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E-Voting Application Interface Design Based on User Emotional Preferences Using Kansei

Abdurrohman, M. Kom.
School of Science & Technology (SST),
Asia e University (AeU), Malaysia
abdurrohman1970@gmail.com

Prof. Ts. Dr. Aedah Abd. Rahman
School of Science & Technology (SST),
Asia e University (AeU), Malaysia
aedah.abdrahman@aeu.edu.my

Muhamad Sabar, M.T.
Department of Informatics Engineering,
University of Technology Bandung, Indonesia
m.sabar.sttb@gmail.com

sabar@sttbandung.ac.id, abdurrohman1970@gmail.com, aedah.abdrahman@aeu.edu.my
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Abstract

The increasing use of technology has made people accustomed to using it, especially in the digital age. In the field of politics, information technology is used to support the holding of elections remotely through the internet. The appearance and design of the user interface of an e-voting application is a crucial factor in determining its success, as the display design can affect user psychology when using it. A well-designed interface can improve the user experience and increase the likelihood of successful adoption and usage of the e-voting system. On the other hand, a poorly designed interface can create confusion and frustration for users, leading to a decrease in trust and adoption of the system.

This research has allowed for a deeper understanding of the emotional and psychological factors that influence people's perceptions and interactions with the e-voting application. By gathering and analyzing data about users' emotional feelings through the use of Kansei words and statistical multivariate analysis, the researchers were able to identify the key emotional and psychological factors that should be considered when designing the user interface, these findings can be used to inform the design of the e-voting application in order to create a more appealing and satisfying user experience

Introduction

Evolutions in product design have lead to many inventions, resulting equally good quality products flooding the market. Duly, consumers have vast choices of product and become more and more sophisticated. Forced by the demanding market, producers strive to design product that stands out and attracts consumers. Theoretically, consumers satisfaction and technical aspects (e.g., functionality, ergonomic and comfort) are equally important in determining the success of product design (Akao, 1990; Green & Srinivasan, 1990; Nagamachi, 1992; Norman, 2004). Hence, producers strive to understand the factors that contribute to consumer‟s satisfaction in their product. Several methods have been developed to support the valuation of consumer‟s satisfaction in the effort to understand the consumer‟s needs and desire. To name a few, there are Quality Function Deployment (QFD) (Akao, 1990), Conjoint Analysis (Green & Srinivasan, 1990), Voice of Customer (VoC) (Griffin & Hauser, 1993), Kansei Engineering (KE) (Nagamachi, 1992).

Kansei Engineering approach is used in this research because of its ability to identify and to translate user's emotional factors into element design concept of user interface for e-Voting application(Ismail & Lokman, 2020). Kansei Engineering is a method that assimilates kansei (feeling), psychology, engineering, and statistics (Hadiana, 2015). Kansei engineering is potential to develop an application that matches the the heart and mind of user. Kansei Engineering's methodology consits of systematic processes to discover the insights of user's responses toward the targeted application including E-Voting application via several psychological assessment methods (SILVA et al., 2019). The final result can be a knowledge to be translated into the detail specification of user interface element designs.

One approach to addressing these challenges is to use Kansei Engineering, which is a methodology that uses emotional and psychological factors to inform the design of products and systems, including e-voting systems. By understanding the emotional and psychological preferences of users, designers can create e- voting systems that are more likely to appeal to users and enhance their experience with the system, while also addressing the technical, security, and transparency challenges that e-voting systems can pose.

This research focuses on investigation of E-Voting application in order to provide better election environment as democracy activity, and also attempts to apply Kansei Engineering to analyze user's emotional preferences related to e- Voting application through its user interface. Multivariate statistical analysis is introduced in order to calculate and analyze the data questionnaire (Ismail & Lokman, 2020). The main aim of this research is to explore the internal E-Voting by analyzing the relationships between user's emotional feelings and it's user interface. The result of this research is a recommendation for developer to enhance user interface of E-Voting application.

The e-Voting application is a program application to support democratic activity, especially in Indonesia, through the internet effectively. This application in general is based on web technology, and it is possible to be connected by using a gadget such as a tablet as a media to access it over

intranet or internet (Samur, 2021) (Dahiya et al., 2012). Many countries around the world are competing to implement a suitable web-based E-Voting application in order to reduce election budgets and convert traditional paper-based elections into digital election.

