Agile Software Development Implementation in Developing a Diet Tracker Mobile Application

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Abstract—Technology era drives people to use mobile phone to support their daily life activities. Technology development has a rapid phase which pushes the IT company to adjust any technology changes in order to fulfill customer's satisfaction. As a result of that, many companies in the USA emerged from systematics software development approach to agile software development approach in developing systems and applications to develop many mobile phone applications in a short phase to fulfill user's needs. As a systematic approach is considered as time consuming, costly, and too risky, agile software development has become a more popular approach to use for developing software including mobile applications. This paper reflects a short-term project to develop a diet tracker mobile application using agile software development that focused on applying scrum framework in the development process.

Keywords—Agile software development, scrum, diet tracker, mobile application.

I. INTRODUCTION

THE United States of America is recognized as the country where most of the technologies were developed including mobile phone technology that was developed by Southwestern Bell Company in 1946 [1]. Statistics show that since the first launched of mobile phone some five decades ago, mobile phone uses penetration was keep increasing in each year. In 2018, 82.1% and 69.6% of the population of 326 million in the United States reportedly use a mobile phone or a smartphone, respectively [2]-[4].

This paper is a reflection of a project about the implementation of the agile software development approach for developing the mobile application. In this project, scrum framework, as one of many agile software development approaches, has been selected as a method in the project's completion.

The aim of the project was to develop a diet tracker application with agile software development approach. This project emphasized on applying scrum framework in developing the application. This application contains two main parts, including daily diet goal and fitness tracker. The daily goal part will allow the user's of the application to set their daily goal to track their food consumption in that time, while the fitness tracker has the capability to help users to count the calories burned in a 24-hour period based on activities input to the application each day. In general, this application helps users to maintain their daily consumption and exercise for the purpose of health performance measurement. This project was developed with the scrum framework which followed all the

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characteristics of the scrum approach, including the rules for scrum team breakdown, product backlog, and sprint procedure. In terms of the project timing, it had a maximum of one semester for 12 weeks for the completion of the project.

This paper consists of five main sections. The first section introduces a glance at the project, followed by the second section that discusses the literature review of related projects. The third section of this paper explains about a method used during the project's development. The implementation of the method and the project outcome are described in section four. The last section summarizes the project's findings as well as lessons learned in the completion of the project.

II. LITERATURE REVIEW

This section is divided into two sections that describe the system development and the agile software development.

A. System Development

System development is a set of processes to capture, design, test, and implement a program, and in general, there are seven different steps in developing a system, including identification of problems, analysis of problems, identification of solution, identification of alternative solution, designing a solution, implementing a solution, and evaluating a result [5], [6].

B. Agile Software Development

Many years ago, a systematic software development approach such as the waterfall model was used to develop software. It has four main distinct phases including planning, analysis, design, and implementation. In last few years, agile software development has emerged as a well-known approach that has a different methodology compared to the systematic method. It acts as a fundamentally different methodology that ships incremental chunks of functionality within short iterations during the development process [7]-[9].

This project implemented an agile software development approach to develop the proposed application. The selected approach has been chosen due to flexibility in developing, delivering and maintaining a project. In agile software development, there are four main values that need to be considered, including focus on specific individuals and communications rather than the processes and tools being used, the efforts towards the software development process compared to the software requirements and specification documentation, a partnership with customers instead of a formal working contract, and a quick response to any improvements needed rather than a systematic plan [10].

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III. AGILE SOFTWARE DEVELOPMENT: METHOD AND TOOLS

This section on agile software development is divided into two major sections: Method and Tools. The agile software method section describes the scrum key roles and responsibilities, product backlog, and sprint, while the tools section describes briefly the variety of tools including different kinds of software used for developing the application.

A. Method

Scrum is one of the oldest agile software development methodologies that can be used in all kinds of environments, from small to big projects with contributions of participants in a team project to produce software in a wide range [11]. In the current project, this team has implemented scrum methodologies to develop a diet tracker application.

1. Scrum Keys Roles and Responsibilities

Three roles and responsibilities were identified during the development of this application: Product Owner, Scrum Master, and Development Team. The product owner took an important role to realize the value of product that will be built during this project by prioritizing items in the product backlog and had defined the acceptance criteria for product marked done. The scrum master acted as a coach to facilitate development team in solving the issues during the software development. The development team is responsible for completing product backlog items during the development of application.

