Research Proposal for New Visualization Tool: Infold

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Abstract:

In this data-soaked world, visual representation of the data plays a decisive role. Human brains are accreted by visuals, not raw data. They can process visuals 60,000 times faster than text. Data visualization has become a trending and valuable skill to improve or create businesses in almost every field. Knowing how to use the data to accelerate the work is the USP. There are several data visualization tools in the market. Each visualization tool and library has its claim of fame, but no one visualizer or library has the lion's share of features. The proposed product has a bulk of functionalities, with a new feature for color blind and blind users.

Project Proposal:

The proposal is to create an application called 'Infold' that makes highly flexible visualizations from almost any type of data with minimum to no code. And allow having multiple visualizations of the data concomitantly by different users. It is attained by using the same cells of the notebook. The system developed will be a cloud-based product and will be contemporized to be used via mobile. Since 56% of internet access came from mobile devices, according to Broadband Search in Feb 2021.

Infold system uses "FlowSense": a natural language interface for visual data presentation. The system allows machine learning inexpert to create a visualization using any data. Furthermore, the system will provide simple drag-and-drop actions to interact with the data. Additionally, the system will include a huge data visualization library that has all new and relevant visualization from Radial Bar Chart, Sankey Diagram to Mind Map, and Non-Ribbon Chord Diagram. These visuals can be searched by Name and Shape. Apart from this, Infold will be competent in converting the spoken or typed sentences to a dataflow diagram and graphical presentation. This functionality will make professionals other than Data Analysts and Data scientists comfortable with the data analysis process. However, it will offer data geeks with shortcuts for a few tasks. Besides that, the tool will let multiple graphical presentations of information by different users on the same data cell in the notebook. It will be helpful because the human frontal cortex has distinct pattern recognition capabilities. Like some, people have a natural gift for seeing signals where others only see noise.

The tool also takes account of color-blind and blind users and adds some features for them. The visual tool allows the customer to export graphs, infographics, maps, and dashboards in PNG, JPG, GIF, PDF, and HTML format. The tool permits the users to work on dynamic data, but a license is required. Under this paid version category, one can develop dynamic dashboards. The tool lets you import multiple data sources. A business account is formed on request for the team with more than 5-members.

Why do I want to develop this project?

I want to develop this data visualization tool because visualization is becoming an increasingly social and competitive differentiator in enterprise. There are already numerous visualization tools and templates for visual representation. But there is no one tool that provides maximum required features. And the visualization tool can cut down the meeting time by 24% as per the research. The aim is to not only illustrate graphs but also convey a strong, clear, and convincing insight or story that numbers and data want to tell. The primary goal of visualization is the affordance of "insights": complex, deep, qualitative, unexpected, and relevant revelations (North, 2006).

There is no visualization tool in the market that provides the feature for blind users. The desire for including a feature for such users in the tool is because there exists a blind Data Scientist in Deloitte. The screen reader is available to read the text but it is not an inbuilt feature in the visualization tool. And the screen reader can't read PDF scanned images. Even adding a single small feature for such customers can open doors to new opportunities.

Background Study and Literature review:

In recent times, many web designers are making efforts in designing the Interface, keeping color blindness in mind. But there are very few visualization tools that have tackled this problem. One of the visualization tools is 'Datawrapper', which has a

built-in color blindness checker. But the tool doesn't make any changes in the visual templates. In color blindness, the person has difficulty discerning red, green, or blue light. Different type of color blindness are Deuteranopia, Protanopia, and Protanopia. Deuteranopia and Protanopia are the most common color blindness where people have difficulty distinguishing between red-green, and red color, respectively. In Protanopia, all red colors look dull. Efforts are taken to improve the user experience of color-blind users because there are about 108 million color-blind users in the world.

The proposed tool preserves the analyzed data in private mode in the paid version. A similar service is offered in Tableau Software. Google charts grant the customer to work with dynamic data for free but an understanding of JavaScript is required. The visualization tool 'Infogram' lets finished visualizations be exported into all the formats the proposed system can export. 'Data Viz Project' and the suggested tool both have a data visualization library. (Ferdio, n.d.) The library of Data Viz Project can be searched using 4 ways whereas the 'Infold' can search using only Shape and Name.

Added/ Original value my idea introduces:

No tool translates spoken audio words to the graph. The available systems can only transform typed and audio sentences into dataflow diagrams. There are several visualization tools in the market but no one Tool includes most of the features required. My proposal makes an effort to include maximal services in the 'Infold' application. So that no user (customer) changes the Tool out of frustration because the analysis tool doesn't include the features they desire it had or the paid for it. The tool does not overkill simple visualization.

In this new tool, the color-blindness checker is built-in at the time of sign-up. If the test illustrates the user is experiencing some level of color blindness, it makes the adjustments in the UI at that particular instant. The User Interface for such users includes textures and patterns in graphs wherever possible. It also incorporates colors, symbols, and textures wherever possible. The tool makes sure that the primary buttons stand out and the operator has no trouble identifying them. The same color theme is cast-off for all types of users. The color theme used has high contrast colors. Despite using a high contrast theme, the customer can face a struggle when using poor color combinations (green-red, green-blue, green-brown, green-black, green-gray, light green-yellow, and blue-purple) in their graphs. Only for color-blind users, such color combinations are available with patterns and textures.

A built-in screen reader for the blind person is available under the public version of the tool. Non-speech sound and haptics are applied significantly to improve interaction with visualizations such as graphs. Non-speech sounds are sounds that are vocal but not speech indeed. A haptic interface lets humans interact with a computer through tactile feedback.

The two stakeholders whose feedback is used to evaluate the idea are:

- User
- Developer

Findings after Quantitative Research and evaluation of the idea:

The survey concluded that 19 out of 22 users were not interested in forking out visualization templates. Therefore, found the way out of invoicing only complex- attractive visuals. And when the individuals were asked to select from image or text. Around 82.82% of users opted for images. It helped summarize that there is a need for a visualization tool in the market. Even after it was discovered the people who took the survey don't have color blindness. Features for color-blind are included in 'Infold' since there are 108 million known color-blind users. Almost 69% of people had a problem integrating data sources to their current visualization tool.

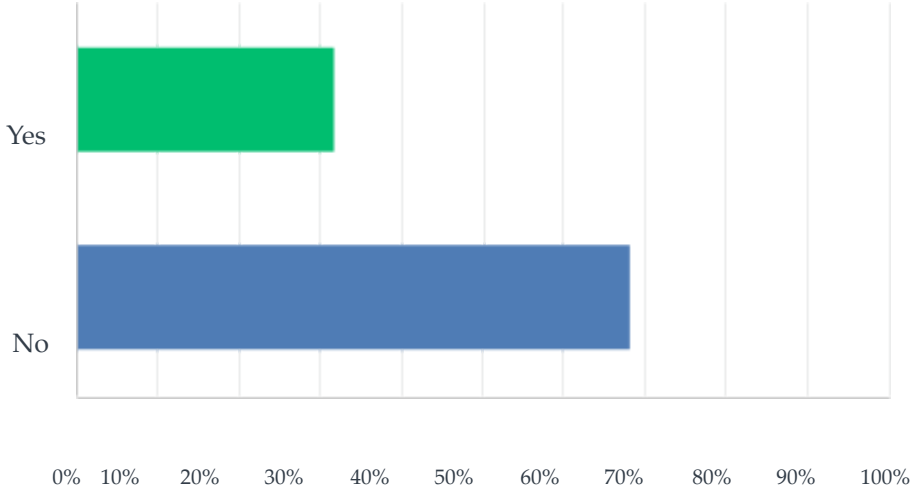
Themes that came out on analysis:

Searching the template by name and shape: Because few users find it easier to search the template by name, while others find it easy searching it by shape. Only a few users prefer searching using the family category.

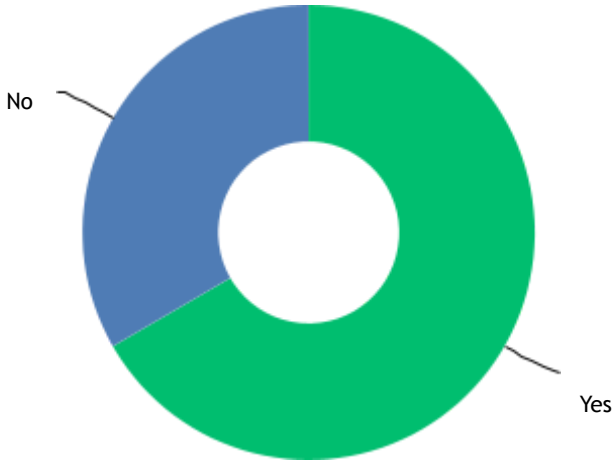
Use of Natural Language for describing the graph to the blind: Most developers suggested that using Haptic Interaction and

Sonification will not be cost-effective. Natural Language for reading the visualization is a more practical option to begin the development of features for the blind.

