CAT304
Group Innovation Project and Study for Sustainability
Initial Project Proposal

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Pediatric Allergy Life Saver System (PALS)

Group 1

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Abstract

Allergies are abnormal responses generated by the immune system of the human body to foreign substances or foods. The triggers that cause allergic reactions can vary for every person, including the symptoms of allergies. Food allergies are particularly prevalent in children, with estimates suggesting that 3-6% of children in developed countries may be affected. Allergic reactions can have serious health consequences and are more common among children who have early onset eczema or itchy rash symptoms. Hence, the Pediatric Allergy Life Saver (PALS) application is designed to assist parents and caregivers to optimally manage and track the allergies of children. The application incorporates the Optical Character Recognition (OCR) feature in the Google Cloud Vision paired with Google Cloud Translation AI which are powered with pre-trained machine learning models to detect allergens that are present in the ingredients label of food products to help parents and caretakers identify whether the food product is safe for the child's consumption, especially for foreign food products. The goal of PALS is to assist caregivers without medical knowledge to take quick action to mitigate the consequences of an allergic reaction and provide a reliable technical service for ensuring that the situation is under control when an allergy reaction occurs.

1.0 Introduction

1.1 Project Background

It is common for parents to be protective of their children, however there are always times when children need to be left with a caretaker, more commonly seen in cases where both parents work full-time. For instance, when the child is placed at the day-care centre, left with a babysitter for the day, or if the child is already attending primary school.

A life may be saved by recognising the early symptoms of a severe allergic reaction, such as anaphylaxis, and responding quickly with the appropriate medical support [11]. The duration that it takes for an allergic symptom to be recognized after a child is exposed to an allergy can make a huge difference [11]. Hence, it is critical to recognize the signs and always keep the action plan readily accessible to be applied in an emergency especially for young children. Currently, there are a few ways to handle the problems stated above. When parents leave their children in a day-care centre, school, or with a babysitter, they will inform the caretaker verbally about their children's allergies. However, in day-care centres and schools, there could be potentially tens to hundreds of students, and it is nearly impossible to memorise every child's allergy. There is no sustainable solution to track every child's allergy for convenient reference.

Selecting the right food products for children with allergies is a task that should not be taken lightly. There are often food products that have long lists of complicated ingredients, which cause any dangerous allergens to be glossed over. For foreign food products that have ingredient labels written in a foreign language, it is difficult to know whether the food product is safe for the child's consumption.

We see this as an important issue to tackle to reduce the risks of children in danger of allergy attacks. In alignment with the United Nations Sustainable Development Goal 3: Good Health and Well-being, we want to develop an application as a platform for parents and caretakers to track the allergies of children, as well as detect allergens that are present in the ingredient labels of food products.

1.2 Existing Solutions/Similar Applications

There are a few similar existing systems in the market. Three applications have been selected for comparison which are *Belay*, *Allergy Assist* and *Allergy Pal*. The common functionality exhibited by these applications is the ability to share a child's allergy profile with third-party profiles [15]. Most of the existing solutions are not available in Malaysia, hence Malaysia is the ideal market for the initial launch of PALS.

The main purpose of these solutions addresses one of the problem statements we have identified concerning the sharing of children allergies with caretakers to enable a systematic method of recording and tracking children's allergies.

The AI allergen detector and translation features in PALS are designed to accept images of ingredients labels of food products as input. The process involves Optical Character Recognition (OCR) to detect and extract text from the image and compare the extracted text to a list of allergens check if the ingredients of the food product contain allergens that are harmful to the child. There are various OCR tools available to perform this function. Among the tools available, Google Cloud Vision is selected as it provides the most accurate results for smartphone-captured images [14].

Table 1: Summary of comparison of OCR tools [14]

OCR tools	**Google Cloud Vision**	**Tesseract OCR**	**Amazon Textract**
Document image	Good	Acceptable	Good
Handwriting	Acceptable	Bad	Bad
Smartphone-captured	Good	Bad	Acceptable

Overall, PALS provides a unique and complete solution to address the concerns of parents regarding children's allergies as it can provide a platform to track the allergies, enable caretakers to view the children's allergies and has artificial intelligence features to detect allergens in the ingredients labels of food products to identify whether the food product is safe for consumption.