In general, the product owner is responsible for a specific product that will be developed as well as a feature and a sprint delivering order, in addition this role acted as a leader to direct the entire project to decide the features and functionalities in each sprint [12]. In this project the product owner was Maxut, who was specifically responsible for the short term as well as long-term product's vision, writing on the user stories, making decisions on the project's scope and schedule, and prioritizing all the features for release based upon the project's expectation. As a product owner, Maxut ensured that the project runs based on the schedule and continually monitored and communicated the project progress with the scrum master. In a systematic approach, a scrum master acts as a project manager who helps the development team to understand the practices for the project development and monitors the process, which means doing a repetitive function that uses systematic data collection, to facilitate the management team and stakeholders to achieve the project's goals and to address questions related to the project's progress and the difficulties being faced? However, in this approach, the product owner is required to conduct meetings when necessary to discuss any issues and update the current work [13], [14].

Dwi was a scrum master in this project. She acted as a bridge between product owner and development team to solve any cross-functional core problems during the development process. In addition, she was responsible for managing the planning process, driving and coordinating the releases sprints, and being able to act as a peer to the product owner and development team on the releases or sprints deployment. As a project facilitator, Dwi was regularly communicating with members of the development team to help solve issues and to make improvement for each development problem.

Nadia and Gulnur were the members of the development team. They were responsible for product delivery that included developing the application, estimating and evaluating size of backlog items, writing a unit test, as well as evaluating the technical feasibility. As part of the team development, the two acted as architect, programmer, designer, and tester of the application to be developed. At the beginning of the project, Nadia and Gulnur created a design of the application before moving to the coding phase. During the coding phase, they were designing the application prototype using Pencil Project software. At the end of project, this team tested the application and tried to find any defects in order to make improvements.
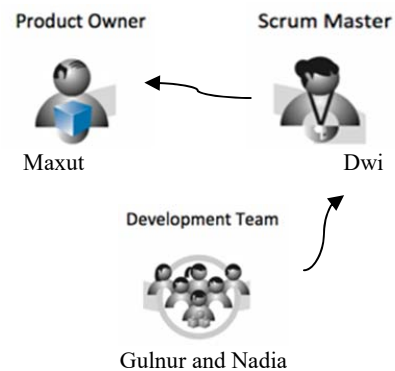

Fig. 1 Project Development Scrum Team adopted from Rubin [15]

2. Product Backlog

Product backlog is created as a list to prioritize each feature that needs to be shipped for each sprint. In this project, there were three shipments with two features included in each.

In this project, we defined two different types of items: high priority items and low priority items. High priority items include feature A, B, C, D, E, and F. However, low priority item includes only feature G.
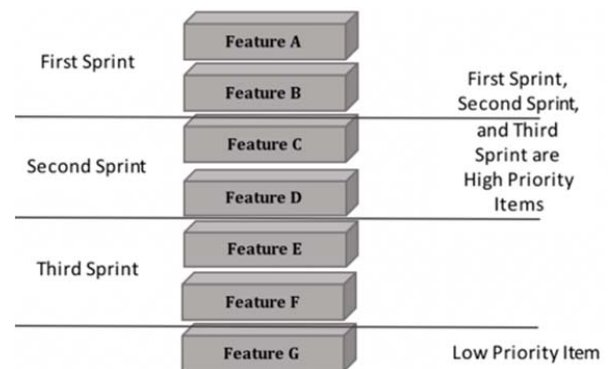

Fig. 2 Product Backlog

Feature A contains the documentation of the project planning and the roles and responsibilities of group members. The plan of the project covers the scope of the project, as well

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as its descriptions and delivery time. These were defined at the beginning of the project as a guide for the group to complete each phase of project. However, the project plan was flexible and adjusted during development based on necessity. The group's roles and responsibility were also defined in this phase, as it is necessary to split the work for each of the team members to maximize individual work and focus attention on their own tasks.

Feature B contains the application prototyping. It is an application blueprint to help the development team in developing the application on the right track. The prototype, as a blueprint of the application, is created in this feature. Even though the prototype was produced as a second feature during this project, the changes were still made based on necessity during the development process based on approval of the scrum master and product owner.

Feature C contains the application's usability and functionality. This feature examines the usability and feasibility of the application. The proposed usability was defined and decided in the next feature.

