

Increasing Recycling Knowledge in Charlottesville

Building an educational website with all needed recycling information

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ABSTRACT

The problem to be addressed is the lack of clear guidelines on how to recycle, what to recycle, and where to recycle for students and residents living in the Charlottesville area. Solving this problem could lead to an increase in the amount of recycling that happens in the area which has clear benefits for the environment.

A website will be built with technically challenging features. The web framework Angular 10, an open source framework maintained by Google, will be used. The design will be focused around ease of use, will be responsive to different technology platforms including mobile devices and desktop computers, and will be accessibility compliant for tools like screen readers. The design will also be focused around a modern, intuitive design that college students expect. The website will collect analytics about the users who visit the site using Google Analytics and will track the engagement that users have with the site. It will be hosted for anyone to visit using AWS S3 with a public domain, cvillerecycles.com. The security of the site will be considered by looking for potential vulnerabilities using OWASP ZAP, patching any possible sources of cross-site scripting attacks, and hosting the site using HTTPS.

The approach to the project will be to first layout the design of the contents of the site. Next the implementation will be done with the design considerations already mentioned as the main focus. Feedback will be gathered through beta testing with friends and technical advisors, and the implementation will be adjusted accordingly. Other factors will then be considered like security and accessibility compliance. Once this is all completed, the site will be hosted in a public domain.

INTRODUCTION

The overall problem that this project is attempting to contribute to solving is the global warming crisis. Climate change experts have estimated that there are only ten years remaining until the world must achieve zero emissions in order for the planet to not experience irreversible damage (United Nations, 2019). Although this is a problem that cannot be solved by a capstone project, this project attempts to contribute on a microscale. There is no easy or singular fix to the climate crisis, but a series of smaller projects and initiatives that must be backed by everyone are necessary to solve the issue. This capstone is one of these smaller initiatives and attempts to increase recycling, specifically in the city of Charlottesville.

Charlottesville gives lots of recycling options to citizens. This includes curbside bins for mixed recyclables and drop off locations for composting and separated recyclables, however the problem exists that the city does not communicate these options to its citizens well. There should be an educational resource allowing people to be able to answer any question they have about recycling quickly and easily. Before the project, this was not an option. Rivanna Authorities is the organization which handles the recycling for the city of Charlottesville. The organization hosts websites themselves which detail the way to recycle along with other websites that have some details like Charlottesville's website, cvilletomorrow, and theclimatecollaborative. Any information about recycling that someone would need exists in these sites, but the information is scattered in poorly designed UIs filled with irrelevant information. The modern internet user expects better. The modern internet user spends very little time on a webpage, and if the information being shown is not clear and focused, users leave or "bounce" in 10-20 seconds (Nielsen, 2011). Websites have to keep up with the consumer and account for these changes and recycling in Charlottesville is no different. There are likely people, especially UVA students, who visit Rivanna's page or other websites looking for recycling information in a hurry, scan for the information needed, and leave because they were unable to find what they were looking for. This leads to a scenario in which one is disincentivized to recycle - clearly a problem. By making information on recycling in Charlottesville more readily available, the amount of time spent searching for answers on how to recycle, where to recycle, and what can be recycled would decrease, and this would therefore likely increase the amount of recycling that would happen. The capstone project described in this paper hopes to solve this problem described.

With the educational resource now completed, as time goes on, a cycle of more people showing it to others, the site getting more traffic, and it being more discoverable on searches will occur, and in the long term, will be a valuable resource to the Charlottesville community. The users of the site include anyone in the Charlottesville community but especially college students who are always moving in and out of new houses and apartments with no consistent way to deal with waste materials.

For the average person living in Charlottesville, there are not many ways to help fight climate change, however, for many, their contribution exists in being more aware of the waste they produce

and by recycling. The capstone project hopes to help motivate more people to do this.

BACKGROUND

Now the technologies that were utilized will be discussed. The website was made using the web framework Angular, an open source framework maintained by Google. The framework is TypeScript based which is a superset of JavaScript maintained by Microsoft. By using a web framework, the site can be built efficiently and reliably using readily available packages that allow common actions like routing and network interactions. The framework Angular was chosen for the excess of documentation available, its popularity within the software industry, and the many UI frameworks that are compatible with it. Angular version 10.2.1 was used which is a stable release of Angular 10 (the most recent version) released in September 2020. A UI framework, PrimeNG, was used which provides styling to common web elements that can be used and were used in order to make the UI modern. Google Maps provides an API which allows for a map to be displayed on the site which was built utilizing Google's Developer Console. Google Maps API documentation and use cases are targeted toward JavaScript applications but AMG Core, an open source library, provides a package allowing Angular applications to more easily access the tools and was used. Google Analytics is a powerful analytics tool and can be integrated into almost any type of user application. It was used to provide statistics on the site's usage such as number of new and returning users, time spent visiting the site, and demographics on the users like location, type of device, and language. Having this information is extremely useful in tracking how users interact with the website.