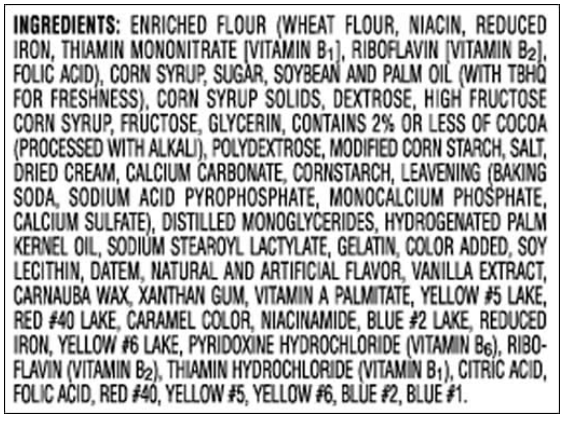
Table 2: Summary of comparison of existing solutions

Existing solutions	***PALS***	***Belay***	***Allergy Assist***	***Allergy Pal***
Available in Malaysia	Yes	No	Yes	No
AI allergen detector feature	Yes	No	No	No
AI ingredient label translation feature	Yes	No	No	No
Centralised view of children's allergies	Yes	Yes	No	No
Allow third party access to children profile	Yes	Yes	Yes	Yes
Emergency contact feature	Yes	Yes	Yes	No

2.0 Problem Statement

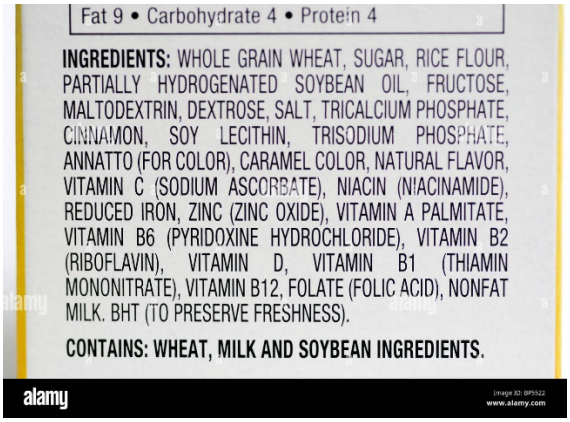
Food allergies are particularly prevalent in children, with estimates suggesting that 3-6% of children in developed countries may be affected. Children from families with a history of allergies are more likely to be affected by allergies [12]. Children are normally not aware of their allergies, as they might not have been discovered if the child has not yet been exposed to the allergen [13]. Younger children might even not comprehend the meaning of an allergy. When the child is facing an allergy attack, it is challenging for them to verbally express or describe the symptoms that they are facing to their caretakers. Caretakers will find it difficult to understand that the child is facing allergy symptoms, which could lead to a delay in taking action to mitigate the consequences of an allergy attack [12]. For parents, this is an overwhelming concern when they need to leave their children with caretakers such as babysitters, nannies, day-care centers, or schools, as there is the constant worry that the caretaker is not equipped with sufficient medical knowledge to handle the situation if their child suffers from an allergy attack.

Food products are mandated to clearly display the ingredients used in the product along with the nutrition information. However, there are often food products that have long lists of complicated ingredients, posing a challenge to identify allergens present in the product. This may cause the allergens to be ignored which will cause an allergic reaction when the food product is given to an allergic child.



