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Food Journal: An application for allergy early detection

Ni Gusti Ayu Putu Harry Saptarini [1], Putu Indah Ciptayani [2]*, Ni Wayan Wisswani [3]

[1,2,3]*Politeknik Negeri Bali, Indonesia*

*Corresponding Author: *putuindah@pnb.ac.id*

Abstract: Allergies are now increasingly common, due to public awareness and lifestyle changes. Although antibody tests and skin pricks can detect allergies, their accuracy is not always 100%, causing some cases of false negatives. Observing the reactions caused by food is an alternative approach, but people often forget the food they consume, especially if the allergic reaction is indirect. Therefore, tools are needed to record foods and reactions, allowing traceability to undetected allergy triggers. This study is applied research that aims to develop a prototype application for recording daily food and tracking the history of eating activities based on the allergy symptoms entered. The software development method used is the Agile method with the Scrum framework. The Scrum framework is used considering that the development of this application requires speed in its provision, and is susceptible to change, so flexibility in development is an absolute must. The software testing was conducted by User Acceptance Testing (UAT) to ensure it meets the user's needs and requirements. The UAT results are ease of use 3.8, functionality 3.99, user interface (UI) design 3.8, utility 4, and support and help 4. UAT results indicate that the ease of use and UI design have the worst scores and need to be improved, while the utility and support have the best results.

Keywords: Food Allergy, Food Journal, Food Tracking, Web-Based Food Tracking

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Introduction

Allergy is a reaction of the human immune system to substances that enter the body which are considered dangerous substances and are known as allergens [1]. When a person is exposed to an allergen, the immune system responds by producing antibodies to protect itself [1]. This response causes various abnormal symptoms ranging from mild symptoms such as itching and sneezing to more serious reactions such as rashes, flatulence, diarrhea, inflammation, shortness of breath, and even life-threatening anaphylaxis [2]. High-intensity exposure to allergens and continuous abnormal reactions can disrupt the body's organ systems and thus affect a human's quality of life [3], therefore it is very important to control it by recognizing the triggers for allergies.

There are various types of allergy triggers such as drugs, animals, pollen, dust, mold, including food. The most common types of food that can cause allergic reactions are cow's milk, eggs, nuts, shelled seafood, various types of shellfish, and even fish [3]. These various foods are then converted into food substances, including protein. It is a protein that often causes allergic reactions in some people who have high sensitivity [4]. The appearance of allergy symptoms after food is introduced does not always indicate that a person is suffering from a food allergy, but can also be caused by other health conditions such as intolerance or sensitivity to certain foods [4].

Regardless of the cause, whether allergies, intolerance, or sensitivity, all of them can affect the human immune and digestive systems, which ultimately if disturbed can disrupt their quality of life [3]. Especially if this happens to babies. Babies aged 6 months and over begin to need various types of food to grow and develop, however, if exposure to allergens occurs continuously it will of course harm their growth and development [5]. When allergic reaction symptoms appear, immediately following the treatment recommended by the doctor to manage the symptoms is

important, but avoiding exposure to the triggering food must still be recommended continuously [6].

There are various tests to find out what type of allergy a person has, such as the Skin Prick Test (SPT) IgE Atopy test, or IgG Food Sensitivity. Both options require consumers to be taken to a laboratory so they cannot analyze anywhere and anytime [7] and of course, require quite a lot of money. As an alternative, a food introduction trial can be carried out for babies [8] or an elimination diet for children and adults, followed by observing allergic reactions that appear after the food is given [9]. Screening can be chosen to carry out early detection [10]. Food trials, continuous observation, and recording need to be carried out to make it easier to conclude the triggers for reactions, therefore it is important to record a track record of food consumption because excessive avoidance is not always wise [11].

