Drag A Star 2.0: An Interactive Artwork With Visual and User Interaction Engagements

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ABSTRACT

"Drag A Star 2.0" is an interactive installation artwork which provides an immersive interactive star field experience. Audience engage this interactive piece with their smart phone application. With the smart phone, audience able to generate their own unique design star and send it to the star field. Audience could even embed their star with a wish, just like the old myth of wishing upon a shooting star. Stars that being generated are stored in the web server database, it is then being retrieved and visually display as a star in the night sky. Thus, every star tells a story. Audience could catch the shooting star by just performing a simple dragging gesture and then able to read at others wishes, or even reply to the wishes. This art piece is a combination of different technologies which involve projection mapping technique display, mobile application, web-based messaging system and web server database. Every action by the users are stored in the web server database and all these actions would determine the visual component of the star field. The visual engagement is due to the user interaction engagement. It is an interactive art piece which greatly involve audience engagement and thus connect the audience to the art piece both physically and digitally.

CCS CONCEPTS

• **Human-centered computing** → *Collaborative interaction; Smartphones; Information visualization;* • **Networks** → Mobile networks;

KEYWORDS

Interactive Artworks, Dynamic Screen Interaction, Smartphones and Mobile Applications, Media Networking, Visual Engagement, User Interaction Engagement, User-Generated Content, Shooting Stars, Star Field.

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1 INTRODUCTION

1.1 Related Works

With the improvement and advancement of technology, it is understandable that artists nowadays are creating art pieces that able to push into new perspective and dimension. Over the past few years, data science had been trying to understand by the researcher for its implication in business marketing decision making [1], while it is now also a favored component by the new media artists. Artists collect data through different medium and then would have explore on it and turn it into an art. This can be greatly see in the web-art and network-art. Partly because of the trend of social media, user-generated contents turn into a key element for new media artist.

Although all these arts that involve user-generated content and data, the authorities of the audience are still often limited due to the aesthetical concern. It is understandable that most artists would opt for maintaining their art identity and personality by limiting some parts of audience involvement. Pushing this borderline of audience collaborative involvement and experiment on how far this line could stretch would be an interesting motivation for an artist to shorten the gap between audience engagement and the art piece.

1.2 Artist Statement

When is the last time mankind look upon the night sky and enjoy looking at the star scenery? When is the last time mankind saw a shooting star flying across the night sky and quickly make a wish? People are so often caught up themselves with the fast and busy pace of life and hardly stop down to take a look at the stunning nature night scenery. Not to mention most of the people living in the city and hardly see any star due to the light pollution. "Drag A Star 2.0" is to resemble this forgotten yet attractive and enticing star scenery to its audience. The artists design and develop the interactive art system behind the star field. And in order for the star field to be complete, it would require the engagement and participation of the audience. The stars on the star field are all generated by the audience themselves, which indicate the traces and marks that leave by the audience throughout the interaction with the art piece. If the star field is part of the art, then the audience themselves can be considered as the co-artist. Every star tells a story. And in this piece, every star do archived a certain wish, hope, belief or faith by the audience. Audience able to

generate their own unique star and embed it with their wish, send it up to the night sky. This was to remind the audience the old forgotten myth of making a wish whenever seeing a shooting star. It's more than just a night sky full of stars, it's a night sky full of wishes. These are stars that waiting to be heard, and if the audience catch the shooting star, then he/she is now a listener. Audience could read at the wish, and reply it back. If he/she is lucky enough, the star that self-generated would be able to catch back in the smartphone, and read at the replies. It's an interactive art piece that not just connect between people and people, it also enable the connection of the past, present and future, much like today's social media. By utilizing today's smartphone technology, this art piece able to engage the audience with their own generated contents. And the audience were to decide, whether he/she want to involve in this art piece as the one who share, or the one who listen. By implementing 3 new novelties: i) user-generated star, ii) crow-generated star field projection and iii) data archiving shooting star into this interactive piece. It enable the art to resolve the visual engagement through the user interaction engagement.

