SANTA CLARA UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Date: June 15, 2023

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Sravani Polkampalli

ENTITLED

Obujulizi Share - Enabling Voices for Rural Ugandan Communities

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREES OF

BACHELOR OF SCIENCE IN COMPUTER SCIENCE AND ENGINEERING
BACHELOR OF SCIENCE IN WEB DESIGN AND ENGINEERING

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Obujulizi Share - Enabling Voices for Rural Ugandan Communities

by

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Submitted in partial fulfillment of the requirements
for the degrees of
Bachelor of Science in Computer Science and Engineering
Bachelor of Science in Web Design and Engineering
School of Engineering
Santa Clara University

Santa Clara, California
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Obujulizi Share - Enabling Voices for Rural Ugandan Communities

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June 15, 2023

ABSTRACT

Rural communities in Uganda currently lack proper technical infrastructure to effectively communicate their issues and find support within their communities. For our project, we collaborated with Rose Academies, a nonprofit organization that aims to empower and aid impoverished communities in Sub-Saharan Africa. We intend to help them by creating a centralized, secure, and accessible system that allows members of the communities they serve to share their experiences. Our project consisted of three parts: an interview application, where Rose Academies' creative team can take and record interviews, a content managing application to allow the creative team to select compelling interviews and write stories about them, and a final application that displays these stories for viewing. This system will allow Rose Academies to gather valuable insights and understanding of each community's needs, enabling them to provide more targeted and effective support. Through our collaboration with Rose Academies, we strove to bridge the technological gap and empower rural communities in Uganda to have a voice, connect with each other, and foster positive change within rural communities.

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Chapter 1

Introduction

1.1 Motivation

We collaborated with Rose Academies, a nonprofit organization aimed at empowering impoverished and marginalized communities in rural areas of Sub-Saharan Africa. Rose Academies hosts a variety of programs that provide the poor with education and healthcare services. The program has effectively improved the lifestyles of many, yet some still desire an outlet to voice their stories. Our aim was to create a centralized network where the underprivileged in rural regions of Uganda could find strength and solidarity in each other's journeys, through the combined efforts of Rose Academies and our team at Santa Clara University. This project is specifically targeted towards rural communities that lack technical support and have a generally low literacy rate. Therefore, the people there struggle to share their stories. Privacy is also a key issue for them, as some prefer anonymity when sharing information about themselves, granted that these stories could be personal and intimate. The organization itself also needed a way to assess whether their efforts were effective in truly helping these communities in Uganda. Hearing directly from their community members would help them monitor their efforts and understand where further guidance and services are required. We believed that Rose Academies would see further success in their efforts to create more healthcare resources for their targeted communities through a common platform that would allow these communities to voice their stories.

1.2 Proposed Solution

Our team proposed a three-part solution to address the issues faced by Rose Academies. We created a safe and secure platform consisting of one web and two mobile applications, which were integrated with each other through required authentication for the creative team at Rose Academies, who managed the project. The first mobile application allows Rose Academies to conduct interviews with their community members, using audio, video, or text formats. This enables people in Uganda to voice themselves without having to risk their privacy. The web application facilitates access to the database and its management on a desktop, as it would be difficult to perform these tasks on a mobile device. The creative team at Rose Academies can then review the interviews based on the types of issues, the interviewee's success in resolving those issues, and the suitability of the content for sharing within the community. Once selected, the team can write a story about the interview, add captions or relevant tags, and publish the story. When these changes are updated and reorganized in the database, our third product, the final mobile application, can be used to present these stories, including the desired features such as captions, tags, and story titles as specified by the Rose Academies team.

We believe in our solution, as it provides a secure network and a protected environment for impoverished communities in Uganda to engage in. With Rose Academies having control over our applications, they will be able to guide their community and give them a voice to share their stories without requiring technical expertise. The organization can also distribute the workload within the creative team for conducting interviews, and writing stories, making the platform user-friendly and efficient for them to manage.

Chapter 2

Requirements

We addressed the critical and recommended requirements for our applications, based on our discussions with the founder of Rose Academies, our client. Defining these requirements helped us prioritize the implementation of important features. We organized our requirements in Tables 2.1-2.3 for all three applications: Interviews, Content Managing, and Stories. Each table was further divided into functional and nonfunctional requirements to describe the expected performance of our applications. Lastly, we listed the design constraints for our system.

2.1 Functional and Nonfunctional Requirements

Table 2.1: Requirements - Interviews Mobile Application

	Critical	Recommended
Functional Requirements	• Users should be able to create an account and sign in with proper credentials • Allow users to read an interview guide to help them take interviews • Allow users to create interviewee profiles • Allow users to upload interviews in forms of text, video, or audio for a particular profile • Users should be able to add relevant description regarding the interview	• Users can upload a digital video signature of interviewees to confirm their participation • Users can be given the option to take live recordings from the application itself
Nonfunctional Requirements	• Authentication must be secure • Enable upload from photos library	• Allow application to use device camera

Table 2.2: Requirements - Content Managing Web Application

	Critical	Recommended
Functional Requirements	• Users should be able to create an sign in with proper credentials • Allow users to select and review interviews • Users should be able to assign a status to interview (i.e. approve, deny, or lay aside,) • Users should be able to flag an interview as important • Users should be able to create a story from approved interviews • Allow users to save story drafts before publishing	• Users can view analytic information about interviews and posts • Users can filter interviews by searching keywords • Users can add their own category tags to a story
Nonfunctional Requirements	• Authentication must be secure • Embed video/audio recordings within application	

Table 2.3: Requirements - Stories Mobile Application

	Critical	Recommended
Functional Requirements	• Users should be able to sign in with proper credentials • Allow users to select stories to read • Allow users to search stories by keyword	• Users are able to favorite a particular story
Nonfunctional Requirements	• Authentication must be secure	• Embed interview videos with the story articles

2.2 Design Constraints

There are two main design constraints for this project:

1. The two mobile applications, namely the Interviews Application and Stories Application, must be implemented for Android tablets.
2. The Content Managing Application must be a web application that will be accessible through internet connection.

Chapter 3

Use Cases

By establishing our use cases, we determined the primary actions our users would perform on our applications. This section shows our use case diagram for the three applications we developed: Interviews, Content Managing, and Stories. The only principal actor using our system is the creative team at Rose Academies. While individual team members can split their work and decide which applications to use (i.e., take interviews from the interviews app, review interviews, or create stories from the content managing website, etc.), the applications will run the same interface for the entire Rose Academies team.

3.1 Use Case Diagram

Figure 3.1 displays our general use case diagram.

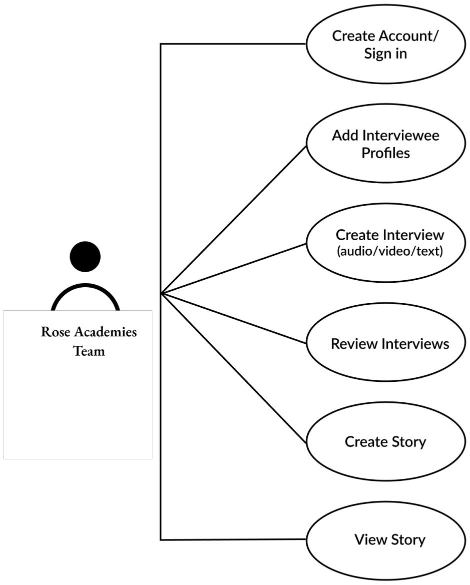


Figure 3.1: Use Case Diagram

3.2 Use Cases

Below, we have outlined use cases specific to each of our applications: Interviews, Content Managing, and Stories.

3.2.1 Interviews Application

The tables below show fundamental use cases specific to our Interviews mobile application. The actors using this application will primarily be the Rose Academies Creative Team that will be conducting interviews. There are four main use cases: creating an account, viewing the interview guide, creating an interviewee profile, and adding an interview.

Table 3.1: Create Account Use Case

Goal	Create an account and sign in
Actor / Role	Rose Academy Creative Team / Interviewer
Precondition	User is a first-time user who has just opened the application, and does not have a pre-existing account
Post-condition	User has created an account and has successfully logged in, leading them to the landing page

Table 3.2: Create Interviewee Profile Use Case

Goal	Create a profile for the interviewee
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User is ready to interview and has information details of the interviewee. The interviewee has not already interviewed with Rose Academies before.
Post-condition	New profile of interviewee is created and saved to the database

Table 3.3: View Interview Guide Use Case

Goal	View the interview guide for how to conduct interviews on the application
Actor / Role	Rose Academy Creative Team / Interviewer
Precondition	User has created an interviewee profile and is about to add an interview to the profile
Post-condition	User is aware of how to interview and has navigated to the add interview screen

Table 3.4: Add Interview Use Case

Goal	Add a new interview and record information
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User has created a profile for the interviewee and is in process of conducting interview
Post-condition	User has filled in all necessary aspects of creating an interview such as adding a digital signature video of the interviewee consenting to having the interview taken, including relevant details about the interview, and uploading the interview media file.

3.2.2 Content Managing Application

The tables below show fundamental use cases specific to our Content Managing web application. There are three use cases: viewing a dashboard that displays interview related statistics, selecting an interview and viewing its details, and finally creating a story from the selected interview.

Table 3.5: View Dashboard Analytic Use Case

Goal	View incoming interview data from the Interviews application
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User has signed into the application
Post-condition	User is aware of interview status, list of interviews, and can view visual charts or graphs describing the available data pulled from the database

Table 3.6: Select and View Interview Details Use Case

Goal	Select an interview and view information and details relevant to it
Actor / Role	Rose Academy Creative Team / Interviewer
Precondition	User has chosen an interview of their liking from the home page
Post-condition	User is aware of the chosen interview's details including interviewee information, can view the interview (depending on format), and has set its approval status. User may also navigate to create a story with the chosen interview.

Table 3.7: Create Story Use Case

Goal	Create a story from the interview chosen and be able to add a title, caption, description, and tags relevant to the story
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User has chosen an interview (from a list of approved interviews) to write a story for.
Post-condition	User has published the story or saved a draft of it for later viewing

3.2.3 Stories Application

The tables below show fundamental use cases specific to our Stories mobile application. There are two use cases: searching for stories and proceeding to view and read a story.

Table 3.8: Search for Story Use Case

Goal	Search for keywords that will filter stories according to preference
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User has signed into the application
Post-condition	User sees filtered stories and selects a story

Table 3.9: Read Story Use Case

Goal	Select and read a story
Actor/Role	Rose Academy Creative Team / Interviewer
Precondition	User has selected a story to read
Post-condition	User is viewing the story they selected

Chapter 4

Activity Diagrams

Figures 4.1-4.3 showcase the activity flow diagrams for all three applications: Interviews, Content Managing, and Stories. These diagrams help with understanding the series of actions related to each application.

