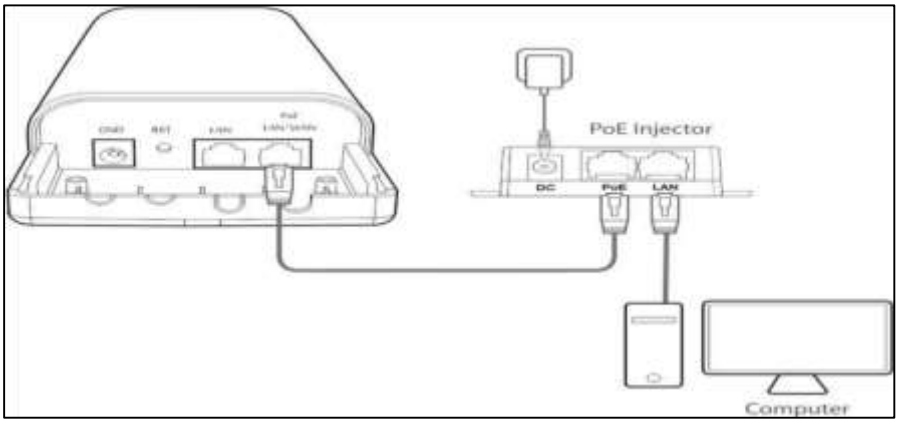
Connect the computer to the CPE.

(a) Uncover the housing of the CPE.

(b) Use an Ethernet cable to connect the **PoE/LAN/WAN** port of the device to the **PoE** port of the PoE injector.

(c) Use the included power adapter to connect the PoE injector to a power socket. The **LAN/WAN** LED indicator of the CEP lights up.

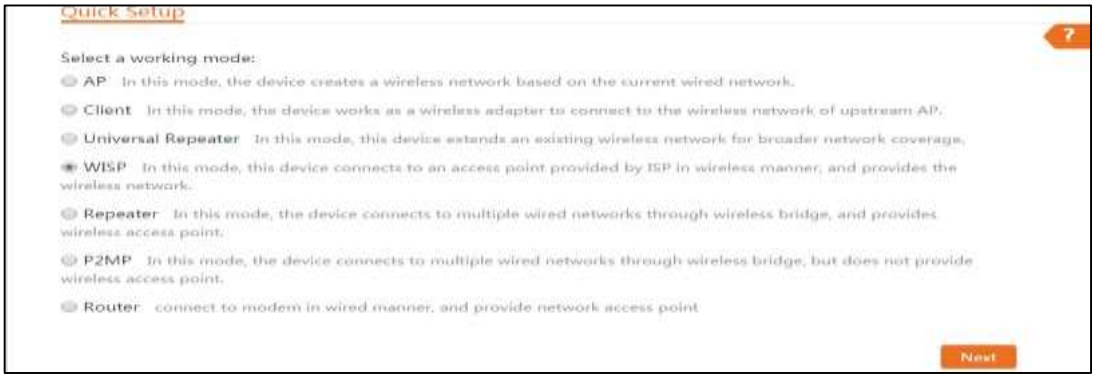
(d) Use an Ethernet cable to connect your computer to the **LAN** port of the PoE injector.



15. **Set the CPE to WISP mode.**

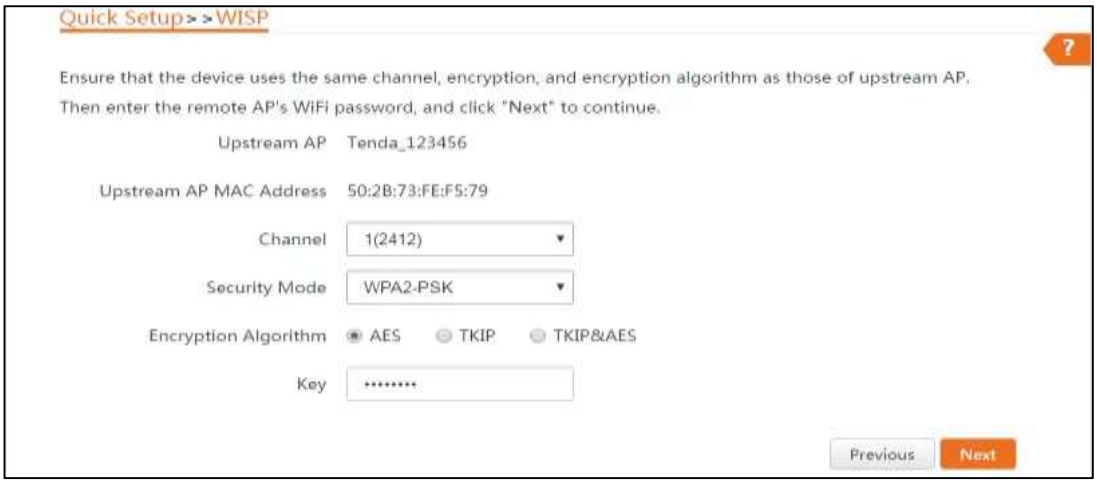
(a) Start a web browser on your computer, and visit **192.168.2.1**. Enter your user name and password (default: **admin/admin**), and click **Login**.

(b) Select WISP and click Next.

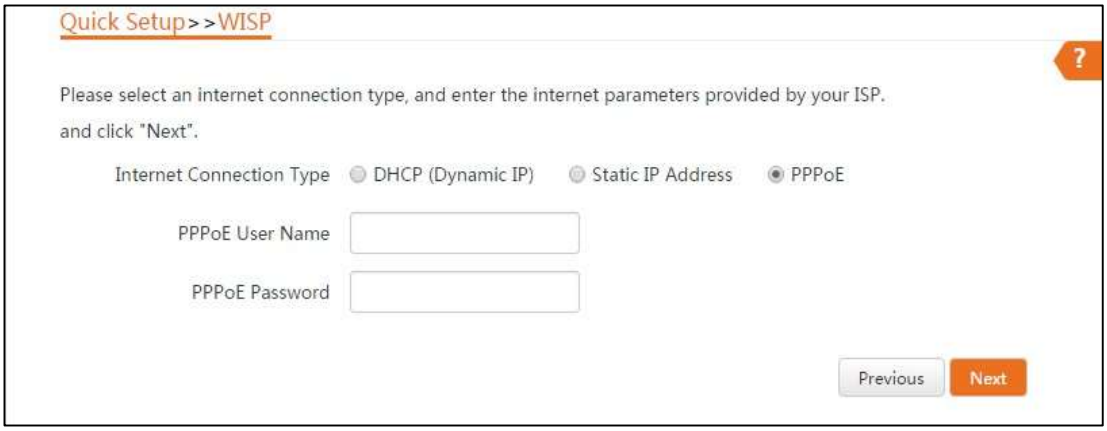


(c) Select the SSID of your ISP (Internet Service Provider) hotspot, which is **Tenda_123456** in this example, and click **Next.**

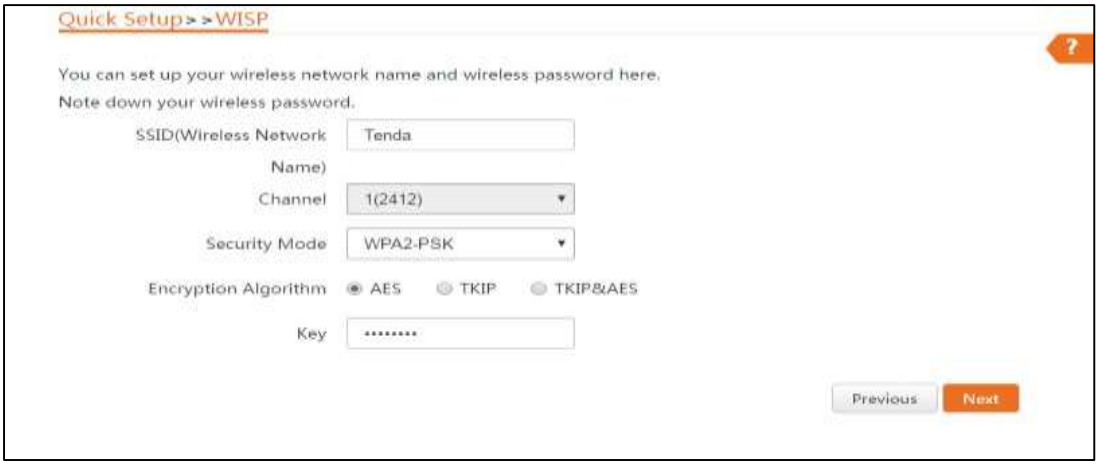
(d) Enter the WiFi password of your ISP hotspot in the **Key** text box, and click **Next.**



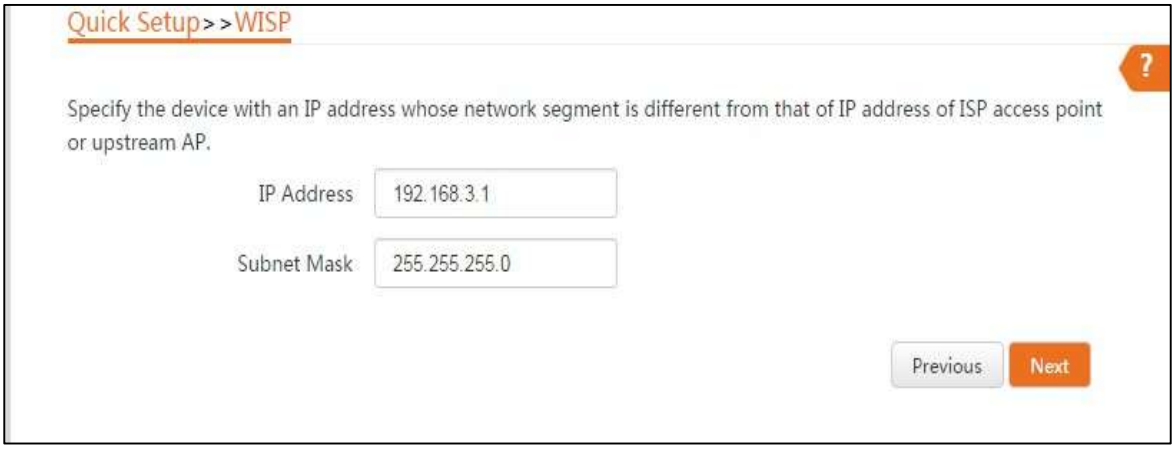
(e) Select the Internet Connection Type of your ISP hotspot, which is **PPPoE** in this example. Enter the PPPoE user name and password provided by your ISP, and click **Next.**



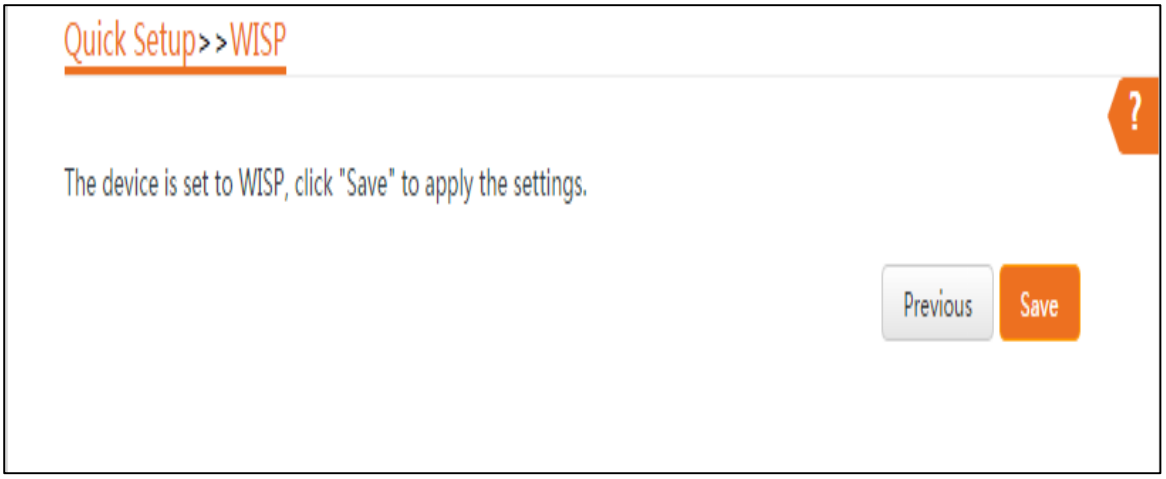
(f) Customize the SSID and key, and click **Next.**



(g) Set an IP address belonging to different network segment as that of your ISP hotspot. For example, if the IP address of your ISP hotspot is 192.168.2.1, you can set this device's IP address to 192.168.*X*.1 (*X* ranges from 0 to 254 excluding 2). Then click **Next.**



(h) Click **Save**, and wait until the device reboots to activate the settings.



(j) When LED1, LED2, and LED3 indicators of the device are blinking, the device is connected to your ISP hotspot successfully.

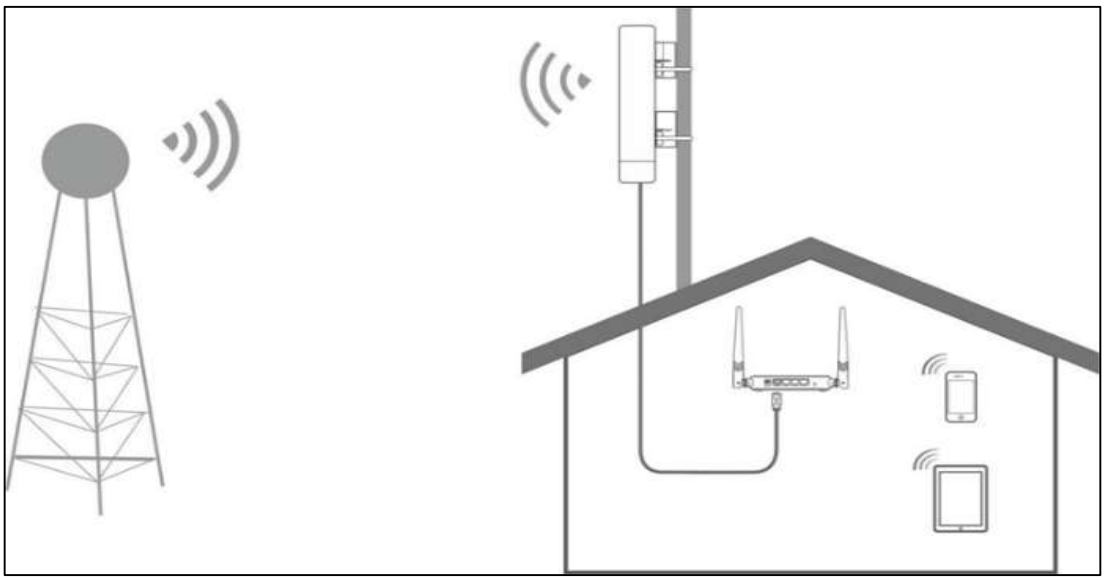
16. **Install the CPE**

(a) Place the device at an elevated position in the open air.

(b) Uncover the housings of the device, and connect the **PoE/LAN/WAN** port of the device to the WAN port of your wireless router. The **LAN/WAN** LED indicator lights up.

(c) Adjust the device's direction or location on the selected pole until the LED1, LED2 and LED3 of the device light up.

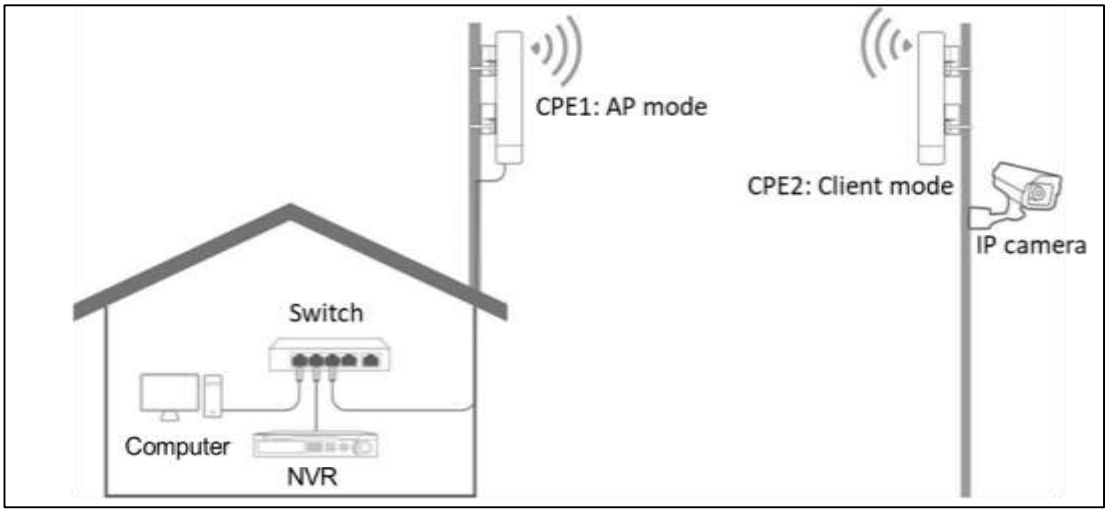
(d) Use the plastic straps to attach the device to the pole.



17. **Installation**

(a) The CPE (transmitter in AP mode) with LED1, LED2 and LED3 solid on should be connected to the switch connecting to a network video recorder (NVR).

(b) The CPE (receiver in Client mode) with LED1, LED2 and LED3 blinking should be connected to the switch connecting to a monitoring equipment.



18. **CPEs Installation**

LED Indicator	Status	Description
		There is device connected to the CPE
LED1, LED2, LED3 (Received signal strength LED indicators)	Solid on/Blinking	● Solid on: The CPE may work in AP, Repeater, P2MP or Router mode ● Blinking: The CPE may work in Client, Universal Repeater or WISP mode Each LED indicator corresponds to a received signal strength value. When the received signal strength of the CPE reaches the RSSI threshold, the corresponding LED indicator lights up. You can judge the connection quality based on the statuses of the LED indicators
		By default, the minimum signal strength of LED1, LED2 and LED3 are -90 dBm, -80 dBm and -70 dBm. You can change them on the Wireless > Advanced page of the web UI of the CPE
	OFF	No device is connected to the CPE, or the received signal strength is less than the RSSI threshold (default: -90 dBm)

19. **Login CPEs** When you log in to the web UI at the first time or after the CPE is reset to factory settings, follow the steps below:-

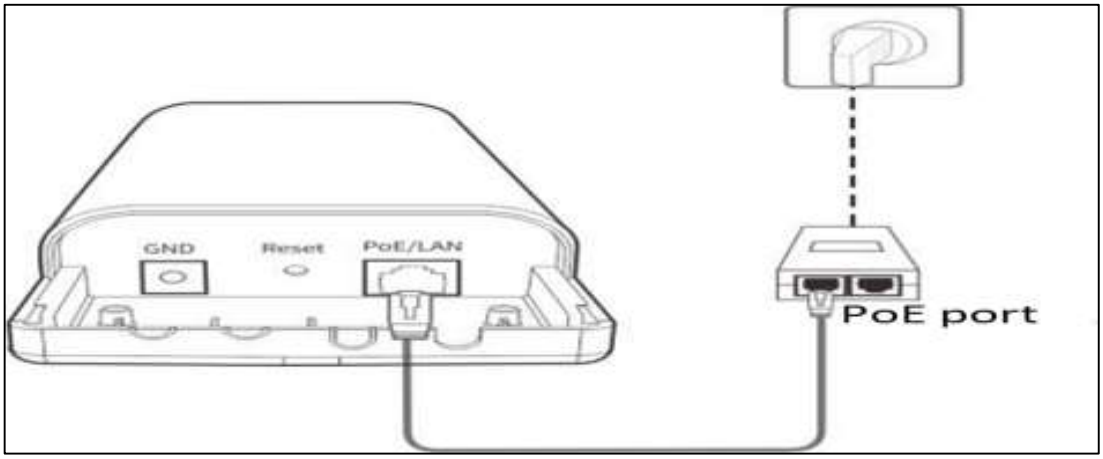
(a) Connect the computer to the device.

