Republic of the Philippines
Technological University of the Philippines
Manila
COLLEGE OF SCIENCE

COMPUTER STUDIES DEPARTMENT
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SOFTWARE ENGINEERING 2

THIRD EYE – APPLICATION FOR BLIND
AND VISUALLY IMPAIRED

Names:
Brondial, Kenneth A.
Burog, Austin Charles
Empino, Jayrald B.
Junsay, Jean Allyson S.
Lizan, Vann Chezter

Year & Section
BSCS NS 3A

Prof. Dolores L. Montesines

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CHAPTER 1

The Problem and Its Background

Introduction

Visually challenged persons account for around 285 million people globally or more than 3.86 percent of the global population. With current technology, visually impaired persons have several issues viewing printed text. According to the World Health Organization, up to 80% of visual blindness reported across the world is either preventable or curable. As a result, people who stay on the visual impairment spectrum must discover new ways to deal with the condition.

The field of assistive technology (AT), which is typically defined as technology designed for persons with disabilities, is a critical one that is rapidly increasing. Assistive technology for the visually impaired (VI) and blind focus on "technologies, equipment, devices, apparatus, services, systems, processes, and environmental modifications" that enable them to overcome physical, social, infrastructure, and accessibility barriers to independence and live active, productive, and independent lives as equal members of society.

This project provides them with assistance in traveling safely and securely. This serves as the Third Eye for vision impaired persons, making their challenging lives a little easier and safer. Third Eye is an Android application that assists visually impaired individuals. The blind user will be able to navigate safely using this technology. With the

aid of others, visually impaired persons may read text on portable devices, sign boards, and other items.

Background of the Study

Chronic eye illnesses are the leading cause of vision loss worldwide, whereas in-corrected refractive errors and untreated cataracts are the top two causes of visual impairment. Visually challenged persons are left behind in today's fast-paced society and are not treated equally. Many treatments and approaches have been attempted and created to assist them and give some amount of comfort.

Orientation and mobility are one of these approaches. A professional assists visually impaired and blind persons and trains them to move independently using this approach. They are taught to rely on their remaining senses to travel safely and independently. Another option is to employ guiding dogs. In this practice, dogs are carefully taught to assist blind persons in moving around. The dogs navigate around the barriers to signal the user to choose a different path. However, the complex instruction supplied by these dogs is difficult to comprehend for visually challenged and blind persons. Furthermore, the expense of these professionally trained dogs is quite high.

Different varieties of canes, such as the white cane, the smart cane, and the laser cane, are now in use. These technologies, however, have a number of limitations. The cane is inconvenient to use because of its length, which makes it difficult to hold in public settings. In addition, the cane has limits when it comes to detecting obstructions. Many approaches have lately been developed to improve the mobility of blind persons. Signal processing and sensor technologies are used to build these approaches. However, in a

crowded environment or one with a large flow of electrical signals, these technologies are more likely to fail.

Objectives of the Study

The main objective of this study is to develop an android application that will give further help to visually impaired persons in order to make their lives safer and more secure anywhere they go. And the following are the other objectives that the study aims to:

1. To develop an android application that is simple to use for both visually impaired and the helper, such as:

   1.1. To build a user-friendly UI and UX design that is ideal for the user experience, especially for visually challenged persons.

   1.2. To make a tutorial o guide for the new user.

2. To build a secure android application that can store the user's basic information such as:

   2.1. Full Name

   2.2. Birthday

3. To integrate an android application to have a reward system such as:

   3.1. Voucher

   3.2. Gift Cards

4. To create an android application that passes numerous testing process such as:

   4.1. User Experience Testing

   4.2. Functional Testing

   4.3. Performance Testing

4.4.   Security Testing

Significance of the Study

This study is being conducted in order to assist visually impaired persons in making their lives safer and more secure. The researcher will expand on the difficulties that visually impaired persons face in their daily lives and how we address these challenges. The following will greatly benefit from the study's findings:

For the **visually impaired people**, through this study, we will be able to provide them with an android application that they may use in their daily lives.

For the **teachers**, through this study, they will be enlightened about the challenges that the visually impaired person encounters in their daily lives. As a result, teachers will be able to use this research to raise awareness among their students about the issues faced by visually impaired people.

For the **students**, the study will provide information on the difficulties that visually impaired people endure on a daily basis. The student will be able to conduct a study on how they will address these issues because of this.

