Delphi Web Application

Project Solution Approach

Scalable Algorithms for Data Science Laboratory (SCADS)

Cyber3

Griffin Gerry, William Heinecke

10.20.24

TABLE OF CONTENTS

I. Introduction

The purpose of the solution approach document is for the team to report on the design of various components of the Delphi web application such as the architecture, data structure, and user interface. From this paper, our client and stakeholders will be able to identify how the application is broken up into subsystems, what data we plan on storing, and how the user will be able to interact with the application.

The Delphi survey creation web application is a tool that allows users to create, distribute, and respond to surveys according to the Delphi method. The goal of this project is to have a streamlined survey creation and distribution system that provides also provides the user with the ability to implement the Delphi method however they choose. Building this project as a web application allows users to access from any location and device which makes the Delphi method easy for both survey administrators and participants.

II. System Overview

Our project is a web-based tool that allows users to create surveys and define the Delphi properties in which the survey is distributed. Users are allowed to define how many rounds are contained in a survey, and which data is released to its participants in between the Delphi rounds. Once the survey is created, an email link will be sent to participants where once they click it, they will be redirected to the web application where they can respond to the survey. Each registered user will have the ability to create a survey, edit surveys, distribute surveys, and participate in surveys.

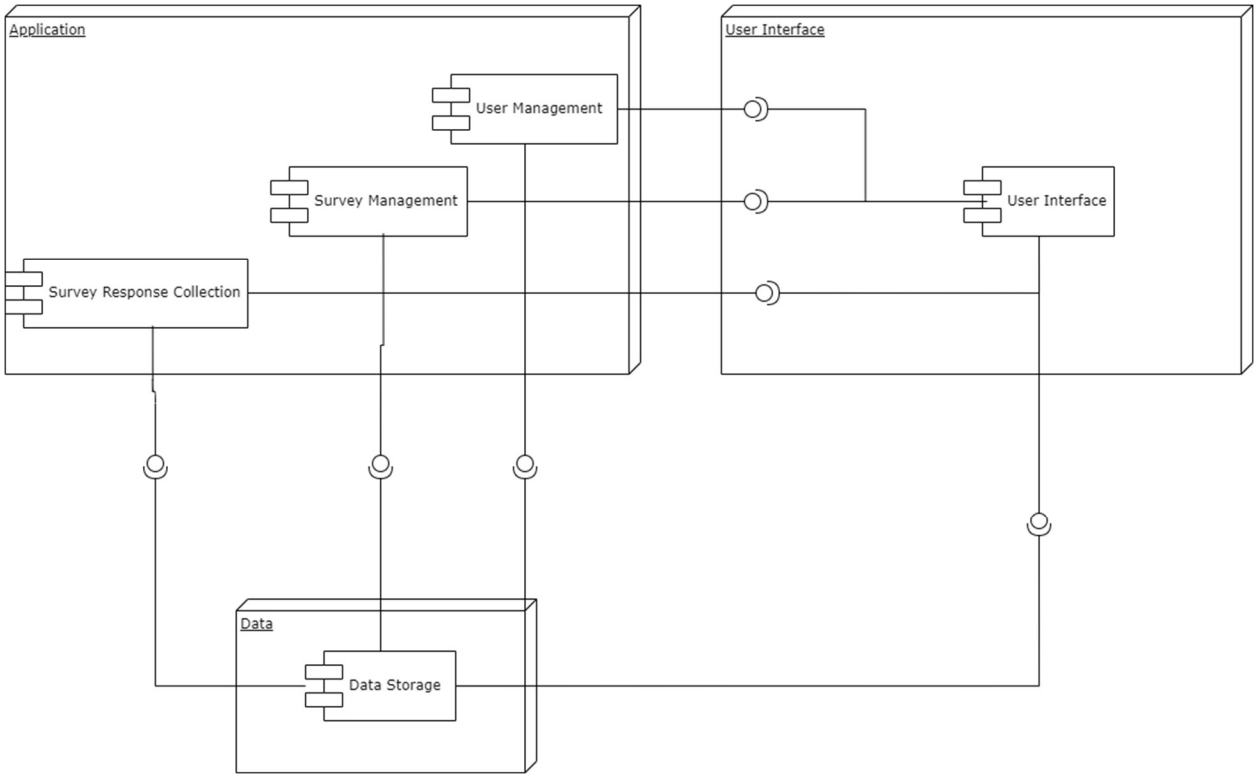
Each of the systems within the Delphi web application will be explained within the Architecture Design section in this document. That section will explain the service each subsystem provides and the dependencies and interfaces of each subsystem. The Data Design section will explain what data is generated and stored by the application. Within the User Interface Design section are details on how a user will be able to interface with the application.

III. Architecture Design

III.1. Overview

Our solution will utilize the three-tier architecture that will organize our web application's code into three tiers, being the presentation, application, and data tiers. This pattern fits well for our system as it is a commonly used pattern for web applications and matches the expectations laid out in our requirements and specifications. The presentation tier is the layer that our end users will interact with, the website that they will see and use. We will utilize React for our presentation layer. The application tier is where information from the presentation tier is collected and processed, where our Express framework running with Node will handle our data. The data tier, as its name explains, is where the data from our application will be stored and managed. MySQL is our data management software of choice, completing our MERN stack.

