VCU College of Engineering

CS-25-325 Plug and Play Clickstream Dashboard and Agent Event Tracker

Final Design Report

Prepared for

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Capital One

By

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Under the supervision of

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04/30/2025

Executive Summary

Before improvements can be made to enhance a user's experience on a website, complex clickstream data must first be transformed into clear visualizations, allowing stakeholders to easily analyze behavioral trends and make data-driven decisions. This project aims to revolutionize not only the collection but also the visualization of clickstream data, enabling stakeholders to identify opportunities for improvements that enhance website navigation and functionality. By tracking user interactions through clickstream events and presenting them in a user-friendly, real-time dashboard, the project empowers non-technical stakeholders to make informed decisions. These insights will lead to a more intuitive website, improving both user satisfaction and operational efficiency.

Key objectives include the development of a scalable website to capture clickstream data, secure cloud-based storage for efficient data handling, and the creation of an interactive dashboard offering a range of visualizations, including graphs and tables. The website will have a variety of clickable options for users to click and interact with, where each interaction is stored to be analyzed later. The dashboard will streamline complex data queries and conceal any unnecessary aspects of what is happening behind the scenes. Data filtering options will be implemented to support unique data visualizations, allowing the user to choose what information will be displayed according to their needs. Despite using data related to an agent servicing site in this project, the dashboard will be generalized to be adaptable to different data inputs for future projects. The project specifications insist that the visual dashboard must provide real-time analytic features, ensuring that information is up to date and quickly retrieved. Both the website and the database must be scalable to accommodate an increasing number of user visits and interactions.

Upon the project's completion on May 2nd of 2025, the following deliverables will have been fully realized and ready to present at the VCU Engineering Expo. These include a fully functional website, a robust data collection and storage system, and an easy-to-use visualization dashboard. This project will follow a structured, sprint-based timeline to ensure continuous progress and timely delivery of all major deliverables and milestones. Important dates to note for the fall semester are the Fall Design Poster due November 15th, 2024, and the preliminary design report due December 9th, 2024. For the Spring semester, the poster file for the Expo is due March 28th, 2025, and the final report must be submitted by May 2nd, 2025. As of April 30th, 2025, our team has completed all previous milestones and has presented our work at the Engineering Expo on April 25th, 2025, including a realized poster and dashboard demonstration.

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Section A. Problem Statement

In the fast-evolving landscape of digital platforms, one primary challenge stakeholders face is understanding how users interact with their platform features. Clickstream data encompasses the information gathered as users move through a website. Often associated with clickstream analytics, this data involves tracking, analyzing, and reporting on user activity, such as which pages they visit and how they interact with them. Clickstream data offers valuable insights into user navigation patterns, enabling teams to leverage these findings for essential business decision-making. (Vettorino 2022).

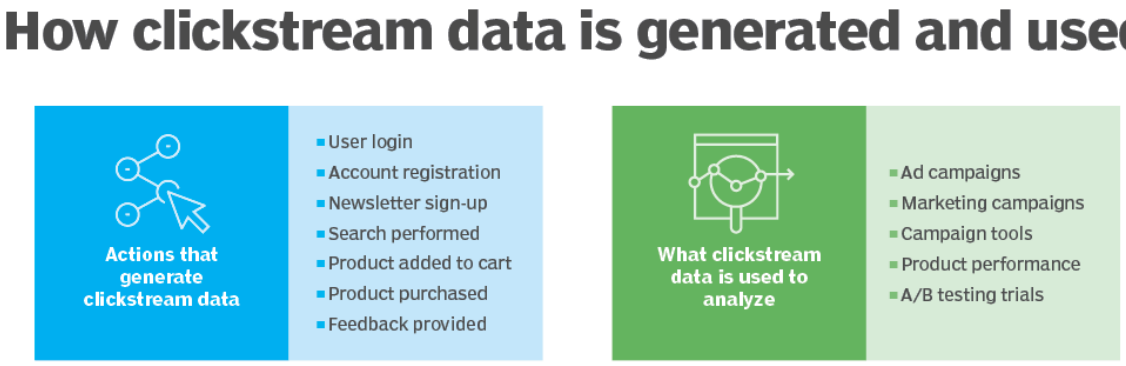


Figure 1: How Clickstream Data is generated and used (Picture: Gillis 2022)

The problem is particularly relevant to platform stakeholders who rely on real-time data analytics for iterative product development, customer experience improvements, and feature enhancement. Many companies struggle with implementing robust clickstream data pipelines that not only capture and store user interaction data but also make it accessible for analysis. A streamlined system that allows stakeholders to easily collect, store, and analyze clickstream data can lead to more impactful insights into user engagement and satisfaction.

This project falls under the field of digital analytics and user experience optimization, specifically within the domain of clickstream data analysis. Clickstream data analytics enables businesses to capture, store, and analyze sequences of user interactions on their websites. Such insights allow companies to understand user engagement, refine their digital services, and improve website or app functionalities based on real-world data. Given the rapid evolution of data-driven decision-making in the financial industry, analyzing clickstream data is especially valuable for companies like Capital One, which prioritizes seamless digital experiences for its customers.

