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Mental Health Awareness Building via Android Application

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Mental Health Awareness Building via Android Application

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Abstract

The goal of this project was to create a tool that provides students at Minnesota State University, Mankato with mental health information through a freely available smartphone application (App). Our approach used a software engineering design process that focused on who our customers are, what resources are available, and how we can best connect the two to improve student lives. We identified the stakeholders involved and worked with campus mental health professionals to help shape our App. While there is a broad range of mental health topics, we have focused on materials related to depression. The first process of the App gives the student a picture of their current mental health state through a frequently used and freely available evaluation questionnaire. Depending on the results, the App then provides supportive feedback in the form of materials that describe coping skills, ways to contact campus counselors, and other local community resources. In addition, we have incorporated formal graphic design to make the App easy to use. The outcome of this work is an App that is free for campus students, connects them to resources and can be improved upon by future developers. As part of future work we plan to incorporate artificial intelligence approaches to provide the most appropriate materials given the student evaluation.

1. Introduction

The purpose of this research paper is to describe the development of a mobile application for mental health information. While conducting the research and building the application, we found that there were many different working pieces and individuals necessary to deliver a finished project. The idea for this App formed through conversations regarding the stigma of mental health problems and access to counseling for students who may be afraid to get help in person or to those who do not have the transportation or financial resources necessary to seek out help immediately. Although the original idea was to build a state-wide database for mental health resources with multiple surveys that could be taken by the user to provide them with information, the scope narrowed to one that could have significant local impact. A more agile approach was taken by starting small with the Minnesota State University, Mankato campus and surrounding communities with the goal to branch out once the application was functional. We identified stakeholders and local experts in mental illness and campus counseling. We also expanded the project team to include an art major that was willing to assist with the logo development and color scheme.

This paper includes background information about mental health issues and mobile application development. We present our application development process including results from user testing. The paper closes with a summary and suggestions for specific improvements and extensions for the App.

2. Mental Health Background

College is a difficult time for many students as it is their first time away from home and their family and friends. This can create stress and tension in a student's life which could lead to symptoms of depression. In addition, other mental illnesses may become symptomatic during this time, however depression is the most common with 30.7% of students saying that they felt depressed and it was difficult to function (Knight, 2000). We decided that focusing solely on depression would allow us to impact the greatest amount of students and also allow us to build an application without too many components. According to the American Psychological Association:

“Depression is more than just sadness. People with depression may experience a lack of interest and pleasure in daily activities, significant weight loss or gain, insomnia or excessive sleeping, lack of energy, inability to concentrate, feelings of worthlessness or excessive guilt and recurrent thoughts of death or suicide. Depression is the most common mental disorder. Fortunately, depression is treatable. A combination of therapy and antidepressant medication can help ensure recovery.” (Kazdin, 2000)

While depression is a serious illness, there are many different impacts depression may have on a student's life. We worked to find a way to determine the level of depression through a basic and easy to take survey. We opted to go with the Goldberg Questionnaire (Goldberg, 1996) as it was relatively short and helped identify levels of depression. This questionnaire is commonly used and available on multiple websites (e.g., <http://counsellingresource.com>, <http://psychcentral.com>, <http://www.mentalhelp.net>). It is considered valid and reliable (Frederiksborg General Hospital, 2001). The survey questions are listed in Appendix A.

There is a lot of evidence to justify pursuing this topic and creating an app to address it. According to the American College Health Association's National College Health Assessment (2010), 91.7% of college students surveyed described that their health as good, very good or excellent. However, they also reported that within the past 12 months the following occurred: 30.7% of students "felt so depressed it was difficult to function", 5.3% intentionally hurt themselves, 6.2% seriously considered suicide and 1.3% attempted suicide.

In the United States our culture attaches a negative stigma to mental health issues. According to an article written by Patrick Corrigan, "Stigma yields two kinds of harm that may impede treatment participation: It diminishes self-esteem and robs people of social opportunities" (Corrigan, 2004). Part of the purpose of this App is to help change this culture, while also keeping it in mind; guaranteed their anonymity, students can pursue resources without fear of cultural stigma. The App performs this through the use of imagery and words. An example of this would be the App title 'First Step' which uses an abstract image of a person moving forward. This forward movement is something we do every day to move toward our goals. Another example is the exercise portion of the App is named 'Strength Builder' to convey a sense of growing stronger through gaining knowledge.

At Minnesota State University, Mankato, students must be on campus to take advantage of the counseling professionals available. Counselors are available Monday through Friday 8:00-4:30pm but

there are no other campus resources available during the weekend or in the evening (Minnesota State Mankato Counseling Center, n.d.). Online and distance students are negatively impacted by this in that they often cannot take advantage of the on-campus resources. Another difficulty is that many may not have the time during the week to take advantage of services. Students in rigorous programs such as Physics or Engineering often spend most weekdays in labs or classes, so scheduling can be difficult. Spending the extra hour or two a week speaking about problems not directly relevant to course work can also seem burdensome for these students. Finally, the campus counseling center does not consult via phone or email. This means distance students have to take the time to travel and speak in person to take advantage of these services. This leaves us with the following points that argue for the need of the First Step Mental Health App: a significant rate of depression, a work load that demands a large amount of time, groups of students such as the distance learners that are unable to access resources, and a stigma that causes students to be concerned or intimidated by the prospect of seeking help.

