

# **AUTOMATED SEO TOOL FOR WEBSITE OPTIMIZATION**

A PROJECT

*Submitted by*

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*in partial fulfillment of the requirements for the degree  
of*

**BACHELOR OF TECHNOLOGY**

in

COMPUTER SCIENCE ENGINEERING

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## ABSTRACT

Search Engine Optimization (SEO) plays a pivotal role in shaping the visibility, reach, and success of any online platform, whether it be a personal blog, business website, e-commerce portal, or content-driven service. As search engines remain the dominant gateway for accessing digital information and services, ensuring optimal search rankings has become not just beneficial but essential. However, traditional SEO processes often demand extensive manual effort, deep technical understanding, and continuous monitoring—factors that can overwhelm individual users and small teams alike. To address these challenges, this project introduces the **Automated SEO Tool**, a web-based platform designed to simplify, automate, and optimize the entire SEO workflow. Unlike conventional tools that require hands-on configuration and maintenance, the Automated SEO Tool leverages automation to handle core SEO functions such as keyword tracking, backlink analysis, on-page SEO issue detection, technical SEO audits, and performance reporting. The system consolidates these capabilities into an intuitive dashboard, offering real-time insights, data-driven recommendations, and user-centric features like role-based access, scheduled reporting, and adaptive workflows. Designed to cater to a diverse user base—from solo content creators to digital marketing agencies—the tool enhances efficiency, eliminates repetitive tasks, and enables strategic SEO decisions without sacrificing control or accuracy. Through this project, we demonstrate how automation can transform SEO management into a streamlined, scalable, and accessible process, ultimately helping users boost their online presence, improve search rankings, and achieve their digital goals with greater ease and precision.

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## **ABBREVIATIONS**

**SDLC** – Software Development Life Cycle

**SRS** – Software Requirement Specification

**DAD** – Dynamic Adaptive System Development

**CASE** – Computer-Aided Software Engineering

**UML** – Unified Modeling Language

**ERD** – Entity Relationship Diagram

**DFD** – Data Flow Diagram

**UAT** – User Acceptance Testing

**MVC** – Model View Controller

**POC** – Proof of Concept

**CI/CD** – Continuous Integration / Continuous Deployment

**API** – Application Programming Interface

**IDE** – Integrated Development Environment

**CRUD** – Create, Read, Update, Delete

**GUI** – Graphical User Interface

**DBMS** – Database Management System

**HTML** – HyperText Markup Language

**CSS** – Cascading Style Sheets

**JS** – JavaScript

**JSON** – JavaScript Object Notation

**REST** – Representational State Transfer

**SQL** – Structured Query Language

**JWT** – JSON Web Token

**JWT Auth** – JSON Web Token Authentication

**QA** – Quality Assurance

**SEO** – Search Engine Optimization

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction to Automated SEO Tool For Website Optimization**

Search Engine Optimization (SEO) has become a critical factor in the success of any digital presence, be it a business website, blog, e-commerce platform, or content-driven portal. With the internet becoming the primary source of information, products, and services, achieving a high ranking on search engines like Google, Bing, or Yahoo is no longer optional—it is essential for visibility, credibility, and traffic generation.

The **Automated SEO Tool** is a comprehensive web-based platform created to assist users in handling their SEO needs efficiently and structured. Unlike traditional SEO tools that require manual setup and constant human oversight, this tool automates many of the core SEO functions, such as keyword tracking, backlink monitoring, on-page issue detection, and audit reporting. Its goal is to empower users to manage their websites' SEO with minimal manual input while maintaining control and visibility over their performance metrics.

SEO often involves multiple layers of analysis, research, implementation, and tracking. This includes identifying high-value keywords, ensuring that content is optimized correctly, acquiring and analyzing backlinks, checking technical SEO aspects (like crawlability, broken links, or metadata), and monitoring the site's performance over time. Performing all of these tasks manually can be time-consuming, complex, and sometimes inconsistent. The **Automated SEO Tool** simplifies these tasks into automated workflows, offering real-time insights and actionable suggestions.

By consolidating essential features into a single dashboard, the tool is designed to serve both individual users and organizations of varying sizes. Whether a user is a solo blogger trying to improve their content visibility, a startup founder managing a small team, or a digital marketing agency handling multiple client accounts, the tool offers role-based access, flexible reporting, and robust automation that adapts to their needs.

## 1.2 Motivation

The motivation behind developing the Automated SEO Tool is deeply rooted in the evolving digital marketing ecosystem and the rising demand for streamlined, scalable, and easy-to-use SEO solutions.

Over the past decade, digital competition has skyrocketed. Businesses of all types, from local services to multinational brands, are investing in online content and competing for visibility on search engines. For a new or growing business, ranking on the first page of search results can determine whether they thrive or struggle to survive.

Despite this, many website owners and digital marketers still struggle with managing their SEO efficiently. Most traditional SEO tools are either:

- **Very complex**, requiring deep technical knowledge and experience.
- **Too expensive**, limiting access for freelancers, small businesses, or solopreneurs.
- **Sometimes fragmented**, requiring users to juggle between multiple platforms to analyze keywords, monitor backlinks, and audit website health.

This fragmented and costly landscape creates barriers for those who want to optimize their websites but lack the resources or knowledge to do so effectively. That's where the Automated SEO Tool comes in to democratize access to essential SEO capabilities and remove the technical hurdles that many users face.

**The tool was built to solve these key pain points:**

- **Time Consumption:** SEO is a time-intensive process. Automation drastically reduces the hours spent on routine checks and data gathering.
- **Complexity:** The tool simplifies complex tasks such as audit reporting, backlink tracking, and keyword positioning into easy-to-understand formats.
- **Scalability:** Manual processes don't scale well. This tool supports businesses as they grow, allowing users to manage multiple projects, domains, or clients with ease.
- **Resource Constraints:** Hiring professional SEO consultants or using premium tools can be out of reach for startups or individuals. The automated tool offers powerful features without the enterprise-level price tag.

Ultimately, the motivation behind this project is to enable individuals and businesses to grow organically through smarter SEO strategies, automated routines, and real-time insights, without needing to become SEO experts or break the bank. It is a response to the market's need for a cost-effective, reliable, and user-friendly SEO platform that bridges the gap between complexity and usability.

### **1.3 Sustainable Development Goal of the Project**

This project supports the United Nations Sustainable Development Goal (SDG) 8: *Decent Work and Economic Growth*.

By equipping entrepreneurs, freelancers, and small business owners with an accessible tool to improve their digital presence, the project contributes to:

- **Target 8.2:** Achieving higher levels of economic productivity through technology and innovation.
- **Target 8.10:** Expanding access to financial services and digital tools for underserved communities and businesses.

Through automation and accessibility, the SEO tool empowers users to improve their website traffic, generate more leads, and increase their economic opportunities.

### **1.4 Product Vision Statement**

#### **1.4.1 Audience**

This tool is built for a wide variety of users who engage in web publishing and digital marketing, including:

- Website owners are aiming to improve their organic reach.
- Bloggers and content creators need to target the right keywords.
- Freelancers manage SEO for client websites.
- Startups and small businesses are looking for affordable optimization solutions.
- Digital marketers require regular performance reports and backlink analysis.
- Administrators oversee user access and system functions.

#### **1.4.2 Needs**

Each user type brings unique SEO needs. This tool addresses them by offering:

- An automated system to monitor keyword rankings, backlinks, and on-page metrics.
- A unified platform to manage SEO audits and issue tracking.
- Tools for keyword suggestion and SERP analysis.
- Performance dashboards that show traffic insights and ranking improvements.
- Easy-to-use interfaces with minimal learning curve.
- Exportable reports for client updates or internal assessments.
- Reliable uptime and secure user data handling.

#### **1.4.3 Products**

The tool will consist of several integrated modules:

- User Management Module: Sign-up, login, and role-based access controls.
- Dashboard Module: Real-time overview of SEO metrics and site performance.
- Keyword Explorer: Suggests, tracks, and monitors keyword rankings.
- Backlink Tracker: Analyzes backlink profiles, domain authority, and referring domains.
- SEO Audit Tool: Performs automated site audits and highlights technical issues.
- Competitor Analysis: Compares SEO strategies and keyword performance across competitor sites.
- Reporting Module: Generates downloadable reports on SEO performance trends.
- Admin Panel: Provides platform maintenance, user control, and module management.

#### **1.4.4 Values**

The development and purpose of this tool are grounded in the following values:

- **Efficiency:** Automating routine SEO tasks to save time and reduce manual errors.
- **Transparency:** Displaying data in a clear, actionable manner.
- **Affordability:** Offering advanced SEO capabilities at a cost-effective rate.
- **Accessibility:** Ensuring that the platform is usable across devices and by users with various experience levels.

- **Simplicity:** Keeping the user experience straightforward and results-focused.
- **Scalability:** Building with flexibility for future enhancements and integrations.

## 1.5 Product Goal

The ultimate goal of the Automated SEO Tool is to empower users of all technical backgrounds to manage and improve their website's visibility on search engines through smart automation, actionable insights, and intuitive interfaces, without the need for extensive SEO knowledge or costly third-party services.

This tool is built with the vision of transforming how individuals, businesses, content creators, and digital marketers approach SEO—from a traditionally complex, manual, and time-consuming process to a streamlined, automated, and results-driven experience.

Key Objectives of the Product Goal:

### 1. Democratize SEO Capabilities

Make professional-grade SEO tools accessible to all, regardless of budget, expertise, or company size. Whether it's a startup founder, a blogger, or a large digital agency, the tool aims to provide value without discrimination.

### 2. Automate Repetitive SEO Tasks

Free users from the burden of repetitive manual activities such as keyword position tracking, on-page audits, backlink analysis, and sitemap monitoring by offering intelligent automation that runs 24/7 in the background.

### 3. Provide Real-Time, Actionable Insights

Deliver real-time data and suggestions that help users make smart SEO decisions, such as which keywords to prioritize, what on-page elements to fix, and which pages need urgent attention for optimization.

### 4. Enhance Website Visibility and Ranking

Support users in improving their organic search visibility through continuous monitoring and optimization recommendations tailored to current search engine

algorithms and SEO best practices.

## 5. Integrate All Essential SEO Functions in One Platform

Reduce the need to rely on multiple tools or switch between software by offering a single dashboard for keyword analytics, site audits, link tracking, performance reporting, and more.

## 6. Facilitate Scalable SEO Management

Allow users to manage multiple websites or client projects simultaneously with features like role-based access, campaign tracking, automated reports, and shared dashboards.

## 7. Educate and Assist Users Along the Way

Include tooltips, recommendations, and simple explanations within the platform to ensure even non-technical users can understand and act on the insights without confusion.

## 8. Ensure Reliability and Transparency

Provide clear, up-to-date reporting and logs of SEO performance to build trust with users and help them track progress over time in a transparent manner.

The platform aspires to become a go-to solution for practical SEO management, reducing the technical burden and allowing users to focus more on growth and strategy.

