

Dimasalang: An Augmented Reality and Interactive Visual Novel Application of José Rizal's Noli Me Tangere

Mariecris A. Arcilla¹, Jayson A. Germono Jr¹, Kimberly B. Samia¹,
and Mary Jesusa Meanh G. Zingalao¹

Abstract

Noli Me Tangere is a Filipino Novel by Dr. Jose P. Rizal that opened the eyes of the Filipinos during the Spanish oppression that lasted for 333 years. It tells the story of the brutality and corruption of the Spanish rulers during their time in the Philippines. Despite the country having this piece of literature, it is shown that the Philippines has shown that Filipino students fared worst among 79 countries in reading comprehension during the pandemic online learning. With the emerging technology being used daily, the researchers decided to make an app to pique the interest of Filipino students to pick up Noli Me Tangere and learn it through a Visual Novel with elements of Augmented Reality (AR). Thus, the researchers created the Dimasalang application to provide a more interactive and enjoyable learning experience for students to learn about Noli Me Tangere. This application is implemented on Android devices. The novel will be based on dialogical storytelling. The Augmented Reality will be a feature that presents 3D Artifacts that are known or mentioned in the novel itself.

Keywords: augmented reality, Noli Me Tangere, digital story telling

Introduction

For decades, Philippine Literature has been part of its education for students to revisit their culture, reminding them of the literature that existed at the time. Books such as "Ibong Adarna" and "Florante at Laura" have been present and are being studied in many schools throughout the Philippines. These are notable Filipino literary classics taught in secondary schools in the Philippines per the Department of Education and Commission on Higher Education's curriculum.

Literature that promotes learning can dramatically increase learner's achievement. This classic literature can be turned into different types of medium. According to (Charter, 2020), An instructive video, for example, may supply a student with fresh insights. However, an appealing worksheet may allow the learner to

practice a new skill learned in class. This approach facilitates learning by allowing the student to explore the knowledge independently and offering repetition. All learning materials, regardless of type, serve some purpose in student learning.

To make these books more fascinating, some publishers use drawings to aid their readers' comprehension of the story. Character designs are one type of artwork. An article from (Pavlova, 2019) stated that character designs is all about uniqueness and diversity, keep inventing all kinds of new character designs and styles inspired by anything and everything. While some trends occurred naturally with the ever-growing potential of the latest graphic and illustration software on the market, others were born from the avant- garde thinking of modern

¹Bachelor of Science in Computer Science, Institute of Computing Studies and Library Information Science

artists, and thirds arose from the needs of the business and marketing world.

One of the best classic pieces of literature with many characters and good character designs is two works written by the National Hero of the Philippines, Dr. Jose Rizal Noli Me Tangere and El Filibusterismo. Rizal wrote in a letter to the painter Felix Resurrecion Hidalgo: "I have laughed about our misfortunes because nobody wanted to weep with me." One index of the novelist's aims is to write a satirical novel filled with painful truths. (Remoto, 2022) The characters from Noli Me Tangere and El Filibusterismo are about the Filipinos in the time of Rizal and how brutal and corrupt the Spanish rulers were in the Philippines.

Despite having beautiful works of literature and character designs, Philippines showed that Filipino students fared worst among 79 countries in reading comprehension and second- lowest in both mathematical and scientific literacy during the pandemic online learning. (Baclig, 2022) Online learning has been draining and exhausting for students and professors because of the lack of resources such as, gadgets and internet connection. Unfortunately, (Reyes, 2019) stated that due to a lack of resources, most high schools only cover four of the Philippines' significant literary classics. When a Filipino who grows up in our education system only knows Ibong Adarna, Florante at Laura, Noli Me Tangere, and El Filibusterismo – and only those four – The Filipinos can see that they will fail to promote themselves as a culture through art and literature.

What's more, if some schools have access to the new and latest technology, those who do are more likely to succeed. For those who could not obtain adequate knowledge to learn technological skills. As a result, when they reach the university level, their technological skills are discovered to be lacking as well. After enrolling in a university, those students gain access to proper learning assistance and computer-based

tasks. Even so, advanced technologies are not widely used.

