

Web Application Development: Outsourcing Software Engineering to Improve Outdated Government Applications

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

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Technical Report

Abstract

Expression Networks, a government contracting company in the nation's capital, primarily functions as a means to provide crucial technological updates meant to push American technology standards forward within the United States' military and agencies. Within the company's web development sector, I was one of the software engineer interns tasked with providing technical expertise to complete contracts by using the newest and most scalable technology stacks. We used Agile methodology to organize the six-member team, JIRA for task management, and the MERN (MongoDB, Express, React, Node) technology stack to recreate the old software.

By the end of the internship, the web application was being prepared for another version release for the client. The user interface was cohesive, usable, and with a high performing database. The web application is still in need of final updates for the production release, added features, additional testing, and maintenance.

1. Introduction

The summer of 2020 I was offered an opportunity to intern at Expression Networks, a small start-up located in Washington D.C., mostly involved in government contracting work. Many computer science students spend days and days preparing for technical interviews, applying to as many internships as possible, and networking with as many people as possible wherever the opportunities might come up (career fairs, special events, etc.).

Over my four years of attending the University of Virginia, I have been an active member of the Society of Hispanic

Professional Engineering organization, a professional development organization. SHPE held a joint event with the National Society of Black Engineers in which there was a networking event with UVA alumni. During the course of this mini-session I met an individual who sent my resume out to a handful of individuals he knew within the software industry. The rest of the story is history, but this anecdote highlights the many ways in which a student is able to find an opportunity such as an internship.

2. Related Works

Throughout the summer I worked on an online reporting system for the military, built using the MERN stack (MongoDB, Express, React, and Node). The MERN stack is one of the most popular technology stacks and one of the newer ones. It is fullstack, handling everything required in an application from frontend to backend. The database used was the document-oriented MongoDB. The web application being built would need to handle a lot of documentation because the application's ultimate utility is focused on reporting. Express is a back end web application framework built on node js, a runtime environment. ReactJS is a javascript library composed of user-interface components, focusing on building the frontend aspects of a web application. The main source I used outside of any company owned documentation was stack overflow. Stack Overflow is a website geared towards programmers, where posts are made by users and others are able to respond to provide any insight and advice to solve a problem or understand a topic.

The team consisted of about six people on average, using the agile methodology in order to improve output. The significance of agile methodology is its ability to lead to

“more stable requirements, earlier fault detection, less lead times for testing, increased communication,” among other positive qualities (Kumar and Bhatia, 2012).

Another crucial part of the team's organization was the use of Atlassian's JIRA, an issue tracking management tool. Each of those tools and technologies combined were used to aid in the creation of the tool for the military. Due to the confidential nature of the technology, I am not able to discuss it further or compare similar applications.

3. Project Design

I detail below each parameter surrounding the successful completion of my internship as it pertains to my role within the specific web application project.

4.1 Project Team Coordination

In Expression Networks, project teams were composed of an average of 3-7 software developers with one often senior developer being the supervisor, or scrum master, leading the project. The scrum master had several main responsibilities, including hosting weekly stand-up meetings, organizing the product backlog, and coaching team members.

Our team's stand-up meetings lasted no more than 20 minutes and consisted of each developer going through what they had done in the past week, highlighting tasks they had recently started. We also spoke about what tasks we would be completing that day and what, if anything, is causing a problem. These meetings were the perfect time to ask for guidance about work we might have been stuck on the day before. The time frame in which we had to complete our tasks was outlined by the two-week long sprints. For meetings that fell on the days just before another version release or the end of a

sprint, the scrum master determined, based on each of our updates, whether the tasks created for the current sprint could be completed in time or must be pushed back to the next sprint.

The second primary responsibility for our scrum master was the specific technical implementations that needed to be completed within the sprint in order to maintain a good pace for the project as a whole. Our team achieved this by using Jira, a project tracking software. The scrum master was able to organize the product backlog by creating tasks during stand-up meetings that met the client's requirements for the application and assigning those tasks to each of us.