(b) Uncover the housing of the device.

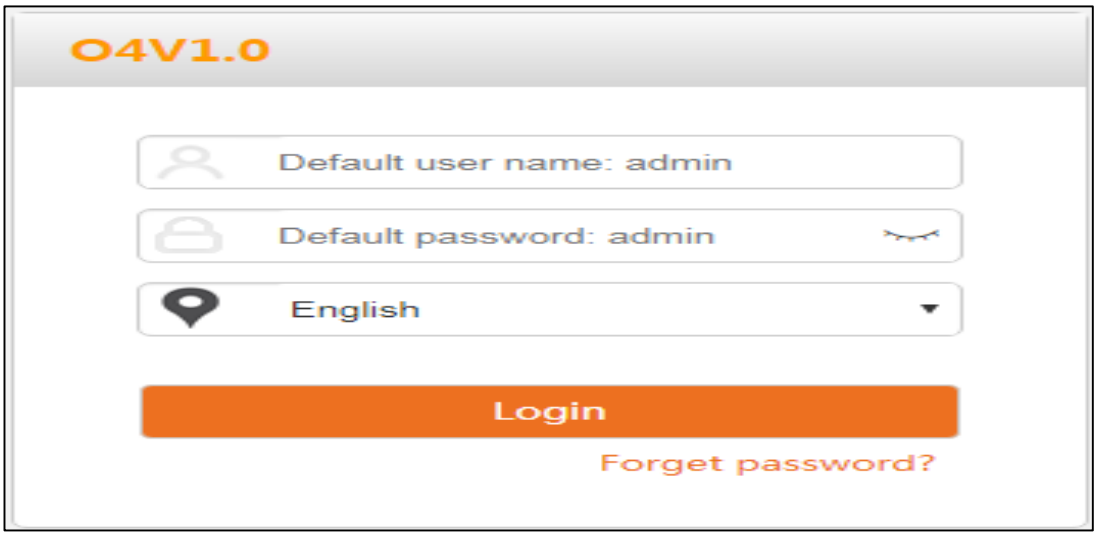
(c) Use an Ethernet cable to connect the **PoE/LAN** port of the CPE to the **PoE** port of the included PoE adapter.

(d) Use the included power adapter to connect the PoE adapter to a power source. The **LAN/WAN** LED indicator of the device lights up.

(e) Use an Ethernet cable to connect your computer to the **LAN** port of the PoE adapter.



(f) Start a web browser on your computer, and visit **192.168.2.1**. Enter your user name and password (default: **admin**), and click **Login.**

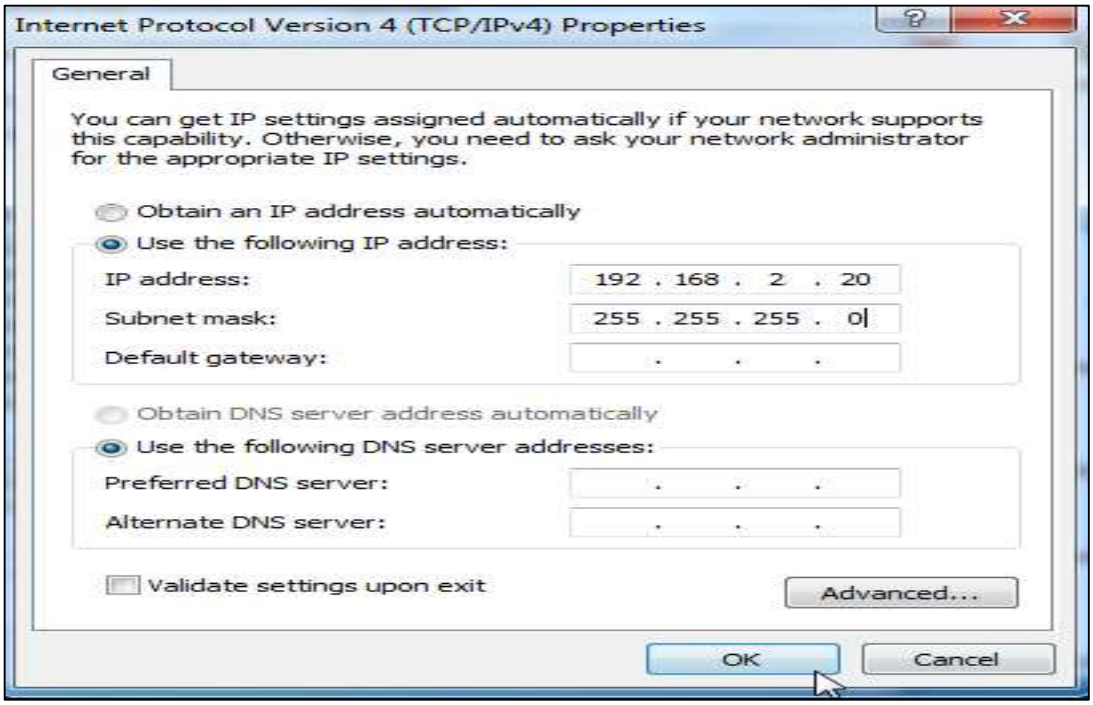


20. **Log In CPEs** Log in to the web UI after the CPE is set to AP mode, Client mode, Universal Repeater mode, Repeater mode or P2MP mode, follow the steps below:-

(a) Connect the computer to the CPE or the switch connected to the CPE.

(b) Set the IP address of the computer to an unused one belonging to the same network segment of the IP address of the CPE.

(c) For example, if the IP address of the CPE is 192.168.2.1, you can set the IP address of the computer to 192.168.2.*X* (*X* is an unused digit ranging from 2 to 254) and subnet mask to 255.255.255.0.



(d) Connect the computer to the CPE or the switch connected to the CPE.

(e) Check the gateway IP address of the computer, and we assume that it is 192.168.0.1 in this example.

(f) Start a web browser on your computer, and visit **192.168.0.1**. Enter the login user name and password, and click **Login.**

21. **Future Trends and Technologies**

(a) 5G and Beyond: Next-generation cellular networks offering higher data rates, lower latency, and increased capacity for massive IoT deployment.

(b) Wi-Fi 6 (802.11ax): Latest standard for Wi-Fi networks, providing improved performance, efficiency, and support for IoT devices.

(c) Mesh Networking: Decentralized network architecture enabling self-configuring and self-healing wireless networks for extended coverage and reliability.

(d) Edge Computing: Moving data processing closer to the source (e.g. IoT devices) to reduce latency and bandwidth usage in wireless communication.

AIM

TO ACQUAINT THE CLASS ABOUT DIGITAL MAPPING

1. **Introduction** Digital mapping (also called digital cartography) is the process by which a collection of data is compiled and formatted into a virtual image. The primary function of this technology is to produce maps that give accurate representations of a particular area, detailing major road arteries and other points of interest.

2. **What is Digital Mapping?**

(a) Digital mapping involves the creation, manipulation, and visualization of geographic data using digital technology.

(b) It provides a digital representation of spatial information, including maps, satellite imagery, and geographic data layers.

3. **Evolution of Digital Mapping**

(a) Early digital mapping: Basic digitization of paper maps.

(b) GIS (Geographic Information Systems): Emergence of computer-based systems for storing, analyzing, and visualizing spatial data.

(c) Web mapping: Development of online platforms for interactive mapping and spatial analysis.

(d) Mobile mapping: Integration of GPS technology with smartphones for navigation and location-based services.

(e) Augmented reality (AR) mapping: Overlaying digital information onto the real world through devices like smartphones and smart glasses.

4. **Components of Digital Mapping**

(a) Geographic data: Information about the Earth's surface, such as terrain, land use, and infrastructure.

(b) Software: Tools for creating, editing, analyzing, and visualizing geographic data (e.g., GIS software, mapping APIs).

(c) Hardware: Devices for data collection (e.g., GPS receivers, drones, satellites).

(d) Connectivity: Internet and communication technologies enabling access to and sharing of spatial data.

5. **Applications of Digital Mapping**

(a) Navigation and routing: GPS-enabled maps for vehicle navigation, pedestrian guidance, and route optimization.

(b) Urban planning and development: Analyzing land use, infrastructure, and demographic data to plan and manage cities.

(c) Environmental management: Monitoring and modeling natural resources, ecosystems, and climate change.

(d) Emergency response: Using real-time mapping to coordinate disaster response and assess affected areas.

(e) Business intelligence: Location-based marketing, site selection, and logistics optimization for businesses.

6. **Benefits of digital maps**

(a) The database can be constantly updated and corrected
(b) The data can be classified by the user according to their own needs
(c) Graphics symbols can be chosen to suit the job in hand
(d) The map is dynamic and under the control of user
(e) Easy to use
(f) strengthens technology skills
(g) Provides a real world look
(h) Allows visual exploration around the world
(j) Great learning about the history and geography

7. **Web mapping platforms.**

(a) **Google Maps Platform:**
(i) Offers a wide range of APIs and SDKs for embedding interactive maps into websites and applications.
(ii) Features include geocoding, routing, and place search.
(iii) Suitable for businesses of all sizes, from startups to large enterprises.
(iv) Pricing is based on usage, with free usage quotas available.

(b) **Map box**
(i) Provides customizable mapping tools and APIs for developers.
(ii) Offers a variety of map styles and customization options.
(iii) Supports real-time data visualization and geospatial analysis.
(iv) Ideal for developers and businesses looking for flexibility and customization.
(v) Pricing is based on usage, with free tiers available for smaller projects.

(c) **Esri ArcGIS Online**
(i) Offers cloud-based mapping and GIS capabilities for organizations and individuals.
(ii) Provides tools for creating, sharing, and analyzing maps and spatial data.
(iii) Supports collaboration and integration with other Esri products and third-party applications.

(iv) Suitable for industries such as government, natural resources, and utilities.
(v) Pricing is subscription-based, with different plans available based on usage and features.

(d) **Leaflet**
(i) An open-source JavaScript library for creating interactive maps.
(ii) Lightweight and customizable, with a strong community and extensive plugin ecosystem.
(iii) Suitable for developers looking for a simple and flexible mapping solution.
(iv) Free to use and can be integrated with various mapping data sources.

(e) **Carto**
(i) Offers a cloud-based platform for analyzing and visualizing spatial data.
(ii) Provides tools for creating interactive maps, dashboards, and data-driven applications.
(iii) Supports data import/export, geospatial analysis, and SQL-based queries.
(iv) Suitable for businesses and organizations in industries such as retail, transportation, and urban planning.
(v) Pricing is subscription-based, with different plans available based on features and usage.

(f) **Open Street Map (OSM)**

(i) An open-source mapping platform created and maintained by a community of contributors.
(ii) Provides freely accessible map data that can be used for various purposes.
(iii) Supports customization and integration with third-party tools and services.
(iv) Suitable for developers, researchers, and organizations looking for open and collaborative mapping solutions.
(v) Free to use, with contributions encouraged.

8. **Mobile Mapping Applications:**

(a) Examples: Google Earth, Google Maps, Deesha App, ArcGIS, Maplt, Locus and Waze

(b) Mobile mapping applications enable data collection, GPS tracking, and field surveys using smartphones and tablets. They're commonly used in asset management, fieldwork, and infrastructure inspection.

9. **Difference between Paper Map and Digital Map**

Activities	Digital Mapping	Paper Mapping

Preparation	Initial version tedious to prepare but quick and efficient to monitor	Start from scratch every time
Storage	Digital Database standardized and integrated, compact memory capacity	Different scales on different standards, voluminous and bulky
Retrieval	Quick retrieval	Paper maps and tables
Updating	Automatic search and replace by computer	Manual check and revision
Overlay	Systematically done faster integration of complex, multiple spatial and non-spatial data sets	Expensive and time consuming
Spatial Analysis	Faster	Time and energy consuming and slow
Display	Easier and faster to prepare better quality	Slow, tedious and time consuming

GOOGLE EARTH

10. **Google Earth** Google Earth is a computer program, formerly known as Keyhole Earth Viewer, that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles. Users can explore the globe by entering addresses and coordinates, or by using a keyboard or mouse. The program can also be downloaded on a smartphone or tablet, using a touch screen or stylus to navigate. Recently Google has revealed that Google Earth now covers more than 98 percent of the world, and has captured 10 million miles of Street View imagery, a distance that could circle the globe more than 400 times.

11. In addition to Earth navigation, Google Earth provides a series of other tools through the desktop application, including a measure distance tool. Additional globes for the Moon and Mars are available, as well as a tool for viewing the night sky.

12. Google Earth has been viewed by some as a threat to privacy and national security, leading to the program being banned in multiple countries. Some countries have requested that certain areas be obscured in Google's satellite images, usually areas containing military facilities.

13. Google Earth has been released on mac OS, Linux, iOS, and Android. The Linux version began with the version 4 beta of Google Earth, as a native port using the Qt toolkit. The Free Software Foundation consider the development of a free compatible client for Google Earth to be a High Priority Free Software Project. Google Earth was released for Android on February 22, 2010, and on iOS on October 27, 2008. The mobile versions of Google Earth can make use of multi-touch interfaces to move on the globe, zoom or rotate the view, and allow to select the current location.

GOOGLE EARTH VERSIONS

(a) Google Earth Pro

(b) Google Earth Plus

(c) Google Earth Enterprise

(d) Google Earth Studio

(e) Google Earth 9

(f) Google Earth Plug-in

(g) Google Earth VR

Google Earth running on Android

14. Google Earth Pro was originally the business-oriented upgrade to Google Earth, with features such as a movie maker and data importer. Up until late January 2015, it was available for $399/year, though Google decided to make it free to the public. Google Earth Pro is currently the standard version of the Google Earth desktop application as of version 7.3. The Pro version includes add-on software for movie making, advanced printing, and precise measurements, and is currently available for Windows, Mac OS X 10.8 or later, and Linux.

15. **Google Earth Engine** is a cloud computing platform for processing satellite imagery and other geospatial and observation data. It provides access to a large database of satellite imagery and the computational power needed to analyze those images. Google Earth Engine allows observation of dynamic changes in agriculture, natural resources, and climate using geospatial data from the Landsat satellite program, which passes over the same places on the Earth every sixteen days.

16. **Why Google Earth**

(a) Free
(b) Easy to use
(c) Good for many subject
(d) Areas
(e) Strengthens technology skills
(f) Provides a real world look
(g) Allows visual exploration around the world
(h) Great learning about the history and geography

17. **Key features of Google Earth include:**

(a) **Satellite Imagery**: Users can view high-resolution satellite imagery of various locations around the world, including cities, landscapes, and landmarks.

(b) **3D Terrain**: Google Earth provides three-dimensional terrain views, allowing users to explore landscapes and geographical features in detail.

(c) **Street View**: Users can access Google's Street View imagery directly within Google Earth, enabling immersive virtual tours of streets, neighborhoods, and cultural sites.

(d) **Historical Imagery**: Google Earth offers historical imagery data, allowing users to view past satellite images of specific locations and observe changes over time.

(e) **Layers and Data Visualization**: Users can overlay additional geographic data layers such as borders, roads, parks, and points of interest. These layers provide context and additional information for exploration.

(f) **Tour Creation**: Google Earth allows users to create custom tours and presentations by recording and narrating their virtual explorations. This feature is particularly useful for educational and storytelling purposes.

(g) **Water and Ocean** Introduced in Google Earth 5.0 in 2009, the Google Ocean feature allows users to zoom below the surface of the ocean and view the 3D bathymetry. Supporting over 20 content layers, it contains information from leading scientists and oceanographers.

(h) **Google Sky** Google Sky is a feature that was introduced in Google Earth 4.2 on August 22, 2007, in a browser-based application on March 13, 2008, and to Android smartphones, with augmented reality features. Google Sky allows users to view stars and other celestial bodies

(j) **Google Mars** Google Mars is an application within Google Earth that is a version of the program for imagery of the planet Mars. Google also operates a browser-based version, although the maps are of a much higher resolution within Google Earth, and include 3D terrain, as well as infrared imagery and elevation data. There are also some extremely high-resolution images from the Mars Reconnaissance Orbiter's HiRISE camera that are of a similar resolution to those of the cities on Earth

(k) **Google Moon** Originally a browser application, Google Moon is a feature that allows exploration of the Moon. Google brought the feature to Google Earth for the 40th anniversary of the Apollo 11 mission on July 20, 2009

(l) **Flight Simulators** In Google Earth 4.2, a flight simulator was added to the application. It was originally a hidden feature when introduced in 2007, but starting with 4.3, it was given a labeled option in the menu. In addition to keyboard control, the simulator can be controlled with a mouse or joystick. The simulator also runs with animation, allowing objects such as planes to animate while on the simulator.

(m) **Liquid Galaxy** Liquid Galaxy is a cluster of computers running Google Earth creating an immersive experience. On September 30, 2010, Google made the configuration and schematics for their rigs public, placing code and setup guides on the Liquid Galaxy wiki.

Overall, Google Earth serves as a powerful tool for digital mapping, exploration, and visualization, offering users an immersive and interactive experience to learn about the world around them.