Furthermore, allowing students to virtually experience the world is an effective and efficient way to practice in educational settings. Students can learn different things through modern technologies. For example, Augmented Reality (AR) and Virtual Reality (VR) can speed up student's learning in closely in any field. With the help of augmented reality, it permits students to absorb knowledge by immersing themselves in the subject center through true-to-life graphics. These simulated realities have a lot of potential when it comes to traditional teaching and learning methods where it may look dull or ineffective, inefficiently explaining essential topics to pupils because of that the instructor can easily monitor maximum students through these simulated realities, and that virtual experience is powerful to encourage and technologically motivate students (Solutions, 2022). AR and VR in education helps the students easily acquire, process, and remember the information. Additionally, AR makes learning itself more engaging and fun. It is also not limited to a single age group or level of education, and can be used equally well in all levels of education; from pre-school up to college, or even at work.

One of the implementations of AR and VR is in India where schools and teachers developed an interactive textbook that helps explain text to students using 3D images, audio clips, and videos (Zitter, 2020). Implementing these new techs in the field of specialization such as education, will further assist students in their reading comprehension and cultural knowledge through the use of these visual representations. By this example, the Philippine Literature may be able to carry out their heritage and culture, modernize their practices, and help build interests for younger generations to read their culture's literature by suggesting the use of these 3D models, illustrations and incorporating them in books and other printed materials; and finally,

the multimedia industry, particularly multimedia practitioners, to further assist students in their reading comprehension through the use of these visual representations. Throughout, the Filipino literacy will improve and gain knowledge and efficiency about having an AR as an educational tool and AR will come as a way to learn comfortably and efficiently.

Statement of the Problem

Noli Me Tangere is a novel by Jose P. Rizal, and reading such a novel will take up most of the reader's time, mainly since the novel contains many pages and chapters. The novel's contents can be overwhelming, especially in a day. This study aims to address the following:

1. Modern technology could be utilized better in education in the Philippines, especially when learning about the culture and historical pieces of literature. Thus, students need to take advantage of many opportunities to learn in the medium the teaching body could take advantage of.
2. Students find reading books and novels uninteresting due to the time it takes to finish them and the material itself not having any interactive functions, unlike smartphones, which have many features that get the student's attention to view the contents.
3. Students spend their time online on social media applications/sites as a source of entertainment. Thus, taking less of their time to learn things about their culture and historical pieces of literature that could help them in their studies.

Objectives of the Study

In order to create and develop Dimasalang: An Augmented Reality and Interactive Visual Novel Application of José Rizal's Noli Me Tangere, the study aims:

1. To provide a modern and widely available medium for students to use, such as smartphones to learn about Jose Rizal's Noli

Me Tangere and make use of the modern technology and software to build an 1800s themed User Interface and User Experience Design that can help the users immerse themselves in reading Noli Me Tangere.

2. To make reading more interesting for students through a visual novel centered application and use elements to make the students be curious about the story of Noli Me Tangere and the characters.
3. To help the students pique their interests in learning about Noli Me Tangere through the use of Augmented Reality as an extra feature the students could use to explore and immerse themselves in the story.

Scope of the Study

1. The application will cover the first 3 chapters of Noli Me Tangere.
2. The application focuses on the visual story telling of Noli Me Tangere through dialogical story-telling and showing the character models for the story.
3. The application features a quiz game after every end of the chapter to challenge the user's knowledge in what they have learned while progressing through the visual novel and the questions on the quiz shuffles. The quiz game is optional for completion and not a requirement to move to the next chapter.
4. The application will feature a character gallery wherein the user can view said characters and view their design, description and role in the story.
5. The users can use the AR features of the app through artifacts which is an added feature and extra content for the users to explore.
6. Two types of AR Tracking are added in the AR Features; a.) Image Tracking which the AR Camera tracks and detects an image to be able to view the 3D object, and b.) World Mapping where the AR Camera has a preloaded 3D object and the user can place the 3D object wherever they want to view said object.

7. There will be music playing in the background of the application that feature's Filipino orchestrated songs to help the users immerse themselves while using the app.
8. The Options menu features a volume slider to adjust the app's sound and an about section that contains the credits for the development of the app.

Delimitations of the Study

1. The application can only present the first 3 chapters of José Rizal's Noli Me Tangere Novel.
2. The application will only be implemented in Android-based mobile devices.
3. The AR feature will only focus on artifacts that will be a feature on the app.
4. The AR objects that will be implemented in the app will only be static objects.
5. The program may not be completely capable of detecting picture trackers with a low-resolution camera.
6. The application will not provide lectures or lessons about the novel or Jose Rizal.