Daily food recording related to diet is preferred if using electronic devices [12]. Currently, there are many applications and research related to food recording, such as self-monitoring calcium consumption applications [13], mindful eating [14], food monitoring for people with eating disorders [15][16], obesity management [17], macronutrients and food calories [18][19][20], healthy eating patterns for adolescents [21], toddler feeding [22]. One application that records food and the reactions it may cause is TummyTrials. This application is specifically for sufferers of irritable bowel syndrome (IBS), where users will try to check the typical symptoms of IBS (stomach pain, bloating or gas, hard defecation, watery defecation, infrequent defecation, frequent defecation, urge to defecate) when consuming foods suspected to be triggered (caffeine, gluten, sorbitol, lactose) [23]. Several applications have integrated the use of artificial intelligence in their applications for the recognition of user-uploaded food photos [17][18][19][24].

Some studies have observed several popular diet applications. Research by Franco et al, [25] found that 9 of the 13 most popular apps had a food diary feature and one of them connected users with health professionals. All apps use text search and barcode scanners to input food. Mostly apps for weight management. None of the apps have a decision engine capable of providing personalized diet advice. Research by Ferrara et al [26] examined the seven most widely used diet apps, and none of them provides tracking features for emotional factors that may be related to dietary patterns. All apps focus on calorie counting and macronutrients.

Existing diet apps are often designed for general weight loss and are not tailored to specific risk factors [27]. Most people who try these free mobile apps to monitor their diet, do not continue to actively use them and those who do may already be healthy eaters [28]. The main challenges that users face include the interface, search options (for food), portion sizes, and reminders when using these applications [29]. Providing recommendations is also required in applications [30].

Based on previous research, it is clear that no food tracking application specifically focuses on food allergies or sensitivities. Several studies have suggested the need for applications for specific risk factors [27] and recommendations [30]. The study by Helander et al [28], suggested improvements to the search and interface. For this reason, this research aims to build an application of daily food tracking applications. The application can record all foods and the symptoms of reactions felt, as well as track foods eaten up to 3 days previously to provide recommendations for possible food causes of allergies so that users can be more aware and make better observations of certain foods that are suspected to trigger allergies. This application is mainly useful for users who are on a food-elimination diet to observe allergic reactions in their bodies to newly introduced or reintroduced foods.

Methodology

This study examines objects in the form of using the Scrum framework in developing food journal applications. The data in this study are collected through a literature review and questionnaire. The data collected by the literature review includes the food tracker application that already exists, the features of the application, and what improvement is needed. The questionnaire was needed to conduct end-user testing.

Scrum is made to be able to develop software flexibly and quickly. The main step was: pre-sprint, sprint, and final testing. Figure 1 shows the brief step of this framework.

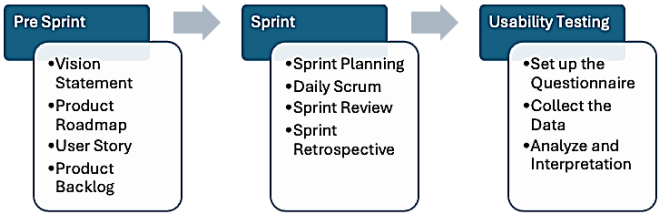

Figure 1. Food journal application development using SCRUM

The pre-sprint stage is the initial stage before developers start building applications. First, a vision statement will be carried out to provide a summary description of the project objectives, which will help the development team to stay focused on its path. Next is to create a product roadmap which is the initial timeline for working on the main features and is usually done by the Product Owner. Next, user needs are collected to create features. This part is called the story. Stories are usually created by the Product Owner based on user needs. All stories will form the Product Backlog. Projects can be carried out without having to wait for 100% product backlog, and the product backlog can also change throughout the project journey.

When the product backlog has been formed, the next step is entering the sprint period. Each module will be carried out in a short sprint, which in this research is seven days. In this sprint planning, the tasks and working hours of each personnel involved in the project are also regulated. In development with Scrum, daily meetings are always held to discuss the progress of the tasks of each work team and determine what to do next. Stand-up meetings do not have to be attended by all team members, but only members who are interested in the current sprint. A Sprint Review is carried out every time a sprint is completed, namely by conducting a demo with the client. In this way, clients can find out about project progress and can provide input or desired changes. The Sprint Retrospective stage aims to carry out an evaluation based on the results of the review that has been carried out. The results at this stage can be in the form of continuing to the next sprint or fixing problems that still exist in the current sprint. All changes will be recorded in the Product Backlog [31].