However, E-Voting systems also have their own challenges and limitations, such as the potential for technical problems, security vulnerabilities, and concerns about the transparency and accountability of the system. In addition, e-voting systems can also pose challenges for users, who may be unfamiliar with the technology or have concerns about the security and privacy of their votes.

There is an important point to be considered in development of E-Voting application. In particular, the part of the user interface that needs more attention, because this is a key part that is directly connected to users. So, we have to explore and analyze what kind of suitable user interface that users psychologically desire, because users are main players in this kind of application. The psychological aspect is one of the important thing to be considered when designing an user interface of an e-Voting application.

LITERATURE REVIEW

Kansei Engineering

The term "Kansei" used in K.E. refers to an organized state of mind which has emotions and images held in the mind towards objects such as products or environment. For example, "luxury", "elegant", "flashy", "young" and alike as in the "that dress looks luxury and elegant", or "that car looks flashy and for youth" are all Kansei words describing feelings to certain product. Although in most cases Kansei is used the form of adjective, nouns as well as short sentences can also be employed (Dahlgaard & Nagamachi, 2008).

Harada (1998) described Kansei as a mental function, and more precisely as being a higher function of the brain, and therefore it is implicit. The process of Kansei begins with gathering the sensory related functions such as feelings, emotions and intuition, by means of the five senses (i.e. vision, hearing, smell, taste and skin sensation). Figure 1 shows the process of Kansei and the five senses within the structure of the brain.

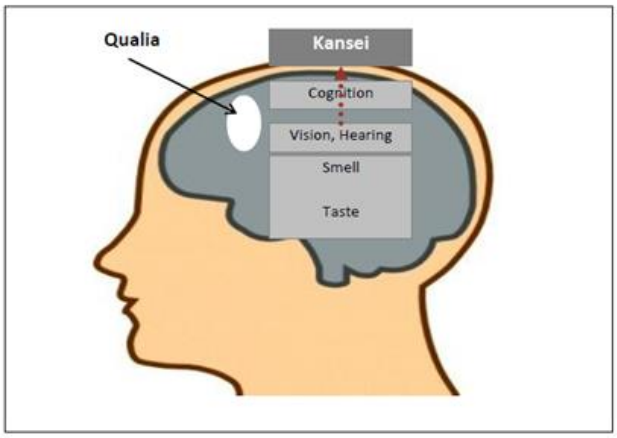


Figure 1. The Process of Kansei (Lokman & Nagamachi, 2009)

When these senses are triggered, psychological cognition concerned with perception, judgment and memory will surface. In the scenario of going into an unfamiliar restaurant, your vision, smell, taste and cognition would judge whether the restaurant is "very friendly" and or provide "good service". These are "Kansei". The Kansei emerges through cognition with several contributing sensations in place. Physiological measures are done by evaluating responses to specific external stimulations. Kansei Engineering is used in many types of products including software product. Kansei Engineering is a technology to combine human emotion into design product. Kansei Engineering consists of 3 stages as shown in Figure 2 bellow.

Figure 2. Kansei Engineering Processes (SILVA et al., 2019)

1. **Kansei Investigation**
   In this stage, customers' Kansei will be investigated using any psychological or psycho-physiological method.

2. **Kansei Analysis**
   In this stage, data will be analyzed through multivariate analysis or physiological equipment's.

3. **Product Design**

In this stage, data will be interpreted into product design by means of Kansei Engineering techniques.

The product builds using Kansei Engineering will have different and unique characteristics as compared to an existing system. In general, the new system designed by Kansei is the kind of product that has not existed in the market yet. In many cases, Kansei Engineering technique contributes to mass product redesign or repackaging especially the product of software.

Kansei Engineering Type I KEPack

Kansei Engineering Type I KEPack is the most popular technique combined as a pack, which is named KEPack. KEPack is formulated as company's product development strategy focuses on design domain as well as the target users (customers). It involves the compilation of Kansei Words relating to product domain. Usually, a compilation of 30 to 40 Kansei Words, adjectives or sentences of feeling is required, and the 5-point or 7-point SD scales will be constructed. Figure 3 shows add the processes of KEPack.