## 1.6 Product Backlog

ID	Title	User Story	Acceptance Criteria	Functional Requirements	Non-Functional Requirements
1	Keyword Research and Suggestion	As a user, I want to generate relevant keyword suggestions based on my website content so that I can improve my SEO ranking and attract more traffic.	<ol style="list-style-type: none"> <li>The user can input a website URL to analyze existing keywords.</li> <li>The system generates keyword suggestions based on website content and SEO trends.</li> <li>The user can filter keyword suggestions based on relevance,</li> </ol>	Extract keywords, generate suggestions, provide search volume, allow filtering, display SEO insights.	Fast processing, secure data handling, user-friendly interface, scalable, accurate analytics.
2	Technical SEO Audit and Fixes	As a user, I want to perform a technical SEO audit to identify issues and apply fixes to improve my website's performance and ranking.	<p>The system scans the website for technical SEO issues.</p> <p>It provides a detailed report of issues and recommendations.</p> <p>Users can apply suggested fixes directly through the tool.</p>	The tool should scan the website for technical issues, generate a detailed report, and allow users to implement fixes based on the findings.	The system should perform audits quickly, ensure data security, and provide a user-friendly interface.
3	Content Optimization & Recommendations	As a user, I want to receive content optimization suggestions so I can enhance my website's content for better SEO performance.	<p>The tool analyzes website content for SEO.</p> <p>Provides content improvement recommendations.</p> <p>Suggests keywords, structure, and readability improvements.</p>	The system should analyze the content for SEO, suggest keyword optimizations, and provide recommendations for structure and readability improvements.	The tool should provide recommendations quickly, ensuring accuracy and clarity, with a seamless user interface.
4	Backlink Profile Analysis	As a user, I want to analyze my website's backlink profile to ensure its quality and effectiveness for SEO improvement.	<p>The system scans the backlink profile.</p> <p>It identifies quality backlinks and potential risks.</p> <p>Provides suggestions for improving the backlink profile.</p>	The tool should analyze the backlink profile, identify valuable backlinks, and provide suggestions for building a better backlink strategy.	The tool should process backlink data efficiently, offer reliable insights, and maintain a secure environment for user data.
5	User Behavior Insights	As a user, I want to gain insights into how visitors interact with my website to improve user experience and optimize content.	<p>The system tracks user behavior on the website.</p> <p>Provides insights on user interactions and engagement.</p> <p>Suggests improvements for user experience.</p>	The tool should track user behavior, analyze interactions, and generate insights to optimize the website's user experience and content.	The system should ensure accurate tracking of behavior, provide real-time insights, and offer a simple, intuitive interface.
6	Competitor SEO Benchmarking	As a user, I want to compare my website's SEO performance with competitors to identify areas for improvement.	<p>The tool analyzes competitors' SEO strategies.</p> <p>Provides benchmarking comparisons on keywords, backlinks, and performance.</p> <p>Offers actionable recommendations based on competitor analysis.</p>	The tool should analyze competitors' SEO strategies, compare them to the user's website, and generate actionable insights for improvement.	The system should process competitor data accurately, deliver real-time benchmarking insights, and ensure data privacy and security.
7	SEO Performance Reports	As a user, I want to generate SEO performance reports to track my website's SEO health and progress over time.	<p>The tool generates detailed SEO performance reports.</p> <p>Provides insights on keyword rankings, traffic, and backlinks.</p> <p>Offers actionable suggestions for improving SEO performance.</p>	The tool should generate detailed SEO performance reports, analyze rankings, traffic, and backlinks, and provide suggestions for improvements.	Reports should be generated quickly, be accurate and easy to interpret, and provide a seamless user experience.

Table 1.1 User Stories

The screenshot shows a Microsoft Planner board titled 'Agile board( Seo tool for Website ... )'. The board is organized into four columns: 'Sprint backlog', 'Awaiting Review', 'Completed Items', and 'Completed'. Each column has a header with a '+ Add task' button and a 'Completed tasks' summary at the bottom.

- Sprint backlog:** Contains tasks like 'Add additional information to tasks', 'Add duration', 'Add attachments', etc., with a total of 2/7 completed.
- Awaiting Review:** Contains tasks like 'User Behaviour Insights', 'Due', etc., with a total of 2/2 completed.
- Completed Items:** Contains tasks like 'Customize buckets', 'Competitor SEO Benchmarking', etc., with a total of 4 completed.
- Completed:** Contains tasks like 'Backlink Profile Analysis', 'Content Optimisation & Recommendation', etc., with a total of 2 completed.

Each task card includes a 'Functional Requirements' section with labels like 'Should have', 'Must have', 'Could have', and 'User story'.

Figure 1.1 MS Planner Board of Automated SEO Tool for Website Optimization

## 1.7 Product Release Plan

The following Figure 1.2 depicts the release plan of the project

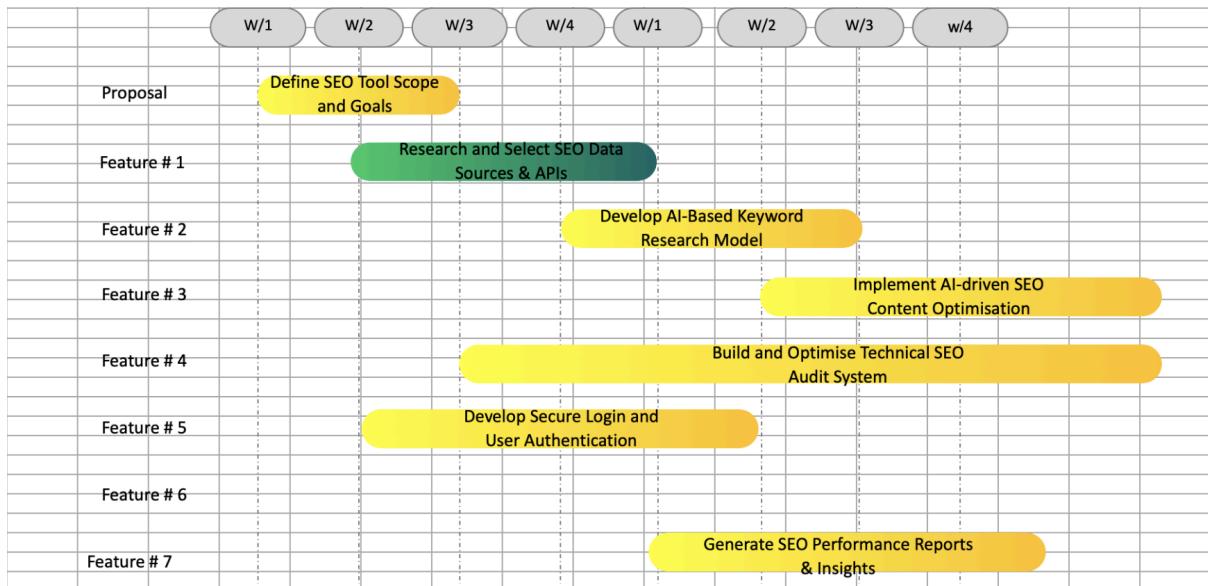


Figure 1.2 Release plan of Automated SEO Tool for Website Optimization

# **CHAPTER 2**

## **SPRINT PLANNING AND EXECUTION**

### **2.1 Sprint 1**

#### **2.1.1 Sprint Goal with User Stories of Sprint 1**

The goal of Sprint 1 in the SEO Optimization Tool is to build a strong analytical foundation that empowers users to understand and improve their website's visibility through keyword research, technical audits, and content optimization. By enabling the extraction of relevant keywords and accessing trend data through SEO APIs, users gain insights that help shape effective content strategies. The implementation of technical SEO audits ensures that critical on-page issues are identified and addressed, enhancing search engine discoverability and performance. Furthermore, content optimization suggestions driven by structure, readability, and keyword recommendations support better alignment with user search intent and improve rankings. Collectively, these stories aim to improve SEO readiness, boost organic traffic potential, and provide users with clear, actionable recommendations.

S. No	Detailed User Stories
USER STORY 1	As a user, I want to generate relevant keyword suggestions based on my website content so that I can improve my SEO ranking and attract more traffic.
USER STORY 2	As a user, I want to perform a technical SEO audit to identify issues and apply fixes to improve my website's performance and ranking.
USER STORY 3	As a user, I want to receive content optimization suggestions and keyword recommendations so that I can improve my rankings, drive more traffic, and match user search intent effectively.

Table 2.1 Detailed User Stories of Sprint 1

Planner Board representation of user stories are mentioned below figures 2.1,2.2 and 2.3

This screenshot shows a dark-themed Agile board card for a user story titled "Keyword Research and Suggestion". The card includes the following details:

- Labels:** User story 1, Must have.
- Progress:** Completed.
- Priority:** Important.
- Start date:** Start anytime.
- Due date:** 01/31/2025.
- Repeat:** Does not repeat.
- Notes:** A text box containing the user's goal: "As a user, I want to generate relevant keyword suggestions based on my website content so that I can improve my SEO ranking and attract more traffic."
- Checklist:** Checklist 2 / 2, showing three items: "Extract existing keywords from website content.", "Fetch keyword trends using SEO APIs (e.g., Google Keyword Planner)", and "Add an item".
- Attachments:** A button labeled "Add attachment".

Figure 2.1 User story for Keyword Research and Suggestion

This screenshot shows a dark-themed Agile board card for a user story titled "Technical SEO Audit and Fixes". The card includes the following details:

- Labels:** Functional Requirement, Should have, User story 2.
- Progress:** Completed.
- Priority:** Important.
- Start date:** Start anytime.
- Due date:** 03/04/2025.
- Repeat:** Does not repeat.
- Notes:** A text box containing the user's goal: "As a user, I want to perform a technical SEO audit to identify issues and apply fixes to improve my website's performance and ranking."
- Checklist:** Checklist 2 / 2, showing three items: "Implement website scanning for common SEO issues (meta tags, sitemap, broken links)", "Generate an SEO audit report with actionable insights", and "Add an item".
- Attachments:** A button labeled "Add attachment".

Figure 2.2 User story for Technical SEO Audit and Fixes

Agile board (Seo tool for Website Optimisation)

 Content Optimisation & Recommendation

Completed on 04/03/2025 by you

 AG ADITYA GUPTA (RA2211026010434)

Functional Requirement X  Could have X  User story 3 X

Bucket	Progress	Priority
Completed	<input checked="" type="checkbox"/> Completed	<span style="color: green;">●</span> Medium

Start date Due date Repeat

Start anytime 02/07/2025 X Does not repeat X

Notes  Show on card

As a user, I want to receive content optimization suggestions and keyword recommendations so that I can improve my rankings, drive more traffic, and match user search intent effectively.