Conceptual Framework / Theoretical Framework / Paradigm of the Study

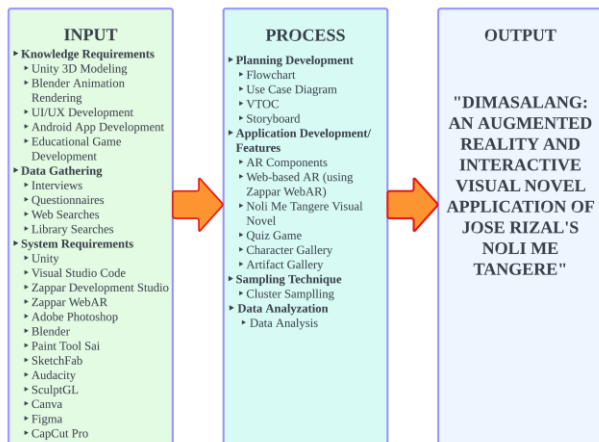


Figure 1. Input-Process-Output Conceptual Framework

Methodology

Research Design

Descriptive research design is a type of research design that aims to obtain information to systematically describe a phenomenon, situation or population. According to (Siedlecki, 2020), The purpose of descriptive design is to describe individuals, events or conditions by studying them as they are in nature. The researchers did not manipulate any of the variables but rather only describes the sample and/or the variables.

System Development Methodology

The researchers used the Agile Development Process for this study. This methodology is based on iterative and incremental development of software development. According to (Kumar & Bhatia, 2012), the principle of agile software development proposes that “at regular intervals”, the team reflects on how to become more effective. This methodology is used to achieve higher quality software in a shorter period of time, self-organizing teams, customer collaboration, less documentation and reduced time to market.

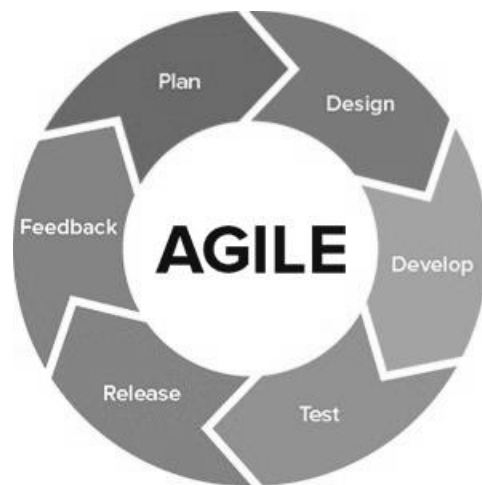


Figure 2. Agile Software Development Methodology Diagram

1. Plan refers to the ability of the researchers to address changes and additions to the projects easily so that the project scope shouldn't be seen as unchangeable.

The researcher's plans are:

- Discussing the required features for the application.
 - Discussion of details for each feature of the application.
 - Assigning tasks to team members.
 - Monitor the progress of each tasks assigned.
 - Check if the progress of the tasks is on, ahead or behind schedule.
2. Design is a highly collaborative way of design and developing new products that breaks big tasks into groups of subtasks to be performed or so called "sprints".
 3. Development refers to the process of creating software based on a defined plan. The researchers design and develop the system based on the defined plan and the gathered information from the respondents.
 4. Test refers to the evaluation and verification of a software application of what it is supposed to do. The benefits of testing are to prevent bugs and errors, reduce development costs and improve the software's performance.
 5. Release is the distribution of the final version of a software application. In agile development, release is a deployable software package culminating in several iterations and can be made before the end of an iteration.
 6. Feedback refers to the respondent's response/review after testing of the software. Feedback will help the researchers meet user demand and satisfaction. The researchers can utilize these feedbacks to improve the software in development. Asking the respondents for suggestions on how the researchers can improve the software.

Participants and Data Analysis

The researchers decided to conduct a study at Angeles City National High School, five (5) sections from the Grade nine (9) level as the participants of this study as these students are taking Noli Me Tangere as their lesson in their Filipino History Subject. The total respondents that the researchers acquired are a total of 153 respondents, 150 students in ACNHS and three (3) IT Experts.

