Industrial Training Report

Subject: Google (Google Maps).

About Company:

Google LLC is an American multinational technology company that specializes in Internet-related services and products, which include online advertising technologies, a search engine, cloud computing, software, and hardware. It is considered one of the Big Four technology companies alongside Amazon, Apple and Microsoft.

Google was founded in September 1998 by Larry Page and Sergey Brin while they were Ph.D. students at Stanford University in California. Together they own about 14 percent of its shares and control 56 percent of the stockholder voting power through supervoting stock. They incorporated Google as a California privately held company on September 4, 1998, in California. Google was then reincorporated in Delaware on October 22, 2002. An initial public offering (IPO) took place on August 19, 2004, and Google moved to its headquarters in Mountain View, California, nicknamed the Googleplex. In August 2015, Google announced plans to reorganize its various interests as a conglomerate called Alphabet Inc. Google is Alphabet's leading subsidiary and will continue to be the umbrella company for Alphabet's Internet interests. Sundar Pichai was appointed CEO of Google, replacing Larry Page who became the CEO of Alphabet.

The company's rapid growth since incorporation has triggered a chain of products, acquisitions, and partnerships beyond Google's core search engine (Google Search). It offers services designed for work and productivity (Google Docs, Google Sheets, and Google Slides), email (Gmail), scheduling and time management (Google Calendar), cloud storage (Google Drive), instant messaging and video chat (Duo, Hangouts, and Meet), language translation (Google Translate), mapping and navigation (Google Maps, Waze, Google Earth, and Street View), podcast hosting (Google Podcasts), video sharing (YouTube), blog publishing (Blogger), note-taking (Google Keep, and Google Jamboard), and photo organizing and editing (Google Photos). The company leads the development of the Android mobile operating system, the Google Chrome web browser, and Chrome OS, a lightweight operating system based on

the Chrome browser. Google has moved increasingly into hardware; from 2010 to 2015, it partnered with major electronics manufacturers in the production of its Nexus devices, and it released multiple hardware products in October 2016, including the Google Pixel smartphone, Google Home smart speaker, Google Wifi mesh wireless router, and Google Daydream virtual reality headset. Google has also experimented with becoming an Internet carrier (Google Fiber, Google Fi, and Google Station).

Google.com is the most visited website in the world. Several other Google services also figure in the top 100 most visited websites, including YouTube and Blogger. Google was the most valuable brand in the world in 2017 (surpassed by Amazon), but has received significant criticism involving issues such as privacy concerns, tax avoidance, antitrust, censorship, and search neutrality.

Reference**:** https://en.wikipedia.org/wiki/Google

Company's Mission: "To organize the world's information and make it universally accessible and useful."

Company's Vision: "To provide access to the world's information in one click."

Reference: http://panmore.com/google-vision-statement-mission-statement#:~:text=Google's%20corporate%20vision%20is%20%E2%80%9Cto,is%20its%20search%20engine%20service.

Product List:

- An Internet search engine.
- Web email.
- A news aggregator.
- Calendar software.
- A suite of productivity applications, including spreadsheet, word-processing, and photo-editing software.
- Cloud storage for consumers
- Cloud storage for businesses.
- Cloud computing for businesses.
- A website for watching Internet videos.
- A web browser.

- A Smartphone/tablet operating system.
- A thermostat.
- Unknown life-extending technologies.
- Computerized contact lenses
- Robot assistants
- Self-driving cars
- "A spoon designed to make life easier for people with diseases such as Parkinson's."
- A home video monitoring system.
- High-speed Internet service.
- Laptop computers.
- Desktop computers.
- A dongle that puts Internet video on your TV.
- Balloons that broadcast Internet signal.
- Drones that deliver goods to homes.
- Computers you wear like glasses.
- Airborne wind turbines.
- A digital collection of all the world's books.
- A map of the world.
- A collection of photographs of every street in the world.
- A social network.
- Software for creating and maintaining blogs.
- An online video rental store.
- An online software store.
- A live-updating database of equities and financial news.
- A service that allows you to pay for things with your phone.
- A language translation service.
- A phone number replacement service.
- Video-conferencing software.

