

EMERGE

a content creation and distribution application

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1. ABSTRACT

The increased development and use of mobile technology are contributing greatly to social empowerment and economic growth in multiple emerging countries. One of the areas with a high potential impact is found in mobile application development. By providing access to information and services through this medium, millions of users can be benefited. For any type of supply and demand, smartphones are affordable, can provide instant information, and can personalize content.

However, despite the increase in development and use of mobile technology, smartphone users in emerging countries are still facing major challenges. The access to the world wide web in these regions suffers from slow load times, poor performances, and limited opportunities dedicated to local content creation and diffusion. Therefore, there is no chance for relevant information to be easily distributed. This, in turn, contributes to the knowledge and economic gap between developed and developing countries to widen.

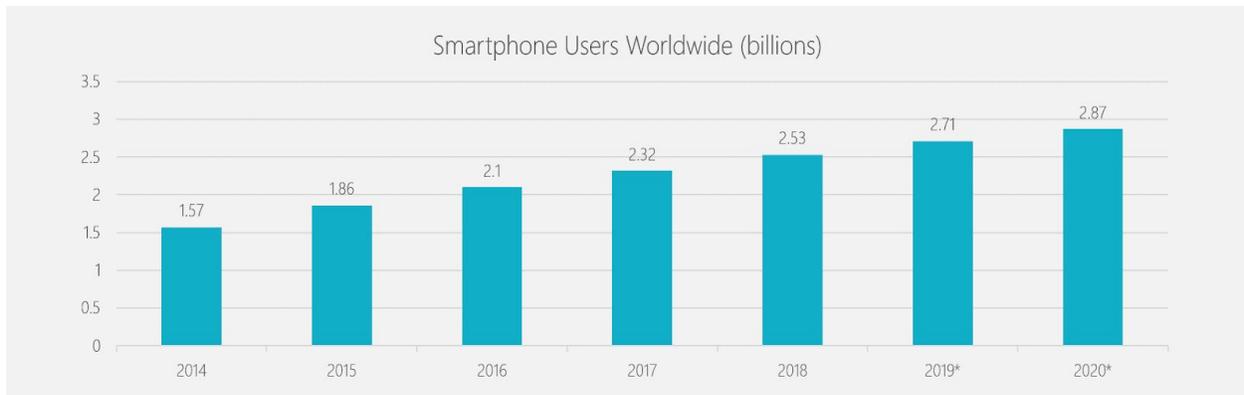
For my computer science capstone project, I have developed a mobile content creation and distribution application to enable the diffusion of locally produced content in emerging countries. By creating a community-driven ecosystem, the goal of my project has been to create a platform that gives users an efficient way of generating and accessing relevant information to improve their economic, social, and technological status.

The application, known as EMERGE, has been developed in Android Studio. It has a series of templates that members can use to efficiently publish content in the form of articles. These articles are organized into several categories that help members easily find information that is most relevant to their interests. The application has been tested in three communities in Central Mexico: Juriquilla, La Barreta, and Colon. Through behavior analysis and a feedback survey, data has been gathered, processed, and presented in this paper. We believe that the results have been generally positive with people praising the features of EMERGE. Nonetheless, there have been several suggestions to improve the application, which will be implemented in the near future.

2. INTRODUCTION, BACKGROUND, AND DATA

2.1 Mobile Technology

Mobile technology is a type of cellular communication where transmitters have the ability to send data on a single channel. Mobile technology has been constantly evolving and its new uses have become much more diverse. Such include GPS navigation, internet browsing, data gathering, and instant messaging.¹ Over the past five years, mobile technology has increased dramatically. At the end of 2014, there were about 1.57 billion users of smartphones worldwide. By the end of 2020, the number is expected to reach almost 3 billion (*Figure 1*).



*Figure 1: Smartphone Users Worldwide (billions)*²

2.2 Mobile Technology in Developing Countries

In developing countries, the use of mobile technology and smartphones has also had significant growth. And there are several reasons that explain why the increase in usage has been so predominant in them. First, the lack of communications infrastructure means that there is a high latent demand for these types of services. Second, mobile networks are much more suitable for developing regions than fixed-line networks, given that some rural areas are quite hard to reach due to harsh terrain or climate conditions. Third, smartphones are much easier to operate than personal computers because they require a lower skill set to use them efficiently. Fourth, smartphones have given users many more business opportunities due to the larger revenue that can come in if they have access to communication, information, and

¹ Team, Editorial. "Mobile Technology, Its Importance, Present And Future Trends." *Finextra Research*, Finextra, 24 Apr. 2017, www.finextra.com/blogposting/14000/mobile-technology-its-importance-present-and-future-trends.