2.1 Mental Health Resources Available

Table 1: Mental Health Resources

Campus Resources and partners	Address	Phone Number
Minnesota State University, Mankato Counseling Center University Security	285 Centennial Student Union Minnesota State University, Mankato, MN 56001	507-389-1455
After Hours Emergency		507-389-2111
Blue Earth After Hours Emergency		507-625-9034
MCHS Hospital Suicide Prevention Hotline		507-304-4319
Minnesota Crisis Connection		1-800-865-0606
		1-866-379-6363
Local Organizations		
Blue Earth Country Mental Health Center	410 S 5th St, Mankato, MN 56002	507-304-4319
Adult Child & Family Services	103 North Broad St, Mankato, MN 56001	507-387-3777
Counseling Services of Southern Minnesota, Inc.	116 South Third St, St. Peter, MN	507-931-8040
Mankato Mental Health Associates	201 North Broad St Suite 308, Mankato, MN 56001	507-345-4448
Mankato Psychology Clinic	209 South 2nd St Suite 306, Mankato, MN 56001	507-387-1350
Mankato Clinic Psychiatric Department	Madison East Center, Suite 352, 1400 Madison Avenue Mankato MN 56001	507-387-3195
New Ulm Medical Psychiatric Services	1325 North 5th St, New Ulm, MN	507-233-1168
Sioux Trails Mental Health Center	360 Pierce Avenue, Suite 108, North Mankato, MN 56003	507-388-3181
Open Door Health Center	309 Holly Lane, Mankato, MN 56001	507-388-2120
CADA Crisis Line(Domestic Abuse)		507-625-7233
MCHS Hospital		507-385-2620

There are many campus resources, local resources and statewide resources that are available to support people experiencing symptoms of depression and other mental illnesses. Taking the step to reach out to these resources may be daunting, but gathering the information and making it available is a feature of the App. A list (shown in Table 1) was gathered to make sure that First Step provides accurate and appropriate information for users as they take their next step. Because each county in Minnesota has a

different Crisis Hotline number, we compiled all of that information as well. There are also a number of state and federal resources that are also available and can be included in the application.

3. App Development Background

There are many approaches to software development. We chose a software engineering approach described broadly by Croll (2000) and shown in Figure 2 because it is straightforward and familiar to the authors. In this approach there are five categories: Customer, Process, Project, Product and Resource. The customer is the end-user of the product, the person or organization who will be using it when it is completed. Customers often interact with the project during the process of producing the product, testing it and providing critical feedback. The Project portion of Figure 2 is at the center because it represents the development process. The development process describes the developers and how they interact with the various aspects of product creation. The Project uses available resources, interacts with the customer through testing and surveying, performs processes based off of available resources and customer feedback, and produces the product. Processes can include any form of action, from consuming resources to produce a component to transforming the Product into a later version. Finally, Product represents the results of the Project production, resource availability, customer feedback and the modifications performed through various processes. This is not enough to fully understand the Software Engineering approach however, as we must know what kind of processes to perform.

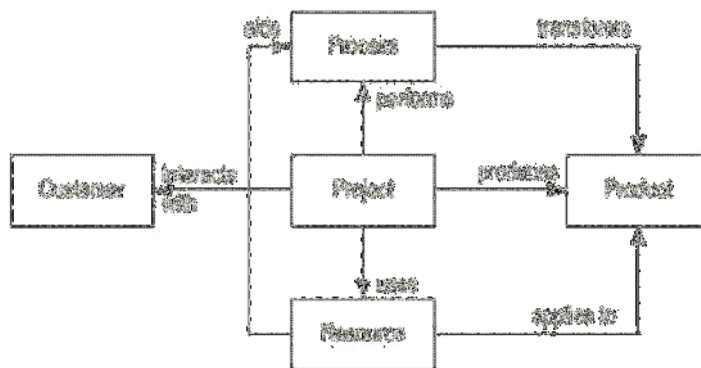


Figure 2: Software Engineering Approach (Croll, 2000)

This approach calls for defining the problem and stakeholders, researching available resources, executing the development of the code itself, and testing our results. This procedure is not entirely linear either, as steps are not only interchangeable but iterative. Resources can disappear, stakeholders can change, and testing can shift the perspective of the development team. Therefore testing itself is a key part of the approach which leads to reassessment of the other steps in the process.

The following steps are key processes that transform the product:

- 1) Planning
- 2) Implementing
- 3) Testing
- 4) Documenting
- 5) Deployment and Maintenance

Steps 3, 4 and 5 all allow the option to return to steps 1 and 2 if the lessons learned from testing, documentation or deploying suggest changes. Planning involves each activity and covers things such as establishing what resources, customers, and possible approaches are present for the project. Often customers of a product have an abstract idea of what they would like as a result but do not know what kind of software is needed. Next, the process enters the implementation portion of the project. This is where Software Engineers actually put together the structure and then code for a project. A vital part of this process, testing is required to verify the integrity of the program. Documentation is also key throughout this process, as changes to the program can come late in the development process and be stalled or even impossible if poorly documented. Finally, deployment begins as soon as the finished code is properly tested and approved. Maintenance is also crucial during this final phase as the cost for maintaining the program and its platform becomes apparent.