2 THE ART AND AESTHETIC DESIGN

2.1 Physical Setup

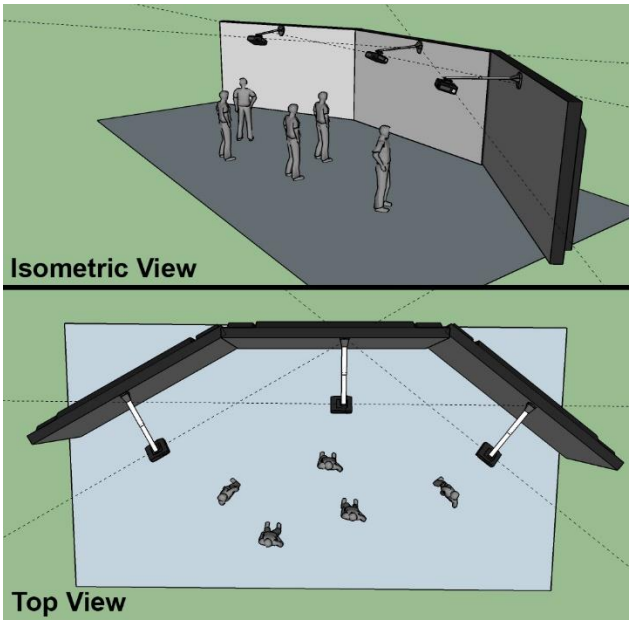

Figure 1: Diagram illustrating the physical setup of the interactive artwork.

Display Screen Panel: 3 screen panels were used in this installation in order to provide an immersive experience to the audience. These are the panels where the star field will be projected on it. The 1st and 3rd screen is set up in a slanted angle so that it could create an immersive feeling to the audience.
Projector Placement: Short-throw projectors are being used in this installation setup due to the mounting placement. With a short distance between the projector and the display screen, short-throw projector will still be able to project the whole area of the display screen. It is also important to ensure that the projector is perpendicular to the display screen panel. When it is not perpendicular to the display screen, the projected visual will be distorted and key stoned [7].
Audience: Audience were to stand in front of the screen panel while engaging with this interactive piece. It were required them to use their smartphone in order to interact and generate content for the star field as showed in Fig. 2.

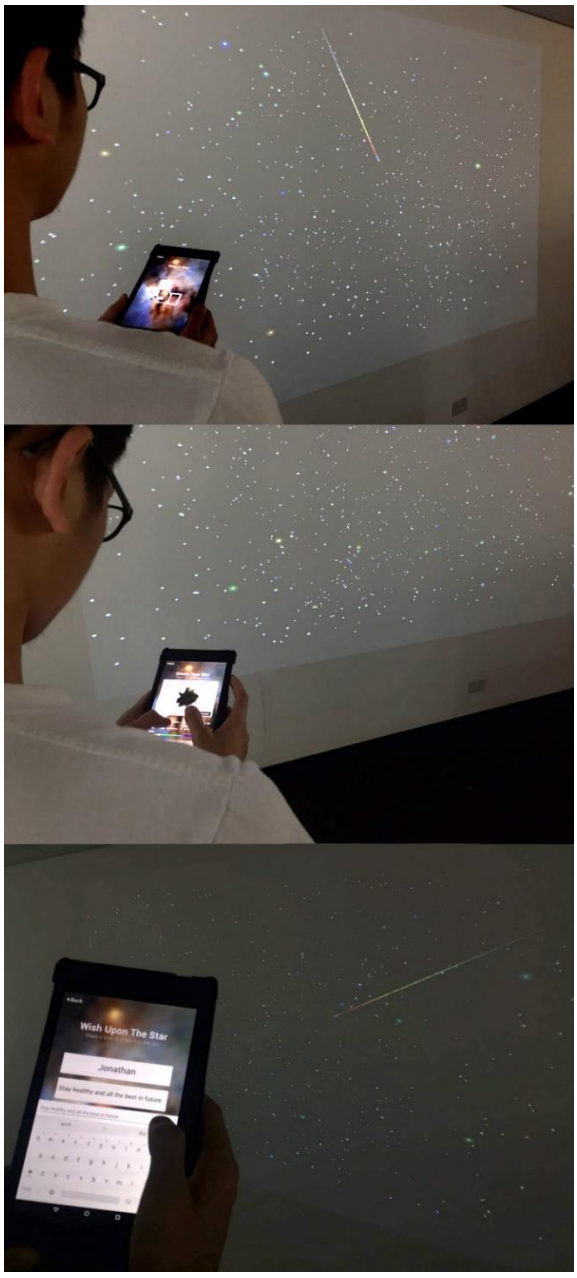

Figure 2: Photos of audience engage the interactive piece with their smartphone application.