The researchers used cluster sampling in Angeles City National High School. Cluster sampling is a technique in which clusters of participants representing the population are identified and are included in the sample. The main aim of this sampling technique can be specified as cost reduction and increasing the levels of efficacy of sampling (Jackson, 2011).

To gather results from respondents, the researchers would use frequency count and percentage count distributions to compute the results. Frequency count distributions are visual displays that organize and present frequency count so that the information can be interpreted more easily. (ABS, 2022). To determine the percentage, count or the frequency distribution in which the individual frequencies are shown as percentage of the total frequencies, the researchers must use the following formula:

$$P = (F/N*100)$$

Wherein: P = Percentage
 F = Frequency Count
 N = Total Number of

Respondents

To determine the percentage, count distribution, first multiply the quotient of the frequency count divided by the total number of respondents by one hundred (100).

The mean is also necessary. The mean is a measure of central tendency of a probability

distribution. It is the average or the most common value in a collection of data. (CFI, 2022)

In order to get the mean of the evaluation results, the researchers must follow this formula:

$$MEAN = ((NV * Rating_1) + (NV * Rating_2) + (NV * Rating_3) + (NV * Rating_4) + (NV * Rating_5))/NR$$

Wherein: NV = Number of Votes
NR = Number of Respondents

To determine the total mean sample, computer the total mean of all sub-criteria divided by the number of sub-criteria in a given criterion.

After getting the mean of each criterion, the researchers will rank each criterion accordingly and make a conclusion.

Table 1. Likert Rating Scale

| Numerical Rating | Equivalent |
|------------------|------------|
| 5 | Excellent |
| 4 | Very Good |
| 3 | Good |
| 2 | Fair |
| 1 | Poor |

Table 1 is a scale that will indicate the measurement of the response of the users based on how they felt and what they experience while using the application. These ratings will appear in the questionnaires that will be answered by the respondents to evaluate the application. For each numerical rating there is an equivalent descriptive interpretation.

Table 2. The Scale for Interpreting the Evaluation Results

| Numerical Rating | Equivalent |
|------------------|------------|
| 5.00 – 4.20 | Excellent |
| 4.19 – 3.40 | Very good |
| 3.39 – 2.60 | Good |
| 2.59 – 1.80 | Fair |
| 1.79 – 1.00 | Poor |

Results and Discussion

The respondents for the evaluation of Dimasalang consisted of 150 users from five (5) different Grade 9 sections in Angeles City National High School and three (3) IT experts. For a total of 153 respondents.

Table 3. Assessment of IT Experts

| Criteria | Mean | Descriptive Rating |
|-------------------------|------|--------------------|
| Functional Stability | 4.78 | Excellent |
| Performance Efficiency | 4.89 | Excellent |
| Compatibility Usability | 4.50 | Excellent |
| Reliability | 4.83 | Excellent |
| Security | 4.75 | Excellent |
| Maintainability | 4.00 | Very Good |
| Portability | 4.80 | Excellent |
| Overall Mean | 5.00 | Excellent |
| | 4.69 | Excellent |

Table 3 shows the results from the evaluation that have been conducted by the I.T Experts. The overall mean that was given to the application was 4.69 which is equates to an Excellent rating. This shows that the application has overall, met the user’s requirements. The details for each criterion for the app will be shown below.

The IT experts gave the application’s functional stability a rating of 4.78 which equates to an Excellent rating. This rating greatly suggest that the application’s function was complete, correct and appropriate. The performance efficiency of the application was given a rating of 4.89 that equates to an Excellent rating. Suggesting that the application was able to load completely without any issues.

The IT experts deemed that the application was able to run and co-exist with other applications that are running in the background, with a very minimal to no issues found, giving the compatibility of the application a 4.5 rating that equates to an Excellent rating.

The IT expert deemed that the application was usable and find the application easy to learn and use. Thus, giving the usability a rating of 4.83 which equates to an Excellent rating.

The application’s reliability was given a rating of 4.75 with an Excellent mark. This suggests that the application provides accurate, mature and available content for its users.

However, the application’s security rating was given a score of 4 with a Very Good mark. This criterion was the lowest rating that the researchers got for the application. But for the application’s maintainability, it was given a rating of 4.80 with an Excellent mark. Proving that the application is able to be effective and reusable even with multiple testing.