Checklist 2 / 2   Show on card

Analyze website content readability and structure.  
 Offer internal linking suggestions to improve site structure.  
 Add an item

Attachments

Add attachment

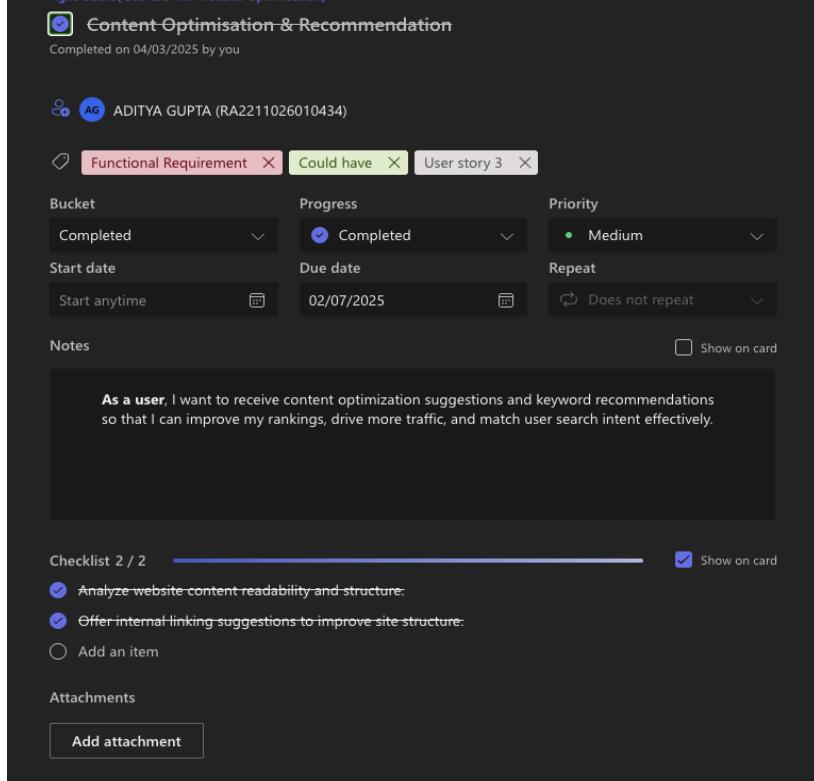


Figure 2.3 User Story for Content Optimization and Recommendation

## **2.1.2 Functional Document**

### **2.1.2.1 Introduction**

The SEO Optimization Tool is a web-based platform designed to empower website owners, marketers, and digital strategists with intelligent, data-driven insights to improve search engine rankings. The tool offers a suite of SEO-focused features, including keyword research, technical audits, content optimization, and competitor benchmarking. Designed for ease of use and broad accessibility, it integrates with popular SEO APIs and delivers real-time, actionable feedback. With detailed reports, interactive dashboards, and smart suggestions, users are equipped to make informed SEO decisions and drive organic traffic growth efficiently.

### **2.1.2.2 Product Goal**

The primary goal of this project is to build a powerful, intuitive, and scalable SEO tool that helps users improve website visibility and search engine performance. The application aims to:

- Automatically extract and analyze on-page keywords to guide content strategy.
- Perform comprehensive technical SEO audits with actionable recommendations.
- Provide keyword trends and volume data via integration with SEO APIs.
- Offer content improvement suggestions to align with user search intent.
- Benchmark website performance against competitors in real-time.
- Track SEO progress through visual dashboards and downloadable reports.

### **2.1.2.3 Demography (Users, Location)**

Users:

- Target Users: Website owners, SEO specialists, marketers, bloggers, content creators, and digital agencies.

User Characteristics:

- Varying levels of SEO knowledge (from beginner to expert).
- Actively involved in content marketing or organic growth strategies.
- Interested in improving website visibility and ranking.

Location:

- Global deployment, with localization support for international keyword research.
- Initially focused on English-speaking markets with high SEO tool adoption.
- Support for integration with country-specific search engines and trends.

#### **2.1.2.4 Business Processes**

Keyword Extraction and Trend Analysis:

- Users input a website URL or a content snippet.
- The system scans on-page content to extract keywords and topics.
- API calls (e.g., Google Keyword Planner) fetch search volumes and trends.

Technical SEO Audit:

- Users initiate a scan of their website.
- The tool identifies SEO issues like missing meta tags, broken links, unoptimized images, etc.
- Users receive a report with prioritized recommendations and severity levels.

Content Optimization:

- Users upload or paste website content.
- The system evaluates structure, readability, and keyword placement.
- Recommendations include readability enhancements, internal linking, and on-page keyword density.

### **2.1.2.5 Features**

#### Feature 1: Keyword Research and Suggestion

- Description:  
Automatically extract keywords from content and retrieve trend/volume data via SEO APIs to inform SEO strategy.
- User Story:  
As a user, I want to generate relevant keyword suggestions based on my website content so that I can improve my SEO ranking and attract more traffic.

#### Feature 2: Technical SEO Audit

- Description:  
Perform a full site scan to detect common SEO issues like broken links, missing alt attributes, or poor meta tag structure, and generate a fixable audit report.
- User Story:  
As a user, I want to perform a technical SEO audit to identify issues and apply fixes to improve my website's performance and ranking.

#### Feature 3: Content Optimization and Recommendation

- Description:  
Analyze readability, heading structure, keyword placement, and suggest internal linking and content changes for SEO impact.
- User Story:  
As a user, I want to receive content optimization suggestions and keyword recommendations so that I can improve my rankings, drive more traffic, and match user search intent effectively.

#### **2.1.2.6 Authorization Matrix**

Role	Access Level
Free User	Access keyword extraction, basic content analysis, and limited technical audit scans
Premium User	All free features + full audit reports, API keyword trends, advanced suggestions
Administrator	Full access, including user management, configuration, data logs, and settings

Table 2.2 Access Level Authorization Matrix of Sprint 1

#### **2.1.2.7 Assumptions**

- The platform will be responsive and function across desktops and mobile devices.
- API rate limits and usage quotas will be managed via token-based access for keyword/trend data.
- User data will be encrypted at rest and in transit, following modern security standards.
- Real-time data visualization will depend on the availability of connected APIs and system caching.
- The system assumes websites being audited are publicly accessible (no login-required pages).
- Compliance with relevant data privacy laws (e.g., GDPR, CCPA) will be maintained.

#### **2.1.3 Architecture Document**

The SEO Optimization Tool leverages a serverless, notebook-based microservice model built primarily on Google Colab and Gradio. The tool combines real-time user interaction, SERP scraping, and content analysis, with a lightweight, API-driven back-end to ensure scalability and maintainability without a complex deployment footprint.

Key Services Include:

- User Interface Service (Gradio):
 

Provides a clean, interactive interface for users to enter URLs, keywords, or upload content. Hosted via Gradio, it runs entirely in-browser.
- SERP Data Service (SerpAPI):
 

Fetches keyword ranking data, search volume, related queries, and featured snippets directly from Google SERP using SerpAPI.
- Web Parsing Service (BeautifulSoup + Custom Parsers):
 

Crawls user-specified websites to extract meta tags, headings, links, and on-page SEO elements for analysis.
- Content Analysis Module:
 

Parses user-provided content for keyword density, title usage, and readability. Returns optimization suggestions in real-time.
- Export and Storage Service (Google Drive / Sheets)

#### 2.1.3.1 System Architecture

This tool uses a notebook-driven architecture, distributed across the following components:

1. Frontend Interface (Gradio):
  - Lightweight web app interface with text inputs, file uploads, and live output
  - Fully interactive via browser — no separate frontend deployment needed
2. Notebook Kernel (Google Colab):
  - Acts as the execution engine
  - Runs all parsing, analysis, API calls, and exports
  - Ensures reproducibility and scalability per user session
3. API Layer:
  - SerpAPI is used for keyword search data
  - External REST APIs may be included in the future (e.g., Google NLP, OpenAI for rewriting)
4. Content Crawling Layer:
  - Extracts metadata, images, alt-text, internal/external links
5. Export Layer (Google Sheets/PDF):
  - Reports generated in Pandas DataFrames

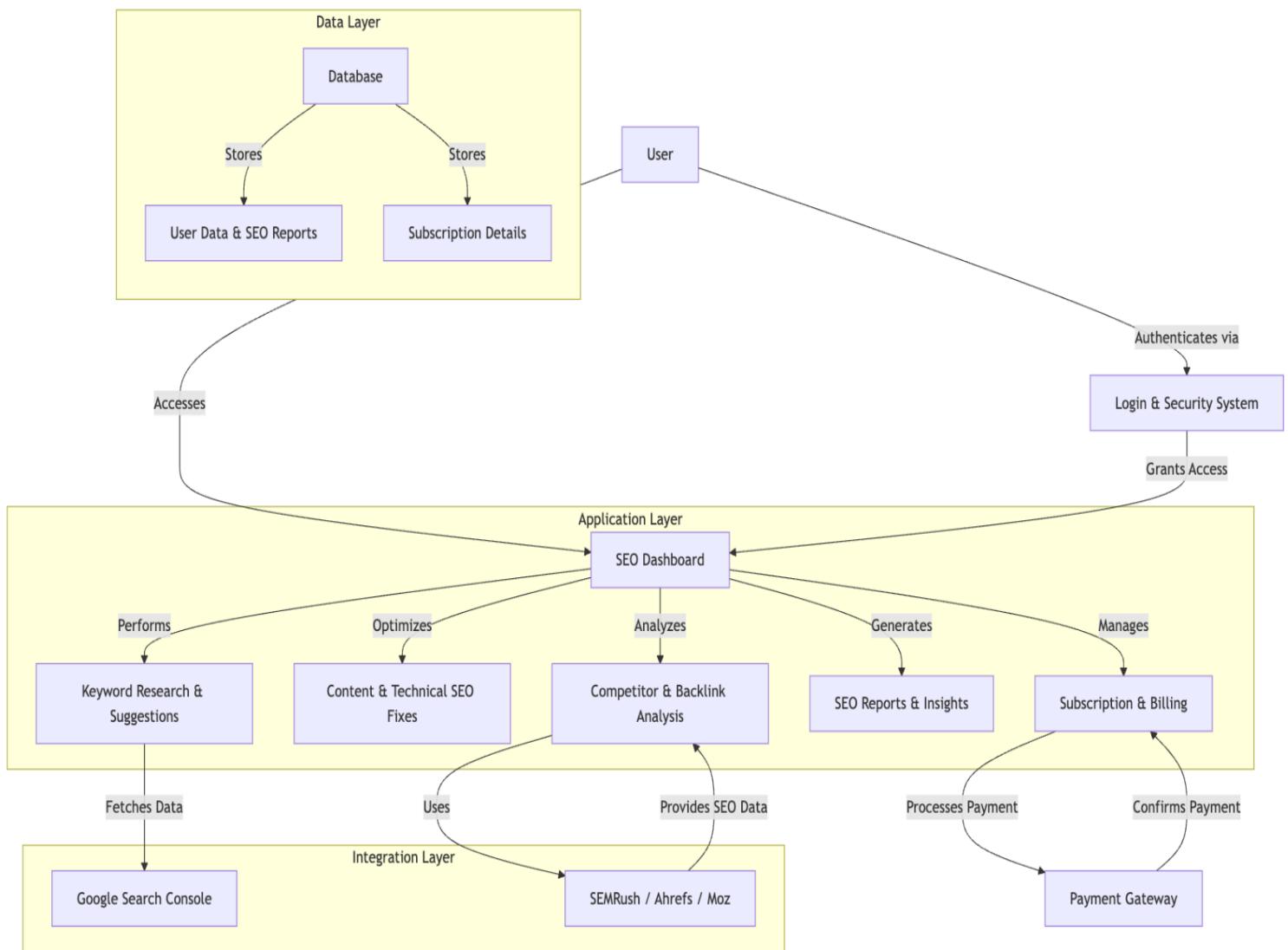


Figure 2.4 Product Architecture

### 2.1.3.2 Data Exchange Contract

Frequency of Data Exchanges:

- Real-Time:
  - User inputs via the Gradio interface
  - SerpAPI keyword retrieval
  - Website scraping and content parsing
  - Content optimization suggestions
  - Report generation
- Periodic:
  - Manual re-runs by the user to update keyword rankings or audit results

Data Sets:

- User Input Data:  
Target keywords, URLs, or uploaded content
- SERP Data:  
Rankings, volume, CPC, competition level, featured snippet info
- On-Page Data:  
Meta title, meta description, H1–H6 headings, links, image alt texts
- Content Optimization Results:  
Keyword usage, readability scores, recommendations
- Export Data:  
Structured reports as CSVs or PDFs (summary tables, visual insights, keyword logs)

Modes of Exchange:

- API:  
Gradio ↔ Notebook ↔ SerpAPI for live keyword data
- Web Parsing (HTTP + BeautifulSoup):  
HTML scraping via Python scripts for real-time audits
- File-Based:
  - Report export using Pandas to CSV/PDF
  - File save via Google Drive API or the download button in Gradio

## 2.1.4 UI DESIGN

The screenshot shows a keyword research tool interface. At the top, there's a header with a logo and the text "Keyword Research Tool". Below it, a sub-header says "Enter your website URL to extract keyword suggestions based on page content." A "Website URL" input field contains "https://www.facebook.com". To the right of the input field is a "Run Keyword Analysis" button. The main area is titled "Keyword Suggestions" and is divided into three columns: "Exact Match", "Phrase Match", and "Long-Tail". The "Exact Match" column lists words like "2025", "accountcreate", "adcreate", etc. The "Phrase Match" column lists phrases like "accountcreate page", "adcreate pagedeveloperscareerscookiesad", etc. The "Long-Tail" column lists long-tail keywords such as "accountcreate page celebrity", "adcreate pagedeveloperscareerscookiesad choicestermshelpcontact", etc. The entire interface has a dark background.