INGREDIENTS: ENRICHED FLOUR (WHEAT FLOUR, NIACIN, REDUCED IRON, THIAMIN MONONITRATE [VITAMIN B_1], RIBOFLAVIN [VITAMIN B_2], FOLIC ACID), CORN SYRUP, SUGAR, SOYBEAN AND PALM OIL (WITH TBHQ FOR FRESHNESS), CORN SYRUP SOLIDS, DEXTROSE, HIGH FRUCTOSE CORN SYRUP, FRUCTOSE, GLYCERIN, CONTAINS 2% OR LESS OF COCOA (PROCESSED WITH ALKALI), POLYDEXTROSE, MODIFIED CORN STARCH, SALT, DRIED CREAM, CALCIUM CARBONATE, CORNSTARCH, LEAVENING (BAKING SODA, SODIUM ACID PYROPHOSPHATE, MONOCALCIUM PHOSPHATE, CALCIUM SULFATE), DISTILLED MONOGLYCERIDES, HYDROGENATED PALM KERNEL OIL, SODIUM STEAROYL LACTYLATE, GELATIN, COLOR ADDED, SOY LECITHIN, DATEM, NATURAL AND ARTIFICIAL FLAVOR, VANILLA EXTRACT, CARNAUBA WAX, XANTHAN GUM, VITAMIN A PALMITATE, YELLOW #5 LAKE, RED #40 LAKE, CARAMEL COLOR, NIACINAMIDE, BLUE #2 LAKE, REDUCED IRON, YELLOW #6 LAKE, PYRIDOXINE HYDROCHLORIDE (VITAMIN B_6), RIBOFLAVIN (VITAMIN B_2), THIAMIN HYDROCHLORIDE (VITAMIN B_1), CITRIC ACID, FOLIC ACID, RED #40, YELLOW #5, YELLOW #6, BLUE #2, BLUE #1.

Image 1: Photo of ingredients label with no allergen emphasis



Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: WHOLE GRAIN WHEAT, SUGAR, RICE FLOUR, PARTIALLY HYDROGENATED SOYBEAN OIL, FRUCTOSE, MALTODEXTRIN, DEXTROSE, SALT, TRICALCIUM PHOSPHATE, CINNAMON, SOY LECITHIN, TRISODIUM PHOSPHATE, ANNATTO (FOR COLOR), CARAMEL COLOR, NATURAL FLAVOR, VITAMIN C (SODIUM ASCORBATE), NIACIN (NIACINAMIDE), REDUCED IRON, ZINC (ZINC OXIDE), VITAMIN A PALMITATE, VITAMIN B6 (PYRIDOXINE HYDROCHLORIDE), VITAMIN B2 (RIBOFLAVIN), VITAMIN D, VITAMIN B1 (THIAMIN MONONITRATE), VITAMIN B12, FOLATE (FOLIC ACID), NONFAT MILK. BHT (TO PRESERVE FRESHNESS).

CONTAINS: WHEAT, MILK AND SOYBEAN INGREDIENTS.

Image 2: Photo of ingredients label with allergen emphasis

Comparing Image 1 and Image 2, the latter has a statement to clearly indicate the allergens present in the food product. However, not all food products print user-friendly ingredients labels. For foreign food products that have ingredient labels written in a foreign language, it is even more difficult to know whether the food product is safe for the child's consumption.

3.0 Project Objectives

1. To develop a children management module to allow the input of the allergies of children to be recorded.

2. To develop a caretaker management module for parents to give access to caretakers to view their children's allergy details.

3. To develop an allergy information module to display allergy symptoms and action plans.

4. To develop an allergen detector module utilising computer vision and image processing technology to identify allergens present in ingredients labels photos.

4.0 Motivation

The main motivation for Juniq to create this system − Pediatric Allergy Life Saver (PALS) stems from the arising health problems related to children we discovered happening in Malaysia, which could be solved with the usage of technology. We strongly believe that our system is a compelling and actionable solution to directly reduce the risks of allergy attacks in children.

Our team sees the importance in raising awareness among the caretakers and parents on the most effective method to communicate the allergies faced by the children while ensuring that basic medical knowledge is made easily available to caretakers and parents so that they will be well-equipped with the information to know how to handle the situation when an allergic reaction occurs.

We realize that there is an overload of information about allergy action plans and many misleading information [10] on the Internet which may cause confusion to caretakers, especially in a critical situation where an allergic attack is already happening. Hence, we are motivated to create a centralized and reliable resource center to display allergy information from verified sources. This is to avoid the intake of inaccurate information which could potentially worsen the situation if not handled properly.