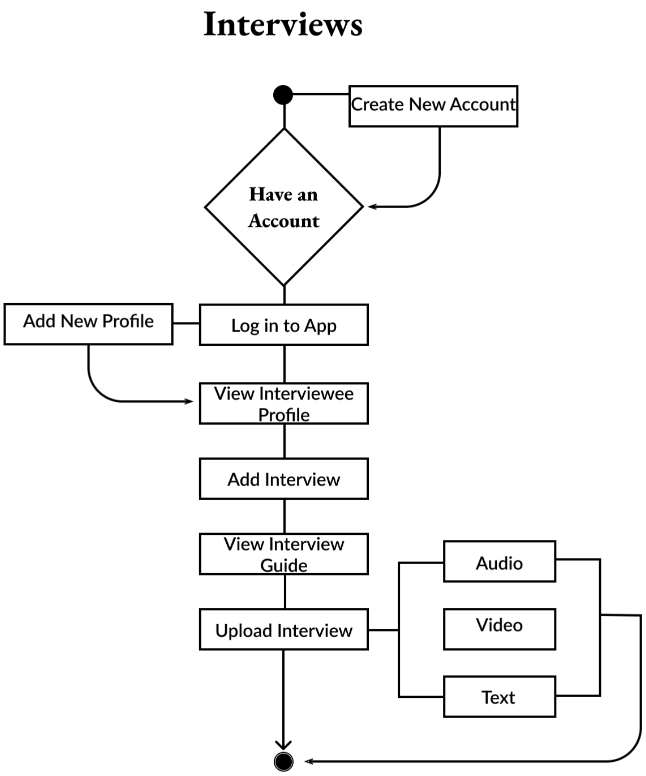


Figure 4.1: Activity Diagram: Interviews Application

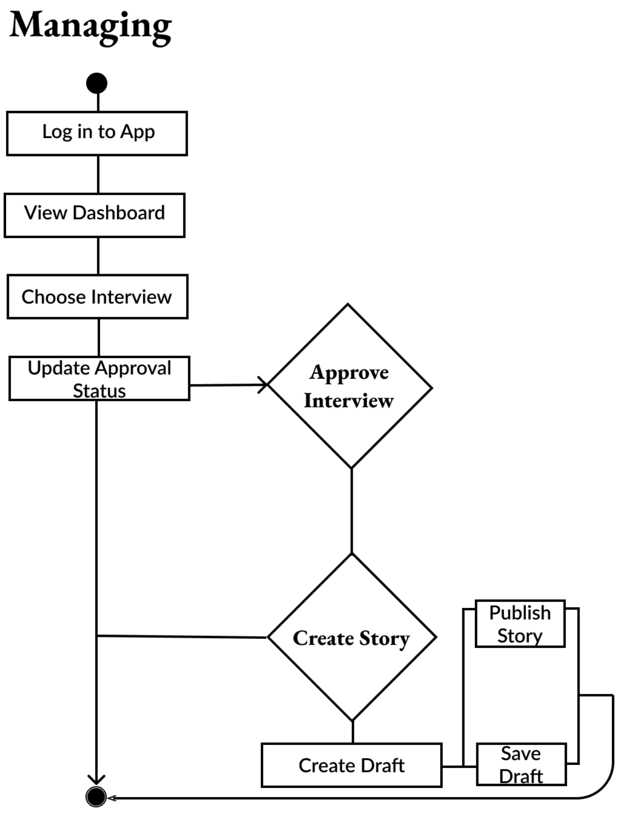


Figure 4.2: Activity Diagram: Content Managing Application

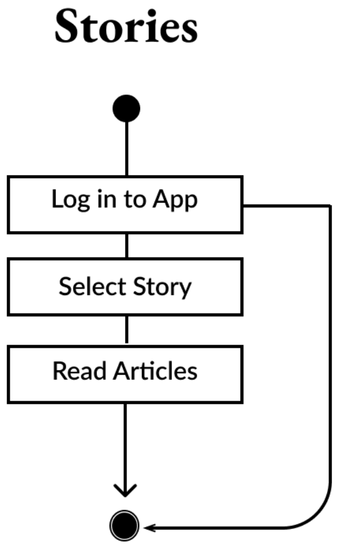


Figure 4.3: Activity Diagram: Stories Application

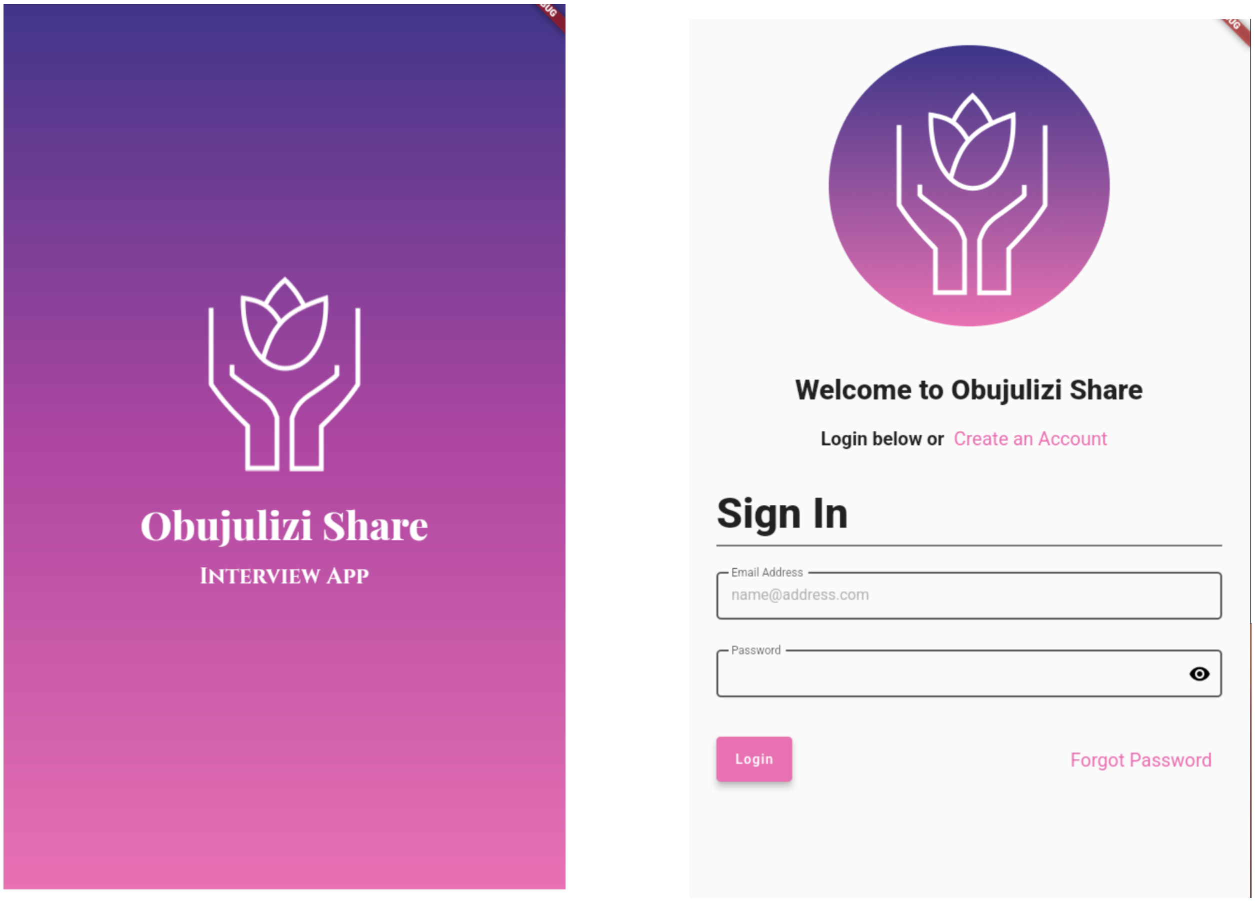
Chapter 5

Final Design

Below is our final user interface snapshots for each application, including key features and functionalities. Our design aims to provide a seamless and intuitive user experience, enabling users to efficiently manage and access interview data, create compelling stories, and read published stories.

5.1 Interviews Application Design

As shown in Figures 5.1-5.5, The Interviews application was designed to allow users to create an account and sign in; the credentials created on this application will allow access to the Content Managing and Stories applications. After signing in and accepting Rose Academies' privacy policy, users are directed to the home page. The home page displays a list of profiles that have previously interviewed with the organization. Each profile page consists of relevant information, such as name, contact information, and a list of interviews for each interviewee. Users can create profiles and add new interviews for a profile by reviewing the interview guide, recording a digital signature, where the interviewee consents to giving an interview, before finally uploading new interview data.



Welcome to Obujulizi Share

Login below or Create an Account

Sign In

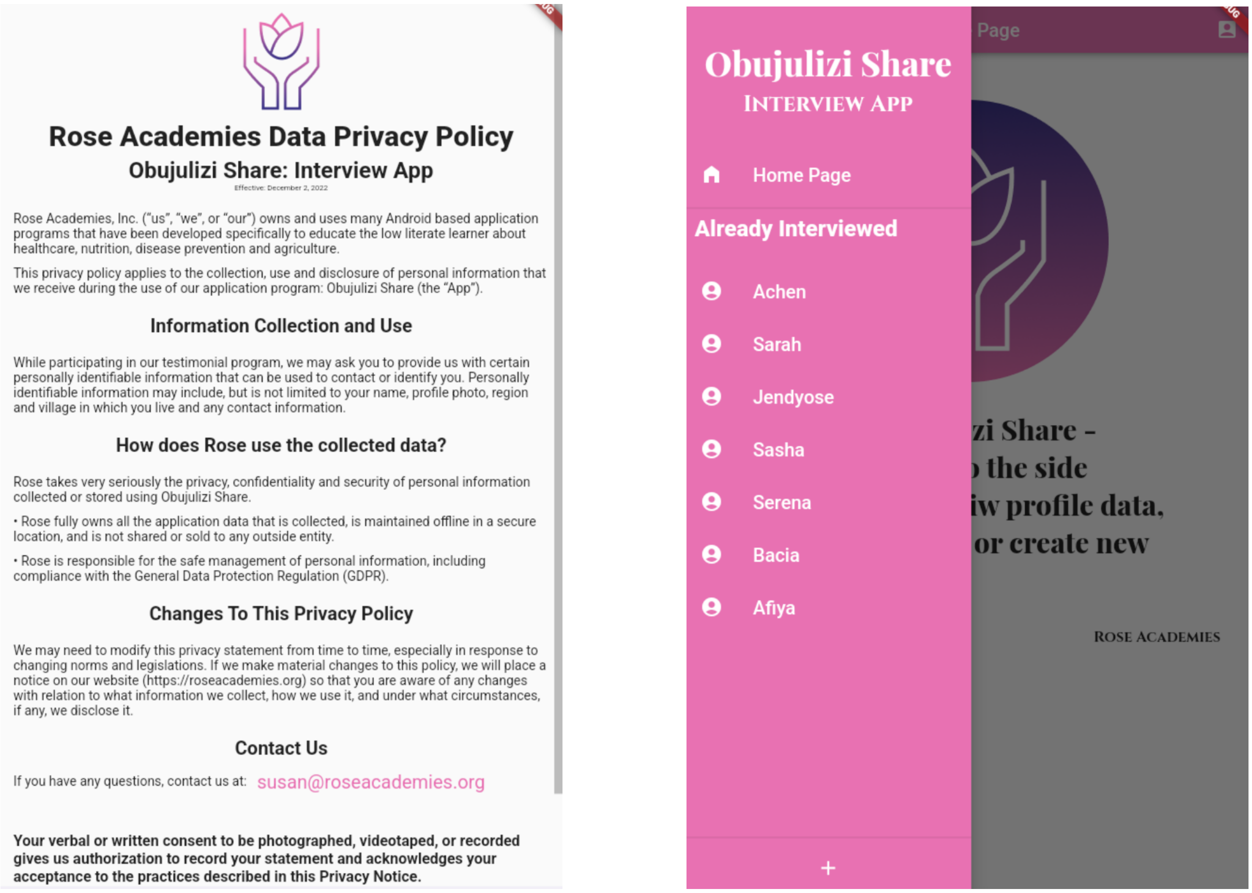
Email Address: name@address.com

Password:

(a) Interview App - Splash Page

(b) Interview App - Login Page

Figure 5.1: Interview App Interfaces



Rose Academies Data Privacy Policy

Obujulizi Share: Interview App

Effective: December 2, 2022

Rose Academies, Inc. ("us", "we", or "our") owns and uses many Android based application programs that have been developed specifically to educate the low literate learner about healthcare, nutrition, disease prevention and agriculture.

This privacy policy applies to the collection, use and disclosure of personal information that we receive during the use of our application program: Obujulizi Share (the "App").