Business Account: A business account for big teams is a good facility as per developers, as a business account makes working on the same piece easy and manageable.



Even the developers reacted no when questioned whether all the visualization templates in the library should be charged or not? And they approved of having a built-in color blindness checker at the time of the sign-up. A range of answers was acquired when the developers were canvassed about the license fee to work on dynamic data. 25% of the 12 developers refused to answer. One developer replied that it should be an affordable periodical subscription. Most of the answers were between €80 and €120. So the final fee of €100 per month was decided. A mixed bag of answers was received when questioned on which method should be brought into practice for developing the features for the blind customer. One developer advised all three approaches should be used for development. The final decision as to which method should be castoff was done after Qualitative Research. About 33.33% of developers recommended that the users must be invoiced if they want to keep their work private.



Description of the process of information gathering for Qualitative Research:

Total 8 users and developers participated in the session. One participant in both the User and Developer category gave opinions in a survey format. While the remaining partaker passed their feedback through an interview.

Issues raised in focus/interview session:

How will features for color-blind be adjusted in business and premium accounts? Should there be a color blindness checker every time a user log-in? How will a shareable notebook work when one user is color blind whereas other users are not? How will the screen reader work for blind users? How will visualization templates be searched? Should the templates be charged or kept free? Which technique will get implemented to develop features for the blind?

Ethical Issues:

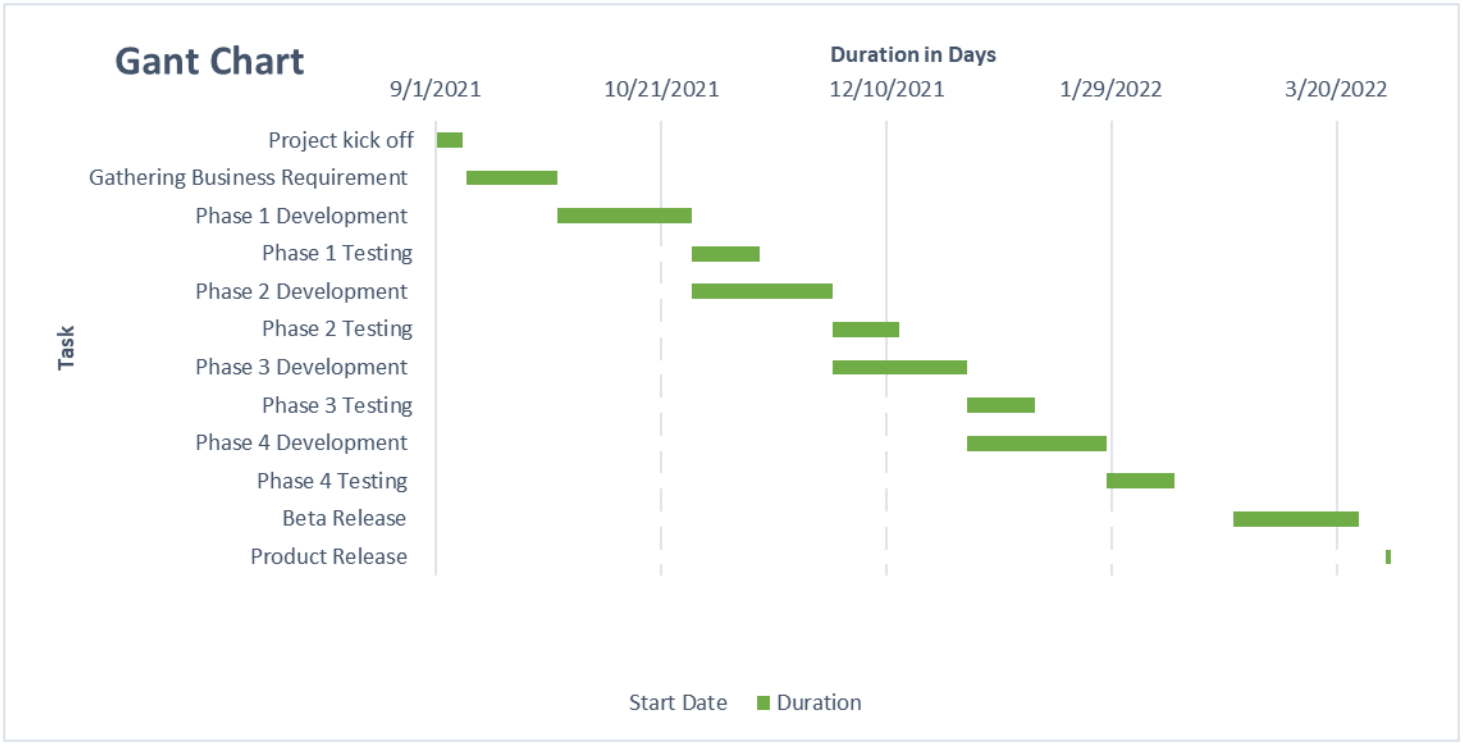
Some ethical implications do come into picture when doing data visualization. Ethical conduct is very important in this field as there are many occasions to manipulate users with mendacious data representation. Sometimes misinformation can be valuable too but mostly it is dangerous. There are many color related issues that need to be taken into consideration while designing visualization tools. In the UX (User Experience Design), the theme should be selected in such a way that there is no hidden cultural meaning, which leads to isoluminance. Isoluminance is a process in which uniform light intensity, pertaining to visual stimuli in which shapes or forms are defined by variation in color without any contrast in lightness, is used. Isoluminant color captures attention. A Hippocratic oath for visualization was suggested by Jason Moore at VisWeek2011. While visualizing the data using the tool, analysis is automated. However, using this analysis system, the consumer lacks the statistical tools to validate the insights. Therefore, analysts can frequently come away with conclusions from visualizations that are empirically false or statistically unsupported(Zgraggen et al.). Automatic methods can exacerbate this problem (Binnig et al.), and create what Pu and Kay call “p-hacking machines” (Pu & Kay)].

Techniques for Fact Finding and Information Gathering:
Techniques used for fact finding and information gathering are:

- Research and Site visits.
- Observation of the environment of the tools.
- Sampling existing Documentation.

Observation aided in discovering issues of color-blindness, integration of data sources. With the help of research and site visits could gather information about blind users and existing visualization tools with their benefits. Possible ethical issues that can arise on product development were disclosed on sampling existing documentation.

Gantt Chart Displaying Breakdown and Scheduling of Activities:



How will the project be developed?

For the color-blindness checker, third-party integration is done because there are already many free color blindness checkers with better accuracy. The agile methodology will be used to develop and manage the project. The project will be implemented in different phases. Acceptance testing is done at the end of every stage. Before acceptance testing, system testing is done. The core features are progressed in the initial stage. The first phase works on the Natural Language Interface, visualization library, and visual exporting facility. The second phase works on UI adjustments for color-blind, data privacy, and screen reader for the blind. In the penultimate stage, there is the creation of infrastructure for dynamic data, shareable workbook, and business accounts. In the last phase, the team works on developing features for the blind using haptic interaction and sonification. As the market of blind users is small as compared to other users. A beta release is done for features developed for the blind. It will help uncover the bugs or usability issues.

Business Plan:

My key customers are color-blind, blind and normal users.

Initial Investment:

An initial investment of €50000 has to made to develop the tool excluding the future maintenance cost. Cost of maintenance, initial investment, technical support and template designer can be recovered from Premium and Business account users.

Cost and Resource Estimation:

For Resource Estimation, multiple project scenarios are built to find the difference in timeline and profit when calculating the resources. Because a lot of variability in time can be experienced while completing some tasks. The chief resources for the tool development are a team of developers, project managers, and designers. The business model makes sure that there is full availability of the development team. And they do not fall short of project needs. The invested money will use €5000 for a facility like working space, material, and equipment. From €50000, €20000 indirect cost (the developers, designers, product managers, and all the tools & Technologies required to develop the product). Other €20000 are spent on utilities and quality control. The remaining €5000 are utilized when the Estimate to Complete (ETC) cost is not sufficient to complete the task. A bottom-up approach for estimation is used to estimate the cost of each part of the project.

