Facilities Management Recycling Web Application

A Technical Report submitted to the Department of Computer Science

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I. Introduction

University of Virginia's Recycling department is responsible for facilitating waste and recycling management. Its goal is to reduce landfill waste and give these waste items a second life. The recycling division collects aluminum (and other metals), cardboard, electronics, glass, plastics and film plastics, and white and mixed office paper (Recycling, 2021). These waste items are delivered to local recycling programs where they are processed and turned into fundamental materials for future use. The University's goal for 2030 is to minimize its carbon footprint, which entails promoting recycling within University departments and accurately measuring the waste collected (Recycling Services, 2021). The department currently utilizes Excel sheets and paper forms to track the volumes of waste collected from each facility at the University of Virginia. Waste collection drivers pick up this waste and report how many waste bags they have collected on paper forms. These forms are passed onto office clerks or supervisors who make the appropriate calculations from volume to weight and enter this data into Excel sheets. This process allows for clerical and data-entry errors that could lead to misinformation about the amount of waste collected.

With the University's ambitious goals, it is crucial to have well-documented information on how much waste is collected overall and from each facility. There are many facilities at the University and manually calculating the volume of waste for each of those facilities is a tedious task that requires a lot of human resources and attention to detail. Paper forms and the lack of a trash bag-to-volume automated conversion tool result in a human error due to the inconsistency in calculating the volume of waste. There is a significant probability of inconsistent data throughout the pipeline, from recording the data to translating it. Any mistake in the paper forms by a driver could jeopardize the accuracy of the volume output. Furthermore, a lack of structure in the Excel sheets makes it significantly difficult to derive a clear snapshot of how much waste has been collected from each facility. Currently, the Excel sheets are structured as one book with different sheets according to pick-up date, type of waste, and various facilities. This format becomes rather inconvenient and confusing when trying to interpret the data.

This technical project aims to develop a modern organizational tool that drivers and management can use to maintain accurate data storage. The objective is for the supervisors at Facilities Management to be able to easily access information about each facility without the hassle of coursing through Excel sheets. Also, moving driver forms from paper to digital would help organize the documents and allow data to be quickly available.

II.   Tools/Technologies Used

The project is divided into two components: the database and the website. The database will be hosted on Microsoft Azure's SQL Server. Microsoft Azure's SQL Server is a cloud-based database service that is scalable and intelligent, which will allow for the recycling to be stored safely without fear of corruption (Azure SQL Database, 2021). We are using the .NET Core MVC (Model View Controller) Framework for the website. NET Core's MVC framework is an architectural pattern that navigates user requests in an ordered manner and is implemented using the programming languages C# (pronounced C Sharp) and CSHTML (Overview of ASP.NET Core MVC, 2021). C# allows for the logic behind the scenes, such as the calculations from volume to weight, while CSHTML is leveraged to display the front-end forms to the users. The university's website and database are currently hosted using these tools and technologies. Therefore, using these tools, it will be easier to maintain both services by the University.

The entirety of the project was completed using the Software Development Lifecycle, which is a framework for breaking down large projects into sprints. Sprints are usually two weeks where developers focus on specific tasks or sections of a project.

III.   Skills Gained

Throughout the course of developing this project, there were several skills gained, ranging from design to logic implementation to user interface skills. From the design side, the design of the database tables and how they connected and interacted with each other was revised multiple times, increasing efficiency and simplicity with each revision.

Alongside that, the division of tasks and flow of data was initially implemented through the MVC framework but failed to be an effective MVC framework due to the group's minimal experience with this framework and web development in general. As the project progressed, the logical division of code and how data flowed throughout the project was also improved with suggestions from Facilities Management's development teams. Furthermore, this project also allowed for ample client interaction where Facilities Management provided frequent feedback on the project's progress to ensure that development was on the path that they desired.

From the user's side of this project, the only requirement from the Facilities Management department was to have the same look as the rest of Facilities Management's websites. Still, a recurring issue was highlighted when there was a realization that the Facilities Management Department's own collection of websites had its own way of displaying logos. Still, after meeting web developers that were experienced in working with the Facilities Management Department, the issues were cleared, and the development team gained further insight into how a website can be implemented to show images.

IV. Reflection on Academic Experience

The first few sprints of this project were centered around ensuring that the requirements put forth by Facilities Management were fully understood by the team. There were several instances where the stakeholders decided to pursue a different layout or add a functionality, so the team did not have a solid set of requirements to work with at the beginning. This was different from the software development experience in CS 3240, Advanced Software Development Techniques. In this class, students were assigned a project and had to send out forms and surveys to gauge what users would like to see from the project. This allowed them to have a fairly short requirements collection process, but in this case, it quickly became apparent that Facilities Management did not have the chance to form an image in their mind about what they desired and initially asked the development team to pursue the direction they see fit. Later on, as more members of the Facilities Management Department were invited to join feedback meetings, they started to steer development in a direction that would best align with what Facilities Management already had and could build off of existing structures.

One such structure that Facilities Management had was a database, but it was not designed for waste collection data. So initially, the development team had the freedom to design a database that fit the needs of data relating to data collection. To test the initial design some sample data was gathered in an attempt to see what types of values would be required and how the columns of each table can be chained together to make the most sensible and connected database. Before building the database, the deliverables provided to Facilities Management were the database schemas and relational diagrams. This process revealed that there were many different ways of formulating schemas. Depending on how the schemas were developed, the relational diagrams could look very different, which was quite different from what was seen in CS 4750, Database Systems.

V. Conclusion

By undertaking this technical project, we were able to gain many invaluable skills that will be useful as we step into the workforce. Not only were we able to gain technical skills, but we were also able to improve our soft skills by reaching out to our stakeholders, demoing our product, and managing our pace on the project. This project gave us a well-rounded understanding of what it is like to be a software developer and we are thankful for that opportunity.

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