Reference: https://www.businessinsider.in/tech/A-List-Of-Products-Larry-Page-Has-Google-Working-On-Other-Than-Search-Such-As-Spoons/articleshow/43188003.cms

Product Name: Google Maps.

About Product:

- Date launched: 8 February 2005.
- Type of site: Web mapping.
- Created by: Jens Eilstrup Rasmussen, Lars Rasmussen.
- Available in: English Language, Catalan language, more.

Google Maps is a web mapping service developed by Google. It offers satellite imagery, aerial photography, street maps, 360° interactive panoramic views of streets (Street View), real-time traffic conditions, and route planning for traveling by foot, car, bicycle and air (in beta), or public transportation. In 2020, Google Maps was used by over 1 billion people every month.

Google Maps began as a C++ desktop program at Where 2 Technologies. In October 2004, the company was acquired by Google, which converted it into a web application. After additional acquisitions of a geospatial data visualization company and a realtime traffic analyzer, Google Maps was launched in February 2005. The service's front end utilizes JavaScript, XML, and Ajax. Google Maps offers an API that allows maps to be embedded on third-party websites, and offers a locator for businesses and other organizations in numerous countries around the world. Google Map Maker allowed users to collaboratively expand and update the service's mapping worldwide but was discontinued from March 2017. However, crowdsourced contributions to Google Maps were not discontinued as the company announced those features would be transferred to the Google Local Guides program.

Google Maps' satellite view is a "top-down" or bird's-eye view; most of the high-resolution imagery of cities is aerial photography taken from aircraft flying at 800 to 1,500 feet (240 to 460 m), while most other imagery is from satellites. Much of the available satellite imagery is no more than three years old and is updated on a regular basis. Google Maps used a variant of the Mercator projection, and therefore could not accurately show areas around the poles. In August 2018, the desktop version of Google Maps was updated to show a 3D globe. It is still possible to switch back to the 2D map in the settings.

Google Maps for Android and iOS devices was released in September 2008 and features GPS turn-by-turn navigation along with dedicated parking assistance features. In August 2013, it was determined to be the world's most popular app for smartphones, with over 54% of global smartphone owners using it at least once.

In 2012, Google reported having over 7,100 employees and contractors directly working in mapping.

In 2017, along with several other Google services including YouTube, Chrome, Gmail, Search, and Google Play, Google Maps reached over 1 billion monthly users.

Reference: https://en.wikipedia.org/wiki/Google_Maps

Architecture:

The traditional way to publish maps over the Internet was to use specialised mapping servers to render GIS data into a simple image and then to serve that single image to a browser for display. A new map was generated every time users panned to a different location or changed zoom level (since there is an infinite number of combinations of map extents and zoom levels it was impossible to generate those maps in advance). And those maps were always less than perfect because every display rule had to be predefined for the entire map and for every possible zoom level. In case of very detailed maps the complexity of defining those rules was very often beyond the capacity of map creators.

Google opted for a solution where maps could be produced in advance and served as small tiles for assembling into one big image at user end. The advantage of this approach is consistency of appearance and graphical quality of the map and, probably more important, enormous scalability that could be achieved. There is no need for server side processing to generate maps and individual map tiles are much smaller than the whole map presented at the user end, so they are able to be delivered and displayed much faster. The trade off was a big effort up front to generate nice looking maps and the need to fix zoom levels rather than allowing a continuous zoom, as is the case with the traditional approach.

Reference: http://all-things-spatial.blogspot.com/2009/06/ingenuity-of-google-map-architecture.html

In this case, you can talk about the need for scalability and elasticity in the serving platform. You could compare the benefits and drawbacks of preprocessing tiles, or rendering them on-the-fly.

It would also be prudent to discuss how you would design a system that scales the tile size based on the type of device making requests (i.e. 256px x 256px tiles may load well on a laptop/desktop, but might make for a choppy mobile consumption experience).