The third primary responsibility was for our scrum master to serve as a source of mentorship for all of us. There was a chain of command beginning with googling, asking other members on the team, and then after two hours of not getting anywhere to finally reach out to the scrum master.

My job as another developer on the team was the same as each other full-time developer, albeit as an intern. For each sprint, I completed certain tasks. Generally, as an intern, I got more descriptive task write-ups than the other junior developers. I spoke to the scrum master at the halfway point and end of my internship to establish what each of us could do to improve on the overall experience. This went along with daily slack updates between the team during the start, middle, and end of the day. Pair programming with the other developers was my primary way of establishing mentorship with the other developers as well as my supervisor.

4.2 Web Application Requirements

Due to the nature of the application I was working on, I cannot disclose specific details of what the project entailed. However, I can broadly discuss elements I worked on and finished, as well as how the technology stack was chosen in order to meet these requirements.

One of the major requirements the client requested was the necessity of a printing interface page. I used HTML, CSS, and ReactJS to create this feature. This high-priority update was necessary for future users of the application to be able to correctly format and display the report information to print.

A second component I implemented was an administrative feature that allowed certain users to upload and download files stored within the database. I used ReactJS to implement this feature, which was a part of an upcoming version release for the client.

This project was not new; an older version already existed. The goal of this project was to take the existing legacy code and revamp it with the newest frameworks, software, and programming languages. ReactJS was chosen as the library of choice because of its great performance and wide community usage. There is so much documentation available and information about different use-cases that are always being updated to improve the library. Because of the reporting aspect of this application, the application needed to be able to handle large amounts of documents. For this reason, the team used MongoDB as the database.

4. Results

I cannot know the current state of the web application, but there are general outcomes that exist when rewritten code is complete. After the completion of the code, there should be many more resources that cut

down on a lot of maintenance. The new application will be able to handle more traffic and workflow.

The result of the administrative feature was that I committed it into the development branch for future incorporation into the production branch. The result of the print application was the same with the additional satisfactory rating from the client once they saw the latest version release just before I completed my internship.

Overall, rewriting the application increased security by using the latest programming techniques and languages to prevent attacks to this government software. The updated technology allowed for greater speed-up and usability because we used a simpler, coordinated user interface framework.

5. Conclusion

The rate at which the software engineering industry is changing is incredibly fast. In order for organizations not to fall behind the rapid advancements and become susceptible to cyber attacks, it is important for software to be kept up-to-date. Safe software is especially important within the government. Companies like Expression Networks are geared towards providing various services, software engineering among them, to the government in order to update legacy code with the newest technology stacks and frameworks. My experience interning was focused on using the MERN stack to update a military web application in a team, which will result in a final version release to be used by military personnel for a critical reporting system.

6. Future Work

Upon the completion of my internship, a new version was released only for the client. The version release still had bugs and backlog tasks that needed to be completed.

Fixing any bugs for the last version release I was a part of was not of utmost importance because our team met the client's more important requests. I am unable to know about the current standing of the reporting application due to confidentiality; however, Expression Networks has continued to provide internship opportunities for students to continue working as software developers on projects tailored to the government community. The types of roles available range from data scientists, to marketing specialists, and software engineers, among others.

7. UVA Evaluation

The best class for prospective software engineers is Advanced Software Development Methods (CS 3240) due to the structure mimicking the environment and organization of an actual team creating a software product. I had completed CS 3240 after completing my internship with Expression Networks, but I could see just how similar it was to my experience as an intern and was able to tell my peers how useful the class was for any future career they wanted to pursue as a software engineer.

Other useful courses for technical interview preparation include CS 2150 and CS 4102, due to the subject matter being related to many of the types of questions asked during technical interviews. A deficit would be a lack of lower level courses related to software engineering, similar to CS 3240 and a lack of diversity of classes. There have been a variety of classes for students interested in cyber security, but beyond that there are not diverse choices for other industries. An improvement to the computer science department at UVA would be more diverse CS class choices and having courses mimic industry practices as much as possible.

8. Acknowledgments

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References

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