3.1 Platform Options

The initial development process yielded three different options for developing the application. We could develop 1) a web-based application that would need to be accessed from a computer, 2) an iPhone based application that would work only on iPhones or 3) an Android application that would work on any Android based smart phone. While the first option has the benefit of being able to use larger computation resources and multiple programming options, it may be less able to fill immediate needs of potential users.

For mobile applications, using either iPhone or Android as the mobile operating system, there are other considerations to take into account including our bounds of cost, ease of use, and availability. While iPhones are extremely popular, Android still has considerable market share as they made up of 81% of devices shipped in Q3 of 2013 and Apple only accounted for 12.9% (Bradley, 2013). iPhones are typically a set cost, with limited low-cost options, while Android devices range greatly in price which allows for a larger customer base. Android has their "Google Play Store" which allows for a great range of applications and pre-approval from Google is not necessary for uploading an application. Android charges a one-time lifetime fee of \$25 to publish applications on their play store while Apples charges \$99 a year for having an App listed on their platform (Viswanathan, 2014). Apple also has to pre-approve the application before it can be listed for purchase.

Android is Open Source which allows for greater community interaction and there are many development resources online such as the Android Application Development Tutorials at buckysroom.org (n.d.).

4. Application Development

Developing the App took into account several key factors. First, we defined our problem. What are we trying to address and what makes it a problem? Second, we defined the solution. How can we solve this problem using the tools and resources available? What platform should we use (Apple or Android)? After this selection process we continued to narrow down our solution as more parameters became known. Part of our iterative process was performance assessment; results of testing were used to improve the App and end user experience.

4.1 Defining the Problem

Although the focus of this application is to create a useful mental health tool for our potential users, there are two challenging factors that need to be taken into consideration: the perceived stigma of seeking help for mental health and depression and overall lack of awareness about mental health. These two factors need to be addressed in order for the App to be successful.

4.2 Defining the Solution

The solution we decided to pursue addresses the main focus as well as the mitigating factors. First and foremost, the App has to be useful while reducing stigma and raising awareness. Several aspects of the project address these concerns, the first of which is the logo for the app itself. It embodies our solution (taking the first step towards better mental health) and tells a story in a single image. By design, it is visually pleasing and ties into something we normally do every day. The solution also has to present resources in a manner that reduces required effort and provides relevant information. Intelligent search and a powerful questionnaire for gathering key information from the user are needed to maximize relevance and minimize user effort to support following through with recommendations. To address the problem of stigma, users are able to maintain anonymity while using the tool. No personally identifiable information is generated or saved by the tool before, during, or after use.

Table 2: Android vs. iPhone Decision Matrix

	Android ✓	Apple
User Friendly	X	X
Open Source	X	
Versatile Software	X	
Nonrestrictive App Policies	X	
Entry Level Access	X	
Learning Resources	More	Fewer

4.3 Platform Decision

Because 73% of college students use smartphones on a regular basis (Ransford, 2013), we chose the smartphone as our platform. Because users own the device, this supports our criteria of user anonymity. To address the issue of cultural stigma, the best option was a mobile App that can be used in private and can be used anywhere an internet connection is available to download it. Once downloaded, it can run without an internet connection. As new app developers, we chose Android as our mobile platform, for the reasons shown in the decision matrix shown in Table 2. Software is open source and contains much less proprietary and restricted access, meaning development options are greater. This meant that we could use cost-free development tools such as the Eclipse development environment and greatly reduce upfront cost. Another major reason for picking Android is the cost to keep the App published. To share your App an up-front cost of \$25 is required, and is a one-time fee. For Apple's iPhone on the other hand, publishing your App requires a yearly subscription cost and was outside the budget for this project. Another factor to consider in platform choice is the difficulty of entry into application

development. Our team had no experience with the programming language Java or App development itself. For entry level, Android has the lowest startup costs. According to VisionMobile, a leading research company tracking the Apps economy, "Android is much more popular as (but not limited to) an entry-level platform on which developers experiment or learn" (Pappas, 2013).

4.4 Logo Decision

Designing a logo for the application was critical as that is the first thing that the user sees when they download the application from the Google Play Store. This would be our first chance to leave a good impression on the user and we knew it was important to find a competent graphic designer. We were able to find a fellow student, Mackenzie Lopez who is majoring in graphic design at Minnesota State University, Mankato. He was willing to help us design and create a logo. He developed different color schemes that we loaded onto the phones for the users to test and determine which color scheme they preferred. The process of coming up with a final logo was the results of many meetings and hours of work by Lopez. The logo and color schemes went through many iterations but the finalized logo and four color schemes are shown in Figure 1.



Figure 1: First Step Mental Health Application Logo and color scheme, created by Mackenzie Lopez 2014.