Information Collection and Use

While participating in our testimonial program, we may ask you to provide us with certain personally identifiable information that can be used to contact or identify you. Personally identifiable information may include, but is not limited to your name, profile photo, region and village in which you live and any contact information.

How does Rose use the collected data?

Rose takes very seriously the privacy, confidentiality and security of personal information collected or stored using Obujulizi Share.

- Rose fully owns all the application data that is collected, is maintained offline in a secure location, and is not shared or sold to any outside entity.
- Rose is responsible for the safe management of personal information, including compliance with the General Data Protection Regulation (GDPR).

Changes To This Privacy Policy

We may need to modify this privacy statement from time to time, especially in response to changing norms and legislations. If we make material changes to this policy, we will place a notice on our website (https://roseacademies.org) so that you are aware of any changes with relation to what information we collect, how we use it, and under what circumstances, if any, we disclose it.

Contact Us

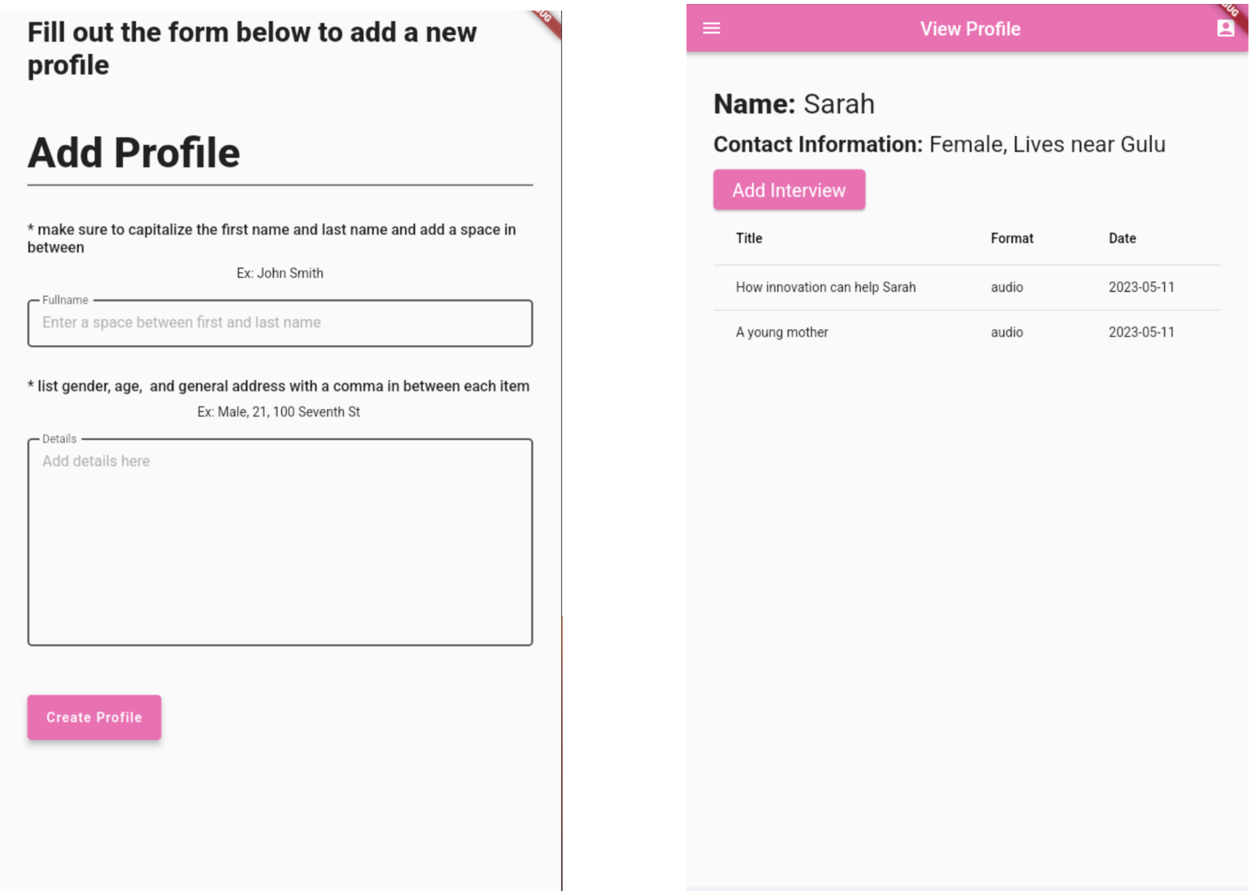
If you have any questions, contact us at: susan@roseacademies.org

Your verbal or written consent to be photographed, videotaped, or recorded gives us authorization to record your statement and acknowledges your acceptance to the practices described in this Privacy Notice.

(a) Interview App - Privacy Policy

(b) Interview App - All Profiles

Figure 5.2: Interview App Interfaces



Fill out the form below to add a new profile

Add Profile

* make sure to capitalize the first name and last name and add a space in between

Ex: John Smith

Fullname

Enter a space between first and last name

* list gender, age, and general address with a comma in between each item

Ex: Male, 21, 100 Seventh St

Details

Add details here

(a) Interview App - Add Profile Page

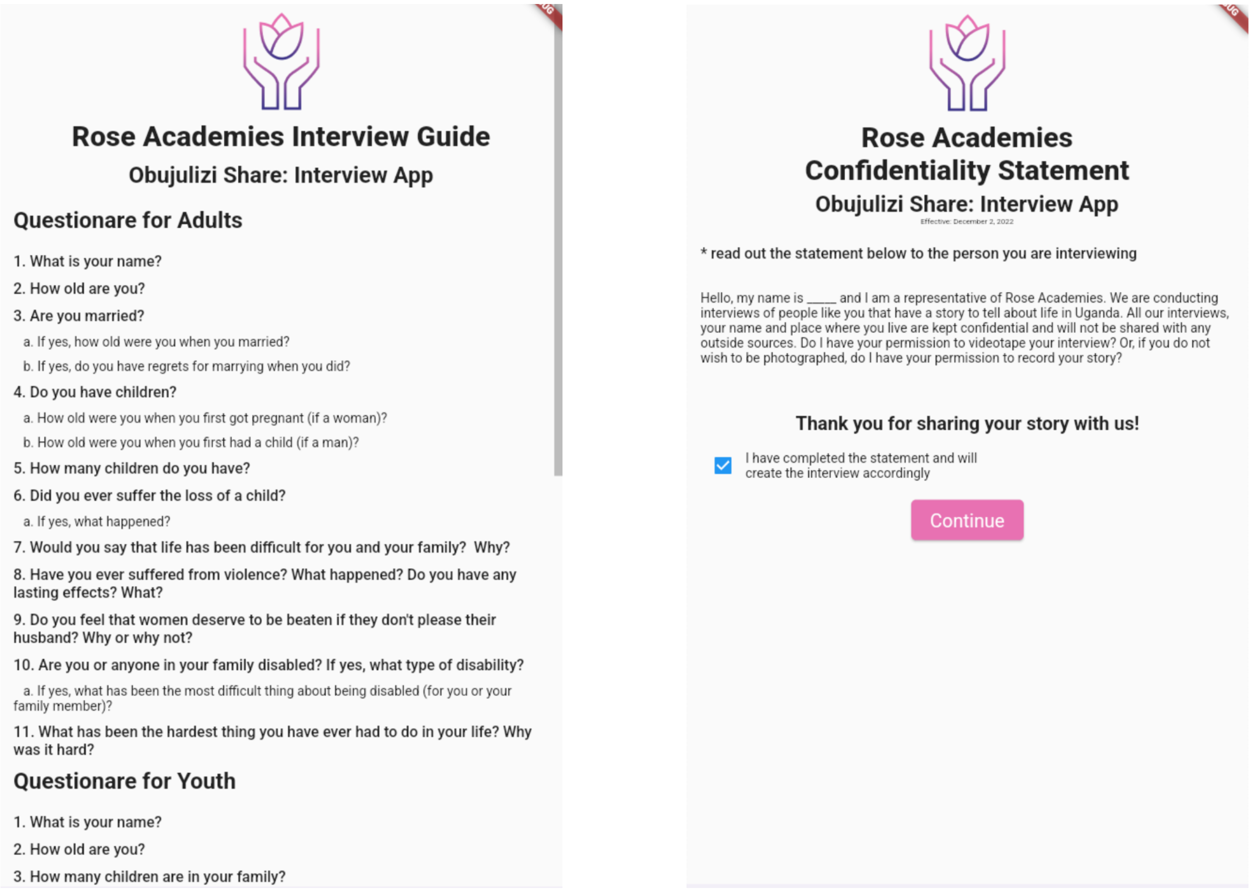
Name: Sarah

Contact Information: Female, Lives near Gulu

Title	Format	Date
How innovation can help Sarah	audio	2023-05-11
A young mother	audio	2023-05-11

(b) Interview App - Profile Details

Figure 5.3: Interview App Interfaces



Rose Academies Interview Guide

Obujulizi Share: Interview App

Questionare for Adults

1. What is your name?
2. How old are you?
3. Are you married?
   a. If yes, how old were you when you married?
   b. If yes, do you have regrets for marrying when you did?
4. Do you have children?
   a. How old were you when you first got pregnant (if a woman)?
   b. How old were you when you first had a child (if a man)?
5. How many children do you have?
6. Did you ever suffer the loss of a child?
   a. If yes, what happened?
7. Would you say that life has been difficult for you and your family? Why?
8. Have you ever suffered from violence? What happened? Do you have any lasting effects? What?
9. Do you feel that women deserve to be beaten if they don't please their husband? Why or why not?
10. Are you or anyone in your family disabled? If yes, what type of disability?
   a. If yes, what has been the most difficult thing about being disabled (for you or your family member)?
11. What has been the hardest thing you have ever had to do in your life? Why was it hard?

Questionare for Youth

1. What is your name?
2. How old are you?
3. How many children are in your family?

(a) Interview App - Questions Guide

Rose Academies Confidentiality Statement

Obujulizi Share: Interview App

Effective: December 2, 2022

* read out the statement below to the person you are interviewing

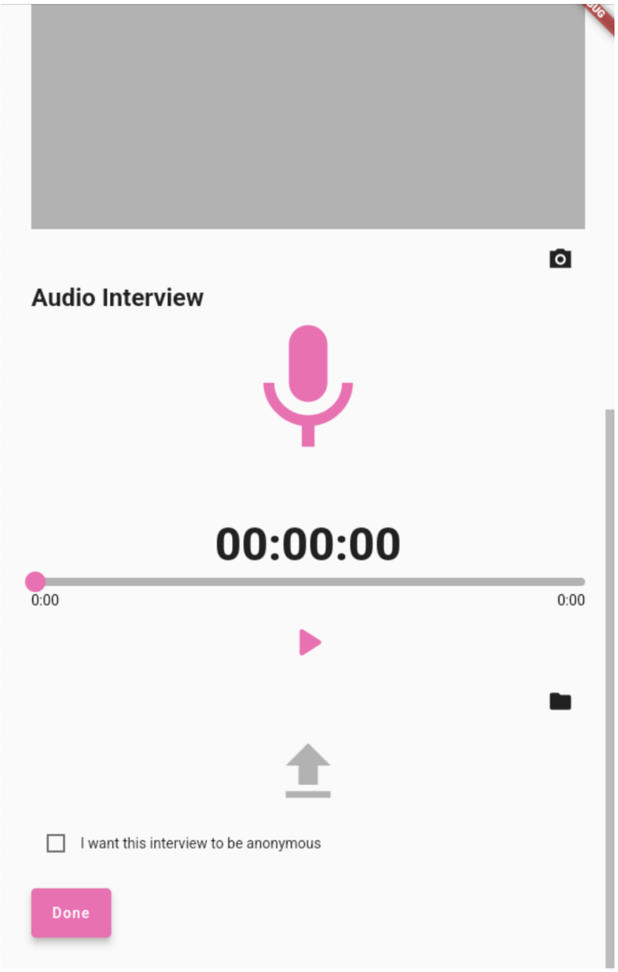
Hello, my name is _____ and I am a representative of Rose Academies. We are conducting interviews of people like you that have a story to tell about life in Uganda. All our interviews, your name and place where you live are kept confidential and will not be shared with any outside sources. Do I have your permission to videotape your interview? Or, if you do not wish to be photographed, do I have your permission to record your story?