As a leading financial services provider, Capital One has continuously invested in technology to innovate and improve customer interactions across its platforms. With offerings spanning credit cards, loans, and personal banking (Capital One 2024), Capital One's digital ecosystem sees significant user engagement across multiple touchpoints. The project aims to

support these efforts by enabling Capital One's agents to access real-time data on customer interactions, empowering them to provide more informed and timely service.

As Capital One aims to elevate its customer experience, integrating insights from clickstream data can serve as a key driver in its data collection strategy. Tools like Google Analytics, launched in 2005, laid the foundation for understanding and optimizing user interactions across digital platforms, providing accessible ways for businesses to track traffic and behavior. Over time, Google Analytics evolved to include real-time data, customizable dashboards, and event tracking, allowing companies to delve deeper into user insights. (Google Analytics Team, 2023) However, Google Analytics does present limitations, as customizing metrics and generating targeted insights often requires specialized expertise. By building on Google Analytics' framework, this project seeks to establish a customized data pipeline tailored to Capital One's needs, enhancing data accessibility and supporting user experience improvements.

Visualizing clickstream data effectively will be central to maximizing these insights. Visualization tools not only translate complex data into actionable insights but also enable Capital One's stakeholders to identify user patterns, navigate engagement paths, and highlight areas for improvement across its digital touchpoints. Clickstream data further supports customer segmentation by revealing behavioral patterns, which helps tailor marketing campaigns and personalize user experiences, leading to higher engagement and improved satisfaction (Lifesight 2023). Implementing advanced visualization solutions, especially in real-time, involves significant investments in cloud storage, data warehousing, and processing power. High-end visualization tools, such as Tableau and Looker, bring additional costs for licensing, customization, and ongoing maintenance. Compliance with financial data privacy regulations adds further to these expenses, requiring secure handling and storage measures. Despite these costs, the strategic advantages, such as refined product offerings, increased customer satisfaction, and improved retention, far outweigh the investment, ultimately supporting data-driven decision-making and enhanced user engagement.

Section B. Engineering Design Requirements

B.1 Project Goals (i.e. Client Needs)

Below is a bulleted list of project goals. Each bullet point is a major objective for the group to accomplish towards the overall goals of the project.

- Create a Mock Agent Servicing Website that will serve as the platform to collect clickstream data from.
- Collect and store clickstream data in a cloud database.
- Create a visualization dashboard that allows stakeholders to generate useful visualizations from the data without requiring technical skills.

B.2 Design Objectives

- Create an easy-to-use Agent Servicing Website that houses many clickable options such as buttons, dropdowns, searches, etc.
- Clickstream data will be collected from the website based on users' interactions with objects on the website.
- Collect only users' interactions within the website, not their inputs.
- Clickstream data will be stored and organized within a cloud-based database, database structure will be optimized for query speed.
- Visual Dashboard will use interactive UI elements to allow for generic user queries, leading to the visualization of clickstream data.
- Visualizations will be generated through SQL queries made against the database based on the users' generic queries.
- Generalization of the visual dashboard, where stakeholders can reuse the dashboard for other projects/data.

B.3 Design Specifications and Constraints

- The dashboard should generate visualizations within a reasonable timeframe, depending on the complexity of the user's query.
- The database must have a minimum of 500 user visits recorded from clickstream data generated by the website. If 500 users are not reached, supplement using functional testing.
- Website clickstream data must not collect personal information.
- Visualizations generated by the visual dashboard must be easily understandable to less technical users.
- The Clickstream website must be functional for the entire duration of the project development lifespan.
- The database storing and organizing the clickstream data must be scalable to accommodate the increasing number of user visits and interactions.
- The website must also be scalable to increase concurrent users, preventing performance issues.
- The visual dashboard must provide users with multiple visualization formats for data sets, i.e., bar graphs, line graphs, etc.
- The visual dashboard must provide real-time analytic features, providing up-to-date information for analysis.
- Data filtering options in the form of dropdown menus will be provided so that the user can focus on specific information within the dashboard.

B.4 Codes and Standards

- GDPR - a large standard of codes implemented by the European Union that Capital One and our project will follow.
- Our project aims to collect clickstream interactions from the user, but no personal information or otherwise sensitive information from users.