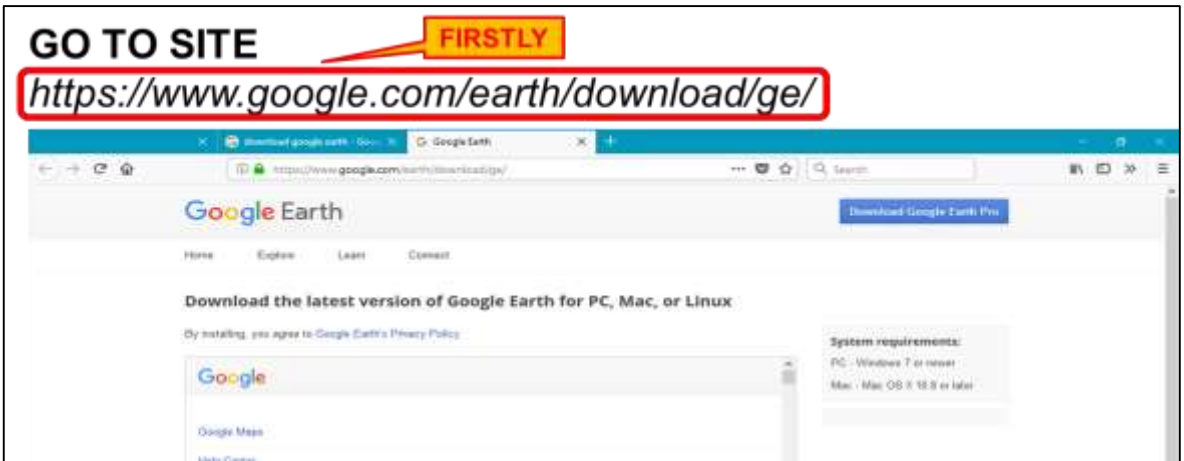
18. Version History of Google Earth

Version history & version		
Version	**Release date**	**Changes**
1.0	June 10, 2001	
1.4	January 2002	
1.6	February 2003	
1.7.2	October 2003	
2.2	August 2004	
3.0	June 2005	• The first version was released after Google acquired Keyhole, Inc.
4.0	June 2006	
4.1	May 2007	
4.2	August 2007	• Google Sky was introduced • A flight simulator was added
4.3	April 2008	• First release to implement KML version 2.2 • Google Street View was added
5.0	May 2009	• Google Ocean was introduced • Historical Imagery was introduced
5.1	November 2009	
5.2	July 2010	• Last version to support Mac OS X 10.4 Tiger (PPC & Intel) and 10.5 Leopard (PPC)
6.0	March 2011	• 3D Trees were added
6.1	October 2011	

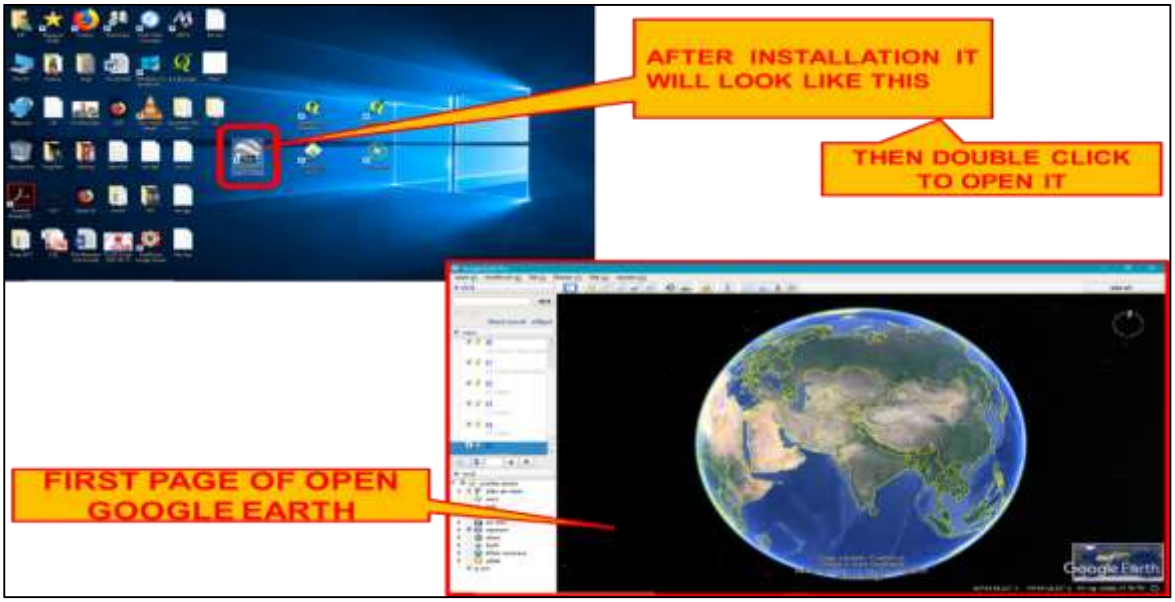
29. **Version of Google Earth**

(a) Google Earth Pro
(b) Google Earth Plus
(c) Google Earth Enterprise
(d) Google Earth Studio
(e) Google Earth 9
(f) Google Earth Plug-in
(g) Google Earth VR

20. **Download Google Earth**



21. **Open Google Earth**



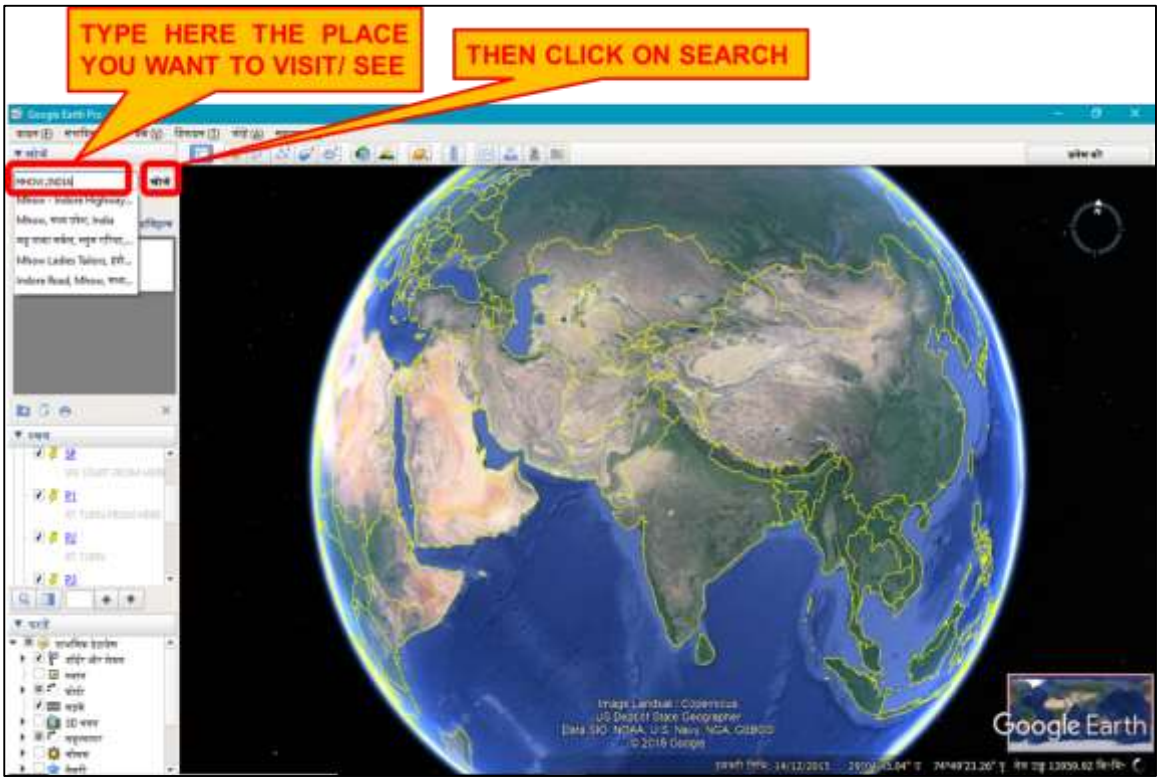
22. **Interface of Google Earth**.

23. **Navigation Tips**

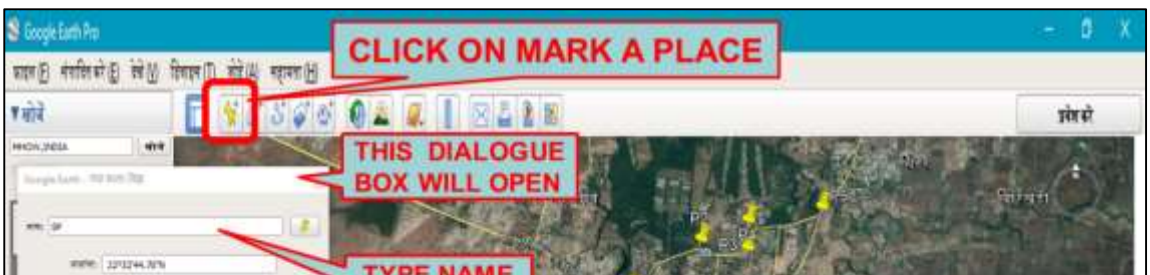
Command	Keystroke(s)	Result
Linear movement	Left, right, up, or down arrow	Moves the viewer in the direction of the arrow.
Look	Ctrl + left mouse button + drag	View changes to mimic head movement.
Reset tilt and compass view	R	'R'esets tilt and rotation to default positions.
Return to "North-up" view	N	Rotates view back to 'N'orth-up.
Return to "Top-down" view	U	Resets tilt to "top-down" or 'U'p mode.
Rotate (perimeter)	Shift + left, right, up, or down arrow	Rotates the view around the map's perimeter.
Rotate (on-the-spot)	Ctrl + left, right, up, or down arrow	Rotates the view from the current position.
Show/hide Overview	Ctrl + M	Displays or closes overview window.
Stop current motion	Spacebar	Stops movement when viewer is in motion.
Tilt	Shift + up or down arrow	Tilts the viewer to/from "horizon" or "top-down"

24. **Historical Imaginary** Google Earth offers historical imagery data, allowing users to view past satellite images of specific locations and observe changes over time.

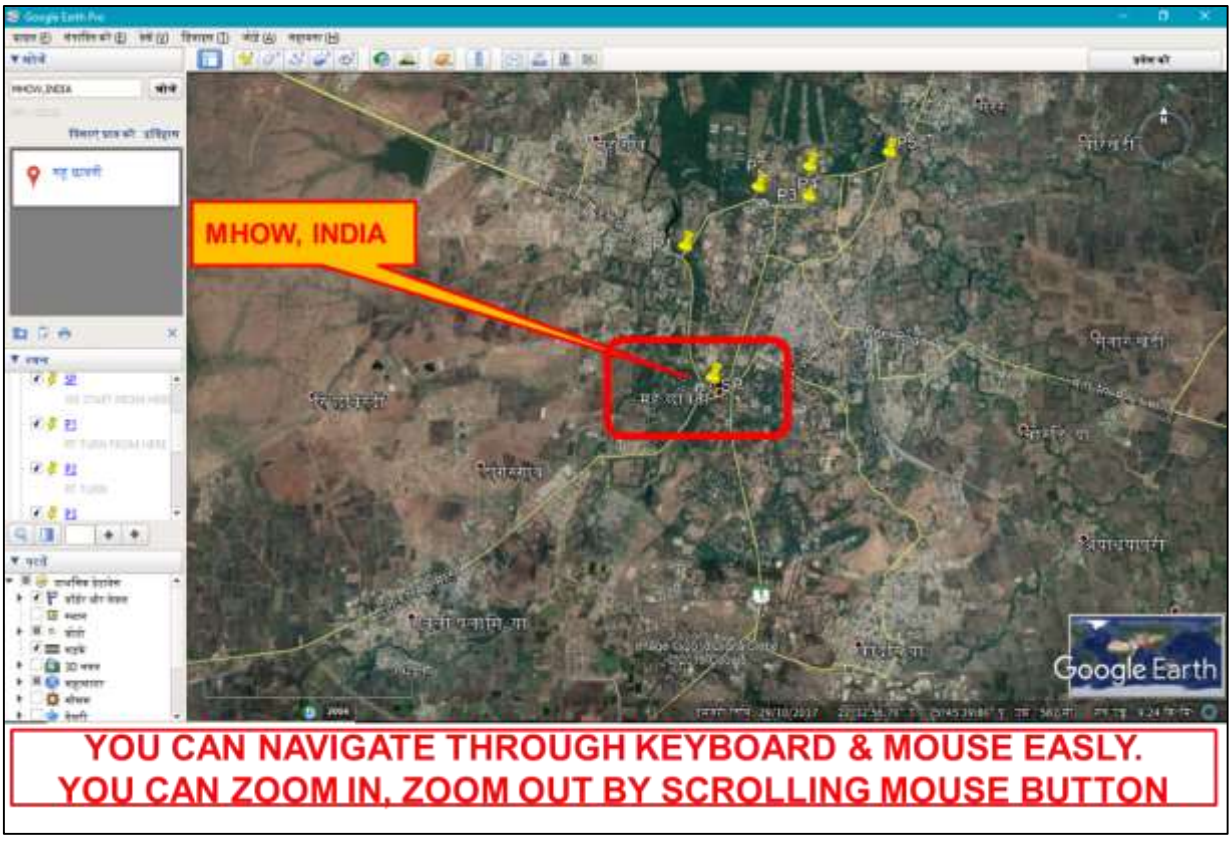
25. **Searching places on Google Earth**



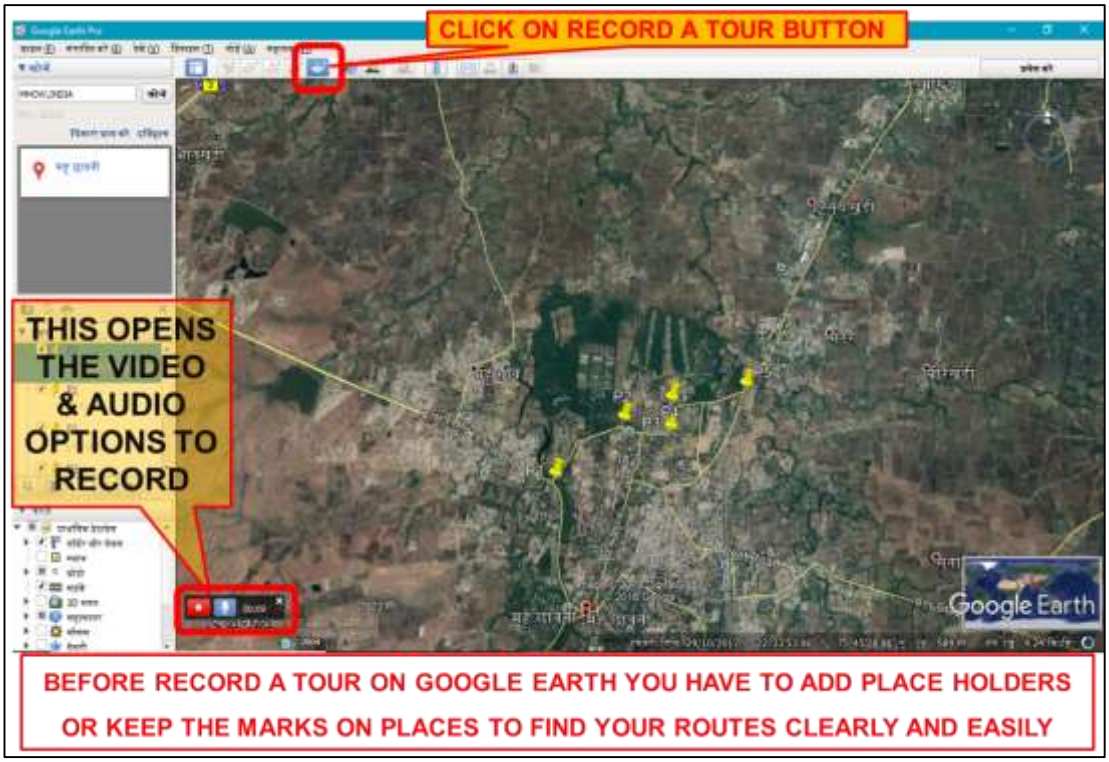
26. **Mark a place on Google Earth**



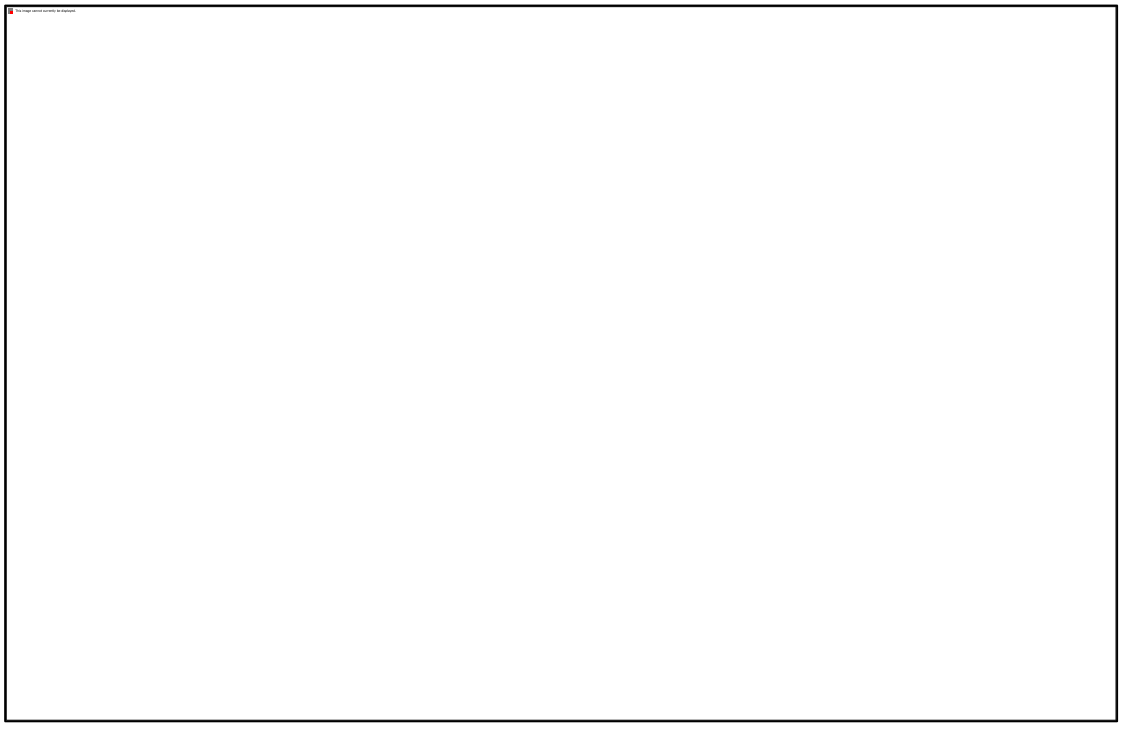
27. **It takes you are here**



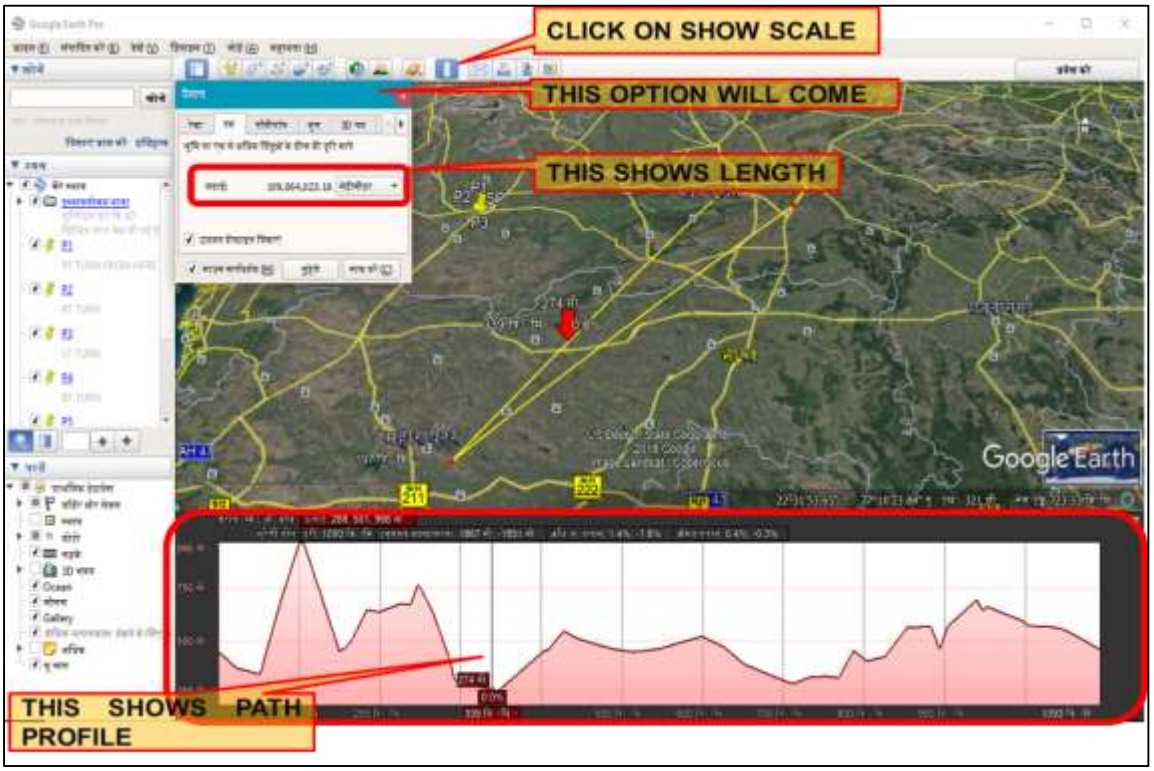
28. **Record a tour on Google Earth** Google Earth allows users to create custom tours and presentations by recording and narrating their virtual explorations. This feature is particularly useful for educational and storytelling purposes.