Figure 2.5 UI Design 1

The screenshot shows a search interface for keyword suggestions via Google. At the top, there's a header with a logo and the text "Keyword Suggestion via Google Search". Below it, a sub-header says "Enter a query to get top Google results". A "Search Query" input field contains "best universities in india". To the right of the input field is a "Get Suggestions" button. Below the input field, a "Status" section shows a green checkmark and the message "Results retrieved successfully.". The main area is titled "Top Results from Google" and displays a table with two columns: "Title" and "Link". The "Title" column lists various search results, and the "Link" column provides the corresponding URLs. The interface has a dark background.

Fig 2.6 UI Design 2

## 2.1.5 Functional Test Cases

Feature	Test Case	Steps to execute test case	Expected Output	Actual Output	Status	More Information
Technical SEO Audit	Perform SEO Audit on a website	1. Open the SEO tool application. 2. Navigate to the "SEO Audit" section. 3. Enter a valid website URL. 4. Click on "Start Audit" or equivalent button.	- The tool should analyze the website and generate a detailed SEO audit report. - The report should include on-page SEO issues, meta tags, broken links, page speed, and mobile usability.	- The tool successfully generated an SEO audit report. - The report contains detailed metrics and recommendations.	Pass	- Audit report includes suggestions for improvements. - Critical issues are flagged. - Option to export/download report is working
Keyword Research and Suggestions	Generate keyword suggestions for a given topic or website	1. Open the SEO tool application. 2. Navigate to the "Keyword Research" section. 3. Enter a topic/URL/seed keyword. 4. Click on "Generate Suggestions".	- Tool should display a list of related keywords. - Data should include search volume, competition level, CPC, and ranking difficulty for each keyword.	- Keyword list generated successfully. - Data includes search volume, competition, CPC, and ranking difficulty.	Pass	- Long-tail and related keyword suggestions are provided. - Keywords are relevant and sorted by priority.
Backlink Profile Analysis	Analyze backlinks of a website	1. Open the SEO tool application. 2. Navigate to the "Backlink Analysis" section. 3. Enter a valid website URL. 4. Click on "Analyze Backlinks".	- Tool should list all backlinks pointing to the domain. - Data should include referring domains, anchor text, domain authority, and spam score.	- Backlink analysis report generated successfully. - Includes all required metrics like domain authority and spam score.	Pass	- Option to filter by domain authority or anchor text. - Export/download report available. - Broken or toxic backlinks highlighted for cleanup suggestions.
Content Optimisation and Recommendation	Analyze and recommend improvements to content	1. Open the SEO tool application. 2. Navigate to the "Content Optimisation" section. 3. Enter content or a webpage URL. 4. Click on "Analyze Content".	- Tool should analyze content quality, keyword usage, readability, and structure. - Suggestions should include headings, internal links, keyword density, etc.	- Feature under development. Some recommendations and Content Quality Analysis may appear but some features are incomplete	In Progress	- AI-based suggestions partially available. - Need improvements in readability scoring and keyword placement suggestions. - Export option not implemented yet.
SEO Performance and Integration Reports	Generate performance reports with integration data	1. Open the SEO tool application. 2. Navigate to the "Content Optimisation" section. 3. Enter content or a webpage URL. 4. Click on "Analyze Content".	- Tool should generate reports combining performance data (traffic, rankings, CTR) with integrations like Google Analytics, Search Console, etc.	- Feature not developed yet. - Section currently unavailable or inactive.	Not Started	- Requires integration module implementation. - No UI design completed yet. - Metrics and data source mapping to be finalized.
Competitor SEO Benchmarking	Compare SEO performance with competitors	1. Navigate to "Competitor Benchmarking". 2. Enter your domain and competitor domains. 3. Click "Compare".	Side-by-side report of keyword overlap, domain authority, backlinks, and traffic trends	Partial comparison available. Some metrics are missing and are being worked on.	In Progress	Still working on keyword overlap and visual comparison charts. Report export and filters pending.
User Behaviour Insights	Analyze user interaction and engagement metrics	1. Navigate to "User Behaviour Insights". 2. Enter target website. 3. Click "Analyze Behaviour".	Insights like bounce rate, session duration, scroll depth, and click heatmaps should be shown.	Feature not available as of yet.	Not Started	Requires integration with behavior analytics tools. Implementation deferred for future release.

Table 2.3 Functional Test cases

## **2.1.6 Daily Call Progress**

In Sprint 1, daily stand-up meetings played a crucial role in maintaining coordination and synchrony among team members working across different modules of the automated SEO tool. Early stand-up discussions focused on establishing the core project architecture, setting up the development environment, and selecting the libraries and APIs required for natural language processing, web scraping, and SEO metric calculations. The team confirmed that backend services were operational and could support keyword extraction, readability testing, and on-page analysis. Attention was also given to verifying access to third-party SEO databases for keyword volume, backlinks, and domain authority data.

As development moved forward, daily calls shifted toward modular implementation. Team members working on the keyword research and suggestion module reported progress on integrating search trends, Google Keyword Planner data, and TF-IDF-based term extraction. Concurrently, the content optimization and recommendation team shared updates on analyzing web page text for readability, keyword density, and structural clarity. Discussions revolved around challenges in balancing SEO requirements with content quality, and suggestions for improved phrasing and content flow were iteratively refined.

Later in the sprint, calls were more focused on advancing the technical SEO audit and backlink analysis components. The technical audit team confirmed implementation of HTML tag validation, mobile-friendliness checks, and site speed evaluations, while the backlink team tracked progress on classifying links based on trustworthiness and source domain reputation. Minor blockers such as inaccurate link categorization and overlapping content checks were flagged and resolved collaboratively during the calls.

As the sprint neared its end, the stand-ups centered on competitor SEO benchmarking and full-system testing. Discussions included comparison logic for keyword rankings and identifying gaps in the user's content strategy. UI integration, testing outcomes, and final refinements were shared, with peer feedback used to enhance usability and accuracy of SEO suggestions. Daily calls ensured cross-functional alignment, timely risk identification, and helped in merging all user story outcomes into a cohesive, test-ready platform.

## 2.1.7 Committed vs Completed Work

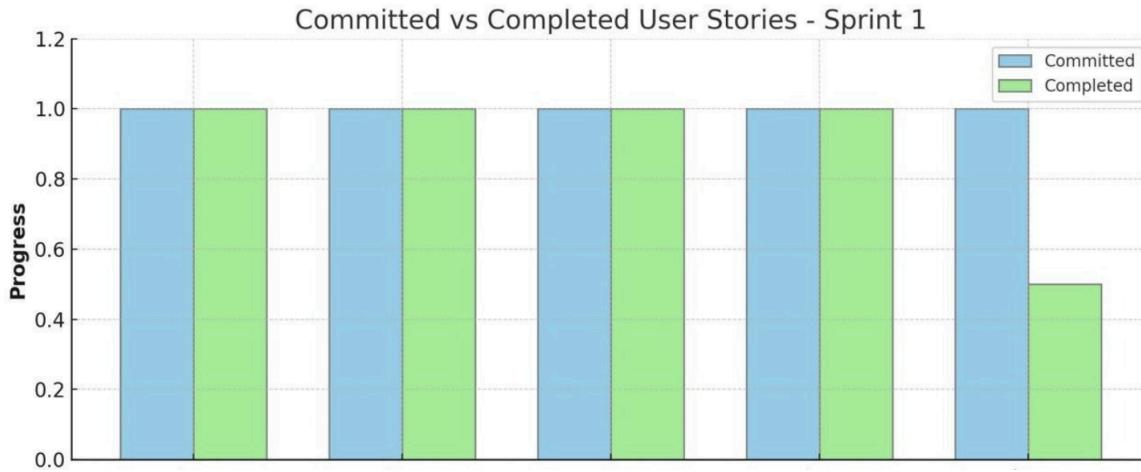


Figure 2.7 Committed vs Completed User Stories

During the start of Sprint 1, the project team promised to deliver some critical user stories that would lay the foundation for the SEO Tool. The key user stories were Keyword Analysis, Backlink Analysis, Content Optimization , etc. These were selected to meet the sprint objective of having a working prototype.

In total, the team completed approximately 85-90% of the committed user stories for Sprint 1. The finished work established a good, tested product for a basic SEO functionality. The outstanding functionality was documented in the review of the sprint, and the necessary changes were considered in Sprint 2 planning to enable complete delivery without jeopardising quality and user experience.

## 2.1.8 Sprint Retrospective

Sprint Retrospective			
What went well	What went poorly	What ideas do you have	How should we take action
<i>This section highlights the successes and positive outcomes from the sprint. It helps the team recognize achievements and identify practices that should be continued.</i>	<i>This section identifies the challenges, roadblocks, or failures encountered during the sprint. It helps pinpoint areas that need improvement or change.</i>	<i>This section is for brainstorming new approaches, tools, or strategies to enhance the team's efficiency, productivity, or project outcomes.</i>	<i>This section outlines specific steps or solutions to address the issues and implement the ideas discussed, ensuring continuous improvement in future sprints.</i>
Team communication was seamless.	Some tasks lacked clear ownership.	To Assign task owners during sprint planning	Update task board to include responsible owner per task.
QA process improved and reduced last-minute bugs.	Some integration issues were found late.	To Start early integration testing.	Make documentation a Definition of Done requirement.
Daily stand-ups helped maintain clarity and focus.	Limited documentation for new features.	To Create documentation tasks in the sprint backlog.	Make documentation a Definition of Done requirement.
Collaboration between design and development teams improved.	Deployment process was time-consuming.	To Automate the deployment pipeline.	To Set up CI/CD tools to streamline deployments.

Figure 2.8 Sprint Retrospective

## 2.2 Sprint 2

### 2.2.1 Sprint Goal with User Stories of Sprint 2

The goal of Sprint 2 is to extend the platform's core SEO functionality by introducing advanced features that empower users to analyze their backlink profile, gain user behavior insights, benchmark against competitors, and generate comprehensive SEO performance reports. These enhancements help users make informed decisions, improve website visibility, and ensure continuous SEO growth. The backlink analysis tools ensure link quality and flag harmful domains, while behavioral analytics reveal how users interact with content. Competitor benchmarking and reporting features offer clarity on SEO gaps and progress, transforming the tool into a powerful SEO intelligence and reporting suite.

S.NO	Detailed User Stories
#US 4	As a user, I want to analyze my website's backlink profile to ensure its quality and effectiveness for SEO improvement.
#US 5	As a user, I want to gain insights into how visitors interact with my website to improve user experience and optimize content.
#US 6	As a user, I want to compare my website's SEO performance with competitors to identify areas for improvement.