Section C. Scope of Work

C.1 Deliverables

- Team Contract due Sept 6th 2024
- Project Proposal due Oct 11th 2024
- Fall Design Poster due Nov 15th 2024
- Preliminary Design Report due Dec 9th 2024
- Capital One Presentation January 28th 2025
- Abstract for Expo due March 28th 2025
- Poster file for Expo due March 28th 2025
- Capstone EXPO April 25th 2025
- Final Report/Completed Project due May 2nd 2025

C.2 Milestones

- Sprint 1: [Oct 1st - Oct 13th] Present Project Proposal to Capital One, complete Project Proposal.
- Sprint 2: [Oct 14th - Oct 28th] Create the Website that will be used to collect clickstream data, building enough buttons and pages to collect meaningful data.
- Sprint 3: [Oct 29th - Nov 11th] Part 1 of clickstream data collection, research, and get familiar with Google Analytics and Google Cloud.
- Sprint 4: [Nov 11th - Nov 25th] Finish the Fall Design Poster, and begin to implement Google Analytics onto the website.
- Sprint 5: [Nov 25th - Dec 8th] Finish the Preliminary Design Report, and plan out individual work over break.
- Sprint 6: [Jan 13th - Jan 27th] Capital One Presentation Prep, create and practice a presentation for Capital One to keep them up to date.
- Sprint 7: [Jan 27th - Feb 10th] Add page data collection to the Google Analytics clickstream collection, and make some updates to the website based on presentation feedback.
- Sprint 8: [Feb 10th - Feb 24th] Finalize clickstream data collection with queries that will help with the dashboard.
- Sprint 9: [Feb 24th - Mar 10th] Create a tableau visualization dashboard incorporating key statistics that have been collected through clickstream.
- Sprint 10: [Mar 10th - Mar 24th] Improve the dashboard to incorporate all key statistics and finalize a rough draft of the dashboard, as well as finalize the EXPO poster and abstract.
- Sprint 11: [Mar 24th - Apr 7th] Finalize the dashboard by adding filtering options to allow for more general or focused views of the visualizations in the dashboard.

- Sprint 12: [Apr 7th - Apr 21st] Final preps for the EXPO, create any visualizations we could need, and discuss what we would like to share with those that are interested in our project at the EXPO.
- Sprint 13: [Apr 21st - May 5th] Attend EXPO as well as finalize the design report, and provide Capital One with anything they may need from our project.

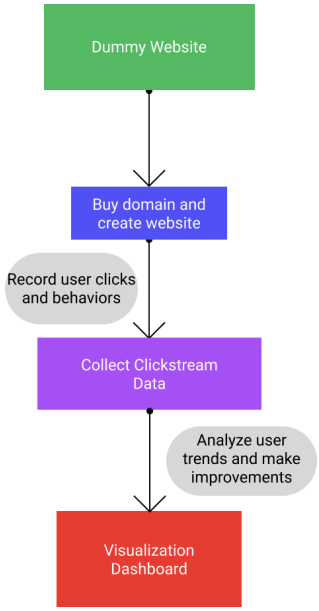
C.3 Resources

Below is the list of resources that were used to complete our project.

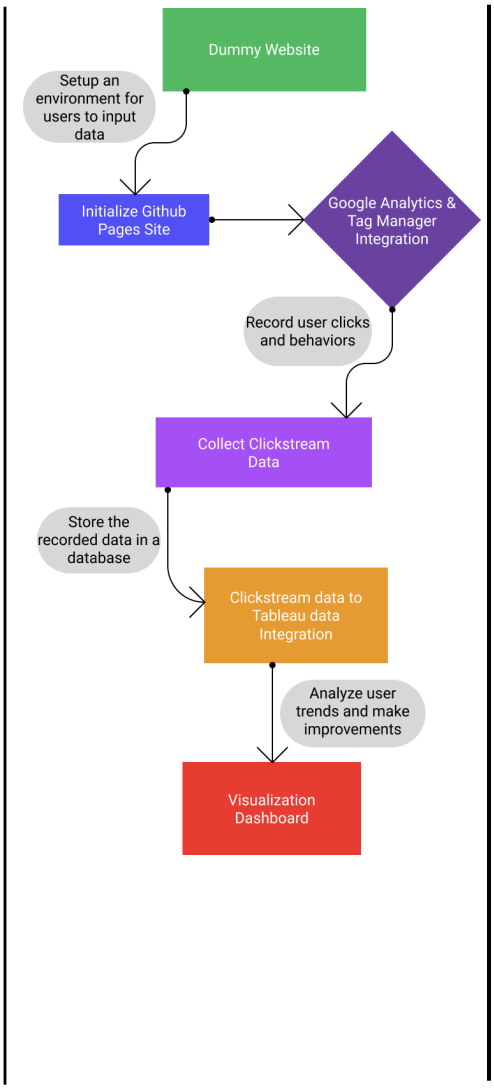
- Google Analytics
- Google Analytics Data API
- Google Cloud
- Big Query
- Google Tag Manager
- ReactJS
- VSCode
- Github
- Github Pages
- Tableau
- Tableau Public
- Discord

