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SANTA CLARA UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Date: June 9, 2015

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Weihan Li
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ENTITLED

Ikamva Youth

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

BACHELOR OF SCIENCE IN WEB DESIGN AND ENGINEERING



Thesis Advisor



Department Chair

Ikamva Youth

by

Weihan Li
Ann Parden

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

Santa Clara, California
June 9, 2015

IkamvaYouth

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ABSTRACT

IkamvaYouth is a non-profit organization in South Africa that would benefit from a streamlined system that expedites registration and optimizes communication for volunteers and learners.

IkamvaYouth currently has multiple mediums for registering users, which is hard to track and manage. Our solution is to make a product for volunteers and learners. The learners will be able to identify the nearest branch. The volunteers will be able to identify the nearest branch and register for a position at that branch.

The primary considerations for an application in South Africa is that it is practical and usable. The solution provide is based on web technologies to deal with the devices in South Africa, particularly focusing on data usage.

The final step of the project entails the deployment of the application by Global Social Benefit Fellowship students who will be implementing the application in South Africa with the organization.

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Chapter 1

Introduction

IkamvaYouth is a non-profit organization that works with learners from township-based secondary schools in South Africa to help them improve their grades, access quality post-school opportunities and return to help others do the same. To accomplish its objective, IkamvaYouth coordinates after-school education programs for learners and volunteer tutors. The after-school programs provide opportunities for learners to receive supplementary peer-to-peer learning and guidance from volunteers to stay in school and succeed in life.

The majority of IkamvaYouths volunteers are former students of the program, and currently those volunteers get in contact with IkamvaYouth through Facebook, emails, or phone calls. The existing process for gathering sign-up forms from volunteers through Facebook or emails and maintaining every profile to find the best match is tedious and time-consuming for the organization. Also, the organization, volunteers, and learners need a more efficient and effective way to begin the communication in a central location. IkamvaYouth would benefit from a system that provides more simplified and streamlined sign-up process for the programs.

Our solution is a location-based web application that provides a more convenient sign-up process for volunteers and suggests the optimal matches to volunteers and learners based on their registered location. This project focuses on the devices and data plans available in South Africa and the best solution for reaching users. Overall, the new application will better streamline communication and stimulate the contributions from both volunteers and learners to the after-school education program.

Chapter 2

Requirements

The following list of requirements define the goals of the project outlined in the introduction. The functional requirements define features that must be done, while the non-functional requirements describe the manner in which the functional ones need to be achieved. Furthermore, each set is divided into three tiers of importance: critical requirements are absolutely necessary, recommended requirements are highly desirable, and suggested requirements could possibly be done but are not essential.

2.1 Functional Requirements

2.1.1 Critical

- Volunteers will be able to locate the nearest tutoring branch using their registered location.
- Volunteers will have a streamlined registration process.
- Volunteers will be given the necessary information for the coordinator of the branch.
- Learners and their parents will be able to locate the nearest tutoring branch using their registered location.
- Learners and their parents will be given the necessary information for the the branch.

2.1.2 Recommended

- IkamvaYouth will have the ability to send an email to all the registered users with specific information about a defined volunteering opportunity.

2.1.3 Suggested

- Volunteers who sign up will be given an account on the IkamvaYouth Zone.

2.2 Non-Functional Requirements

2.2.1 Critical

- The system will be user-friendly with a simple user interface.
- The system will be accessible and usable on wide range of devices.
- The system will be maintainable with the option for IkamvaYouth to expand with more branches.

2.2.2 Recommended

- The system's user interface will be aesthetically pleasing.

2.2.3 Suggested

- The system will be easily updateable by organizing source code files and keeping clear documentation.
- The final product will be open source as a platform for other charities to do something similar.

Chapter 3

Use Cases

For our implementation, the following figure outlines anticipated uses of our system. The actors, goals, and conditions are indicated as components of the listed use cases and described in greater detail below.