The last step was the final testing. Although in sprint review, the testing is already conducted by the client, it is very important to do final testing involving the end user. The testing was conducted using the System Usability Scale (SUS). The first step was to set up the questionnaire. The data was collected from 30 users and the the result was interpreted.

Results and Discussions

Results

The pre-sprint stage resulted in nine product backlogs as shown in Table 1. There are three user roles identified: guest (unregistered user), member, and system administrator. As implied in Table 1, each user has a role in the application. Each product backlog becomes a single sprint, which is conducted every seven days.

Table 1. The user backlog

Backlog	Item	User role
User management	Guest can show general information, but to use a food journal feature, they must be registered into the application. The authentication process is very important to ensure that only authorized users can access records.	Guest: to register Member: login Administrator: login
Food and nutrition information	Users can read and search the information about food and nutrients. The information must be up to date.	All Users: read and search Administrator: add or update information
Article management	Users can read and search the general information about food allergy/sensitivity/intolerance. The information must be up to date.	All Users: read and search Administrator: add or update information

Food journaling	Members can input daily food consumption, including the amount and time. The system must enable the member to input the complete ingredients of certain food. For the same kind of food that has been recorded in the system, no need to reinput the ingredients.	Member: Input and read the daily journal
Symptom management	Members can input the symptoms they feel at a certain time. The application must enable the member to track certain symptoms and show all the food they consume for a range of three days before each symptom and rank the food based on frequency/amount. For additional information, the sleep quality, mood, Bristol chart, and daily notes are also shown.	Member: input and search symptom, view the information related to the time of the symptom.
Mood management	Members can input the mood they feel at a certain time.	Member: input
Bristol stool management	Member can input the stool based on the Bristol Scale at a certain time.	Member: input
Sleep management	Member can input the quality and time of their sleep	Member: input
Daily notes management	Members can input other information, such as prescription drugs consuming	Member: input

The main feature of the application is food tracking related to certain symptoms based on the time. The page of symptom searching is shown in Figure 2. For example, the member enters the keyword "pusing" (headache) in the search bar. The application will respond by showing the appropriate symptom, their frequency, and the specific time the symptom occurs. Users can view all the food they consumed starting from 3 previous days of the symptom and the foods are ordered from the most frequently eaten.