Section D. Concept Generation

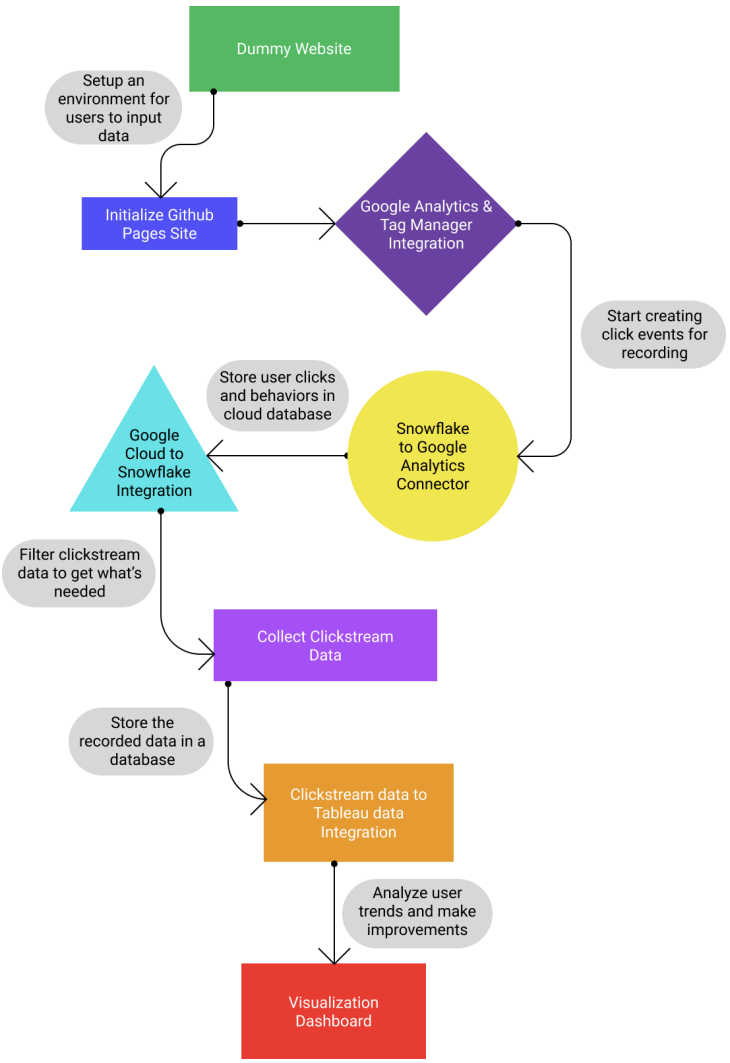
Design 1:



Design 2:



Design 3:

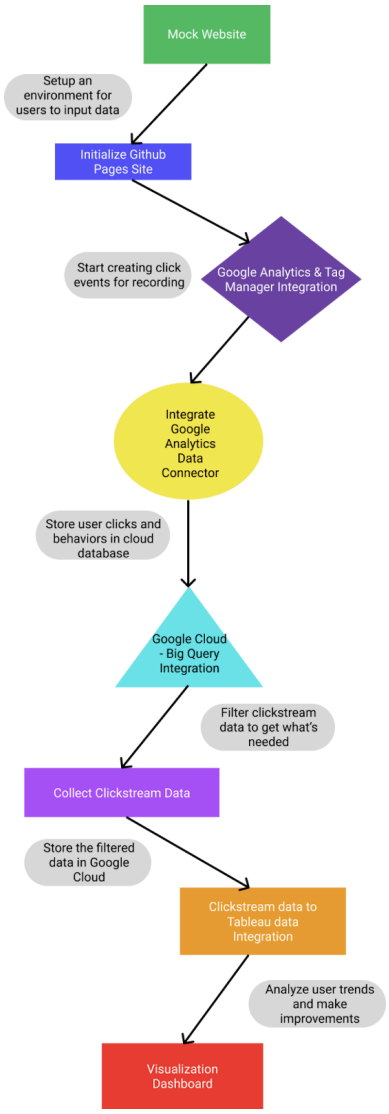


Design 1: Initial Design, basic dummy website hosted on a domain. Still deciding clickstream analysis platform.

Design 2: Utilized GitHub pages instead to host a dummy website. Integrated Google Analytics & Tag Manager for clickstream data.

Design 3: Integrated AWS Snowflake for cloud database clickstream collection. Created Google Analytics connector for Snowflake. Implemented Google Cloud's BigQuery to collect & format user events in a Snowflake table. The visualization dashboard will be created separately using the Tableau API.

Design 4 (Final Design):



Design 4: Final Design, replaced AWS Snowflake with Google Cloud for cloud database clickstream collection and storage. Created Google Analytics connector for BigQuery. Implemented Google Cloud's BigQuery to collect & format user events in a Google Cloud table. The visualization dashboard will be created directly in Tableau.

Section E. Concept Evaluation and Selection

Metrics:

- Cost - represents the total cost of the design.
- Reliability - represents the overall confidence in the design, allowing for the final product desired.
- Performance - indicates the speed and ability of a design from collecting to displaying data.
- Security - represents the ability of the design to not allow for the collection of user data and only collect their interactions.
- Reusability - represents the ability for our design to be reused for other projects, specifically Capital One projects.

