Project Title: DicMath

Brief description:

The solution is a web app that allows a user to dictate equations which are then written down and can be exported and downloaded on the computer.

The idea is that one can write down their own equation as they are thinking, and then modify it at their convenience:

One can delete an equation line, copy, and paste it wherever they want, rewrite a bunch of lines, and modify an equation. The website also has a vocal assistance option, to tell the user when the dictation starts and to repeat an equation line if needed.

Team Number: 101

Project Partner: Philippe Trotin

Project Team:

Team Member	Project Role (if defined)
Kyllian Asselin de Beauville	Referent
Wael Ben Baccar	
Julia Cuvelier	
Théo Le Roux	
Mathilde Salaün	

The Project Closure Report contains key descriptive information about the project.

*As the **last document written** on the project it **analyzes the outcome** of the project and the **process** by which that outcome was produced.*

Its purpose is twofold: to ensure that the closure activities are carried out properly and to facilitate the transfer of experience (or the transfer of experience if the project is not completed or if a follow-up to the project is envisaged) to the customer's organization.

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1   Objectives Set versus Results Achieved

1.1   Project Initial Objectives

Describe the Project initial objectives (defined in the kickoff meeting) expressed in terms of technical specifications, costs (if relevant) and deadlines. This part recalls the performance objectives and their declinations.
If the objective varied during the process, just describe evolutions, and explain these evolutions (why?).

The project's initial objectives were to create an application (web or local) which would allow visually impaired users to write down mathematical content, at least at the beginning of high school level, thanks to vocal dictation and commands. It was also required for users to be able to smoothly manipulate and modify the written equations, as well as export them and download them onto documents. The application also had to be easy to navigate for a visually impaired user, so we had to avoid relying on the mouse or touchpad of the computer and instead favor vocal commands and keyboard shortcuts.

In terms of deadlines, we knew that the product had to be ready by the end of March, and that, in the meantime, we had to give our partner updates on our progress every two weeks at least. We therefore held multiple meetings during which we exchanged with our Microsoft handler about what we had managed to produce, whether it fit the requirements, and what to do next.

Regarding the budget, there was no need to define any, since we relied mostly on the Microsoft Azure Cognitive Tools, which were available for free, provided we did not use them for too long. All other resources, like python, our code editors, or flask, were fully available to us for free.

The objective remained the same throughout the whole process, but some requirements were further developed during our meetings. For example, the clarity of the equation writing required for the equation lines to be broken down into smaller blocks which could be changed individually. We discussed this topic throughout the meetings and came up with a satisfactory solution, which was different than what we had originally imagined.

We did manage to achieve the project's main goals and meet our partner's expectations, and even tried to further improve the product. Our DicMath tool currently enables a user to:

- navigate using only their voice and keyboard,
- dictate high school level equations,
- navigate and modify elements within equations,
- export equations in LaTeX format in a .pdf document,
- copy and paste equation lines (added function to simplify the writing process)

1.2   Results Achieved

Describe the main results and comment on the negative and positive deviations: why such and such an objective was not achieved? Or on the contrary: what are the reasons for such success?

Indicate whether the Objectives/Expectations of the partner have changed during the course of the project and if such is the case, indicate the reasons.

The main result of this project was getting the app up and running, with all the main functionalities cited by our partner during kickoff (see the details above) which was mainly about the app usability.

The objectives of our partner remained mostly the same throughout the months. However, while we were originally supposed to work closely with the Institut National des Jeunes Aveugles (INJA) to get a better grasp on the needs of our target audience, there was no follow up in our partner's exchanges with the organization, which forced us to move forward without them.

In the end we were able to achieve most of our goals successfully through open communication with our partner on what was expected of us and our project, and a lot of trial and error to put the project together, one requirement at a time.

At some points our work was hindered by our diverging schedules (particularly according to missing modules for our group composed of student from 4 different TD group) and other projects, which might have been easier to handle with more fluid in-group communication and a better repartition of the workload during some phases of the project.

1.3 List of Deliverables

Detail the list and content of deliverables (technical report, prototype, GitHub links, etc.) of the project and indicate whether they have been accepted by the partner or are subject to comments/reservations.

If needed, attach as appendixes to this report these deliverables (if they are documents of course).