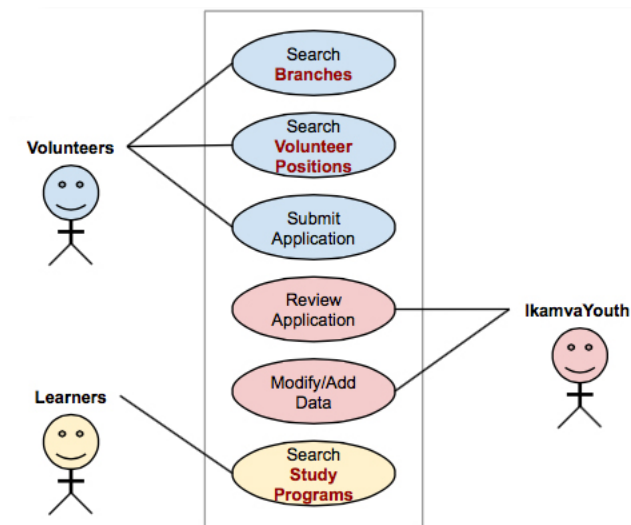


Figure 3.1: Use Case Diagram

3.1 Use Case 1

User Type: Learners, Volunteers

Goal: Searching for nearby branches and programs.

Preconditions: Learners and volunteers have access to the program website.

Postconditions: Learners and volunteers find a page with a list of branches and programs available based on their registered location.

Scenario:

1. Learners/volunteers arrive on the main page of the program website.
2. The website asks the user to click on branches, volunteer positions, or study programs.
3. The website uses the users registered location and asks for the browser permission to track the user's location.
4. The website retrieves and displays any branches and programs available based on the input location.

3.2 Use Case 2

User Type: Learners

Goal: Applying for the program.

Preconditions: Meeting qualifying conditions.

Postconditions: Being approved into the program.

Scenario:

1. Volunteers click on the apply button to open the application form.
2. Type in all the required fields.
3. Click on the submit button.
4. View the confirmation page.

3.3 Use Case 3

User Type: Organization

Goal: Screening and approving applications from volunteers.

Preconditions: Volunteers submit the pre-formatted application on the program website.

Postconditions: Organization adds the qualified applicants to the program and notifies applicant.

Scenario:

1. Organization reviews basic information and short answers on the applications.
2. Organization approves the qualified applicants to add their profiles to the program server.
3. Organization contacts and notifies the applicants regarding the screening result.

Chapter 4

Design Rationale

This project went through a considerable amount of changes from start to finish. The initial design was more of a solution for how the problem would be solved in the United States. After showing IkamvaYouth this solution the organization pointed out two issues that did not match the solution they had expected. First the design used too much data, primarily in the map view. And secondly the two sets of users, volunteer and learners, needed more information from the individual branches, for example the programs being offered at each branch.

The organization established requirements they expected the application should do. The main target user is the volunteers, so the organization expressed interest: Volunteers can use their registered location to be suggested the optimal branches; volunteers will have a central location with a more streamlined sign-up process; and volunteer will be given relevant contact information of the coordinators of the branch.

Learners and their parents, depending on who has access to a phone, will also be able to find the optimal branch and be given the relevant contact information to start communication. The learners do not have a sign-up component because their sign-up process is a lot more extensive and requires essays that would go beyond functionality of what the application should do.

Lastly the organization needed a way to contact the registered users, so IkamvaYouth will be able to email registered users.

We wanted to create something that is user friendly and would be accessible and usable on a wide range of types of phones. After this project is finished and the Global Social Benefit Fellowship students deploy it in South Africa, the organization should be able to maintain it and have the option of expanding with more branches.

4.1 Attempt 1

We chose these technologies because they are some of the most common ways to implement applications for devices with a good data plan. The implementation was designed to be simple and portable, while being powerful enough to fulfill the product requirements.

The architecture of the site was a multi-page application. We used a minimal amount of pages to keep the application process simple and require only what is necessary from the user. The initial page only had the essential content. It included a short piece on IkamvaYouth and the option for the user to distinguish between volunteer and learner.

The user was taken to a map with icons indicating the locations of volunteering branches. The icons on the map page followed a traditional map applications, making the option of clicking a location recognizable. We chose to use recognizable icons to reduce the uncertainty in features.

By clicking on an individual location icon the user will see the details of that volunteering branch, with the option to contact or apply to that specific location. We decided it was easiest for the user to have the contact and application information on the same page as the basic information of a specific branch.

After applying, the user was taken to a success screen notifying him or her of a successful submission. This page was designed to let the user know that his or her application has been sent successfully and prevent confusion.

4.2 Attempt 2

The first design attempt did not take into account the multiple programs at an individual branch. This knowledge of the programs is important for the volunteer to distinguish their skills and the learners to find out what is available near them.