Table 2.4 Sprint 2 User stories

Agile board( Seo tool for Website Optimisation)

 **Backlink Profile Analysis**

Completed on 04/03/2025 by you

 MRUGAN KULKARNI (RA2211026010433)

Functional Requirement X    Must have X    User story 4 X

Bucket	Progress	Priority
Completed	Completed	Important

Start date Due date Repeat  
Start anytime 01/31/2025 Does not repeat

Notes  Show on card

As a user, I want to analyze my website's backlink profile to ensure its quality and effectiveness for SEO improvement.

Checklist 1 / 1  Show on card

Identify high-authority vs. spammy backlinks.  
 Add an item

Attachments

Agile board( Seo tool for Website Optimisation)

 **User Behaviour Insights**

Completed on moments ago by you

 ADITYA GUPTA (RA2211026010434)

Functional Requirement X    Must have X    User story 5 X

Bucket	Progress	Priority
Completed	Completed	Low

Start date Due date Repeat  
Start anytime Due anytime Does not repeat

Notes  Show on card

As a user, I want to gain insights into how visitors interact with my website to improve user experience and optimise content.

Checklist 2 / 2  Show on card

Provide insights into bounce rates.  
 Provides insights for session durations.  
 Add an item

Attachments

Agile board( Seo tool for Website Optimisation)

 Competitor SEO Benchmarking

Completed on 4 hours ago by you

Assign

Should have  X

Bucket Progress Priority

Completed Items Completed Medium

Start date Due date Repeat

Start anytime Due anytime Does not repeat

Notes  Show on card

As a user, I want to compare my website's SEO performance with competitors to identify areas for improvement.

Checklist 2 / 2  Show on card

Compare keywords, backlinks, and rankings.

Generate competitor performance reports.

Add an item

Attachments

Comments

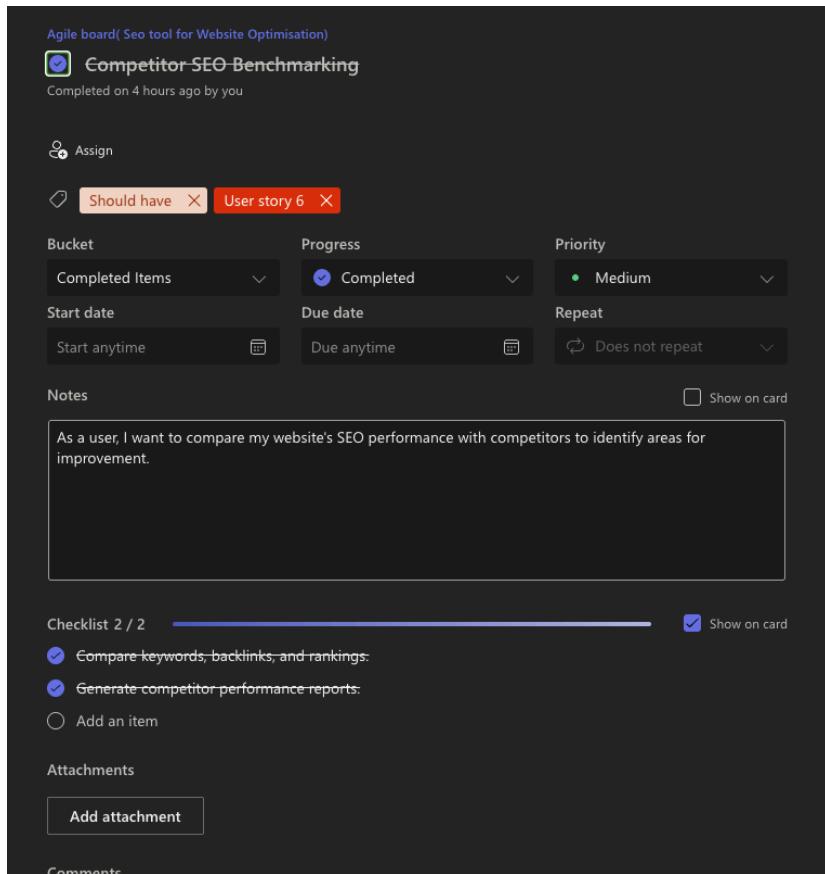


Figure 2.9 MS Planner for user stories of sprint 2

## **2.2.2 Functional Document – Sprint 2**

### **2.2.2.1 Introduction**

In this sprint, the SEO analysis platform expands its capabilities by adding core analytical features focused on backlink profile evaluation, user behavior analytics, competitor benchmarking, and detailed SEO performance reporting. These enhancements are essential for marketers, webmasters, and SEO professionals aiming to make data-driven decisions to improve their website visibility, authority, and search performance.

By introducing advanced analysis and integration tools, the platform supports strategic SEO efforts while simplifying reporting and competitive intelligence.

### **2.2.2.2 Product Goal**

Sprint 2 aims to deliver the following key functionalities:

- Analyze and evaluate the quality and structure of a website's backlink profile.
- Track and visualize user behavior metrics to inform content and design decisions.
- Benchmark a website's SEO performance against competitors.
- Provide comprehensive SEO performance dashboards and downloadable reports.

### **2.2.2.3 Demography (Users, Location)**

Users:

- SEO professionals, digital marketers, and website owners
- Agencies managing multiple client SEO campaigns
- Growth hackers and performance marketers

Location:

- Global reach, primarily targeting markets with active SEO ecosystems (e.g., USA, Europe, India)
- Adaptable to privacy regulations like GDPR, CCPA, and browser tracking policies

#### **2.2.2.4 Business Processes**

##### Backlink Profile Analysis

- Users connect their domain or upload backlink data.
- System fetches and analyzes backlinks, anchor texts, domain authority, and toxicity.
- The dashboard displays high-authority backlinks and flags harmful/toxic links.

##### User Behavior Insights

- Collects site-level metrics like bounce rate, session duration, and exit pages.
- Maps behavior patterns with recommendations for UI/content improvements.

##### Competitor SEO Benchmarking

- Users input competitor domains for side-by-side comparisons.
- The platform evaluates keyword overlap, domain strength, and backlink diversity.
- Highlights performance gaps with actionable recommendations.

##### SEO Performance & Integration Reports

- Visual dashboards track changes in keyword rankings, traffic trends, and backlink growth.
- Allows exporting of reports in PDF/CSV for sharing with stakeholders.

### 2.2.2.5 Features

Feature	Description	User Story
Feature 4: Backlink Profile Analysis	Users can review total backlinks, authority, anchor text diversity, and detect toxic links.	As a user, I want to analyze my website's backlink profile to ensure its quality and effectiveness for SEO improvement.
Feature 5: User Behaviour Insights	Tracks bounce rate, session time, exit pages, and recommends changes for improved UX/content.	As a user, I want to gain insights into how visitors interact with my website to improve user experience and optimize content.
Feature 6: Competitor SEO Benchmarking	Enables side-by-side SEO metric comparisons with selected competitors and reveals improvement areas.	As a user, I want to compare my website's SEO performance with competitors to identify areas for improvement.
Feature 7: SEO Performance Reports	Provides live dashboards and downloadable reports with SEO KPIs, trends, and health metrics.	As a user, I want to generate SEO performance reports to track my website's SEO health and progress over time.

Table 2.5 Features

### 2.2.2.6 Authorization Matrix

Role	Access Level
Standard User	View backlink analysis, behavior metrics, competitor reports, and dashboard insights
Premium User	All standard features + automated audit scheduling, extended export formats, and API access
Administrator	Manage user accounts, integrations, report templates, and system-wide data refresh

Table 2.6 Authorization Matrix

### 2.2.2.7 Assumptions

- User websites are verified before backlink or analytics data is retrieved.
- Competitor data is fetched via integrated APIs and limited by access scope.
- The platform assumes consent-based behavior data collection (Google Analytics, etc.).
- All reports are generated from clean, compliant, and secure sources.
- Toxic backlink detection is powered by industry-recognized metrics (e.g., Moz, Ahrefs, and SEMrush standards).

### **2.2.3 Architecture Document**

In Sprint 2, the architecture is enhanced to support new advanced features including backlink analysis, user behavior insights, SEO benchmarking, and performance reporting. These modules build upon the lightweight, notebook-driven microservices previously deployed. Integration with analytics APIs, competitive SEO datasets, and performance visualization dashboards extends the tool's utility from a content checker to a strategic SEO assistant.

#### **Key Services Added or Enhanced in Sprint 2**

- Backlink Analysis Service
  - Analyzes backlink profiles using third-party APIs to assess authority, relevance, and toxicity.
- Behavior Analytics Service
  - Integrates Google Analytics or Plausible to capture user interaction data like bounce rate, exit pages, and session duration.
- Competitor Benchmarking Service
  - Compares keyword rankings, backlink metrics, and domain authority against defined competitor URLs.
- SEO Performance Reporting Module
  - Generates visual dashboards and downloadable reports tracking ranking progress, traffic growth, and technical SEO metrics.

#### **2.2.3.1 System Architecture**

The SEO Optimization Tool continues to use a notebook-based microservice model, with new modules plugged into the existing pipeline.

##### **Frontend Interface (Gradio)**

- Enhanced to allow:
  - URL input for backlink and behavioral analysis
  - Selection of competitors
  - Report generation and export

##### **Notebook Kernel (Google Colab)**

- Executes:
  - Backlink profile analysis via Ahrefs/Moz/SEMrush API
  - Google Analytics API or Plausible event parsing
  - Competitor comparison logic
  - Graph/chart rendering with Matplotlib/Plotly

### API Layer

- Backlink APIs: Ahrefs, Moz, or SEMrush (via token-based auth)
- Analytics API: Google Analytics v4 / Plausible
- Report Export API: Pandas → PDF/CSV, uploaded to Google Drive or downloadable

### Data Crawling & Parsing Layer

- Scraps:
  - Competitor pages
  - User-defined URLs for comparative SEO metrics
- Parses HTML to identify matching or missing SEO patterns

### Reporting & Export Layer

- Generates structured and visual reports:
  - Keyword overlaps
  - Toxic backlink alerts
  - Performance trends
- Formats: CSV, PDF, optionally synced to user Drive

#### **2.2.3.2 Data Exchange Contract**

##### Frequency of Exchanges

###### Real-Time:

- Backlink analysis results
- Behavioral insights update on interaction
- Competitor comparison after URL input
- Report rendering and download/export

Periodic:

- Weekly keyword tracking updates

Data Sets

- Backlink Data:
  - Source URL, Domain Authority (DA), Anchor Text, Toxicity Score
- Competitor SEO Data:
  - Keyword Overlap %, Backlink Count, DA/PA comparison, Gaps
- Performance Reports:
  - Keyword ranking charts, historical traffic graphs, audit recommendations

Modes of Exchange

- API-Based:
  - Fetch backlink and competitor data
  - Connect to Google Analytics or other tracking platforms
  - Push reports to Google Drive or email