How Traffic Sensors Work:

Three above-ground types have become more common in recent years: radar, active infrared and laser radar. radar traffic sensors deploy a measureable area of microwave energy that is reflected back to the device when a vehicle passes through it. Active infrared and laser radar sensors operate in a similar manner, using low power infrared energy and infrared beams to form detection areas. In all three types of devices, the time it takes for the energy to bounce back to the sensor is compared to data collected in an unobstructed field to determine the size and speed of the vehicle passing through it.

Sweating the Small Stuff on smaller rural and neighborhood streets:

To accomplish this, Google turned toward the very people it was gathering the information for: its customers. GPS-enabled cell phones running the Google Maps application continually pass along each user's location and speed to Google in real time. Using a technique known as "crowdsourcing," Google combines the information provided by thousands of active cell phones to determine how swiftly traffic is moving through a given location.

https://www.quora.com/Design-a-server-architecture-for-serving-Google-maps-images

https://www.ncta.com/platform/broadband-internet/how-google-tracks-traffic/

http://prismoskills.appspot.com/lessons/System_Design_and_Big_Data/Chapter_07_-_Designing_Google_Maps.jsp

Map Rendering:

The technology could generically be described as a map server. The map server generates a map for the requested location from a large set of pre-generated map tile images covering the entire planet. The map server may overlay data from other databases on top of this. The combination of a map viewer client and geographical database is traditionally called a Geographical Information System (GIS).

As stated, Google generated all of these 256x256 tiles and is just serving the relevant tiles.

The javascript code on the page and the server code use the numbers in the link to determine the location of the map you are viewing, the zoom level, and the size of your viewing window to determine the tiles to send to your browser.

Google Maps and Google Earth use something known as KML, or "Keyhole Markup Language", which is a special variant of XML.

A bit more detail, Google maps uses a big div element to contain several image elements. each of those image elements is 256 pixels square, and is positioned on a regular grid. from there, the Google maps JavaScript program calculates which grid images should be loaded into each image tag and uses regular DOM manipulation to position each image in the right place. Only the tiles of the map that would be visible inside the div are loaded. when you scroll off the side, the JavaScript library unloads the image, and loads new ones as needed. Other elements, like the zoom controls, markers, and lines, are stacked or drawn on top of that as needed.

Reference: http://stackoverflow.com/questions/1204258/how-does-google-maps-render-the-map-etc-is-it-flash-a-java-applet

http://stackoverflow.com/questions/204644/how-does-google-maps-work

Working:

Google, a private corporation, cannot possibly expect to gather all this data on its own. For its basic geological map, Google depends on its Base Map Partner Program, which collects information from a range of credible organizations, such as the US Geological Survey, Forest Service, city and state councils and so forth, using them to construct everything from massive

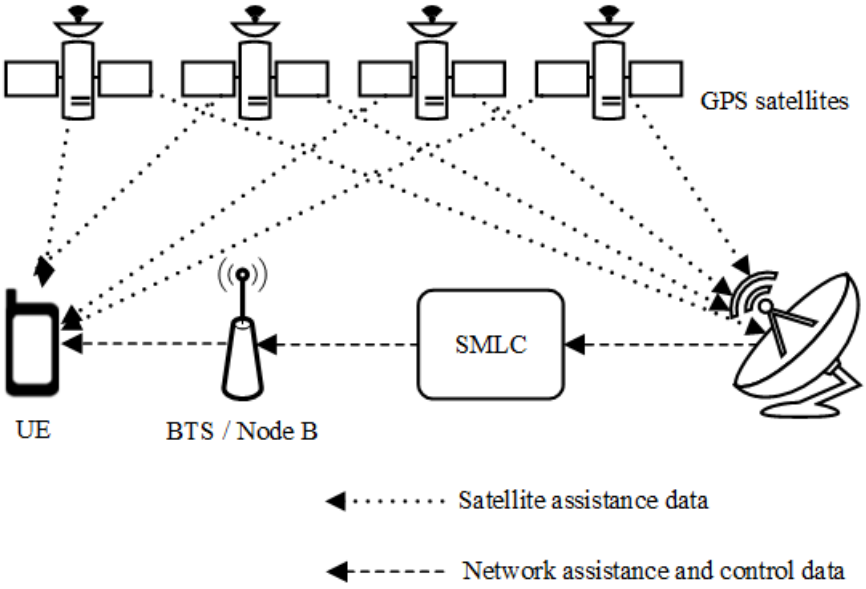
freeways to remote lanes and stitching them together into the comprehensive digital image that we call Google Maps.