Other than that, we are keen to explore the potential of integrating artificial intelligence into our system to implement the allergen detection feature. We believe that this feature can assist the caretakers and parents to identify whether a food product is safe for a child's consumption.

5.0 Proposed Solution

We see a critical need for a system to be developed to solve the pain points of parents and caretakers when it comes to handling the allergies of children. Hence, Pediatric Allergy Life Saver (PALS) is developed to address these circumstances.

The application allows parents to input their children's allergies into an organized list and control access to specified people to view their children's allergy information. This information will be displayed to caretakers who have been given access to view the children's allergy information to help them recognize the symptoms and know what to look out for when an allergic reaction happens while the children are under their care so that they can take immediate action to help the allergic child. Our system also integrates the usage of computer vision and image processing technology to allow parents and caretakers to take a photo of the ingredients label of a food product to detect allergens present in the product to identify whether the product is safe for consumption.

The allergen detector and translation features involve the usage of Optical Character Recognition (OCR) to detect and extract text from the ingredients label image. The OCR tool used in PALS is Google Cloud Vision to generate the most accurate results for smartphone-captured images. The extracted text is translated to English using Google Translate AI which uses neural machine translation technology powered by Google. The translated text is then matched to a list of allergens to check if the ingredients of the food product contain allergens that are harmful to the child.

The application consists of five main modules, which are the user module, children management module, caretaker management module, allergy information module and allergen detector module.

See Appendix A for the architecture diagram of Pediatric Allergy Life Saver (PALS).
See Appendix B for the module diagram of Pediatric Allergy Life Saver (PALS).

6.0 SDG Alignment

By implementing the Pediatric Allergy Life Saver system, we hope to achieve Sustainable Development Goal (SDG) number 3 – Good Health and Well-being. This goal is designated to ensure healthy lives and promote well-being for everyone at all stages of life [8]. According to the American Academy of Allergy Asthma and Immunology, there are around 40% to 50% of school children with high sensitization rates to one or more common allergens, and this percentage has a high possibility of increasing in future [9]. Since allergy attacks are a serious health condition which should not be overlooked, we hope the development of the PALS system can help the parents or caretakers to promote a healthy lifestyle and a well-being for their children when they are facing allergy reactions with the usage of advanced technology.

7.0 Benefits / Impact / Significance of Project

The development of the PALS system aligns with SDG 3, which is a significant turning point in the landscape of the current technologies used in children's health.

Our system can reassure parents that the allergies of their children are recorded and can be easily referred to by the caretakers, giving the parents a peace of mind when it is ensured that caretakers have access to know how to prevent the allergic reactions from occurring and what to do if the reactions occur.

Moreover, our system will boost the confidence of caretakers when taking care of children with allergies to help them take the right actions when an emergency happens. Normally, caretakers such as teachers and babysitters are not well-equipped with medical knowledge, hence it is common to panic when an allergic reaction happens. Now with PALS informing the caretakers of the steps to take, the situation can be handled correctly.

Our allergen detector feature helps caretakers and parents to identify whether a food product is safe for a child's consumption as the computer vision technology highlights the allergens present in the food product. This can reduce the occurrence of allergy attacks when the food products given to children are always ensured to be safe and free from harmful allergens.

8.0 Uniqueness of Proposed Solution

The PALS system has several outstanding features when compared to similar systems in the market.

Firstly, our PALS system introduces a mobile web-based application which is convenient for the parents and caretakers. Parents or caretakers can utilise their mobile phones to easily access allergy information such as symptoms and action plans to ensure the right steps are taken immediately. The reason that this aspect stands out from other solutions is because it is not required to download a mobile application, instead the interface and data can be accessed from any browser. This is because it is more difficult to implement the usage of PALS in schools and daycare centers if the installation of an application is required. Hence, a web-based application is developed instead of a mobile application.