For the last criterion which is the application’s portability, the IT experts rated it with a 5.00 with an Excellent mark. Which is the highest rating that the researchers got. This means that the IT expert find the application to be working properly on the Android devices it was tested and it was easy to install and uninstall.

Overall, the highest rating for application was its portability with a score of 5.00, and it is shortly followed by its performance efficiency with a 4.89 score, then by usability with a 4.83 rating, then maintainability with 4.80, functional stability with 4.78, reliability with 4.75, compatibility with 4.50 and lastly security with a rating of 4.00.

Table 4. Assessment of Students/Users

| Criteria | Mean | Descriptive Rating |
|------------------------|------|--------------------|
| Functional Stability | 4.46 | Excellent |
| Performance Efficiency | 4.38 | Excellent |
| Usability | 4.54 | Excellent |
| Reliability | 4.43 | Excellent |
| Portability | 4.62 | Excellent |
| Overall Mean | 4.49 | Excellent |

Table 4 shows the results of the evaluation that the students/users have conducted. The overall

mean that was given to the application was 4.49 which equates to an Excellent rating. This shows that the application has met the users’ requirements. The details for each criterion for the app will be shown below.

The functional stability of the application was rated by the students/users at 4.46 which equates to an Excellent rating. This rating greatly suggest that the application’s function was complete, correct and appropriate.

For the performance efficiency of the application, it was given a rating of 4.38 that equates to an Excellent rating by the users. Suggesting that the application was able to load completely without any issues.

The users deemed that the application was usable and find the application easy to learn and use. Thus, giving the usability a rating of 4.54 which equates to an Excellent rating.

The application’s reliability was given a rating of 4.43 with an Excellent mark by the users. This suggests that the application provides accurate, mature and available content for its users.

Lastly, the application’s portability was given a 4.62 score with an Excellent mark by the users. Which is the highest rating that the researchers got. This means that the users find the application to be working properly on the Android devices it was tested and it was easy to install and uninstall.

Overall, the highest rating that the application got was a 4.62 score for its portability. Followed by usability with a 4.52 score, then by functional stability with a score of 4.46, then by reliability with a score of 4.43, and lastly the application’s performance efficiency got a score of 4.38.

Based on the evaluation results of the 150 students from the five (5) sections at Angeles City National High School and the three (3) IT Experts, the application was found to be suitable and usable for students who are learning about

Noli Me Tangere. The highest rating the application got was from its portability for both the users and the IT Experts. Both the users and IT Experts' overall mean was given an Excellent rating. There are still features in the application that needs to be improved in terms of security given that it had the lowest rating for IT Experts. The researchers also viewed and looked into the comments and suggestions given by the 153 respondents for further development of the application.

Conclusion

The researchers acquired new knowledge and a better understanding of the field as they progressed in the development of the application.

The conclusions are:

1. The researchers have successfully made an interactive and immersive application using Visual Novel Story Telling and Augmented Reality (AR) that is Android-based. The researchers also provided paper-printed images that the students could use to track the 3D Objects the researchers made. The application's success was backed by the Excellent overall rating by the IT Experts and the students/users.
2. The application offered a colorful and well-made character artworks, backgrounds, UI and UX design as said by the IT Experts and the students. The application used old, 1800s themes and backgrounds that the researchers had made to immerse its users. This means that the application was deemed to be interesting and engaging for both students and IT Experts to try and learn about Noli Me Tangere and be immersed in its story.
3. The application can be used as an introduction to Noli Me Tangere for users who are intrigued to know about the novel and be used as a source of entertainment and knowledge as well, because the application provides an immersive experience while progressing through the dialogical visual novel, a quiz game that can challenge the users' knowledge

retention and features other contents that the users can explore such as the character gallery which users can use as art references and the artifact gallery which can be used for the Augmented Reality part of the application.

Recommendations

The researchers successfully provided an application that met the research objectives and goals of providing the user an interactive learning experience application. It has a Dialogical Visual Novel of Noli Me Tangere, Character Gallery and an Artifact Gallery, which is the Augmented Reality of the application. The Augmented Reality has 2 options, which is the image tracking and world mapping. The 3D Objects for the AR uses references from the Novel and descriptions.

