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Lecture Goggles

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Table of Contents

Abstract

The project proposed by Team 22 is a free, open-source, educational resource repository to help students gain a better understanding of school subjects. Lecture Goggles is meant to help resource sharing between students and professors. Initial implementation will be focused on a web application design using a back-end web server and database to quickly manipulate and store uploaded resources and user accounts. Lecture Goggles limits the administrator's interaction using a front-end design mimicking a tree structure that can be built upon as more resources and subjects are added.

Project Description

Lecture Goggles is a web application that is built to store and share helpful resources. Resources can be HTTPS links or files provided by students or teachers. This will be limit file sizes to an appropriate size which has not been determined yet. To provide a safe environment for all users, each link will be checked for malicious content or inappropriate HTTPS forwards. The first implementation will limit resource contribution to authorized college students and college professor accounts.

This project is directed and implemented with college students and professors in mind. The benefits are that students around the world will have the ability to share helpful resources. These resources can cover a spectrum of topics such as English, Math, Science, and any other commonly and uncommonly used topics required by universities. Instead of searching through google, students will have Lecture Goggles to search for links that they find helpful. This will hopefully eliminate confusion when searching for helpful resources. Lecture Goggles will be limited to college students and professors providing resources but will allow any individual to look for helpful links. Given that Lecture Goggles will be kept free for everyone, Team 22 needed a way to limit malicious links and files. This is done by limiting contributors to authorized college emails.

The main functionalities are as described in the following. With an authorized college email, each user will have the ability to provide https links and accepted file formats after creating an account. These links will be posted online for the public to look through. If there are missing topics (Math, Science, English, etc.) that have not been

added yet, authorized users can add these topics and subtopics (Vectors, Chemical Bonds, The Use of Adverbs, etc.). Reporting bugs and malicious content are also a couple more minor functionalities.

The current technologies are broken into a few parts. Our front-end is developed using React which is written using Javascript and Python. This portion will be kept separate from the back-end on a Ubuntu VM server. The portion that the React front-end will communicate with is our API. Django Rest Framework will be used for the API. This is written with Python and will translate Javascript into PostgreSQL and also PostgreSQL into Javascript. The API is a translator and validator between the front-end and back-end database. As done with the front-end, the API will also be contained on its own Ubuntu VM server. Finally, we have the PostgreSQL database server. PostgreSQL is written in C but will communicate with the API using PostgreSQL format language. This will also be on its own Ubuntu VM server to provide full access to computational power and storage. The current implementation will be focused on web development. Using the web we gain access to the largest user base without needing to launch applications for each platform.

Since Lecture Goggles will be deployed as a web application, the reliability is as strong as the backup techniques and communication between each process. If any of the servers are out of commission, there will need to be a backup server that can be switched to in a matter of seconds. This is currently used by corporations to limit downtime. The API will be using a token-based verification technique to verify the users during use. This combined with encryption and salt password should minimize any theft of personal information.

Significance

The reason this project is worth pursuing and interesting is the personal endeavor that contributors to Lecture Goggles have endured during their college careers. Given that Team 22 has faced the problem of finding helpful study material, we wanted to give future students the opportunity to use Lecture Goggles. We see that the market needs a product like this and wanted to give something back.

The main learning curve for this project has been teamwork. Having the opportunity to work with other future professionals to implement a planned project is humbling. Each individual brings new techniques and technologies to the table. Learning how to divide project requirements among the developers is a skill you cannot learn without this kind of opportunity.

The techniques used in Lecture Goggles are not all groundbreaking. Each technology is commonly used in industry. Where Team 22 does do things differently are the ways in which we allow more freedom to users. Giving users the ability to add topics and subtopics to the website allows for limited staff and the opportunity for the website to grow to scope not currently imaginable. We want to allow the growth potential to match the users, not the developers.

Lecture Goggles business potential lies in its access and relevance to education. The resources will continue to stay relevant as long as education is important. Seeing how Lecture Goggles could also expand internationally, with some success in the united states, the project can be easily translated and deployed in available countries. If the project was open source, we could access these other markets more quickly. This would give new coders the ability to learn how the program interconnects while also helping their countries gain access to this helpful resource.

The potential for Lecture Goggles to grow is closely related to the ease of development. Making changes and expanding on ideas can be done with a small team. Since each part of Lecture Goggles front-end, API, and database are separated into their own bits, making changes to one section should keep the other sections safe from corruption if done correctly.

Similar or Related Projects

Websites:

- "200 Free Kids Educational Resources: Video Lessons, Apps, Books, Websites & More." *Open Culture*, www.openculture.com/free_k-12_educational_resources.
    - This website has an enormous list of hyperlinks to free educational resources all around the internet. Though they are listed as K-12 resources, many remedial or introductory level college courses cover similar or identical content, making them excellent resources to use with Lecture Goggles

- Khan, Salman. "Khan Academy." *Khan Academy*, Khan Academy, www.khanacademy.org/.
    - Khan Academy is an excellent resource for many topics, but especially math and science-based topics. Khan Academy does not require an account to use their resources, so it is easy to locate them using

hyperlinks. These videos, worksheets, and interactive problems will be excellent initial resources to add to Lecture Goggles.

