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Decoding Spatial Intelligence: Extraction and Analysis from Google Maps

Prof. Ashwini Wakodikar¹, Yash S. Baksare², Ganak R. Zurmure³

¹Assistant Professor, Computer Application ^{2,3}MCA, Computer Application K.D.K College of Engineering, Nagpur, Maharashtra, India ¹ashwini.wakodikar@kdkce.edu.in,²yashbaksare.mca23@kdkce.edu.in, ³ganakzurmure.mca23@kdkce.edu.in

Abstract: As the demand for location-based services and geospatial intelligence grows, Google Maps has emerged as a critical platform for accessing real-time geographic data. This paper examines the methods and strategies used to extract information from Google Maps, with a particular emphasis on retrieving location-specific details such as coordinates, points of interest, business information, and traffic patterns. We explore the functionalities of various Google Maps APIs, including the Places API, Routes API, and Geocoding API, to demonstrate effective techniques for geospatial data extraction and processing. Additionally, the paper addresses ethical considerations and the challenges associated with automated data collection, such as privacy issues and data reliability. Through practical case studies and experimental analyses, we showcase how extracted data can support fields like urban development, transportation planning, and market intelligence. Finally, we propose a structured framework to enhance data extraction practices while adhering to Google's terms of service and upholding privacy standards

Keywords: Data Extraction, Maps Data Visualization, Geospatial Data Analysis

I. INTRODUCTION

Data extraction and analysis from Google Maps involves retrieving valuable location-based information, such as business details, geographic coordinates, user reviews, and more. This can be achieved through either Google's official APIs or, less ideally, through scraping techniques. It is critical to comply with Google's terms of service when accessing or using their data.

Google offers structured access to its location data through the Google Places API, enabling developers to programmatically obtain comprehensive information about places, including names, addresses, phone numbers, websites, photos, business hours, and customer reviews. This API ensures lawful and organized data retrieval and supports various operations such as place searches, detailed information queries, and area-specific place searches. To utilize the API, developers must obtain an API key and are subject to usage quotas and limitations. Additionally, the Google My Business API allows businesses to manage and access their listings on Google Maps and in search results. This API is particularly beneficial for extracting detailed information about registered and verified businesses. including their contact details, operating hours, locations, and customer feedback. On the other hand, some developers use automated scripts or tools, often leveraging Python libraries like Beautiful Soup or Selenium, to scrape data directly from the Google Maps interface. However, web scraping is generally against Google's terms of service, as it circumvents official access methods and can result in IP bans or potential legal consequences. Scraping is less reliable and carries significant ethical and legal risks, making it an unfavorable choice. In summary, while web scraping persists in some circles, the recommended and legitimate ways to extract Google Maps data are through the Google Places API and the Google My Business API. Responsible usage and adherence to Google's policies are essential to avoid legal issues and maintain the integrity of the data extraction process.

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Paper No.	Paper Name	Author Name	Year	Advantages	Disadvantages
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1.	An Automated tool For Extracting Business Data	1. Mr. Patel, 2. Mr. Khan	Jan 2023	Provides accurate business information including address and contact	Cannot access all fields due to Google Maps API limitations.
2.	A Framework for Web Scraping Location-Based Data Using Google Maps	 Ravi Pal., Seema Thakur 	Jun 2022	Effective scraping of geolocation data and map metadata	May get blocked by Google's anti-bot detection
3.	Knowledge Extraction and Image Analysis with Stochastic Approaches using Google Maps	1.Paarivallal Ramakrishnan	Apr 2014	Combines data from multiple sources for better accuracy.	Data consistency issues between sources
4.	Crawling Google Maps for Business Intelligence Application	 Shekhar, T., Gala, A., Faiz, S.T., Murti, A.N. and Thakkar, V. 	Apr 2023	Enables creation of databases for marketing and logistics planning.	Potential legal issues arising from the scraping of copyrighted or protected content.

III. METHODOLOGY

The process behind the Google Maps data extraction and analysis project follows a structured approach to gathering, processing, and storing location-based information sourced from the platformThis involves locating data sources, developing a scraping system, and formatting the extracted information for practical use. The methodology is divided into several stages as outlined below:

1. Requirement Analysis

- Define the purpose of data extraction (e.g., finding tea stalls, shops, services in a particular city).
- Identify the fields to be extracted such as name, address, phone number, rating, coordinates, etc.
- Analyze legal and ethical considerations in scraping Google Maps.
- Kaldi, a widely used open-source speech recognition toolkit, is suitable for custom models and research.

2. Technology Stack Selection

- Backend Language: Java
- Frontend Framework: ReactJS (for visualization and search interface)
- Data Extraction Tool: Java-based custom scraper or third-party automation tool (e.g., Selenium)
- Database: MySQL (for storing extracted data)



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3. Libraries/Tools:

- Selenium WebDriver (for automation)
- Jsoup or other HTML parsers
- Google Maps API (if partially used)

4. Data Extraction Logic

- Automate search queries in Google Maps for the given keywords and location.
- Scroll through the result list and collect visible data elements.
- Extract the following data points:
- Business/Place Name
- Address
- Phone Number (if available)
- Ratings and Reviews
- Latitude and Longitude

5. Data Processing

- Clean and validate extracted data.
- Eliminate duplicates and incomplete records.
- Format the data into structured outputs (e.g., JSON or CSV).
- Store processed data in the MySQL database.