The researchers suggest that the application would be more efficient if the following recommendations would be considered:

1. Provide a detailed information about the quiz results and give explanation as to why it is the correct answer.
2. Provide voice lines for the characters to further immerse the users in the experience in the Visual Novel.
3. Provide lessons and trivia that could further use the application as a suitable learning material for the students. This could be used as an alternative for students who don't have textbooks for the novel or don't have pamphlets available.
4. Use a better AR Software that could be integrated in the application itself instead of using a third-party WebAR Software that redirects users outside of the app.
5. Enhance the user experience by improving the System UI and minimizing the application size so that users can install the app faster and save storage space.

References

- ABS. (2022). Statistical Language - Frequency Distribution. Retrieved from Australian Bureau of Statistics: <https://www.abs.gov.au/websitedbs/D3310114.nsf/home/statistical+language+-+frequency+distribution>
- Anderson, C. J., & Allen, M. (2018, December 19). Library Research. Retrieved from Sage Research Methods: <https://methods.sagepub.com/reference/the-sage-encyclopedia-of-communication-research-methods/i7725.xml>
- Android Developers. (2022, October 12). Get started with the NDK. Retrieved from Android Developers: <https://developer.android.com/ndk/guides>
- Audacity. (2022). Audacity. Retrieved from About: <https://www.audacityteam.org/about/>
- Baellig, C. E. (2022, April 08). When 10-year-olds can't read: The dulling of PH education. Retrieved from INQUIRER.net: [https://newsinfo.inquirer.net/1580203/when-10-year-olds-can't-read-the-dulling-of-ph-education](https://newsinfo.inquirer.net/1580203/when-10-year-olds-can-t-read-the-dulling-of-ph-education)
- Blender. (2022). Blender. Retrieved from About: <https://www.blender.org/about/>
- CFI. (2022, January 30). Mean. Retrieved from Corporate Finance Institute: <https://corporatefinanceinstitute.com/resources/knowledge/other/mean/>
- Charter, R. (2020, October 25). OLCreat: General Teaching Methods: Purpose of teaching and learning materials. Retrieved from OLCreat: <https://www.open.edu/openlearncreate/mod/page/view.php?id=168509>
- Dealessandri, M. (2020, January 16). Games Industry.biz. Retrieved from What is the best game engine: is Unity right for you? <https://www.gamesindustry.biz/what-is-the-best-game-engine-is-unity-the-right-game-engine-for-you>
- Edwards, L. (2022, May 10). Tech & Learning. Retrieved from What is Canva and How Does It Work? Tips and Tricks: <https://www.techlearning.com/how-to/what-is-canva-and-how-does-it-work-for-education>
- Gamescrye. (2017, October 17). How to Storyboard Your Game. Retrieved from Gamescrye: <https://gamescrye.com/blog/how-to-storyboard-your-game/>
- Gauld, C. (2018). Introducing Zappar WebAR. Retrieved from Zappar: <https://www.zappar.com/blog/introducing-zappar-mobile-webar/>
- George, T. (2022, March 10). Types of Interview in Research | Guide & Examples. Retrieved from Scribbr: <https://www.scribbr.com/methodology/interviews-research/>
- Gonzales, R. (2017, July 25). WIRED. Retrieved from Figma Wants Designers to Collaborate Google-Docs Style: <https://www.wired.com/story/figma-updates/>
- IDF. (2022). User Interface Design. Retrieved from Interaction Design Foundation: <https://www.interaction-design.org/literature/topics/ui-design>
- Jackson, S. (2011). "Research Methods and Statistics: A Critical Approach" 4th edition. Cengage Learning.
- Jaehnig, J. (2019, May 15). Zappar Launches Updated Platform for Making AR Apps. Retrieved from AR Post:

<https://arpost.co/2019/05/15/zappair-launches-updated-platform-for-making-ar-apps/>

Kastrenakes, J. (2020, February 20). The Verge. Retrieved from How photoshop became a verb: <https://www.theverge.com/2020/2/19/21143794/photoshop-30th-anniversary-adobe-verb-origin-story>

Kumar, G., & Bhatia, P. K. (2012, August 4). Impact of Agile Methodology on Software Development Process. Retrieved from *International Journal of Computer Technology and Electronics Engineering*:

https://www.researchgate.net/profile/Gaurav-Kumar-175/publication/255707851_Impact_of_Agile_Methodology_on_Software_Development_Process/links/00b49520489442e12d000000/Impact-of-Agile-Methodology-on-Software-Development-Process.pdf