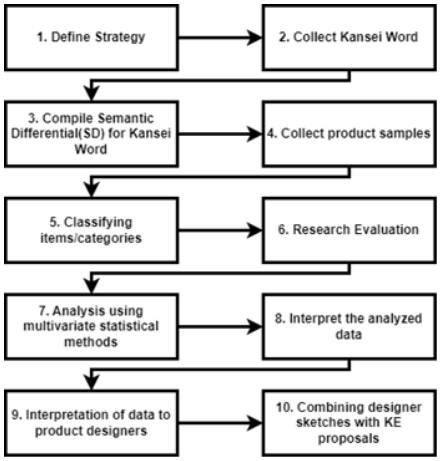


Figure 3. Kansei Engineering Type I (Lokman, 2010)

A. Decision of strategy

Kansei engineer listens to the client company's CEO or top R&D manager and understands the company's new product development strategy. The most important point for a Kansei/ affective engineer is to grasp what kind of requirements the company has and what will give them the highest satisfaction in new product development.

B. Collection of kansei words

After understanding the client company's strategy, the kansei engineer collects Kansei words related to the product domain. We usually synthesize from related magazines, business newspapers, or salespeople's information concerning customer emotion and opinion. The Kansei words are adjectives, nouns, or verbs, and sometimes sentences. Beautiful, elegant, premium, smart, simple, large, colorful, red, blue, square, easy to open, and so forth are all Kansei words. It is recommended that you first collect a lot of Kansei words and then reduce these to a small number of very important and relevant words.

C. Structuring SD scalse for the Kansei Words

The SD scale (the semantic differential) is a psychological measurement scale devised by C. E. Osgood and his colleagues (Osgood et al. 1957). This method is used to make clear the psychological language structure. Osgood arranged positive and negative words on both sides of a horizontal line. For instance, beautiful—ugly are set on both side of a continuum. But Kansei/ affective engineering is intended to achieve a good design, not an ugly design. So, we arrange positive and negative Kansei words on both sides of the scale such as beautiful—not beautiful. There are several scales, 5-scale, 7-scale, 9- scale, and 11-scale, but the 5-scale is the easiest to understand and the easiest for clients to use, ass shown figure in Table 1.

Table 1. Example of SD Scale (Lokman, 2010)

SD Scale Sheet

Good	5	4	3	2	1	Not Good
Beautiful	5	4	3	2	1	Not Beautiful
Unique	5	4	3	2	1	Not Unique

D. Collection of specimens

The Kansei/ affective engineer should gather products that are similar to the targeted product. If the targeted product is a shampoo bottle, the engineer collects many similar shampoo bottles from the market. If it is an automotive exterior design of a passenger car, the engineer collects many passenger vehicles. About 20 or 25 samples are usually enough, at figure 4 bellow

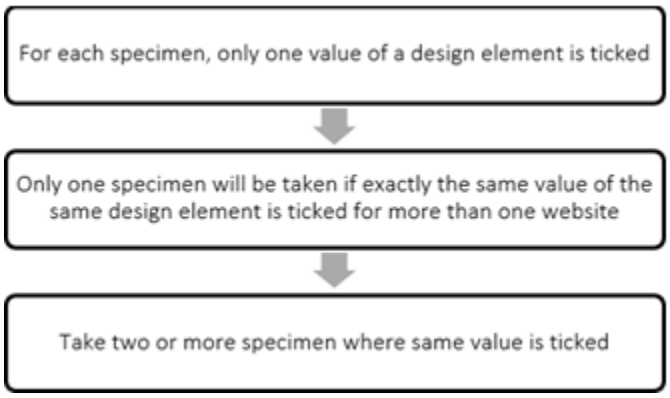


Figure 4. Rule of Specimen Validation (Lokman, 2009)

E. Classification of item/ category

Item/ category is related to the final design specifications: item implies the design item of the sample product, and category means the detail of the design item. For instance, color, shape, size, roundness, and so forth are examples of items; and red, yellow, green, blue, and so forth are the categories for the color item. The Kansei/ affective engineer should be very careful of the sample product's items and categories. A very refined classification of the items and categories will lead to a successful design. The output of item/category's classification can be seen as the example in Table 2 and Table 3 below

Table 2. Example of Design Elements Classification

Design Element	***Value***
Page Background Color	Green
Top Menu Location	Center
Font Type	Times New Roman
Font Size	12pt

Table 3. Example of Design Elements Classification

Spesimen No.	Page Background Color				Top Menu Location			…
	None	***Blue***	**Grey**	**Green**	**Left**	**Right**	**Center**	…
1		√				√		…
2	√						√	…
3				√			√	…
4			√		√			…
…	…	…	…	…	…	…	…	…
10			√		√			…

F. Evaluation experiment

The sixth step is to conduct the evaluation experiment using subjects. The subjects receive an instruction and evaluate each sample with the 5-point SD scale of Kansei words.