Return On Investment:

There will be returns by making some features available only in the paid version. On quantitative analysis, it was discovered that users are not willing to pay for using visualization templates available in the library. So only the complex visualization shapes will come under paid version. Premium account on the tool offers data privacy, access to all templates from the library and allows up to 5 users to work in the notebook simultaneously. The cost for each Premium account is €99 per month. The business account permits more than five users to use the account, with a fee of €199 euros each month. All the features for color-blind customers will be available for free. The customer has to pay to work on dynamic data and create a dynamic dashboard. The monthly charge for that should be €100. If the users have already paid for the premium or business account, they don't have to pay to work on dynamic data. Other than the screen-reader, all other features for blind users cost €100 per month.

Conclusion:

In a few years, nearly all businesses will compete at the razor's edge of data visualization by pitting their advanced data analysis and algorithms for achieving maximum efficiency. At this point the need for visualization tools like 'Infold' will elevate the pictorial and clip representation of the information. Without making the user switch to a competitor due to the nonexistence of a feature that is a prerequisite to complete the task.

Future directions:

Other prospective services that can be incorporated in the immediate future into the tool are Augmented Reality (AR) and Virtual Reality (VR). To make data visualization more interesting, lively, and interactive. The features for the blind can be provided for free and improved in the future.

References:

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Check List:

Element & Activity	Check
Clearly articulated project idea Project idea aims & objectives. What it is; who is this for (users); what additional benefits & functionality it will provide.	✔
Literature Review Must include citations and bibliography.	✔
Review of the idea in the light of literature review.	✔
Quantitative Research Identify all stakeholders Description of the information you intend to capture. Undertaking quantitative research by developing, conducting surveys and then reviewing the findings.	✔ ✔ ✔
Review of the idea in the light of quantitative research.	✔
Qualitative Research Plan, develop and conduct brainstorming / focus group sessions with stakeholders Perform theme analysis and present findings; discuss these findings.	✔
Review of the idea in the light of qualitative research.	✔
Final Version of the Proposed Project Idea	✔
Are there any ethical considerations?	✔
How will you do this project? How will you Develop it? Work breakdown structure, timeline, GANTT Chart	✔ ✔ ✔
Business Plan Costing and Resource Estimation Initial Investment Return of Investment	 ✔ ✔ ✔

Appendix A. Feedback Survey for New Product to Users

All the information collected is used only for research

1. Select Your Profession.

ANSWER CHOICES	RESPONSES	
Sales	0.00%	0
Marketing	0.00%	0
Finance	0.00%	0
Product Development	0.00%	0
Engineering	45.45%	10
Human Resources	4.55%	1
Supply Chain and Logistics	0.00%	0
Genomic Science	4.55%	1
Pharmaceutical	31.82%	7
Astronomy	0.00%	0
Others	13.64%	3

2. Have you ever used a visualization tool?

ANSWER CHOICES	RESPONSES	
Yes	68.18%	15
No	31.82%	7
TOTAL		22

3. Do you have any experience of programming?

ANSWER CHOICES	RESPONSES	
Yes	50.00%	11
No	50.00%	11
TOTAL		22

4. Do you prefer captivating visuals for office presentation/memos?

ANSWER CHOICES	RESPONSES	
Yes	72.73%	16
No	27.27%	6
TOTAL		22

5. Do you have difficulty identifying colors?

ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	100.00%	22
TOTAL		22

6. Do you face issues integrating data sources with the data visualization tool you are currently using?

ANSWER CHOICES	RESPONSES	
Yes	31.82%	7
No	68.18%	15
TOTAL		22

7. Does the visualization tool you are currently using provides data security?

ANSWER CHOICES	RESPONSES	
Yes	45.45%	10
No	54.55%	12
TOTAL		22

8. Will you prefer paying for some visualization templates?

ANSWER CHOICES	RESPONSES	
Yes	13.64%	3
No	86.36%	19
TOTAL		22

9. Please indicate the size of your team.

ANSWER CHOICES	RESPONSES	
1	27.27%	6
Less than 5	40.91%	9
Less than 10	18.18%	4
Less than 20	13.64%	3
TOTAL		22

10. Select 1 option from the options given below:

ANSWER CHOICES	RESPONSES	
Stan Lee initially broke into comics at just 17 years of age during a time before Marvel was even its own company. Hired by Captain America co-creator Joe Simon, Lee started off as an assistant at Timely Comics, the pulp magazine division of a much larger publishing house owned by mogul Martin Goodman. Before long — after two years, in fact — Goodman tapped Lee to take over as interim editor and the rest is history. From 1941 on, Lee served in several editorial roles before rising to Editor-in-Chief and eventually succeeding Goodman as publisher of Marvel in 1972.Along with comic icons like Jack Kirby and Steve Ditka, Lee helped build and shape the superhero as we know it today	22.73%	5
	81.82%	18
TOTAL		22

Appendix B. Survey to the developers to finalize the features of new visualization tool

All the information collected is used only for developing the product.

1) Should all the visualizations in our visualization libraries be paid?

ANSWER CHOICES	RESPONSES	
Yes	0.00%	0
No	100.00%	12
TOTAL		12

2) Can we make adjustments to the user interface considering the users experiencing color-blindness?

ANSWER CHOICES	RESPONSES	
Yes	91.67%	11
No	8.33%	1
TOTAL		12

3) Should we charge for keeping the analyzed data private?

ANSWER CHOICES	RESPONSES	
Yes	66.67%	8
No	33.33%	4
TOTAL		12

4) Should we include a built-in color blindness checker once a user sign-in?

ANSWER CHOICES	RESPONSES	
Yes	100.00%	12
No	0%	0
TOTAL		12

5) Should the service be charged when the user exports the analysis as .GIF and .HTML?

ANSWER CHOICES	RESPONSES	
Yes	25.00%	3
No	75.00%	9
TOTAL		12

6) Should we bill the user for some selective visualization templates?

ANSWER CHOICES	RESPONSES	
Yes	91.67%	11
No	8.33%	1
TOTAL		12

7) Which method, developer must apply for describing visualization to blind users?

ANSWER CHOICES	RESPONSES	
Haptic Interaction	33.33%	4
Sonification	33.33%	4
Description of the graph in Natural Language	75.00%	9
Total Respondents: 12		

8) Should we employ Natural Language Processing and a Voice-based command to create visualizations in the tools?

ANSWER CHOICES	RESPONSES	
Yes	100.00%	12
No	0.00%	0
TOTAL		12

9) Should we provide a business account facility for the visualization tool?

ANSWER CHOICES	RESPONSES	
Yes	83.33%	10
No	16.67%	2
TOTAL		12

10) What should be the charges to get the developer license for working on the dynamic data?

Answered: 8 Skipped: 4

Appendix C. Focus Group/Interview Session to evaluate idea with Users

User 1:

Speaker 0:03: So as a user, for instance, the visualization tool allows you to give commands to the user interface and allow you to draw the Creator graphs, rather than using programming language. Would you like to use such a feature?
Speaker T 0:23: Yes, definitely, it would be good to have features, because not every user is a developer who has experience in the programming language. So having something like in a voice command would be unquote, a feature to have.
Speaker 0:39: And would you like to suggest multiple visualizations for a particular data, like for a data set or a particular graph you're creating?
Speaker T 0:55: Because not every representation that we think of could be the good one, there could be something a better representation of your data that we might not be aware of, or that doesn't come to my mind would be definitely a good feature to have.
Speaker 1:19: Okay, so the visualization, we also provide with a library they can search for your visualization. So how would you like to search those entries by just the name or by the family or its shape?
Speaker T 1:44: By just the name.
Speaker 1:48: And do you have ever experienced or you know, the security by understanding the graph, or particular color combination, like the ones that have created issues while analyzing this? No analyzing your major and chart?
Speaker T 2:14: No.
Speaker 2:15: Okay. And do you know, colorblind people or No? If not? Would you think adding patterns and textures inside the graph would help the colorblind piece understand visuals better?
Speaker T 2:35: Yeah, I think like someone who is colorblind for them to differentiate among the different visuals, or the pattern, having different patterns in the visual would be a good thing to differentiate those textures.
Speaker 2:52: And do you think text labels for different features should be provided to colorblind users
Speaker 3:05: different types of feature in
Speaker 3:09: as in the description of the feature should be given in text format for the colorblind user so that they can better understand the feature
Speaker T 3:20: should be Yeah, it can be helpful for them here. Okay.
Speaker 3:24: And do you think a voice base feature command is, you know, add on to the add on to the visualization tool? Or is it like just having a drop down or drag down is enough.
Speaker T 3:43: Command for creating the visual, right?
Speaker 3:47: Yes.
Speaker T 3:51: So forth to avoid Space Command, like I already mentioned, should be a good feature to have like that would be easier to represent those visuals even by giving the command rather than doing something programmatic or selecting some options will be a pro added benefit for the blind people. Okay, thank you.
Transcribed by https://otter.ai

User 2:

Speaker 0:03: Okay, as a user, for instance, the visualization tool allows you to use natural language and give commands to the system to create graphs rather than using programming language. Would you like to use such facilities?
Speaker S 0:24: Yes. Okay. Because, you know?
Speaker 0:29: And can you explain why, like, why would you like to use rather than just using the drop down feature?
Speaker S 0:39: Because it will ease my work and it will reduce my tasks.
Speaker 0:49: Do you want the tool to suggest your visualizations for the data set you are using? On the graph you have already made? Do you want the system to give you more suggestions? If, Yes and why so?
Speaker S 1:12: Because at that time, I would not see the patterns which I could see in the recommendations. And would be helpful for analysis.