4.5 Software Development Approach

Following the steps described for software engineering in Section 3, we defined the overall structure of the App before coding. This constituted the planning phase, which would be followed by the implementing, testing, documenting and deployment/maintenance phases. Each page of the App was sketched out in a flow diagram so that we could see the scope of the project, as well as individual pages themselves. Figures 3-7 describe app flow, where users can move through the App, and the planned development.

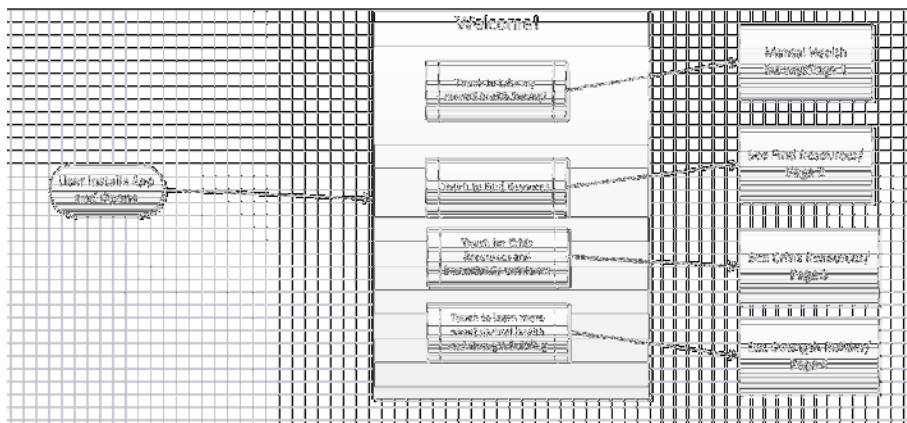


Figure 3: Flow of the Home Screen

The home screen is a critical page of the App. It provides the first impression of the App, ties all the other pages together into a cohesive whole, and is the point the user returns to when finished with subsequent pages. Figure 3 shows how this flow currently operates in our App's design. In an effort to make more of a branded impression, we also display a five second splash screen with just the logo itself before the user arrives at the home screen.

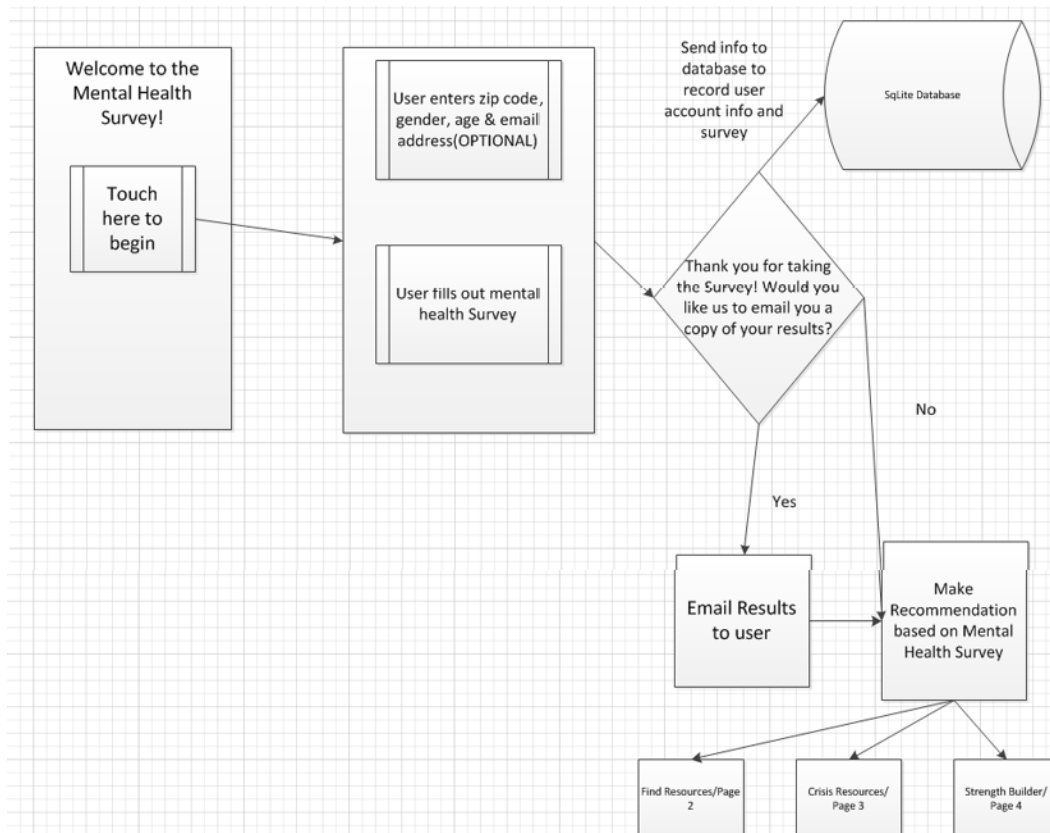


Figure 4: Flow of the Survey Screen and Decision Making Process for Recommendations

The survey screen shown in Figure 4 provides our App with user input that is critical for decision making and tailoring results. The user goes through the process of answering survey questions (listed in Appendix A) in a spectrum that goes from 'Not at all' to 'Very much', allowing the App to judge the severity of an issue. Once the user completes the survey, the application would then provide an option to email the results to the user. This is not necessary, as we will also provide the results in the application, but simply for their own reference and tracking if they wish to do so. The App then makes a recommendation based on their score and also recommends that the user checks out a specific page on the App, such as the Strength Builder (Figure 7) if they have a low likelihood of depression or the Crisis Resources page (Figure 6) if they have an extremely high likelihood of depression. This flow is illustrated in Figure 4, as the flow moves from the 'Health Survey' step to pages 2, 3, and 4. The flow here is dictated by the score and nature of the results of the survey: Page 2 is for finding resources (Figure 5), page 3 covers crisis resources (Figure 6), and page 4 sends the user to the Strength Builder portion of the App (Figure 7).