Thank you for sharing your story with us!

☑ I have completed the statement and will create the interview accordingly

(b) Interview App - Consent Form

Figure 5.4: Interview App Interfaces


Audio Interview

00:00:00

0:00

0:00

□ I want this interview to be anonymous

Done

Figure 5.5: Interview App - New Interview Page

5.2 Content Managing Application Design

As shown in Figures 5.6-5.11, The Content Managing application serves as a platform for users to manage incoming interview data from the Interviews application. Each interview has a default status of ”pending.” Users can select an interview to view its details, set its approval status, and create a story based on the interview content. Users also have the option to create a story directly from a list of approved interviews. They can choose to save their draft or publish the story.

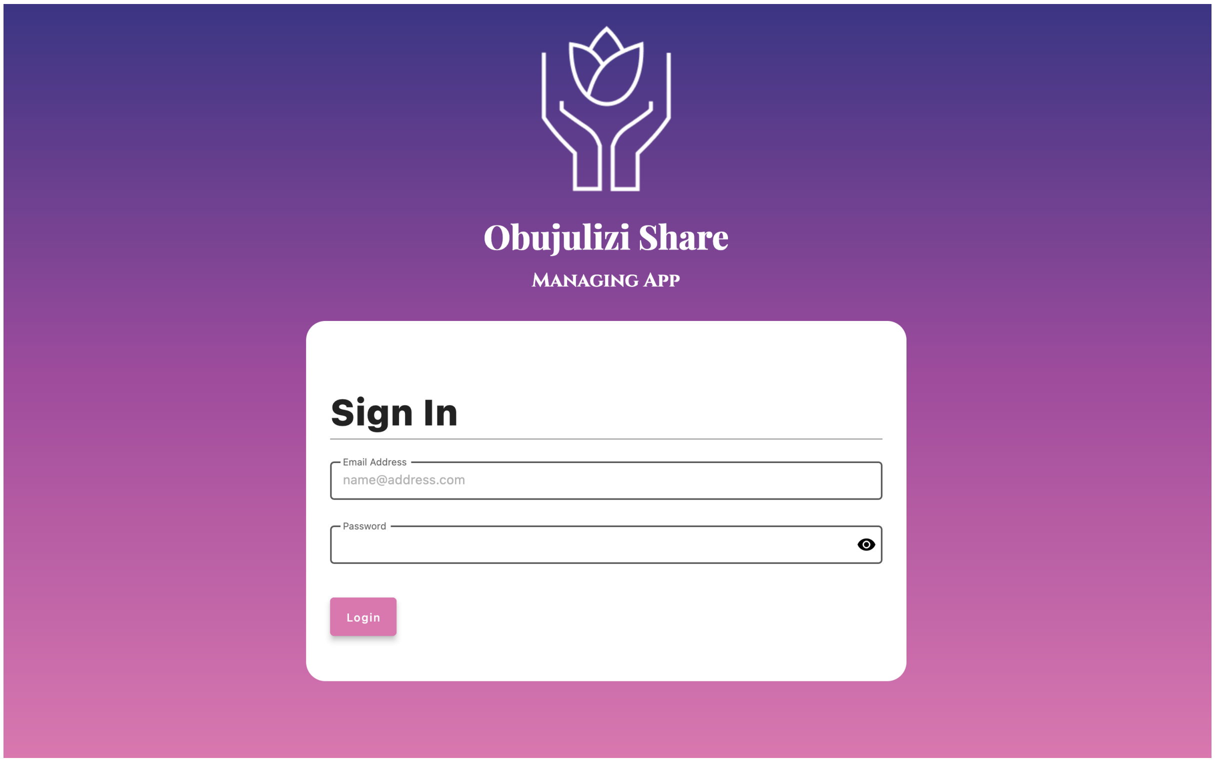
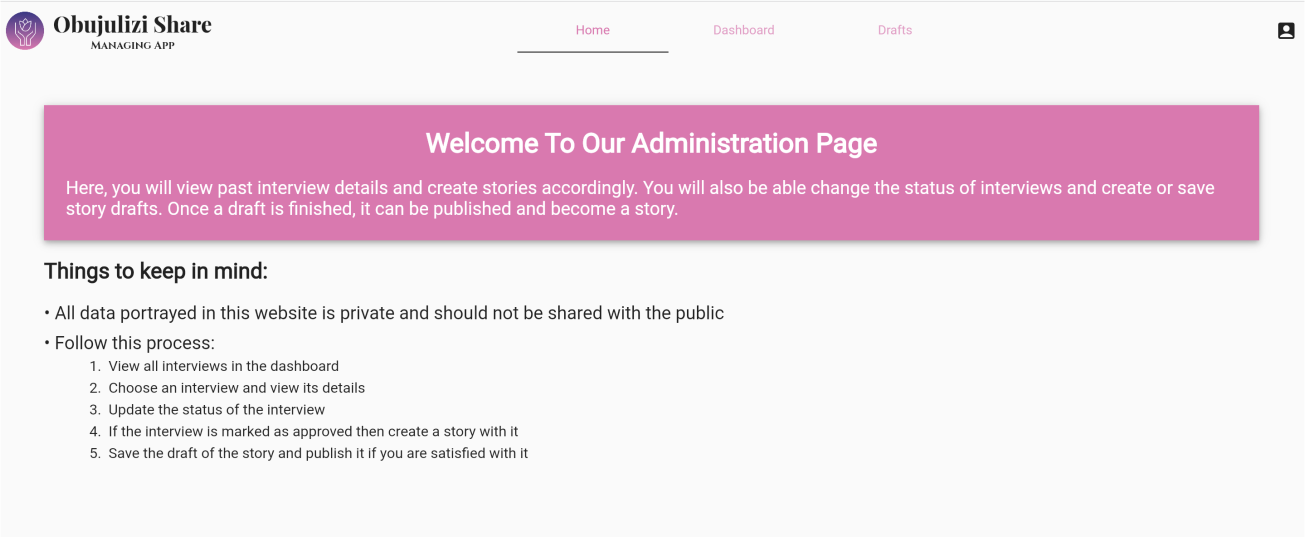


Figure 5.6: Content Managing - Sign In Page



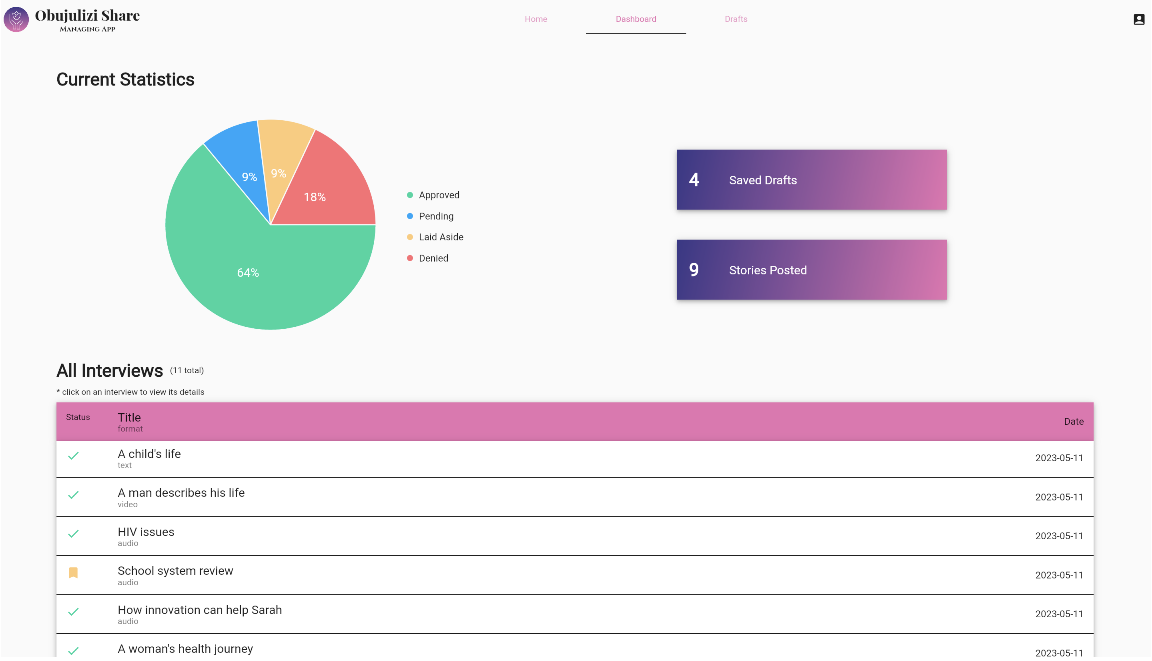
Welcome To Our Administration Page

Here, you will view past interview details and create stories accordingly. You will also be able change the status of interviews and create or save story drafts. Once a draft is finished, it can be published and become a story.

Things to keep in mind:

- All data portrayed in this website is private and should not be shared with the public
- Follow this process:
  1. View all interviews in the dashboard
  2. Choose an interview and view its details
  3. Update the status of the interview
  4. If the interview is marked as approved then create a story with it
  5. Save the draft of the story and publish it if you are satisfied with it

Figure 5.7: Content Managing - Home Page



Current Statistics

4 Saved Drafts

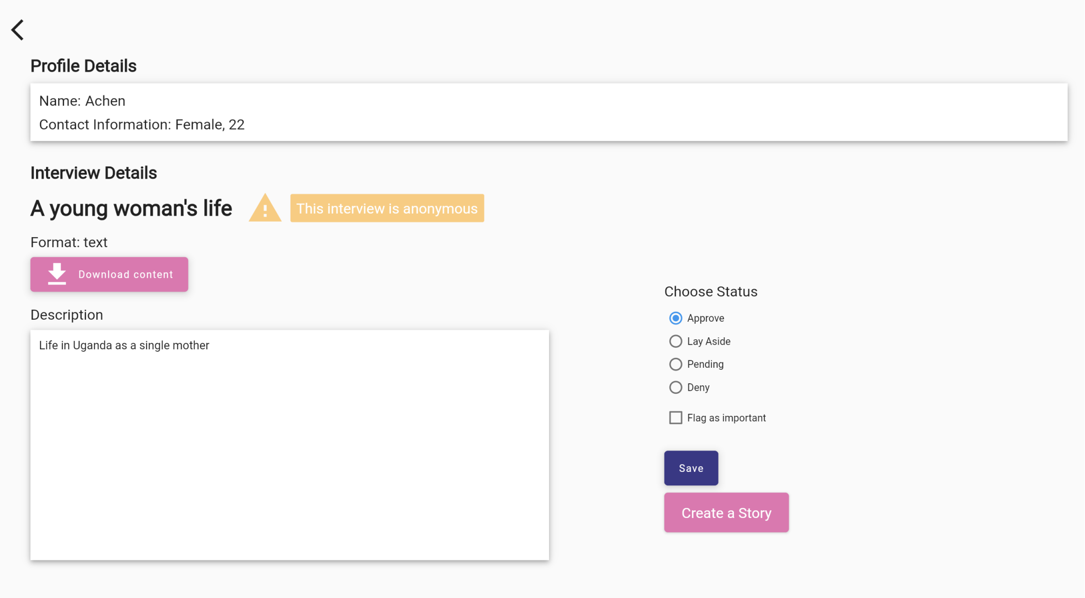
9 Stories Posted

All Interviews (11 total)