This application integrates computer vision and image processing technology in the allergen detector and translation features which involve the usage of Optical Character Recognition (OCR) to detect and extract text from the ingredients label image as well as a neural machine translation technology to enable the ingredients labels of foreign food products to be translated to assist parents and caretakers to identify whether the food product is safe for the child's consumption without language barriers.

9.0 Expected Outcomes

The main expected outcome from the PALS system is to record children's allergy information for easy retrieval as a mobile application. Below are the expected outcomes promised by the Juniq team:

1. A complete and organized database of children's allergy information
    a. Able to keep track of each child's allergy information.
    b. Able to control the access to specified caretakers that can access and view the information of child's allergies

2. Accurate information
    a. Able to retrieve accurate information regarding the child's allergy in a short time.

3. Allergen Detector
    a. Able to recognize allergens present in the ingredients label of food products to identify whether the food product is safe for consumption.

10.0 Status of the project

Our proposed system PALS is an original project that is newly developed by Juniq.

11.0 References

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Appendix A

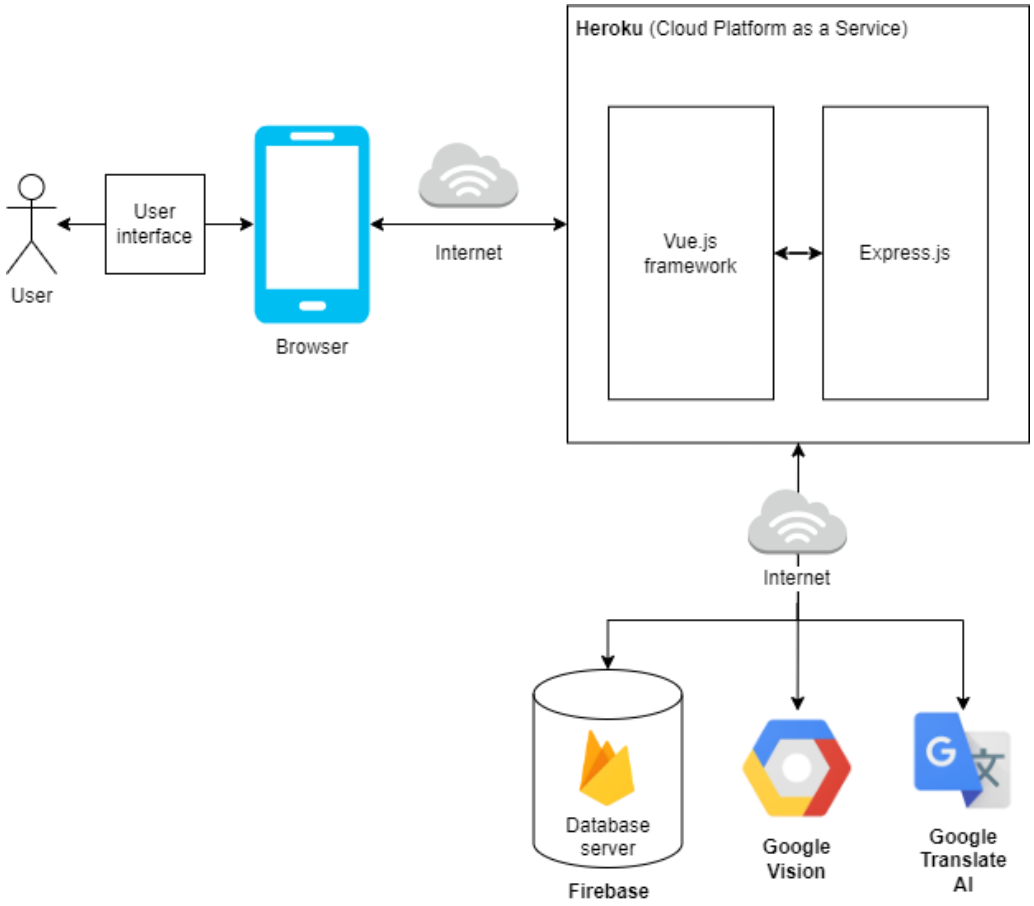

Figure 1: Architecture diagram of Pediatric Allergy Life Saver (PALS)