The architecture of the website stayed multi-page but was greatly reduced by the new technologies used that reduced the size of each page. The design is as simplified as it can be while achieving all of the requirements.

The user is taken to a home page where they are given the introductory text for IkamvaYouth, and three buttons with the option to choose branches, volunteer positions, and study programs.

By clicking on branches the user will be taken to a page that uses their registered location to organize the branches based on distance to the user. The closest branch would be at the very top. After the user picked a branch they will be taken to the individual branch page with all the relevant information for that branch, including the option to use their phones map component and call feature

with the branches information. After the information, the programs for that individual branch is displayed, with the option for the user to click on that program and find out the information. At the bottom of a branch page is the sign-up component with all necessary questions used by the organization. This was designed to be on the same page of each branch to limit the number of pages.

Another option from the home page was the volunteer positions. This takes the user to a page with all the positions offered at every branch. By clicking on a position the user will be taken to a page with the information for the position in an organized fashion. The design of this page was purposefully done to be user friendly. After the information, we show the branches that offer the position, giving the user the option to find a branch by first looking at what position they are interested in.

The last button on the home page is the study programs, designed primarily for the learner. This takes the user to a page that display all the study programs offered by IkamvaYouth. On each individual page for the program is the information for the program followed by the branches that offer that program. From there the user can get back to a branch page and find the information for the branch they are interested in with the correct program.

Chapter 5

Conceptual Model

5.1 Attempt 1

Figure 5.1 is the first attempt and the initial prototype of the web app. The app starts by asking users to select a role to help the app apply a filter on the next screen. The role can be either volunteer or student. The user can choose a specific subject to specify an academic domain. Think of the first screen as a search box page with more specific options. If the user is a student, the second scene will be a map view that marks the locations of the nearby academic program providers. Clicking on a mark sign will open a detailed page about the provider. The student may further click on Contact to call or email that provider. If the user chooses his/her role as a volunteer, then instead of showing a Contact button, it will be an Apply button that takes the user to a basic application form. The program provider will receive the information immediately after the user submits the form. Meanwhile, a success page will be displayed on the user's screen.

5.2 Attempt 2

Figure 5.2 is the actual design of the homepage of the application. The homepage starts by giving the user the option to choose between branches, volunteer positions, and programs. The branches page, Figure 5.3, is a list of branches in order based on location. As seen in Figure 5.3 the location used in this example is Santa Clara. From the branch page is the individual branch information page, Figure 5.4, on that page is the information including location and contact information, available programs, and an application form for the volunteers.

From the homepage the volunteer position button takes the user to a page, Figure 5.5, with all the position offered. From there to a page, Figure 5.6, with all the information for an individual position and the branches that position is available at.

The last option on the homepage is the programs page, Figure 5.7, that displays all the available

programs at every branch. By choosing a program, Figure 5.8, shows the information for that program and every branch it is available at.