* click on an interview to view its details

Status	Title format	Date
✓	A child's life text	2023-05-11
✓	A man describes his life video	2023-05-11
✓	HIV issues audio	2023-05-11
🔖	School system review audio	2023-05-11
✓	How innovation can help Sarah audio	2023-05-11
✓	A woman's health journey	2023-05-11

Figure 5.8: Content Managing - Dashboard



Profile Details

Name: Achen

Contact Information: Female, 22

Interview Details

A young woman's life ⚠ This interview is anonymous

Format: text

Description

Life in Uganda as a single mother

Choose Status

● Approve

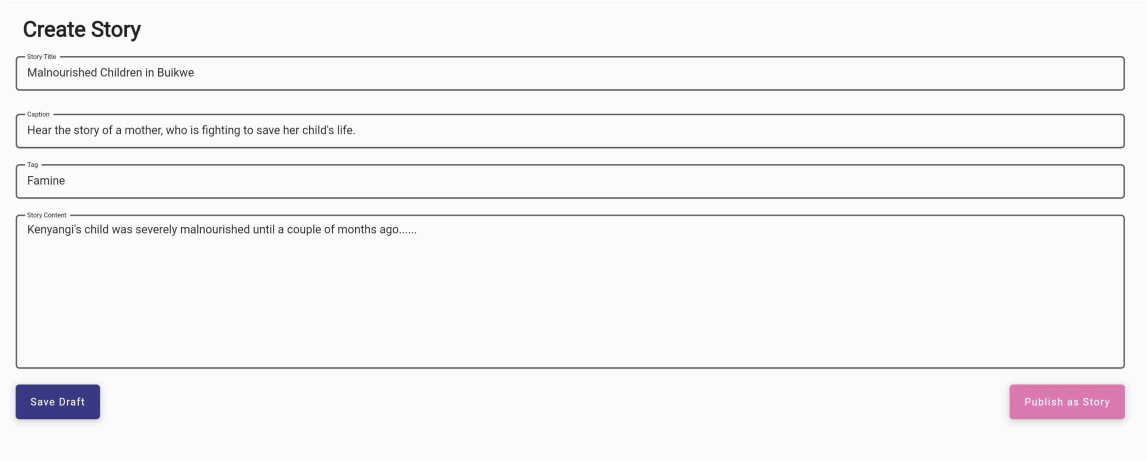
○ Lay Aside

○ Pending

○ Deny

□ Flag as important

Figure 5.9: Content Managing - View Interview



Create Story

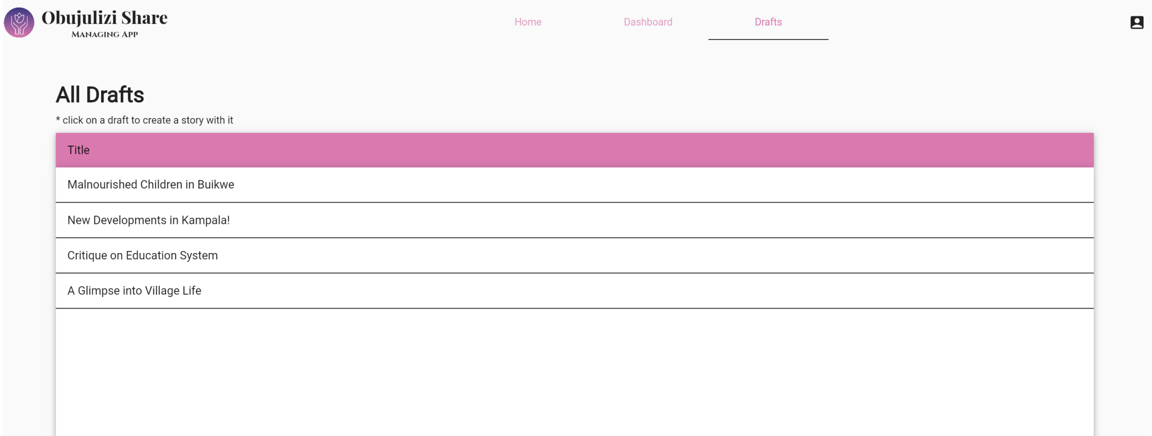
Story Title: Malnourished Children in Buikwe

Caption: Hear the story of a mother, who is fighting to save her child's life.

Tag: Famine

Story Content: Kenyangi's child was severely malnourished until a couple of months ago......

Figure 5.10: Content Managing - Create Story



All Drafts

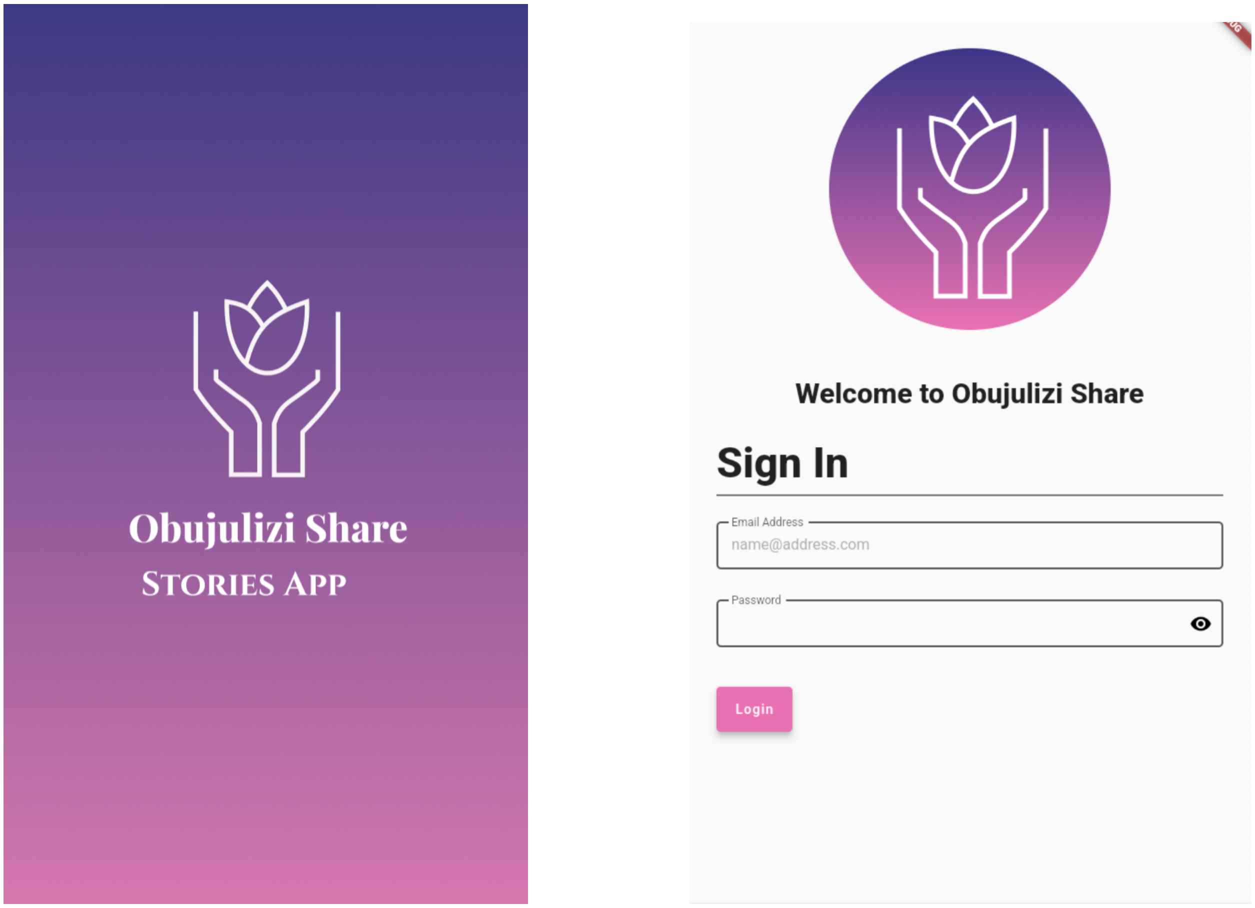
* click on a draft to create a story with it

Title
Malnourished Children in Buikwe
New Developments in Kampala!
Critique on Education System
A Glimpse into Village Life

Figure 5.11: Content Managing - View Saved Drafts

5.3 Stories Application Design

As shown in Figures 5.12-5.13, the Stories application allows users to view published stories generated from the Content Managing application. Stories are presented in a list format, and users may use the search functionality in the top bar to search for stories based on keywords. Users can also choose to read stories of their interest from the list.



Obujulizi Share

STORIES APP

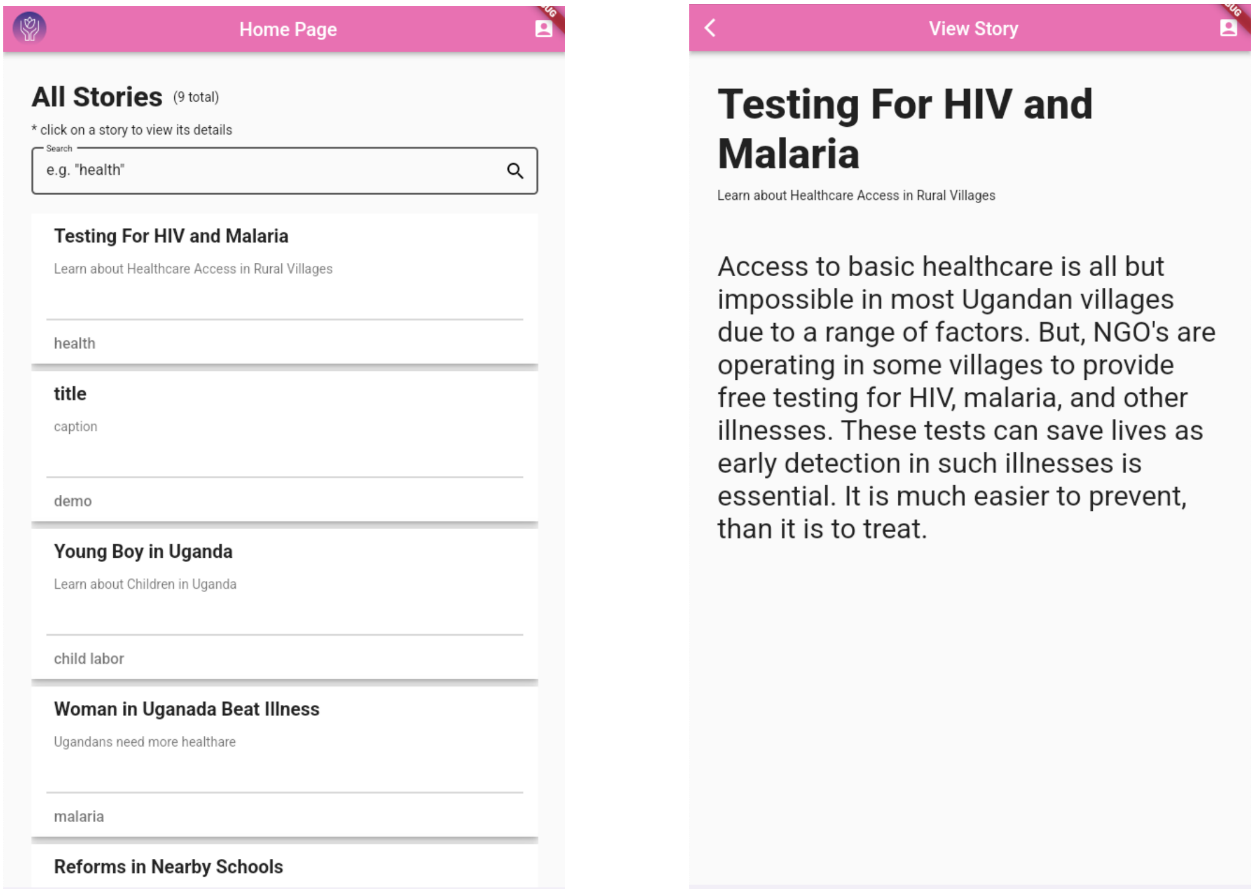
Welcome to Obujulizi Share

Sign In

(a) Story App - Home Page

(b) Story App - Sign In Page

Figure 5.12: Story App Interfaces



All Stories (9 total)

* click on a story to view its details

Search

e.g. "health"

Testing For HIV and Malaria

Learn about Healthcare Access in Rural Villages

health

title

caption

demo

Young Boy in Uganda

Learn about Children in Uganda

child labor

Woman in Uganada Beat Illness

Ugandans need more healthare

malaria

Reforms in Nearby Schools

(a) Story App - Dashboard

Testing For HIV and Malaria

Learn about Healthcare Access in Rural Villages

Access to basic healthcare is all but impossible in most Ugandan villages due to a range of factors. But, NGO's are operating in some villages to provide free testing for HIV, malaria, and other illnesses. These tests can save lives as early detection in such illnesses is essential. It is much easier to prevent, than it is to treat.