2.2 User Interaction Engagement

The key interaction device for this interactive artwork is smartphone. Therefore smart phone application user journey is 1st being discussed in the development stage in order to successfully engage the audience throughout the whole artwork experience. At the start of the journey, audience will be given 2 options to select which are also the 2 main user interaction engagement for this artwork as seen in Fig. 3. Audience are free to select any of the options because whichever choice made, it will eventually lead them back to the start. The user journey is designed as such so that it provides a seamless interaction flow to the audience.

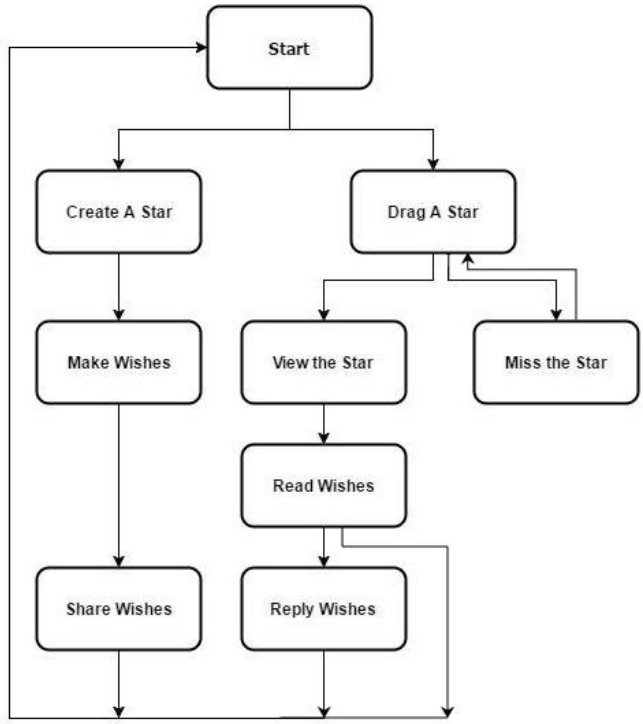

Figure 3: Engagement of user interaction.

Smartphone application user interface (UI) is designed to facilitate the audience throughout the whole experience. The application UI only consist of 3 minimal levels which enable the audience to learn quickly about the whole interaction as showed in Fig. 4. Level 1 is educating and choice making level. Audience will be taught with tutorial video and then let them select their favorable choice. Level 2 UI is action and exploration level. Audience will perform the main tasks of the interaction and at the same time explore around the interaction process. Last level is the level of completion, audience will perform an action which complete their main task. Last level will bring the audience back to level 1 again. By having only 3 simple levels which indicate distinctive and obvious purpose, it would able to provide the audience with a smooth learning curve user experience (UX) which is a pragmatic quality for UX measurement [3].

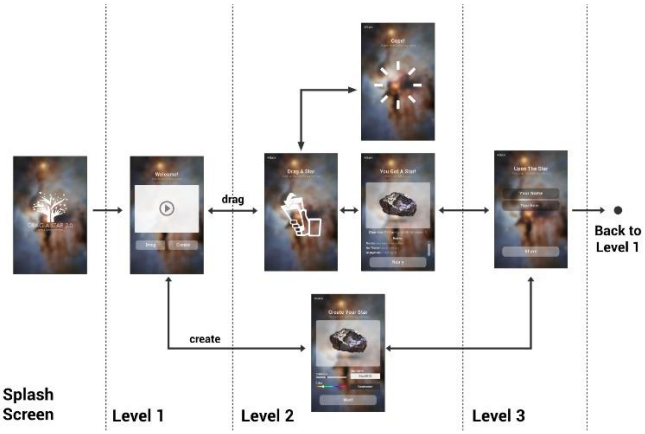

Figure 4: Mobile UI design in 3 simple levels.

2.2.1 Interaction Task 1 – Drag A Star

There are 3 UI pages for the task of drag a star. At the 1st page of drag a star, a very simple iconic instruction is being placed in the middle accompanied with a short sentence. Audience would take less than 3 seconds to understand about what should be done. After performing the drag gesture, it will depends on whether the audience success or fail, which will lead them to different page. If the audience fail, the UI page indicating the miss will pop out. This page will return back to the drag page automatically in 3 seconds if the audience did not perform any action. This automated back is effective at letting the audience know how to respond with the missed of catching a star. If the audience success in dragging a star, a UI page will followed in immediately showing the information about the star being dragged. 2 categories of information are being showed so that audience would not be overwhelm with excessive input. 1 is the visual appearance of the star being caught, another is the wish and replies on the star.