Our main deliverables consist in:

- A working web application which fulfills the previously stated requirements, whose code will be made available publicly on GitHub.
- Extensive documentation on how to set up the app, how to run it and how to use it plus an intuitive code structure with comments.
- A scientific poster to explain the ins and outs of the project.
- A closure report (this document).
- A 2-minutes max video presentation about the project.
- A simple logo for our application
- A French and English abstract about the project.

The partner accepted and approved all the deliverables we provided and expressed great satisfaction with our results.

2   Methodological review

Evaluate how the project was conducted: distribution of roles and responsibilities within the team, the method adopted ("Agile" method, etc.).

We decided to adopt the Agile method to develop our project. We worked in two to three-week sprints in between our meetings with Microsoft to produce what was asked, then showed our results, got some feedback on what to change, improve or do next, and repeated the cycle. We worked on the front end and the back end in parallel. For the back end we progressed one functionality at a time, going from the core/basic requirements to the more complex ones. The code was shared by the whole team and updated on a GitHub repository.

The repartition of the responsibilities changed a bit following the constraints of each member throughout the months, but it can be broken down into the following. During the first semester, Kyllian (who, as the referent, handled most of the communication with our handler, Mr. Trotin) worked on the vocal recognition tools with Julia, while Mathilde, Theo and Wael worked on the front-end part and how the platform was to be used. During the second semester, our team mainly focused on the flask app (back-end in python using the Azure Speech tools), depending on the member's availabilities.

According to soft skills, we respected each other and each other's opinions, we discussed about the project evolution and made important decisions all the time together.

3 Risk Management

Summarize the main projects risks.
Identify key actions to manage main project risks and indicate if these actions have been successful or not and the associated reasons.

The main risks of the project were to end up with a tool that was not or not fully functional, impractical or not suited for visually impaired users, who are our target users.

The main action we took to prevent these risks from becoming a reality was to always keep in mind the user's point of view and their needs, both as a visually impaired user, and as a person studying/using mathematics. That is also why we wanted to contact the INJA even if it never happened. Moreover, our frequent meetings with the partner made sure that we did not stray too far from what was expected of us.

In addition, we kept objectives in mind and asked our partner what he precisely wanted to consider the project as achieved. We then added some functionalities with the rest of the time which was granted to us.

4 Constraints

Please identify and list in this section all the constraints taken into account for your project: for illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

The main constraints we had to consider were:

- Functionality: Every function of the app had to work smoothly and cohesively with the other functions. For this purpose, we ran tests upon adding new chunks of code.

- Precision: For instance, we wanted the dictation function to be precise, to work almost every time and without error, so we made sure each mathematical term was understood correctly by the cognitive tool by creating a dictionary.

- Usability: especially for our target audience, visually impaired students. Indeed, it was important to keep in mind the main goal of the project, which was to allow the visually impaired to pursue scientific studies. Any function we added, any improvement we made had to be made with this goal in mind. For example, we established early on that it was important to have an interface that could be navigated using one's voice or keyboard. Another important aspect was to keep the dictation and modification processes as simple as possible to prevent misuses or malfunctioning. This was one of the most challenging aspects of creating the structure of the tool. Indeed, we needed to break down each equation into smaller pieces which could be changed individually, while also making the vocal commands as simple as possible. This was the topic of many discussions between us and with our partner, which lead us to the current structure: an equation is made up of lines, which can be broken down into blocks. To modify a line, one has to say "modifier ligne …" and state the changes to implement. This is also why we left detailed user's guides along with our code.

- Accessibility: We were required to make our work available to any potential user or person interested in it, which is why it can all be found on a public GitHub repository.

- Code: Besides having a working and efficient program, we also needed to make sure that our code was as structured and as readable as possible, since our work was going to be left as open source.

5   Technical Review

Deepen the appropriateness of the technical options chosen with regard to the functional specifications. Evaluate the outcome of the project: technical, organizational, managerial system...

We chose Python to code the structure because it allowed us to use libraries such as PyLatex using LaTeX which is one of the most optimized languages for representing complex mathematical content. In addition, we already had to discover other languages such as HTML, CSS, JavaScript... Taking a familiar, well known and well documented programming language like Python seems like a necessity.

