



VCU

College of Engineering

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

Prepared for

Emily Croxall, and Tyler Jordan

Capital One

By

Maxwell Goehle, Hoang Le, Benjamin Aber, Mohammed Ahmed

Under the supervision of

Rachita Sowle

10/11/24

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 UI improvements that enhance website navigation. 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 with ease. Ultimately, these insights will lead to a more intuitive website interface, 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 charts, 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. 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 Nov 15th, and the preliminary design report due Dec 9th. For the Spring semester, the poster file for expo is due March 28th and the final report must be submitted by May 2nd, 2025. As of October 11th, 2024, our team has submitted the Team Contract and Project Proposal, and are on track to complete the Fall design project due Nov 15th.

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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 each one. Clickstream data offers valuable insights into user navigation patterns, enabling teams to leverage these findings for essential business decision-making. (Vettorino 2022).

How clickstream data is generated and used

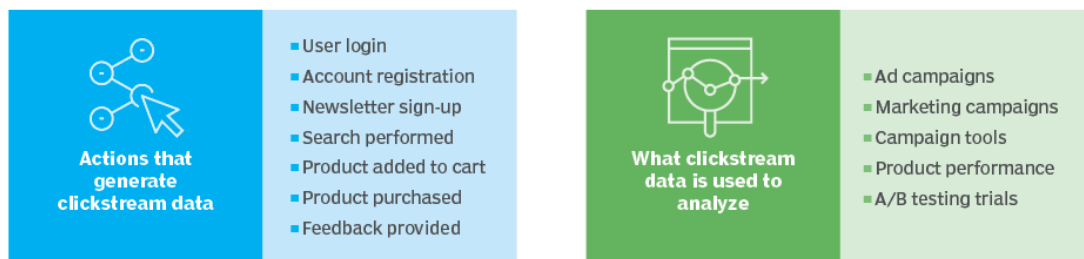


Figure 1: How Clickstream Data is generated and used (Picture: Gillis 2022)

The problem is particularly relevant to platform stakeholders who rely on real-time data analytics for iterative IT 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 digital platforms. 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. By advancing its capacity to capture and interpret clickstream data, Capital One can enhance the user experience through more personalized services, intuitive navigation, and targeted feature updates. 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 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 require 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.
- Collection and storage of clickstream data into a cloud database.
- Create a visualization dashboard that allows stakeholders to query the data into visuals without requiring technical skills.
- Make insightful changes to the website based on observations from the visual dashboard.

B.2 Design Objectives

- Create an easy to use Agent Servicing Website that houses many clickable options such as: buttons, dropdowns, searches, etc.
- Collect users' interactions within the website, not their inputs.
- Clickstream data will be collected from the website based on users' interactions with objects on the website.
- 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 visualization of clickstream data.
- Visualizations will be generated through SQL queries made against the database based on the users generic queries.
- Visualizations such as line graphs, bar graphs, tables, etc. can be generated based on the user's choices in interaction with the UI.
- Generalization of the visual dashboard, whereby stakeholders are able to reuse the dashboard for other projects/data.

B.3 Design Specifications and Constraints

- 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 visual dashboard must be easily understandable to less technical users.
- 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 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., pie charts, line graphs, etc...
- The visual dashboard must provide real-time analytic features, providing up to date information for analysis.

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
- Abstract for Expo due March 28th 2025
- Poster file for Expo due March 28th 2025
- Final Report/Completed Project due May 2nd 2025