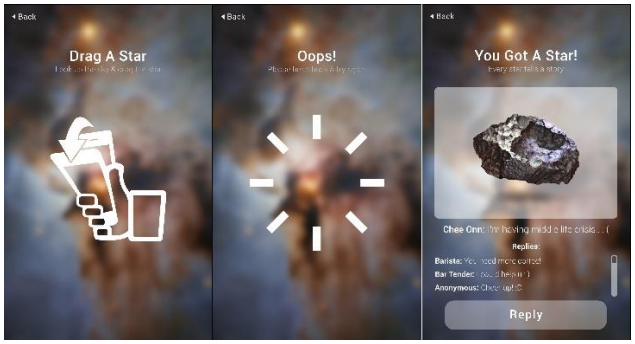

Figure 5: Mobile UI for star dragging task.

2.2.2 Interaction Task 2 – Create Your Star

Create your star UI page is where audience might spend a little bit more time compare to the drag a star UI page. In this page, audience able to play around and explore on the parameters

provided. Only 2 sliders are placed in this page which accompanied with very layman label. Audience would quickly understand what the 2 sliders are about. The visual appearance of the star is changing real-time when the audience move the slider, this would provide a constant feedback to them without any delay. This is a visual engagement due to the user interaction engagement. The audience are also given a choice to skip all the exploration by tapping at the "Randomize" button. This would randomize the slider value and give the audience convenience to proceed for the next interaction process.

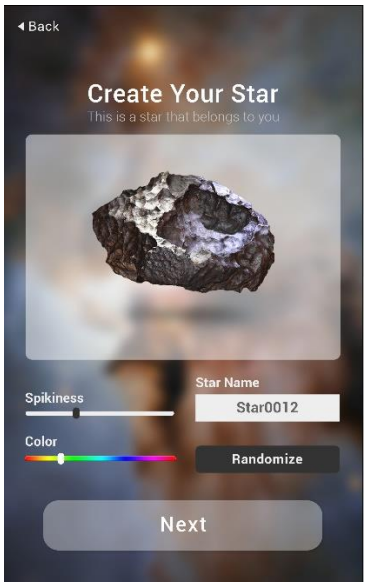

Figure 6: Mobile UI for star creation task.

2.3 Star Field Design and Composition

Star Field is the 1st visual component that exposed to the audience when approach to this interactive artwork. Therefore it is important to ensure that the star field is aesthetically pleasant and stunning in order to engage and catch their interest. The composition of the star field is designed based on the balance of positive and negative space. The positive space refers to the key focus of a visual while the negative space refers to the background of a visual. In this case, the star is the positive while the night sky is the negative. It is crucial to strike the balance between this two components because audience are exposed in front of a big immersive display, if the stars are over excessive and overwhelm, it would create a cramped and discomfort feeling. Fig. 7 showing the comparisons of the number of stars in the star field. The image on the top which provide more eyes resting space would look more pleasing to the audience. Color can represent emotion or affect emotion in real life [2]. In semiotic studies, some of the signs used color to deliver different messages. This interactive artwork is to stand at neutral point, to collect what audience want to share or express. Thus, black color background is chosen for a few reasons. Besides representing the color of night sky, black color background able to show the star easily without any distraction. By giving audience the possibility to select the color of the star generated, it is interesting to able to see the diversity of color in the star field.