For the **future researchers**, they will be able to use this study as a source of both conceptual and research literature when they conduct their own studies related to this study. Therefore, they will be able to broaden the scope of the current study and make a more thorough conclusion.

Scope and Delimitations

This study will focus on developing an android application that will assist visually impaired persons. This study will ensure that all the information provided by the individual is safely kept. The researchers gather accurate data to ensure that the android application that is being developed would truly aid visually impaired people.

This study is confined to visually impaired people wherein other disabilities are not included since the time for making this android application is limited. Also, to be able to use the android application a mobile device is needed so that it can send a request to someone to help them. For this android application to work it needed mobile data or internet to be able to send a request for someone to help them.

CHAPTER 2

Conceptual Model

In this chapter, the research will cover the following related literature and studies, as well as how these various literature and studies are connected to the study. In addition, the theoretical framework and conceptual framework will be discussed in this chapter, as well as how these many theories will aid the study in developing an Android application that will substantially benefit visually impaired people. Furthermore, the system architecture will be provided in order to demonstrate how our Android application performs.

Review of Related Literature and Studies

The number of smartphone users worldwide has risen to 4.78 billion, implying that 61.62 percent of the global population now possesses one. According to Faudzi et al., (2020) that the smartphones have become an indispensable part of daily life. It has several features, including calling, texting, and the ability to interact with others via social media. This is an expected conclusion because cellphones include mobile apps that provide several benefits and assist us in a variety of ways. For example, we can make payments or even order food by using mobile apps. We may also use a smartphone app to monitor our power bills and pay them instantly. However, it is only useful for normal individuals, and the majority of its applications are restricted to the visually handicapped. Visually impaired persons confront several problems that are taken for granted by sighted people.

According to Hisham et al. (2020), advances in mobile technology have caused a significant shift in people's everyday lives, resulting in a strong demand for software that may help a person using a mobile device. According to Hisham et al. (2020), mobile apps are shown visually on a smartphone, making them inaccessible to visually challenged persons. Every country around the globe is seeing an increase in the number of visually impaired persons. Because persons with visual impairment still have difficulty utilizing assistive technology, the majority of technologies are being created to help them. They attempted to present insights on the initiative for visually impaired persons to detect items using their cellphones through a comprehensive literature review. The present level of object identification for visually impaired persons on mobile platforms was collected and reviewed using the systematic literature review (SLR) technique (Hisham et al., 2020).

Furthermore, Patel et al., (2021) mentioned many people suffer from temporary or permanent disabilities. Although technology may assist visually impaired persons in a variety of ways, recognizing things remains a difficult endeavor. Even though there are several detecting methods, their accuracy, speed, and efficiency are insufficient. Patel et al., (2021) use a deep learning approach to show real-time object recognition using the YOLO v3 algorithm, intending to design an efficient and cost-effective assistive device for those with vision loss or impairment. It makes use of a smartphone to collect real-time things in the user's environment and provides voice feedback to the user. Their project was created as an application for the Android platform (Patel et al., 2021).

Salankhe et al. (2021) developed a simple android app to aid visually impaired persons in comprehending their environment. They also mentioned that information about the surrounding environment was acquired using a phone's camera, and that real-time

object identification was performed using TensorFlow's object detection API. Using Android's text-to-speech library, the discovered items were then turned into audio output. TensorFlow lite made it simple to process complicated algorithms offline (Salankhe et al, 2021).

Also, according to Faudzi that as we recognize items in our daily lives as sighted users. Without eyesight, finding an object in an unknown area is nearly difficult. In any case, visually impaired persons rely on their memories to locate their items and become irritated if the object is misplaced or taken. Visually handicapped or blind persons are unable to see the item in front of them, making daily living difficult for them. They won't be able to see what the thing is even if they touch it since certain objects are unfamiliar to them, and even if they can recognize the object after touching it, it will take some time and the outcome won't always be right.

Koharwal at el., (2019) stated that in this fastmoving world, visually impaired people are left behind and not treated equally. To help them and provide them with some level of comfort, many solutions and techniques have been tried and developed. One of these techniques is called orientation and mobility. In this technique, a specialist helps the visually impaired and blind people and trains them to move on their own. They are trained to depend on their other remaining senses to move independently and safely. Another method is through using a guide dog. In this method, the dogs are trained specially to support the movement of the blind people. The dogs navigate around the obstacles as an alert to the user to change his way. However, it is difficult for visually impaired and blind people to understand the complex direction provided by these dogs. Additionally, the cost of these trained dogs is very high.