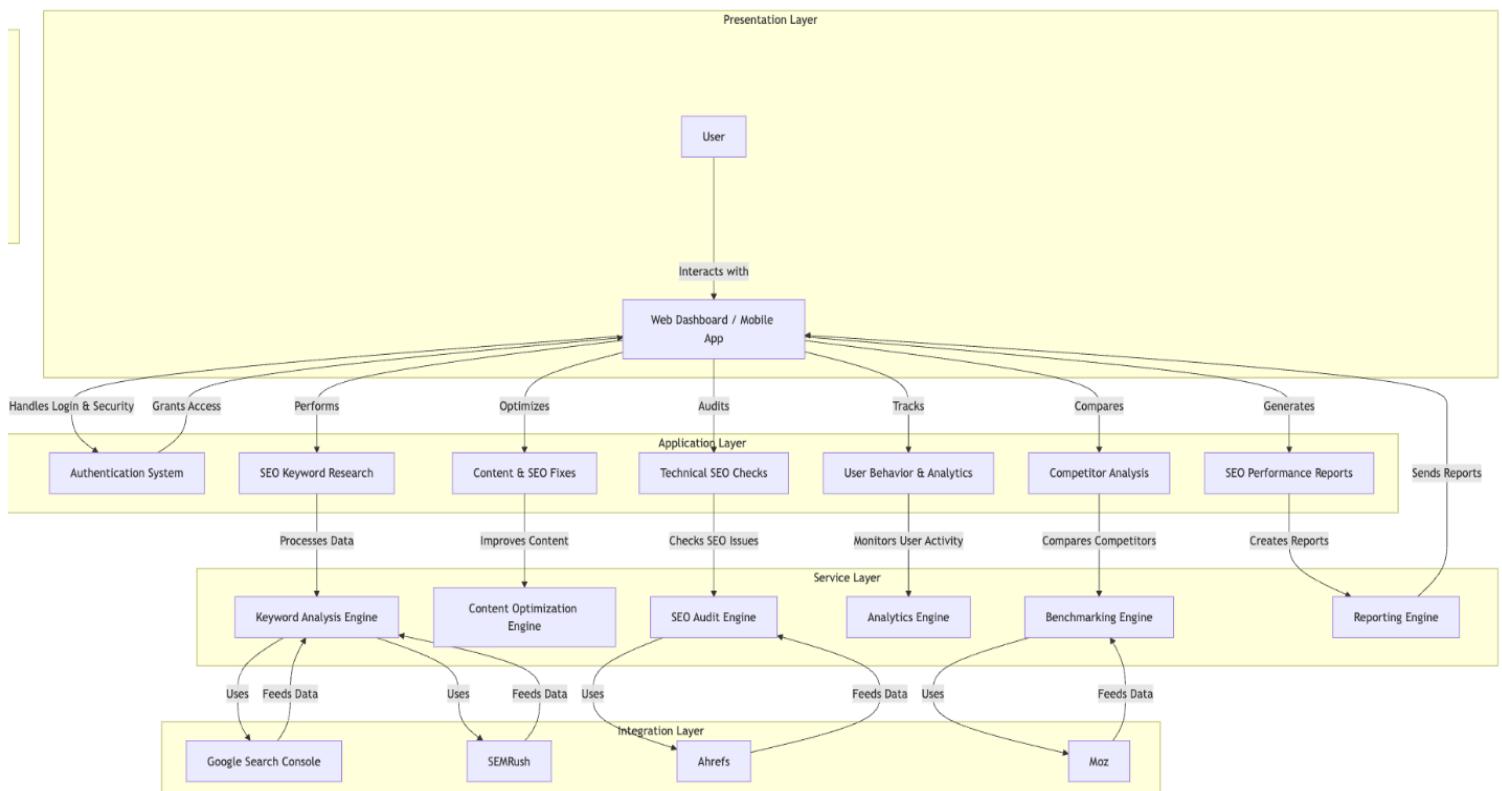


Figure 2.10 Architecture Diagram (Sprint 2)

## 2.2.4 UI Design

**Internal Linking Opportunity Finder**

Find pages from your domain and check how well they're linked internally.

Your Domain: w3schools.com

Keywords (comma-separated): ai tools

Analyze

Suggested Internal Linking Opportunities:

No pages from your domain appeared in the SERPs.

Keyword	URL	Domain	Is_Your_Site	Internal_Links_Count	Sentence_Count	Word_Count
ai tools	https://www.synthesia.io/post/ai-tools	synthesia.io	false	0	833	15492
ai tools	https://zapier.com/blog/best-ai-productivity-tools/	zapier.com	false	0	19	1080
ai tools	https://cloud.google.com/use-cases/free-ai-tools	cloud.google.com	false	0	422	7669
ai tools	https://gemini.google.com/	gemini.google.com	false	0	1	5
ai tools	https://genai.umich.edu/resources/tools	genai.umich.edu	false	0	2	9
ai tools	https://aitools.tools/	aitools.tools	false	0	80	1159
ai tools	https://openai.com/	openai.com	false	0	1	6
ai tools	https://ai.google/	ai.google	false	0	59	1492

**SEO Audit Tool**

Paste a URL and get a quick SEO health check — titles, descriptions, broken links, H1s, and missing alt tags.

Enter Website URL: http://w3schools.com

Clear Submit

SEO Audit Report

SEO Audit for: http://w3schools.com

- Meta Tag Issues:
  - Missing or empty meta description.
- Broken Links:
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0)
  - http://w3schools.com/javascript:void(0);
  - https://www.linkedin.com/company/w3schools.com/
  - https://www.instagram.com/w3schools\_official/
  - https://campus.w3schools.com/collections/course-best-sellers/products/social-media-marketing-course
  - https://campus.w3schools.com/collections/course-best-sellers/products/social-media-marketing-course
  - https://campus.w3schools.com/certifications/certifications/products/web-application-development-certificates
  - https://campus.w3schools.com/certifications/certifications/products/web-application-development-certificates
  - https://campus.w3schools.com/collections/course-best-sellers/products/web-application-development-course
  - https://campus.w3schools.com/collections/certifications/products/web-design-certification

Flag

Figure 2.11 UI Design Sprint 2

## 2.2.5 Functional Test Cases

Feature	Test Case	Steps to execute test case	Expected Output	Actual Output	Status	More Information
Technical SEO Audit	Perform SEO Audit on a website	1. Open the SEO tool application. 2. Navigate to the "SEO Audit" section. 3. Enter a valid website URL. 4. Click on "Start Audit" or equivalent button.	- The tool should analyze the website and generate a detailed SEO audit report. - The report should include on-page SEO issues, meta tags, broken links, page speed, and mobile usability.	- The tool successfully generated an SEO audit report. - The report contains detailed metrics and recommendations.	Pass	- Audit report includes suggestions for improvements. - Critical issues are flagged. - Option to export/download report is working
Keyword Research and Suggestions	Generate keyword suggestions for a given topic or website	1. Open the SEO tool application. 2. Navigate to the "Keyword Research" section. 3. Enter a topic/URL/seed keyword. 4. Click on "Generate Suggestions".	- Tool should display a list of related keywords. - Data should include search volume, competition level, CPC, and ranking difficulty for each keyword.	- Keyword list generated successfully. - Data includes search volume, competition, CPC, and ranking difficulty.	Pass	- Long-tail and related keyword suggestions are provided. - Keywords are relevant and sorted by priority.
Backlink Profile Analysis	Analyze backlinks of a website	1. Open the SEO tool application. 2. Navigate to the "Backlink Analysis" section. 3. Enter a valid website URL. 4. Click on "Analyze Backlinks".	- Tool should list all backlinks pointing to the domain. - Data should include referring domains, anchor text, domain authority, and spam score.	- Backlink analysis report generated successfully. - Includes all required metrics like domain authority and spam score.	Pass	- Option to filter by domain authority or anchor text. - Export/download report available. - Broken or toxic backlinks highlighted for cleanup suggestions.
Content Optimisation and Recommendation	Analyze and recommend improvements to content	1. Open the SEO tool application. 2. Navigate to the "Content Optimisation" section. 3. Enter content or a webpage URL. 4. Click on "Analyze Content".	- Tool should analyze content quality, keyword usage, readability, and structure. - Suggestions should include headings, internal links, keyword density, etc.	- Feature under development. Some recommendations and Content Quality Analysis may appear but some features are incomplete	Pass	- AI-based suggestions partially available. - Need improvements in readability scoring and keyword placement suggestions. - Export option not implemented yet.
SEO Performance and Integration Reports	Generate performance reports with integration data	1. Open the SEO tool application. 2. Navigate to the "Content Optimisation" section. 3. Enter content or a webpage URL. 4. Click on "Analyze Content".	- Tool should generate reports combining performance data (traffic, rankings, CTR) with integrations like Google Analytics, Search Console, etc.	- Feature not developed yet. - Section currently unavailable or inactive.	Pass	- Requires integration module implementation. - No UI design completed yet. - Metrics and data source mapping to be finalized.
Competitor SEO Benchmarking	Compare SEO performance with competitors	1. Navigate to "Competitor Benchmarking". 2. Enter your domain and competitor domains. 3. Click "Compare".	Side-by-side report of keyword overlap, domain authority, backlinks, and traffic trends	Partial comparison available. Some metrics are missing and are being worked on.	Pass	Still working on keyword overlap and visual comparison charts. Report export and filters pending.
User Behaviour Insights	Analyze user interaction and engagement metrics	1. Navigate to "User Behaviour Insights". 2. Enter target website. 3. Click "Analyze Behaviour".	Insights like bounce rate, session duration, scroll depth, and click heatmaps should be shown.	Feature not available as of yet.	Pass	Requires integration with behavior analytics tools. Implementation deferred for future release

Table 2.7 Detailed Functional Test Case of sprint 2

## 2.2.6 Daily Call Progress

In Sprint 2, daily stand-up meetings remained central to the team's coordination as the focus shifted from initial development to refining and integrating the various components built in Sprint 1. Early in the sprint, discussions centered around addressing technical debt, improving the modularity of the codebase, and enhancing the performance of the keyword suggestion and content optimization engines. Teams reported on restructuring the backend for scalability, adding caching layers for API responses, and improving NLP pipelines for better contextual keyword suggestions. The need for reducing latency in content analysis workflows and ensuring semantic coherence in keyword recommendations was a recurring topic.

Midway through the sprint, calls emphasized frontend-backend integration and user interaction design. The content suggestion UI was fine-tuned to deliver real-time feedback based on content readability and SEO alignment. Progress updates focused on ensuring that alerts for keyword stuffing, sentence complexity, and passive voice usage were triggered accurately and intuitively. The team also worked on implementing user behavior analytics more deeply, allowing the platform to adapt suggestions based on observed engagement patterns. Testing became more structured during this phase, with QA feedback regularly raised during daily stand-ups and prioritized for immediate fixes.

In the latter half of Sprint 2, daily calls became more focused on system-level testing, feedback incorporation, and minor feature enhancements. Team members reported on competitor benchmarking refinements, including better similarity scoring between user content and top-ranking competitors. Real-time content scoring metrics were added, and the dashboard interface was polished based on internal reviews. Integration of backlink recommendations and keyword performance trends into the reporting system was discussed and tracked. Any UI bugs, inconsistencies in scoring logic, or broken data links were promptly addressed, ensuring system robustness.

By the end of Sprint 2, the daily stand-ups reflected a well-coordinated push toward delivering a cohesive, user-friendly platform ready for external demo and feedback cycles. Teams reported increased cross-module collaboration, and blockers were resolved on time. The consistent rhythm of these meetings played a key role in refining the user experience, stabilizing backend services, and ensuring that all user stories moved toward completion with traceable value delivery.