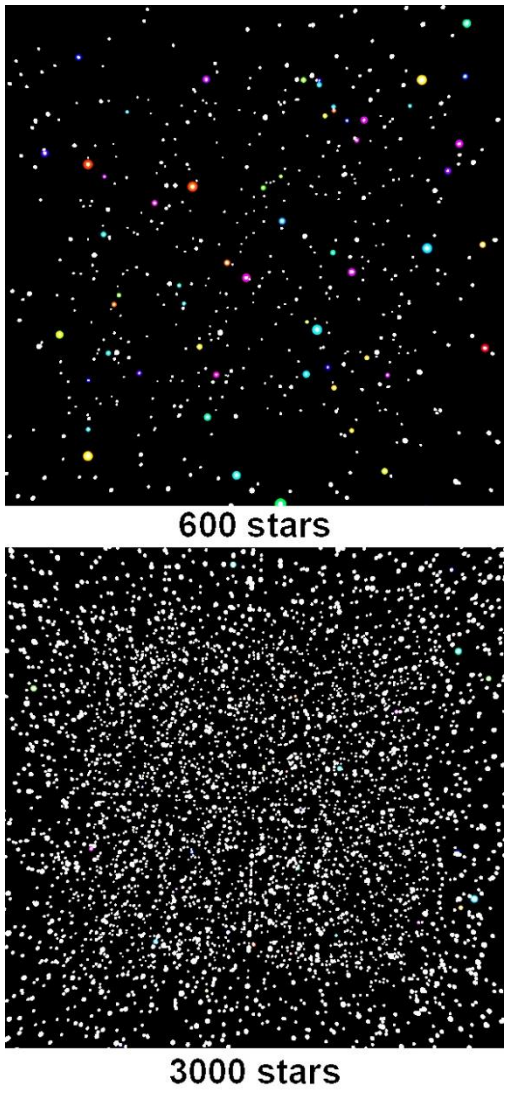

Figure 7: Comparisons of different total stars number in order to achieve the balance of positive and negative space.

2.4 Shooting Star

In order to engage the audience in the experience, before each star started to fly over the screen, it will gives out the visual cue to the audience. It will start to glow in the color of the star creator selected. The point of view would slightly move and zoom in to the glowing star. This movement is used to guide and move the audience eye through placement of elements so that the audience eyes move towards the visual cue [5]. These cues will signal the audience to anticipate for the shooting star and be ready to drag or catch it. When the shooting star start to move, the point of view

will resume back to the original position. The color design of the shooting star trail is based on the real meteor trail color. The shooting star is a burning object, so the trail will start off with a small part of blue color, follow by bright red then yellow and fade out with white color as demonstrated in Fig. 8.

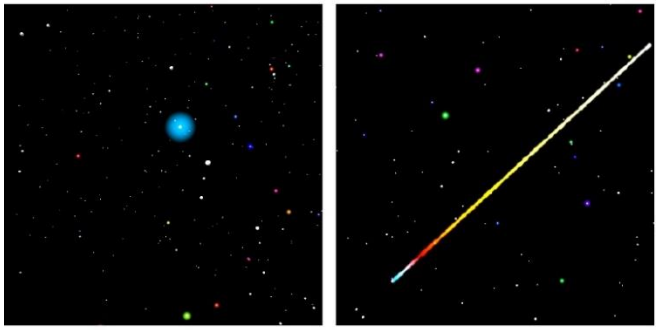

Figure 8: Screenshot of the shooting star giving visual cue and the color of the shooting star trail.

The direction of the shooting star heading to is determined by the initial position of the star. The direction consist of 2 o'clock, 4 o'clock, 8 o'clock and 10 o'clock. But because of the camera point of view is rotating in a very slow pace, which over time causing the star not shooting in the direction mentioned above. With the visual cues and the dynamic direction of shooting star, this would engage the audience in a predictable but unexpected experience.

3 VISUAL ENGAGEMENT AND TECHNICAL DESIGN

3.1 User-Generated Star

Star generation function is introduced in this interactive art installation. Audience able to generate their own unique design of star through the smartphone application. Every star is initially a primitive shape of sphere. Its vertices are being repositioned and hence creating a rock or star like shape and design. The "spikiness" is actually the parameters of noise scale, this setting will increase the fluctuation of the vertices position. When the noise scale is low, the fluctuation is lesser and the star will look more rounded and closer to its initial form - a sphere. Whereas when the noise scale is high, the fluctuation increase and making the vertices position in a higher difference which cause the star to look sharper. By increasing the "spikiness" will make the star look spikier, while decreasing it will make the star look rounder as showed in Fig. 9.

The "color" slider is where audience able to change the color of the star material, the moving of slider will change the value of the hue, where hue value will directly change the color of the star. And hence the material color is based on hue, saturation and luminosity (HSL) instead of red, green, blue (RGB) color.

Besides being able to decide the appearance of a star, audience also able to make a name for their star, leave their own name and wishes into the star. Once the audience complete the star generation process, all the data mentioned above will then being archived into the server database.