Feature D contains the details of the application usability. The application has three usability features: daily used, remaining, and activity earned. For each of these features, the usability details were briefly defined and completed during feature D activity. In this feature, the functionality of the entire buttons was defined and ensured that all worked properly.

Feature E contains the user's goal. The user's goal feature required the user to set a daily goal. This feature includes daily meals. The total consumption will sum up the meal inputs of the user on daily basis. This feature ensures the "set your goal" section works properly when users input their daily calorie consumption.

Feature F contains the fitness activity. This feature tracks the user's fitness activity to calculate the number of calories burned in a day. The total calories burned will be calculated and combined with the daily user's consumption.

Feature G contains the activity to add the map location. This feature is classified into the low priority item which is not mandatory to be shipped, but is defined as a future feature to be built and implemented in the next project.

3. Sprint

In sprint planning, the project development planned to be developed in less than two months of work that needs to be completed in three sprints. In each sprint, there were four different sections: Sprint Planning, Scrum Meeting, Sprint Review, and Sprint Retrospective.

a. Sprint-1

Sprint Planning

In the first sprint, there were two main tasks that need to be completed. First, the team is responsible for defining the roles and responsibilities for each team member. The first task determined the team member and defined their roles, namely Product Owner, Scrum Master, and Development Team. Secondly, after deciding that Maxut was the product owner, he was responsible to complete the plan of the project, the details of project, as well as the estimation of the project scope and schedule. After the details of project were defined by the product owner, the development team collaborated with the scrum master to work on creating the application prototype.

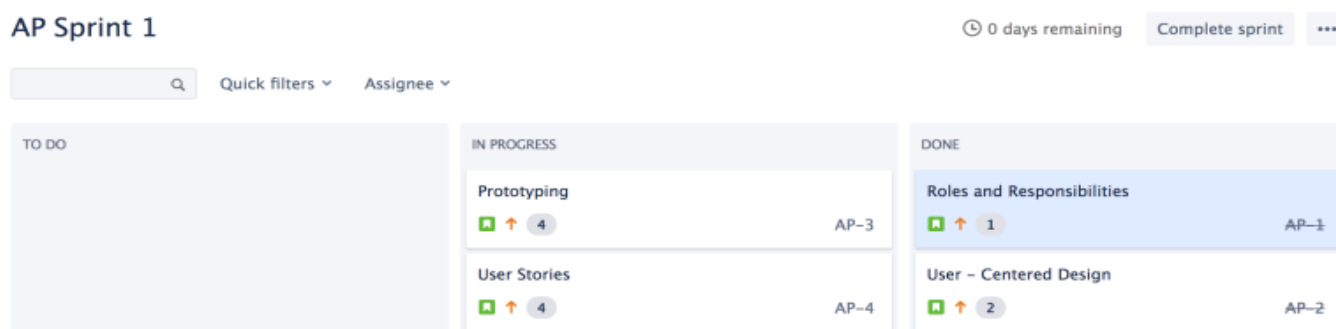Sprint-1 working progress and burn up chart are shown in Figs. 3 and 4.

Fig. 3 Sprint-1 Working Progress

Scrum Meeting

The scrum stand up meeting is a 15-minute daily meeting attended by all team members; these meeting took place from March 13, 2018 to March 26, 2018. In the very first stand up meeting, this group created to do list and defined the current and upcoming tasks.

The team communicated regularly to discuss any updates as well as issues that appeared during the project progress. The scrum meetings were conducted to address the three basic scrum questions: "What did you accomplish since the last meeting?", "What are you working on until the next meeting?", and "What is getting in your way to preventing you from doing your job?" [16].

Sprint Review

A sprint review was conducted before the deployment of each sprint. Each team member including the Product Owner, Scrum Master, and Development Team conducted a meeting to review the sprint backlog before sprint deployment. The first review for the first sprint was on Monday, March 26,

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2018 to review the planning documentation and application prototyping.

A sprint review was held at the end of sprint-1 in order to conclude the sprint-1 work accomplishment. The scrum master shared the entire completed planned features. The roles and responsibilities were again clearly defined, the prototyping model was successfully completed, and the requirements and user stories were collected from the product owner.

Sprint Retrospective

During the collection of the requirements and user stories, the scrum master and development team found that some of the requirements were not clearly identified and that it required revision in the next sprint.

b. Sprint-2

Sprint Planning

In the second sprint, the plan was to work on the revised user stories and release the first sprint. The product owner required to complete the user stories by defining the application's functionality. In addition, another task is to define the application usability. This task is under the responsibility of the development team.