29. **Saving a recorded tour**



30. **Scaling and path profile on Google Earth**



31. **Create a view shed**

(a) **Launch Google Earth Pro**: Open the Google Earth Pro application on your computer.

(b) **Locate Your Area of Interest**: Use the search bar or navigate manually to the area where you want to analyze the viewshed.

(c) **Enable "3D Buildings"**: Go to the "Layers" panel on the left sidebar. Check the box next to "3D Buildings." This will display the 3D buildings in your area of interest, which will be essential for your analysis.

(d) **Add a Placemark**: Click on the "Add" menu at the top, then select "Placemark." Place the placemark at the location from which you want to analyze the viewshed.

(e) **Adjust the Eye Level**: Right-click on the placed placemark, then select "Properties." In the dialog box that appears, adjust the "Clamped to Ground" checkbox and the "Altitude" slider to set your eye level. This represents the height of the observer's eyes above the ground.

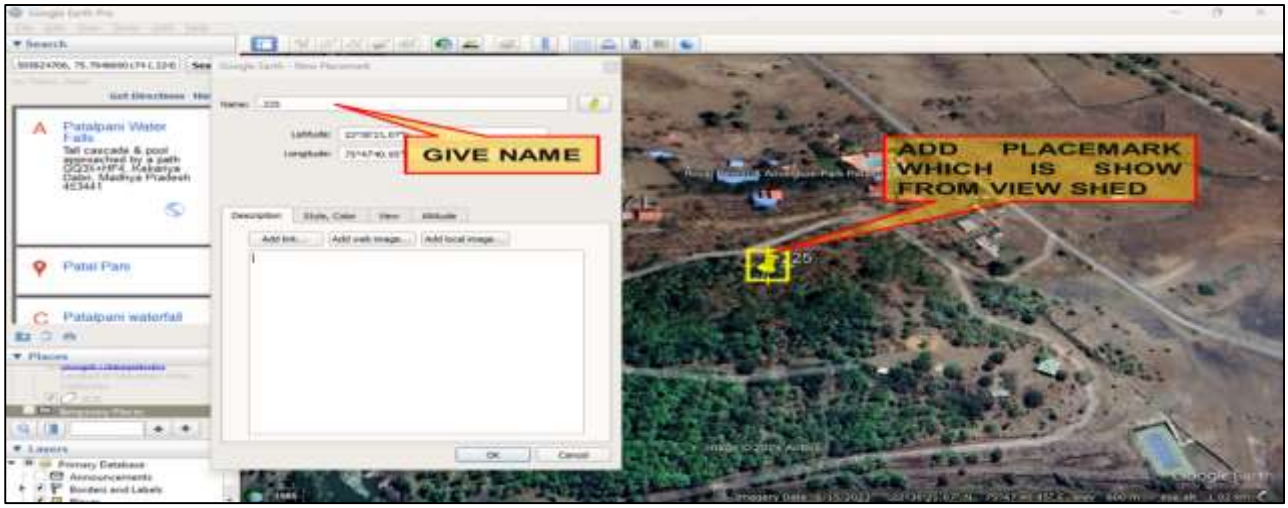
(f) **Set the View Angle**: While the placemark properties dialog is open, you can also set the "Tilt" and "Heading" to adjust the view angle. This will determine the direction in which the viewshed is analyzed.

(g) **Analyze the View**: You will need to manually rotate the view to cover the entire area you want to analyze. You can do this by clicking and dragging the view or by using the navigation controls in the top right corner. As you rotate the view, take note of areas that become obstructed from view by buildings or terrain.

(h) **Repeat for Different Perspectives**: Depending on your needs, you may want to place multiple placemarks at different locations and repeat the process to analyze the viewshed from various vantage points.

(j) **Document and Analyze**: As you move around and observe the viewshed, you can document your findings by taking screenshots or notes. This will help you analyze the visibility of certain areas from different perspectives.

While this method provides a basic visualization of the viewshed, for more detailed and accurate analysis, especially over larger areas or with more complex terrain, you'll need to use dedicated GIS software that supports viewshed analysis.



Intro to Deesh App

An innovative mobile application crafted by Deep Pradhan to revolutionize how you navigate and experience the world around you. Deesha is more than just a navigation tool; it's your personalized guide to seamless exploration and discovery.

32. **Major Features**

a) Displays location in Indian Grid System and other major formats.
b) Location formats supported by Deesha are:
c) Geodetic format/Longitude and Latitude (in either Decimal Degrees, Degree Decimal Minutes or Degree Minutes Decimal Seconds).
d) GEOREF (World Geographic Reference System), with configurable decimals for minutes.
e) Indian Grid System (with support for all Zones and Grid Letters).

33. **Tools of Deesha App**

(a) **Area**: This option allows you to calculate the area and perimeter as defined by given points. Calculated area as enclosed by the defined points. Perimeter of the area enclosed by the defined points. Total number of defined points. List of the locations of defined points. From the 'Options Menu' you can select the following:-

(i) Add point - add existing waypoint or specified location as point.

(ii) Add Current - to add current location as point.

(iii) Edit - edit selected point.

(iv) Move up - move selected point up in the order.

(v) Move down - move selected point down in the order.

(vi) Remove - remove selected point.

(vii) Remove all - remove all points.

(viii) Options Area Unit - specify the unit to be used to display area. Options are:

(aa) Square Kilometres (Km^2)/Metres (m^2).

(ab) Square Nautical Miles (NM^2)/Feet (ft^2).

(ac) Square Statute Miles (Mi^2)/Feet (ft^2).

(ad) Acre (Ac).

(ae) Hectare (Ha).

(b) **Conversion**: This option allows you to carry out conversion between various supported location formats.

(i) Conversion screen has following options:

(ii) Specify location format to convert from.

(iii) Specify input location.

(iv) 'Swap Button' - Swap the convert from and convert to location formats.

(v) Specify location format to convert input location to.

(vi) Converted location is accordingly displayed. You can also Share/Copy converted locations.

(c) **GeoTag Photo** Allows you to capture a photograph and save location related information. The device default camera app is started to capture the photograph. Information can be saved by following means:

Deesha Android app GeoTag photo tool

Add location to the filename - adds the location to the filename. A unique filename is generated as per the date and time. Add Exif tags to the image - adds the location (longitude, latitude, altitude, data and time) as Exif (Exchangeable image file format) tags to the photograph. Additional text file - creates an additional text file with following data:

(i) Photograph filename.

(ii) Location.

(iii) Altitude.

(iv) Estimated error in position.

(v) Satellites in use/view.

(vi) Data/Time with Time Zone offset.

(vii) Additional notes (optional).

(viii) Google Maps link.

Note:

You can enable 'Correct time as per satellites' to correct the date/time of the photograph as per data from satellites.

Photographs are saved in 'photos' folder under 'Deesha' folder on your device storage.

GeoTagged photographs can be used for navigation.

Deesha will also register to open JPEG files to read any Exif location tags and provide options similar to shared locations.

(d) **Projection** From a specified location, this option allows you to:-

Deesha Android app Projection tool Calculate a projected location from a specified location based on Bearing (in Degrees) of the projection from specified location. You can also get the projection Bearing from the device compass with the 'Bearing from Compass' button (with an icon of compass). To do this, with the device flat align the top of the device towards the location to project to and press the 'Bearing from Compass' button.

Note: Most device compasses are inherently not very accurate. Distance of projection from specified location.

(e) **Sun/Moon Information** This option displays various information regarding the Sun and Moon. Various information of Sun and Moon is shown:-

(i) **Sun**.

(aa) Rise time.

(ab) Transition (noon) time.

(ac) Set time.

(ad) Azimuth angle.

(ae) Elevation angle.

(ii) **Moon**

(aa) Rise time.

(ab) Transition time.

(ac) Set time.

(ad) Azimuth angle.

(ae) Elevation angle.

(af) Phase.

(ag) Age (the approximate age in days since last New Moon).

(ah) Illumination percentage.

(aj) Graphical depiction of the Moon.

(ak) Share: The Sun/Moon Information can also be Shared.

34. **Deesha App main screen** Deesha starts with this screen by default. The main screen has two modes:-

(a) **Normal Mode** This is the default screen which opens when Deesha is started and while not navigating. You can use it to gain basic position information.

(i) Current position, in either of the selected primary or secondary format. The format can be toggled between the primary and secondary formats by clicking on the position field.

(b) **Navigation Mode**

While navigating additional information in addition to the Normal Mode is displayed on the Main Screen Name of current destination.

(i) Distance (in a straight line) to destination.

(ii) Bearing (in Degrees), i.e. the compass direction from current position to the destination.

(iii) Trip information, selectable out of any one of the following:

(iv) Average Speed (abbreviated as Avg Spd), based on the last 1,000 readings of speed.

(v) Estimated Time of Arrival (abbreviated as ETA), i.e. the time of day of your arrival at the destination, based on the present average speed.

(vi) Estimated Time Enroute (abbreviated as ETE), i.e. the time left to reach the destination, based on the present average speed.

35. **Map View** On the main screen you can toggle between displaying the Graphical Compass dial or the Map View by clicking the toggle button on the lower left corner. The Map View displays the device Waypoints with your position marked with a blue arrow in the centre by default.

(a) A configurable Grid Overlay is also show for grid coordinate location formats.

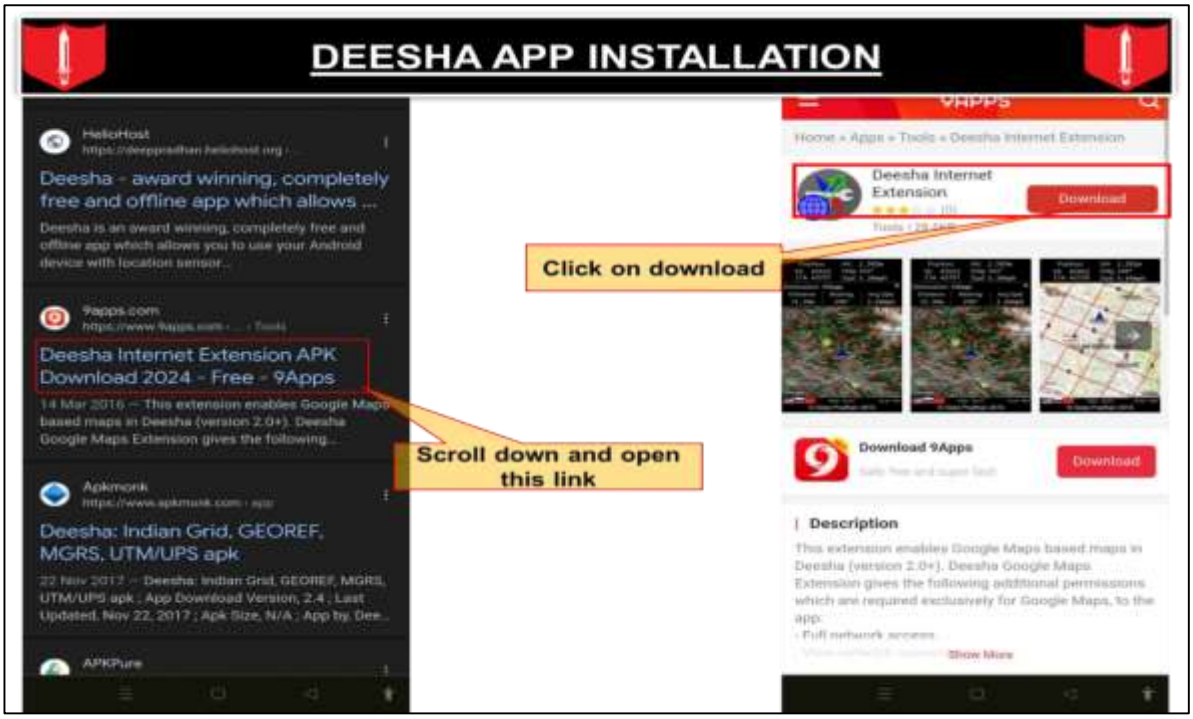
(b) Map images (PNG & JPEG format) can also be configured to be displayed.

(c) Optionally Google Map based maps (Normal/Street, Satellite, Terrain and Hybrid) can also be used.

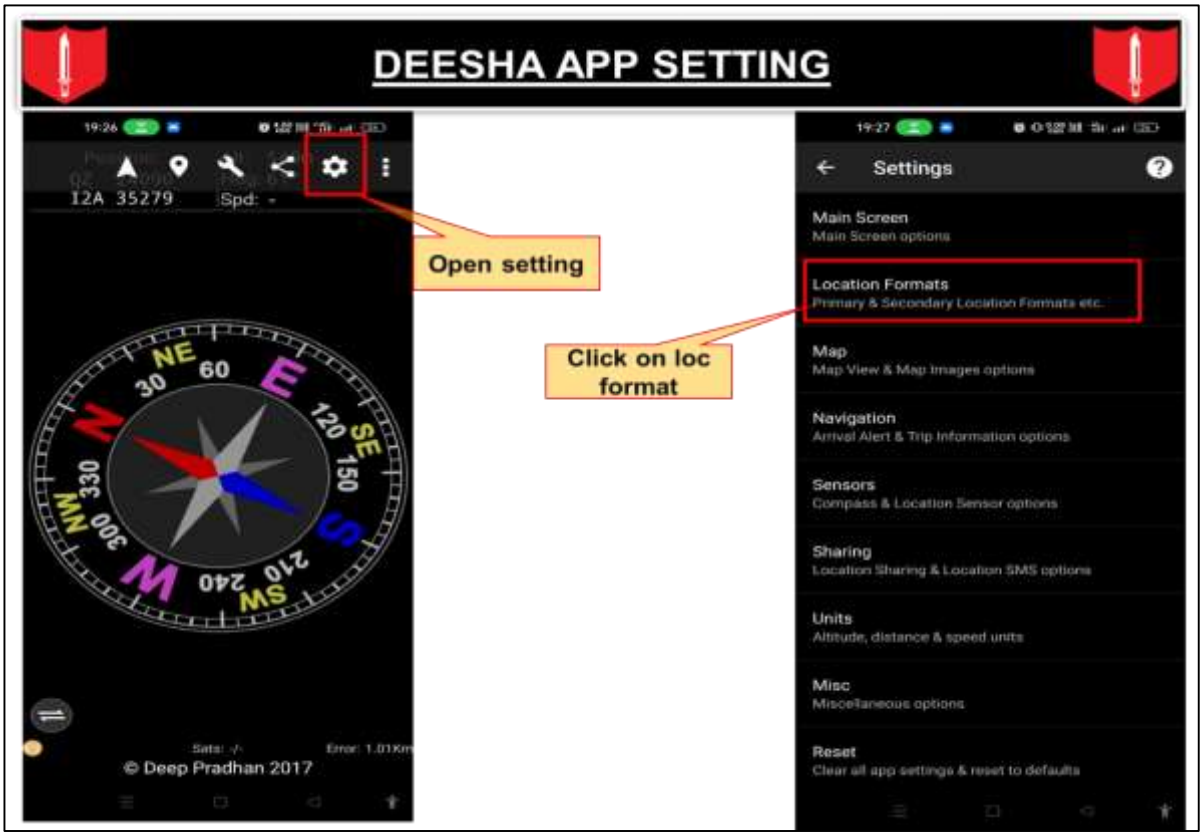
36. **Download and installation of Deesha app**.

(a) Go to google and search Deesha app, open first link which is shown in fig. click and download and install apk.

(b) To use Google Map based maps, you need to install 'Deesha Internet Extension'. For download internet extension scroll down on same page and choose Deesha app internet extension apk download and install.



37. **Deesha App setting**



AIM

TO ACQUAINT THE CLASS ABOUT DIGITAL MAPPING

INTRO TO QGIS, COMMON FUNCTIONS AND ITS APPLICATIONS

1. A geographic information system (GIS) can manipulate and analyze spatial datasets with the purpose of solving geographic problems. GIS analysts perform all kinds of operations on data to make it useful for solving a focused problem.

Geographical Information System (GIS) is a system for capturing, storing, analyzing and managing data and associated attributes, which are spatially referenced to the Earth. The geographical information system is also called as a geographic information system or geospatial information system.

2. As information becomes increasingly spatially aware, there is no shortage of tools able to fulfill some or all commonly used GIS functions. Why should anyone be using **QUANTUM GIS (QGIS** over some other GIS software package? Here are only some of the reasons:

3. QGIS (or Quantum GIS) is an open source geographic information system, meaning that it can be downloaded and installed on your desktop free of charge.
   It runs on Windows, Mac OS X, and Linux.
   There are also numerous plug-ins that extend the functionality of QGIS

   (a) It's free, as in launch. Installing and using the QGIS program costs you a grand total of zero money. No initial fee, no recurring fee, nothing.

   (b) It's free, as in liberty. If you need extra functionality in QGIS, you can do more than just hope it will be included in the next release. You can sponsor the development of a feature, or add it yourself if you are familiar with programming.

   (c) It's constantly developing. Because anyone can add new features and improve on existing ones, QGIS never stagnates. The development of a new tool can happen as quickly as you need it to.

   (d) Extensive help and documentation is available. If you're stuck with anything, you can turn to the extensive documentation, your fellow QGIS users, or even the developers.

   (e) Cross-platform. QGIS can be installed on Mac OS, Windows and Linux.

   (f) One of open source GIS software

   (g) Free and Open Source Software for Geospatial

(h) A user friendly GUI

(j) Multi-platform Win, Mac OS X, Linux

(k) Multi-language

(l) Rich functions for a function enhancement

3. History

Developer(s)	QGIS Development Team
Initial release	July 2002
Stable release	3.10.0 "A Coruña" (October 25, 2019)
Written in	C++, Python
Platform	Windows, Linux, Mac OS X, Android
Available in	Multilingual
Type	Geographic information system
License	GNU GPLv2
Website	qgis.org/en/site/

4. **Father of QGIS** Roger F. Tomlinson, (17 November 1933 – 07 February 2014), was an English Geographer . He first coined the term Geographic Information System (GIS). and considered the primary originator of modern computerised Geographic Information Systems. He has been acknowledged as the "father of GIS". He was chairman of the International Geographical Union GIS commission for 12 years.

5. Versions of QGIS

VERSION	CODENAME	LAUNCH DATE
2.12	Lyon	23 October 2015
2.14	Essen	29 February 2016
2.16	Nodebo	8 July 2016
2.18	Las Palmas	21 October 2016
3.0	Girona	23 February 2018
3.2	Bonn	22 June 2018
3.4	Madeira	26 October 2018
3.6	Noosa	22 February 2019
3.8	Zanzibar	21 June 2019
3.10	ACorouna	25 October 2019

3.12	[to be determined]	21 February 2020
3.14	[to be determined]	19 June 2020
3.16	Hannover	23 October 2020
3.18	Zurich	19 March 2021
3.20	Odense	2021-06-18
3.22 LTR	Białowieża	2021-10-22
3.24	Tisler	2022-02-18
3.26	Buenos Aires	2022-06-17
3.28	Firenze	2022-10-21
3.30	's-Hertogenbosch	03 Mar 2023
3.32	Lima	23 Jun 2023
3.34 LTR	Prizren	27 Oct 2023
3.36	Maidenhead	23 Feb 2024

6. What is GPS

(a) GPS stands for Global Positioning System. It is a radio navigation system used in land, sea, and air to determine the exact location, time and velocity irrespective of weather conditions. The US military first used it in the year 1960.