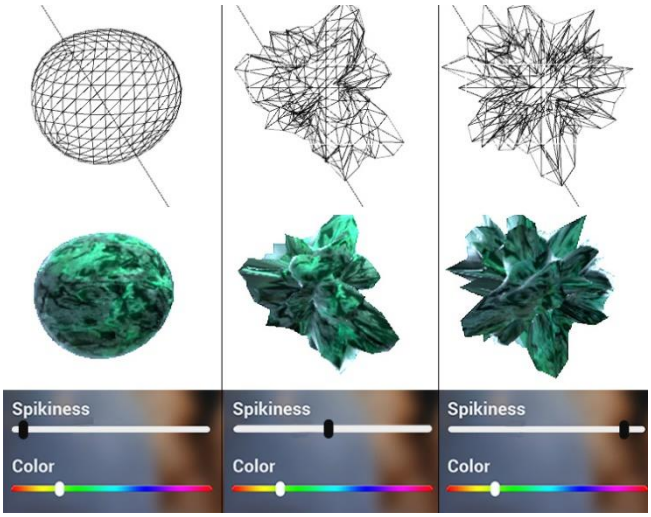

Figure 9: Screenshots of star with different noise scale fluctuation.

3.2 Crowd-Generated Star Field Projection

The star field projected on the screen is not just images and videos. It is composed by the stars generated by the audience. Painters produced a beautiful star field drawing through their attentive drawing skills and paintbrush. As for this crow-generated star field projection, it was produced technically through code and programming yet at the same time, the visual output is aesthetically engaging to the audience. All the stars that are archived in the server database are being retrieved and visually display on the projection screen. When all the stars are being display on the screen, it then formed into an aesthetically stunning star field. Each of the star placed on the night sky contains data and information. Recent study found out that meteorite are actually hard drive from space that could store where it has been travelling [4]. It is like a media storage drive which stores important information such as the name of the audience, their wishes and parameters that decide the visual appearance of the star. When looking at the projected screen, other than a stunning night sky full of stars, it is also a night sky that is saturated with digital data.

As audience are keeping on creating new star throughout the engagement, eventually the night sky will full of excessive stars and visually it will not be appealing. In order to maintain the aesthetic of star field, the star field is to limit at a range of 500-600 stars. So individual lifetime will be introduced to each of the star. Every star will start with a lifetime of 10, and it will be decreased by 1 lifetime every 20 minutes. With every increment of 50 total stars, it will decrease the lifetime deduction interval by 1 minute, which explain that when it is 500 stars, the lifetime will be deducted by 1 every 10 minutes. When the star reaches zero

lifetime, it will then goes off and vanished from the star field. This approach would help with controlling the total stars on the night sky. In order for the exceeded stars to not just vanish altogether from the screen, a certain rules are being implemented. If a star is being selected as the shooting star, it will decrease by 2 lifetime. This will increase the percentage of other stars to shine and become the shooting star. Besides, star that is dragged by the audience, will gain a reward of 1 lifetime. And if its wish got a reply from the audience, each reply will give a reward of 2 lifetime as well. These rules implemented will help to make the star field looking more dynamic and less predictable.

Star that are vanished will be given the chance to reborn if certain condition meet during the audience interaction. For a star to reborn, if one of the 5 star generated before the vanished star and one of the 5 star generated after the vanished star is being dragged by the audience, it will then reborn and appear back on the night sky with full lifetime. This method of controlling the star field provides the possibilities for the audience to be part of the control and not just limited to the star field system itself. The star field is a visual engagement output due to the user interaction engagement with the artwork.

3.3 Shooting Star Categorization and Selection

Stars that are placed on the night sky will get the chance to be selected by the star field system to be the shooting star. The method of selection is going through 2 steps of process, i) categorization, ii) random selection. All the stars are first being categorized into 2 categories. The 1st category is the category which include the 20 latest star generated and also the star that has less than 5 replies on the wish. The 2nd category will be the category consist of all other stars exclude those in category 1. Categorization algorithm as showed in Fig. 10. Category 1 will have more priorities to be selected as compare to category 2. Category 1 will take 3 turns then only category 2 will take 1 turn for star selection. The star is selected in a random manner. There will be an interval of 10-20 seconds for the star selection to happen which means that this interval will decide how long it takes for a shooting star to appear. This approach would ensure that the new stars that are just generated by the audience and the star that are less interacted can be draggable during the interaction. And at the same time, the old stars would also get the chance to shine and be the shooting star.