Speaker 1:23: okay. And our system also allows you to select the templates from the library for your visualization. So how would you like to search those templates, like just by the name, or by the shape or the family? So for example, by name, I mean, just the name, line graph, all the line graph templates will be available. And we go by shape. So you know, go ask for the shapes and such. So how would you like to search? Shape? Family? Name?
Speaker S 2:01: It's a combination of both, it would be really helpful, because sometimes we know the data, how our data is, and we search the graph accordingly. And sometimes what we do is we search by the shape.
Speaker 2:16: Okay, and do you know any colorblind users? If yes. Let us know. And if not, there is a feature for colorblind users. So like, we are trying to develop features for colorblind users? And would you think adding patterns and textures in the graph will be a good option for them?
Speaker S 2:45: Yes, because some time it's, like, we get a lot of color because we have a lot of data. Okay, it is scattered. Sometimes. It is. So sometimes it's not possible to read by naked eyes directly. Clean coder, so texture would be really helpful.
Speaker 3:06: And do you think we should provide text labels for some features for colorblind users for better understanding? So by text label, I mean, you know, the drop down feature is named. And description is also given
Speaker S 3:31: Yes, yeah, it could be helpful. Okay.
Speaker 3:36: And for blind users, do you think a voice based feature to screen readers would be a good option?
Speaker S 3:49: Not currently. But we can think about it more or less in the future. Okay. Thank you.
Transcribed by https://otter.ai

User 3:
Speaker 0:02: Okay, so as a user, for instance, the visualization tool allows you to use natural language to create graphs rather than programming language. Would you like such a feature?
Speaker P 0:19: Yeah, so it depends on what kind of feature it is. So if it is like converting my text to converting my voice to text, then yes. If it is able to understand from that, from that text that it has just converted, then I would actually be willing to do that, if it's just a transcription service, probably, like that feature already exists. So, yeah, it should be able to do something with that data.
Speaker 0:52: Do you want the tool to suggest your visualization for your data or suggest templates to use?
Speaker P 1:03: Yeah, of course, as I said, it's using my data, like my voice data. To do something it should be able to, like enhance my experience, and provide me with easy templates, which I can directly plug and play and use to create visualizations.
Speaker 1:25: And for instance, let's say if you are searching for a template which is available in the library of visualization tools, how would you like to search for the particular template? just by name, or the shape or the family? With the shapes it comes under?
Speaker P 1:44: Like? I would probably just have a general idea of what I want, I wouldn't know the name of the template itself, because that's very specific to what kind of visualization tool I'm using. So I'll be using something like this. I want to make a table, then I'll just go and search for a table.

Speaker 2:11: Our visualization tool also has features for the colorblind users. So do you think the Pattern and textures on the graphs for the colorblind people will help them better understand it? Like, would that be a helpful thing for them?
Speaker P 2:36: Can you repeat the question?
Speaker 2:39: Like our visualization tool also, keep the colorblind users in mind? And for the colorblind users adding certain textures to the graph will improve the visuals? Is it a good option?
Speaker P 3:00: I'm not sure of colorblind people. So when you say pattern and texture, you mean the kind of experience that people of color, people of color are actually blind people have when they touch the screen or touch some interface?
Speaker 3:18: No, no. I mean, the colorblind people like the colorblind, people have issues identifying the difference between the color when they are in shades of blue-green, or gray-green, or you can say blue-gray. So those shades are quite similar. And then they can't differentiate the end point and the next point where the next part begins. So if we add texture to the graphs, like if it's a bar graph, but it is using a color theme, which is like cool colors are diffusing. So if we add patterns and texture there, they can understand it better. So do you think it is a good option for them?
Speaker P: Yes.

Speaker: And do you see the voice based feature like the screen reader is enough for the blind users to understand or should we use something more than that for the blind users to understand the visualization and the complete tool?
Speaker P 4:25: So screen reader will just read out the text that is on the screen right
Speaker 4:30: yeah, it will really guide you where to go like what thing is in what part of the interface.
Speaker P 4:36: right you cannot really explain color to a blind person in that way right. So you need to is a person who has not seen the color black at all in his life. How are you going to explain that okay, this is black in color? So, there should be some AI logic which converts the images, for example, if there's a bar graph, okay, now a blind person doesn't know what a bar graph is, it's like useless for you to tell him that, okay, this is a bar graph.
Speaker 5:15: So for the blind people, the thing they do know lots of stuff, they are expert in most of the concepts and all the mathematical stuff and they learn everything using certain techniques in the school with the help of the touch and sounds, like tactical feedback is used for them. So, I think that they do learn. So, do you think we should like the voice based feature leader more than enough for them?
Speaker P 5:45: For this feature will be how it will read out the graphs and just curious about that, because every graph will be different right. So, it will have to understand the graph first, for example, if there is a, let's say, a simple pie chart, which has said that Earth comprises some 71% of water and like the rest is land or country. So do you want the what is it the AI or like the screen reader to tell the user that Okay, so from the data that you have submitted, Earth has what I said basically like just reading out the information from the graph, or telling them exactly that this is a pie chart with three fourths or whatever three eighths of the quarter has been in
Speaker 6:43: reading out for table analysts as well that just reads nothing more than that. Okay,
Unknown Speaker 6:51: and this is not a screen reader then right, it has to decipher the graph first and then tell them yes. So, that is a good feature for sure. It will definitely take up development time because that's not readily available easily. You have to add some machine learning logic so that given any pie chart or even any table content machine can convert that into text. Thank you
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User 4:
Speaker 0:03: So as a user, for instance, the visualization tool allows you to use natural language to create a graph other than programming language. Would you like to use that facility? Like it, this would be an add on feature, including with the drop down.
Speaker G 0:25: Yes, I will, as a user, it will be very beneficial to have a natural language, where learning actual language helps us to understand what the graph will actually demonstrate using the data. So like, if the tool uses natural language for our data, for example, if it's a time like if it's a time series data, okay. So, if like if there's a data which is across a period then if the match using natural language the tool can actually demonstrate like how which graph to be used and which is more applicable and which will have a better representation for a data it will be quite useful like for you especially for someone who has less or like who's a non-programmer and has less knowledge of programming. So, at least for me, you, I have some background of programming knowledge, but there are certain visualization tools which are advanced which have advanced charts, which may not, which I may not have knowledge of. So, in that case, natural language can help a lot.
Speaker 1:27: Okay. And do you want the tool to suggest multiple visualizations to represent data such as, suggest you the type of graphs you can use? Would that be a good option?
Speaker G 1:50: Yes, like, as in for, for example, for a particular type of data, I want to analyze like, if because we have a very limited, like, you know, a very few options and charts or graphs, which we can use, but if the tool has already inbuilt measures, visualizations that already present, and as per data and maybe if the tool can, seeing the data like and actually maybe if it's a categorical data or if it is a time bound data, or something along those lines, then the tool can such as then it will be easier to like, use more detailed visualizations rather than using the simple ones.
Speaker 2:28: Yeah. Okay. So, the tool also has, you know, a library, which has a list of templates for the graphs. So, how would you like to search for those visuals or templates? Like, would you like to search it by just the name, shape or the family, like the category they come under in?