² Statista. "Number of Smartphone Users Worldwide from 2014 to 2020 (in Billions)." *Statista - The Statistics Portal*, Statista, www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

resources at all times. Lastly, the price of smartphones has decreased greatly in the last years, thus making them available for the general public.³

2.3 Mobile Technology in Mexico

Mexico is an example of a developing country that has “followed many of the mobile communication trends seen elsewhere in the world.”⁴ Today we can find the number of smartphone users to be 62.64 million and we can see that the number is expected to rise to 75.39 million by 2022 (Figure 2). This figure represents two-thirds of the country’s population. Due to these statistics and the access that we have to it, Mexico will be used as the place where the studies will be conducted for the capstone project.

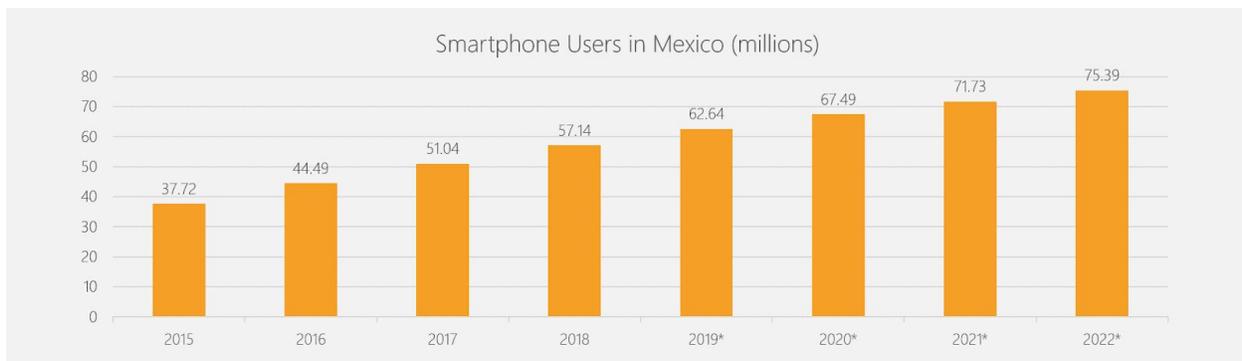


Figure 2: Smartphone Users in Mexico (millions)⁵

2.4 Mobile Technology’s Problems

Smartphones have helped extend the access to communications and have helped narrow the technological gap. However, there are still major challenges that smartphone users face while living in rural places. Some of them include slow access to the internet, the lack of network infrastructure, and the shortage of local content. For the purpose of this capstone project, I will be focusing on the last one.

The shortage of local content creation and distribution problem emerges as a result of a lack of technical expertise within local communities, expensive hosting capabilities, lack of content and community-driven ecosystems, and the existing advertising models which are irrelevant for rural users. Having little to no local content creation causes developing regions and their markets to expand at a

³ Handbook of Mobile Communication Studies, edited by James E. Katz, MIT Press, 2008. ProQuest Ebook Central, <https://ebookcentral.proquest.com/lib/nyulibrary-ebooks/detail.action?docID=3338873>.

⁴ Handbook of Mobile Communication Studies, edited by James E. Katz, MIT Press, 2008. ProQuest Ebook Central, <https://ebookcentral.proquest.com/lib/nyulibrary-ebooks/detail.action?docID=3338873>.

⁵ Statista. "Number of Smartphone Users in Mexico from 2015 to 2022 (in Millions)." *Statista - The Statistics Portal*, Statista, www.statista.com/statistics/270970/number-of-smartphone-users-mexico/

much slower pace, thus limiting economic growth and the opportunity for community members of being competitive. It is true that users in developing regions could potentially get access to external global content, but it might not necessarily be relevant to their needs or they might not know how to access it. Consequently, external content is rendered useless. Without fast and efficient access to the creation and distribution of local knowledge, the technological gap that exists between developed and developing countries becomes incredibly hard to bridge. It becomes harder to store, gain, and teach knowledge that could be useful for the community to thrive economically, socially, and politically.