C.2 Milestones

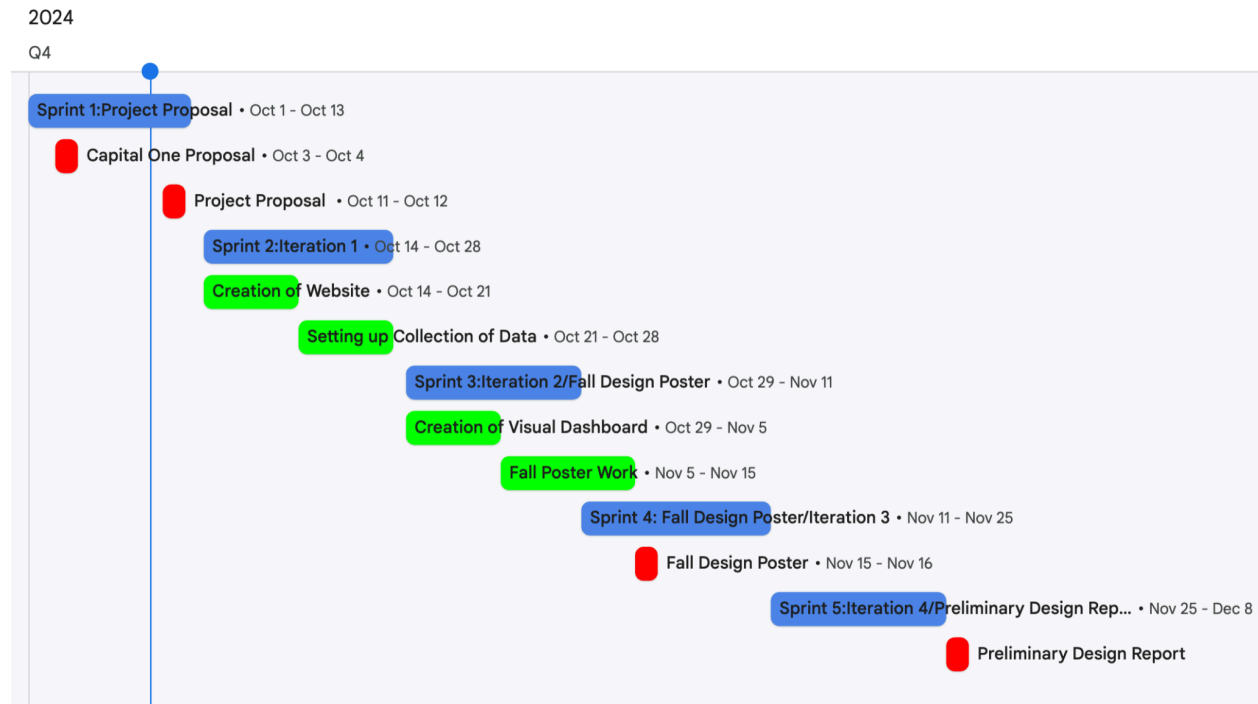
- Sprint 1: Sept 30th - Oct 14th: Present Project Proposal to Capital One, complete Project Proposal
- Sprint 2: Oct 14th - Oct 28th: Lay out foundations of all project goals: website creation, collection of clickstream data, and visualization of clickstream data
- Sprint 3: Oct 28th - Nov 11th: Iterating on foundations laid in the last sprint, should have a working website and collected data should be stored and organized. Visualization dashboard should be under progress. Work on the Fall Design Poster should be started.
- Sprint 4: Nov 11th - Nov 25th: Finish Fall Design Poster. Improvements should be made to the visualization dashboard, as well as the presentation/efficacy of the website.
- Sprint 5: Nov 25th - Dec 9th: Finish Preliminary Design Report. Continue improvements on the visualization dashboard.
- Spring Sprints tbd overall milestones:
 - Create overall improvements to the website using findings from the visual dashboard, continue collecting clickstream data, while continuing to improve the visual dashboard itself.
 - Abstract for Expo due March 28th 2025
 - Poster file for Expo due March 28th 2025
 - Final Report & Completed Project due May 2nd 2025

C.3 Resources

Resources needed for project completion should be listed at the proposal stage. These resources can either be purchased within the Project Budget, or provided by the project sponsor. Some examples are: hardware such as HPCs or servers, software such as IDEs, data analysis platforms or version control systems. Access to cloud computing services may also be necessary to scale certain procedures. Additionally, databases containing operational data for testing, as well as libraries or APIs relevant to predictive analytics and machine learning may be required.

- Google Analytics
- Google Analytics Data API
- ReactJS
- VSCode
- Github
- Tableau
- Snowflake
- AWS

Appendix 1: Project Timeline



Key:

- Red: Deadlines
- Blue: Major Sprints
- Green: Tasks to accomplish during sprints

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

Step 1: Get to Know One Another. Gather Basic Information.

<i>Team Member Name</i>	<i>Strengths each member bring to the group</i>	<i>Other Info</i>	<i>Contact Info</i>
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 detail, Collaboration	AWS Certified, Experienced in java, python, and C. Always looking for ways to improve.	ahmedm12@vcu.edu

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

Step 2: Team Culture. Clarify the Group's Purpose and Culture Goals.

<i>Culture Goals</i>	<i>Actions</i>	<i>Warning Signs</i>
Punctual for both meetings and delivering tasks	<ul style="list-style-type: none"> - Arriving on time for meeting - Submitting work and completing work by the agreed date - Set reasonable timeline and schedules for project tasks 	<ul style="list-style-type: none"> - Normally arriving late for team meetings - Constantly missing deadlines or needing more time - Lack of urgency or respect for other people time in scheduling or communication
Clear and concise communication at each step of the process	<ul style="list-style-type: none"> - 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 	<ul style="list-style-type: none"> - Teammate is ghosting the groupchat for an extended period of time - Not asking questions when confused about task - Teammate takes feedback but then accidentally overcomplicates the assignment
Put teammates in positions to work well together	<ul style="list-style-type: none"> - 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, be accommodating and understanding of teammates. 	<ul style="list-style-type: none"> - Teammate(s) are struggling to meet deadlines or has sloppy work. - Individuals struggle to complete tasks that another individual or as a group could be done more efficiently.

Step 3: Time Commitments, Meeting Structure, and Communication

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

Step 4: Determine Individual Roles and Responsibilities

Team Member	Role(s)	Responsibilities
Maxwell Goehle	Project Manager	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Coordinates group communication and meetings throughout the year • Obtaining 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 sponsor advisor and VCU advisor
Ben Aber	Systems Engineer	<ul style="list-style-type: none"> • Understand 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	<ul style="list-style-type: none"> • Identify and integrate relevant data sources, and ensure accuracy and clean data collection • Design and develop 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: Ben Aber *Signature:* Ben Aber

Team Member: Mohammed Ahmed *Signature:* Mohammed Ahmed

References

Citations:

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- [5] Lifesight. “How Clickstream Data Can Benefit Your Business.” *Lifesight Blog*, September 6, 2024. Accessed October 10, 2024. <https://www.lifesight.io/blog/clickstream-data-for-business>.