Speaker G 2:53: Okay, maybe it can be a combination of both but more so on the family, maybe like all bar charts together, that would be more helpful and easier to understand, rather than the just the name maybe a combination of family shapes, and name like, okay, in that sense, where most of the family and the shape because it will give us a better understanding of how the visual look will look to us, okay.
Speaker 3:20: And if the tool also allows you to have multiple visualizations of the same data set inside in your workbook or the notebook so what do you feel would be a good option for you as a user?
Speaker G 3:38: Yes, it will be always useful because it will help us look at it from a different angle, every using multiple visualizations, maybe through a visualization not all parameters can be analyzed or demonstrated. So like using multiple visualizations, more variables can be added to the like analysis and especially if the visualization can have multiple various variables impacted, like see can give us a more comprehensive view
Speaker 4:13: Okay, and okay, and our tool, also keep the colorblind users in mind. So do you think using pattern or textures or when there are combinations of blue, you know, like light contrast color using the graph or at that point, if we use pattern in textures, you know, suggest that to the colorblind user, would that be a good option?
Speaker G 4:48: To be honest, as a user, like for me, I'm not sure when I'll face a problem. So maybe, maybe like, because from my end, like if I'm facing a problem eliminate certain color combinations. It's better if there are more options available to us. Like, for me, I'm not sure what colors will have a problem. But if there are other options, in case I'm facing during the year, at the time of using the tool, and maybe at the time of seeing the different color combinations there, it's always good to have options available.
Speaker 5:19: So I do okay. So there is a range of color, you know, combinations, which are not suggested for colorblind users. And if we remove those, you know, those from the, from the UI, those color combinations, you know, a lot of options will go away, and it will be a clear indication to them that you know, that there's something different there's a difference in the facility. So do you feel some texts, labels and symbols throughout our UX, when there's this such color combination? Would that be a good option for users?
Speaker G 6:03: Yes, that would be a good option, because it will, like, represent the visual accurately and appropriately for users as in for the colorblind users. Okay, using those patterns, maybe using more shapes in a different way, can be also done.
Speaker 6:21: okay, and our future plan is to also include features for the blind users. So currently, we just have a screen reader facility, throughout our user interface for blind users, do you think we should, you know, charge the blind users for that?
Speaker G 6:46: I think currently, like, if, as in for instance, this firstly, it should be dependent on number of users that are going to use it, but like if there is a simple reader option for the blind users for the understanding and interpreting data, so I don't think it should be chargeable for them. We can add some features, but if there are particular things that the tool is doing to enhance their experience, like maybe giving them summarized versions of the graph, like what does the graph say? It's like in more detail where the tool has to compute something before actually communicating as in communicating the details for the blind user, then it can be chargeable, but a simple voice reader, like it can be kept free for blind users. Okay, thank you. Okay, thank you.
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User 5:
Speaker 0:03: Okay, so as a user, for instance, a visualization tool allows you to use natural language rather than programming language to create graphs? Would you like to use such a feature?
Speaker A 0:19: You Yes, I think just having a natural language interaction mode will make life easy for me to like work on the tool. I don't have to think a lot about coding anything and don't have to, like, learn anything new, rather I can simply write anything in natural language and unlike before, perform my tasks. Yep.
Speaker 0:41: And do you want the visualization tool to suggest a graph for your data, the graph you have created? By that, I mean, if you have created a particular graph, the system will also suggest templates you can use.
Speaker A 1:02: Yes, I think that would be a great add on to the application. Because a lot of times we are in a hurry to generate graphs and come back, we are not able to think how to generate it. And having our automated system that suggests graphs would be a better way like it could possibly help us improve our graph and make sure that we represent our data using the best possible graph.

Speaker 1:28: yeah. And so first, like, when you're searching for this template, how do you like to search those templates, because the library can be big. So you want to search by the name, or by the shape, or the family, they come? By family, I know certain graphs come under bar graphs and some pie charts, you know, some categories. So how do you want to search for those?
Speaker A 2:02: I think I would use the like groups based on the group I would search because a lot of times we don't know the word like boxplot, or the exact name of the graph. So searching based on the group would be easier and faster.
Speaker 2:19: And the system we are trying to develop is also keeping the colorblind users in mind. So you know, for the colorblind users, they have difficulty when viewing certain color combinations for example, green-blue, gray, or you know blue. So for that in the graph, so that you present the visualization they are doing , if you know if we give them an option of pattern and texture, default pattern and texture, they select the color combination which creates confusion. So do you think those color combinations are a really good option for them?
Speaker A 3:03: Okay, definitely, I think, since colorblind people have difficulty in like, repeatedly understanding colors, and if we give them the add -on option to like, it has their experience of generating graphs, that would obviously be a good feature. And that would help them make better graphs as well and to present their better color, like represent the graph in a better way, because every color has an emotion.
Speaker 3:31: And do you think this voice feature is a good option or it's just to add on the drop down option of leaving graph is
Speaker A 3:45: sorry, I didn't get you about
Speaker 3:48: The voice base feature which allows you to use different features by giving a command that way you can use various drop down features and make the graph. So is that a good option or just you know, a drop down feature is enough for you as a user?
Speaker A 4:12: For me, I think I would be happy with like, drop down features or like NLP. I'm fine. I'm fine. It's not a priority for me to have audio based interaction. Okay. Thank you
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User 6:
Speaker 0:04: As a user, for instance, the visualization tool allows you to use natural language to create graphs other than programming language. Do you think such a feature is a good option?
Speaker B 0:37: It's a good option. It would be quite useful.
Speaker 0:40: Okay. And do you want the system to suggest visualization to represent your data? So by that, I mean, when you make a particular graph, using a dataset, the system would suggest a better option?
Speaker B 1:04: Yeah, that kind of suggestion. The feature would be a good idea. And from a user perspective, I would definitely like to just have those kinds of features.
Speaker 1:21: And our visualization to also have a library, which has lots of templates for visualization. So how would you like to search those by their name, or their shape? Or the family they come from?
Speaker B 1:40: And basically, if it is via the shape, then I think it would be better? Because sometimes the Yeah, I mean, name and shape, I should say here.
Speaker 2:09: well. you know, there are colorblind people that have misjudged, like this developing features keeping the colorblind users in mind. So, for colorblind users, they have difficulty understanding color combinations, like green, gray, or blue and can or you know, blue and purple. So if such a color combination is there in the graphs, and if we use patterns or texture on top of that for them, would that be a good option?
Speaker B 2:52: Can you just repeat it again? I mean, I couldn't hear the last part with you again.
Speaker 2:58: Since color blind people have issues understanding certain color combinations on the screen? If we now give them an option to use patterns and textures on graphs, which are having such color combinations? Would that be a good option?
Speaker B 3:16: Yes. You mean in terms of the short text? I mean, small text kind of thing? Right? Like on the graph? Yeah. Wherein in identifying the color? That would be a good idea, it would be a clear guide for the people, colorblind people.

Speaker: 3:35: Okay. And what do you think about voice based features to give in command to the visual, like, for creating division is a valuable feature?
Speaker B 3:48: Voice based feature as in how it would be?
Speaker 3:51: So. Yeah, so the feet, what the feature does is instead of, you know, selecting the drop down feature, and creating the graph, if you give this command, you know, to give command to this thing is to remove carry on the task and recreate the graph.
Speaker B 4:16: Yeah, yeah. So you mean, the users would already be first I mean, guided based on this feature, that based on the feature, basically, how this was based. The feature works, right. So if it's the case, then yeah, I would say it's a good idea. I mean, just giving voice as an input and generating the graph as per the input. Yeah, that would be a good idea.
Speaker: Okay, thank you. Transcribed by https://otter.ai

A survey was conducted instead of interview for developer 7
User 7:
For instance, the visualization tool allows you to use natural language to create graphs other than a programming language. Would you like to use that facility & Why?
Yes, I would like to use such a feature. Because, like me, there are many other people who are non- programmers but still process the data to fulfill a given task and probably want to visualize the data in graphical format to understand various patterns. However, we are unable to do so as visualization tools available in the market require users to have basic programming knowledge. Hence, this feature would be very useful for non-programmers.
Do you want the tool to suggest multiple visualizations to represent your data?
Yes, definitely,
This is because some sort of data visualization template might facilitate understanding a certain type of data (let's say data 'a') but might not help to envision some other type of data (let's say data 'b'). Thus, it would be highly helpful if a toll can have multiple data visualization templates.
For example, you want to search for a visualization template for your data. How would you like to look for the visuals, by family, shape, or just name?
I would prefer to search for the template's name. I guess that would be very convenient for me.
Did you ever experience difficulty viewing visuals comprising color combinations like blue-purple, green-red, blue-green, green-brown, green-black, green-gray, blue-gray, light green-yellow, blue- purple? If yes, would you like the visuals to be presented using patterns or textures?
No, I have never faced difficulty while viewing visuals consisting of different color combinations. However, this feature might actually help people with color blindness and would ensure fairness in service for all its users.
Do you think a voice-based feature to give commands to present your visual is a valuable feature?
Yes, definitely, this will be a good additional feature that will help to serve users who are not well versed with the technology.