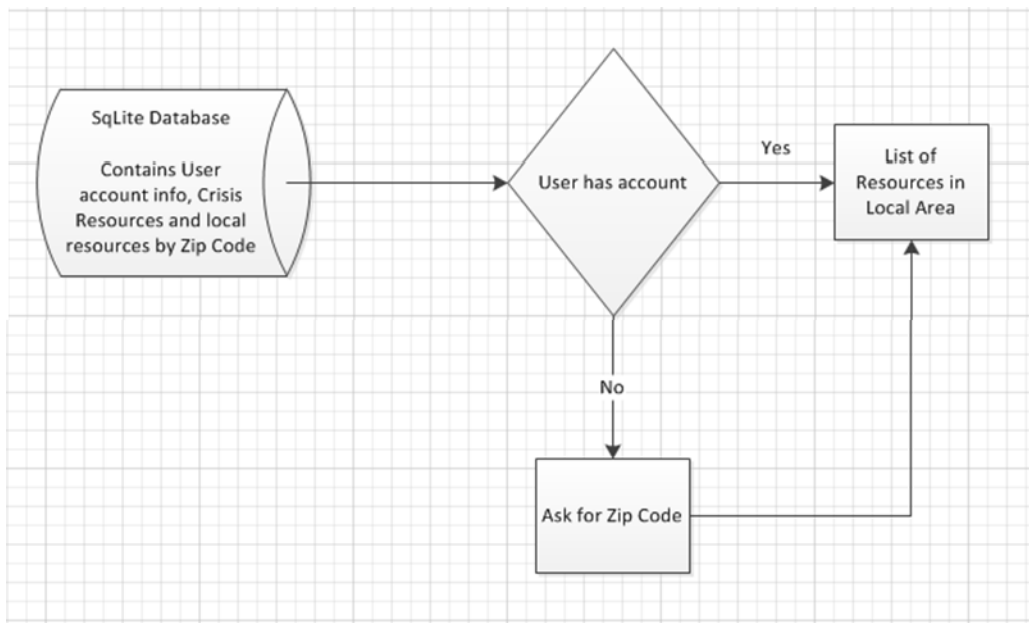


Figure 5: Flow of the Find Resources Screen

Figure 5 illustrates the process of finding local resources for the user. After analyzing the results of the user's survey, the App can use an entered zip code to find local resources if the user has not created an account. The default resources are local to MSU. Future plans call for the account and zip code to be stored in a SQLite database on the local machine, in order that this basic information not be shared and anonymity be maintained.