3. METHODOLOGY

3.1 EMERGE

Emerging countries have a rich knowledge base that should be recognized and recorded for the benefit of the world. Communities are defined by their culture, language, region, location, work, and ethnicity. Therefore, the content that is most important to them is the one that is relevant to their own experiences and day-to-day activities. For my computer science capstone project, I have proposed EMERGE, an Android mobile application that enables the propagation of customized and relevant local content to users within developing regions. With mobile technology and smartphones becoming more and more predominant in emerging countries, the usage of mobile applications has also begun growing dramatically. Mobile applications for rural development provide numerous economic, practical, and accessible routes to information creation, storage, and distribution for millions of people.

EMERGE has the purpose of empowering communities through the creation and distribution of local content. It will change the way information is generated and presented to users within communities trying to overcome the challenges presented by the poor content creation infrastructure currently present in the world. The application will allow individuals to exercise greater choice and control over the content they consume. And it will also give creators and consumers the opportunity to generate or browse information widely at very low costs.

The local content will be able to be generated through two sources: community users and organizations that interact with the community on a daily basis. The content posted will be completely relevant to the users due to the sources involved in the creation of information. Additionally, it will be able to break through the language barrier because users will be able to read the information in their native tongue and/or view it through image or videos.

3.2 Existing Technologies

There are currently several technologies that seek to bring faster web pages and content to developing regions. Some examples are Google AMP (Google) which enables “the creation of fast websites and advertisements”⁶, Opera Turbo (Opera) which provides a “free service that speeds up browsing on slow

⁶ Bender, Gabe. “Ads and AMP: Year in Review and Looking Ahead.”. AMP Project, 14 Feb. 2018, www.ampproject.org/latest/blog/ads-and-amp/

connections”⁷, and Community Networks (Internet Society) where they “improve network conditions in developing regions.”⁸

The first two companies are focusing on giving users access to fast global content, but are not necessarily providing them with tools to develop their own local content. The third company is focusing on going to rural areas and installing better network connections, but is not providing a tool to use those same improved networks. There are no current competing ideas that follow the exact EMERGE model.

3.3 Implementation Design

EMERGE was developed in Android Studio, the official IDE for Android application development. We made this design choice because we wanted to target users living in developing regions, most of whom own Android phones instead of iPhones, which can prove to be too expensive.⁹ The templates for the application were developed in basic HTML, CSS, and JavaScript. For the server-side development of the application, we installed the **Linux Apache MySQL Python** stack. Furthermore, we used Python CGI to handle all requests sent from the client to the server.

3.4 Application Design

In EMERGE, the user is able to open up the platform, register an account (Image 1), log in into the application (Image 2), scroll through articles posted by other users (Image 3), search specific articles by title, author, and keywords, filter posts by category, choose a predefined template (Image 4), fill it in with text, images, and/or videos, and publish it in the form of an article.

When designing the application, we believed it was important to have all these features implemented in order to provide a better user experience for the people using it. However, we considered, and still do, that the two most important features are: the templates and the categories

3.4.1 Templates

The template design of the project was crucial toward the success of the application. Two static templates were designed using basic HTML, CSS, and JavaScript: the basic and the gallery templates. The basic template allows the upload of text and one image or video, while the gallery template allows

⁷ Opera. “Data Savings and Turbo Mode.” Opera, 2018, www.opera.com/turbo

⁸ Internet Society. “Stand Together for A Connected World.” Internet Society - Project, 2018, www.internetsociety.org/issues/community-networks/

⁹ Sara Salinas. “Tim Cook Says the New iPhones Are so Expensive Because They Replace Most Other Gadgets You'd Need.” *CNBC*, CNBC, 18 Sept. 2018, www.cnbc.com/2018/09/18/apples-tim-cook-explains-expensive-prices-of-iphone-xs-and-xs-max.html.

the upload of text and four images or videos. When using EMERGE, users can select the template they need, fill it in, and immediately publish it as an article for the rest of the community to view.