In order to host the site, Amazon Web Services (AWS) was used. AWS provides many web services allowing tools to host many different types of applications. For this project, AWS was used for domain registration through Route53, a SSL certificate through Certificate Manager, and hosting of the website through S3. The HTTPS protocol was used which meant any data sent to the user was encrypted and guaranteed to be authentic, giving the user confidence when using the website. The OWASP ZAP application was used to ensure site security. OWASP ZAP is a free and open source tool that checks for vulnerabilities in web applications. The tool was used on the application and the only vulnerability found existed with the Google Analytics setup code which was ensured to be safe, therefore meaning that there were no significant vulnerabilities detected.

RELATED WORK

As mentioned previously, there already exists websites displaying Charlottesville recycling information. For example, any information about recycling in Charlottesville that someone would want to know could be found on official Rivanna Authorities websites or even one of the independent websites listed previously. The website for this capstone is not novel in its goal to provide recycling information to citizens, however it is different in that it attempts to clearly explain all information

someone would need to know about recycling in a concise, clean way. For example, on the list of available recyclables on Rivanna's website, the site uses pictures taken of diagrams that are posted at the recycling center rather than displaying graphs directly on the site. The site also has no clear flow of information or organization with random facts written in red and black text across the screen. The Rivanna website was built using WordPress, which makes it easy to build websites but does not always translate into a site that looks good. This is the problem that the capstone is trying to solve by building a website which consolidates the Rivanna website and other third party websites holding information to a single location while also being stylish and modern.



Figure 1: Rivanna Website displaying recyclable materials

Websites have been created for other cities which display recycling information in a clean way like the one for this capstone that were referenced. For example, the Ireland recycling website had a nice table displaying the information about each type of recyclable. This was referenced to create the table of recyclables for each location that the website for this capstone has. The Ireland website also had videos from recycling authorities which explain information about recycling in that area, and the website for this capstone has some too with a video from the Executive Director of Virginia Recycling Association explaining how recycling works in the county of Albemarle. By referencing sites which serve similar roles of displaying information about recycling in a way that is concise and clean, the capstone website could be made better.

	McIntire	Ivy	Curbside	Material
	✓	✓	✓	Aluminum Cans with: beer cans, soda cans not with: foils, trays, pet food cans, aerosol cans
	✓	✓	✓	Cardboard with: corrugated cardboard not with: single layer packaging, with grease or wax
	✓	✓	✓	Glass with: glass bottles, jars, labels not with: ceramics, porcelain, caps, lids, corks, mirrors, laminates, window, lightbulbs, cookware
	✓	✓	✓	Mixed Metal with: plates, trays, foil, tin cans, empty aerosol cans, metal coat hangers not with: liquids, batteries, hazardous material, toxic material

Figure 2: cvillerecycles.com screen of available recyclables

SYSTEM DESIGN

The design of the site was a heavy consideration because having a good design was essential to the needs and goals of the site. In

order to brainstorm and make design decisions, the markup site Figma was used which created a template to reference when creating the site. The design was focused around ease of use, meaning users can quickly find answers to questions they have about recycling. Information about where to recycle, what kind of materials can be recycled (e.g. types of plastic), and information about what can be placed in city bins is available. Being able to easily navigate to find the information was the goal. This was achieved by having navigation links at the start of the site and by having the most important information at the top of the page. In accordance with ease of use, the design also was focused around being both modern and intuitive, as college students and citizens expect. To achieve this, web components (e.g. tables, navigation options, and buttons) that are stylish and beautiful, yet still useful were programmed by using the open source component library PrimeNG.

Different configurations of the site were considered, including using tabulation in order to separate the different sections of the site which represented different information about recycling. After doing research into best practices in design, having single page applications where users scroll rather than click and navigate to new pages was shown to be a better decision. Both were tried and beta tested with users and the decision was made to have navigation links separating information rather than tabs. These links are displayed at the top of the site and when clicked jump to different portions of the page.

Navigation

[Drop off locations](#)

[What can be recycled](#)

[More ways to Recycle](#)

[Identifying the type of plastic](#)

[What happens to Charlottesville Recycling](#)

[Meade Ave Paper Sort](#)

Figure 3: Navigation links on cvillerecycles

Compatibility with all devices including desktop computers, tablets, and mobile phones was another important consideration. Since mobile phones account for 50 percent of internet traffic, this was especially considered as many web components can act unexpectedly on smaller screens (Clement, 2020). To account for this, the CSS pixel size of components never used set lengths and always used a percentage of the screen. Whenever the screen changes size, the elements of the screen like photos and tables dynamically change to account for the shift in available space. This accounts for viewing on tablets and different sized computers screens. This was not enough to account for mobile usage, however, and smaller sizes had to be accounted for. When the screen size is 400px or less, the styles of the components are changed and many elements get larger, are no longer aligned horizontally but now are vertical, or simply are no longer displayed. For example, on screens over the size of 700 pixels, the content's width accounts for 70% of the screen, but when the width is under 400 pixels, the width accounts for 93% of the

screen. By accounting for the change in the size of the screen, the site can attract the most users and allow the most amount of people to use the site. The site is also fully accessibility compliant for tools like screen readers. In order to achieve this the guidelines posted by the Web Accessibility Initiative (WAI) were referenced.