Moreover, Awad et al., (2018) discussed that many special standalone devices were designed for people with loss of vision such as talking watches, thermometers, scales, blood glucose reader and blood pressure measuring, among others. Indeed, having a standalone device for every task is not very practical. If a user wants to benefit from a number of solutions available, he will have a device for each problem he may encounter, which leads to increased cost and complexity. In addition, many software that intend to provide blind users with detection and recognition capabilities on their smart phones, lack the ability to offer accurate information, sometimes due to some external factors i.e. (light intensity, distance between the camera and the recognized object…), and sometimes due to wrong choice of tools and software development kits (SDKs) which may result in some problems such as long-time response and high resources usage (Awad et al., 2018).

The authors created the Intelligent Eye Mobile application to assist and help the visually impaired people by providing sets of useful features such as the light detection, color detection, object recognition and banknote recognition. According to Awad et al., (2018) it is stated that the aim of the Intelligent Eye Android mobile application is to combine several features in a single application that runs on the mobile phone and provide visually impaired people with high quality services. The following main features are provided in the current version:

Light Detection

For light detection, we will take advantage of the embedded light sensor of a smart phone, so that values of light intensity are read, and sound beeps are

played with different pitches according to light intensity and associated with a spoken description about the nature of the captured light.

Color Detection

The color detection approach works on images taken by the back camera of a smart phone. The main camera is invoked by the color detection activity, and by using the OpenCV library, the RGB color of the area of the screen that is touched by the user is identified and according to specific RGB values that are detected, a color name is reported to the user by invoking the text to speech engine available on the smartphone. As the user moves his finger on the screen, new colors are identified and reported by audible means to the user. If the captured object is composed of many colors, this approach will prevent the application from reading colors continuously whenever the light condition and the distance changes.

Object Recognition

For object recognition, we worked on having a database object with their associated labels resided locally on the mobile phone in order to avoid the need for internet connection, and to make the response faster.

Banknotes Recognition

We used the same approach for the banknote's reader activity so that the user can identify banknotes faster rather than waiting for a server response over the internet

Thus, creating the "Intelligent Eye" that will eliminate the need for different devices to be owned by blind users, and provide a user-friendly, cost-effective way for helping visually impaired people. (M. Awad et al., 2018)

Theoretical Framework

This study is supported by the theory of Peter Rodney which is the Social Inclusion Theory wherein it is a model was adapted for visually impaired people who wanted to participate in the Third-eye initiative. In 2003, Peter Rodney developed the SIT (Social Inclusion Theory), which states that the essential pedagogic and psychological concept behind inclusive education is that there is no difference between the educational demands of individuals with disabilities and those of other people. They all want to be included in society. These ideas are therefore founded on the social inclusion approach, which is vital to promote improved life outcomes for persons via increased social engagement and to benefit them regardless of their impairment.

Moreover, Social Exclusion occurs when people are unable to fully participate in economic, social, political, and other activities. Cultural life, as well as the processes that contribute to and maintain it. Because of social exclusion, this where the socialization comes in, wherein this is the process through which a person struggles to fit into a group (or society) and behave in a way that is acceptable to the group (or society). Individuals, whether disabled or not, should strive to improve their social skills in order to integrate into society or achieve social inclusion.

According to Social Inclusion Theory, is that everyone is ready, everyone can learn, everyone needs help, everyone can communicate, everyone can contribute, and together we are better. It claims that our most valuable renewable resource is difference.