The templates cannot be edited or modified. The templates can only be filled in (Image 5). This design choice was made with the purpose of providing a smoother user experience. We believe that a simple interface allows people who possess little technological literacy have an easier time when navigating and interacting with the application. Additionally, the templates are designed to provide a quick and efficient way of creating and accessing content. When a user is uploading images or videos to the application, the files are immediately resized and compressed in the server. As a result, the published articles in the home screen are able to load faster. In developing regions, the higher speed access for lower quality image and/or video content is a trade-off necessary to have. Furthermore, the templates and their labels can be translated into different languages. This helps everyone use the application without any additional literacy barrier.

3.4.2 Categories

The categorization design of the project was also significant for the development of the application. Ten categories were selected for the first version of EMERGE: agriculture, nutrition, machinery, animals, health, government, fishing, security, research, and education. They were picked based on the interests of the target users we interviewed (see Section 4.1).

In EMERGE, once the users are finished filling in the template with information, they are given the option of choosing the category they want their article to belong to (Image 6). This selection is saved alongside the article in the server's database and displayed when the user is browsing all posts on the home screen. We believe it is very important for categories to be implemented in the application in order to give users the ability to create and find content that is relevant to them.

In this version EMERGE, only one category can be selected per article. Nonetheless, for future versions of the application, we are looking to increase that number and allow an article to appear under multiple filter searches. This version also only allows users to choose from the predetermined list of ten categories, thus limiting different areas of interest they could potentially publish content in. We implemented this because we were using a specific group of target users that were interested in similar content. Yet, we also plan on extending the list of available categories and let users submit their own.

3.4.3 EMERGE Design

The final result of how the application looks can be seen in the image screenshots provided below:

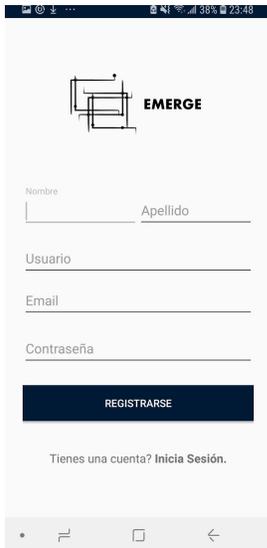


Image 1: Registration Screen



Image 2: Login Screen



Image 3: Home Page

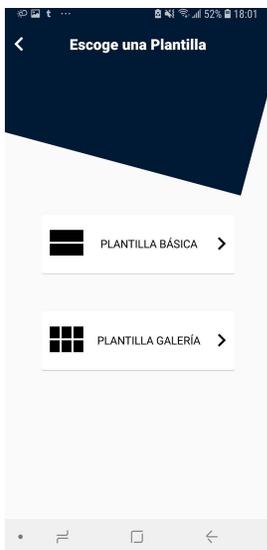


Image 4: Select Template

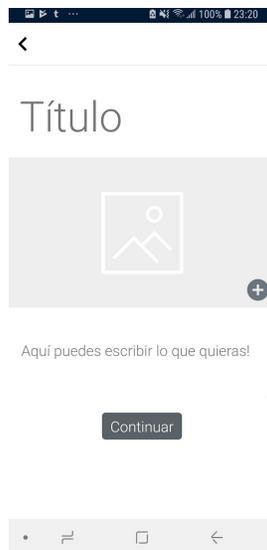


Image 5: Basic Template



Image 6: Category Selection



Image 7: Published Basic Article (with image)



Image 8: Published Gallery Article (with images)



Image 9: Published Basic Article (with video)

*Note: In order to provide a safe environment in EMERGE, all articles are subject to review by the administrator before being released and published for the rest of the users to view.

4. RESEARCH

4.1 Fieldwork

The field research for the development of the application was carried out during January 2019 in three different rural communities in Queretaro City, Mexico: Juriquilla, La Barreta, and Colon. This early round of fieldwork had the purpose of:

- Evaluating how understandable template designs must be for users in developing regions
- Determining potential categories based on the interests of users in developing regions

In order to conduct a successful field research we:

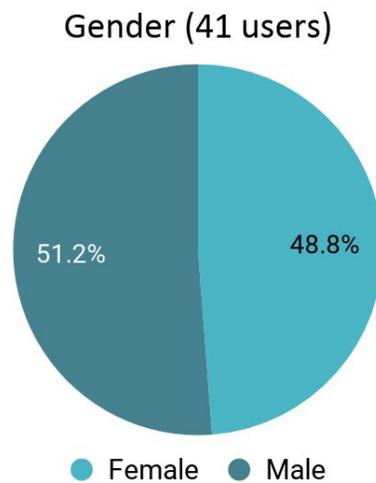
1. Identified the testing zone
 - 1.1. Three rural communities in Queretaro City, Mexico: Juriquilla, La Barreta, and Colon
2. Identified the target audience
 - 2.1. Males and females
 - 2.2. Thirty to fifty years old
 - 2.3. Android smartphone owners
 - 2.4. Living in rural communities
3. Determined the main questions
 - 3.1. How to design simple and easy to use templates for non-technical users?
 - 3.2. What type of content are the users interested in?
 - 3.3. What is the technological literacy level of the target users?
 - 3.4. How to encourage users to engage with the application and publish articles?

The quantitative and qualitative data that I gathered in the fieldwork was particularly useful. It really helped me make the necessary design improvements for the actual development of the EMERGE application.

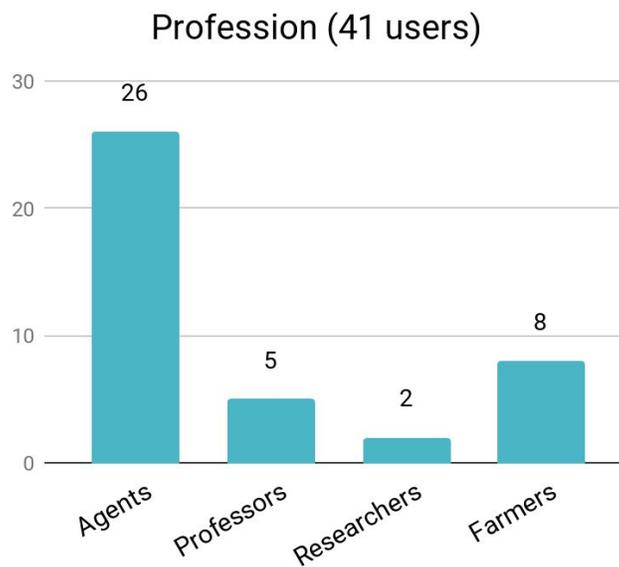
4.2 Findings

Graph 1 showed that the number of male (51.2%) and female (48.8%) users interviewed was quite proportionate. This was truly valuable since I was able to get different user perspectives from both gender sides. Graph 2 indicated that the majority of the people interviewed were extension agents (26),

advisors employed by the government to assist people in rural areas in the area of farming and home economics,¹⁰ followed distantly by farmers (8), professors (5) and then researchers (2). This encouraged us to gear the development of our application towards the users found in the agent's group.



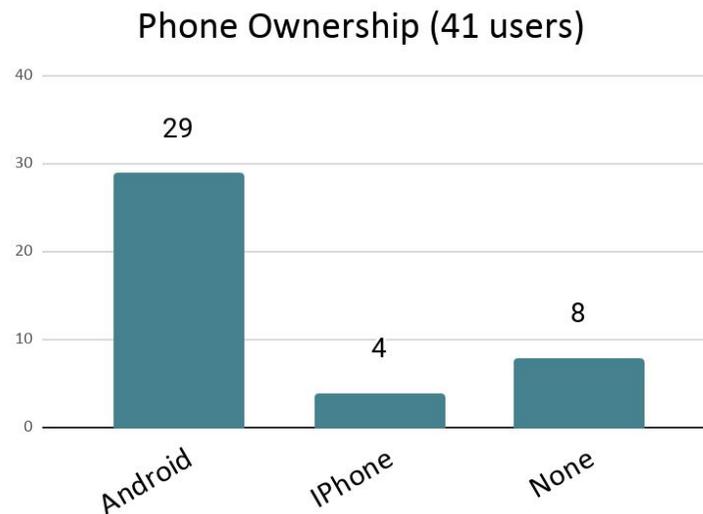
Graph 1: Gender (41 users)