3.4 Mechanical of Drag a Star

Audience could perform a drag gesture whenever seeing a shooting star. The key element that making the drag gesture work is through smartphone accelerometer sensor data. Accelerometer sensors are believe to have a main role in future mobile market since the implementation by Nintendo and Apple [6]. It is the timing that determined whether the audience can successfully catch the star in their smartphone. Once the shooting star is being selected, it will gives out a visual cue of glowing as mentioned in Section 2.4. After the visual cue, the shooting star will fly over the screen with a certain speed.

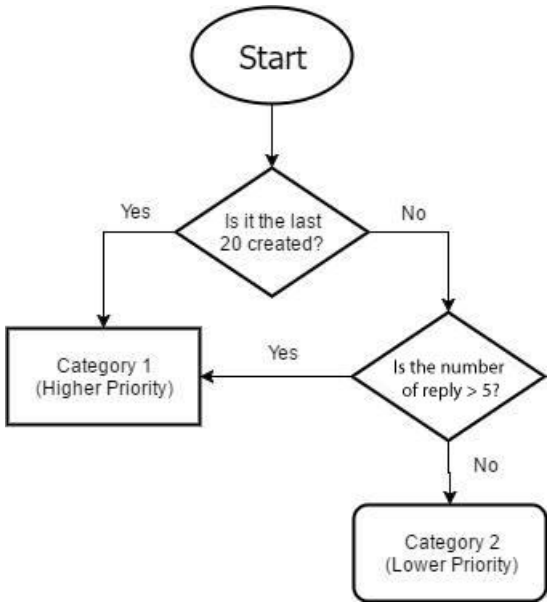

Figure 10: Algorithm of star categorization.

The speed of the shooting star is determined by the factor of user interaction engagement. If a shooting star had been dragged by the audience, the next time it got selected as the shooting star, the speed of it will increase. The higher the number of drag, the faster the speed.

During this star shooting period, the star field system will send a message to the server database to indicate that it is draggable. Whenever the audience perform the drag gesture with their smartphone, the smartphone application will check with the database server to see if it is allow to drag. If the condition match, then the audience will be able to catch the shooting star into their smartphone. Likewise, when there is no shooting star, the star field system will send a message to the server database to indicate that it could not be dragged. After the successful drag, the audience will be able to see all the data that contained by the shooting star. The data of noise scale and color is being visually display in the form of the star appearance, whereas the name of star, name of creator, the wish and the reply, can be seen in the form of text in the smartphone application UI.

3.5 Evaluation

Evaluation of the interactive artwork system parameters were carried out in order to provide the best engagement experience to the audience. Visual Level and Challenging Level are the key elements that being test out in order to find out the most suitable parameters for the interactive art.

The Visual Level is the element that decide how the star field is going to look like visually. $V\ell$ is Visual Level, $\mathcal{S}$ is Total Star Number, $\mathcal{C}$ is the Number of Different Star Color, while $\mathcal{L}$ is the Average of Star Lifetime. The formula for calculating the Visual Level is written as follow:

$$V\ell = \frac{\mathcal{S} \times \mathcal{C}}{\mathcal{L}} \quad (1)$$

The multiple of Total Star Number and Number of Different Star Color divided by the Average of Star Lifetime would determine Visual Level of the star field.

As for the Challenging Level, it is the element that focus on how challenging it is for the audience to felt when performing the task of dragging the star. Cℓ is Challenging Level, $\mathcal{s}$ is Speed of Shooting Star and i is the Interval of Shooting Star Appear. The calculation of Cℓ is written as follow:

$$C\ell = \mathcal{s} \times i \quad (2)$$

The calculation is done by multiplying the Speed of Shooting Star and Interval of Shooting Star Appear.

5 sets of different Vℓ and Cℓ are being used for evaluation purpose as showed in Fig. 11.

Visual Level Description	Visual Level (Vℓ)	Total Star Number ($\mathcal{S}$)	Number of Different Star Color ($\mathcal{C}$)	Average of Star Lifetime ($\mathcal{L}$)
Very Unpleasant	4	10	4	10
Unpleasant	94	150	5	8
Neutral	300	300	6	6
Appealing	788	450	7	4
Visually Stunning	2400	600	8	2

Challenging Level Description	Challenging Level (Cℓ)	Speed of Shooting Star ($\mathcal{s}$)	Interval of Shooting Star Appear (i)
Very Easy	5	5	1
Easy	30	6	5
Neutral	70	7	10
Challenging	120	8	15
Very Challenging	180	9	20

Figure 11: Tables showing 5 sets of different system parameters which result in different Vℓ and Cℓ.