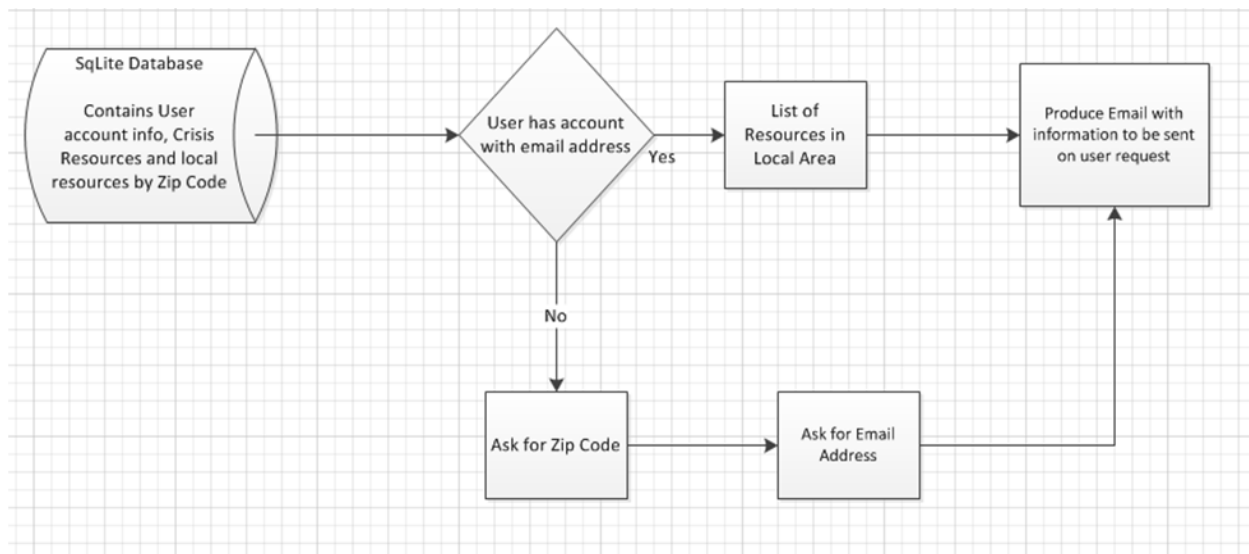


Figure 6: Flow of the Crisis Resources Screen and Decision Making Process

For times when typical resources are not adequate to meet the urgency of a situation, the crisis section of the App shown in Figure 6 provides critical resource information such as crisis hotline and emergency information. During the planning phase, we decided that it would be too confusing for the user if we mixed severity level information in one screen and force the user to filter it, especially given the size of smart phone screens. Ease of use and rapid deployment of information is critical, especially when it comes to urgent situations. In Figure 6, a major point in the flow of the diagram shows the user being asked for an email address. The benefit of using an email address means that the user has a permanent log of the resources and recommended results. The downside to this is that it reduces anonymity when compared to simply displaying the results on the screen. Further research may prove that this reduction in anonymity may not be reasonable and will result in a display on the local screen only, as users may find giving their email intolerable and will not use the app because of it.

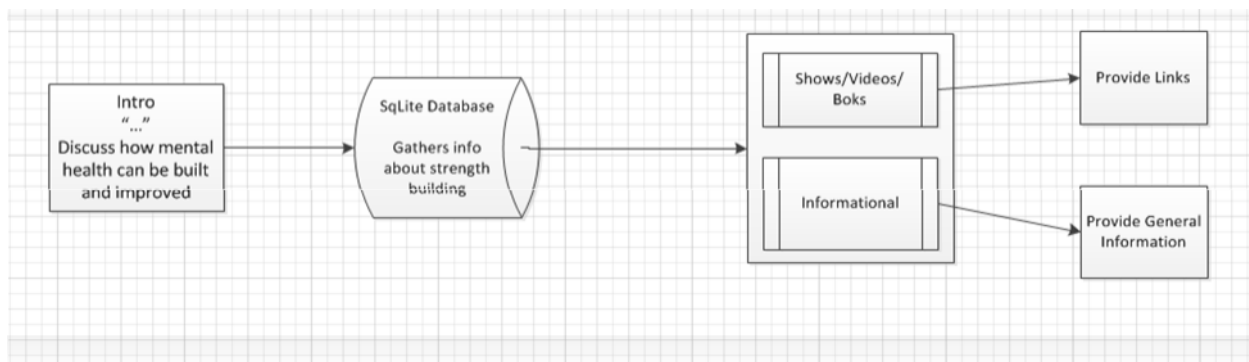


Figure 7: Flow of the Strength Builder Screen

Figure 7 shows the program flow of the Strength Builder portion of our App. Not all students need immediate help or even counseling. Because of this, we decided that the App would be stronger with a portion dedicated simply to general mental health improvement and information. We wanted to include videos and books that the user could reference for their own benefit. Videos have the benefit of being linkable from the application and the user can watch them on their phone, either later or immediately.

4.6 Implementation

Once we completed the design process, we coded the App. We used many of the videos at Android Application Development Tutorials, (n.d.) as a guide. Due to the amount of programming it would take to implement our initial idea, we scaled down the plan to get a baseline application working. Currently only the depression survey and local resources portion are working without a user signup process although there are plans to enhance the application and implement the user account feature.

While the flows were a great start from a planning perspective, the team did not yet have the software skills for all aspects of the plan. We had difficulties implementing the SQLite database that is normally used with Android applications. We wanted to use the database to store the user account profiles and also to manage the resources as they would need to be updated periodically. We decided to eliminate the user profiles and also the idea that we could use the database to store the resource information. A user account is important as accounts would be able to capture results and usage history and allow users to view their progress. This would be a key component of the application but it is currently a future enhancement. As the following screenshots indicate, the application is still in development but the basic framework is there. It is currently usable as a diagnostic tool that can be used in conjunction with counselors or to encourage a student to seek counseling.



Figure 8: Screenshot of the Home Screen

The home screen has the App logo in the background, shown in Figure 8, and currently has three options. The first option is to take the survey, the second option is for the resources and the third option is available if a user is in crisis. Selecting the Crisis! Button will take the user to another screen that provides a list of numbers, such as those shown in Table 1. This button is currently not functional, but coding is straightforward so it can be completed in the next round of coding.