G. Analysis using multivriate statistical methods

The evaluated data are analyzed using a multivariate statistical analysis. In this method, we utilize correlation coefficients to check the relationship of meanings between Kansei words, principal component analysis (PCA) for positioning, factor analysis to make clear the sample data structure, and finally quantification theory Type I (QTI) or partial least squares (PLS) to identify the design element relevant to the specific emotion, just like table 4 bellow

Table 4. Flow of Multivariate Statistical Analysis

No.	Method	Result
1	*Cronbach's Alpha* (CA)	Data Reliability
2	*Coefficient Correlation Analysis* (CCA)	Emotional Concept
3	*Principal Component Analysis* (PCA)	
4	*Factor Analysis* (FA)	

H. Interpretation of the analyzed data

Each statistical analysis has a specific interpretation property. Correlation coefficient implies the similarity in meaning between each Kansei word, and PCA is able to show us positioning interrelated among Kansei and sample products. Factor analysis shows us the psychological structure of Kansei words related to the selected product sphere and sample product position related to the Kansei structure. QTI or PLS tells us what Kansei words will have what kinds of design specifications. We interpret the data and integrate them into the product design properties.

I. Interpretation of the data to designer

The most important step is the collaboration with a product designer. The Kansei/affective engineer should explain the analyzed data and the interpretation to the designer. Sometimes several suggestions are derived from data analysis. The engineer has to motivate and stimulate the designer to understand the final data interpretation and to draw out the designer's new design idea of emotional design beyond the data, as shown in Table 5 as shown bellow

Table 5. Example of Matrix of Design Guide based on Kansei Engineering

Factor No	**Concept of Emotion**	**Element of Emotion**	**Design Element**					
			Body* Bg *Color	***Body* Bg Style**	**Page Shape**	**Page Orientation**	**Dominant Item**	…
1	Exclusiveness	Mystic	Red	Textured	N/S	Plain	Picture	…
		Futuristic	Red	Gradien	Sharp	Plain	Picture	…
		…	…	…	…	…	…	…
2	Gracefulness	Feminine	Light Blue	Textured	Sharp	*Footer*	Picture	…
		Chic	Light Blue	Textured	Sharp	*Footer*	Picture	…
…	…	…	…	…	…	…	…	…

J. Incorporate designer's sketch with Kansei Engineering proposal

Check the new design idea. Finally, the Kansei engineer should evaluate whether the newly designed product will fit the customer's emotion and whether it reveals the emotional design. If not, she motivates the designer to a better intrinsic design idea.

E-Voting

Electronic Voting System (E-Voting) is a system that utilizes electronic devices and processes digital information to create ballots, cast ballots, calculate vote acquisition, send vote tally results, display vote tallying, maintain and produce vote counts (Sambo & Alexander, 2018).

There has been significant research and debate about the benefits and drawbacks of E-Voting systems. Some of the potential advantages of E-Voting include:

1. Increased convenience: E-Voting systems can make it easier for people to cast their votes, especially if they have difficulty physically going to polling stations or are located far from polling stations.
2. Improved accuracy: E-Voting systems can reduce the potential for errors in the voting and counting process, as they often use automated systems to tabulate votes.
3. Increased security: E-Voting systems can be designed to be more secure than manual voting systems, with measures such as encryption and two- factor authentication to prevent fraud and tampering.

However, E-Voting systems also have some potential drawbacks, including:

1. Cost: E-Voting systems can be expensive to implement and maintain, especially if they involve the use of electronic voting machines or other specialized equipment.
2. Security concerns: E-Voting systems can be vulnerable to cyber attacks and other forms of tampering, which can undermine the integrity of the electoral process.
3. Accessibility issues: E-Voting systems may not be accessible to all voters, particularly those who do not have access to computers or internet connectivity.