Key: 0 - .25 performs poorly in this attribute

.26 - .75 performs well in this attribute

.76 - 1 performs extremely well in this attribute

	Design 1	Design 2	Design 3	Final Design
Cost	0.5	1	0	1
Reliability	0.25	0.25	1	0.75
Performance	0	0.25	0.5	1
Security	0.25	1	1	0.5
Reusability	0	0.25	1	1
Total	1	2.75	3.5	4.25

Design 3 was our initial final design, which we were confident in due to its reliability, security, and reusability. However, the high costs associated with Snowflake and Tableau API made it unsustainable for long-term use.

This issue caused us to revise the final design, which led to Design 4 of our project, shifting from AWS Snowflake to Google BigQuery, significantly reducing the costs. We also had to reevaluate our use of Tableau, as the original plan exceeded our budget. By switching to the free Tableau Public, we gained accessibility in terms of collaboration but sacrificed some security and encountered limitations that raised concerns about the platform's reliability.

Section F. Design Methodology

The design methodology for the clickstream visualization project focuses on processing real-world data collected from users of a mock Agent Servicing Website. Through iterative improvements and engineering practices, the project ensures that the system meets performance, scalability, and usability objectives. This methodology combines data engineering, efficient backend, and visualization design to create a robust, user-friendly solution. Google Tag Manager and Google Analytics are configured to track user interactions on the website to capture clickstream data. This data is processed and stored using Google Cloud, with queries optimized to handle large datasets efficiently. Validation of the dashboard involves comparing the generated visualizations to client-provided specifications, ensuring accurate representation of clickstream patterns. Capital One sponsors provide feedback and iterative adjustments to ensure continuous improvements (prototype refinement, feature adjustments, and website UI), culminating in a robust, scalable solution that meets all client needs and project goals.

F.1 Architecture/High-level Design

The architecture of the clickstream visualization project consists of three key components: the website interface, the data processing pipeline, and the visualization dashboard.

1. Website Interface:
    - Built with React.js, the website tracks user interactions (e.g., clicks, page views) using Google Tag Manager and Google Analytics to capture clickstream data.
2. Data Processing Pipeline:
    - Data from Google Analytics is processed using Google BigQuery for efficient querying and storage.
3. Visualization Dashboard:
    - Tableau is used to visualize processed data from Google Cloud in real time. The dashboard is designed for non-technical users to generate intuitive visualizations and can be adapted for future datasets.

The system is cloud-based, ensuring scalability and performance, with real-time data processing and visualization. It is designed to grow with increasing data and user interactions while maintaining data privacy and compliance standards like GDPR.

F.2 Validating Specifications

1. The website's clickstream data must not collect personal information.
    - The software used to capture clickstream data (Google Tag Manager and Google Analytics) will be configured to exclude any personal data features
    - The data collected from the website will be examined to confirm that no personal information is stored or tracked.
2. Visualizations generated by the visual dashboard must be easily understandable to less technical users.
    - The design will be reviewed for clarity and simplicity in the display of information, ensuring that visualizations (such as bar charts, pie charts, and line graphs) are intuitive.
3. The database storing and organizing the clickstream data must be scalable to accommodate the increasing number of user visits and interactions.
    - The database will scale and update accordingly through scheduled queries.
4. The visual dashboard must provide users with multiple visualization formats for metrics, i.e., pie charts, line graphs, etc.
    - Users will be able to modify these visualizations using the filtering system provided for each graph.
5. The visual dashboard must provide real-time analytic features, providing up-to-date information for analysis.
    - Graphs will update accordingly through changes within the clickstream data.

F.3 Validation Procedure

The team has met with Capital One advisors Emily and Tyler to discuss the dashboard and ensured it fulfills the requirements both parties agreed upon. Visualization outputs were analyzed against the original data to verify their accuracy. Each design objective/specification was verified and validated through the methods above in F.2.

Section G. Results and Design Details

G.1 Modeling Results

The system architecture was meticulously modeled to ensure scalability and performance. The key modeling efforts include:

1. **Data Pipeline Modeling**:
    - The pipeline captures user interactions through Google Analytics and processes them using BigQuery before storing this data in Google Cloud.
    - A high-level data flow diagram illustrates the sequence from data collection to visualization, ensuring end-to-end system clarity.
2. **Database Schema**:
    - Google Cloud's schema was optimized for clickstream data, with partitioned tables for enhanced query efficiency.
3. **Dashboard Interface**:
    - Wireframes and mockups were iteratively refined to optimize user experience.
    - The dashboard was designed with filters allowing users to refine graphs to fit their specific needs

G.2 Experimental Results

Experimental testing focused on validating the accuracy and responsiveness of the data pipeline:

1. **Data Integrity Tests**:
    - A set of 500 user interactions was simulated to ensure that Google Analytics accurately captured events.
    - Ensure visualizations are representative of the numbers stored within the Google Cloud database.