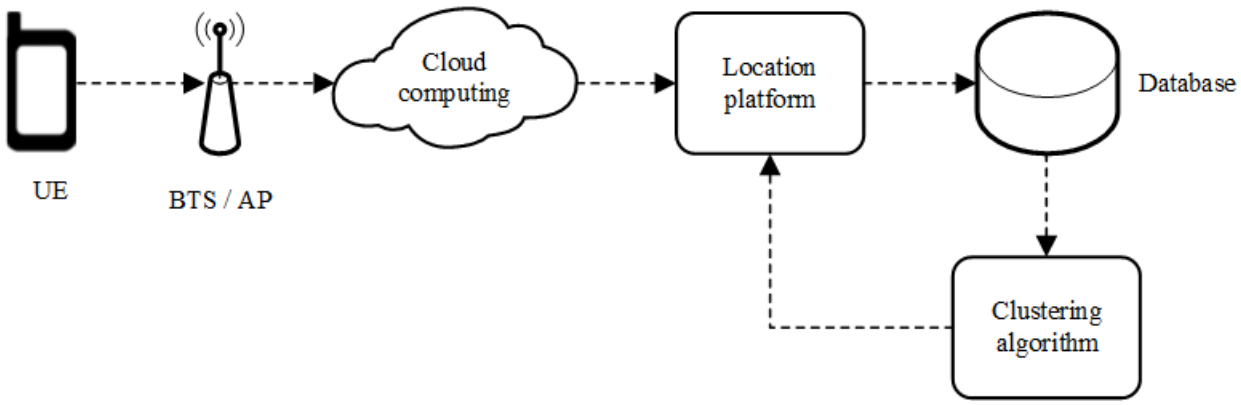
Simply documenting the roads and highways, isn't enough, which is why Google makes use of round-the-clock vehicles to patrol each and every street, neighborhood and residential complex, providing minutely detailed digital images of the same. The idea here is to run cars, motorboats, snowmobiles and other assorted vehicles through every possible road and alleyway, taking 360-degree images everywhere they go. The images thus obtained are then plotted on to the base map using GPS coordinates, leading to the end result that is Google Street View. And Google, along with a number of innovators, aren't just stopping outdoors. Initiatives like Project Tango are taking map digitization inside our buildings and offices.

Once again, private companies and third-party organizations remain a huge part of Google's endeavor, supplying satellite imageries and map data to help construct the entire big picture. The satellite view available via Google Maps is created through collaboration with Google Earth, depending on images from third-party satellites to be stitched into the mainframe to provide high-resolution photographs of the world taken from above. These images are then referenced with Street View and base map data, resulting in a single application that can provide you with a glimpse of the entire world with a tap on a screen.

The key difference between Google Maps and Google Earth lies in the dimensions of the images rendered (2D/3D) and whether the images are rendered in real time. As the two products continue to converge, the differences between them are narrowing down to a blur, though they still form an important distinction. For the sake of improving user experience. Google Maps asks for access to the location data on your phone. Using this information adds yet another dimension to the product, providing users with such things as real-time traffic updates and so on. These little things help implement more features into the already intricate mapping service, making your everyday life a little more easy.

Google's outdoor navigation system is a massive undertaking, one that requires the cooperation of many organizations, government and private. While the inner workings of the system get more and more complicated the deeper you dig in, this is an overall view of how the system really works, and how it gathers and processes the data it needs.