Therefore, the Social Inclusion theory is aligned in the program as it will stand as an effect of using the Third Eye app for developing the social skills of the visually impaired person. Since Third Eye is all about helping the disabled person to gain more confidence to interact, communicate to others without barriers.
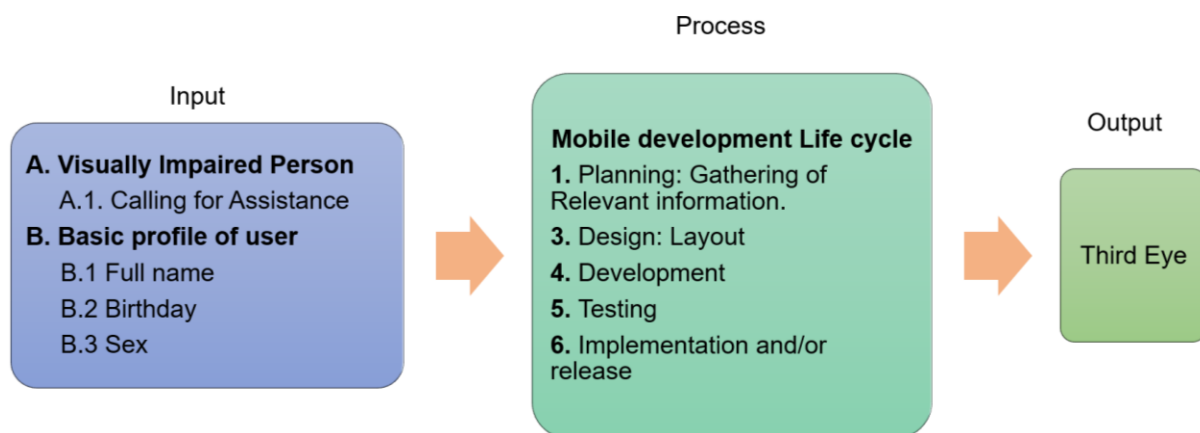
Conceptual Framework

Figure 1. Conceptual Framework of the Study

The input consists of the call for assistance of the visually impaired person and the basic profile of the user such as their full name, birthday etc., both visually impaired and sighted people.

The research process includes the different cycle of creating a web development including:

1. **Planning: Gathering of relevant information** – this stage includes gathering of information that involves the needs of partially impaired people

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and gathering of information of what is needed and necessary in creating the website. After conduction the relevant information, the researchers will create an initial design for the proposed web application.

2. **Design: Layout** – this stage includes designing the UI/UX of the proposed system. It includes on how the system would look according to the gathered user requirements.

3. **Development** – this stage includes the developing of the web application.

4. **Testing** – in this phase researchers will test the function of the web application. Researchers will test the flow of the proposed system. Also, in this phase the testers will inform the developers of any suggestions and flaws within the web application's functionality.

5. **Implementation and/or release** – in this phase the researchers will discuss the recommendation and suggestions of the testers if it was met or if the proposed system is up for an upgrade or improvements.