The components within the system's architecture are listed below in a short overview. The User Management subsystem handles user registration, login, and authentication. Survey Management handles the creation, distribution, and editing of surveys. Survey Response Collection gathers responses from survey participants and compiles the data. Data Storage stores all persistent data, including user profiles and survey responses. The User Interface is the front-facing side of our application where users will interact with the system.



III.2. Subsystem Decomposition

III.2.1 User Management

Description

The user management subsystem will be responsible for any operations relating to user profiles. This includes user registration, login, and authentication.

Concepts and Algorithms Generated

Discuss the concepts, algorithms or solutions generated and considered for this subsystem. Report the selected solution and explain the solution selection process. Include any special considerations and/or trade-offs considered for the solution approach you have chosen.

- For user registration the username, email, password, and other relevant profile information will be stored in the database. The password will be encrypted before being inserted into the database.
- For authentication we will be using JWT (JSON web tokens) to authenticate the user when they are trying to access other subsystems. Once the user logs in they will be given a JWT which will then be passed into any requests that are made into the database.

Interface Description

Provide a description of the subsystem interface. Explain the provided services in detail and give the names of the required services.

Services Provided:

Service	Service Provided To	Description
User Registration		This service will allow new users to have the ability to make a profile, or register, with the application. The inputs consist of the user's name, email address, and password. The output will be a user profile in the web application.
User Authentication	Survey Management, User Interface	This service will allow the user's identity to be confirmed by the system.

Services Required:

Service Required	Subsystem
Store Data	Data Storage
Fetch Data	Data Storage
Render Layout	User Interface
Handle Input	User Interface

III.2.2 Survey Management

Description
The survey management subsystem will be responsible for any operations relating to surveys. This will include survey creation, editing, and distribution.
Concepts and Algorithms Generated
The system ensures that surveys are only accessible to authorized users and that data integrity is maintained through transactions.

Flexibility may be a trade off in this subsystem. If administrators are allowed to edit surveys while a survey is published, this may result in a failed round due to potential differences in user answers. However, administrators may make mistakes in their survey before publishing.

Interface Description

Services Provided:

Service Name	Service Provided To	Description
Create Surveys	User Interface	This service will allow users to create surveys, filled out with details such as questions, questions, and participants. These surveys can be edited and refined as necessary.
Publish Surveys	User Interface	This service will allow administrators to publish their surveys to the participants specified in their surveys.

Services Required:

Service Required	Subsystem
User Authentication	User Management
Store Data	Data Storage
Fetch Data	Data Storage
Render Layout	User Interface
Handle Input	User Interface

III.2.3 Survey Response Collection

Description

The survey response subsystem shall be responsible for handling all data returned by survey participants. The data shall be gathered, compiled, and used to produce meaningful results for the administrator.

Concepts and Algorithms Generated

Survey responses will be collected while ensuring the integrity of user data and the privacy of user identities.

One trade-off that must be considered for this subsystem is the need for participant privacy versus the need for proper authentication of participant responses.

Interface Description

Services Provided:

Service Provided	Service Provided To	Description
Record Participant Response	User Interface, Data Storage	Records and stores the participants' responses.
Generate Report	Data Storage	Compiles survey data for analysis.

Services Required:

Names of the required services and the subsystems that provide them.

Service Required	Subsystem
Store Data	Data Storage
Fetch Data	Data Storage
Render Layout	User Interface
Handle Input	User Interface

III.2.4 Data Storage
Description

The data storage subsystem shall handle the persistent storage of all data including user profiles, surveys, and survey responses.

Concepts and Algorithms Generated
MySQL will store data in normalized tables, with relationships between tables managed using foreign keys. These tables will be expanded upon in the Data Design section.

Interface Description

Service Provided	Service Provided To	Description
Store Data	User Management, Survey Management, Survey Response Collection, User Interface	Stores delivered data in the correct format in the database. Data will be validated by this subsystem to ensure that
Fetch Data	User Management, Survey Management, Survey Response Collection, User Interface	Fetches requested data from the database for use by the designated subsystem.

III.2.5 User Interface

Description
The user interface subsystem shall handle all user interactions and inputs, from both survey administrators, survey participants, and site visitors. It handles UI layout, rendering, and interaction events, such as button clicks or form submissions. User inputs are processed and passed to backend services for further actions, such as logging in, submitting surveys, or viewing results.

Concepts and Algorithms Generated

The user interface subsystem shall provide a clear, responsive website utilizing React. This is expanded upon in the User Interface Design section. The subsystem renders the layout and appearance of the site while also handling inputs triggered by the user.

Interface Description

Services Provided:

Service	Service Provided To	Description
Render Layout	User Management, Survey Management,	Renders a responsive layout on the browser that allows interaction and inputs from the user.

	Survey Response Collection	
Handle Input	User Management, Survey Management, Survey Response Collection, Data Storage	Validates and passes user inputs to backend services for further processing and/or storage.

Services Required:

Names of the required services and the subsystems that provide them.