- Fox, Carolyn. “A Guide to Free and Open Source Education.” *Opensource.com*, 2013, opensource.com/education/13/4/guide-open-source-education.
    - This page points to multiple large databases containing thousands of educational videos and courses. Some of the resources mentioned are designed to work in a similar way to Lecture Goggles, which will help us narrow down the specific functionalities that are well received, and which ones are not. The videos will be excellent to add to our initial release of Lecture Goggles.

Legal and Ethical Aspects

The legal aspects pertaining to Lecture Goggles will be related to customer protection. The audience of Lecture Goggles are college students and professors, but in the future will open to K-12 when all bugs are worked out. Malicious content will be posted to Lecture Goggles at some point. Keeping a young audience protected from adult content, malicious links, and any other damaging material, is a priority and responsibility of Team 22. With all the reports on how user data has been leaked, even from the most reputable companies, Team 22 must use current security methods of encryption and storage.

In the ACM code of ethics PUBLIC section, software engineers shall ensure that their products and related modifications meet the highest professional standards possible. This may relate to the security aspects talked about in the previous paragraph. Current security techniques must be used to protect users. If corners are cut while developing Lecture Goggles, leaks of user information could lead to stolen personal information and/or use of user accounts to post malicious content.

Software engineers are responsible for many professional responsibilities as outlined in section 2 of the Code of Ethics. Since professionals are required to “strive to achieve high quality in both the processes and products” (ACM Code of Ethics, 2.1), Lecture Goggles is constructed to follow the best practices for testing and development.

Changes and Progress since the Initial Project Concept

Summary of Progress

Team 22 has made progress in the overall architecture of the application, with a database schema laid out. Team 22 has three servers on Azure set up, with one for the database, one for the API server, and one for the web server. A rough user interface has been prototyped in a combination of Adobe XD and React, with a good chunk of the site being implemented in React now. The API server is configured to work with both the frontend and the database, which is coded in Python using Django. A firewall exists so that the API server is the only connection the database server will accept, in order to prevent possible attacks. The database is a PostgreSQL database with tables made for users, subjects, topics, resources, and other data the site will need to operate.

Team 22 has progressed the low-fidelity prototype from the previous semester into three functional components which need to be linked together and tested. The frontend of the website was reconstructed with integration and unit tests written to ensure easy refactoring. The API server is able to authenticate users, with a token generated for authentication. The database server has a rough architecture created.

Major Changes

In a previous document, Team 22 stated that a public facing API would be possible. Team 22 has decided to move that objective to possible future work, since a public facing API is not required for the core functionality of Lecture Goggles. Since Team 22 had a successful prototype evaluation, the core functionality, technology stack, and system architecture will not need major changes.

Major Developments

While refactoring the frontend prototype, 19 test suites were composed with 90 integration and unit tests, using Jest and react-testing-library. Frontend form validation has been constructed to ensure a pleasant user experience. The frontend has been updated to run the most recent version of React.

Lecture Goggles' API has been developed to authenticate users. The API has the functionality to communicate with the web server and database server. The database has not had major changes or developments made since the prototype meeting, since a lot of the changes will need to happen after the API is linked up with the two other servers.

Project Responsibilities

Zachary Johnson:
Zachary is in charge of the Application Programming Interface (API) server. He is using Django to create the public facing API, and will test using Postman or a similar product. Zachary acts as the middle-man between Logan and Nathan, and is responsible for ensuring that the results from the database are translated into data that the web server can correctly process.

Logan Long:
Logan is in charge of the Database Server and the overall architecture of the application in Azure. He implemented the proposed database schema and the security features of the Azure architecture. Logan ensures that the features and functions used in Azure are correct and only used as needed. He is also responsible for the proper hiding of data between servers, and making sure that only authorized users can access the raw database server. The database server holds all of the critical data for Lecture Goggles, and can only be accessed by the API server.

Nathan Yocum:
Nathan is in charge of the Web Server. He is implementing the front end using React, and is writing a full test suite. Nathan has experience with front-end development, and is using that to ensure the user accessible portion of the site is easy to navigate. He is also responsible for ensuring that proper calls are made to the API server, and that input into the website is validated. The web server hosts the public website, and is how most users will interact with Lecture Goggles.

Project Monitoring and Risks

The project will be monitored by requiring the team to set small, accomplishable goals for their subsystems each week, and have them completed or an update on their status by the following week. Using Slack, the team can communicate regularly, ask for help from each other, and send reminders or updates on their tasks. Having all of the team members know what is expected of each other will hold them accountable for the work they have been assigned. For example, a small goal for Logan might be that he needs

to have the login information stored securely in the database within the next week. This is a reasonable goal, and is easy to be held accountable for.