G.3 Prototyping and Testing Results

The prototype underwent rigorous testing to ensure scalability and functionality:

1. **Website Performance**:
    - Integration with Google Tag Manager ensured seamless event tracking.
2. **Data Visualization**:
    - Various visualizations were tested to ensure clarity, including line graphs for interaction trends, bar charts for feature usage, and heatmaps for button click frequency.
3. **System Security**:
    - Verified compliance with GDPR by anonymizing all user interactions.

G.4 Final Design Details/Specifications

The final design integrates advanced data handling with user-centric visualization, meeting all objectives:

- **Website**:
    - Developed using React.js with a focus on capturing interaction events via Google Tag Manager.
    - Features include buttons, dropdowns, and search bars that encourage diverse user activity.
- **Data Pipeline**:
    - Real-time event processing using BigQuery and Google Cloud ensures a robust backend.
- **Visualization Dashboard**:
    - Built on Tableau to enable non-technical users to generate insights effortlessly.
    - Provides various visualization formats like bar graphs, line graphs, and scatter plot graphs.
- **Scalability**:
    - Both the website and database infrastructure are designed for increasing user loads.
- **Compliance**:
    - Ensures data privacy through rigorous adherence to GDPR standards, collecting only non-sensitive interaction data.

Section H. Societal Impacts of Design

H.1 Public Health, Safety, and Welfare

1. **Protects digital safety and privacy:** The system uses secure cloud infrastructure with strong encryption to safeguard data, reducing risks of unauthorized access or breaches that could compromise user welfare.
2. **Promotes ethical data use:** By intentionally excluding personal or sensitive data collection, the design prioritizes non-invasive tracking, ensuring user interactions are respected and protected.
3. **Supports reliable and accessible use:** A stable, scalable system ensures continuous access and smooth performance, while an intuitive interface allows individuals of varying technical ability to observe insights regarding their website through the visualizations.

H.2 Societal Impacts

The visualization dashboard fosters better decision-making by enabling stakeholders to understand user behavior without needing technical expertise. The project supports inclusivity by promoting intuitive web design that benefits users of varying technical proficiencies and abilities.

H.3 Political/Regulatory Impacts

Adhering to GDPR standards, the design reflects a commitment to ethical data practices and regulatory compliance, ensuring that personal information is not collected. These measures align with global privacy laws, setting a precedent for responsible data usage.

H.4 Economic Impacts

The project offers significant economic advantages:

1. **Cost Efficiency**: Automates data analysis, reducing the need for specialized personnel and expensive third-party tools.
2. **Business Growth**: Provides stakeholders with actionable insights that can lead to better user retention and increased revenue.
3. **Scalability**: By supporting dynamic user loads, the system ensures long-term economic sustainability, reducing operational costs.

H.5 Environmental Impacts

The project leverages cloud-based solutions to minimize environmental impact:

1. **Efficient Resource Use**: Google Cloud data storage dynamically scales, using resources only as needed, minimizing unnecessary power consumption.
2. **Digital Transformation**: By enabling digital insights, the project reduces the need for physical reporting and documentation, contributing to paper waste reduction.

H.6 Global Impacts

As businesses increasingly operate on a global scale, the project supports international collaboration by providing a standardized, adaptable dashboard for data visualization. This adaptability allows the system to cater to diverse industries and geographic locations, fostering innovation and improved user experiences worldwide. Adhering to global data privacy standards, this project sets a foundation for trust and ethical data practices across borders.

H.7 Ethical Considerations

The ethical implications of the design are central to its development:

1. **User Privacy**: By avoiding the collection of personal data, the design ensures user trust and respects individual rights.
2. **Transparency**: The system clearly communicates the nature of the data being collected, allowing users to understand what is being collected and why.
3. **Fair Access**: The dashboard is designed to be inclusive, ensuring that stakeholders from diverse backgrounds can leverage its insights without advanced technical knowledge.

Section I. Cost Analysis

Component	Category	Description	Source (Vendor/Repo)	Cost
Visual Studio Code	Development Tools	Code Editor for writing and debugging code	Visual Studio Code Official	Free
Frontend Framework	Development Tools	Framework for Building Website/User Interface	React.js (NPM)	Free (Open-Sourced)
Static Website	Hosting	GitHub Pages for deploying the project	Github	Free (Open-Sourced)
Google Analytics	Monitoring/ Analytics	A tool for tracking website traffic and user behavior	Google	Free
Google Analytics API	Monitoring/ Analytics	API for querying and managing Google Analytics data	Google Developer Console	Free
Google Tag Manager	Tag Management	Tool for managing and deploying data tags	Google	Free
Google Cloud	Cloud Hosting/Compute	Database Storage	Google	Free - based on our usage
Google Big Query	Data Warehousing	Cloud-based data warehouse for storing and querying large datasets	Google	Free - based on our usage
Tableau Public	Data Visualization	BI Tool for creating an interactive dashboard & Visualization	Tableau	Free - Student Trial

Section J. Conclusions and Recommendations

The journey to the final design was a culmination of iterative engineering practices, collaboration, and innovative problem-solving. This project began with a clear objective: to empower stakeholders with real-time insights into user interactions by creating a robust clickstream data pipeline and an intuitive visualization dashboard. Using the engineering design process, the team systematically addressed the problem, starting with concept generation and progressing through evaluating alternatives and refining solutions to meet requirements. Early iterations focused on establishing foundational capabilities, such as a scalable website and an effective data collection mechanism. Challenges, including ensuring data privacy, optimizing the data pipeline for real-time performance, and designing a user-friendly dashboard, were overcome through valuable feedback from stakeholders.