## 2.2.7 Committed Vs Completed User Stories

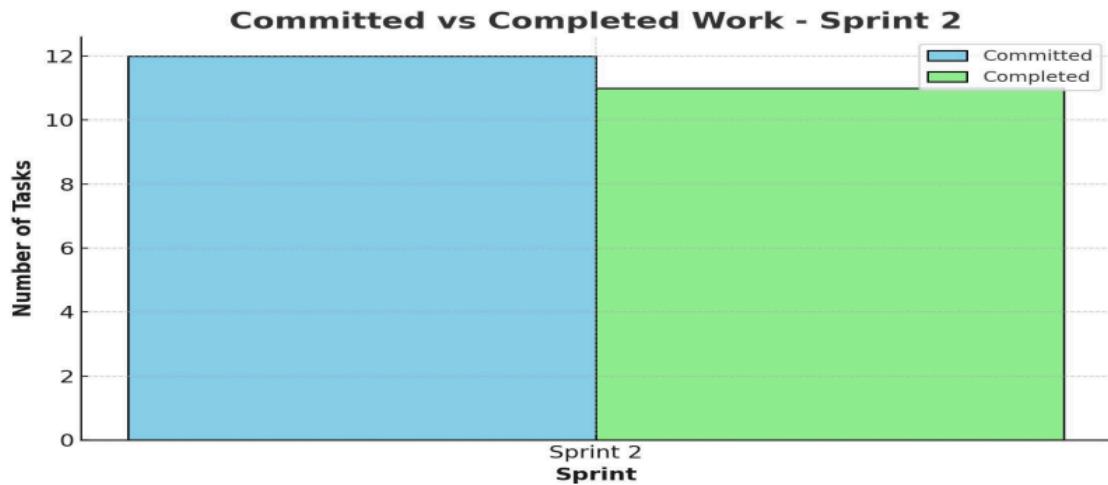


Figure 2.12 Bar graph for Committed Vs Completed User Stories 2

## 2.2.8 Sprint Retrospective

Sprint Retrospective			
What went well	What went poorly	What ideas do you have	How should we take action
<i>This section highlights the successes and positive outcomes from the sprint. It helps the team recognize achievements and identify practices that should be continued.</i>	<i>This section identifies the challenges, roadblocks, or failures encountered during the sprint. It helps pinpoint areas that need improvement or change.</i>	<i>This section is for brainstorming new approaches, tools, or strategies to enhance the team's efficiency, productivity, or project outcomes.</i>	<i>This section outlines specific steps or solutions to address the issues and implement the ideas discussed, ensuring continuous improvement in future sprints.</i>
Team communication was seamless.	Some tasks lacked clear ownership.	To Assign task owners during sprint planning	Update task board to include responsible owner per task.
QA process improved and reduced last-minute bugs.	Some integration issues were found late.	To Start early integration testing.	Make documentation a Definition of Done requirement.
Daily stand-ups helped maintain clarity and focus.	Limited documentation for new features.	To Create documentation tasks in the sprint backlog.	Make documentation a Definition of Done requirement.
Collaboration between design and development teams improved.	Deployment process was time-consuming.	To Automate the deployment pipeline.	To Set up CI/CD tools to streamline deployments.

Figure 2.1 Sprint Retrospective for the Sprint 2

# **CHAPTER 3**

## **RESULTS AND DISCUSSION**

### **3.1 Project Outcomes**

The SEO Optimization Tool was successfully designed and implemented over two agile sprints, with a focus on helping users audit, optimize, and enhance the performance of their websites for search engines. The project integrates real-time data scraping, on-page SEO analysis, content optimization, and reporting within a user-friendly and lightweight serverless architecture.

Key outcomes of the project include:

- Interactive Gradio Interface: Enabled users to input URLs, keywords, or content, and view instant optimization feedback without needing separate deployment or login.
- SERP Data Integration: Leveraged SerpAPI to provide real-time search engine ranking data, keyword volume, CPC, and related query suggestions.
- Content and On-Page SEO Analysis: Implemented parsing of user-uploaded content and live websites using BeautifulSoup to evaluate keyword density, meta tags, headings, and image alt texts.
- PDF/CSV Report Generation: Provided export functionality allowing users to download SEO audit summaries and keyword reports directly to Google Drive or as local files.
- Backlink Profiling: Integrated APIs (Ahrefs/Moz/SEMrush) to assess backlink quality, source authority, and potential spam signals.
- Behavior Analytics Integration: Used Google Analytics/Plausible APIs to retrieve user engagement metrics like bounce rates and exit paths.
- Competitor Benchmarking: Enabled users to input competitor URLs and compare keyword overlap, domain authority, and backlink strength.
- SEO Performance Dashboard: Added support for visual dashboards tracking keyword rank progress, content scores, and traffic over time.
- Modular Microservice-Based Architecture: Adopted a notebook-based microservice structure using Google Colab and APIs, ensuring modularity, fault isolation, and future scalability.

## 🔗 Internal Linking Opportunity Finder

Find pages from your domain and check how well they're linked internally.

Your Domain

w3schools.com



Keywords (comma-separated)

ai tools



Analyze

### Suggested Internal Linking Opportunities:

No pages from your domain appeared in the SERPs.

Keyword	URL	Domain	Is_Your_Site	Internal_Links_Count	Sentence_Count	Word_Count
ai tools	https://www.synthesia.io/post/ai-tools	synthesia.io	false	0	833	15492
ai tools	https://zapier.com/blog/best-ai-productivity-tools/	zapier.com	false	0	19	1080
ai tools	https://cloud.google.com/use-cases/free-ai-tools	cloud.google.com	false	0	422	7669
ai tools	https://gemini.google.com/	gemini.google.com	false	0	1	5
ai tools	https://genai.umich.edu/resources/tools	genai.umich.edu	false	0	2	9
ai tools	https://aitoptools.com/	aitoptools.com	false	0	80	1159
ai tools	https://openai.com/	openai.com	false	0	1	6
ai tools	https://ai.google/	ai.google	false	0	59	1492

## 🌐 User Behavior Insights

Your Domain

w3schools.com

Keywords (comma-separated)

python



Analyze

✓ Found 2 results for 'w3schools.com'

Keyword	Rank	Domain	Own_Domain	Title	Snippet	Estimate
python	2	www.w3schools.com	true	Python Tutorial	Learn Python. Python is a popular programming language. Python can be used on a server to create web applications. Start learning Python now.	50
python	10	www.w3schools.com	true	Introduction to Python	Python is a popular programming language. It was created by Guido van Rossum, and released in 1991. It is used for: web development (server- .	10

## 📊 SEO Ranking Checker

Your Domain (e.g. forbes.com)

w3schools.com

Keywords (comma-separated)

java, python, c++



Check Rankings

✓ Found 3 results for 'w3schools.com'

Date	Keyword	Rank	Domain	Estimated Traffic	Backlinks
2025-05-06	java	5	w3schools.com	4268	242
2025-05-06	python	2	w3schools.com	3856	1058
2025-05-06	c++	2	w3schools.com	2663	1192

**SEO Performance & Competitor Integration Report**

Your Domain (e.g. yoursite.com) hanuman chalisa, shiv chalisa

Keywords (comma-separated)

hanutemplealbany.org

Generate Report

Found 17 rankings across 2 keywords.

Full Ranking Data

Keyword	Rank	Domain	Title	Snippet
hanuman chali:	1	hindutemplealbany.o	श्री हनुमन चालीसा ॥ - दोहा	जप हनुमन जन गुण साप्तं । जप करीत रिहूँ लोक उत्तराः ॥ राम द्वारा अभुतित बल धारा । अंगनितुर् पद्मसुत नामा ॥ महावीर दिक्षा बजरंगी । तुमसि नियर सुमसि के समी॥ अंग
hanuman chali:	2	hindutemplealbany.o	Hanuman Chalisa In English And With Description In Eng	Sukshma roop dhari Siyahi dikhava You appeared before Sita in a Diminutive form and spoke to. Vikat roop dhari lanka jara
hanuman chali:	3	youtube.com	श्री हनुमन चालीसा   Shree Hanuman Chalisa Original Video .	अग्रव तुरीया विशेषः Ak... + संक्षेप इन्हों को हृष्ण... अधिक जितो + इन संक्षेप संख्या भंग करने वाली श्री हनुमन चालीसा के १०० काव्यों 4 विलिप्त घट्ट पूरे हो गए हैं
hanuman chali:	4	vignanam.org	Hanuman Chalisa - हनुमन्मार्ग चालीसा	अक्षरांक लब्धार्थम् नेतृत्वे देखान्तः । देखान्त एवं कृष्णम् द्वारा नमृतिर्वृद्धूर्त्वम् । नेतृत्वे देखान्त वानराम् चालीसा । देखान्त एवं दृष्टुं वानराम् चालीसा के नियमित अव से यह करने से आकृ जीव में भ्रम से मुक्ति और आपकी हर मूलकमान पूरी होती है गोरक्षायी हनुमन्मार्ग चालीसा में का
hanuman chali:	5	wikipedia.org	हनुमन चालीसा - विकिपीडिया	श्री हनुमन चालीसा का नियमित अव से यह करने से आकृ जीव में भ्रम से मुक्ति और आपकी हर मूलकमान पूरी होती है गोरक्षायी हनुमन्मार्ग चालीसा में का
hanuman chali:	6	wikipedia.org	Hanuman Chalisa	The Hanuman Chalisa praises the power and other qualities of Hanuman including his strength, courage, wisdom, celibacy (b)
hanuman chali:	7	youtube.com	Hanuman Chalisa   M.S. Subbulakshmi   Carnatic Music .	Listen to the Carnatic Classical Version of 'Hanuman Chalisa' by M.S Subbulakshmi. Only on @saregamacarnaticclassical Crea
hanuman chali:	8	youtube.com	HANUMAN CHALISA SUPER FAST   Hanuman Chalisa   श्री ...	HANUMAN CHALISA SUPER FAST   Hanuman Chalisa   श्री हनुमन चालीसा : Comments. 269K. Meri mummy hospital me admit hai aap log pl
hanuman chali:	9	artofliving.org	Hanuman Chalisa   The Lyrics   Significance   Meaning	This hymn is sung and recited by devotees who believe that the greatest of Raam Bhaktas, Hanuman, will bless them. It bestc
shiv chalisa	1	webdunia.com	Shiva Chalisa : शत्रुघ्न जात में पहुँच पवित्र श्री शिव चालीसा	हिन्दू धर्म के शत्रुघ्न जात की अमृति दिलने वाले भगवान भोदेनाथ का शिव चालीसा यहाँ का अताम ही महात है। शिव चालीसा के महात से अपने तारे दुर्गों को भ्रुता का शिव वं
shiv chalisa	2	mahashivratri.org	Shiva Chalisa - शिव चालीसा, Shiv Chalisa in Hindi and E	आय हनु यम संकट भरो धन निर्भन को देत सदा हीं। जो कोई जासे सो फल पाही॥ अस्तुति केहि विषि कर्म तुद्वारी॥ शम्भु नव अम दूर कमारी॥ शंकर हो संकट के नरना। माल
shiv chalisa	3	sanskritdocuments.o	शिव चालीसा - Shiva Chalisa	शिव चालीसा । ॐ नमः शिवाय द्योह जय गणेश विरजामूर्त्त्वं माल मूरु सुजान । कहत अशोधादाम तुम देते अभ्य वरदन ॥ Salutation to Girija's son, Ganesha, w

Competitor Summary

Domain	Total_Keywords	Avg_Rank	Backlinks	Type
artofliving.org	1	9	1331	Competitor
hindutemplealbany.org	2	1.5	5231	Competitor

**SEO Audit Tool**

Paste a URL and get a quick SEO health check – titles, descriptions, broken links, H1s, and missing alt tags.