User 8:
Speaker 0:03: So as a user, for instance, though, a visualization tool allows you to use natural language and speak out and create graphs other than the programming language. Would you like to use such a feature and line?
Speaker ST: Yes, I would like to use this facility as it will make work easier. And even non coders, and people who are not technically sound will be able to use it.
Speaker: Okay. And do you want the tool to suggest multiple visualizations to represent your data? So, like for example, if you have drawn a particular graph, the system will suggest you in a better way, or a better template that you can use**.**
Speaker ST: If you like that, I would love to have this feature. Okay, that would allow me to choose the best way by which my data is representable, understandable and visually appealing.
Speaker: And visualization tools also have a library which provides templates and to search, you have to search for the standard. So while searching which method by which we would like to search the templates, just by their shape, or their name, or the family, or they come by family, and in the category they come and live by grouse family or no pie chart family.
Speaker ST: Okay, I think family or shape would be better as I will, like, get to choose whatever I want to work, whatever I want to use.

Speaker: And are you aware of color blindness? And since our system is also developing features for colorblind people, do you think it is added like on the graphs, if we use patterns and textures, when the color combination, or the contrast of the colors using the graph is light? Would that be a good option?

Speaker ST: Yes, I think that would be great for the colorblind people, and I don't think there is a tool currently in the market, which has this feature for color blind people.

Speaker: And do you think, oh, voice based feature, which is like a screen reader that reads out the results, all the graphs and the complete interface features to this library? So do you think it's a good feature?

Speaker ST: I think there might be many blind developers who want to use who want to visualize the data and this will be very effective for them.

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Appendix D. Focus Group/Interview Session to evaluate idea with Developers

Developer 1:

Speaker 0:03: So do you think the user interface for data visualization should be designed keeping the blind and the colorblind users in mind?
Speaker TA 0:16: Most are actually the user and both kinds of users who use these kinds of tools for design keeping both the user's perspective as well is a good option
Speaker 0:27: which method would you use for developing the features for blind people, the haptic interaction sonification or a just a description of the graph, which can be done using natural language.
Speaker TA 0:46: I think the best option and because that can be used, even for the current blind people are not non blind people as well, because that is basically the description of the graph which can be used for other purposes, as well
Speaker 1:10: do you feel the voice command feature to create the graph will be a good option, and it will allow us to analyze more, and analyze more domains or more areas, which we are not able to analyze still using data visualization tools?
Speaker TA 1:34: your voice, this command will definitely be a good option, I believe, because that can enable like, you don't need to actually use all those functionalities and provide all the functions that are provided on all the instructions overboard. So that wouldn't be a convenient feature to have.
Speaker 1:54: Okay, and do you have any suggestions for a Business account for large teams? All in all, there should be just individual accounts like for carrying on the visualization?
Speaker TA 2:08: No, definitely having a business account is a good option over here. Because when people when it's a large team and all of them having a need to want upgraded feature on to some functionality, then first scenario, the user should be user should have a business account, and the individual account can have some restricted feature which are not available on the business account.
Speaker 2:37: And for colorblind people, do you think the color blindness checker at the time of logging in or signing in is a good option?
Speaker TA 2:53: Oh, one-time test. One-time test is a good option to have but during the signing every time it asked for if they are colorblind or not, that would be bad experience for the user. It is a one time check. And if we can store that details in the DB and use that as the format for every time the user logs and it's a good feature to have.
Speaker 3:17: And what do you have to say for the features we develop for blind users should we charge for every feature? We should give a few features free.
Speaker TA 3:34: We should have few features. Like even for the normal product as the like we have few features as free and few as the paid ones. Even that should work in the blind people as well.
Speaker 3:47: Okay. Thank you
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Developer 2:
Speaker 0:04: So as a developer, do you think the user interface for the data visualization tool, the design keeping the color blind and blind means yes and?
Speaker S 0:16: Yes.
Speaker 0:17: Okay. And do you think so?
Speaker S 0:22: Because there are many people who have color blindness, but they don't realize it. Okay, so it would be a better option.
Speaker 0:32: Okay. So, as a developer, which method would you prefer for describing, you know, the visualization to the blinds of haptics in reaction sonification, or you just feel the description of the graph, using natural language with the fangs?
Speaker S 0:57: So, I will go with description of graph in natural language,
Speaker 1:02: okay. And can you give a reason for this?
Speaker S 1:09: Because it would help more, because people are more people are more focused while they're talking. And it would help more because they can explain it properly.

Speaker 1:22: Okay. And, you know, do you think the, you know, using natural language and voice commands feature the, using that feature to give the command to shul and you allow that to be a good option or the drop down features which are already available are hard enough?
Speaker S 1:52: So we can use a combination of both, okay. And sometimes we are comfortable using natural language, okay, sometimes we just observe data and drag and drop.
Speaker 2:06: Okay. Okay, so no, okay. And what do you have to say, for business accounting for big teams? Do the tools should, you know, give business accounts for the things or, do you think, individual accounts and Premium accounts are enough?
Speaker S 2:28: We can use business accounts to be shared. Okay.
Speaker 2:36: And do you think adding or, you know, updating color blindness checker at the time of signing is a good option. And by saying that, I mean, just one time, you know, one-time checker which checks whether the person is colorblind or not, you
Speaker S 2:55: know, it could hurt someone sometimes. So, it can be an option, and it cannot be like, if the person is comfortable, it will be okay. But sometimes, it might hurt. So,
Speaker 3:08: Okay, so the thing is that the checker doesn't ask you the questions, it just let you know, select, given the option to select images from the set of images, and then it makes the decision. So the first not even aware of such a feature would be fine, or do you think we should ask the question directly?
Speaker S 3:34: No, this will be fine. Okay, we cannot ask them directly, because sometimes they won't answer correctly. Yes.
Speaker 3:41: Okay. And are there features available for blind? So do we think we should charge for all the features which are available for blind users or not? Or do we keep a few of them?
Speaker S 4:00: We should keep it free, because not everyone would pay for it.
Speaker 4:06: But as a developer, do you think we are in a position to provide all the features for free because, you know, for blind users, the adjustments made to the features are much more than normal common users.
Speaker S 4:24: I think now if it's open source, then we can go for free but if we are also getting charged, we have to get it from them. Okay. Thank you.
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Developer 3:
Speaker 0:05: So as a developer, do you think the user interface for data visualization tools should be designed keeping the colorblind? And the blind users?
Speaker P 0:17: Um, yes. But then the features for both of them are completely different. Yeah. So but yeah, they should be designed in a way that it's inclusive of all people.
Speaker 0:35: Which method as a developer would apply for describing visualization, for blind people? So you know, there are many different methods to do so, one is haptic interaction, second is sonification, or just descriptive? Like there's a description of the graph, or the complete interface using natural language? And because cost is involved in developing what, as a developer, which one do you think would be the best option currently?
Speaker P 1:10: Okay, so as a developer, I would say whichever is consistent across devices, will be the best method. Because nowadays, people don't just use their personal computers or their laptops, or something like that to access the web. But they also use mobile devices, like a phone or tablet, or it can be anything, basically. So if you are, like creating a web based plugin, you should keep in mind that there can be multiple devices that are accessing that. And not all devices will have the haptic feedback or something like that, like the hardware to support what you're suggesting, to the user. So probably something that all devices have. And can, can be like, given to the user on all devices is the best way to move. And some of them are some of the techniques that I feel can help. Voice right. So text to voice or graphed voice, or visualization to voice should be available on all devices now, like, every device has a microphone, so that should be consistent across devices. It can add a feature in which you check what kind of device it is first. Like it's if it's a mobile device, then currently mobile devices and iPads or like any tablet already has the haptic feedback. So if that is the case, you also provide that option else you don't. So you don't want to be providing haptic feedback in, let's say, a laptop, because it's useless. They're like it won't work. So you have to understand where to where to provide what