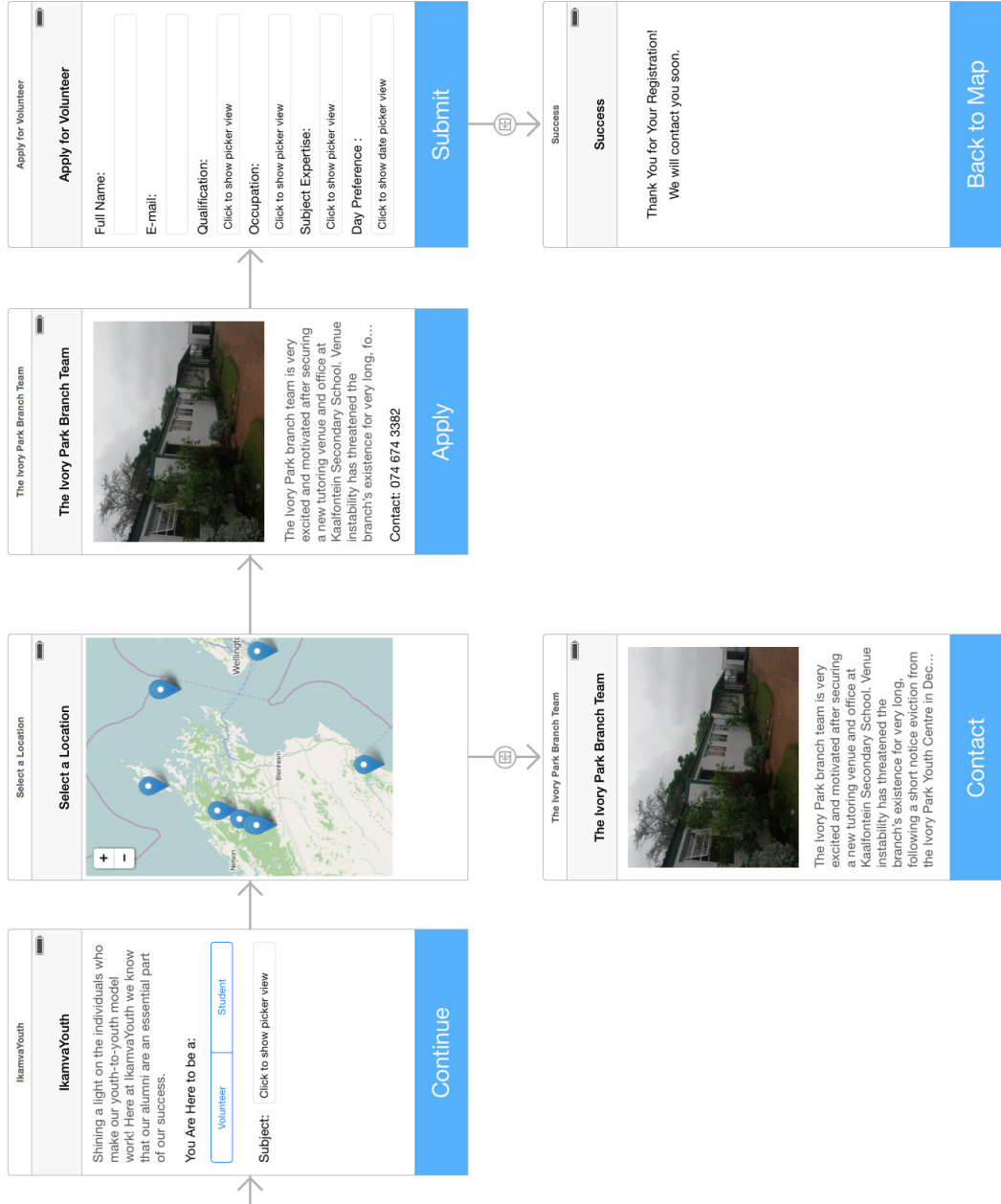


Figure 5.1: Conceptual Model

The image shows a conceptual model of a website layout for IKAMVAYOUTH. It features a top navigation bar with the organization's name and an 'Admin' button. Below this is a main content area with a descriptive paragraph, a 'BROWSE BY CATEGORIES:' section, and three large orange buttons for 'Branches', 'Volunteer Positions', and 'Study Programs'.

IKAMVAYOUTH Admin

Ikamva Lisezandleni Zethu is a South African non-profit organization focussed on the empowerment of youth through education, e-literacy training and career guidance.

BROWSE BY CATEGORIES:

Branches

Volunteer Positions

Study Programs

Figure 5.2: Conceptual Model

IKAMVAYOUTH Admin

Branches

Sorted by distance to your current location **Santa Clara**

Makhaza Public Library	>
Nyanga Community Centre	>
Masiphumelele Public Library	>
Head Office Office building	>
1070 ikamva.parseapp.com	>

Figure 5.3: Conceptual Model

IKAMVAYOUTH Admin

Makhaza

Public Library

Location
[Cnr Lansdowne and Cekeca Road](#)
[Makhaza, Cape Town](#)

Work Time
09:00 to 17:00

Available Programs
Tutoring, Mentoring, Career Guidance, eLiteracy,
MIE (media, image and expression) and Life skills