Sprint-2 working progress and burn up chart are shown in Figs. 5 and 6.

Scrum Meeting

The scrum stand-up meetings for the second sprint were conducted starting from March 30, 2018 to April 9, 2018.
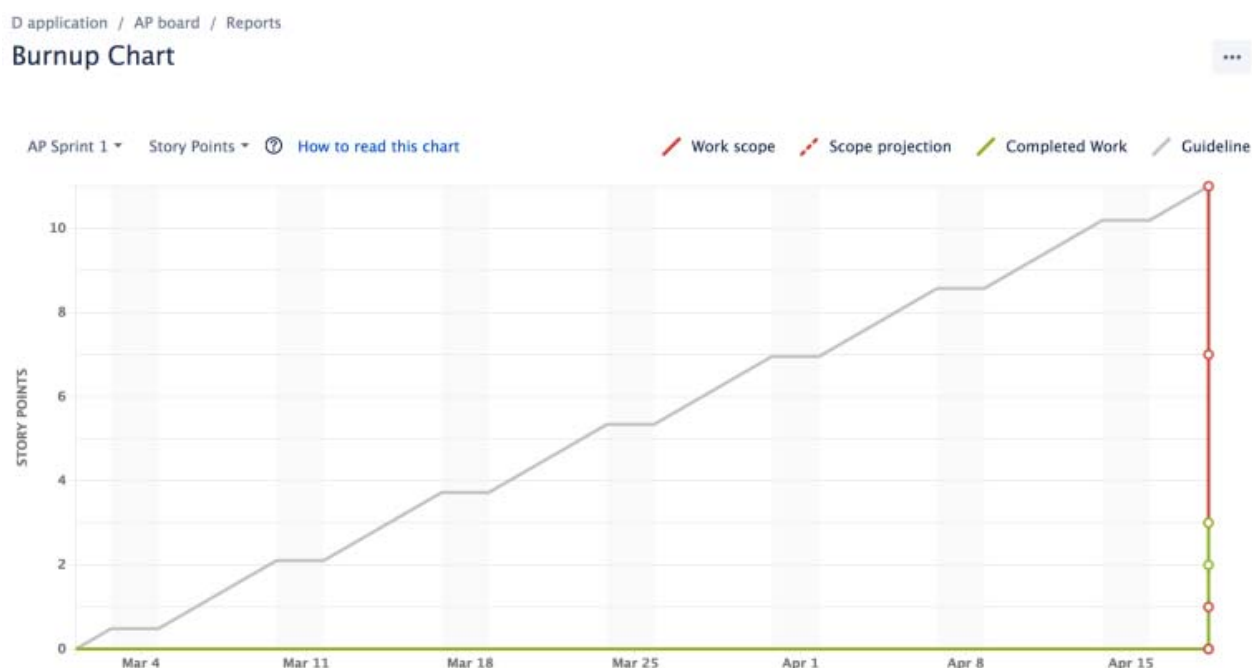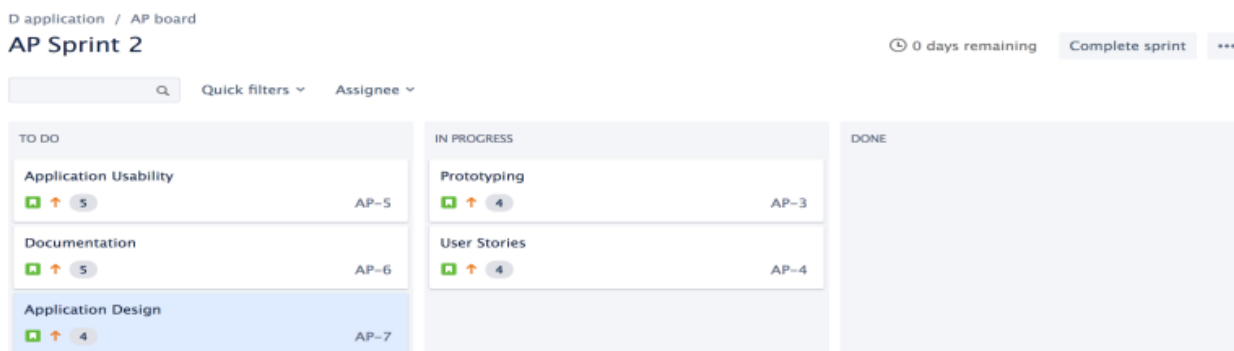