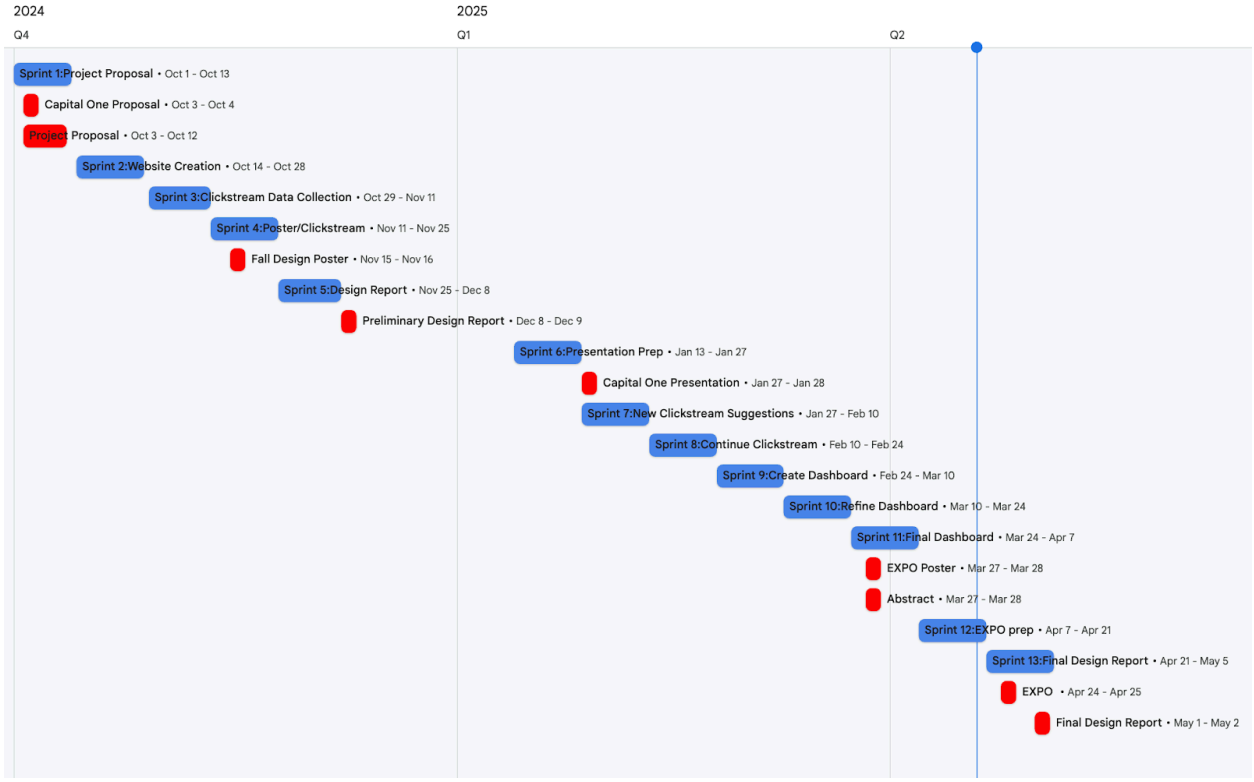
Several major milestones marked the progress of this project. The integration of Google Analytics and Tag Manager ensured accurate tracking of user interactions. Google Cloud provided a scalable and efficient database solution tailored to handle large-scale data queries. Tableau was utilized to create an interactive visualization dashboard that presented insights in an accessible format for non-technical stakeholders.

The final design features a scalable and secure data pipeline capable of collecting, processing, and storing clickstream data in real time. An intuitive visualization dashboard enables stakeholders to generate actionable insights through visualizations, which include bar graphs, line graphs, and scatter plot graphs. Additionally, the Tableau dashboard includes robust filtering options that empower stakeholders to isolate and analyze data relevant to their departments. The system's cloud-based infrastructure ensures scalability, adapting to increasing user interactions without performance degradation. Strict adherence to global privacy standards, such as GDPR, guarantees the ethical and secure handling of user data, reinforcing user trust.

This project provided valuable lessons that shaped the final design. Regular feedback from stakeholders proved essential for improving visualization clarity and usability. Balancing performance with cost was another significant learning experience, requiring careful analysis of cloud services like Snowflake, Google Cloud, and Tableau to align with project constraints.