E-mail
makhaza@ikamvayouth.org

Figure 5.4: Conceptual Model

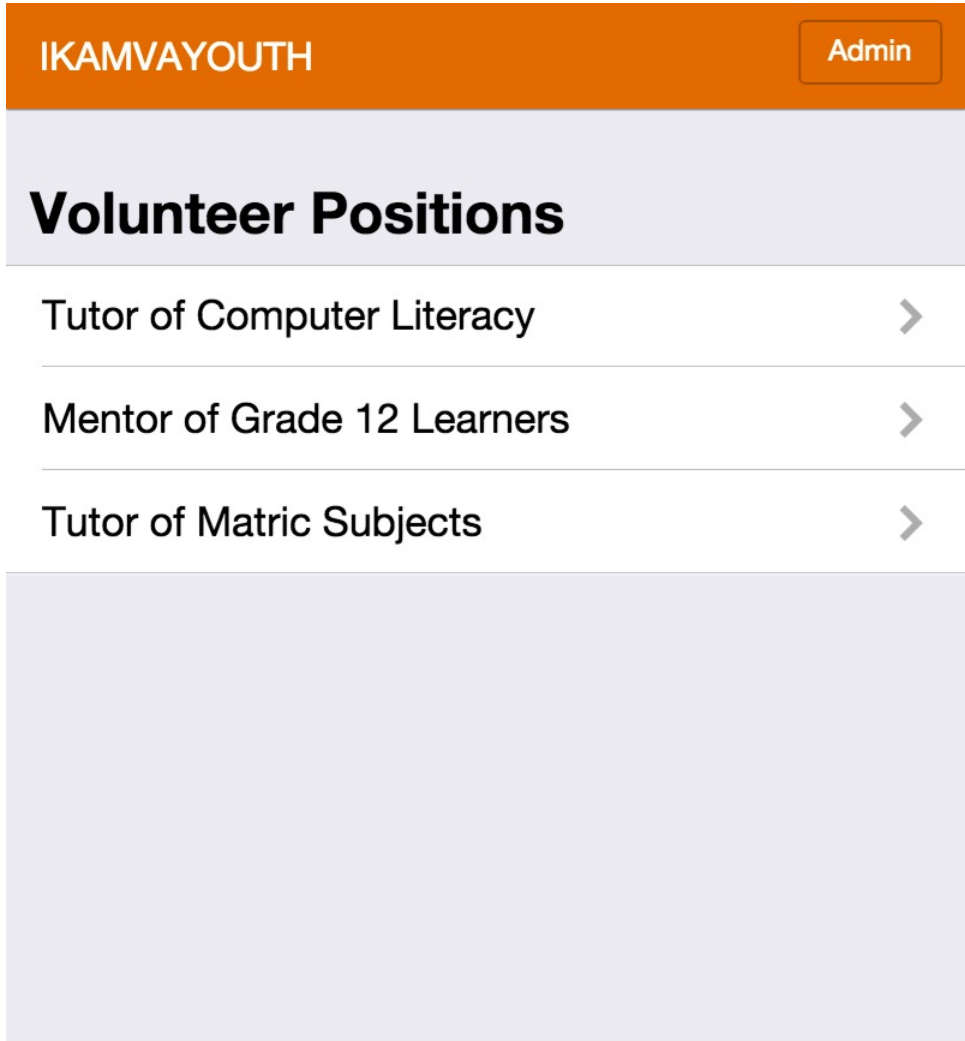


Figure 5.5: Conceptual Model

Tutor of Computer Literacy

Description

Designing and/or facilitating workshops on a variety of subjects and topics from drama, creative writing, debating and photography to leadership, entrepreneurship, health and social justice during a two-week Winter School i.e. 25 June – 6 July

Tutoring at secondary school level:
Maths, Science, English, Economics,
Accounting, Business Economics, Life
Science, Geography and History

Administrative tasks: creating student

Figure 5.6: Conceptual Model

IKAMVAYOUTH Admin

Study Programs

- Career Guidance >
- HIV Programme >
- Media Image and Expression >

ikamva.parseapp.com/detailsOf/program?id=Rcc0I0mLY

Figure 5.7: Conceptual Model

Career Guidance

Description

The career guidance programme broadens learners' awareness of career options and ensures that they know about the various post-school study, financial aid, learnership and work opportunities available and understand how to access them. Career Guidance workshops are held for an hour after tutoring sessions twice a month and during holiday programmes. IkamvaYouth also hold an annual Careers Indaba where professionals from various fields describe their jobs and institutions, organisations

Figure 5.8: Conceptual Model

Chapter 6

Architectural Diagram

Our system is based on a three-tier architecture (depicted in Figure 5.1). The clients communicate with a web server, which accepts search queries and data submission. The data of academic program providers and the application forms are stored in the database. The database is optimized for geoquery to provide fast access.