(b) Allows to find their exact Position anywhere in the world

(c) Aid in navigation

(d) GPS receiver uses the Signals from the Satellites to calculate its Latitude, Longitude and Elevation

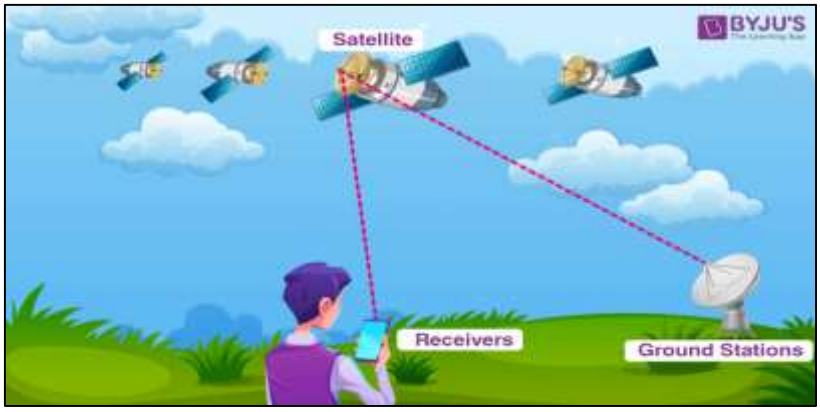
COMPONENTS OF A GPS SYSTEM

GPS is a system and it is made up of three parts: satellites, ground stations, and receivers.

(a) Satellites act like the stars in constellations, and we know where they are because they invariably send out signals.

(b) The ground stations make use of the radar to make sure the satellites are actually where we think they are.

(c) A receiver is a device that you might find in your phone or in your car and it constantly seeks for the signals from the satellites. The receiver figures out how far away they are from some of them. Once the receiver calculates its distance from four or more satellites, it knows exactly where you are.



HOW GPS WORKS?

(a) There are at least 4 GPS satellites in the line of sight of a receiver on the earth.

(b) The transmitter GPS sends information about the position and time to the receiver GPS at fixed intervals.

(c) The signals that are sent to the receiver devices are radio waves. By finding the difference in time between the signal sent from the GPS satellite to the time the GPS receives, the distance between the GPS receiver and the satellite can be calculated. Using the trilateration process, the receiver locates its position as the signals are obtained from at least three satellites.

(d) **For a GPS to calculate a 2-D position, which includes the latitude and longitude, a minimum of 3 satellites are required. For a 3-D position that provides latitude, longitude, and altitude, a minimum of 4 satellites are needed.**

What Is Trilateration?

Trilateration is defined as the process of determining the location based on the intersections of the spheres. The distance between the satellite and the receiver is calculated by considering a 3-D sphere such that the satellite is located at the centre of the sphere. Using the same method, the distance for all the 3 GPS satellites from the receiver is calculated.

Following are the parameters that are calculated after trilateration:

(a) Time of sunrise and the sunset
(b) Speed
(c) Distance between the GPS receiver to the destination

GPS systems are remarkably versatile and can be found in almost any industry sector. They can be used to map forests, help farmers harvest their fields and navigate aero planes on the ground or in the air.

7. Common Functions

(a) **Geocode** To create points on a map from street addresses in spreadsheet form.

(b) **Overlay** To superimpose two or more maps or layers in the same coordinate system, to show the relationships between them.

(c) **Geo-reference** To align geographic data (map, layer, etc.) with a given coordinate system, allowing for overlays.

(d) **Select by location (proximity analysis)** To select features according to their relationship in space to other features

(e) **Select by Attribute** To select features according to their properties (attributes), like querying a database

(g) **Network Analysis** To find the distance from a feature travelled along a network (such as roads, public transit) rather than as the crow flies

(h) **Join** To attach fields from one table to those of another through an attribute or field common to both tables.

(j) **Viewshed Analysis** To determine what areas are visible from a particular location.

8. Applications of QGIS

(a) GIS in Mapping
(b) Telecom and Network services
(c) Accident Analysis and Hot Spot Analysis
(d) Urban Planning
(e) Transportation Planning
(f) Environmental Impact Analysis
(g) Agricultural Applications
(h) Disaster Management and Mitigation
(j) Landslide Hazard Zonation
(k) Navigation (routing and scheduling)


gettyimages
Quick Route 1
3 routes
Route
Guide
10:27


IMAGE BANK

9. **Mil Application of QGIS**

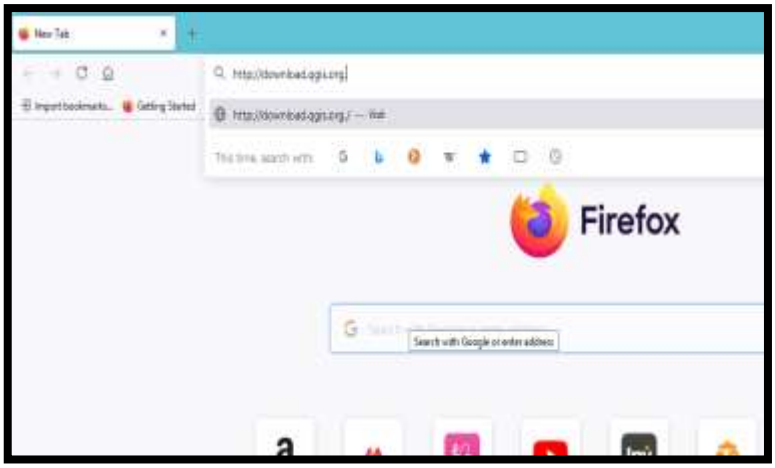
(a) Terrain simulation
(b) Ops planning
(c) Locating sites
(d) Op trg
(e) Disaster planning
(f) Maping and geospatial work
(g) To find the patrolling routes
(h) To find ambush sites
(j) Attacking Approach

INSTALLATION OF QGIS

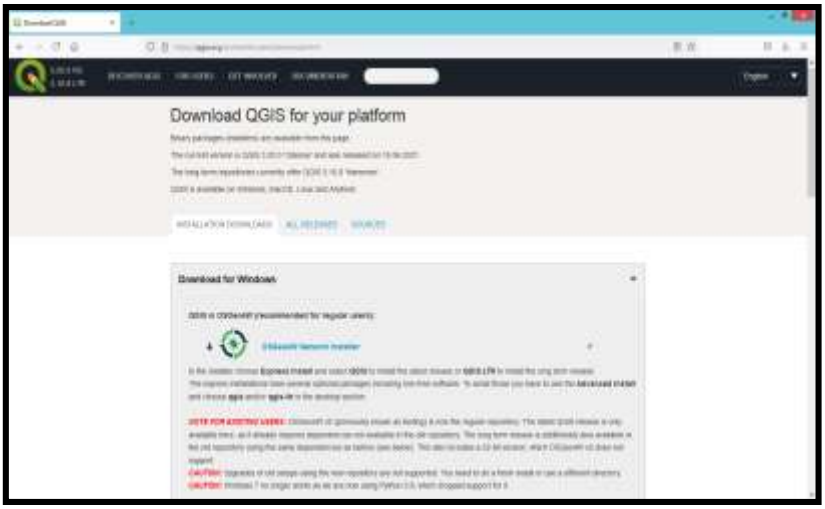
11. This chapter provides a quick overview of installing QGIS, downloading QGIS sample data, and running a first simple session visualizing raster and vector data.

12. Download the QGIS Installer (https://www.qgis.org/en/site/forusers/download.html)

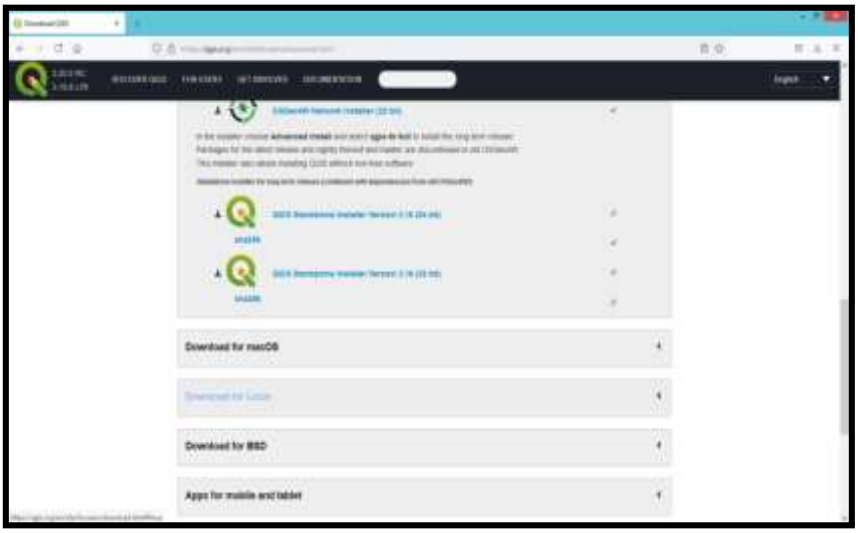
13. Get the latest information on packages at the qgis website at http://download.qgis.org.