There are eight major risks that Lecture Goggles will need to account for.

1. Acquiring funding for Azure products is a possible risk because without funding, the project would need to be hosted on cheaper or personal servers, hurting performance. To mitigate this, Lecture Goggles needs to acquire an accurate quote for the used Azure services, and request funding from the CSE department.
2. There is a risk that the open source software that Lecture Goggles relies on could stop being maintained, exhibiting security holes and poor performance. To mitigate this, Lecture Goggles will use open source products that are maintained by major companies or organizations.
3. A large risk is that of cyber attack. To mitigate this, Lecture Goggles needs to use current security software, such as an intrusion detection system, or Azure's next-gen firewall to detect and stop attacks before they happen. Additionally, using current hashing and encryption techniques can mitigate the risk of cyber attacks.
4. Users may not find the product useful, causing a drop in usage. Lecture Goggles can mitigate this risk by allowing users to provide feedback, and supply them with features that changes their view on the usefulness of the product.
5. Competing services may take market share, leaving Lecture Goggles with fewer users. To mitigate this risk, Lecture Goggles must constantly improve the product, ensure it is competitive with similar services, and offers an easy and enjoyable experience for users.
6. Malicious actors may attempt to manipulate voting results to have certain submitted information pushed to the top. This can be mitigated by creating an algorithm that takes many factors into the ranking of links, rather than solely thumbs up and thumbs down ratings.
7. Donations or other sources of funding may not be secured. This can be mitigated by requiring non-student accounts (such as faculty) to pay for service, serve advertisements on the site, or find corporate sponsors. Additionally, the scale of the Azure services can be cut to reduce costs.
8. Azure may not behave as expected, causing system outages. This can be mitigated by ensuring that there is redundancy within the Azure systems to prevent total system outages.

Table 1.

Risk Register											
Risk ID	Risks	Current Risk			Status	Owner	Raised	Mitigation Strategies	Residual Risk		
		Likelihood	Impact	Severity					Likelihood	Impact	Severity
RP-01	Acquiring funding for Azure products	2	3	6	Open	Logan, Zachary, Nathan	2/8/2019	Get accurate estimates of Azure virtual box costs, request funding from CSE department	1	3	3
RP-02	Open source software that Lecture Goggles relies on has maintenance stopped	4	3	12	Open	Logan, Zachary, Nathan	2/8/2019	Stay up to date on currently maintained open source tools. Use tools from large companies such as Facebook, Twitter, Microsoft, Apple, Google, etc.	2	2	4
RP-03	Cyber attacks expose critical or sensitive data	3	4	12	Open	Logan	2/8/2019	Install a network-based IDS. Use Azure's next-gen firewalls to alert admins to suspicious activity.	1	4	4
RP-04	Users do not find the product useful	2	4	8	Open	Logan, Zachary, Nathan	2/8/2019	Conduct surveys to connect with users and ask for feedback and feature requests.	1	3	3

RP-05	Competing service begins to take market share	3	3	9	Open	Logan, Zachary, Nathan	2/8/2019	Run analytics to find information on what is turning away users, and conduct surveys to ask why users left Lecture Goggles.	2	3	6
RP-06	Malicious actors attempt to manipulate voting results	4	4	16	Open	Zachary, Nathan	2/8/2019	Find/Create an algorithm that minimizes the impact of vote manipulation. Confirm that accounts are registered to real people and not bots.	2	3	6
RP-07	Donations/Funding does not meet requirements for system usage	3	4	12	Open	Logan, Zachary, Nathan	2/8/2019	Decrease resources used in Azure to cut costs as needed. Introduce a subscription model for users unable to prove active student status.	1	4	4
RP-08	Azure infrastructure does not behave as intended and causes system outages	2	4	8	Open	Logan, Zachary, Nathan	2/8/2019	Create redundant infrastructure to minimize outage times. Only use Azure services intended for web application usage.	1	3	3

The Risk Register for Lecture Goggles.

Contributions of Team Members

Zachary Johnson contributed to the Abstract, Project Description, Significance, Legal and Ethical Aspects. ~3-4 hours

Logan Long contributed to the Project Responsibilities and Project Monitoring and Risks sections. ~3.5 hours

Nathan Yocum contributed to the Changes and Progress since the Initial Project Concept section, Project Responsibilities, and the Legal and Ethical Aspects section. Nathan worked on the report for around 3 hours.

References

- “200 Free Kids Educational Resources: Video Lessons, Apps, Books, Websites & More.” *Open Culture*, www.openculture.com/free_k-12_educational_resources.
- Khan, Salman. “Khan Academy.” *Khan Academy*, Khan Academy, www.khanacademy.org/.
- Fox, Carolyn. “A Guide to Free and Open Source Education.” *Opensource.com*, 2013, opensource.com/education/13/4/guide-open-source-education.