Fig. 4 Sprint-1 Burn Up Chart

Fig. 5 Sprint-2 Working Progress

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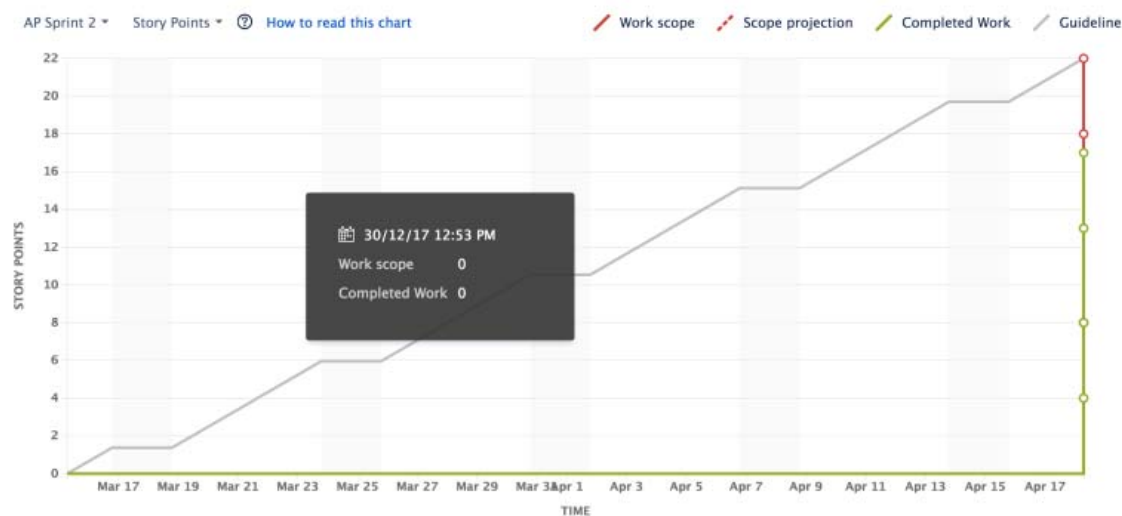
Fig. 6 Sprint-2 Burn Up Chart
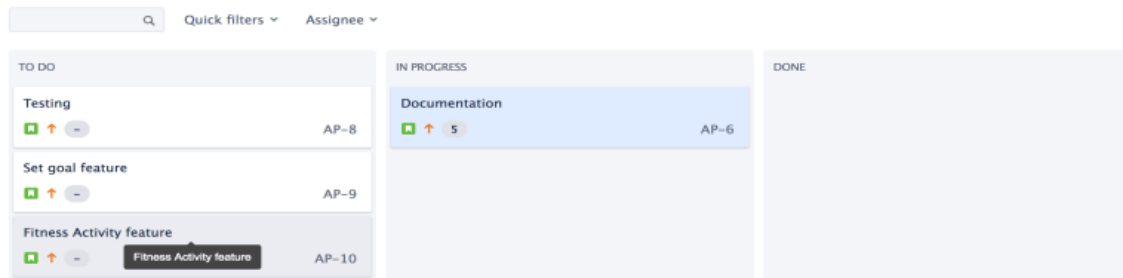
Fig. 7 Sprint-3 Working Progress

Fig. 8 Sprint-3 Burn Up Chart

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Sprint Review

The second review of this sprint was conducted on Monday, April 9, 2018 to review the user stories documentation, application usability, and application functionality.

Sprint Retrospective

An external expert provided feedback about the application improvement. The feedback received was removing some features that were considered unnecessary items based on the original requirements. The feedback was implemented on the next sprint. As a result, the development team agreed that they needed more application development training.

c. Sprint-3

Sprint Planning

In the third sprint, the plan was to define the application features including the user's goal and fitness activity.

Sprint-3 working progress and burn up chart are shown in Figs. 7 and 8.