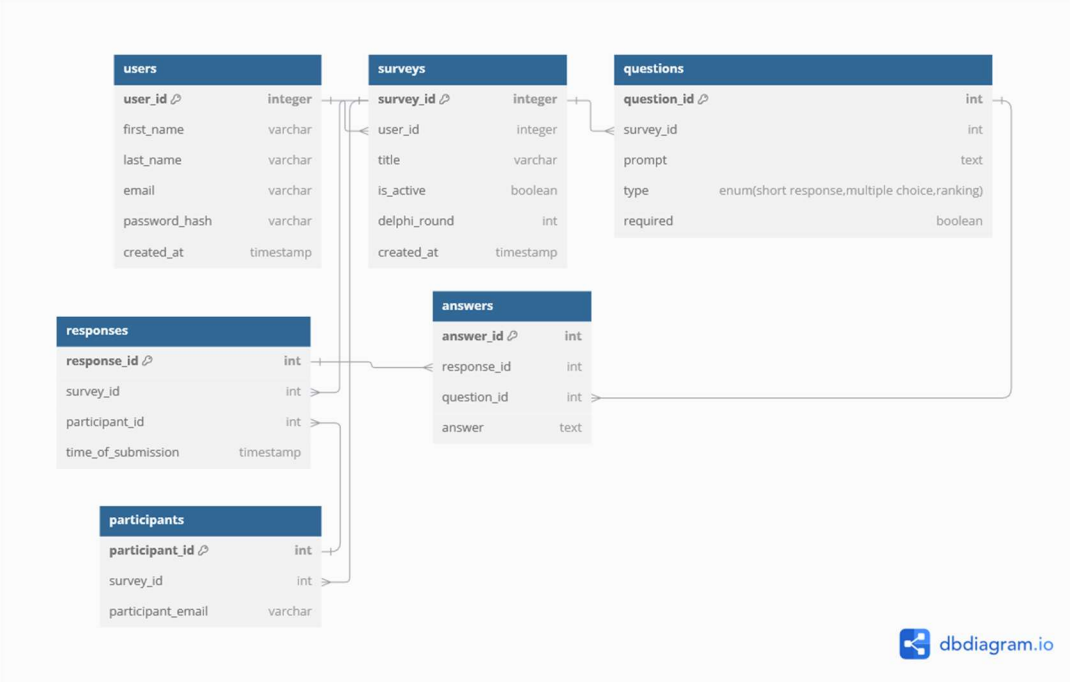
Service Required	Subsystem
Store Data	Data Storage
Fetch Data	Data Storage

IV. Data design

The Delphi web application will make use of the MySQL database to store all the data generated by the tool. Our database will make use of six tables:

- Users
- Surveys
- Questions
- Responses
- Answers
- Participants

Here is a diagram of the database structure:



The Users table will keep track of registered users along with their personal information. The user will provide their name, email, and password during the user registration process. The password will first be encrypted before being stored in the database. Each user will be given a unique id.

The Surveys table will keep track of all surveys created by users within the Delphi web application. The Surveys table will consist of a unique id, a user id which is the user who created the survey, the title of the survey, the active status, which Delphi round the survey is currently on, and when the survey was created.

The Questions table will keep track of all questions created for surveys. Each entry will contain a unique id, a reference to the survey id where the question was created, the question prompt, the type of question, and whether the question is required to be answered by the creator.

The Responses table will keep track of who responded to which survey and when. Each entry in the table has a unique response id, a reference to the survey id, a reference to the participant id, and a timestamp of when the response was recorded.

The Participants table will keep track of who participated in a survey. Each entry in the table will represent a participant where they will have a unique participant id, a reference to the survey which they are participating in, and the participants email address.

The Answers table will keep track of each answer to a question submitted by participants. Each entry in the answers table will have a unique answer id, a reference to the participants response id, a reference to the question id, and the actual text of the answer.

V. User Interface Design

During the design of the user interface for the Delphi web application, our team has created multiple UI mockup pages using Figma. Designing the user interface before development of the web application allows the team to understand how the user will interact with the application and

gives the developers and clients a clear idea of what systems will be required in the final product. One of the teams' goals during the design process included following current website design good practice trends which will allow the user to have a more intuitive experience. Each image referenced in this section will be included in the Appendix. When the user clicks the main link that shows up from the search engine, they will be greeted by the about us page (Image 1). The goal of this page is to allow users to read more about the tool and the Delphi method. When the user clicks on the login button in the top right of the header, they will be taken to the login page (Image 2). Within the login page the user will be able to input their email and password to login to their profile. After they login they will be taken back to the about us page (Image 1). If the user is brand new to the web application, then they will be able to register or create a new profile by clicking the "Sign Up" button in the top right of the header which will take them to the sign-up page (Image 7). Within the sign-up page the user can enter in their first and last name, email, and password then after they click "Sign Up" they will be a registered user and will be directed back to the "about us" page (Image 1).

To go to the survey management page the user can click on the "Manage Surveys" link at the bottom of the header which will take them to the page where they can manage the surveys (Image 3). In the manage surveys page they will be shown a list of previously created surveys and a button to create a new survey. When they click on "Create Survey" the user will be taken to the page where they can create a survey (Image 4). In the create survey page the user will have the opportunity to define the questions in the survey and will be able to invite participants by clicking on "Invite Participants" which will pop up the invite participants modal (Image 5). Within the invite participants modal, the user will be able to enter emails of the participants that will be invited to the survey after the survey is complete. From the "Manage Surveys" page (Image 3) the user will be able to manage or edit a specific survey by clicking on one of the survey links within which will take them to the survey management page (Image 6). Within the survey management page, the user will be able to view the results of the survey, edit the survey, and manage the Delphi settings for the survey.

When a participant is invited to participate in a survey, they will be emailed a link which they can click and will enter the portal where they can answer the questions in the survey (Image 8). Here they will have the opportunity to give their input to the questions within the survey, then when they hit submit their responses will be recorded in the database and the participant will be given thanks for their responses (Image 9).