In the research output, after the proposed system is functionally done and met. Thus, the researchers have concluded that the study's objective had been achieved and therefore recommends the implementation of the project, named "Third Eye".
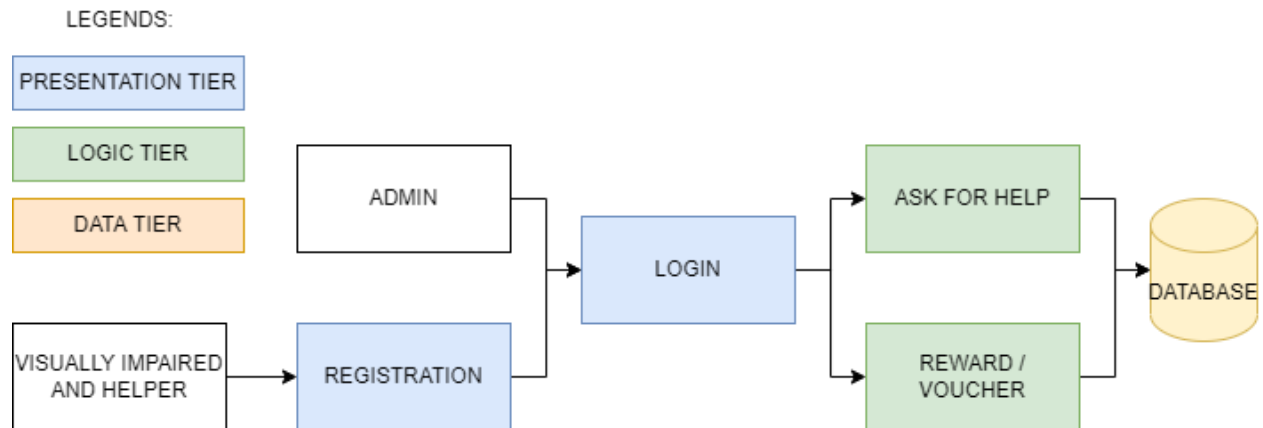
System Architecture
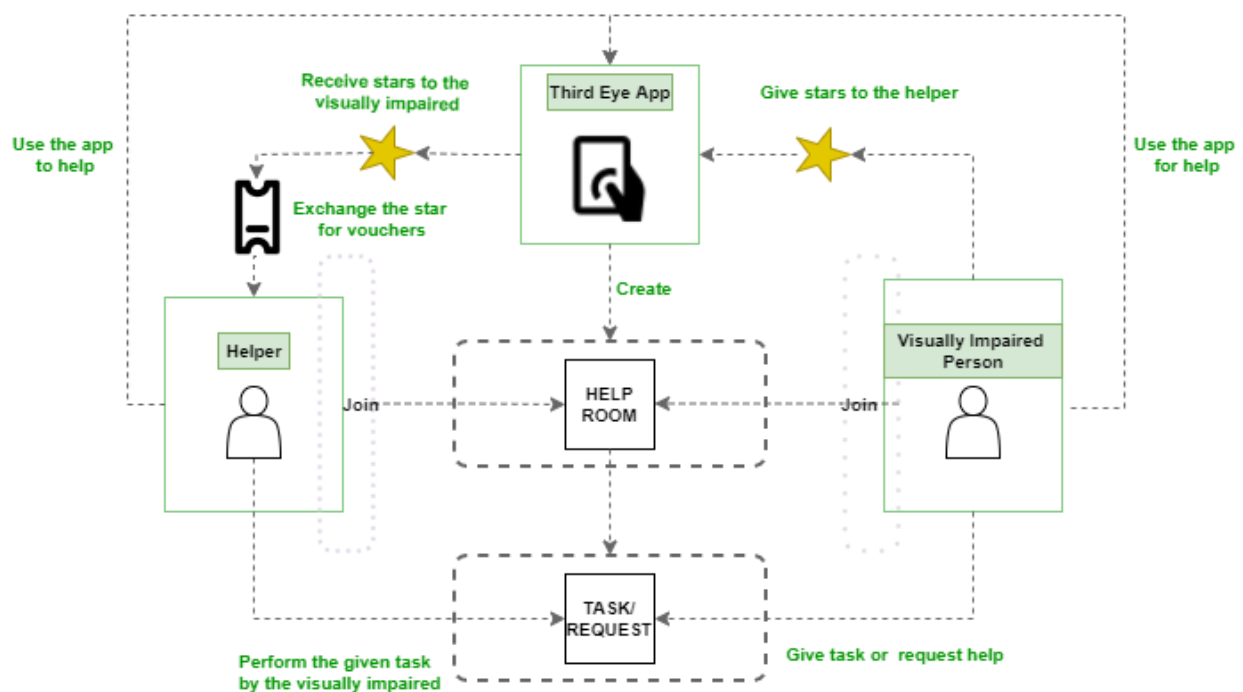

Figure 2. *Proposed System Architecture*

Figure 3. *Process of the System Architecture*

The overall functionality of our proposed system is to be able to find a visually impaired person who can assist them. Our Android application has the feature that if a helper is able to assist, they will receive points that they can exchange for rewards or

vouchers. And by doing so, they will be motivated to assist more visually impaired persons. As a result, both parties on our Android app will benefit from one another.

Definition of Terms

Android application - is a software application for the Android operating system.

Canes – is an equipment that blind or visually challenged usually use. A cane helps the user scan their surroundings for obstructions or direction markers, but it also helps spectators recognize the person as blind or visually handicapped and provide necessary care.

Chronic eye - is an inflammatory condition that affects the tears and the ocular surface of the eye.

Database - is a structured collection of information or data that is often saved electronically in a computer system.

Guide Dogs - are assistance dogs trained to aid persons who are blind or visually handicapped by leading them around obstacles.

Object Recognition - is a term for a group of computer vision tasks that include recognizing objects in digital photos.

RGB - is a color model that uses the colors red, green, and blue in various combinations to generate a broad range of colors.

SMS - is a text messaging service that is included in most phone, Internet, and mobile device systems.

Social media – wherein users may produce and share information on websites and apps, as well as participate in social networking.

Visually impaired – to describe any type of vision loss, whether someone can't see at all or has partial vision loss.

CHAPTER 3

Research Methodology

Project Design

The goal of this project is to create an Android application that will enable visually impaired individuals to navigate their environment with the assistance of others. The researcher will be able to improve their lives through this, making them safer and more secure everywhere they go.