If we had to do it again, we would probably opt for a basic local application, instead of a web application, because the setup took a lot of time and we had to catch up on a lot of skills, which delayed our work on the application's content.

Review the human, financial, organizational, technical, etc. resources dedicated to the conduct of this project. Take stock of what was actually consumed. Enrich the finding with comments explaining the discrepancies.

Regarding human resources, a team of five people seems to be an appropriate work force for a project such as this one, although it did pose a few challenges to balance the workload depending on the availabilities of each and on the common constrains associated with our student lives (exams, projects, deadlines).

We didn't expect any financial cost because we could do everything by hand and improve our technical background by following tutorials. We also exclusively used free open-source services, which worked well. This is why the only thing consumed during the project was time.

The organizational resources consisted of group work tools and a few communication channels:

- GitHub for all code sharing.
- Teams for formal reunions with our Microsoft handler, our soft skills advisor, as well as document sharing.
- Messenger for less formal, daily communication within the work team.

The technical resources we used were consistent with what we had estimated in the first weeks following the kickoff meeting. They consisted mostly of programming tools, which we already had at our disposition, such as code editors, python, flask, and all the associated documentation available online. We also relied greatly on the Microsoft Azure cognitive tools (Azure Speech), which Mr. Trotin recommended we used, the project being for the Microsoft group.

The deadlines were a little bit overestimated, indeed Mr. Trotin was mostly satisfied with the version that we handed in 1 month before the end of the project, which is why we added and further improved some functionalities. However, we were unable to use that extra time to greatly improve the final product since this semester was particularly unpredictable. Indeed, we frequently had trouble meeting up due to the weekly strikes, schedules changes, late modules courses and cancelled ones.

6 Engineering standards

For the development of our web application, we were interested and inspired by two engineering standard documentation:

- The Web Content Accessibility Guidelines (WCAG): a standard that provides a set of guidelines for making web content accessible to people with disabilities, including visual impairments. The WCAG outlines techniques for ensuring that web content is perceivable, operable, understandable, and robust.

- The ISO 9241: a standard that provides guidance on the ergonomic design of interactive systems, including web applications. It includes recommendations on designing interfaces that are easy to use and understand, considering the needs of different user groups, including people with disabilities.

7 "Post-project" tasks

If necessary, *indicate the list of actions and deliverables still to be performed in order to ensure the handover if the project is not completed or if a follow-up is envisaged by the originator.*

Besides the code and user's guides required by our partner, and the poster, report, video, and presentation required by the EGPE, we do not have any other pending tasks for this project.

If another team wanted to take the lead next, we would recommend that they focus on integrating more complex math such as square roots, sums, and integrals because this is something that we had to set aside in order to provide a user-friendly app.

Also, we were mainly interested in the commands concerning equations and lines. For the future, it could be interesting to focus on the blocks and why not, to add new keyboard shortcuts to be able to navigate more easily in the equation. In addition, adding a remember function allowing the site to gather all special keywords linked to the app functionalities but without having to watch out into the documentation which is not very suited for visually impaired people.

Finally, it would be great to deploy the solution on an external server so that it can be tested easily by other people concerned by this project such as "INJA" and by anyone who wants to use it. It would also be great to test this solution directly with the people concerned and to make some tests with visually impaired people.

8 Project Completion Recommendations

Summarize the key points identified in the closure report to identify the key recommendations:
• best practices to be generalized,
• improvements: methodological aspects to be reviewed, for example,
• the peripheral actions to be taken: corrective actions resulting from this project.

The best practices that can be taken from this report are an open and frequent communication with the company partnering the project, as well as the constant focus on the user's needs (user stories in agile method).

Although the project went smoothly in the end, we could have had a better in-group communication with more face-to-face meetings and a better organization regarding the workload throughout the semester.

In addition, for a project which is hard to set up like this one, we have to produce some user-friendly documentation and tutorials so that the next team working on it as well as other team members would be able to transport the solution easily from one computer to another. If this is skipped, commitment around the project is harder to maintain when the application is not easily accessible for other developers.

9   Annexes to the closure report.

If necessary, please list the annexes to the report.

GitHub: https://github.com/kyllianasselindebeauville/dicmath