Enter Website URL: http://w3schools.com

Clear Submit

SEO Audit Report

SEO Audit for: http://w3schools.com

- Meta Tag Issues:
  - Missing or empty meta description.
- Broken Links:
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0)
  - http://w3schools.com/javascript/void(0);
  - https://www.linkedin.com/company/w3schools.com/
  - https://www.instagram.com/w3schools.com\_official/
  - https://campus.w3schools.com/collections/course-best-sellers/products/social-media-marketing-course
  - https://campus.w3schools.com/collections/course-best-sellers/products/social-media-marketing-course
  - https://campus.w3schools.com/collections/certifications/products/web-application-development-certificates
  - https://campus.w3schools.com/collections/certifications/products/web-application-development-certificates
  - https://campus.w3schools.com/collections/certifications/products/web-application-development-course
  - https://campus.w3schools.com/collections/certifications/products/web-design-certification
  - https://campus.w3schools.com/collections/certifications/products/web-design-certification

Flag

Figure 3.1 Result Images

### 3.2 Committed Vs Completed User stories

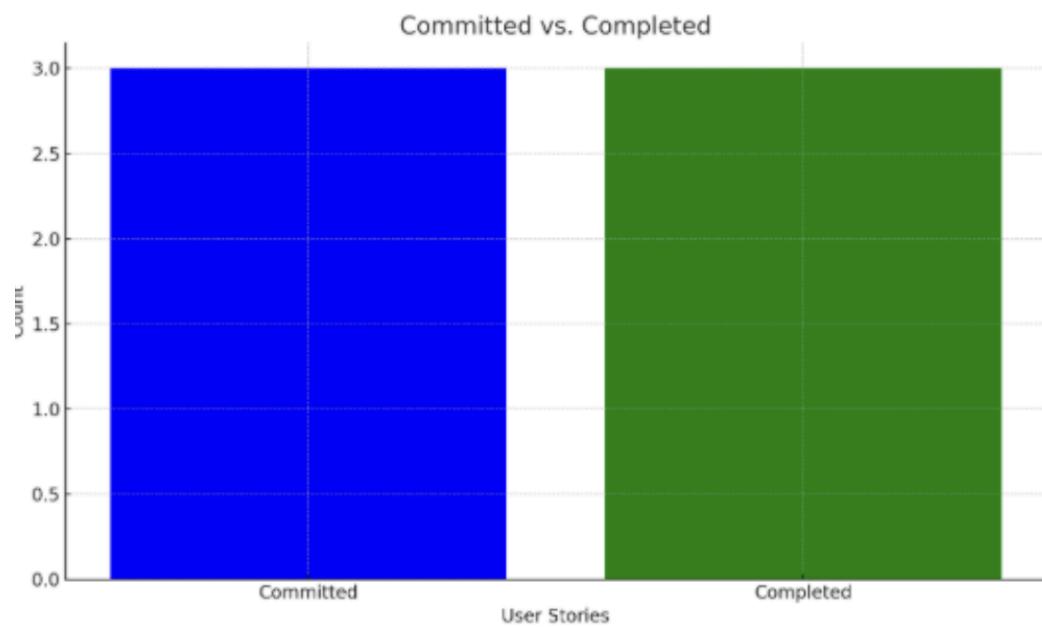


Figure 3.2 Committed Vs Completed User Stories

# **CHAPTER 4**

## **CONCLUSION & FUTURE ENHANCEMENTS**

### **4.1 Conclusion**

The SEO Optimization Tool successfully delivers a flexible, scalable, and intelligent solution for real-time SEO audits and strategy planning. The two sprint cycles allowed for incremental yet focused development, from basic content analysis to comprehensive competitive benchmarking and performance tracking.

The use of a notebook-based microservice model with Gradio and Google Colab provides a cost-effective and accessible development environment. External API integrations such as SerpAPI, Ahrefs, and Google Analytics enhance the tool's capability to serve actionable insights to users with minimal setup overhead.

With all core features and user stories completed across both sprints, the tool stands as a fully functional Minimum Viable Product (MVP) for SEO strategists, content writers, and digital marketers.

### **4.2 Future Enhancements**

To improve functionality and appeal to a wider user base, the following future enhancements are proposed:

- Google Search Console Integration: Automate indexing status, crawl errors, and performance metrics directly from verified GSC accounts.
- AI-Based Content Rewriting: Integrate with OpenAI or similar models to auto-rewrite low-performing content for SEO improvements.
- Voice Search Optimization Analysis: Provide audit checks for voice-friendly keyword phrasing and question-based content.
- Local SEO and Map Pack Insights: Add support for local rankings, business citations, and NAP consistency checks.

- Team Collaboration Features: Allow multiple users to comment, tag, and work on shared SEO projects with roles and permissions.
- Scheduled Audits and Email Reports: Enable users to schedule weekly/monthly SEO audits with auto-generated email summaries.
- Multi-Language SEO Auditing: Extend support for internationalized content audits and hreflang checks.
- Customizable Dashboards: Allow users to configure what metrics or visuals appear on their performance overview dashboard.

## APPENDIX

### A. SAMPLE CODING

```
!pip install cryptography beautifulsoup4 scikit-learn requests  
!pip install beautifulsoup4 scikit-learn requests  
  
from bs4 import BeautifulSoup  
import requests  
from sklearn.feature_extraction.text import TfidfVectorizer  
  
  
url = "https://w3schools.com"  
html = requests.get(url).text  
soup = BeautifulSoup(html, "html.parser")  
text = soup.get_text()  
  
  
vectorizer = TfidfVectorizer(stop_words="english", ngram_range=(1, 3),  
max_features=50)  
X = vectorizer.fit_transform([text])  
keywords = vectorizer.get_feature_names_out()  
  
  
import requests
```

```
from bs4 import BeautifulSoup
import validators
import time

def fetch_page(url):
    try:
        headers = {'User-Agent': 'Mozilla/5.0'}
        response = requests.get(url, headers=headers, timeout=10)
        response.raise_for_status()
        return BeautifulSoup(response.text, 'html.parser')
    except requests.exceptions.RequestException as e:
        print(f"Error fetching {url}: {e}")
        return None
```

```
def check_meta_tags(soup):
    issues = []
    title = soup.find('title')
    meta_desc = soup.find('meta', attrs={'name': 'description'})
    if not title or not title.text.strip():
        issues.append("Missing or empty <title> tag.")
    elif len(title.text.strip()) > 60:
```

```
issues.append("Title is too long (more than 60 characters).")  
  
if not meta_desc or not meta_desc.get('content', "").strip():  
    issues.append("Missing or empty meta description.")  
  
elif len(meta_desc['content']) > 160:  
    issues.append("Meta description is too long (more than 160 characters).")  
  
return issues
```

```
def check_broken_links(soup, url):  
    broken_links = []  
  
    base_url = '/'.join(url.split('/')[3:])  
  
    for link in soup.find_all('a', href=True):  
        href = link['href']  
  
        full_url = href if validators.url(href) else base_url + href  
  
        try:  
            response = requests.head(full_url, timeout=5, allow_redirects=True)  
            if response.status_code >= 400:  
                broken_links.append(full_url)  
  
        except requests.exceptions.RequestException:  
            broken_links.append(full_url)  
  
    return broken_links
```

```
def check_headings(soup):

    headings = [h.name for h in soup.find_all(['h1', 'h2', 'h3', 'h4', 'h5', 'h6'])]

    issues = []

    if headings.count('h1') == 0:

        issues.append("Missing H1 tag.")

    elif headings.count('h1') > 1:

        issues.append("Multiple H1 tags found.")

    return issues


def check_image_alt(soup):

    missing_alt = [img['src'] for img in soup.find_all('img') if not img.get('alt')]

    return missing_alt


def run_seo_audit(url):

    print(f"Running SEO audit for {url}...\n")

    soup = fetch_page(url)

    if not soup:

        return

    audit_report = {

        "Meta Tag Issues": check_meta_tags(soup),
```

```
"Broken Links": check_broken_links(soup, url),  
"Heading Issues": check_headings(soup),  
"Images Missing Alt": check_image_alt(soup),  
}  
  
for category, issues in audit_report.items():
```

```
    print(f"{category}:")  
    if issues:  
        for issue in issues:  
            print(f" - {issue}")  
    else:  
        print(" No issues found.")  
    print("\n")
```

```
if __name__ == "__main__":  
    website_url = input("Enter website URL: ")  
    run_seo_audit(website_url)
```

```
exact_match = [kw for kw in keywords if " " not in kw]  
phrase_match = [kw for kw in keywords if " " in kw and len(kw.split()) == 2]  
long_tail = [kw for kw in keywords if len(kw.split()) >= 3]
```

```
print(" Exact Match Keywords:", exact_match)

print("Phrase Match Keywords:", phrase_match)

print(" Long-Tail Keywords:", long_tail)

import requests

import pandas as pd

from urllib.parse import urlparse

SERP_API_KEY =

"9dacf46abcf7d3d709ab1bd109949f95502770c3e655620ee3ccff551ee73db7"

# List of high-authority domains for classification

HIGH_AUTHORITY_DOMAINS = ["gov", "edu", "org", "mil", "bbc",
"nytimes", "forbes", "cnn", "wikipedia", "harvard", "mit"]

def classify_domain(url):

    try:

        parsed_url = urlparse(url)

        domain = parsed_url.netloc.lower()

        if any(auth_domain in domain for auth_domain in

HIGH_AUTHORITY_DOMAINS):
```

```
    return "High Authority"

elif domain.endswith(".gov") or domain.endswith(".edu"):

    return "High Authority"

else:

    return "Spammy"

except:

    return "Unknown"
```

```
def get_serpapi_backlinks(domain):

    """Fetches backlinks using SerpAPI"""

url = "https://serpapi.com/search.json"

params = {

    "engine": "google",

    "q": f"link:{domain}",

    "api_key": SERP_API_KEY

}

response = requests.get(url, params=params)
```

```
if response.status_code == 200:

    data = response.json()

    backlinks = data.get("organic_results", [])
```

```
classified_backlinks = []

for link in backlinks:

    url = link.get("link", "")

    title = link.get("title", "N/A") # Get page title

    snippet = link.get("snippet", "N/A") # Get anchor text (if available)

    authority = classify_domain(url)

    classified_backlinks.append({

        "Referring Page URL": url,
        "Page Title": title,
        "Anchor Text": snippet,
        "Authority": authority
    })

df = pd.DataFrame(classified_backlinks)

return df

else:
    print("Error fetching data from SerpAPI")
    return None

# Example usage
domain = "w3schools.com"
```

```
serpapi_data = get_serpapi_backlinks(domain)

# Save to CSV if needed

if serpapi_data is not None:

    print(serpapi_data) # Print results

    serpapi_data.to_csv("backlink_report.csv", index=False)

from google.colab import files

files.download("backlink_report.csv")
```

## B. PLAGIARISM REPORT

The screenshot shows a digital interface for a plagiarism detection tool. At the top, there's a navigation bar with icons for 'Apps and Extensions' (with a dropdown arrow), a user profile icon ('M'), and three buttons: 'New Scan' (green plus sign), 'Previous Scans' (refresh/clock icon), and 'Feedback' (comment icon). Below the navigation is a large central box displaying the text '1.5%' in a large font, followed by 'Plagiarism' with a small circular info icon.

Below this main box, the word 'Results (6)' is displayed. Six individual results are listed in separate, rounded rectangular boxes, each with a small dropdown arrow icon on the right side:

- 1% papers.phmsociety.org
- <1% www.linkedin.com
- <1% mostwiedzy.pl
- <1% ltu.diva-portal.org
- <1% ltu.diva-portal.org
- <1% en.wikipedia.org