(b) Story App - View Story Details

Figure 5.13: Story App Interfaces

Chapter 6

Architectural Diagram

Figure 6.1 depicts our data-centric architectural diagram, which shows how our applications interact with the back-end. We used AWS as our cloud computing service, which hosts our REST API, and through which our three applications send and receive data from the database.

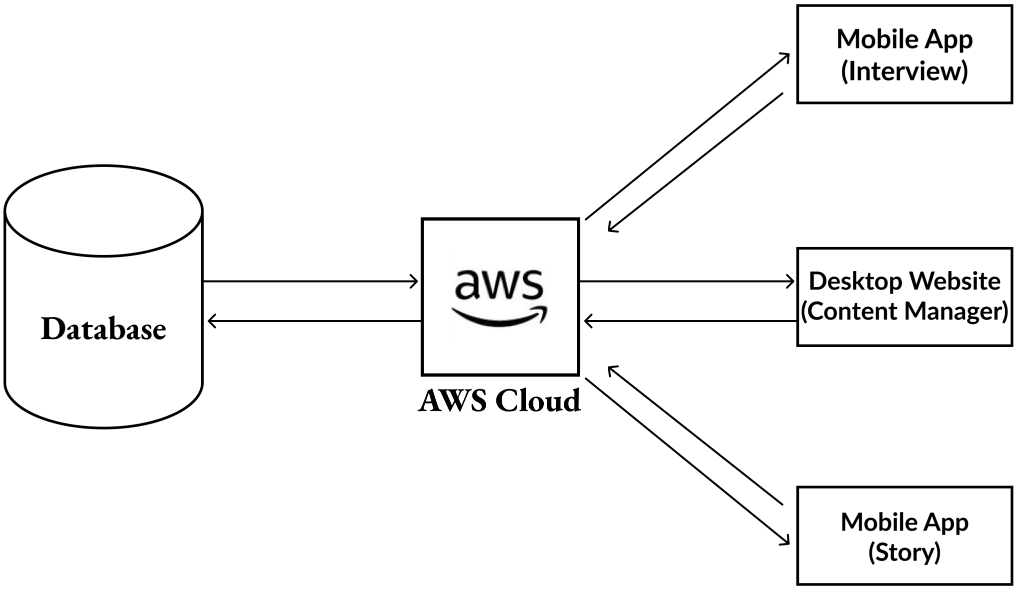


Figure 6.1: Architectural Diagram

In Figure 6.2, we have our AWS specific diagram, which shows how individual services interact with one another. While our system data is stored on DynamoDB, the actual media files of the interviews and digital signatures are stored separately in the AWS S3 storage bucket. Our back-end development consisted of creating Lambda functions that would trigger events to and from DynamoDB or AWS S3. After integrating our Lambda functions on API Gateway, we were able to create and deploy our REST API. The endpoints from our API were used as a middle-ware by the front-end to process HTTP requests and communicate with the back-end. The front-end web application was also deployed on AWS using a separate S3 bucket to host the web pages.

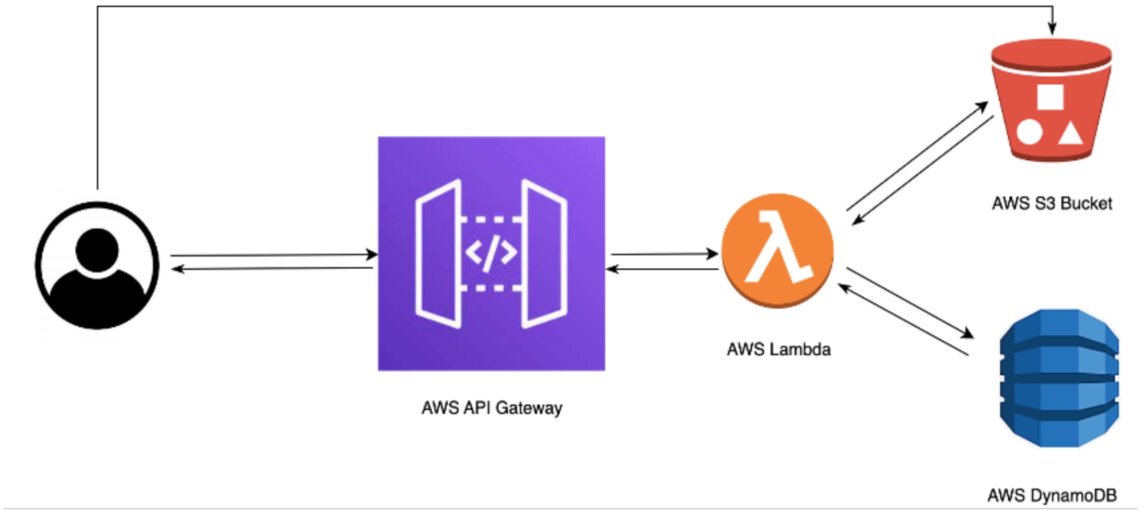


Figure 6.2: AWS Architectural Diagram

Chapter 7

Technologies Used

The following sections cover the devices our applications are suited for and the technologies we used for developing the applications.

7.1 Intended Devices

- Android tablet for mobile applications
- Computer Desktop for web application

7.2 Technologies

- Front-end
  - Framework: Flutter
  - Language(s): Dart
- Middleware: API Gateway
- Back-end:
  - Database: AWS DynamoDB, AWS S3 (Simple Storage Service)
  - Computing Service: AWS Lambda
  - Runtime Environment: Node.js
  - Language(s): JavaScript

Chapter 8

Design Rationale

8.1 Structure

Our project consisted of one web and two mobile applications. The first application was used for gathering interview data. It allowed users to log into their accounts and view profiles of past interviewees. Each interviewee had their own profile for easy identification and the potential to be interviewed again to share updates on their issues.

The web application was used to manage the data from the first mobile application. It served as an administrative tool, determining what could be shown on the final mobile application, which was dedicated to sharing the stories of the interviews.

The final mobile application solely displayed published stories and required minimal technological engagement, allowing Rose Academies to extend its use to the community in rural Uganda.

8.2 Technologies

8.2.1 Front-end Technologies

We chose to utilize the Flutter framework for both our web and mobile applications, enabling us to develop a single cross-platform application. This decision offered several advantages, including streamlined development, consistency across different interfaces, and expedited deployment. By using Flutter, we avoided the need for separate code bases for our web and Android applications, saving time and effort on the development front.

One of the key benefits of Flutter is its open-source nature and the vibrant community surrounding it. This provided us with access to a wide range of resources, documentation, and community support, which aided us in troubleshooting and further enhanced the development process. To handle HTTP requests within our application, we leveraged Flutter's HTTP package. This package offers reliable and efficient functionality for making network requests, allowing us to communicate with back-end systems and retrieve data seamlessly. By leveraging the capabilities of the Flutter framework and package, we could develop a robust and responsive application that offers a consistent user experience across different platforms. This approach not only accelerated the development process but also ensured that our application performs optimally when making HTTP requests, facilitating smooth data retrieval and interaction with the back-end system.

8.2.2 Back-end Technologies

For the back-end portion of the project, we implemented a server-less architecture, using AWS Lambda and API Gateway. We chose a server-less design because it allows our system to be automatically scaled and provisioned by the AWS servers. For our project, especially, since we are dealing with large amounts of data and can see this project grow in the future, with more interviews and stories being created, using a server-less architecture will allow for automatic scalability, managed by AWS. Having this in place also gave us time to concentrate on simply developing individual Lambda functions and expanding functionalities of our applications, while AWS abstracted the server and infrastructure management process.

Finally, we used AWS DynamoDB for our database, because of its ability to store large data sets and use of hash keys to sort through data. We wanted to intentionally use a NoSQL database due to the unstructured nature of the data we are dealing with. For example, interviewee profiles can contain different types of contact information. Due to the flexibility of data types NoSQL databases offer, we opted for choosing DynamoDB. While other NoSQL databases such as Firebase or MongoDB are viable options, we specifically chose DynamoDB because of its compatibility with other AWS services we used in our project. For storing the interview media files, we chose to use the AWS S3 service. This allowed for sizable interview video and audio files to be taken, stored, and accessed from our back-end without interfering with the overall latency of our system.

8.3 User Interface

Our goal was to create simple interfaces that would allow users to quickly and easily adapt to using our applications. To ensure ease of use, we decided to develop three separate applications, each serving a specific purpose: interviewing, managing, and viewing. This approach minimized the complexity of navigating multiple features within a single application.

We utilized design components on Figma to maintain consistency throughout our interfaces, incorporating common elements for a cohesive user experience. Furthermore, access to our interface was restricted to authorized users from Rose Academies, and users were required to accept the privacy policy and adhere to the interview guide before proceeding with the application.

Chapter 9

Testing Plan

9.1 Verification Testing

To test our front-end framework, Flutter provided built-in testing packages to test the functionality of individual UI components. Also known as component testing in other frameworks, we performed widget testing on UI components. For our two mobile applications, we built Android Package Kits (APKs) to test the end-to-end functionality of our applications as a whole. Before their deployment, we tested our web application by running an Android emulator.

To test our back-end, we configured test events for each of our Lambda functions to ensure their functionality. While testing individual Lambda functions was important, testing their integration with API Gateway was a completely different process. To verify our REST API endpoints, we tested method executions on API Gateway after integrating our Lambda functions with their respective endpoints.

9.2 System Validation

After the end of our development phase, we sent all of our deployed applications to the Rose Academies team to conduct user testing in Uganda. The two Android applications were sent by building APK files and uploading them to a Google Drive folder for easy access by our client. The web application, however, was deployed on AWS S3 (Simple Storage Service), and we simply provided the website URL to our client.

Our applications have been sent for testing, and we are currently awaiting their feedback. Based on their feedback, we intend to make any necessary changes.

Chapter 10

Risk Analysis

The table below depicts an analysis of the problems we predicted we would encounter during development, including consequences, relative probability of occurrence, severity, and ways we might avoid them. The value of impact was calculated by multiplying the values of probability and severity together to give a final value between a scale of 1 and 10.