Speaker 3:05: you see, should there be a business account for teams of bigger sizes, or more than five members?
Speaker P 3:18: Can you explain what a business account would look like?
Speaker 3:24: Okay, so the premium account allows the users, at a particular time more than five users can use a particular notebook simultaneously. The normal account allows you to use stuff for free, there's a free public option for that. And the premium, which provides you with two, three more features compared to the normal one. And the business account allows you to have multiple, more than five users using the same name.
Speaker P 4:01: Oh, yes. So in that case, yeah. Business Account makes sense. Because you don't want to be paying for five individual accounts. So that helps a lot. And if the pricing is different as well, that would be helpful as well. Yeah. Okay.
Speaker 4:16: And do you think a built -in color blindness checker at the time sign in is a good option? And by that, I mean, there's only a one-time test which is done to know whether the person has color blindness or not.
Speaker P 4:39: So with a one-time test, you mean signing in every time or signing in?
Speaker 4:46: When I sign up for the first time, at the first time when I'm creating an account for the tool? Only that time the testing is done to differentiate whether the person has any vision issues or not.
Speaker P 5:01: So how would this work with a business account variant, different people will be accessing the same account.
Speaker 5:07: So this feature will not be available in the business account, but for when it's a normal account the feature will work.
Speaker P 5:22: I still feel you should be doing it every time they log in, or they start a new session. Because it might happen like a personal account, let's say someone is having a personal account, there are multiple family members in their apartment or wherever they live, or their colleagues who are using their account in the same household, right? So it might be like one person is colorblind, but the other person is not. So it won't be a very good experience for the other person. Basically, okay, so it's probably better whenever they log in to a new session, let's say they open up a new tab and sign into their account. It just verifies that every, every session, what kind of user?
Speaker 6:17: And, like, there are features for the blind users? Do you think we should charge for all the features the blind user uses? Or should we keep it completely free?
Speaker P 6:35: So that depends on the business model that you are going through? How are you going to monetize this service? Okay,
Speaker 6:45: So for now, the features for the blind user are currently not available, it's like the future idea for how to, you know, improve the tool. So currently we majorly focus on colorblind people and the normal user. So for the future purpose, do you think since the market for the blind users is not big should we charge for that or should we keep the features free? And developing features for the blind users is also a heavy cost.
Speaker P 7:17: You will be charging for the usage of the service itself, but the additional features won't be charged. Is that right?
Speaker: Yes.
Speaker P: Okay. Then in that case, you should not because it's still in the development phase, it should be like a beta version, which you are still gathering feedback for so it should be great.
Speaker 7:38: Thank you.
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Developer 4:
Speaker 0:03: So as a developer, do you think the user interface of data visualization tools should be designed keeping the colorblind and the blind users in mind?
Speaker G 0:17: Yes, I think at the time of designing the data visualization tool, it's important to keep like colorblindness options templates and like even color combinations, preferable for even colorblind people. And since like, it can be like the initial one can be one for a normal vision one, but the charts and the alternatives that are there for the color combinations which are pertaining to colorblindness should be always ready and the users can have a like, it can be like, easier for them to navigate to an option where the same visualization of the same chart is available in a colorblind version, maybe like through patterns or through textures. And even for blind users, like how the data visualization tool can help them and impact them, maybe through in, like, conveying it to them, like what the data represents, maybe highlighting the important points to them.

Like if there are any outliers, or what are the critical pointers in the visualization, maybe like using statistics, since many users have a statistical background. So using statistics, in simple layman's language to convey the key highlight, highlighting points in the visualization can help the right people.

Speaker 1:41: So as part of the development team, do you like what methods we should use for describing the visualization to blind users. So there are multiple ways we can describe, you know, help. So which realizations get described. So one is haptic interaction. And the second one is sonification. And the final one is just distracting. There's a description, there's a screen reader, which reads out, you know, contained throughout the UI, and also the graph. So you know which method you think we should prefer and why. And,

Speaker G 2:22: yeah, I think, as an initial one, like using haptic interaction, and sonification will add on to the complexity of the tool. And it will be like a separate add one thing that will require a lot of like, brainstorming, and it will also require a lot of inputs from the direct users and how they are interacting with the tool. So as an initial part of it, using the name using natural language description of the graph would be the most suitable way. And I think the users will be most comfortable, like, it's something that they are more, it's more, it can be easier, easily adopted by them, rather than using haptic interaction, or sonification. Well, they require themselves to innovate, require a certain level of training from the RN, like how they can understand maybe like in using the natural language description, but having like, maybe two different things like maybe a simpler version and a more advanced version of the description of the graph. Like something maybe for, for blind users, it can be that the graph can be simply read out, like what is the graph? Maybe what initially can be like very simple features of the graph, the x axis y axis, which variables are represented, how are the variables varying according to as in whatever the graph it denotes. And also maybe like, in the more advanced description of the graph can be, like, as I mentioned earlier, something like more sort of the highlight, like the main points of the graph, for example, like in a sales graph, if a user or if a blind user is actually analyzing sales data for a product when a company. So in that case, maybe like highlighting which months are showing that there are higher sales or lower sales, what are the average sales? How is the pattern looking? Is it an upward trend or low or downward trend, these things maybe can be done for each type of graph, maybe not all types of graphs, maybe we can initially set up the initial 10 most common chart options that are used by the various users, even for the blind users, we can, we can actually recommend them that these 10 to 12 charts have options where we can give you a we can give you a detailed description of what the chart does for their data.

Speaker 4:41: And do you all feel there should be a business account for things like themes of bigger sizes? And also like

Speaker G 4:56: yeah, like, for the majority of you The tools that are used today in the industry, like collaboration is one of the most important features that teams and enterprises require. So maybe like, if multiple people, like multiple users from a team can actually work together on a single piece of visual or a dashboard, it will be easier for them to, like collaborate directly. Like usually what happens is B, there's a, the iterations increase of a person is a single user entering at a particular time, and it has to flow and it has to follow multiple users to do it. But if multiple people are working together in it, and it makes it easier for them to brainstorm together and keep changing, keep iterating and making as it saves a lot of time, and it makes it more convenient for them to have to collaborate on a single visual,

Speaker 5:49: okay? Do you feel like adding a built in color blindness checker at the time of logon is a good option? So by that, I mean just one time you know, check whether the user is, you know, colorblind or not. And if the person detects that there is some level of colorblind, then the UI is adjusted according to that and fully such a UI displayed to them.

Speaker G 6:22: Yeah, I think it is a great thing. But like using the thing, at the time of the first sign in the colorblindness checker it will be really helpful for them as the UI can change dynamically. And they can actually all the visuals will be adjusted to the as in as to make the experience as good as for the normal vision users. I think it can also be done that the color blindness can be checked at periodic intervals, maybe that can be decided because users can develop color blindness ongoing. So it can be a dynamic process, but at the time of assignment is a very good option for the start. And also maybe like keeping options of colorblindness, like checkered force, as in keeping templates ready for photographs, like maybe the color blindness checker may not be the thing, which can be the first thing that is there as a first part feature of the product, maybe that can be the most important one. But maybe to integrate, maybe to implement, it can be something, maybe there must be challenges, maybe a third party already in the market can use this particular part, to make the process easier. Because to rely on the accuracy of a color blindness checker, which is already verified in the market, is a much better option, rather than developing a new one on your own. So maybe integrating the existing API's by analyzing and assessing them can be better.