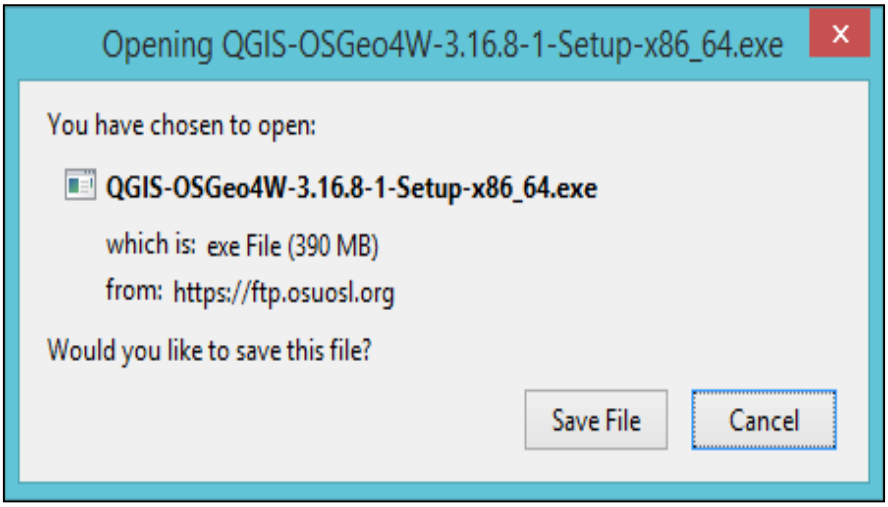


Search the URL in any Browser



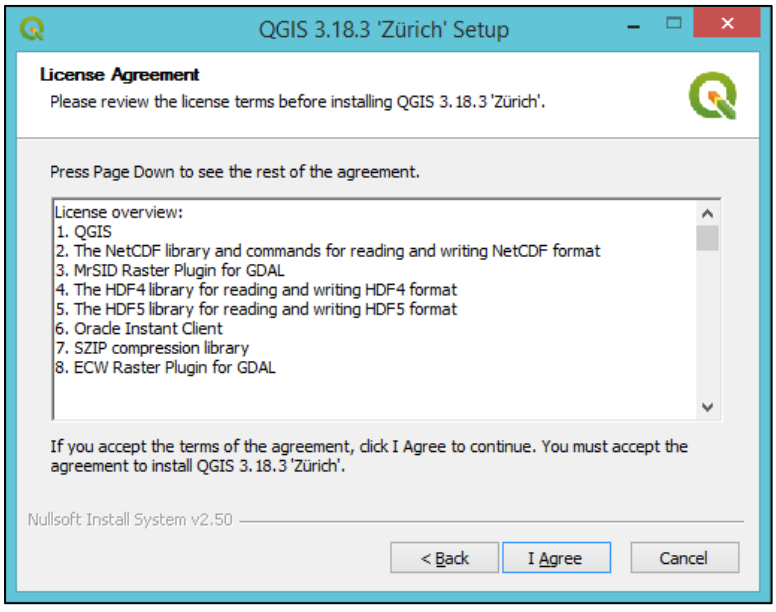
Download windows will open



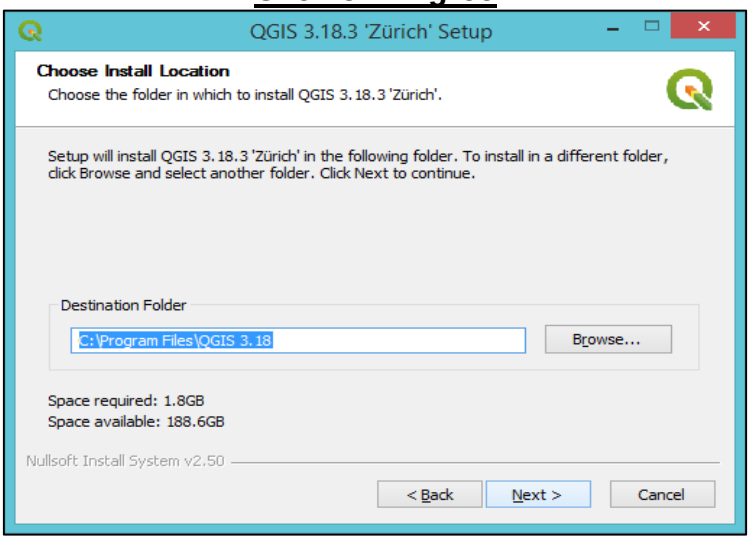


Run the Installer downloaded in PC

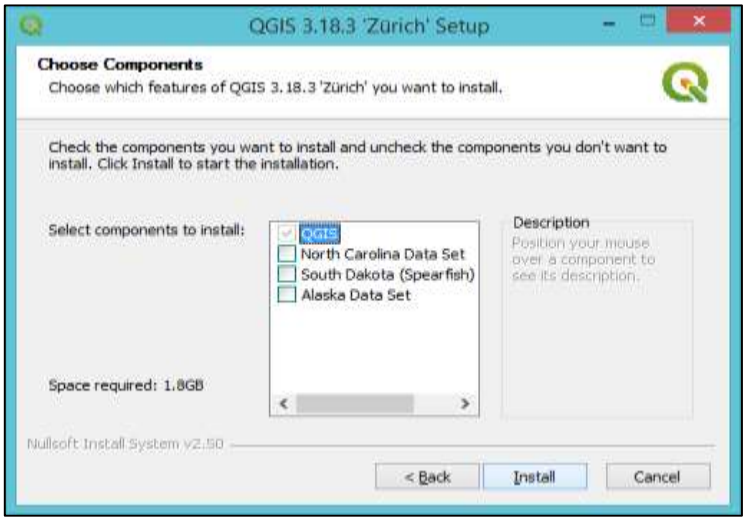
Click Next to run the pgme



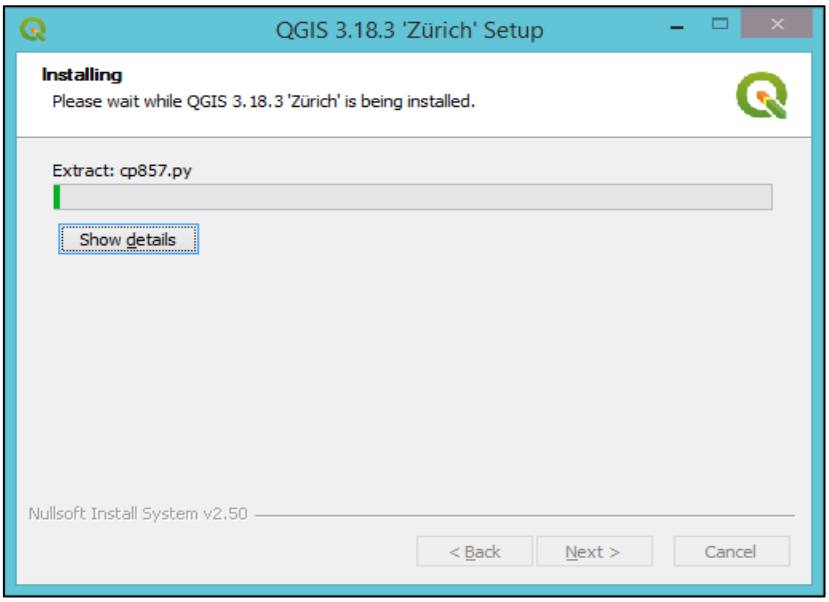
Click on I Agree



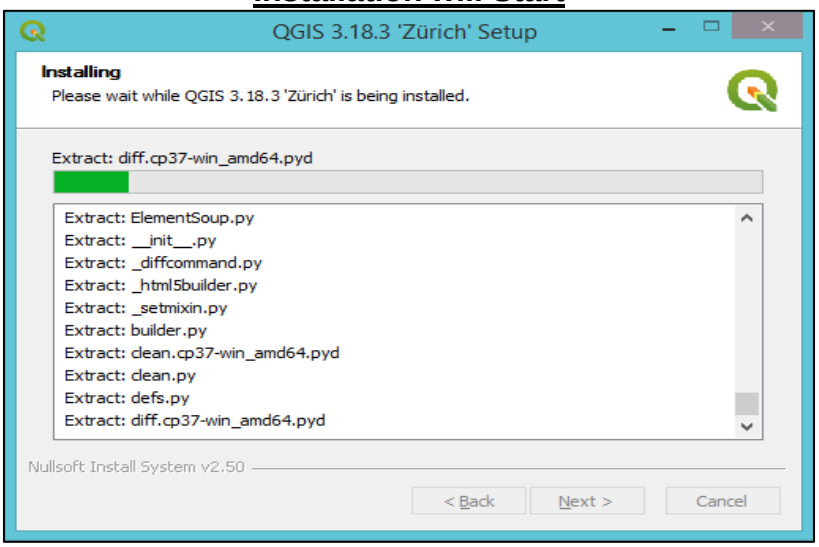
Click on Next



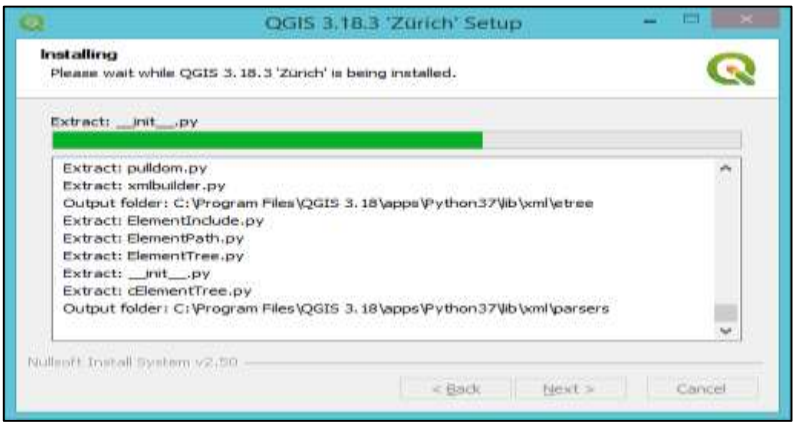
Click on Install



Installation will Start

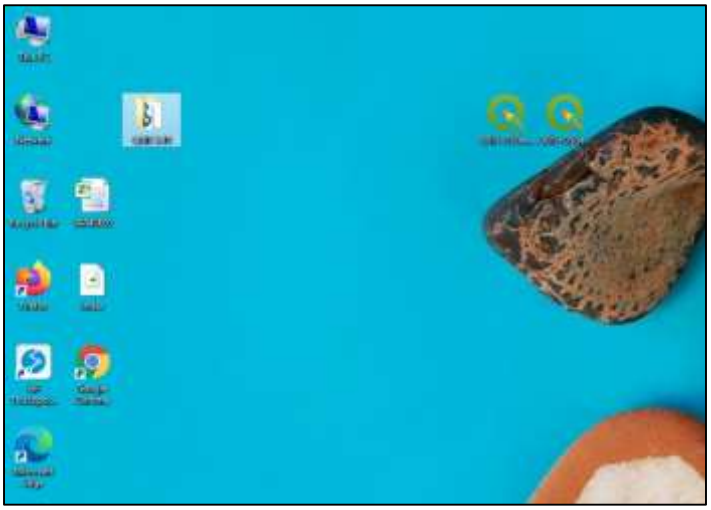


It Takes time to Install

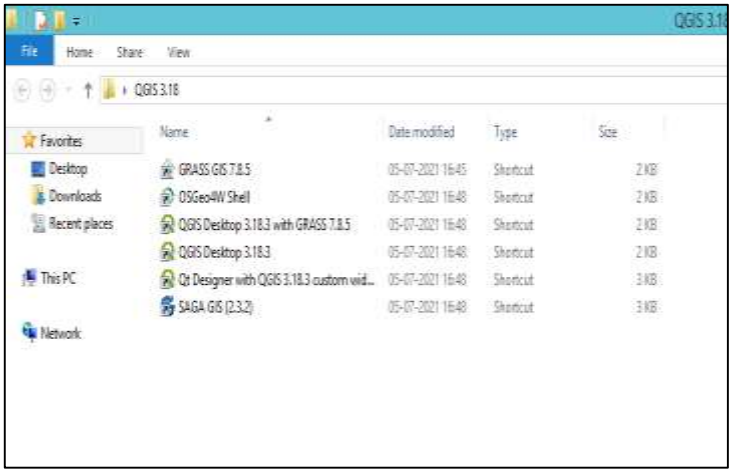


Installation in Prog

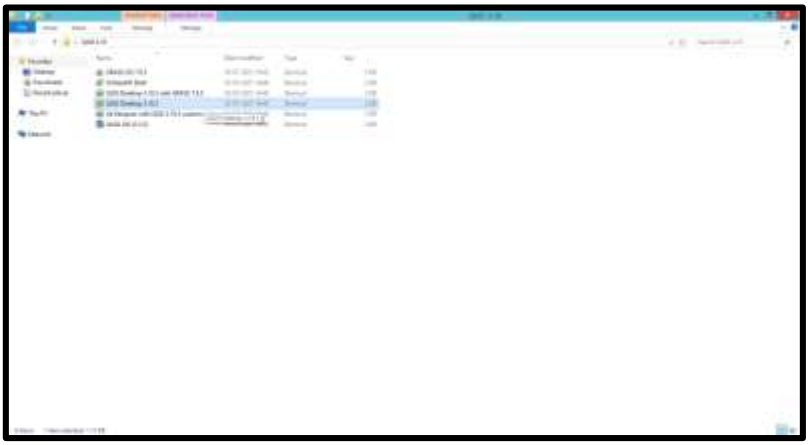
Click Finish



Folder with the name of QGIS 3.18 will appear



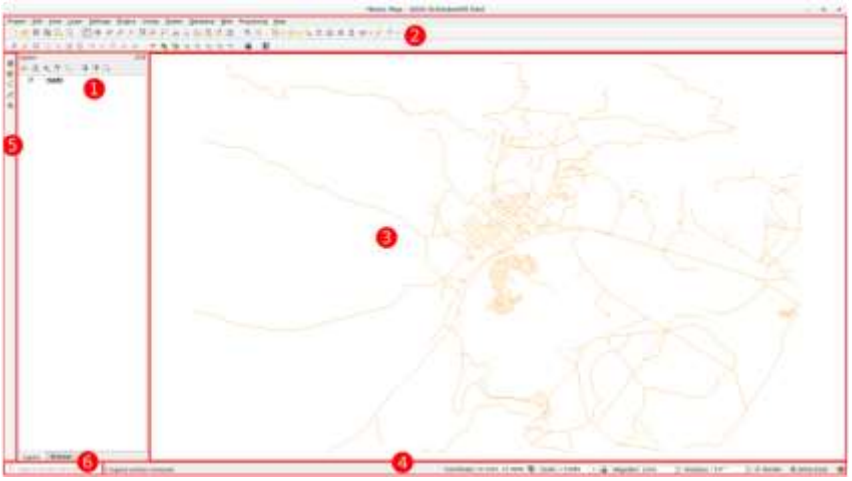
Six Menus will be there inside the folder



OVERVIEW AND NAVIGATION OF QGIS INTERFACE

14. The elements identified in the figure above are:

(a) Layers List / Browser Panel (1)
(b) Toolbars (2)
(c) Map Canvas (3)
(d) Status Bar (4)
(e) Side Toolbar (5)
(f) Locator Bar (6)



15. **Browser Panel** The QGIS Browser is a panel in QGIS that lets you easily navigate in your database. You can have access to common vector files (e.g. ESRI Shapefile or MapInfo files), databases (e.g. PostGIS, Oracle, SpatiaLite, Geo Package or MSSQL Spatial) and WMS/WFS connections. You can also view your GRASS data. If you have saved a project, the Browser Panel will also give you quick access to all the layers stored in the same path of the project file under in the Project Home item. Moreover, you can set one or more folder as Favorites: search under your path and once you have found the folder, right click on it and click on Add as a Favorite. You should then be able to see your folder in the Favorites item. It can happen that the folders added to Favorite item have a really long name: don't worry right-click on the path and choose Rename Favorite... to set another name.

16. **Toolbar** Your most often used sets of tools can be turned into toolbars for basic access. For example, the File toolbar allows you to save, load, print, and start a new project. You can easily customize the interface to see only the tools you use most often, adding or removing toolbars as necessary via the View Toolbars menu. Even if they are not visible in a toolbar, all of your tools will remain accessible via the menus. For example, if you remove the File toolbar (which contains the Save button), you can still save your map by clicking on the Project menu and then clicking on Save.

17. **Map Canvas** This is where the map itself is displayed and where layers are loaded. In the map canvas you can interact with the visible layers: zoom in/out, move the map, select features and many other operations that we will deeply see in the next sections.

18. **The Status Bar** Shows you information about the current map. Also allows you to adjust the map scale, the map rotation and see the mouse cursor's coordinates on the map.

19. **The Side Toolbar** By default the Side toolbar contains the buttons to load the layer and all the buttons to create a new layer. But remember that you can move all the toolbars wherever it is more comfortable for you.

20. **The Locator Bar** Within this bar you can access to almost all the objects of QGIS: layers, layer features, algorithms, spatial bookmarks, etc. Check all the different options in the Locator Setting section of the QGIS User Manual. With the shortcut Ctrl+K you can easily access the bar.

21. Try to identify the four elements listed above on your own screen, without referring to the diagram above. See if you can identify their names and functions. You will become more familiar with these elements as you use them in the coming days.

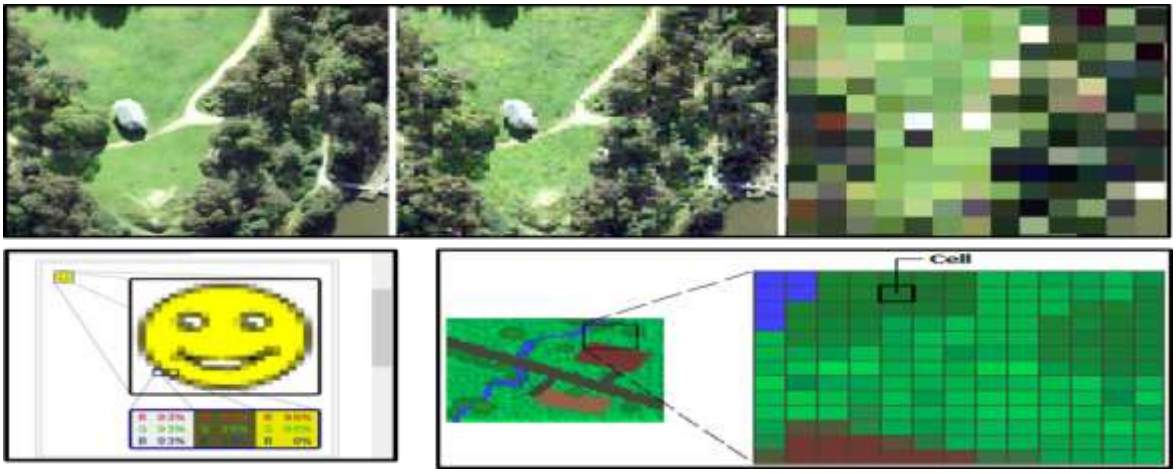
22. If any of these tools is not visible on the screen, try enabling some toolbars that are currently hidden. Also keep in mind that if there isn't enough space on the screen, a toolbar may be shortened by hiding some of its tools. You can see the hidden tools by clicking on the double right arrow button in any such collapsed toolbar. You can see a tooltip with the name of any tool by holding your mouse over the tool for a while.

TYPES OF DATA

23. **Types of Data in QGIS**

(a) **Spatial Data**. Spatial data, also known as geospatial data, is information about a physical object that can be represented by numerical values in a geographic coordinate system. It represents the location, size and shape of an object on planet Earth such as a building, lake, mountain or township.

(b) **Raster Data**. In its simplest form, a raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps. A raster image can take many forms, such as .bmp, .tif, .jpg etc



Raster Format

(i) **RPF** – Raster Product Format, military

(ii) **DRG** – Digital raster graphic

(iii) **ECRG** – Enhanced Compressed ARC Raster Graphics

(iv) **ECW** – Enhanced Compressed Wavelet

(v) **GeoTIFF** – TIFF variant enriched with GIS relevant metadata

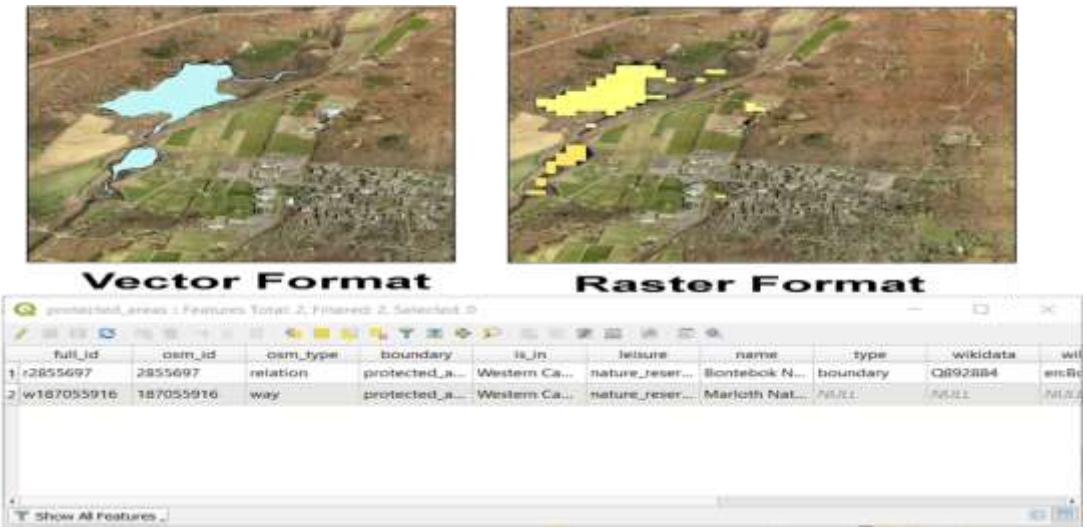
(vi) **IMG** – image file format used by ERDAS

(vii) **JPEG2000** – Open-source raster format

(viii) **MRR**- Multi-Resolution Raster

(ix) **MrSID** – Multi-Resolution Seamless Image Database

(c) **Vector Data**. Vector data provide a way to represent real world features within the GIS environment. A feature is anything you can see on the landscape. Imagine you are standing on the top of a hill. Looking down you can see houses, roads, trees, rivers, and so on. Each one of these things would be a feature when we represent them in a GIS Application. It can be zoom as per our requirement. A vector layer is a dataset, usually of a specific kind of object, such as roads, trees, etc. A vector layer can consist of either points, lines or polygons.



Vector Formats

(i) **DLG** – Digital Line Graph

(ii) **GML** – Geography Markup Language

(iii) **NTF** – National Transfer Format

(iv) **Spatialite** – is a spatial extension to SQLite,

(v) **Shapefile** – Most popular vector data

(vi) **SOSI** – a spatial data format used for all public exchange of spatial data in Norway

(vii) **Spatial Data Fil**e – Autodesk's high-performance geo-database format

(viii) **TIGER** – Topologically Integrated Geographic Encoding and Referencing

(ix) **(VPF)** – Vector Product Format

(d) **Tabular Data**. Data store in tabular form. It helps in generating attribute and spatial queries.

IMPORTANT TERMS

24 **Map Canvas**. Map canvas is a place where we work on the map. It is a place occupied by raster layer. This is where the map itself is displayed and where layers are loaded.

25. **.QGS.** .qgs is the extension of qgis file. project file of a qgis application is saved automatically in the format of .qgs.

26. **Warehouse**. Warehouse is a source of spatial data, which is linked with workspace. For example access (database).

27. **Attributes**. A column and field in database table is called attributes. Which stores nongraphic info in a table and linked with any feature.

28. **Feature class**. Group of feature ex river, road.

29. **PAN**. We can move map to any direction.

30. **Map Object**. The feature labels and images which appears on map window.

31. **North Arrow**. Indicate North Position Of Map.

32. **Buffer Zone**. A buffer zone is an area that is within a given distance from a map feature. When you buffer on a set of features, the output is a set of polygons. (buffering points or lines creates a new polygon layer.

33. **Plugins** These are Small Software Components Which Add A Specific Ability To The Qgis Application.

34. Various core and third party plug-ins can be accessed and managed by using plugins toolbar.

35. QGIS comes with a core plugin named **spit (shapefile to postgis import tool).**

ABBREVIATIONS

36. **Abbreviations**

(a) **CAMS** - CENTRAL AUTOMATED MIL SURVEY (DIGITAL MAP KE LIYE)

(b) **D:M:S** - DEGREES, MINUTES, AND SECONDS

(c) **DTED** - DIGITAL TERRAIN ELEVATION DATA (HEIGHT NAPNE KE LIYE)

(d) **INGR** - INTERGRAPH GRID DATA. (GRID LINE KE LIYE)

(e) **DTEDX** - OUTPUT DIGITAL TERRAIN ELEVATION FORMAT (FOR 3D)

(f) **GPS** - GLOBAL POSITIONING SYSTEM

(g) **MBR** - MINIMAL BOUNDING RECTANGLE

(h) **MGRS** - MILITARY GRID REFERENCE SYSTEM

(i) **CRS** - COORDINATE REFERENCE SYSTEM

(j) **UTM** - Universal Terrain Measurement

(k) **MGSM** - MGE SEGMENT MANAGER

(l) **MSI** - MULTI-SPECTRAL IMAGERY

(m) **NITF** - NATIONAL IMAGERY TRANSMISSION FORMAT

(n) **RPF** - RASTER PRODUCT FORMAT

(o) **TIFF** - TAGGED IMAGE FILE FORMAT

(p) **TTC** - TONAL TRANSFER CURVE

(q) **UPS** - Universal Polar Stereographic

(r) **MSL** - MEAN SEA LEVEL

(s) **GDAL** - GEOSPATIAL DATA ABSTRACTION LIBRARY

(t) **GRASS** - GEOGRAPHIC RESOURCE ANALYSIS SUPPORT SYSTEM

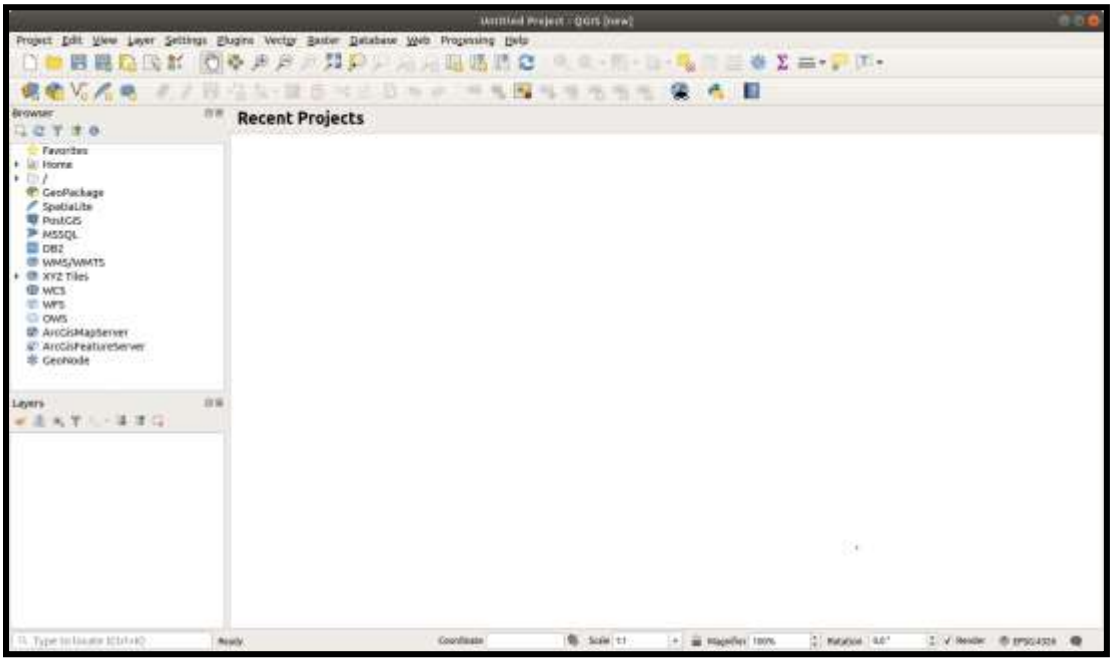
(u) **OTF** - ON THE FLY

(v) **SPIT** - SHAPEFILE TO POSTGIS IMPORT TOOL

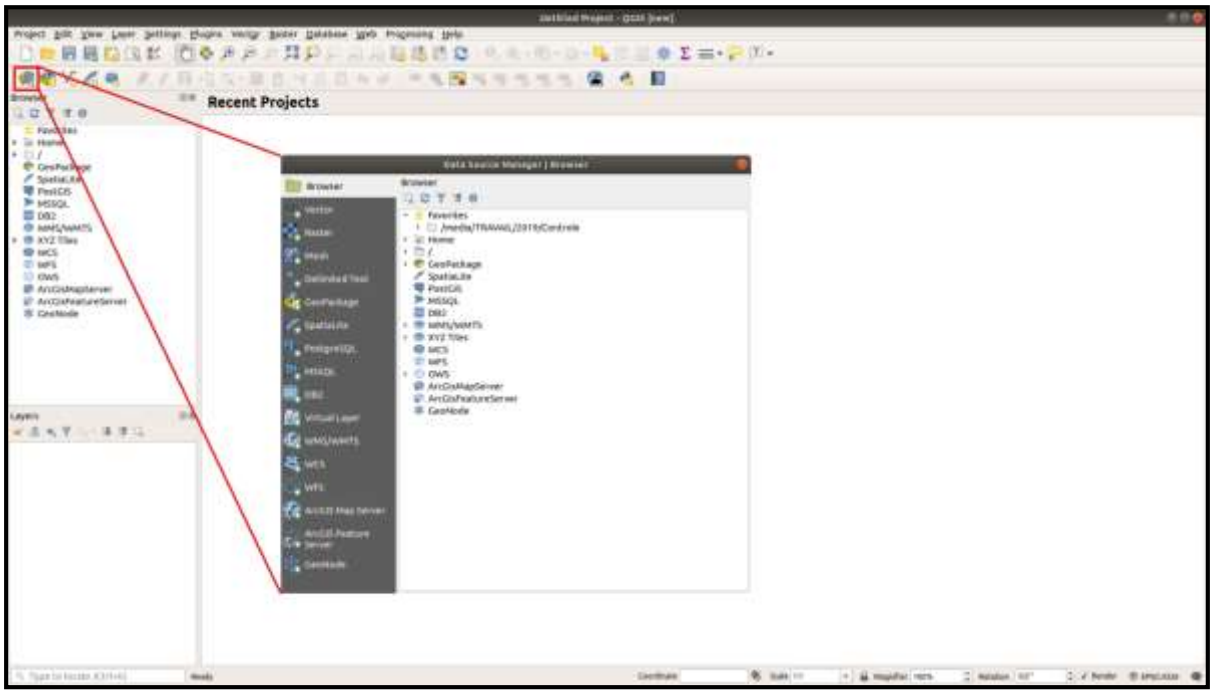
(w) **UOR** - UNIT OF RESOLUTION

ADDING LAYERS

37. Open QGIS. You will have a new, blank map.



38. The Data Source Manager dialog allows you to choose the data to load depending on the data type. We'll use it to load our dataset: click the Open Data Source Manager button.If you can't find the icon, check that the Data Source Manager toolbar is enabled in the View ► Toolbars menu.