The hardest decisions to make were what content about recycling was most important as it was gathered from online resources. Judgement had to be used on what information should be displayed near the top of the page meaning it was more important and what needed to be displayed lower on the website or not displayed at all. One compromise often made was to include a 'learn more' link where the original information was found on the topic, and the user could always have a deeper dive into the topic when enough information of the site was shown. For example, there is an excess of information available about the pilot program of composting that the city provides, but only a one sentence summary is on the website with a link to learn more. This linking to external resources was used often and helped with the initiative of keeping concise and displaying the most important information in order for the user to not be overwhelmed with text of irrelevant information.

PROCEDURE

The target user of the site is someone who wants to learn more about recycling in the Charlottesville area. This can include people moving to a new location (including college students who do this often), long time citizens who are beginning their recycling journey, or people who want to quickly reference recycling information. The user would find the site by searching or through a friend, click a navigation link, and read the answer to their question. For someone who has just moved to the Charlottesville area, this site is ideal. Looking through the site, they are able to find what materials to recycle, what to do in order to best recycle their materials, and even a tool to help them find which is the nearest drop off location to them.

RESULTS

Because Google Analytics is used, the results of the website are easy to find. If the site has many users and a high amount of time spent on the website, then the capstone would be considered a success. However, at the time of the writing of this paper and after only two days of it being hosted publicly, 2 users had visited the site. This should be expected as it will take time in order for more people to discover the site, realize its usefulness, and tell others about it. In a month, the statistics of Google Analytics can be reevaluated and it would show whether or not the site is successful.

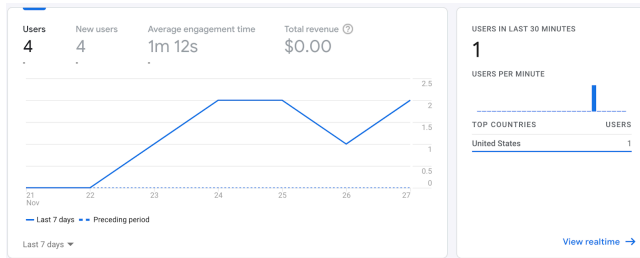


Figure 4: View from Google Analytics on cvillerecycles

However, users visiting the site is not a direct correlation of whether the site is successful. Another goal of the site is less objective which is whether or not the site was able to display useful information in a concise way. This analytic was measured through beta tests of friends who were and were not knowledgeable in recycling. The beta tests were a formal process where the users filled out a form and specific questions about the site were asked. The result of this was overall positive feedback and comments that the goal of usefulness and conciseness was achieved. There were certain edits made as a result of the feedback such as including more information about identifying the types of plastics and how to correctly recycle each, and a whole section was added to account for this feedback.

CONCLUSIONS

The goal of cvillerecycles.com is to be an educational resource aiding college students and the overall Charlottesville community better understand the options available for recycling. The hope is to indirectly increase the amount of recycling done in the community by having a tool available that can be a guide to answering any questions people may have about recycling. The website was built using the framework Angular 10, styled using PrimeNG, and hosted using the tools provided by AWS. It includes design choices to make the site as useful, concise, and intuitive as possible and conforms to different screen sizes and therefore any device. In order to be compatible to as many users as possible, UI best practices of styling and accessibility were referenced and followed.

The website was made in order to fill the need of having a website that shows the information on how to recycle in Charlottesville. Although this is not the only site which does this, other sites that do this are poorly designed, contain irrelevant information, or are not easy to navigate. The website does this by having a UI which is well organized, has concise information, and contains any information one would need to know about recycling. This website could potentially replace the many scattered pages that Rivanna Authority hosts displaying information on recycling, and although the sample size is small, it has been proven to do so with beta testing. With this website now being hosted for years to come, as the number of users increase, ideally the knowledge of recycling in Charlottesville will increase and therefore lead to more recycling in the area.

FUTURE WORK

The website is meant to be an educational resource to help people do their part in helping make the planet better and in the future could contain more information about giving back to the Charlottesville community. To achieve this, a section where local events about giving back could be posted by users such as volunteering opportunities. Information on energy consumption also could be shown too including how Charlottesville gets its energy and how much an individual Charlottesville contributes to the climate crisis. These and other information relating to being green in the community could be included.

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