VI. Glossary

Delphi: A survey technique that consists of polling a panel of experts over multiple rounds.

JWT: JSON web token.

VII. References

IBM. (2024, August 15). *What is three-tier architecture?*. IBM. https://www.ibm.com/topics/three-tier-architecture

(Dutoit, 2010), 3rd Edition, by Bernd Bruegge and Allen H. Dutoit, Prentice Hall, 2010.

"A Free Database Designer for Developers and Analysts." Database Relationship Diagrams Design Tool. Accessed October 20, 2024. https://dbdiagram.io/d/6715bdb697a66db9a3a5a331.

VIII. Appendices

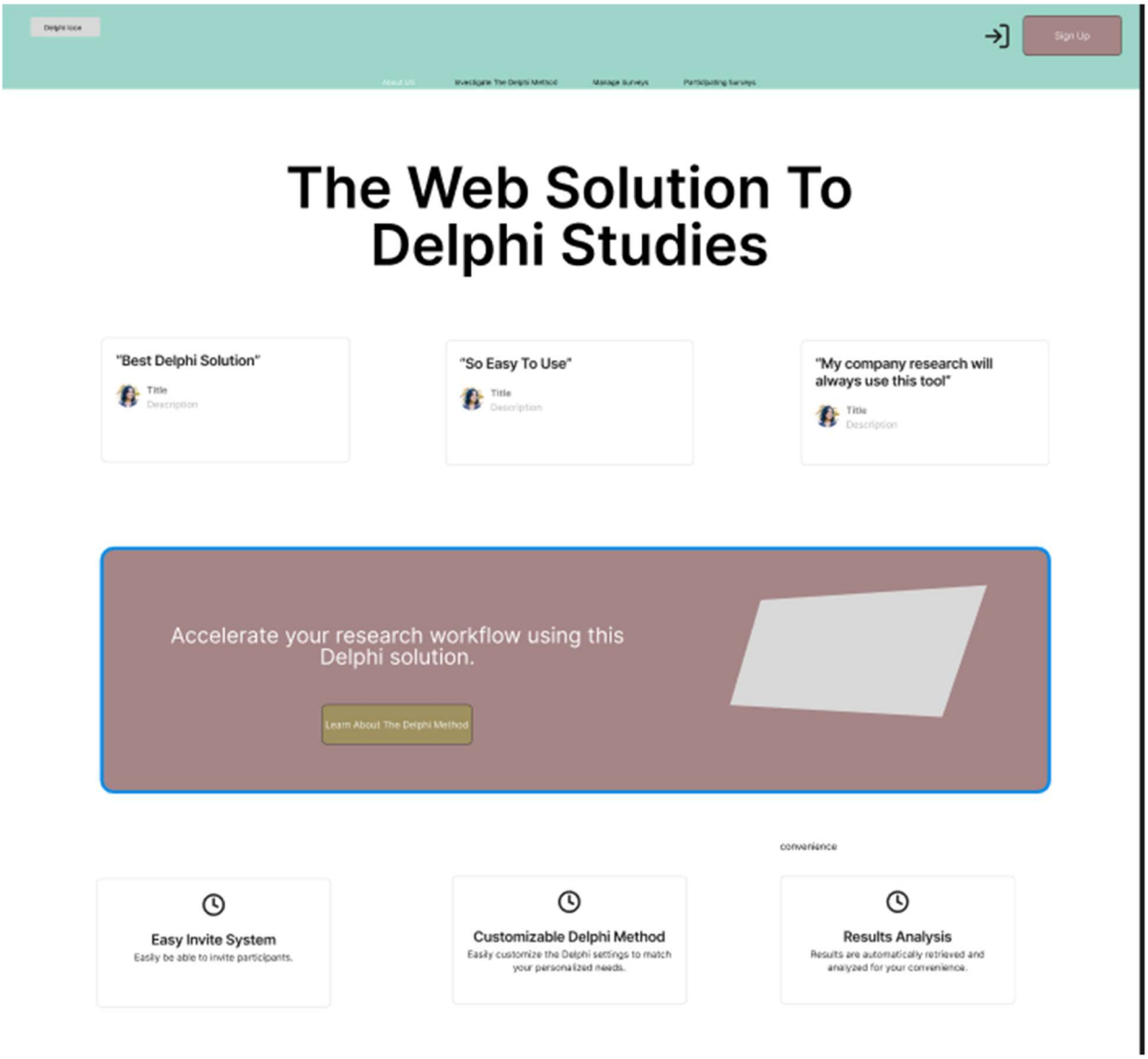


Image 1