39. Load the protected_areas.shp vector dataset:

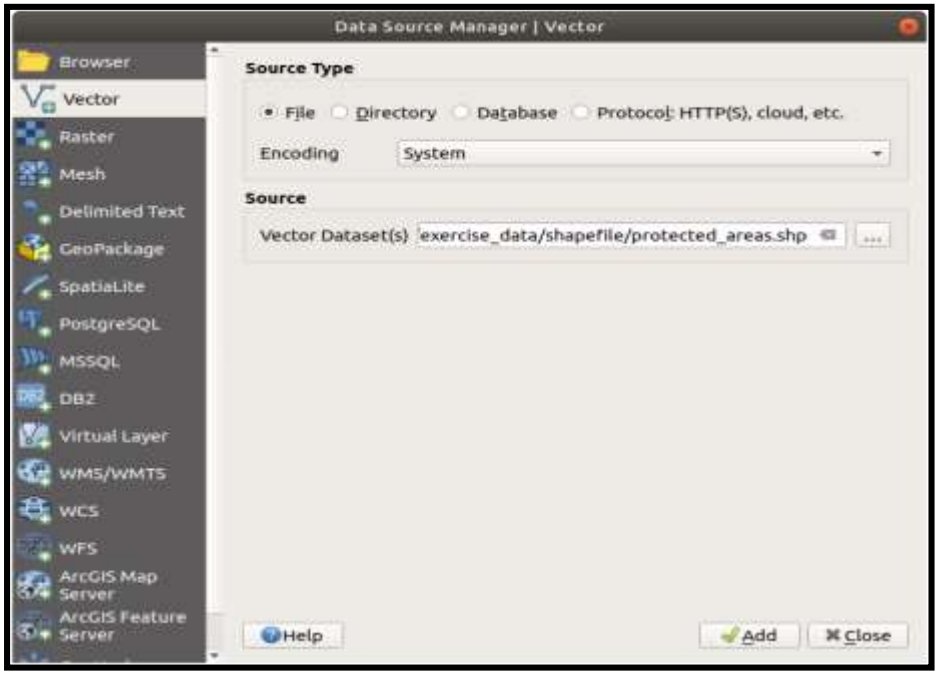
(a) Click on the Vector tab.

(b) Enable the File source type.

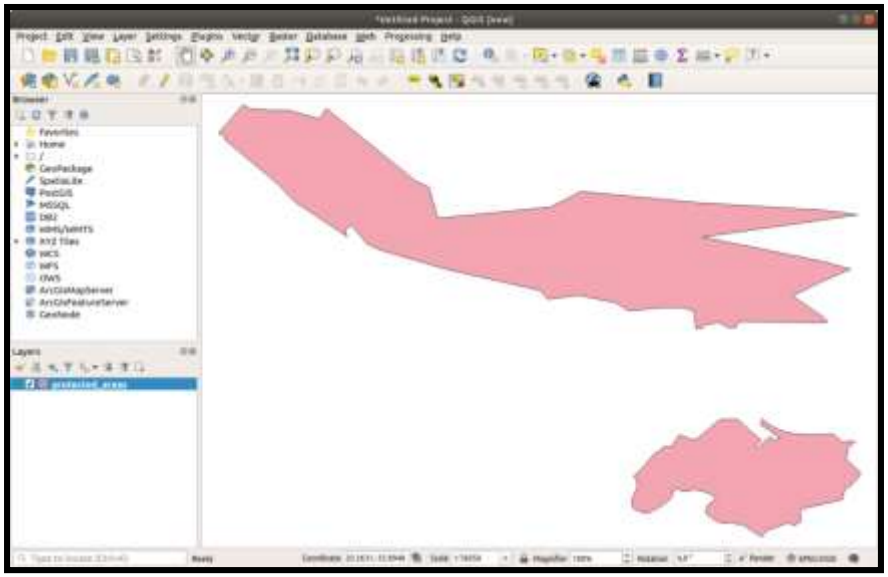
(c) Press the … button next to Vector Dataset(s).

(d) Select the exercise_data/shapefile/protected_areas.shp file in your training directory.

(e) Click Open. You will see the original dialog, with the file path filled in.



40. Click Add here as well. The data you specified will now load: you can see a protected_areas item in the Layers panel (bottom left) with its features shown in the main map canvas.



41. Congratulations! You now have a basic map. Now would be a good time to save your work.Click on the Save As button:

(a) Save the map under a solution folder next to exercise_data and call it basic_map.qgz.

42. Repeat the steps above to add the places .shp and rivers .shp layers from the same folder (exercise_data /shapefile) to the map.

43. Databases allow you to store a large volume of associated data in one file. You may already be familiar with a database management system (DBMS) such as Libre office Base or MS Access. GIS applications can also make use of databases. GIS-specific DBMSes (such as Post GIS) have extra functions, because they need to handle spatial data.

44. The GeoPackage open format is a container that allows you to store GIS data (layers) in a single file. Unlike the ESRI Shapefile format (e.g. the protected_areas.shp dataset you loaded earlier), a single Geo Package file can contain various data (both vector and raster data) in different coordinate reference systems, as well as tables without spatial information; all these features allow you to share data easily and avoid file duplication.

45. In order to load a layer from a Geo Package, you will first need to create the connection to it.

46. Click on the data Source Manager Open Data Source Manager button.

47. On the left click on the new Geo Package Layer Geo Package tab.

Reordering the Layers

48. The layers in your Layers list are drawn on the map in a certain order. The layer at the bottom of the list is drawn first, and the layer at the top is drawn last. By changing the order that they are shown on the list, you can change the order they are drawn in.

49. You can alter this behaviour using the Control rendering order checkbox beneath the Layer Order panel. We will however not discuss this feature yet.

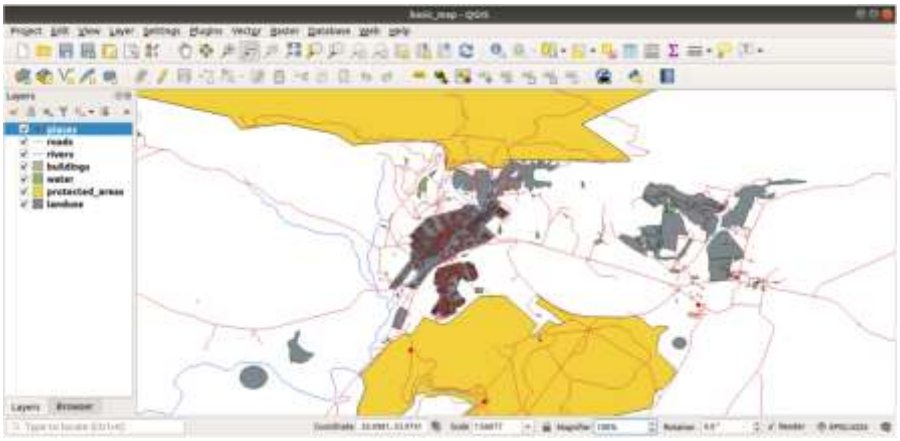
50. The order in which the layers have been loaded into the map is probably not logical at this stage. It's possible that the road layer is completely hidden because other layers are on top of it.

51. For example, this layer order…

52. … would result in roads and places being hidden as they run *underneath* the polygons of the land use layer.

53. To resolve this problem:

(a) Click and drag on a layer in the Layers list.
(b) Reorder them to look like this:



54. You'll see that the map now makes more sense visually, with roads and buildings appearing above the land use regions.

55. Now you've added all the layers you need from several different sources and created a basic map!

INTRO TO MAPS

56. A Map is a visual representation of an entire area or a part of an area. Symbolic Depiction with relationship among objects. Diagrammatic representation of an area of land or sea showing physical features, cities, road etc. A map is a symbolic depiction emphasizing relationships between elements of some space, such as objects, regions, or themes. Many maps are static, fixed to paper or some other durable medium, while others are dynamic or interactive.

57. **Elements of Map**.

(a) **Title:** The title of a map is one of its vital features. It is the keyword that grabs the reader's attention. A short 'title' might be apt if readers are familiar with the theme being presented. The need for a suitable title, whether small or long, depends on the reader but the title should provide an answer to their "What? Where? When?"

(b) **Direction**: Direction is shown on a map by using a compass rose. The compass rose shows the directions of the map so that map readers can relate those directions to the real world. Sometimes a compass rose will just show North. If you know which way North is, you can figure out East, West, and South.

(c) **Legend:** The principal reference to the map symbols; subordinated to the title and direction. However, this is still a key element for map reading; describing all unknown or unique map symbols used. The legend serves as the decoder for the symbology in the data frame. Therefore, it is also commonly known as the key. Descriptions detailing any color schemata, symbology or categorization is explained here. Without the legend, the color scheme on the map would make no sense to the viewer. The legend tells the viewer that the lighter the color, the longer the last recorded date has been.

(d) **North Arrows:** North arrows indicate the orientation of the map and maintain a connection to the data frame. When that data frame is rotated, the north arrow element rotates with it. North arrow properties include its style, size, color, and angle. The size of the north arrow is in points. Decimal fractions can be entered here. One can control the alignment of the north arrow by selecting one of the following options: Data Frame Rotation—North arrow angle uses the rotation of the data frame. True North—North arrow angle uses geodetic north or the direction to the north pole. The true north calculation is based on the coordinate system using the center point of the data frame.

(e) **Distance(Scale):** Distance or scale must always be indicated or implied unless the audience is so familiar with the map area or distance of such little relative importance that it can be assumed by the audience. Distance and scale can be indicated in a variety of ways on a map in verbal, numeric, or graphic form. In using computer systems, the graphic form of representing scale is often preferred. With computers, maps are often drafted at different scales than they are printed. In using verbal or numeric scales, the cartographer must be certain that the map is printed at precisely the scale indicated. If a graphic scale is inserted in a digital map, it will always maintain its relative size with respect to the digital map no matter how it is printed. Since scale varies significantly across the area of some maps, one should be sure to note the adjustments required.

(f) **Labels:** Labels are the words that identify a location. They show places (streets, rivers, and establishments) with specific names and can also be used to represent something if there is only one of it, instead of making up a symbol to just represent one thing.

(g) **Grid and Index:** Not all maps use a grid and index, but it really helps in finding locations. A grid and index are common in an atlas and on roadmaps. A grid represents a series of horizontal and vertical lines running across the map whereas index helps the map reader find a particular location by following the numbers and letters in the grid.The index is mainly in alphabetical order that

makes it easy to look up to the name of the place. There are coordinates (A2, B3, etc) next to the location on the map.

(h) **Citation:** The citation portion of a map constitutes the metadata (description) of the map. This is the area where explanatory data about the data sources and currency, projection information and any caveats are placed. Citations help the viewer determine the use of the map for their own purpose.

58. **List of map types**

(a) Aeronautical chart
(b) Atlas
(c) Cadastral map
(d) Climatic map
(e) Geologic map
(f) Historical map
(g) Linguistic map
(h) Nautical map
(j) Physical map
(k) Political map
(l) Relief map
(m) Resource map
(n) Road map
(o) Star map
(p) Street map
(q) Thematic map
(r) Topographic map
(s) Train track map
(t) Transit map
(u) Weather map
(v) World map

MAP SCALE

59. **Representative Fraction**

(a) Representative Fraction (rf). A representative fraction (rf) is the ratio of distance on the map to distance on the ground.

(b) This is a simple ratio in the form of 1:10,00,000 or 1/10,00,000. In an rf, the number on the left side is the map distance, and its value is always related to ground.

(c) An rf of 1:24,000 means one inch on the map equals 24,000 inches on the ground and one centimeter on the map equals 24,000 centimeters on the ground.

(d) Many maps are drawn to a scale expressed as a ratio, such as 1:10,000, which means that 1 unit of measurement on the map corresponds to 10,000 of that same unit on the ground.

Advantages and disadvantages

60. Representative fractions allow the amount of reduction to be easily understood, but it is harder for most people to determine specific distances on the map because distances must either be multiplied or divided by the RF. Representative fractions are invalid if the map is reduced or enlarged. An advantage of adding RFs to your map is that they are extremely easy to determine in Arc Map - simply look at the Map Scale text on the to bar menu of the Arc Map interface. If you do plan to use an RF and the current scale of your map is a number that is not either standard or rounded off, you should change your map scale before creating the final version of your map so that the RF is an easier number for your map readers to understand. Sometimes it is helpful to provide a scale bar along with the RF to give your map readers the advantages of using both.

Map Projections

It is the system of transformation of the spherical surface onto a plane surface. It is carried out by an orderly and systematic representation of the parallels of latitude and the meridians of longitude of the spherical earth or part of it on a plane surface on a conveniently chosen scale.
Map projection is the method of transferring the graticule of latitude and longitude on a plane surface. It can also be defined as the transformation of spherical network of parallels and meridians on a plane surface. As you know that, the earth on which we live in is not flat. It is geiod in shape like a sphere.

Datum

61. A “DATUM” is a model that describes the position, direction and scale relationship of a reference surface to positions on the surface of earth.

62. Datum is, from its Latin origin, a singular form of "data", and may refer to a single item of data. A “Datum” is a model that describes the position, direction and scale relationship of a reference surface to positions on the surface of earth.

63. There are two main datums in the United States. Horizontal datums measure positions (latitude and longitude) on the surface of the Earth, while vertical datums are used to measure land elevations and water depths.

64. **Geodetic Datums**. Geodetic Datum's are established to provide positional control that supports surveying and mapping projects covering large geographic areas such as a country, a continent, or the whole world.

65. **Vertical Datums**. A Vertical Datum is the zero surface from which all elevations or heights are measured. The MSL was used as a vertical datum for mapping because the sea surface is available worldwide.

GEO-REFERENCING

66. Internal coordinate system of a map or aerial photo image can be related to a geographic coordinate system.

67. The relevant coordinate transforms are typically stored within the image file (GeoPDF and GeoTIFF are examples), though there are many possible mechanisms for implementing georeferencing.

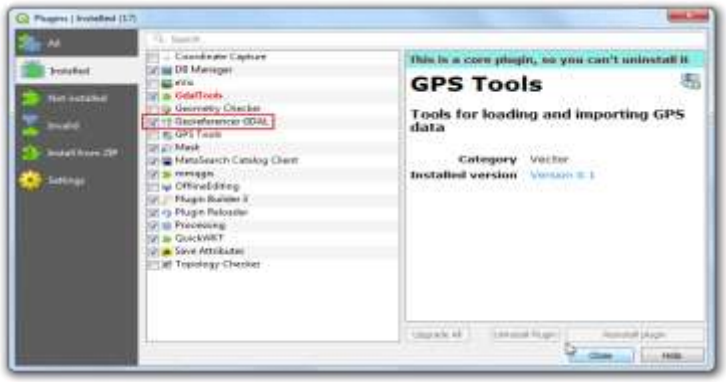
68. The most visible effect of georeferencing is that display software can show ground coordinates (such as latitude/longitude or UTM coordinates) and also measure ground distances and areas.

69. In other words, georeferencing means to associate a digital image file with locations in physical space.

70. Georeferencing may be applied to any kind of object or structure that can be related to a geographical location, such as points of interest, roads, places, bridges, or buildings.

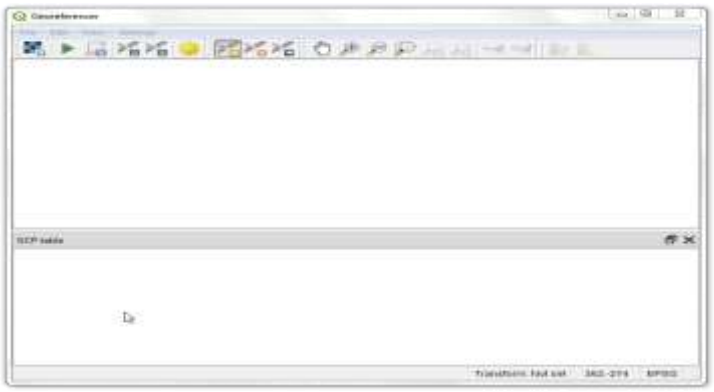
71. Geographic locations are most commonly represented using a coordinate reference system, which in turn can be related to a geodetic reference system such as WGS-84.

72. **Procedure** Georeferencing in QGIS is done via the **Georeferencer GDAL** plugin. This is a core plugin - meaning it is already part of your QGIS installation. You just need to enable it.