Speaker 7:57: And what do you think should be charged for the features which are developed for blind users, the screen reader, which is the so should we charge for that or we should keep all the services and even the screen reading service for the languages.
Speaker G 8:17: I think the majority of the features should be kept free for the blind users. Like it's a feature which is quite unique. And it's, it's something like a screen reader is not that difficult to implement, seeing the current technology that is there as in it requires a little bit of computation on the tool side where the pointers can be computed by the tool itself, which have to be read out. So in case the basic features are the basic screen reading can be committed free for the blind users, which can help them with the 80% or like 70% of the information that is displayed through graphs. But if like for example, a data of a blind user as a data analyst or more sort of in a data science role, where he wants to do more in depth analysis of the chart or something on those lines, those particular features can be added. But it should be at a charge which is comparable like it should not be as it should be as nominal as possible for them. It's not maybe it should be developed as an add on feature for them, but maybe like only for a particular I think do two, I think the kind of work it is like the population of blind users actually going into data analytic and Time flows. It can be capped at a nominal value where they can get it for the advanced features. Thank you. Thank you
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Developer 5:
Speaker 0:04: So as a developer, what do you think the tool should be designed keeping the colorblind and blind users in mind?
Speaker A 0:16: Okay, so firstly, if we're not sure what portion of like users are colorblind or blind or so
Speaker 0:29: I would say that around the world there are 800 million color blind people. It is factual information.
Speaker A 0:43: Yeah, so if you're using our like application as a US, we're making an application with USPS like it can be used by colorists called vendor blind people. So definitely we should add a feature so that that gives us an edge over other applications.
Speaker 1:02: And I know love for developing features for colorblind blind people, which method would realize things? Or haptic interaction solicitation or just description of the graph using the natural language? Natural language processing? Would that be enough?
Speaker A 1:30: Haptic would be a little bit difficult, I think we can use the second one that is based on sound or like description that you can build on like audio Yeah.
Speaker 1:45: And do you think natural language processing, or use it for just reading and combining the graphs, will be a good option.
Speaker A 2:07: I think a lot of people actually like using natural language to interact. And I think that would be a hit among the users. So definitely.
Speaker 2:17: What do you have to say about business accounts?
Speaker A 2:29: Yeah, since a lot of time, there used to be corporations and companies having a business account and charging them on premium would help us with our revenue model. Yeah, definitely, we should add it.
Speaker 2:43: adding the built in color blindness checker at the time of Sign-in, do you think that is a good option? Like and by that I mean, there's a one-time checker, check whether the person is color blind or not?
Speaker A 3:11: Yes, I think that would be a good thing, because that would customize the whole application based on the user. So that would help the user interact like a youth application much, much more efficiently rather than like, at the later stage allowing the credit so at the start therapy allowed, give them the facility, it would be beneficial and it will drive the like scale of our application.
Speaker 4:12: What do you have to say for the features we develop for blind users? Should we keep all the features for free or should we charge for some of them in the future, which ones should be and which ones should be kept free?
Speaker A 4:24: definitely we are putting core earnings as well. So cannot be cannot have all the features as three. So basically just could be added as like the basic one, at least a basic one can be free and then the more advanced features could be more on a premium basis, like an add on basis. So you could add on to your whole package new features based on some fixed price. Thank you

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Developer 6:

Speaker 0:03: Do you think the interface of the data visualization to be designed keeping the colorblind and the blind users?

Speaker B 0:29: It's because from the developer perspective, we look after how the screen, how the user interface is, how much interactivities while coding, etc., I mean, when we are having an interaction with the database relation to the Okay.

Speaker 0:51: Like, as a developer, which method would you use for describing the visualization to blind people? So you know, there are multiple ways by which you can do the process. First is haptic interaction, second sonification, and the third method is just given a description of the graph using the natural language.

Speaker B 1:14: Normally, I would prefer is the third one. And also the second one. Yeah. Like giving the description. It's because the description will generally be easily readable, right? So there won't be any issue.

Speaker 1:36: So do you believe that the natural language processing and the voice based command to create the graph will be a good option for the users?

Speaker B 2:06: Yes, especially for the colorblind people. I think that would be a good idea.

Speaker 2:17: What do you think? We should have a business account for a team of bigger size?

Speaker B 2:37: You mean, in terms of the licenses costing?

Speaker 2:42: Yeah.

Speaker B 2:45: Yeah, yeah. Especially like the features which are quite complex, right? Like, for example, the graph basement. I think it, if we have a pricing for it, but Yes, that too, if it's a nominal, I mean, if it doesn't charge too much, based on the complexity of the system, I think it would be okay.

Speaker 3:00: And do you think the built in color blindness checker at the time of assignment is a good option? I mean, the checker is a one-time check when you sign up, or create an account on the tool, it will check whether the person is colorblind or not, if the person is detected with some kind of colorblindness then changes are made to the UI.

Speaker B 3:46: Oh, yes, I think that would be a good idea. But yes, one point I would like to add is, like whatever the questioner that we will be asking at the start of the signing, maybe the questions should be in such a way that could actually detect at the end that he is colorblind, I mean, straight away. Normally. It should be easily trackable. I mean, this is what I'm, I mean, yeah.

Speaker 4:00: Go for this checker, there won't be any question that certain kinds of images will be available. And then yeah, if it's the case, meaning, basically just analyzing his color, visual eye color, visual localization perspective, then it's fine. Instead of asking the general questions, if we set up the product in such a way wherein once at the first sign, and the data is collected, and based on that the UI would be visible, like for the colorblind people, some adjustments will be made to the website.

Speaker B 5:00: it would be a good idea.

Speaker 5:10: What do you think, should we charge for all the features that are developed for blind users or we should see three of them free?

Speaker B 5:24: I would say based on the complexity, the charges should be there and that too in a nominal price pair a development developer can afford okay. Because we can't keep everything free so yeah.

Speaker 5:45: Thank you.

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A survey was conducted instead of interview for developer 7

Developer 7:

Do you think the User Interface of data visualization tool be designed keeping color blindness and blind users in mind?

Yes, the feature to facilitate users with color blindness is easy to incorporate within the core functionality of the system as it would not require additional resources like time, budget or FTEs to develop.

However, incorporating features to blind users is not feasible as of now as it would incur considerable time to carry out requirement engineering to elicit and analyze the requirement.

Furthermore, a lot of time would have to be spent on designing the architecture of the system to implement this feature. Moreover, we would need SMEs who can have domain knowledge and who can guide software architects while designing the architecture of the system.

Which method, developer must apply for describing visualizations to blind people? Haptic Interaction, Sonification, or Description of the graph in Natural Language and Why?

In my opinion, describing the graph in the natural language would be better way to describe the visualization to the blind people because of two reasons:

1) Easy to implement (i.e. would not require much efforts and resources to develop this feature)

2) It can be used to describe the graph in a much better way when compared to other alternatives.

Do you believe Natural Language Processing and voice-based commands to create the graph will open doors to analyzing unfathomed domains? Or will it just make the process easy for Data Analysts and other users?

Using NLP or voice commands to create graphs would help users (including data analysts) a lot as they don't have to invest their time to explicitly code or use drag and drop implementation to create graphs. As a result, they can focus more on other tasks that need more attention.

What do you feel should there be a business account for teams?

Yes, there should be a business account for teams.

Is adding a built-in color blindness checker at the time of sign-in a good option?

In my opinion, we can implement the entire system in such a way that all requirements to facilitate all user classes can be covered rather than implementing checkers at the time of sign-up. This would make implementation and maintenance tasks much easier as we would only have to deal with one single feature for all users rather than having two different features which would facilitate two different user classes.

Should we charge for the feature we develop for blind users? If yes, then explain why?

Yes, we will have to charge for the features for the blind users as we would be investing a lot of our budget on hiring SMEs and other resources which would play a key role in the success of the project. And thus, this capital can only be recovered if we charge the users to avail the services.

Developer 8:

Speaker 0:03: So as a user what do you think, the user interface of data visualization tool, be designed keeping the colorblind and the blind users in mind?

Speaker ST: Yes, absolutely. This will open room for people who are visually impaired, and will also get to work on data visualization with.

Speaker: And as a developer, which method will you use for describing the visualization to blind people? So, you know, for, you know, describing the visualization, there are multiple ways. One is haptic interaction, then there is sonification. And the last option is just describing the graph using natural language.

Speaker ST: sonification would give, I think, the visually impaired, perpetual access to images by an acoustic signal or three feedbacks about the image would be great.

Speaker: do you feel the visualization tool should have a business account for teams with big size or more than five people?

Speaker ST: Yes, I think business account is a great idea is having an account for each business, where they have all the return charts at one place will be easy for them to manage.

Speaker: Okay, and do you think natural language processing or Voice Base combined graph will be a good option and it will save time for some other users?

Speaker ST: Yes, it will make life easier for data analysts users and even for people who have lost limbs or who are special who are especially abled for them also to be good.

Speaker: What do you think we should charge for the features we developed for blind people?

Speaker ST: Some features can be chargeable, while few can be free or you can display ads next to the content if they want to go and if they want to go ad free, then they can pay.

Speaker: Is adding a built-in color blindness checker at the time of sign-in a good option?

Speaker ST: Yes, and I think there are various tools and methods by which this can be tested. Like there is one method known as Ishihara marrin there are various dots and numbers are formed out of dots. So if a person is able to guess the number then the person has no issues but if they aren't, then probably they are colorblind.

Speaker: Okay. Thank you

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