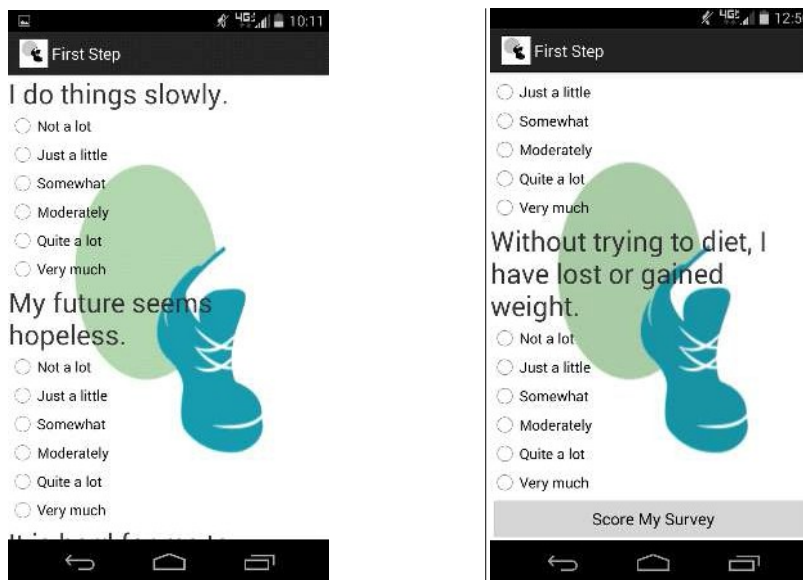


Figure 9: Survey Screen top (left), bottom (right)

The survey screen, shown in Figure 9, contains the 18 questions of the Goldberg questionnaire. There is a built-in scrolling feature that allows the questions to all be on the same page, with the logo remaining in the background at all times. Once the survey is complete, the user can click the Score My Survey button at the bottom to confirm the survey.

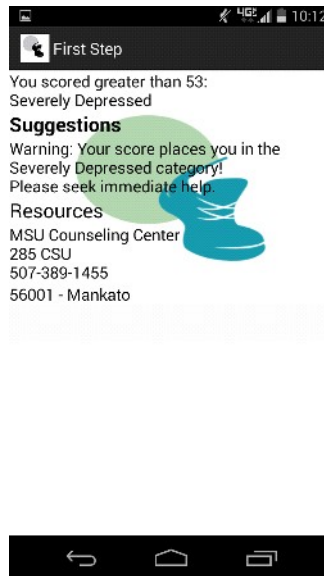


Figure 10: Results and Recommendations of Survey

The screen shown in Figure 10 is for the results of the survey. We plan to enhance this page to recommend a multitude of resources based on the score and location of the user. Results change based on the user's score, as well as which questions they scored highly on.



Figure 11: Brain Health Resources Screen

The brain health resources screen shown in Figure 11 is geared towards the idea of the Strength Builder in Figure 7. Currently, we have hyperlinks listed for books that may be helpful for the user based on their current mental state. This is a prime candidate for intelligent search, as the questions from the user's survey can be used as search conditions to retrieve relevant books for example.

4.7 Performance Assessment

During implementation, local testing was to insure a working App. Before providing the App to users, it was valuable to do external assessment with naïve users and to get feedback from experts. We received Institutional Review Board (IRB) approval to conduct surveys with students on campus. We created a usability survey consisting of seven Likert questions, three open-ended questions and color scheme preference which allowed us to determine which color scheme would work best. Based on their feedback, the color scheme shown in the top left of Figure 12 was chosen. Thirteen student subjects were surveyed and their results are listed in Table 3. We provided phones to the students with the application preloaded onto the device and the students were able to view multiple devices to determine which color scheme they liked best. The students were given fifteen minutes to view the application, test it and complete the survey. While the students were testing it, we were taking notes and observing their reaction to the application.



Figure 12: Color Scheme Decision (top left)

Many of the responses to the opened-ended questions pointed out minor errors in the App such as spelling or spacing errors in the user survey. One user experienced an issue with the App crashing and found a bug in the scoring system. A few sample responses included “Cool idea”, “I like it but it could be more robust”, “Spelling Errors”, “App crashed, make it work!” In the instance where the App crashed, this ruined the user experience and they lost all faith in the application and the information due to the fact that they did not have a polished, working product.

A demo session was also conducted with Dr. Kari Much and the rest of her team at the Minnesota State University, Mankato Counseling Center. We knew that this would be an iterative process, so we were able to take the feedback we received regarding the color scheme and make a final decision. We also are now aware of a bug in the application that causes the application to crash that needs to be corrected.

Table 3: User survey and results

User Survey	Strongly Agree		Neutral		Strongly Disagree
	1	2	3	4	5
The App is easy to use.	84.6%	7.7%	0%	0%	7.7%
The App has a calming feel to it.	53.9%	23.1%	15.4%	0%	7.7%
I feel tense or anxious using the App.	7.7%	7.7%	0%	23.1%	61.5%
The results of the questionnaire were helpful to me.	53.9%	0%	38.5%	0%	7.7%
The local resources listed were clear and concise.	53.9%	23.1%	15.4%	0%	7.7%
I don't think there were any useful resources provided.	7.7%	0%	30.8%	7.7%	53.9%
I would recommend this App to a friend who may have questions about mental health.	53.9%	38.5%	0%	0%	7.7%
Opened-ended Questions:					
-Did you find any bugs or problems in the App? What were they?					
-What ideas do you have for improving the App?					
-Any additional comments?					

5. Summary

We began this project with the goal of creating a simple and useful tool for providing mental health information and resources to students. As part of the planning phase we gathered information on the problem and possible solutions and chose to focus on depression. We then narrowed our possible solutions and focused on cheap, readily available resources that provided a reliable and powerful platform to operate on in addition to being a resource students actually use. We studied which mobile phone (Android vs. iPhone) most aligned to our bounds of cost, ease of use, and availability for a mental health application. Focusing on Android, we then expanded our knowledge of the coding languages involved and called upon mental health experts to fill the gaps in our domain knowledge. We demonstrated the App and its purpose to thirteen college students and received positive response to the concept, with limited negative feedback based on typos and bugs. This confirmed for us that our approach to the problem of on campus depression was in line with what students needed and wanted.