Lardinois, F. (2015, April 30). Techcrunch. Retrieved from Microsoft Launches, Visual Studio Code, A Free Cross-Platform Code Editor for OS X, Linux and Windows: <https://techcrunch.com/2015/04/29/microsoft-shocks-the-world-with-visual-studio-code-a-free-code-editor-for-os-x-linux-and-windows/>

Lucidchart. (2022). UML Use Case Diagram Tutorial. Retrieved from Lucidchart: <https://www.lucidchart.com/pages/uml-use-case-diagram/>

Lucidchart. (2022). What is a Flowchart? Retrieved from Lucidchart: <https://www.lucidchart.com/pages/what-is-a-flowchart-tutorial/>

Mehta, D. (2021, March 8). Does TikTok own CapCut? The best video-editing app ever! Retrieved from Hashtag Hyena: <https://hashtaghyena.com/tiktok/does-tiktok-own-capcut-the-best-video-editing-app-ever/>

Pavlova, I. (2019). Top Character Design Trends for 2019: Bold & Impressive. Retrieved from Graphic Mama: <https://graphicmama.com/blog/top-character-design-trends-for-2019/>

PGCC. (2022, June 6). Searching the Web. Retrieved from Library & Learning Resources: <https://pgcc.libguides.com/c.php?g=60038&p=385669>

Remoto, D. (2022, January 15). A Novelist's Diagnosis. Retrieved from The Philippine Star: <https://www.philstar.com/opinion/2022/01/15/2154030/novelists-diagnosis>

Reyes, G. (2019, MAY 29). [OPINION] Appreciating the Filipino identity through our literature and culture. Retrieved from Rappler.com: <https://www.rappler.com/moveph/231763-appreciating-filipino-identity-through-literature-culture/>

Siedlecki, S. L. (2020). Understanding Descriptive Research Designs and Methods. Retrieved from Clinic Nurse Specialist: https://journals.lww.com/cns-journal/Citation/2020/01000/Understanding_Descriptive_Research_Designs_and.4.aspx

Solutions, E. E. (2022). AR and VR in Education: Extended Reality Uses. Retrieved from Enterprise Engineering Solutions: <https://www.eescorporation.com/>

Systemax. (2022). Home/ PaintTool SAI. Retrieved from Easy Paint Tool SAI: <https://www.systemax.jp/en/sai/>

Techopedia. (2020, October 6). Android SDK. Retrieved from Techopedia: <https://www.techopedia.com/definition/4220/android-sdk>

Techstars. (2013, April 3). Techstars. Retrieved from Techstars NYC 2013 Class: <https://web.archive.org/web/20150924113812/http://www.techstars.com/techstars-nyc-2013-class/>

Thomas, L. (2020, September 7). Cluster Sampling | A Simple Step by Step Guide with Examples. Retrieved from Scribbr: <https://www.scribbr.com/methodology/cluster-sampling/>

Tyson, M. (2022, September 23). What is JDK? Introduction to the Java Development Kit. Retrieved from InfoWorld: <https://www.infoworld.com/article/3296360/what-is-the-jdk-introduction-to-the-java-development-kit.html>

Upadhyay, S. (2022, November 18). What is An Algorithm? Characteristics, Types and how to write it. Retrieved from SimpliLearn: <https://www.simplilearn.com/tutorials/data-structure-tutorial/what-is-an-algorithm/>

Yasuzawa, M. (2019, August 1). Styly Magazine. Retrieved from Introduction to SculptGL – A Free 3D Sculpting Tool: https://styly.cc/tips/3d_sculptool_sculptgl/

ZapWorks. (2022). Image Tracking. Retrieved from ZapWorks: <https://docs.zap.works/universal-ar/a-frame/tracking/image-tracking/>

ZapWorks. (2022). Instant World Tracking. Retrieved from ZapWorks: <https://docs.zap.works/studio/getting-started/instant-world-tracking/>

Zitter, L. (2020, August 07). How VR and AR Can Be Used to Support Students with Special Needs. Retrieved from Tech Learning: <https://www.techlearning.com/how-to/how-vr->

[and-ar-can-be-used-to-support-students-with-special-needs](#)