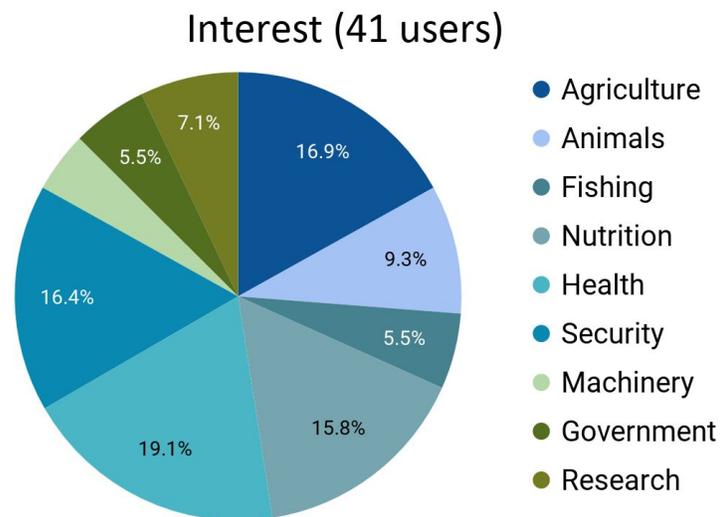
Graph 2: Profession (41 users)

¹⁰ WordNet 3.0, Farlex clipart collection. 2003-2008. Princeton University, Clipart.com, Farlex Inc. 11 May. 2019 <https://www.thefreedictionary.com/extension+agent>

Graph 3 proved that our initial predictions were correct. The majority of the users interviewed were owners of an Android phone. However, the graph also demonstrated that several users, mostly farmers, didn't own a phone at all. Unfortunately, this made us exclude the farmers as potential users of EMERGE. Graph 4 revealed that most users were interested in agriculture, animals, nutrition, health, and security. This data allowed us to select the ten categories that would be presented in the application.



Graph 3: Phone Ownership in Target Users (41 users)



Graph 4: Interests in Target Users (41 users)

5. TESTS

Two rounds of user testing were conducted for the EMERGE application. The first round of user testing occurred in the New York University Abu Dhabi campus and the second round occurred in the three rural communities researched in Queretaro City, Mexico: Juriquilla, La Barreta, and Colon.

To successfully test the application, two different web servers were set up in the United Arab Emirates and Mexico, respectively. Furthermore, the application was uploaded to the Google Play Store as a beta version.

5.1 Abu Dhabi, United Arab Emirates

Place: NYU Abu Dhabi

Subjects: NYU Abu Dhabi Students

Testing Period: Fourteen Days

Incentive: None

For the NYU Abu Dhabi round of user testing, fifty students signed up, thirty students downloaded the application, twenty-five registered an account, and ten published one article each using the templates. In this testing round, we were not interested in achieving high user engagement. In fact, we just wanted to make sure that the application worked accordingly in multiple smartphones. We were looking for bugs, crashes, and user feedback. In the end, despite the low engagement from the students in terms of publishing content, we did receive a considerable amount of feedback. This was incredibly favorable because it helped me fix, change, and improve several features of EMERGE.

5.2 Queretaro City, Mexico

Place: Juriquilla, La Barreta, and Colon

Subjects: User Extension Agents

Testing Period: Ten Days

Incentive: Free Cellular Data Vouchers

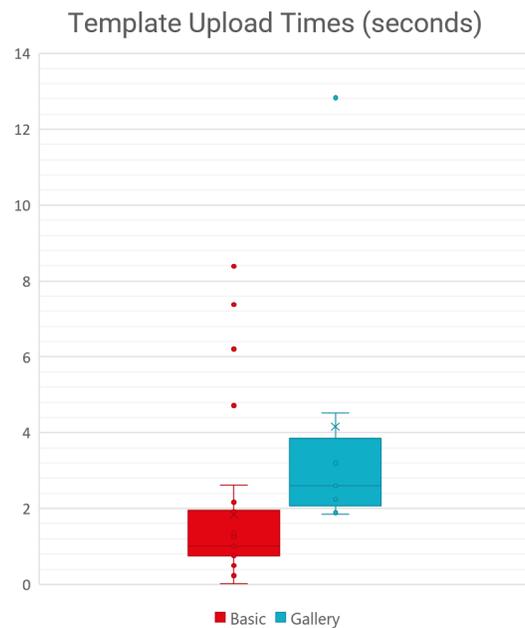
For the second round of user testing in Mexico, twenty agents signed up, nineteen agents downloaded the application, seventeen registered an account, and fifteen published approximately three articles each using the templates. In this testing round, we saw very high user engagement with fifty articles being published in just one week. The application did not have any major issues and it did not crash. After the

testing period was over, data on template upload times (quantitative), article load times (quantitative), and user feedback were collected (qualitative).