With these 5 different sets of parameters, a small sample group of 10 is being engaged to carry out the testing. Sample group is given to interact with this interactive art piece for 5 times with 5 different system parameters setup. Sample group are then being assessed to find out their satisfaction level in term of visual pleasing and challenging. Satisfaction level is a hedonic quality in UX measurement which is a non-task oriented quality aspect [3]. The average of their satisfaction level are then being calculated and showed in Fig. 12 and 13.

Based on the result in Fig. 12, it was found out that the sample group are satisfied when the Visual Level is at its highest. While Fig. 13 showed that satisfaction level of the sample group dropped when it is very challenging. Result showed that audience would prefer not over challenging to remain the excitement and addiction.

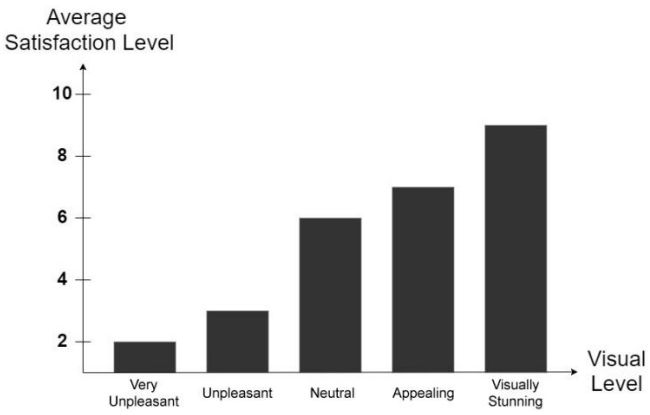

Figure 12: Chart of average satisfaction level to visual level

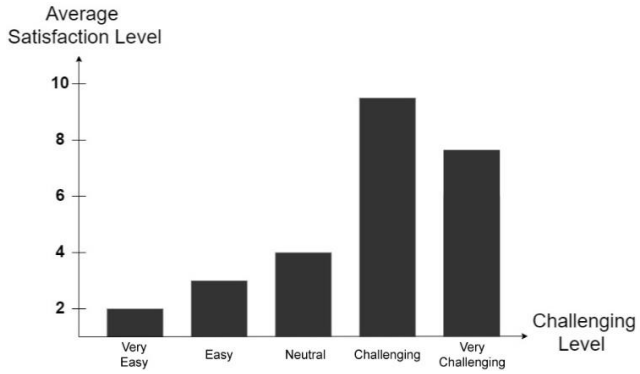

Figure 13: Chart of average satisfaction level to challenging level.

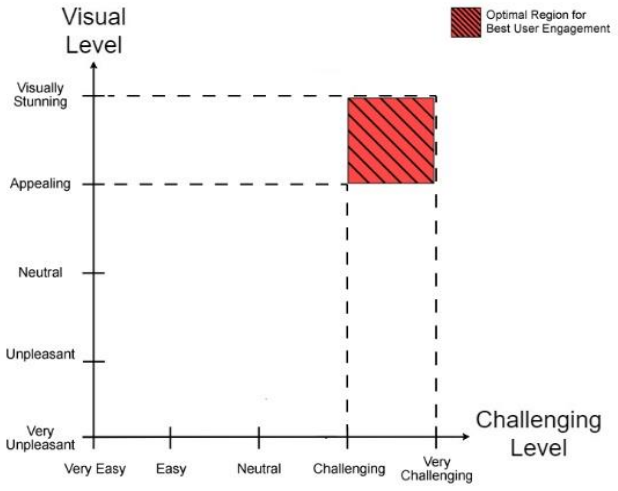

Figure 14: Mark area showing the sweet region for best user engagement.

By combining both evaluation result as seen in Fig. 14, it is then being able to find out the optimal interactive artwork parameters which would be able to engage the audience by providing them from visual engagement to user interaction engagement.

4 CONCLUSIONS

This interactive art installation tries to engage the audience with an immersive and interactive experience, in allowing audience to generate their own star and share their wishes to crowd-generated star field projection. The star field visual component which greatly affected by the audience action is what enable the connection and engagement. It is to develop a platform for audiences to have physical movement while having the authorities to determine how the art piece going to look like. To achieve the completeness of this art piece, user-generated content played the key role. It involve the audience from visual engagement through user interaction engagement. Concurrently, the interactive art installation have great potential in implementing space and aviation theme site and context.

5 ACKNOWLEDGEMENT

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