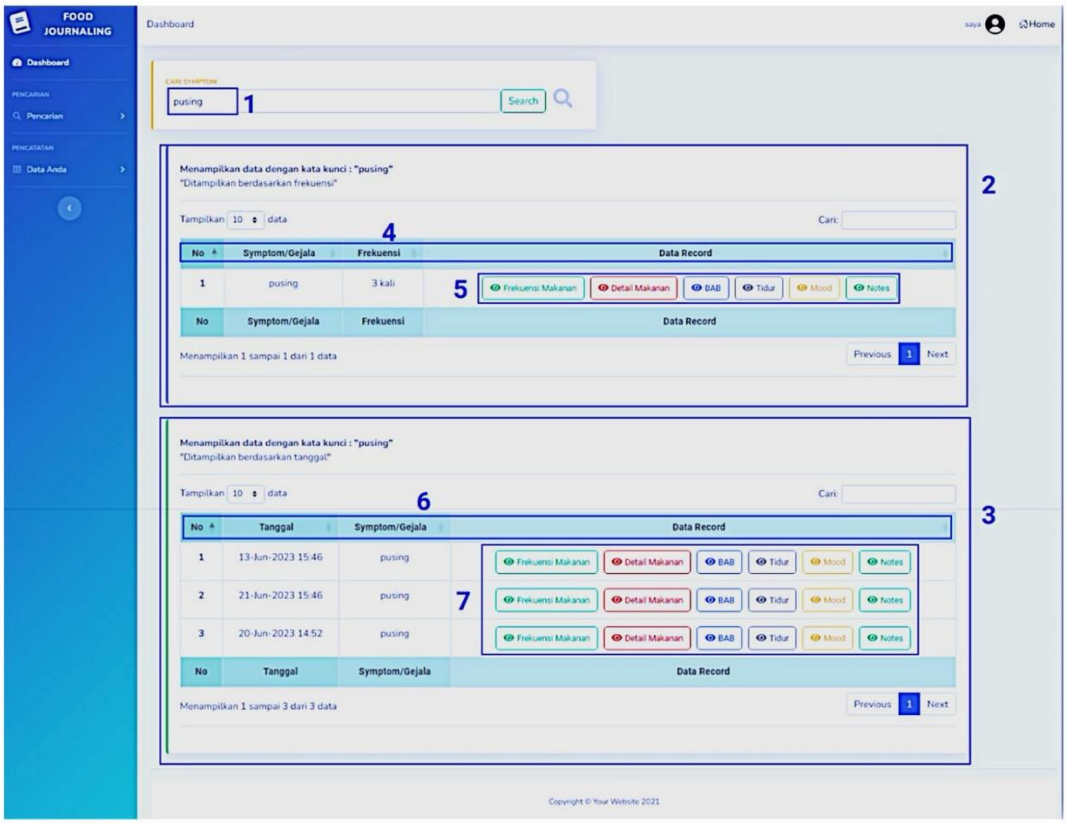

Figure 2. Symptom search result

User Acceptance Testing (UAT) was conducted to make sure the application met the user's needs and requirements. The are 22 respondents to the UAT questionnaire. The UAT measures six dimensions and 14 questions as shown in Table 2.

Table 2. The User Acceptance Test (UAT) result

Dimension	Question	Score
Ease of Use	You find the application easy to use.	3.9
	The navigation of the application is intuitive and easy to understand.	3.7
Function-ality	The food logging feature in the application works well.	4
	The mood logging feature in the application works well.	4
	The symptom logging feature in the application works well.	4
	The search feature for meal history based on symptoms helps you find previous records.	3.95
User Inter-face De-sign	The interface design of the application is attractive and visually pleasing.	3.9
	The layout of elements in the application is neat and well-organized.	3.7
Perfor-mance	The application functions smoothly without technical issues.	3.9
	The response time of the application is quick when logging food or searching meal history.	3.9
Utility	The application helps you manage daily food logging.	4
	The meal history search feature is useful for monitoring eating patterns.	4
Support and Help	The user guide and support in the application help you resolve issues.	3.95
	You feel adequately supported when encountering problems with the ap-plication.	4.05

Discussions

The Food Journal application developed is primarily aimed at logging an individual's eating history and various symptoms experienced daily. Through the tracking feature or searching for specific symptoms, users can view the rankings of foods consumed over the last 3 days when the symptom was felt. This feature differentiates this application from other existing ones.

From the results of the user acceptance testing (UAT) shown in Table 2, the average scores are as follows: ease of use 3.8, functionality 3.99, user interface (UI) design 3.8, utility 4, and support and help 4. There are two dimensions with the lowest scores: ease of use and UI design. A good user interface should ideally facilitate user interaction with the system. This indicates that improvements are needed in UI design to enhance usability. Improved ease of use will affect user experience and the sustainability of application use. Therefore, addressing UI issues is crucial. Dimensions that show benefits and usefulness to users are functionality and utility. The UAT results show that the functionality score is 3.99, which is nearly good, while the utility score is 4, indicating good. This suggests that users find the features provided useful and functioning as well as expected. Additionally, support and help, in the form of a user manual, also received a good score.

Conclusion

From the study that has been done, it can be concluded that the use of the Scrum frame-work can build an online learning application. The use of this framework fits perfectly with the characteristics of users who have not been able to clearly and in detail define their needs. The existence of deliverables that are directly given and can be used by users directly after a sprint is executed can explore more data on user needs. The User Acceptance Testing (UAT) determines six criteria: ease of use 3.8, functionality 3.99, user interface (UI) design 3.8, utility 4, and support and help 4. The lowest scores are in the UI design and ease of use dimensions. UI design and ease of use are closely related; the easier a UI is to understand, the better the ease of use. This indicates that these two dimensions need attention and improvement. The best scores were ob-tained in the utility support and help dimensions, while the functionality dimension has a score of

3.99 that quite good. These results show that the system is considered good at meeting user needs. The further study focuses on improving the ease of use and user experience, as well as additional features for personal allergic food warning systems.

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