6. RESULTS

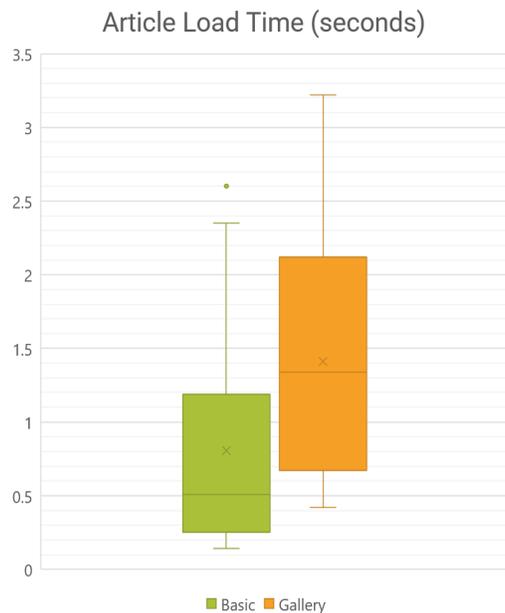
6.1 Quantitative Results

The template upload times and the article load times proved to be very fast. For the template upload times, I recorded the time that it took for the text, images and/or videos to be sent and saved in the server for the fifty articles posted. In Graph 5, we can observe that the minimum upload time for the basic template was 0.40 seconds and the maximum upload time was 8.34 seconds, resulting in an average of 1.84 seconds. We can also see that the minimum upload time for the gallery template was 1.85 seconds and the maximum upload time was 12.82 seconds, giving us an average of 4.16 seconds. It makes sense that the basic template will be much faster to upload to the server, given that it holds only one image or video compared to the four images or video that the gallery template can hold. Additionally, it is important to note that the upload times in the application vary widely because users are uploading images or videos. Naturally, videos will take much longer to be saved in the server.



Graph 5: Template Upload Times (seconds)

And for the article load times, I recorded the time that it took for the text, images, and/or videos to be fully displayed in the application. The results varied, but not as much as they did in the template upload times. In Graph 6, we can see the minimum load time for the basic template was 0.30 seconds and the maximum load time was 2.62 seconds, resulting in an average of 0.82 seconds. Similarly, we can observe that for the gallery template, the minimum load time was 0.49 seconds and the maximum load time was 3.22, giving us an average of 1.41 seconds.



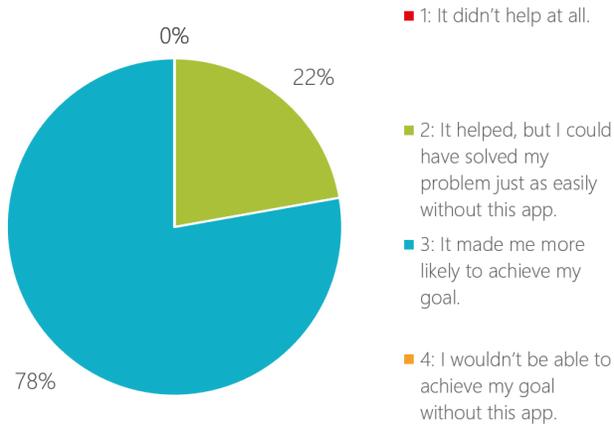
Graph 6: Article Load Times (seconds)

6.2 Qualitative Results

Once the trial period was over, the users were asked to fill out a feedback survey with four closed-ended questions and two open-ended questions. Out of the fifteen users that participated in the testing of the application, twelve users filled it out.

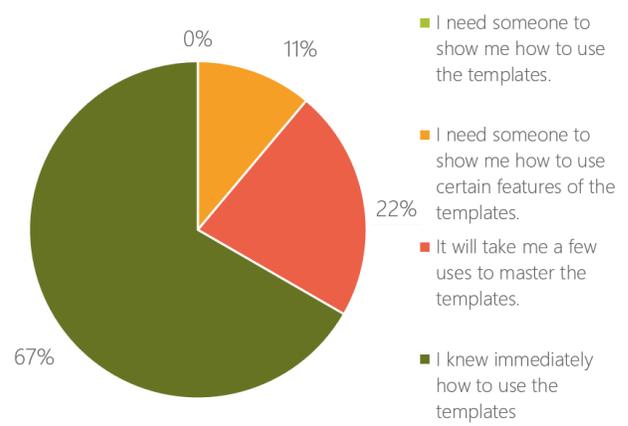
The four closed-ended questions related to the most important focuses of our application: the usefulness, the accessibility, the content, and the speed. The two open-ended questions were related to suggestions and improvements. Overall, the answers to all questions were generally very positive with most of the users praising the idea and the potential for the application. Many of the users also provided highly helpful suggestions for future iterations of the application.