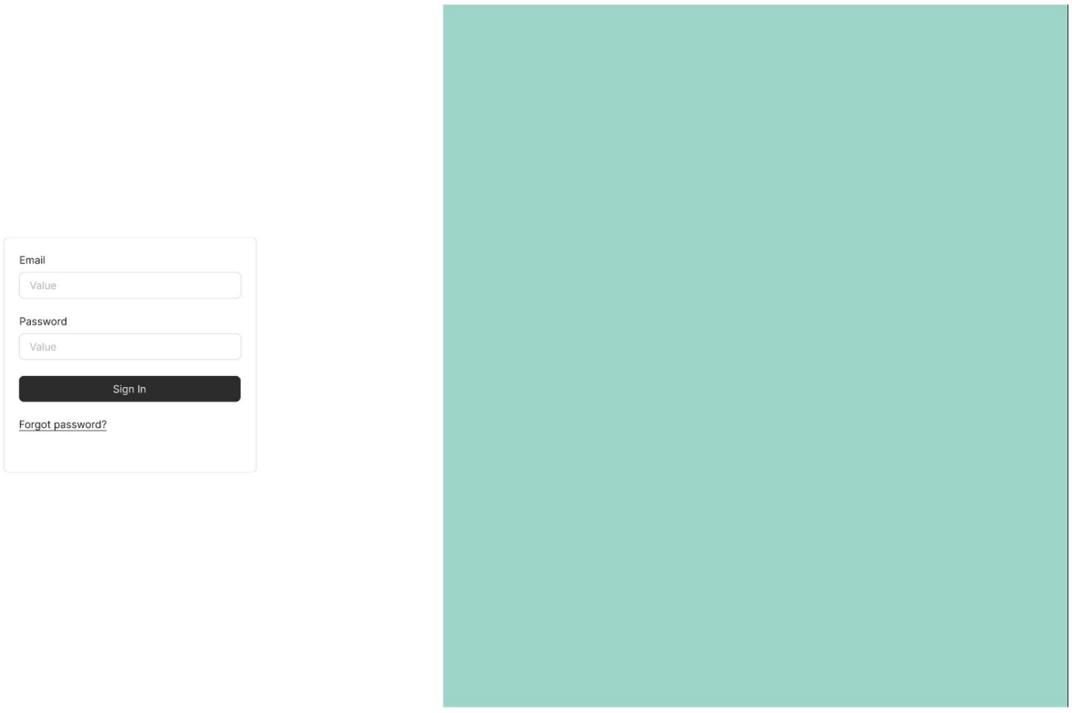


Image 2

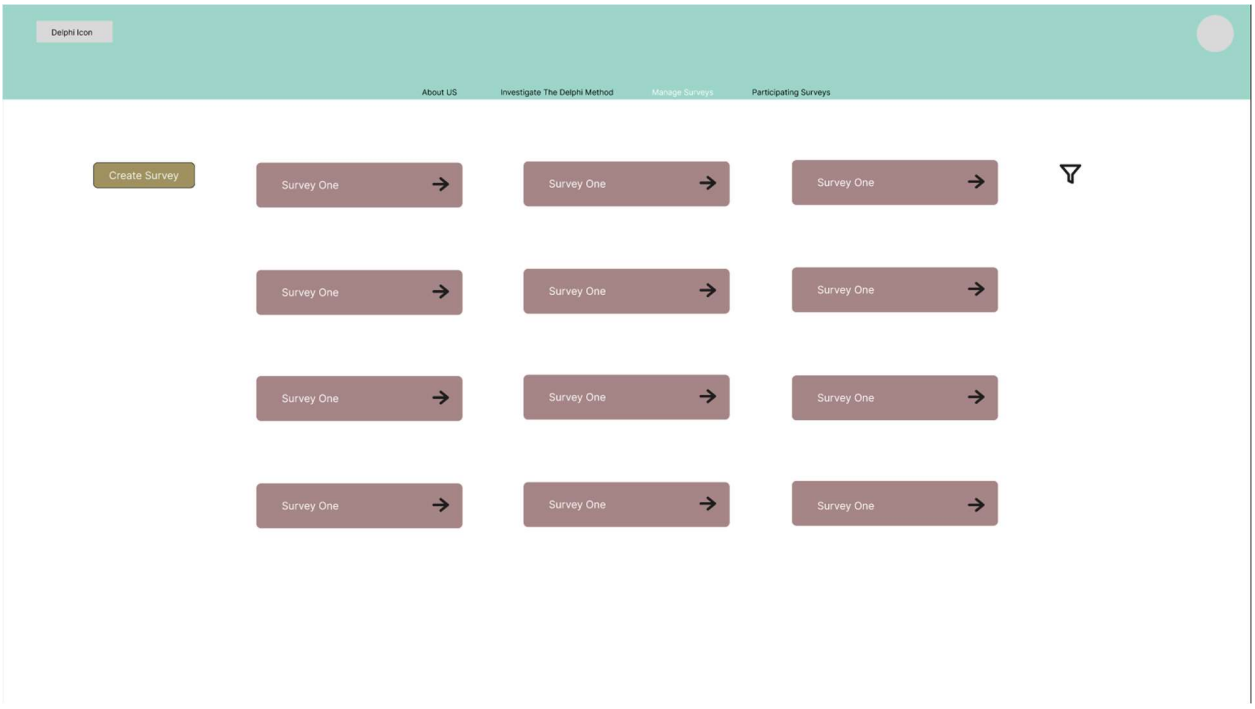


Image 3

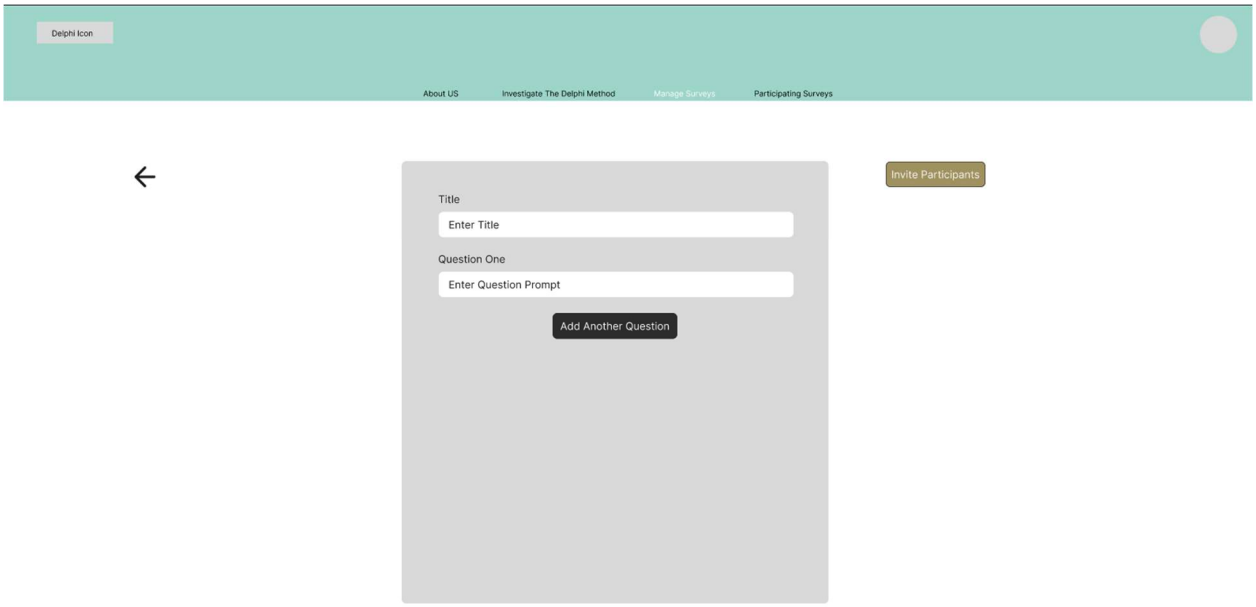


Image 4

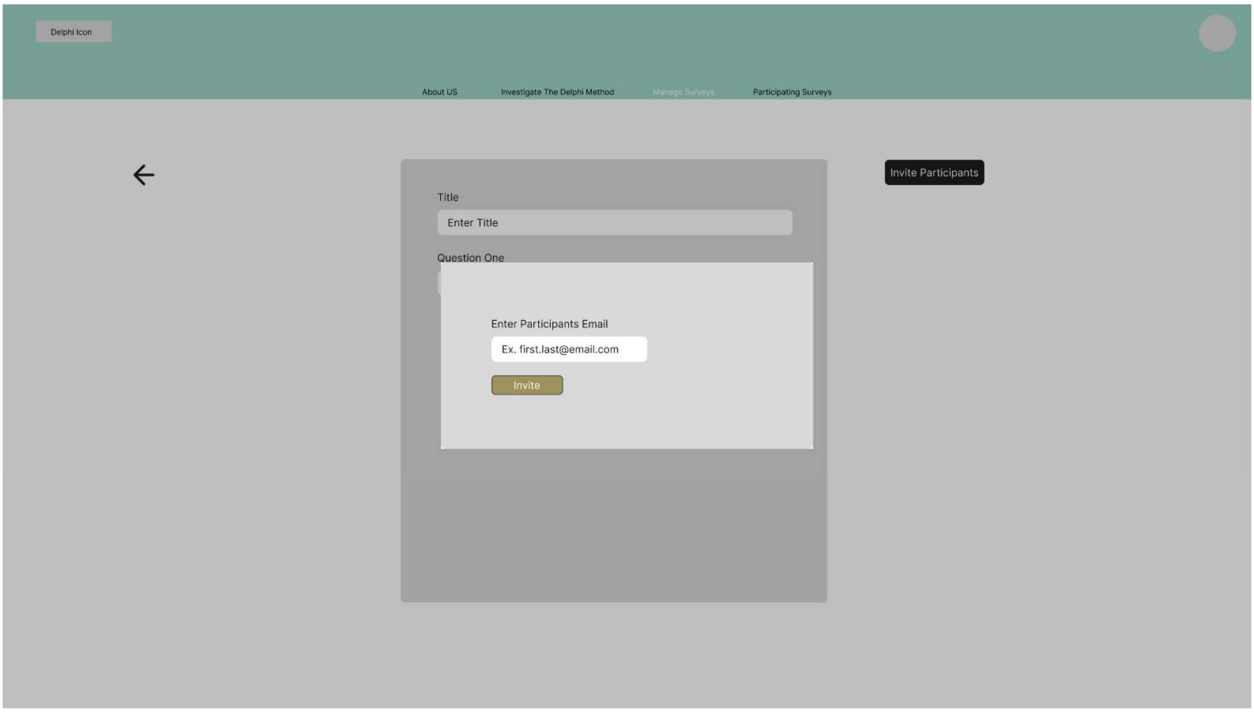


Image 5