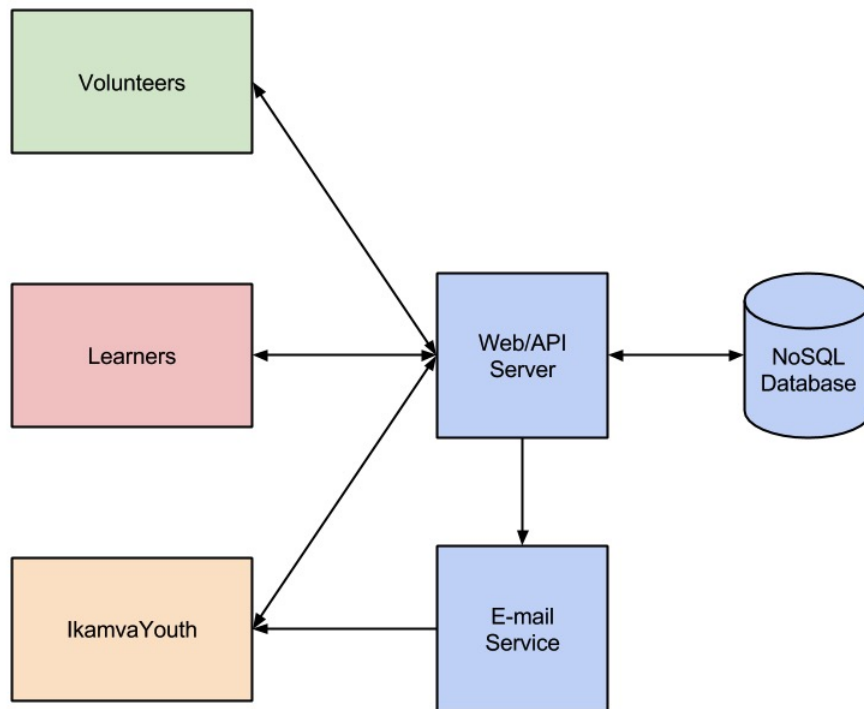


Figure 6.1: Architectural Diagram

Chapter 7

Technologies Used

The final product went through two different designs, focusing on different technologies to create the outcome requested by the organization. After presenting the first design IkamvaYouth requested a redesign that focused on compressing data so the greatest amount of users could access it on the largest number of devices. The initial design of the project used technologies that did not fit these request.

7.1 Attempt 1

The following list describes our initial efforts of the technologies for the first design:

- HTML5, the latest version of Hyper Text Markup Language, is the standard language used to create web pages.
- CSS3, modern Cascading Style Sheets, defines the look and layout of a web page. CSS defines the formatting of the HTML content.
- JavaScript is a dynamic language that allows the client side to interact with the user. The application will be hosted by SCU web servers.
- Node.js is an open source, cross-platform runtime environment for server-side and networking applications. Node.js is a platform built on Chrome's JavaScript runtime for easily building fast, scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices.
- AngularJS is a structural framework for dynamic web apps. It lets programmers use HTML as the template language and extend HTML's syntax to express the application's components

clearly and succinctly. Angular's data binding and dependency injection eliminate much of the code programmers would otherwise have to write.

- Apache Cordova is a set of device APIs that allow a mobile app developer to access native device function such as the camera or accelerometer from JavaScript.
- Chrome Apps deliver an experience as capable as a native app, but as safe as a web page. Just like web apps, Chrome Apps are written in HTML5, JavaScript, and CSS. But Chrome Apps look and behave like native apps, and they have native-like capabilities that are much more powerful than those available to web apps.
- Karma is a test runner for the browser supported by the Angular.js. Karma helps us execute tests on real devices and get instant feedback from the tests.
- Git is a free and open source distributed version control system. Our team uses git to track history, merge branch, and resolve conflict.

7.2 Attempt 2

The following list describes the technologies actually used. These technologies benefited the request made by the organization to compress data. Some of the technologies followed over from our first design:

- HTML5, the latest version of Hyper Text Markup Language, is the standard language used to create web pages.
- CSS3, modern Cascading Style Sheets, defines the look and layout of a web page. CSS defines the formatting of the HTML content.
- ECMA5 is a client side scripting language comparable to JavaScript.
- Node.js is an open source, cross-platform runtime environment for server-side and networking applications. We decided to use Node.js because it compatible with Parse.
- Zepto.js is the minimalist JS Library with JQuery APIs.
- Ratchet is the CSS framework used to minimize size and make an application feel native. Ratchet is lighter and more responsive, creating faster page load times.
- Parse is a cloud platform used to hold the scalable and powerful backend. Creating the smallest size of the basic libraries and creating a faster load time.