Did the application help solve your problem or achieve your goal?



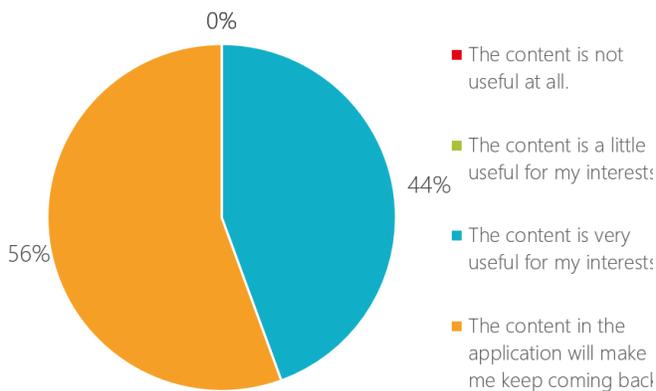
Question 1: Goals

How easy to use are the templates in the application?



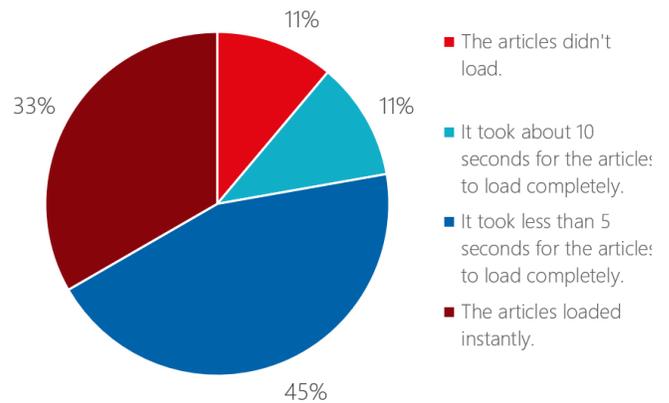
Question 2: Templates

How useful is the content that you found in the application?



Question 3: Content

How fast did the articles (text, images, and video) took to load?



Question 4: Speed

7. CHALLENGES

Despite having positive results and feedback, there are still plenty of challenges to face with the development of this application. Firstly, standard mobile phones are still dominating the market in developing countries and will continue to do so for the next couple of years, probably even longer in rural areas. Even if the smartphone market is growing, as mentioned previously, finding many communities in Mexico where most of the inhabitants are using smartphones might prove to be difficult. This was seen in the community where none of the farmers had a single phone.

Additionally, networks in developing regions are not as reliable as in developed ones. Sometimes, access to internet connections will be very weak and sometimes there will be no connection at all. The application might have some problems when being using if a proper network is not set in place.

8. CONCLUSION

EMERGE succeeds in accomplishing the purpose of providing a platform where local content can be efficiently and easily accessed by users. Regardless of the challenges faced, we believe that with the increase in usage of mobile technology in developing regions, the application will have the potential of helping a large number of people suffering from the lack of local and relevant information.

9. FURTHER DEVELOPMENTS

For the further developments of the application, we would like to add several new features that we believe could help improve user experience. Some of which are: allowing the creation of groups, enabling the choosing of interest categories, providing a forum section for people to discuss topics, adding a comment section in the articles, and permitting the sharing of articles in other social media platforms.

10. ACKNOWLEDGMENTS

Firstly, I would like to thank my mentor, Yasir Zaki. This project would have absolutely not been possible if it were not for all the help, support, understanding, and extension deadlines provided.

Secondly, I would like to thank my suitemates, Flavia, May, Mati, who patiently listened to my frustrations every time a bug appeared in my code.

And lastly, I would like to thank my mom, Monica, who was my direct link of communication to the three communities in Mexico. You single-handedly managed to contact all the extension agents, introduce them to the concept of the application, and convince them to trust me. I am, as always, grateful for everything.

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