Scrum Meeting

The scrum stand-up meetings for this last sprint were conducted from April 10, 2018 to April 17, 2018. For day 1 to

day 3, the development team worked on creating the feature for the user's goal and fitness activity. The scrum team continued working on the application documentation. For day 4 to day 7, the development team designed the application's logo and proposed it to the product owner for approval. For day 8 to day 11, the development team tested the entire application and fixed some defects found during the previous testing phase. For day 11 to day 14, the application documentation was completed. The final meeting and presentation were conducted with the product owner. At the end of this project, the application and documentation were delivered to the product owner.

Sprint Review

The third review of the last sprint for this project was on April 17, 2018 to review the application features including the user's goal and fitness activities.
Sprint Retrospective

In sprint retrospective, this group was focused on improvements of the application in the future. In this case, the group was thinking to expand the usability of this application to detect the location of the nearest gym for the application's user to exercise.
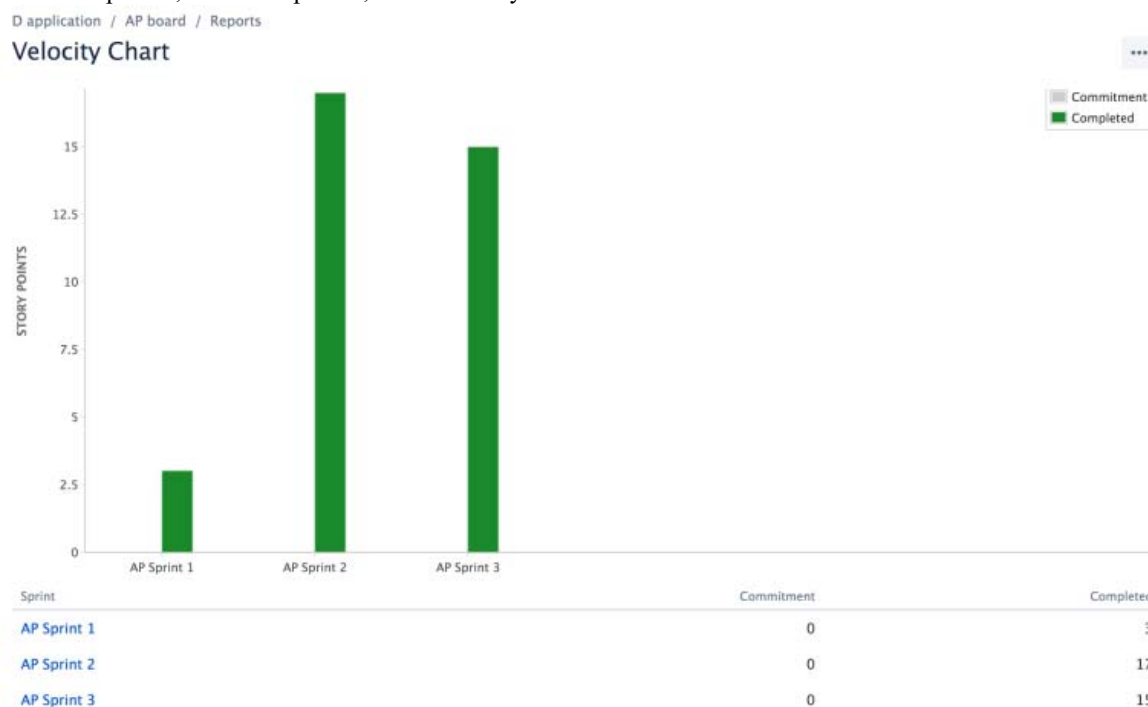

Fig. 9 Velocity Chart

B. Tools

In this project, this group used various software to develop the application. As this application is categorized as a type of web page and web application, Hypertext Markup Language (HTML) and Hypertext Preprocessor (PHP) were used as the markup languages for creating the application and a server-side scripting language was used as a general-purpose programming language [17]. In addition, Cascading Style Sheets (CSS), as a style sheet language used to present a

document written in a markup language, was used to add the style of the application looks. JQuery also used during the application development as a cross-platform JavaScript library in order to make a simple client-side scripting from the HTML side. Brackets, an open-source code editor for web developers, was used as an editor writer in HTML and CSS was used by the development team to edit their application codes.

In order to create a prototype design of the application, Pencil software used as a GUI prototyping tool to create

mockups for this Diet Tracker application. Moreover, Google Images was also used to design the application logo.

Jira, a project management tool, was used by this team to track any issues related to the application development. Jira is an issue and project tracking software that is able record bugs and project management function problems.