- Express is a minimalist Node.js framework for web applications.
- Yeoman is the project setup framework used to build the application. It contains multiple open source tools that simplified the development process.
- Grunt is a JavaScript task runner that preforms frontend automation in the most minimized form.
- Bower is a package manager optimized for frontend. And requires only a single version for each package, reducing page load.
- Git is a free and open source distributed version control system. Our team uses git to track history, merge branch, and resolve conflict.
- MailChimp is the email service that will send the the registration information to IkamvaYouth, and was a simple choice for automating the information. MAilChimp has a back end for managing applications that will benefit the organization.
- Qunit is a JavaScript unit testing framework used to test the benefits of the new design decision made in the second attempt.

Figure 7.1 shows the improvements from attempt 1 to attempt 2. The loading time and location look-up is faster, and the average page size is smaller. The number of request and number of domains is also decreased. Overall, making for a more efficient solution.

	1st Attempt	2nd Attempt
Loading Time	760ms	120ms (6.3X Faster)
Location Lookup	560ms	270ms (3.2x Faster)
Avg Page Size	~270kb	~50kb (5.2x Smaller)
Number of Requests	7	4
Number of Domains	3	2

Figure 7.1: Comparison Chart

Chapter 8

Flow Chart

The Figure 7.1 below illustrates the workflow of our system, along with different integration and functionality depending on the type of user.