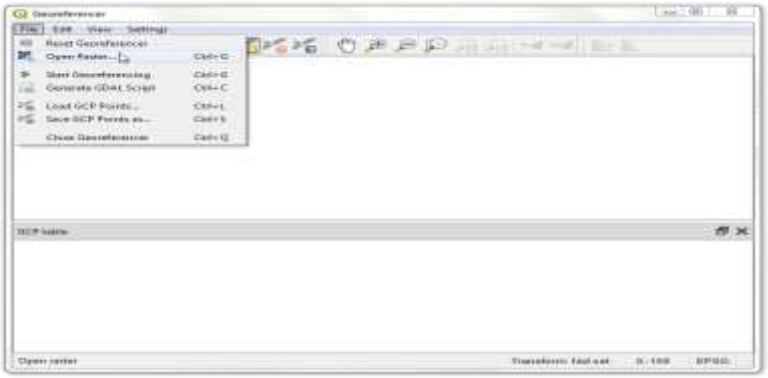


73. The plugin is installed in the Raster menu. Click on Raster ‣ Georeferencer to open the plugin.

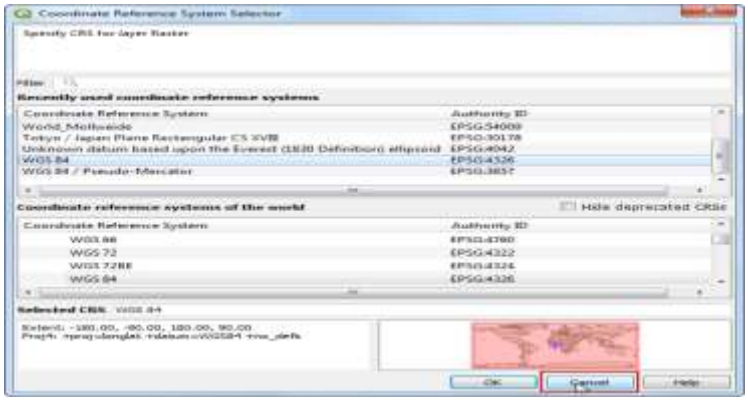
74. The plugin window is divided into two sections. The top section where the image will be displayed and the bottom section where a table showing your GCPs will appear.



75. Now we will open our JPG image. Go to File ‣ Open Raster. Browse to the downloaded image of the scanned map and click Open.

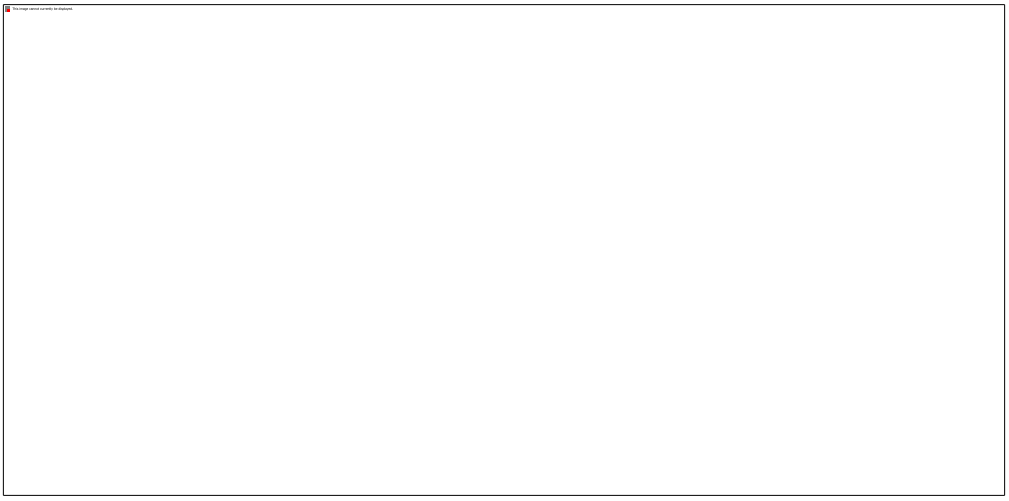


76. In the next screen, you will asked to choose the raster's coordinate reference system (CRS). Our source image is a plain JPEG file and doesn't have any coordinate reference system attached to it, so you can click Cancel.



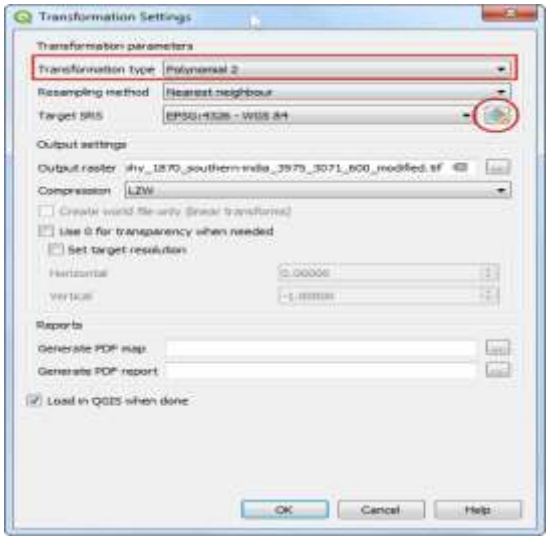
77. You will see the image will be loaded on the top section. You can use the zoom/pan controls in the toolbar to learn more about the map.

78. Now we need to assign coordinates to some points on this map. If you look closely, you will see coordinate grid with markings. These are Latitude and Longitude grid lines.

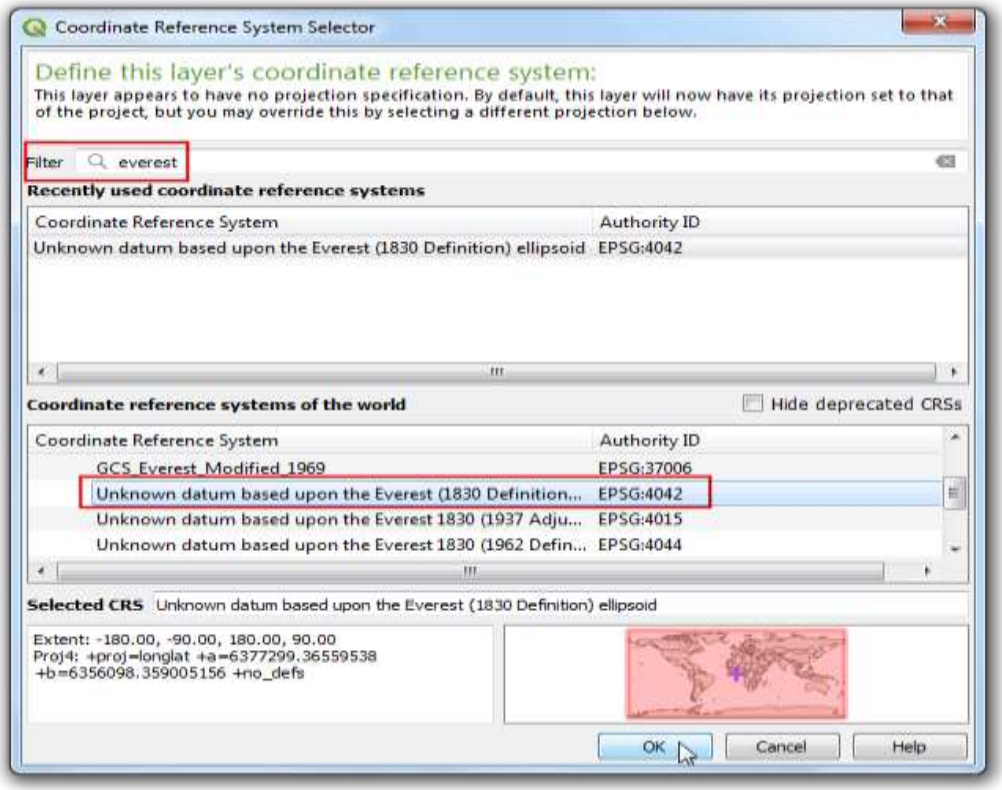


79. Before we start adding Ground Control Points (GCP), we need to define the Transformation Settings. Go to Settings ‣ Transformation settings.

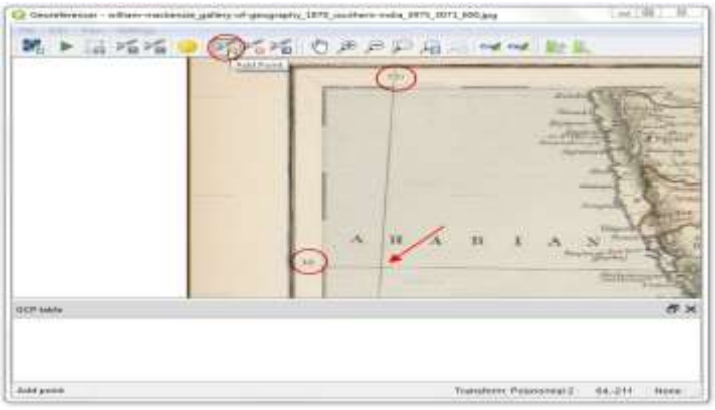
80. In the Transformation settings dialog, choose the Transformation type as Polynomial.



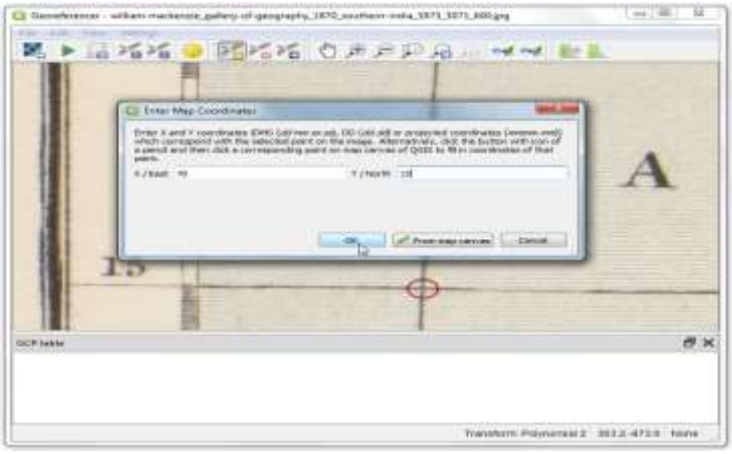
81. If you are geo-referencing a scanned map like this, you can obtain the CRS information from the map itself. Looking at our map image, the coordinates are in Latitude/Longitude. There is no datum information given, so we have to assume an appropriate one. Since it is India and the map is quite old, we can bet the Everest 1830 datum would give us good results. Search for everest and select the CRS with oldest definition of the Everest datum (EPSG:4042). Click OK.



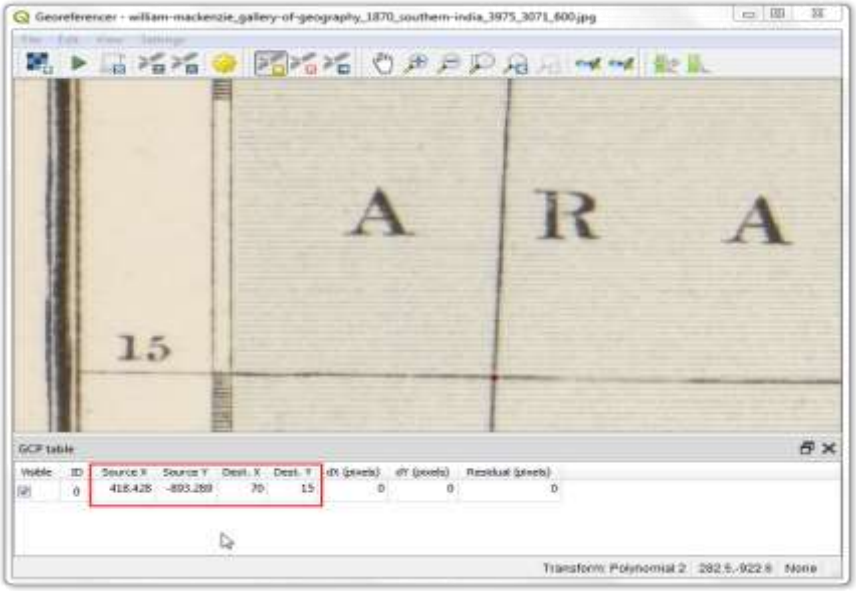
82. Now we can start adding the Ground Control Points (GCP). The intersections of the grid lines will serve as the *ground-truth* in our case. As the grid lines are labeled, we can determine the X and Y coordinates of the points using them. Click Add Point.



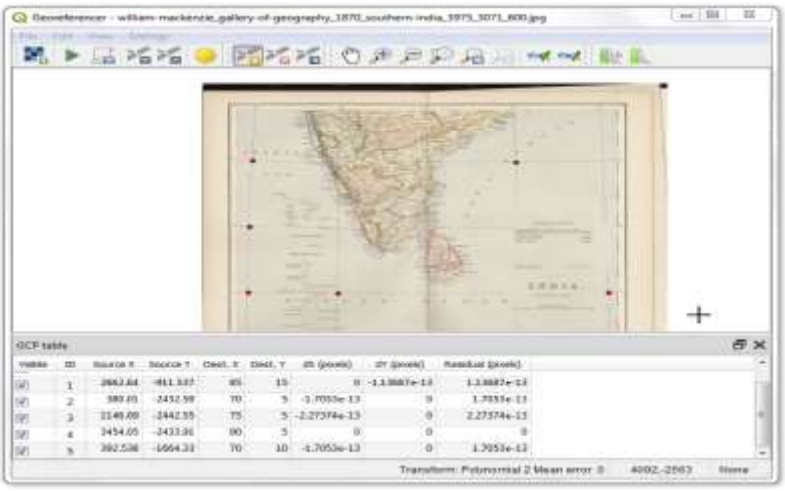
83. In the pop-up window, enter the coordinates. Remember that X=longitude and Y=latitude. Click OK.



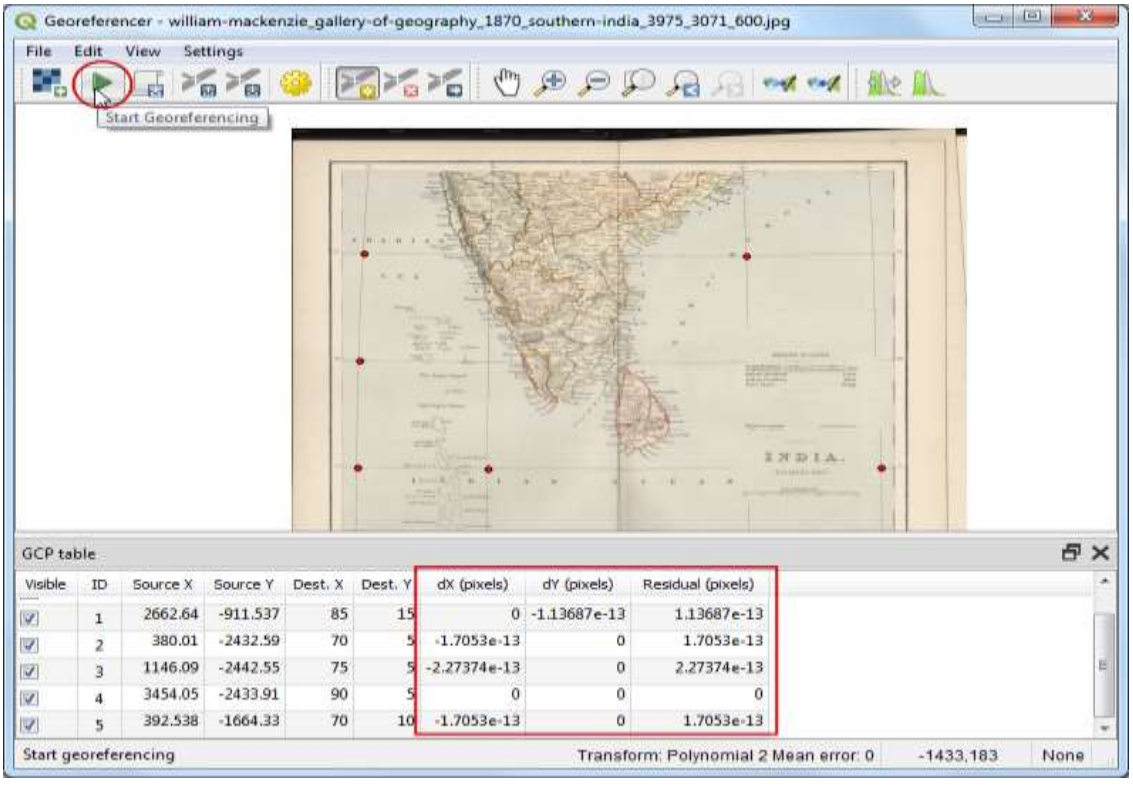
84. You will notice the GCP table now has a row with details of your first GCP.



85. Similarly, add at least more GCPs covering the entire image. The more points you have, the more accurate your image is registered to the target coordinates. The Polynomial 2 transform requires at least 6 GCPs.



86. Once you have added the minimum number of points required for the transform, you will notice that the GCPs now have a non-zero dX, dY and Residual error values. If a particular GCP has unusually high error values, that usually means a human-error in entering the coordinate values. So you can delete that GCP and capture it again. You can also edit the coordinate values in the GCP Table by clicking the cell in either Dest. X or Dest. Y columns. Once you are satisfied with the GCPs, go to File ‣ Start georeferencing. This will start the process of warping the image using the GCPs and creating the target raster.



87. Once the process finishes, you will see the georeferenced layer loaded in QGIS. The georeferencing is now complete.

Surveykshak 3.0

An open source GIS software has been customized as 'SURVEYKSHAK' GIS Software, Desktop version 3.0, to meet the requirement of Defence forces on the pattern of newly designed Defence Spatial Data Model Structure (SDMS) for Defence Series Maps.

88. **HW REQD**

(a) can run dektop pc
(b) for best performance
  (i) windows 10
  (ii) ram - 4 gb
  (iii) i3 processor
  (iv) 2 GB GRAPHICS

89. **INPUT DATA**

(a) Digital map data in shape files (*.shp).
(b) *.qml files for Symbology definition.
(c) Projection parameters *.prj file of the respective zone. Satellite imageries/ Topo scanned map (Geotiff).
(d) GPS data (points) coordinates .txt/.csv file.
(e) DEM for 3D analysis.

90. **CAPABILITIES**

(a) To open digital topographical data and display as per mil coordinate system along with dsm sheet numbering, datum (wgs-84) projection system (lcc), grid (lcc) and file format (.shp).
(b) display of digital data in appropriate cartographic symbol of the features as depicted on hard copy map (not available in any of cots s/w).
(c) Pan, zoom, identified, refresh digital data.
(d) Vertical tiling of the digital data (raster & vector) as per zoom scale
(e) To handle geo-referenced digital satellite imagery/ scanned topo maps.
(f) Capturing/ readout of co-ordinates in the terms of lat/long or 10 fig gr.
(g) Adding/ placing pt feature with the help of list of coordinates in the database/file.
(h) Editing/updation of spatial data/features, if reqd.
(j) Digitization of overlays as reqd by engr regt.
(k) Creating of new features class i.e point, line & polygon along with attribute tables.
(l) Grouping of feature classes.
(m) Addition/ alteration/ updation of attribute data.
(n) Creating of new attribute table.
(o) Distance measurement.
(p) 3d capabilities in surveykshak

91. **Simple query**

Finding a feature with known attribute eg :-

(a) Show the loc of bridge with cl.
(b) Display the roads
(c) Show all the hospitals with surgical
(d) Facility.

92. **Special query**

finding a feature at given distance with respect to another feature:-

(a) Show all the helipads along the rd within 5 km.
(b) Show all the bridges of cl-24 along the given rd.

how many stream crossing the rd with more than 5 mtrs

93. **Map**

As part of nmp (national map policy) 2005, two series of maps are being published by survey of india, which are meant to replace the existing everest series maps. Maps being published as part of nmp 2005 are:

(a) open series maps (osm).
(b) defence series maps (dsm).

94. **OSM**

(a) The open series maps (osm) are devoid of the military grid,
(b) Height/contour data (in restricted areas).
(c) These are meant for civil agencies and are available for purchase, commercially.

95. **DSM**

(a) The defence series maps (dsm) are meant for exclusive use by defence and para military forces. These maps contain all topographic information, and are classified as restricted and above.
(b) This method of map numbering is much simpler and logical. Using this method, the numbering system can be extended to any part of the world; which has been an inherent drawback in everest series maps.