Appendix B

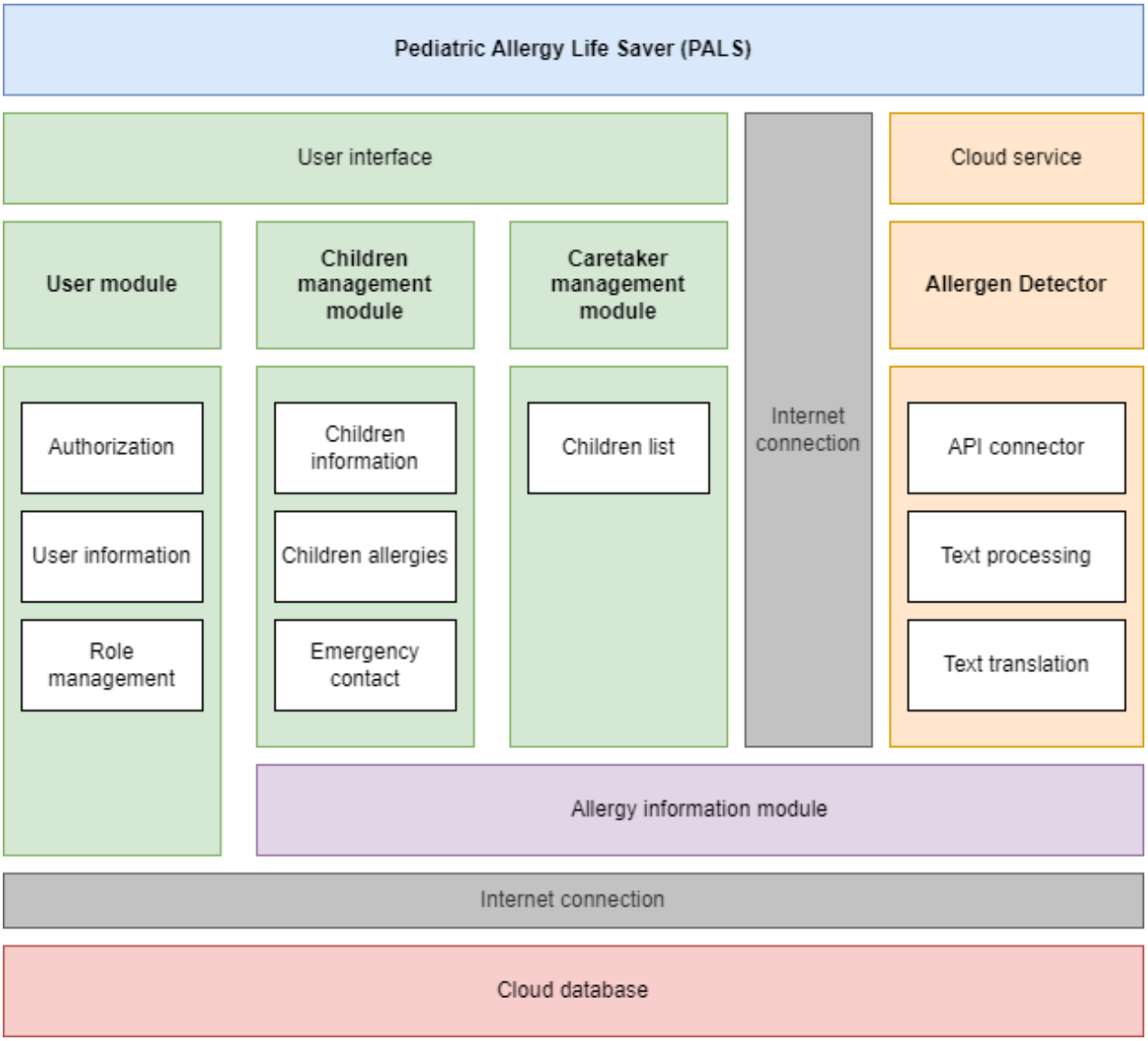

Figure 2: Module diagram of Pediatric Allergy Life Saver (PALS)