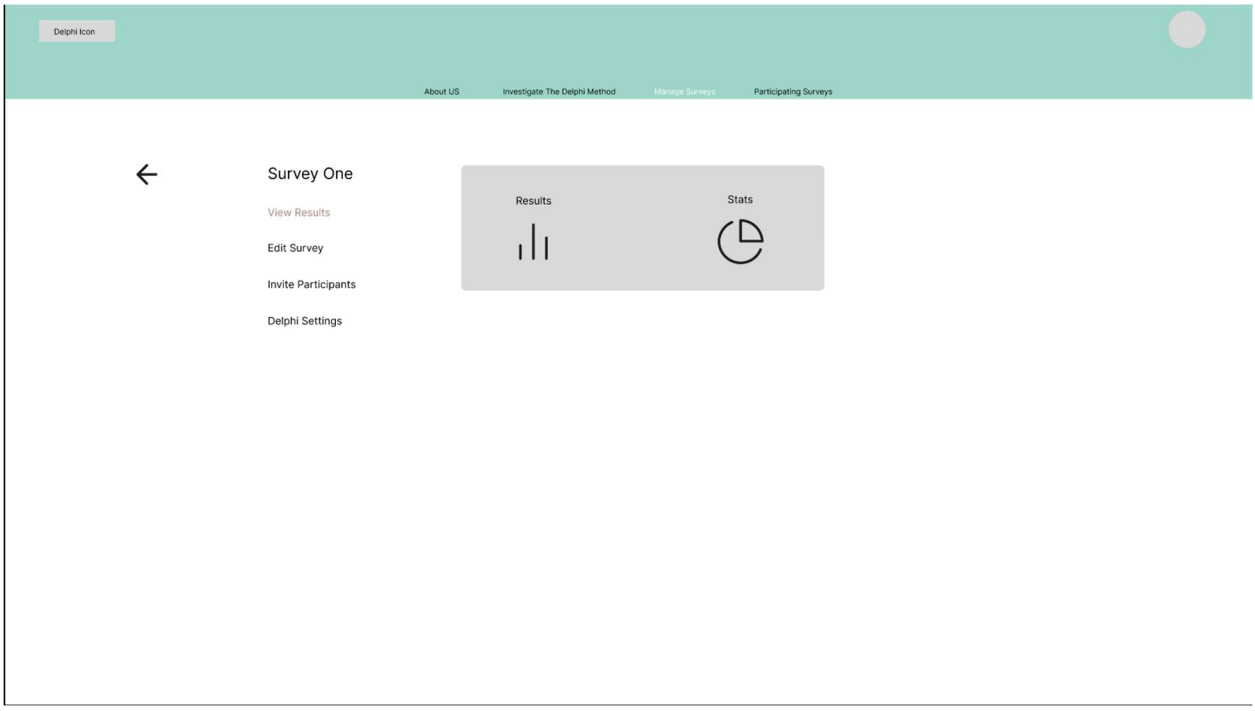


Image 6

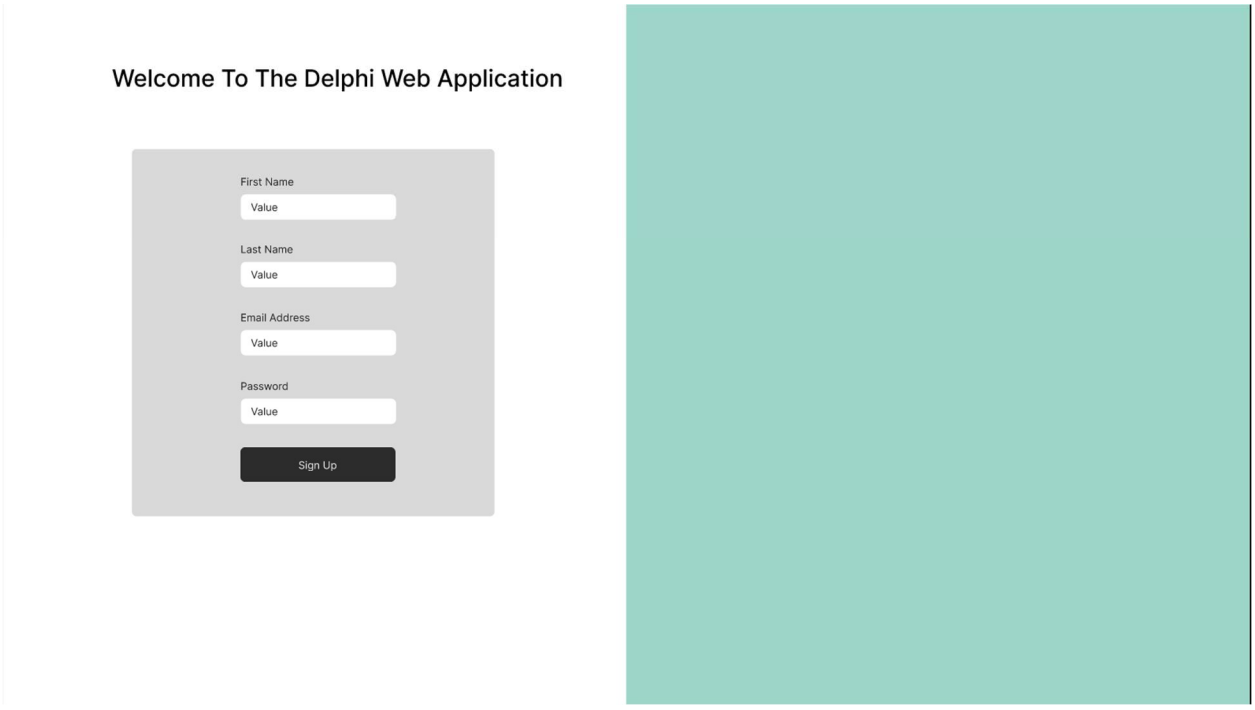


Image 7

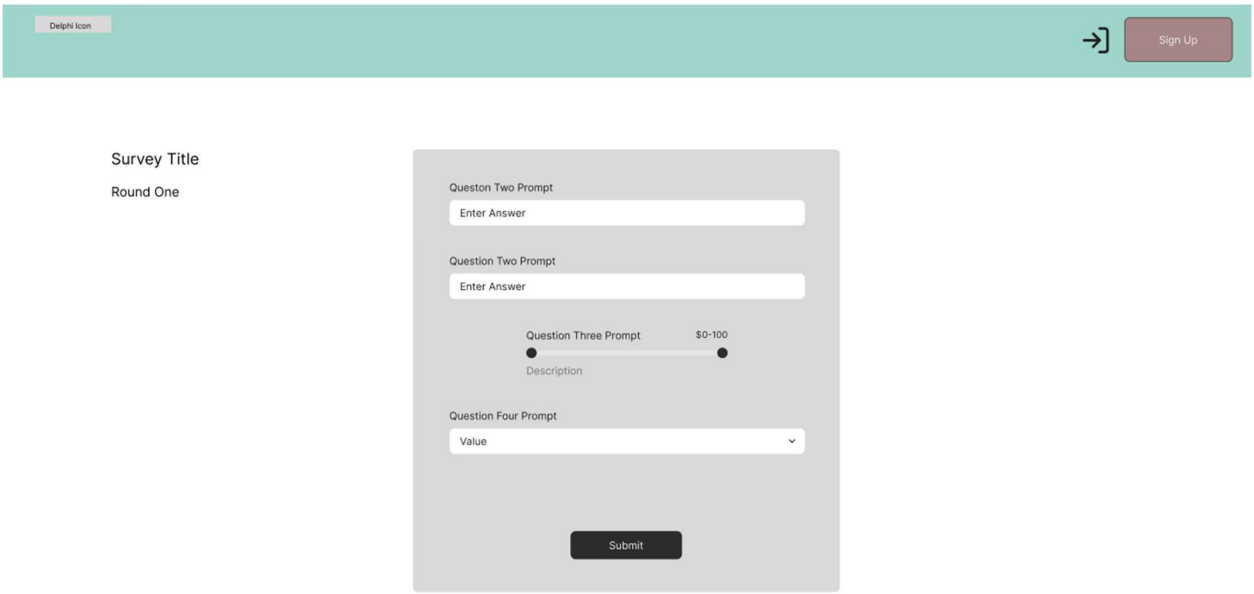


Image 8

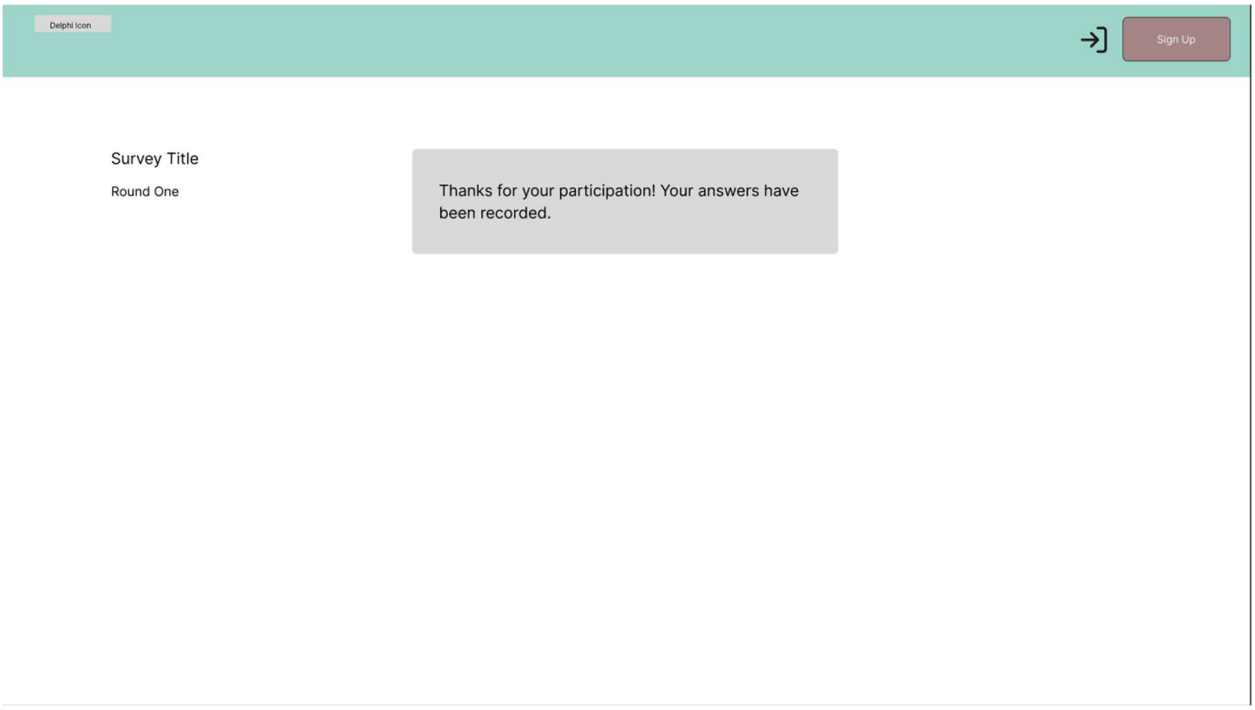


Image 9