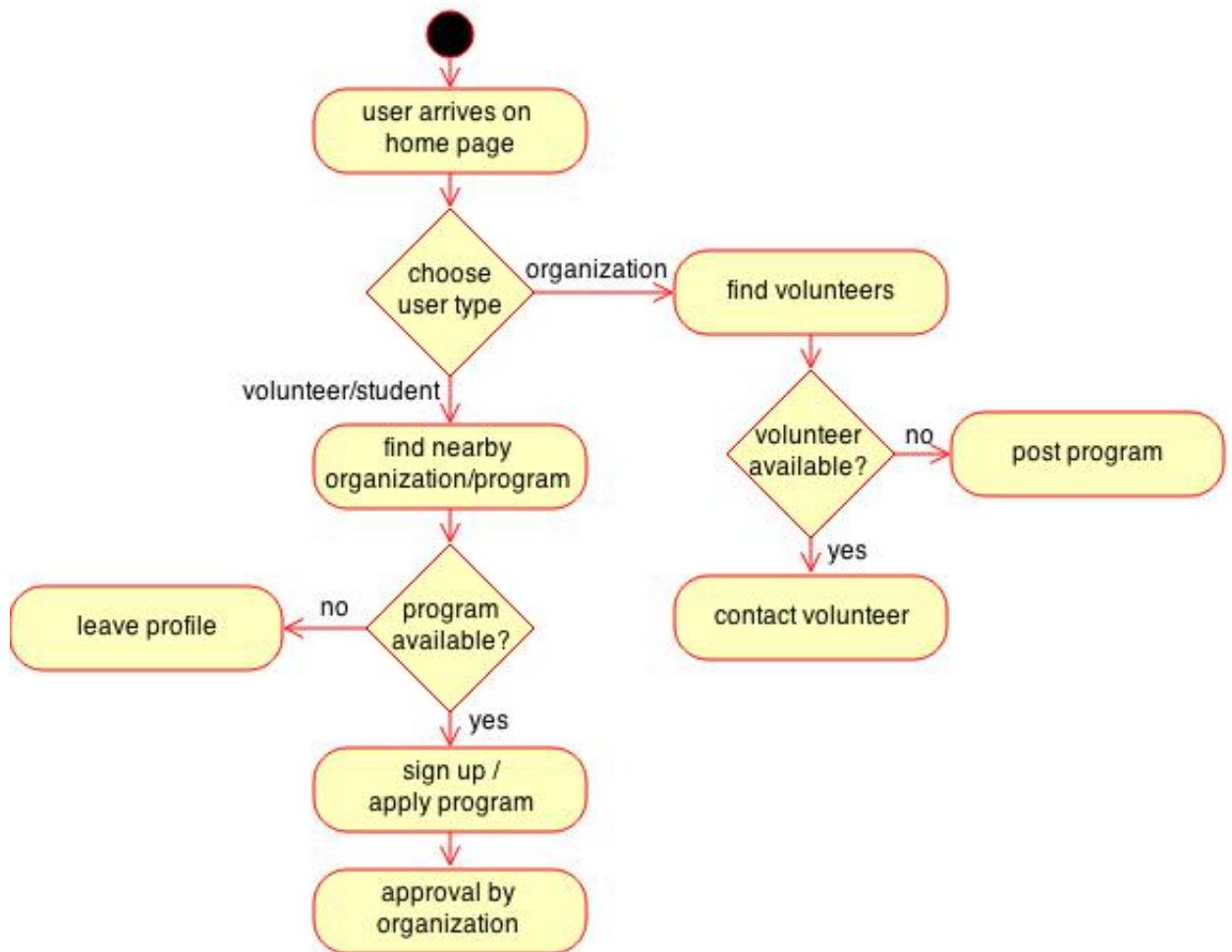


Figure 8.1: Activity Diagram

Chapter 9

Testing

Based on the requirements set by our customer, we tried to meet the organization's needs and make the correct product by showing multiple prototypes to the customer. Following every interaction, our senior design team tested the product. After every few iterations we conducted further tests with our advisor. Based on the comments from the prototypes, we adapted our test plan and made the necessary changes.

9.1 Unit Testing

JUnit is the framework we will be using to do the unit testing.

The Global Social Benefit Fellowship students will be doing their own unit testing while in South Africa.

9.2 Alpha Testing

For our system, our alpha testers will be our team, our advisor, and the Global Social Benefit Fellowship (GSBF) students. Our advisor knows our project details closely, so she is a great source to get help for alpha testing.

While educating the Global Social Benefit Fellowship students on the application we plan on running through any test cases that they might face while in South Africa.

Chapter 10

Deployment

A significant part of the project is its deployment in South Africa by two Global Social Benefit Fellowship (GSBF) students, Kate and Jake. For about two months these GSBF students will help the IkamvaYouths marketing team to deploy it in their main headquarters. The start of their trip will be a break in the schooling cycle of South Africa, and all the branch coordinators will be in the IkamvaYouth headquarters to learn more about the organization. The fellowship students' focus, at this time, is to teach the coordinators of the branches how to use the application. Giving the individual branches the knowledge they will need to teach the users about the application. Then Kate and Jake will travel to individual branches to see the application in use and help with any issues.

Our team will be available during this period to help with any issue that might arise that the GSBF students need assistance figuring out.

An option for this project is to extend it to another senior design team or student so that they can build on the work that has already been done, particularly on the back end and how the IkamvaYouth organizes users information. A part of this project has been keeping track of the issues we faced and organizing the code so that another group can use it to advance on.

Chapter 11

Societal Issues

The purpose of the project is to expedite the work of an organization that works to educated students to achieve higher education opportunities and further their success. According to IkamvaYouth, this organization equips learners from disadvantaged communities with the knowledge, skills, networks and resources to access tertiary education and/or employment opportunities once they matriculate. IkamvaYouth aims to increase the collective skill level of the population, to grow the national knowledge base, and to replicate success in more communities.

Our involvement in this project is an extension of Santa Clara invest in projects that enrich educational opportunities. This project is an example of how students can make an impact. A component of this project are the Global Social Benefit Fellowship students that will be taking the application to South Africa to implement with the organization.

This project has given us the chance to develop our engineering skills while making a difference in the lives of young students. As engineers, we have a responsibility to work on projects that improve the work of an organization like IkamvaYouth.

By benefiting the organization, the learners will have a chance at education and hopefully a better chance at achieving economic equality.

One of the most important factors we learned is that the application is being made for an audience different to our own. Learning about the norm of South Africa and the factors that go into making an application helped shaped our ideas on an engineering impact.

We plan on making this project open source so that other charities can use is as a platform to do something similar and hopefully benefit from this project.

We are making this product for a non-profit organization and have a high level of respect for the work they do. This product will best meet IkamvaYouths needs and be something they are proud of.

Chapter 12

Next Steps

After educating and testing the Global Social Benefit Fellowship students, we will stay available to them while they are in South Africa. Kate, a Fellowship student, is an engineer that we prepared with the code and she will hopefully be able to make any changes before having to contact us.

Our last step is to make the code open source so that other charities can use it as a platform to do something similar. By making the code available, this project could be used by other charities that have similar requirements focused around registration.