Table 10.1: Risk Analysis Table

Risk	**Consequences**	**Probability**	**Severity**	**Impact**	**Mitigation**
Limited Time	An insufficient amount of available time to develop our project might force us to omit some features.	0.80	8	6.40	Stay on schedule as determined by development timeline and prioritize critical requirements
Lack of Required Skills	Learning new frameworks and languages will lower the available time needed for development and might lead to mistakes due to lack of experience	0.75	2	1.50	Learn necessary skills ahead of development period
Discrepancy between back-end and front-end	Lack of collaboration between back-end and front-end developers can lead to an inconsistent design	0.35	5	1.75	Communicate efficiently between group members and maintain thorough documentation
Software Bugs and Errors	Failure to foresee future bugs might create hurdles during product testing	0.75	4	3.00	Research potential bugs and test regularly during development
Limited Scope	Can restrict future implementations for project	0.25	2	0.50	Create an open-ended design that allows for future ramifications

Chapter 11

Development Timeline

The figure below depicts the development timeline we created in the beginning of the project, where we drew out how much time we will be allocating for the different phases of this project. Having this set in place helped us pace ourselves and make sure that we are on track for completion. While not completely, we followed this timeline as closely as we could. Because of the size of this project, our testing phase was pushed back, but we were able to stay on track for the development of each of our applications.

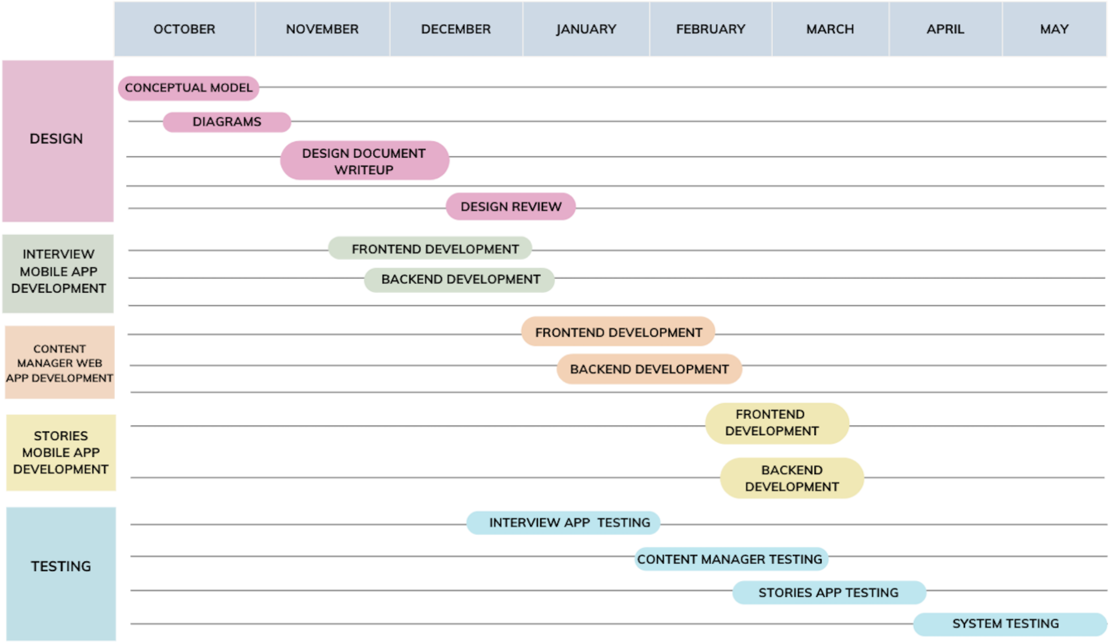


Figure 11.1: Development Timeline

Chapter 12

Societal Impact

12.1 Ethical Concerns

One of the main goals of our project was to provide a secure system for Rose Academies to learn about their communities' issues and how best to serve them by listening to their stories and experiences. We recognized that these experiences could be highly sensitive and private to share, yet crucial for the organization to understand in order to provide the necessary services to help them effectively. To achieve the organization's goals while respecting the rights of those who chose to participate in sharing their stories, we outlined key ethical objectives as developers to address and ensure the security of our system.

1. All incoming data must be secure and privatized.
2. Users of the application and those being interviewed should be made aware of what is required of them when using our system and how their data is intended to be used.
3. People selected to interview must explicitly give consent of having their interview taken.

12.2 Social Context

The system we created was designed not only for Rose Academies to assess the needs of the communities they served, but also to provide a secure platform for sharing stories and fostering a connected community that could learn from each other's invaluable experiences. By assisting Rose Academies in achieving their goals, we are directly impacting these communities.

The targeted communities face a range of social issues, including health, education, poverty, and famine. To better understand how to help them, having a tool that allowed direct input from the people themselves regarding their individual issues, resource needs, and desired improvements will enable Rose Academies to make more informed decisions on how to support them. By developing a way to conduct interviews of the individuals living in these rural areas, we provided them with a voice to effectively communicate their issues.

Using our web application, Rose Academies can review and select interviews to create stories. These stories are then published on our Stories app, allowing the organization to share these stories with the rural communities.

12.3 Health and Safety

Ensuring the health and safety of the individuals participating in the sharing of their stories was of paramount importance to us as developers. We realized the sensitive and private nature of these experiences, and we were committed to upholding the highest standards of security within our system.

To protect the health and safety of participants, we implemented strict authentication protocols to prevent unauthorized access to the platform. Additionally, we placed a priority on the well-being of participants by providing clear guidelines and informed consent processes. We ensured that individuals had full control over their own stories and had the option to remain anonymous if they wished.

12.3.1 Digital Signatures

For our project, we introduced a digital video signature, that will allow interviewees to digitally consent to having their interview taken. They will be read a confidentiality agreement by the interviewer, making them aware of how Rose Academies intends to use their data. After they agree to terms, the interviewer will ask them to record a verbal statement of their approval. This not only protects those being interviewed, but also Rose Academies, as an organization, will be able to show digital proof that interviews were taken with consent of the parties involved.

12.3.2 Granting Anonymous Participation

As mentioned before, some of the issues rural communities are suffering from are extremely sensitive and private to share, such as those relating to HIV testing or child-birth complications. Yet, discovering these issues and hearing about them would serve as a great asset to Rose Academies for them to be able to develop plausible solutions for these communities. To ensure that they feel safe in sharing their stories, we implemented a feature that would grant them anonymous participation in our system. While their personal data, such as their name and contact information will still be recorded for the organization, the interview itself can be flagged as anonymous, respecting the interviewee's choice of whether they would like Rose Academies to identify them on their platform.

12.4 Data Privacy

12.4.1 Privacy Policies and Confidentiality Agreement

In order to communicate the importance of data privacy in our system, our Interviews application clearly outlines Rose Academies' privacy policy and requires the user to read and accept the terms before moving forward with our application. This policy details how Rose Academies plans on using the data collected from the application and their commitment on ensuring confidentiality of the data. It also clarifies the nature of the data collected (i.e. name, contact information, etc.), along with how it will be used on their platform. Additionally, before taking an interview, the interviewer will be required to read out a confidentiality agreement, which makes it clear to those being interviewed that the stories they share will be recorded. It asks for their permission in participating with Rose Academies, and only after they agree, the interviewer can continue using our application.

12.4.2 Secure Media Storage

By now, we have established that interview content in our system will contain highly confidential information. These interviews, taken in audio, video, and / or text formats, are meant to be seen only by authorized users of our system, which is the Rose Academies team. In order to ensure that none of the interview media files created from our application would be accessible from our storage system on AWS S3, we privatized the S3 bucket which holds all the media files. These files are referred to as objects, as part of one S3 bucket. When made public, objects within a bucket are easily accessible by its object url generated by S3. This allows us, as developers, to use the object url of the media file(s) and have users on the front-end either upload interview media to the S3 bucket or download its contents through our website. While the url itself would be abstracted from our users, having it remain public on AWS still risks the confidentiality of the interviews, in the event the url to the public S3 bucket be made accidentally available to those unauthorized to use our system. Our solution to solve this problem was to make the bucket holding all the media files completely private. However, this would mean that even as developers, we would not be able to access the interview media files simply by using its object url. As a result, in order to successfully obtain the interview contents and display them on our content managing website, we used the concept of pre-signed urls.

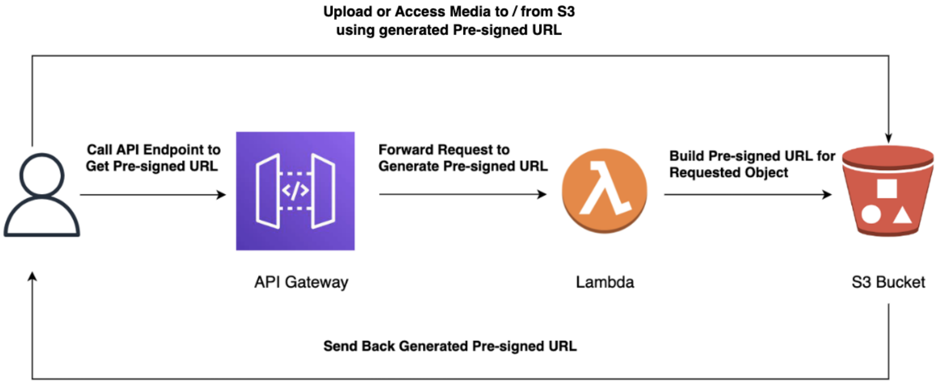


Figure 12.1: Generating Pre-Signed URLs

As shown in Figure 12.1, pre-signed urls are short-lived urls generated on the back-end that allow temporary access to an S3 bucket, even when made private. When a user wants to view or upload a media file, the front-end will invoke our REST API on API Gateway to request a pre-signed url, giving access to the S3 bucket. This request is forwarded to Lambda, which uses the S3 API to create a pre-signed url to access the S3 bucket. The generated url is not only different from the actual object url, but it also times out after a certain amount of time, meaning to access the same object, the front-end will have to request again for new pre-signed url. Thus, our process ensures that all interview media files remain completely secure and accessed by only authorized users.

12.5 Usability

In addition to prioritizing security and the well-being of participants, we were dedicated to ensuring a user-friendly and accessible system. Usability played a critical role in our development process, as we aimed to create an intuitive platform that encouraged engagement and participation, especially since our target users have limited technical background.

To enhance usability, we conducted extensive user research and incorporated feedback from various stakeholders, including Rose Academies and potential participants. This iterative approach allowed us to design a system that was easy to navigate, with clear and concise instructions for users. For example, in our Interviews app, we created an Interview Guide that lists potential questions an interviewer can ask to help them conduct the interview in a professional and respectful manner.

By prioritizing usability, we aimed to create a system that was not only secure and privacy-conscious but also intuitive and accessible to all participants. This approach enabled us to maximize engagement, encourage meaningful contributions, and ultimately support the goal of fostering a connected community where valuable stories and experiences could be shared and learned from.

12.6 Compassion

Compassion lies at the heart of our project, driving our efforts to create a secure and supportive system for Rose Academies and the communities they served. We deeply value the experiences and stories shared by individuals, recognizing the courage it took to open up and contribute to the collective understanding of community issues.

We approached our work with empathy, understanding that the stories being shared might encompass hardships, vulnerabilities, and deeply personal aspects of individuals' lives. We strove to create a compassionate environment that respected the dignity, privacy, and emotions of every participant.

We acknowledged the power of storytelling as a tool for empathy and connection. Through our secure platform, we aimed to facilitate meaningful connections between community members, enabling them to learn from one another's experiences, find solace in shared struggles, and draw inspiration from stories of resilience and hope.

Chapter 13

Conclusion

13.1 Obstacles Encountered

One of the major obstacles we faced during the project was efficiently managing our time to ensure the completion of all the intended developmental features. The design of our project and the desired functionality of our system required the implementation of numerous features, which posed a challenge for our small team of only two members. However, through consistent weekly meetings and by starting the development process early, we were able to successfully complete the project according to our original vision.

During the development process, we encountered difficulties related to troubleshooting errors in the Lambda integrations on API Gateway. As this was our first time working with AWS services, it took some time to navigate and resolve the debugging issues specific to AWS, separate from the logic of our code. We overcame this obstacle by extensively reading through documentation and gaining a better understanding of how the integrations between various services functioned within AWS.