Overall, the adoption of e-voting systems has been met with both enthusiasm and skepticism, and the debate about their benefits and drawbacks is ongoing. The advantages are paperless, minimizing fraud and real time results. Equipped with an anti-hack system so it is safe and reliable. E-Voting systems can take various forms, including electronic voting machines, online voting systems, and mobile voting apps. There are several potential advantages to using e-voting systems, including:

1. Increased convenience: E-Voting systems can make it easier for people to cast their votes, especially if they have difficulty physically going to polling stations or are located far from polling stations.
2. Improved accuracy: E-Voting systems can reduce the potential for errors in the voting and counting process, as they often use automated systems to tabulate votes.
3. Increased security: E-Voting systems can be designed to be more secure than manual voting systems, with measures such as encryption and two- factor authentication to prevent fraud and tampering.
4. Increased voter participation: E-Voting systems can potentially increase voter participation, especially among groups that may have difficulty accessing polling stations or are otherwise less likely to vote.
5. Cost savings: E-Voting systems can potentially reduce the costs associated with conducting elections, as they can eliminate the need for paper ballots and manual vote counting.

It is important to note that while e-voting systems can offer a number of potential benefits, they also have some potential drawbacks and challenges that need to be carefully considered.

User Design

Users basically are the people who will use the final product or artefact to accomplish a task or goal (Vdovjak et al., 2020). Good design begins with the needs of the user, and no design, no matter how beautiful and ingenious, is any good if it does not fulfil a user need (Nurmanditya, 2021). It is pointed that finding out what the customer wants is the first and the most important stage of what designers have to do.

The designer then develop product based on the results with a mixture of creativity and commercial insight. Although gut instinct is part of the designer's arsenal, there are more scientific ways of making sure the design achieves the target. Different designers use different methods, combining techniques of market research, user testing, and prototyping and trend analysis.

The scope of this research where website emotion is the centre of attention, to successfully design a website that engage emotional connectivity, involving users in determining emotional design requirement is essential. Assumptions cannot be made and scientific investigation with users involvement must be performed.

Website pages have elements in them such as text, images, videos and so on. The design of a website greatly determines the quality of the beautiful interface of a website. This will have an impact on user satisfaction when visiting the website. Positive output from a good quality website will have a positive impact on users so that users feel happy and will return to visit the website. Website elements that must be considered include page layout and web page orientation (Farozi et al., 2015).

Web Design

The building blocks of web design is called the design elements. There are many literature that explicate classification of design elements. Among others, the elements of web design are classified to content, layout, delivery, objective and technology (Bleier et al., 2019).

Web design is an activity that aims to design applications and their appearance on a web basis using a programming language (Oppenlaender et al., 2020). Building the appearance of website pages so that they can be accessed is one of the most challenging things for web designers. With the diversity of potential website visitors, it requires designers to understand every characteristic of potential website visitors.

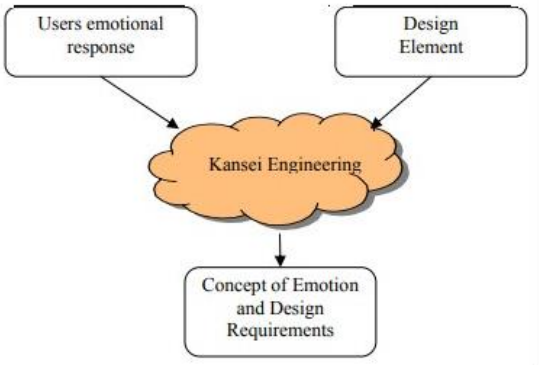
In designing a web page, there are several things that must be understood, such as determining the color composition used on the web, layout, typeface (font), and the quality of the images contained on the web page. Incorrect selection will make web visitors feel uncomfortable, for example if the font color is similar to the background color which makes it difficult for visitors to read the text.

This research attempts to investigate user experience at first sight when visiting a website, it concentrates on content and layout aspect of design elements. This research calls both elements as visual design since it is the most visible aspect of web design from the user's view point.