The system should have the following features once it was deployed:

- To have an interface that is user-friendly especially for visually impaired person.
- To have a reward system wherein, people who are going to help visually impaired they will receive a coupon or voucher.

Furthermore, the system has limitations as well, which would be a great improvement for future works. This includes the fact that the Android application will support many languages in addition to English speakers. The researcher also aims to increase the application's security so that neither the user nor the assistant will be concerned that their personal information would leak.
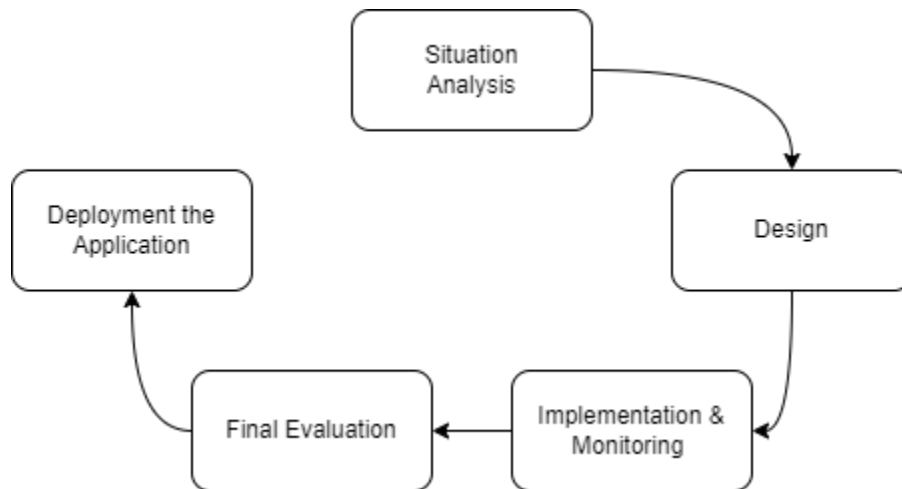
Project Development

Figure 4. *Project Development Cycle*

The researcher evaluates the situation where people who are visually impaired struggle to create an application that would meet their needs. The design phase shows how the researcher may make the program more user-friendly, particularly for those who are blind or visually challenged. The application will then be implemented and monitored to identify any issues that need to be fixed or improved. The application is then evaluated to see if it meets all the goals that the researcher has for it. Finally, the program is deployed and made available to the public for usage by those who are visually impaired.

Testing and Operating Procedure

A. Component Testing

To identify and correct errors as well as confirm the functionality of features, each system component must be tested.

a. Test the application registration system.

b. Test the help system of the application if its accurate to what the visually impaired needs.

c. Test the accept/tasks system of the application if its correct to what the helper needs to perform according to the given task.

d. Test the receive/points voucher of the system if it is giving correct points to the helper.

e. Test the accuracy of the whole Application System.

B. Functional Stability

The System and the Application will be thoroughly tested (with many users) for unexpected and/or runtime faults (crashing, timeouts on servers, etc.)

Operation Procedure

1. Install the Third-Eye Application with a smartphone device.

2. Choose if you want to be helped or a helper. (With gestures)

3. Double tap to ask for help (for visually impaired people) / Press the I'm available button (for helpers)

4. Wait for someone to accept your request (for visually impaired people) / Press accept button to accept the request (for helpers)

5. Perform the given request of the visually impaired

6. Once task is done, receive points (for helpers).

7. Exchange points for vouchers.

Project Evaluation

a. **Planning**

- Prior to deployment, the system must pass a thorough test and be used in accordance with its intended features and objectives (see Operation and Testing Procedure).

b. **Implementation**

- Following the deployment, the system and the application must be examined for accuracy and consistency among system testers, in relation and with perspective against the system characteristics.