Requirements:

Computer :-

To use the full Google Maps with 3D imagery and Earth view, you need the latest version of one of these browsers:

- Google Chrome
- Internet Explorer
- Firefox
- Safari
- Microsoft Edge

To use the full Google Maps with 3D imagery and Earth view, you need the latest version of one of these operating systems:

- Mac OS 10.12.0 and up
- Windows 7 and up
- Chrome OS with an Intel CPU
- Linux

Your computer's graphics card controls how graphics like pictures, videos, and 3D, are displayed. Search online to learn how to find out which graphics card you have.

You won't be able to see the map in 3D with the following cards:

- Intel 965GM
- Intel B43
- Intel G41
- Intel G45
- Intel G965
- Intel GMA 3600
- Intel Mobile 4
- Intel Mobile 45
- Intel Mobile 965

Android :-

To receive updates to Google Maps for Android, make sure your Android phone or tablet is on Android 5.0 or up.

IOS :-

To download Google Maps for iPhone or iPad, make sure your phone or tablet is on iOS 11 and above.

Cost and data:

Google does not charge you to use the Google Maps app. Because Google Maps might use your phone or tablet's data connection, your mobile service provider might charge you for your data usage.

https://support.google.com/maps/answer/3096703?co=GENIE.Platform%3DiOS&hl=en&oco=1

Features:

Explore: In the Explore tab users can search for local information and businesses. Local business information such as ratings, reviews, and more will be available for over 200 million worldwide locations including restaurants, attractions, and city landmarks.

Commute: The Commute tab allows users to set their daily commute and get real-time traffic updates, travel times, and suggestions for alternative routes. This tab caters to all types of commuters, car, public transportation, or other.

Saved: The Saved tab is a central location for users to find their saved locations, plan group events, and share recommendations on places they've visited in the past.

Contribute: The Contribute tab allows users to share local knowledge in order to keep Google Maps up to date. This includes things like adding business reviews and photos, making suggested edits, and updating details about roads and addresses.

Updates: The Updates tab provides users with a feed of trending businesses from local experts and publishers. This tab also connects users with businesses to get questions answered quickly through a chat tool.

- Temperature.
- Accessibility.
- Security Onboard.
- Number of Carriages Available (Japan only).

Upcoming Features:

- Augmented Reality comes to Street View.
- Stay Updated with 'For You'.
- AI-powered Virtual Assistance.
- Plan a Group Activity.
- Expanding Live View Directions.

Latest Version:

Android: Google Maps 10.47.1

IOS: Google Maps 5.49

Tools & Platform Used:

Google Maps began as a C++ desktop program at Where 2 Technologies. In October 2004, the company was acquired by Google, which converted it into a web application. After additional acquisitions of a geospatial data visualization company and a realtime traffic analyzer, Google Maps was launched in February 2005. The service's front end utilizes JavaScript, XML, and Ajax. Google Maps offers an API that allows maps to be embedded on third-party websites, and offers a locator for businesses and other organizations in numerous countries around the world.

Written-in:

C++ (back-end), JavaScript, XML, Ajax.

Applications:

- Locate any place on the map with the information of latitude and longitude.(This feature is available in various other applications too).
- Personalised details of places you visit:
  - You can know how much distance you have travelled
  - You can have your own timeline to track the places you visit.
- Google maps gives dynamic updates about the traffic and gives suggestions of alternate routes for avoiding the traffic.
- Google database also has the details of the local transport service, one the use them to know the details of the public transport available.
- Satellite view: satellite view enables the user to look at the earth of particular area (these are photographs taken by satellites which are updated repeatedly) .
- One can also become “Local Guides ” for google maps which enables the user to add place on the google maps , and also to suggest an edit to the existing database.
- One can also download a part of map for offline use.

Advantages:

- It Builds Trust With Your Customers.
- It Helps With the Research Process.
- It Creates a Better Connection.
- Better Access to Your Target Audience.

- It Helps Customers Make Informed .
- Passive Marketing.
- It’s a Convenient and Comfortable Experience.