E-Voting Application Design

In Kansei/ affective engineering, many cases have a larger number of design variables than of samples. Then, the analyst has to divide design variables to do analysis. The second defect is a problem of interactions between x variables; if there are heavy interactions between x variables, its analyzing result is distorted. This problem is known as multicollinearity in multiple regression analysis. PLS has the possibility to resolve both problems as seen at figure 5 bellow

Figure 5. PLS Process



this study discussed the implementation of interface designs in E-Learning applications with case studies at STIMIK CIC. The difference between this research and the research conducted by Freedy, some key differences between these two research studies might include:

1. Research question: The research questions for these two studies are likely to be different, as they are focused on different types of applications and are addressing different design challenges. Freedy uses Kansei engineering to design the interface of a learning application, while the second research study involves the use of Kansei engineering to design the interface of an e-voting application.
2. Methodology: The two studies may use different research methods and approaches to collect and analyze data, depending on their specific research questions and goals.
3. Results: The findings and conclusions of the two studies are likely to be different, as they are focused on different applications and design challenges.
4. Implications: The implications and applications of the two studies may also differ, depending on the specific focus of the research and the design recommendations or prototypes developed.

Rrecommendations as a take-away for E-Voting interface designers, and researchers looking for future research issues related to the ballot and vote casting, namely interface design. Simple and Clear Ballot Instructions, and Providing of Review/ Confirmation Screens. Identifying Mental Models, describe people's perceptions of objects, determining how people then interact with the objects (Staggers & Norgio, 1993). Mental models are an important consideration in design, as designers are then able to use knowledge of the user's mental model in designing an object is the next subsection.

The frameworks of innovation of meaning and design thinking provide a new description of Nagamachi's practice that translates un-awakened future meanings of consumers' life into product design. The product designing through KE therefore maximises its performance only when combined with solid design thinking, following the logic of science and utilising technology. In this sense, his hitherto works should actually be called Kansei Design. Furthermore, design thinking that consists of intuitive and analytical thinking also provides an opportunity for considering future application of artificial intelligence (AI) to KE approach.

Figure 6. Empathy Maps

From the empathy map we can see that many user are being confused while they use e-vote application. We find two factors that have cumulative value of more than 60%. So, we are able to continue to analyze to find the strength of each Kansei word.

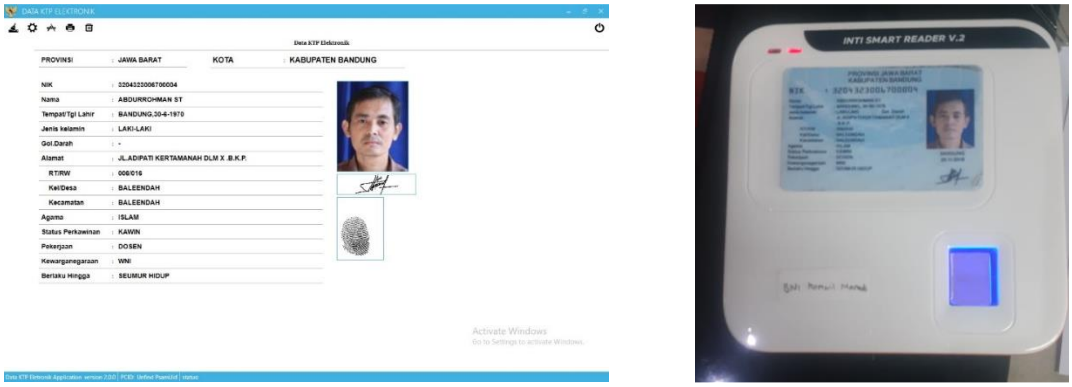


Figure 7. Recommendation

Conclusion and Recommendations

Kansei Engineering has been adopted in this research to analyze users' emotional feelings related to the user interface of the E-Voting application. Emotional feelings shown by Kansei words are translated into the design concept for the user interface of the E-Voting application. Statistical multivariate is used to analyze each specimen of the E-Voting application and to determine which emotional feeling has the biggest impact on the E-Voting application.

The use of Kansei engineering in this research has allowed for a deeper understanding of the emotional and psychological factors that influence people's perceptions and interactions with the E-Voting application. By gathering and analyzing data about users' emotional feelings through the use of Kansei words and statistical multivariate analysis, the researchers were able to identify the key emotional and psychological factors that should be considered when designing the user interface of the e-voting application. These findings can be used to inform the design of the E-Voting application in order to create a more appealing and satisfying user experience.

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