Although the final design meets its objectives, several recommendations can guide future development. Incorporating advanced analytics such as predictive modeling or AI-driven insights could enhance the depth of the dashboard's outputs. Expanding the dashboard to include live session tracking and alert systems for unusual activity would increase its functionality. Creating a recommendation system that would pre-filter a dashboard to show only relevant information to a user based on their involvement with the project.

Appendix 1: Project Timeline



Appendix 2: Team Contract (i.e. Team Organization)

Team Member Name	***Strengths each member bring to the group***	***Other Info***	***Contact Info***
Hoang Le	Communicates well, can be flexible with workload responsibilities	Experience with Python, Java, JavaScript, and C.	leht8@vcu.edu
Ben Aber	Creative thinker, adaptable, and reliable in a team.	Proficient in Java, Python, and C. Always open to new ideas and constructive criticism.	aberb@vcu.edu
Maxwell Goehle	Problem solver, works well in a group environment by being patient and flexible.	Experience with Java, C, and Python, and always looking to learn.	goehlemc@vcu.edu
Mohammed S. Ahmed	Time-management, Attention to detail, Collaboration	AWS Certified, Experienced in Java, Python, and C. Always looking for ways to improve.	ahmedm12@vcu.edu

Other Stakeholders	***Notes***	***Contact Info***
Mahesh Nair (Capital One)	*Capital One Team Lead*	mahesh.bahulleyannair@capitalone.com
Rachita Sowle(Mentor/ Advisor)	*VCU Faculty Advisor*	sowler@vcu.edu
Tyler Jordan (Capital One)	*Capital One Advisor*	tyler.jordan@capitalone.com
Emily Croxall (Capital One	*Capital One Advisor*	emily.croxall@capitalone.com

Culture Goals	***Actions***	***Warning Signs***
Punctual for both meetings and delivering tasks	- Arriving on time for the meeting - Submitting work and completing work by the agreed date - Set a reasonable timeline and schedules for project tasks	- Normally arriving late for team meetings - Constantly missing deadlines or needing more time - Lack of urgency or respect for other people's time in scheduling or communication
Clear and concise communication at each step of the process	- Text/email each other when issues or delays occur - Hold each other accountable regarding their respective work - Individual tasks are specified so everyone understands their specific role	- A teammate is ghosting the group chat for an extended period of time - Not asking questions when confused about a task - Teammate takes feedback but then accidentally overcomplicates the assignment
Put teammates in positions to work well together	- Utilize each other's strengths to avoid relying on others' weaknesses. - Be understanding of issues that may come up over the course of the project, and be accommodating and understanding of teammates.	- Teammate(s) are struggling to meet deadlines or have sloppy work. - Individuals struggle to complete tasks that another individual or a group could do more efficiently.

Meeting Participants	***Frequency*** ***Dates and Times / Locations***	***Meeting Goals*** ***Responsible Party***
Students Only	Meet on Wednesday from 10 am to 11 am, Discord call	-Update the group on week-to-week challenges and accomplishments -Communicate what needs to be done and plan ahead -Update Github
Students Only	Available for Discord calls/chats in the Discord server as necessary.	-Solve problems that arise during the project -Understand others' statuses on tasks and help each other along the way.
Students + Faculty advisor	*Weekly 9 am Fridays*	-Provide the faculty advisor with weekly status reports -Check in weekly and report project progress
Project Sponsor(s)	*Weekly 9 am Fridays*	-Update stakeholders on progress and current roadblocks -Work together to find ways to improve the project and or workflow

Team Member	*Role(s)*	*Responsibilities*
Maxwell Goehle	Project Manager	● Be a contact person for Capstone staff if a problem arises ● Leads and records important information discussed in meetings throughout the duration of the project ● Mediate any potential problems that occur outside or within the group pertaining to the completion of the project
Hoang Le	Logistics Manager	● Coordinates group communication and meetings throughout the year ● Obtaining the necessary information/specifications to help complete tasks at each step ● Keeps track of what is being done by each group member ● Sets up communication between the sponsor advisor and the VCU advisor
Ben Aber	Systems Engineer	● Understand the client's initial design requirements and specifications to ensure the product matches the expectations ● Clarify any ambiguities that may arise in the design requirements ● Coordinate, recommend, and manage any development and system architecture design improvements ● Manage product interfaces
Mohammed Ahmed	Manufacturing Engineer	● Identify and integrate relevant data sources, and ensure accuracy and clean data collection ● Design and develop a data process for meaningful insights ● Continuously optimize and maintain the dashboard for performance

Step 5: Agree to the above team contract

Team Member: Maxwell Goehle *Signature: Maxwell Goehle*

Team Member: Hoang Le *Signature: Hoang Le*

Team Member: Benjamin Aber *Signature: Benjamin Aber*

Team Member: Mohammed Ahmed *Signature: Mohammed Ahmed*

References

Citations:

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