c. **Completion**

- Upon performing the evaluation, it should be summarized with the overall performance of the system and its features.
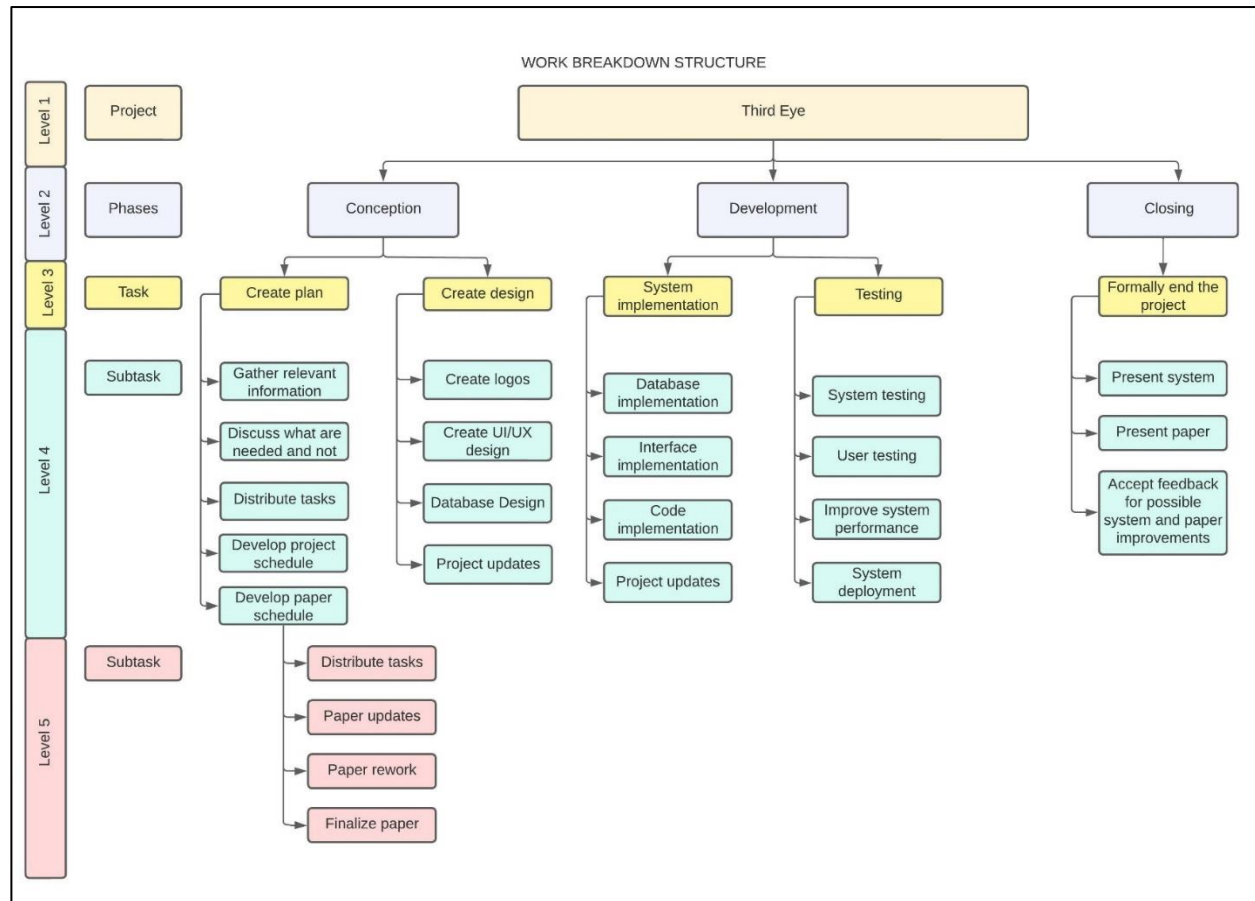
Work Plan

Figure 5. *Work Breakdown Structure of Third Eye*

The work breakdown structure of developing the system and paper of third eye composed of 5 level. In creating the Third Eye, it composes of three levels which are the conception, development, and closing. In Conception, there are tasks and subtasks that need to be met. It includes the creating of plan, and its subtasks are gathered relevant information, discussing what are needed and not, distributing tasks, develop project schedule, develop paper schedule. Under the task of developing the paper, tasks will be equally distributed, group will have daily meetings for paper updates, if changes are needed, then paper rework will be done and considered, then finalizing the paper. Next task is creating the design, the subtasks are creating logos, creating the interface, database design, and will have regular meetings for system update. In phase of the

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development, it includes two tasks, the system implementation, and the testing. In system implementation, the subtasks are the database implementation, then code, implementation, and project updates. In testing, system will be tested, user testing, improve system performance, if necessary, then when finished, the system will be deployed. In the closing, the task is to formally end the project, the subtasks include presenting the paper and the system. If improvements are needed, then changes are open in developing the third eye.

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