6. Future Work

While the App is currently functional, there are still many improvements that can be made. The application currently has an issue that causes it to crash with a specific scoring range. We need to improve the scoring conditions of the application to prevent it from crashing to increase usability and the overall user experience. While we have a list of the available resources, they are not all currently included in the application. We would like to import all of the resources into a database and then have

the resources recommended based on the user's location. We could then enhance the available resources to include a larger area to allow for a boarder range of users that could benefit from the App and then test it with a broader population. Ultimately, we would like to have two databases, one for the user accounts and one for the resources.

Including intelligent search is important for our vision of the App to be complete. Intelligent search has enormous potential for decreasing the required effort for a user to seek and obtain help for dealing with depression. Information provided by the survey portion of the App will be used to prune the results page shown for the user, providing relevant resources for each user. The search process can also be informed by information such as frequency of App use, links followed by the user, which resources the user has pursued from the results page, and even the path the user takes through the App itself.

The results of our user feedback surveys also gave us suggestions for future improvements. According to our survey, 7.7% of users chose Strongly Disagree with 'The app has a calming feel to it.' with 7.7% choosing Strongly Agree and 23.1% choosing Disagree with 'I feel tense or anxious using the app.' indicating that a portion of the population does not completely favor the App's structure. There are options such as different color schemes or flow that can be tested to shift users perspective. In addition, users that are uncomfortable with the format or layout could be provided with options to change the layout to make them more comfortable. For the statement 'The local resources listed were clear and concise.' only 23.1% agreed, with 15.4% neutral and 7.7% Strongly Agreeing with 'I don't think there were any useful resources provided.' The results are limited because feedback survey results are based on thirteen participants from the same university, which may not fully represent populations at other universities or the broader population at this university. However, the results do indicate a need for improvement of the resources provided by the App. Finally, 38.5% of the users surveyed indicated Agree instead of Strongly Agree when asked 'I would recommend this App to a friend who may have questions about mental health.' Future work includes improvements in these areas with additional surveys to confirm results.

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Biographies

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James Faraday is a senior majoring in Computer Engineering with a minor in Mathematics at Minnesota State University, Mankato. During his enrollment at MSU, Mankato, he has been involved with the Minnesota State University Physics Department Applied Physics undergraduate research team resulting in a presentation at the National Conference of Undergraduate Research and a publication. Starting in May 2013 to May 2014 he was employed by Seagate Technology as a Software Engineering intern creating python-based data mining tools. Since 2007 he has also served as an Avionics specialist in the United States Air Force, achieving the rank of staff sergeant and contributing aircraft improvement proposals.

Joshua Martin

Joshua Martin is from Massillon, Ohio and graduated in 2014 from Minnesota State University, Mankato with a Bachelor's in Computer Science and a minor in Mathematics. He started working for Verizon Wireless in 2007 early in his college career and is currently part of their network team out of Owatonna, Minnesota. He enjoys spending time with his wife and his two dogs in his free time.

Dr. Rebecca Bates

Dr. Rebecca Bates is a professor in the Department of Integrated Engineering. Her PhD in Electrical Engineering is from the University of Washington where she worked to develop computer modeling of pronunciation to improve automatic speech recognition. She has a degree in theological studies from Harvard Divinity School, an M.S. in Electrical Engineering from Boston University and a B.S. in Biomedical Engineering from Boston University. Current research projects include the Speech Recognition Virtual Kitchen, a toolkit to support research and education in the field of speech recognition and a multi-institution effort examining the impact of connection to community on student engagement in undergraduate STEM majors.

Appendix A

Goldberg Questionnaire (Goldberg, 1996)

All questions have the responses of not at all, just a little, somewhat, moderately, quite a lot and very much with each response having a weight from zero to five accordingly.

1. I do things slowly.
2. My future seems hopeless.
3. It is hard for me to concentrate on reading.
4. The pleasure and joy has gone out of my life.
5. I have difficulty making decisions.
6. I have lost interest in aspects of my life that used to be important to me.
7. I feel sad, blue, and unhappy.
8. I am agitated and keep moving around.
9. I feel fatigued.
10. It takes great effort for me to do simple things.
11. I feel that I am a guilty person who deserves to be punished.
12. I feel like a failure.
13. I feel lifeless more dead than alive.
14. I'm getting too much, too little or not enough restful sleep.
15. I spend time thinking about HOW I might kill myself.
16. I feel trapped or caught.
17. I feel depressed even when good things happen to me.
18. Without trying to diet, I have lost or gained weight.

Screening test scoring ranges (Total accumulation):

- 0-9 No Depression Likely
- 10-17, Possibly Mildly Depressed
- 18-21, Borderline Depression
- 22-35, Mild-Moderate Depression
- 36-53, Moderate-Severe Depression
- 54 and up, Severely Depressed