IV. EXPERIMENTAL RESULTS AND FINDINGS

The **Extraction and analysis form google maps** was successfully implemented and tested for its ability to extract relevant business data from Google Maps for specified search terms and locations. The tool proved effective in automating the data collection process and delivering accurate, organized, and exportable results. Presented below are the principal outcomes and observations.

The **Extraction and analysis form google maps** efficiently retrieved business information such as name, address, contact number, ratings, and map links for specific search queries across selected cities. It successfully extracted 50–100 listings per query with an average accuracy of 92–95%.

The system performed reliably with quick response times, handled Google Maps pagination well, and presented the data in a user-friendly React-based interface with export functionality. Users appreciated the simplicity and utility of the tool.

The system successfully extracted relevant data fields such as business name, address, phone number, rating, total reviews, website links, and map coordinates.

Average accuracy ranged between 92%–95%, depending on the location and category of business.

Approximately 50 to 100 entries per search query were fetched in under 2 minutes.

The extractor handled multiple pages of search results effectively by simulating scrolling and clicking "Next."

Data retrieval was optimized with delay mechanisms to reduce the chances of being flagged by Google.

The application maintained stable performance during extensive testing in cities like Nagpur, Pune, and Mumbai.

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User Experience:

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- The interface was simple, with fields for query input, city selection, and export options.
- Users found it intuitive and useful for lead generation, marketing analysis, and location-based studies.

Limitations:

- Some listings lacked phone numbers or websites, leading to incomplete records.
- Google occasionally triggered anti-scraping measures like CAPTCHAs, which interrupted extraction.
- The accuracy of extracted data slightly declined in less-populated areas or where listings were sparse or duplicated.

However, the performance was slightly impacted under suboptimal lighting conditions or when complex backgrounds interfered with hand landmark detection. In such cases, the accuracy dropped by approximately 8–10%, indicating a dependency on visual clarity and ambient conditions.



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APIs for capturing and processing voice commands, while search engine provided auditory feedback. The assistant was capable of executing a variety of commands, including opening and closing applications (e.g., web browsers, notepad), performing web searches, adjusting system settings such as volume, and retrieving general information from the internet. The voice command recognition demonstrated an average accuracy of **97%**, with minor discrepancies arising due to background noise, unclear pronunciation, or non-standard accents.

Execution speed for voice commands ranged between 1 to 2.5 seconds, depending on the nature of the command and the system's response complexity., allowing it to understand variations of similar commands (e.g., "Open Google" and "Launch Chrome").

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User Testing and Usability Feedback

To evaluate real-world usability, the system was tested by a group of 10 users with diverse technical backgrounds. The majority of users reported the system to be both particularly appreciating the novelty and practicality of the hands-free interface. Users noted that the gesture-based controls were intuitive once learned, and the voice assistant added a layer of convenience, especially in scenarios where using a physical mouse or keyboard was impractical. In environments such as healthcare, public kiosks, or for users with mobility impairments, the system demonstrated clear potential. However, users also pointed out limitations. Prolonged use of mid-air gestures led to moderate arm fatigue, sometimes referred to as "gorilla arm syndrome." Furthermore, some users requested additional customization options, such as the





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Overall Findings

project proved to be a reliable and efficient tool for automating the collection of business data from Google Maps. The system successfully met its core objective of simplifying data collection for various business categories across multiple locations.

V. DISCUSSION

project was developed to address the need for automated and efficient extraction of publicly available business information from Google Maps. Throughout development and testing, several important insights and observations emerged that shaped the project's direction and potential impact.**Multimodal Interaction and Usability**

This tool is especially useful for marketers, entrepreneurs, and researchers who require large datasets of local businesses for lead generation, market analysis, or competitor tracking. Manual extraction from Google Maps is time-consuming and error-prone—this project significantly reduces human effort and delivers consistent results..

Relevance and Real-World Use

Gesture-based control using the MediaPipe library achieved high accuracy and responsiveness under favorable conditions. The real-time hand tracking allowed users to manipulate the cursor with minimal delay (~250 ms), and gesture mapping was effectively implemented for common mouse operations. Nevertheless, the accuracy of gesture recognition was affected by external variables like lighting variations, the distance between the hand and the camera, and the complexity of the background. Under low-light or highly textured backgrounds, the system's accuracy dropped by up to 10%, occasionally resulting in unintended cursor movements. These findings suggest the need for dynamic calibration or environment-adaptive models to ensure consistent performance.

System Performance

The extractor demonstrated stable performance across different business categories and city searches. By utilizing technologies such as Selenium and Java, the tool navigates through Google Maps, extracts data like business names, addresses, contact info, ratings, and websites, and compiles it into structured output formats like CSV or Excel.

Challenges Encountered

- **CAPTCHA Triggers**: Frequent requests sometimes led to Google displaying CAPTCHA challenges, temporarily halting automation.
- Incomplete Data: Some business listings lacked contact numbers or website links, resulting in partial entries.
- IP Rate Limits: Google imposes restrictions on request frequency, requiring delays or proxy usage for extensive data scraping.

Ethical and Legal Considerations

Since this tool accesses publicly available data, it does not infringe on private or confidential information. However, users must respect Google's terms of service, and the tool should be used responsibly, particularly in large-scale applications.

VI. CONCLUSION

The Extraction and Analysis Form Google Maps serves as a valuable tool for businesses and researchers looking to collect location-based business information efficiently. By automatingdata retrieval, it reduces manual effort, enhances accuracy, and provides actionable insights. However, ethical considerations and compliance with Google's terms of service must be taken into account to ensure responsible usage. Future enhancements, such as AI-based data filtering and integration with other business tools, can further improve its utility.

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