Another significant obstacle we faced was ensuring the security and privacy of confidential data. In order to display the contents of the interview files on the managing website, we initially kept the S3 bucket public to verify the accuracy of the data input. However, as we neared the completion of the project, we realized the potential risks associated with a public S3 bucket, even if the URL itself was not readily accessible to the public. To address this concern, we implemented the use of pre-signed URLs, generating a new signature URL each time the S3 bucket needed to be accessed. This approach allowed us to maintain complete privacy for the bucket and all the interview objects stored within it.

13.2 Future Work

In order to enhance the user experience and improve the functionality of our project, we identified several areas for further development:

1. Content Managing Website: In our future development plans for the content managing website, we will address the inconvenience of users having to download media files to view interviews. We have recognized the importance of improving the user experience, and to achieve this, we plan on integrating embedded audio and video players directly on the website. By incorporating these embedded players, users will no longer need to rely on external players or download files to access and view the interview content. Instead, they will be able to easily play the audio and video files directly within the website itself. This enhancement will provide a more efficient and user-friendly experience, allowing users to consume the interview content without the need for additional software or media players.

2. Stories Application: In order to enhance the functionality of the Stories app, we will introduce additional features that will improve the user experience, such as a bookmarks or favorites tab, which will allow users to save and easily access stories that they find valuable or wish to revisit in the future. By implementing this feature, users will have the ability to conveniently navigate through their saved stories and quickly access the content that is most important to them. Furthermore, to manage scalability, as the number of published stories grows, we will implement pagination. This feature will optimize front-end latency by dividing the stories into smaller, manageable chunks. With pagination, users will be able to navigate through the collection of stories in a more organized and responsive manner, improving overall performance and user satisfaction.

3. Integration of AWS Services: Building upon our familiarity with AWS, we will integrate other services such as AWS Cognito and SES (Simple Email Service) to enhance the authentication process in our system. By leveraging AWS Cognito, we will ensure a secure and reliable authentication system for our users. With the integration of AWS Cognito, we will be able to handle user authentication and authorization more efficiently. It will provide features such as user sign-up, sign-in, and user pool management, making it easier for us as developers to manage user identities and access control. Furthermore, we plan to integrate SES (Simple Email Service) to enhance the verification process during user sign-up. By leveraging SES, we will be able to send verification codes to users' email addresses, adding an extra layer of authentication. By incorporating AWS Cognito and SES into our authentication process, we aim to enhance the security and reliability of our system, providing users with a seamless and trustworthy experience while ensuring the protection of their identities.

By focusing on these improvements, we will create a more engaging and secure environment for our users. This, in turn, will enhance accessibility and usability, making it easier for individuals in rural Uganda, as well as Rose Academies' creative team, to participate and benefit from the platform. Our commitment to these enhancements demonstrates our dedication to providing a high-quality and user-centric solution that empowers users and fosters a connected community.

13.3 Lessons Learned

1. Importance of User-Centered Design: Incorporating user feedback early and often allowed us to gather valuable insights and gain a deeper understanding of the user experience. By actively engaging with our users and involving them in the design process, we identified pain points, discovered areas for improvement, and addressed any usability issues. This iterative approach helped us refine and enhance our system.

2. Prioritization: We learned the importance of prioritizing tasks based on their urgency and importance. By identifying and focusing on high-priority activities, we tried to ensure that critical milestones were met and essential project components received adequate attention.

3. Planning and Scheduling: Effective planning and scheduling can help optimize time utilization. We learned the significance of breaking down the project into manageable tasks, estimating time requirements for each task, and creating a realistic timeline. This approach enabled better allocation of resources and reduced the risk of delays.

4. Flexibility and Adaptability: While having a well-structured plan is important, we recognized the need for flexibility in the face of unexpected challenges or changes in project requirements. Being adaptable allowed us to make necessary adjustments to the schedule, resources, or priorities while minimizing disruptions to the overall progress.

Chapter 14

Obujulizi Share - User Instructions Manual

Our applications work together as a system for Rose Academies to be able to best document stories of their beneficiaries in a safe and secure manner. While our apps can be used concurrently, it is important to understand the order of in which data flows through the applications. The Interviews App is meant to be used first in order to take interviews in the rural communities. These interviews and its details can be viewed in the Content Managing Website, where users can create stories on approved interviews. These stories will then be featured on the Stories App. In our manual, we have created a step-by-step guide that will help users navigate through all three applications.

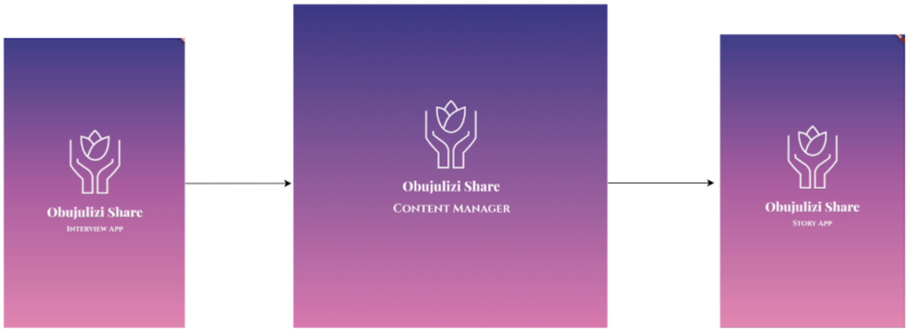


Figure 14.1: Application Flow

14.1 Interviews App

1. Read through Rose Academies' Data Privacy Policy

   This is important for the interviewers to understand how Rose Academies intends to use the data being collected. While the users of this application will be from Rose Academies' team, it is essential to understand the company's privacy policy before moving forward with the app. Check the box below the document that reads “I have read and agree to the Privacy Policy" in order to continue using the app.

2. Use the navigation bar on the left to view all interviewee profiles

   The navigation bar will show the list of all interviewee profiles. These profiles represent the people who have agreed to interview with Rose Academies. When clicking on their names, you can see more information about them and how many interviews they have taken with the organization. If they would like to interview again with Rose Academies, you can add an interview directly from their profile page.

3. Add a new interviewee profile

   On the navigation bar, click on the plus (+) sign below to add a new profile for a new interviewee (meaning they have never interviewed with Rose Academies before). Enter their name and any relevant information about them that can help the organization contact them in the future. Follow the instructions on the application for how to enter this information correctly.

4. Add a new interview

   - Use the navigation bar to click on the profile you would like to create a new interview with. All profiles (old or newly created) will be visible on this navigation bar. Once having clicked on the profile, choose 'Add Interview'
   - Carefully read through the Interview Guide as this contains the questionnaire Rose Academies wants you, as the interviewer, to ask their beneficiaries. This page does not show again until another interview is created, so please take your time to read through the questions before moving ahead to the next step.
   - Once you have finished reading the interview guide and are ready to take the interview, click on the check box at the end of the document that reads: "I have read and will follow the Interview Guide"

     Ask your interviewee how they would like to interview: in audio, video, or text formats, then choose the relevant format.

5. Take the interview

   (a) Read the Confidentiality Agreement

   This is meant to be read to the person you will be interviewing. In the blank provided, use your name. This is meant for taking the person's permission before moving forward with the interview process. Check the box below and move on to the next step.

   (b) Write Interview Descriptions

   Add an interview title that uniquely describes the interview and fill in details about the interview to provide more context which could be useful to Rose Academies' team. We suggest first taking the interview, so you have a better idea of what title / details would best suit the interview, but this is entirely up to your discretion.

(c) Record a Digital Signature

Although your interviewee should have already agreed to give an interview by this step, Rose Academies requires you to record a video (called a digital signature) where the interviewee on video "signs" to this agreement. Ask your interviewee to look in the camera and verbally confirm that they understand our confidentiality agreement and are willing to have their interview taken.

(d) Record Interview

Depending on the format, record the interview. Take a video of your interviewee if the format is video. If the format is audio, click on the microphone icon to start recording. Stop recording when you feel ready. If you or your interviewee makes a mistake, you can re-record by clicking the microphone button again, and this will overwrite the previous recording. If the format is text, type your interviewee's answers in the text box provided. IMPORTANT: Click the upload icon when you are ready to upload the interview. This is a crucial step, otherwise the interview will NOT be saved.

(e) Ask about Anonymity

Ask your interviewee if they feel comfortable having their name addressed if a story is made on them. If they respond no, check the box below that reads: "I want this interview to be anonymous." Otherwise, leave it unchecked.

Carefully review all the information: interview title, details, digital signature, interview content, and anonymity status before clicking "Done." Once clicked "Done," you will not be able to go back to edit, so be sure you have collected all the correct information.

14.2 Content Managing Website

1. Read the instructions on the home page. This will give you a good idea of how to proceed with using the website

2. Go to the Dashboard to see statistics of all the interviews taken

    - Keep in mind that all the new interviews that come from the interview app are initially marked as "Pending" by default. This means that this interview is new, has not been reviewed and requires someone to view its details and assign a status to it. The statuses are 'Pending', 'Laid Aside', 'Approved', and 'Denied.' Follow the color code to see which interviews are assigned to which status. The pie chart will give a good idea of the distribution of these statuses.

- On the right, you will see how many saved drafts there are, which means they might need editing or reviewing so they can be published soon. It also shows how many stories have already been published to the Stories app.
- Ideally, the Content Managing website should have 0 saved drafts and 0 pending interviews, so the first job to do on the website is to take care of any pending work by reviewing interview details of new interviews and reviewing the saved drafts to eventually publish them.

3. View / Review Interview Details

   - Use the table on the dashboard page to click on an interview to view further details. View the ones marked as pending first, because those are new interviews that have not been reviewed yet. You will see the profile details of the person who was interviewed and the interview details which consist of the interview title, format of the interview, and the description as noted by the interviewer. Use the "Download Content" button to download the interview.
   - Use your computer's local players / software to view the interview. If the format of the interview is video or text, we recommend simply dragging the downloaded file to another tab on your browser. If the format is audio, you will have to use your own computer player to hear the interview. We recommend using VLC or QuickTime players.

4. Assign Interview Status

   As mentioned before, all new interviews will already be marked as 'Pending,' by default. Once you have gathered all the information, you can decide how to categorize this interview. If you do not feel sure about whether the interview is strong or compelling enough to write a story about, click on 'Lay Aside.' If you feel confident that a story can be written about this interview, then click on 'Approve.' Only click on 'Deny,' when the interview is missing details, clearly does not have sufficient information, or the interview itself is of bad quality. Make sure to hit 'Save' when you finish.

5. Create a Story

   - You will only be able to create a story if the interview is marked as 'Approved.' If you feel ready to write a story about the interview then click on the 'Create a Story' button.
   - Add a compelling story title, a caption that gives a brief summary, and write your story! Be sure to add relevant tags that can help give a better understanding of what the story is about. For example, for stories about health concerns or issues, simply write 'Health.' Other ideas for tags are: 'Education,' 'Rural,' 'Lifestyle,' 'Medicine,' etc.

    - If you like the story you have made, publish the story. However, if you would like to revisit the story to make edits then click on ‘Make a New Draft,’ and you will find your draft in the Saved Drafts folder.

6. Click on the Drafts tab to view Saved Drafts

   You can click on these drafts to make further edits. Publish the story if you are satisfied with it, otherwise you can still save the draft and keep it in the drafts folder until you are ready to publish it.

14.3 Stories App

1. Scroll through all the stories and choose the one you find interesting

2. Use the search bar to search for a tag, such as ‘Health’ or ‘Education.’ These tags are also visible in purple on each story.

3. Read a story you find interesting!

The data involved in using these applications are extremely confidential and private, so please remember that access to all these applications must be given to the team at Rose Academies only.