IV. IMPLEMENTATION

A. Project Estimation

Project estimation is considered as a crucial phase, and therefore, this group creates the project's estimation measurement in the preliminary stage of the project development.

Estimation as a foundation of plan, predicts the length as well as the cost of the project that interplays with business targets, commitments, and control [18]. This project has 35 story points in total. In sprint-1, the team counted there were three story points required to complete, while there were 17 story points and 15 story points for sprint-2 and sprint-3, respectively.

As mentioned earlier, this team selected the release planning for every sprint; the estimation to deliver each sprint was by the end of the second week of the start date for each sprint. The release planning estimation date for this project is shown in Fig. 10.
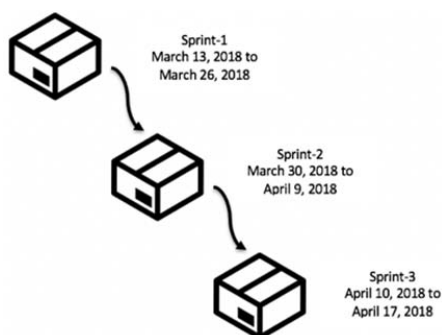

Fig. 10 Release Planning Estimation Date

As each sprint was released every 2-weeks, there were three deliverables during this project with two features released in each sprint deliverable. The release constraints consist of scope, date, and budget, as described in Table I.

TABLE I
PROJECT RELEASE CONSTRAINTS

Release Constraints		Details
Project Type	Fixed date	One semester length project (in Spring 2018).
Scope	Flexible	Able to add some more features when necessary.
Date	Fixed	Started in Mid-March 2018 and finished before End-April 2018.
Budget	Fixed	The budget is defined at the beginning of project.

B. Diet Tracker Application

1. Application User Story

User story is a short and simple description about a feature that describes users' accessibility to the application. User story was able to cover a large amount of this application functionality during the implementation of the agile software development iteration.

There were two personas for this application: the application's user and the development team. The user stories created are as shown in Table II.

2. Diet Tracker Application

The application prototype and layout are shown in Figs. 11 and 12. From the figure, it shows that that there are three main sections in the application: daily used, remaining, and activity earned.

The application's users are required to input their personal daily goal, so it can record their target by measuring against the input of total calories consumed and calories burned from exercise for a day. Fig. 12 (A) is a layout for the input section and Fig. 12 (B) is an example of the output layout from the data input by users.
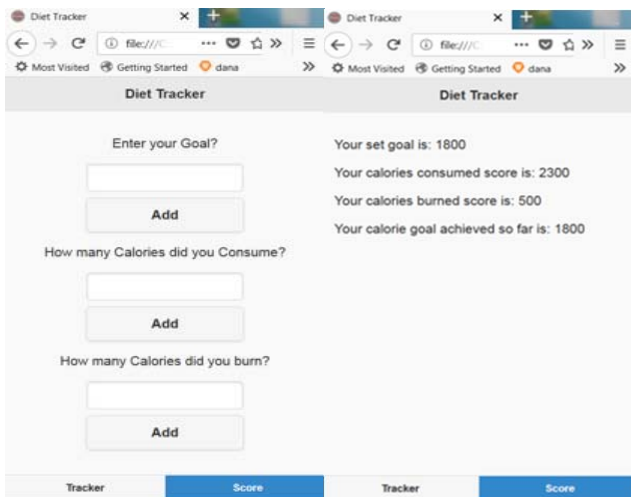
There were some options for selecting the application type including: Native Application, Web Application, and Hybrid Application. Due to budget and time restraints, the Web app type was selected as the best option for this project. This project is a Web-based app that can be accessed through the browser of major devices such as Android and iOS; as well, users are able to access the application offline.

TABLE II
PROJECT RELEASE CONSTRAINTS

Requirements	Person
As a user of the diet tracker application, I am responsible for opening the application, so I can start using it.	Application's User
As a user of the diet tracker application, I am responsible for entering my goal into the application, so the application can start to record my personal daily goal.	Application's User
As a user of the diet tracker application, I am responsible for entering the calories consumed to the application, so the application can start counting my calories consumed.	Application's User
As a user of the diet tracker application, I am responsible for entering the calories burned to the application, so the application can start counting my calories burned.	Application's User
As a user of the diet tracker application, I am able to track the total score for my daily consumption on the application, so I can notice my total calories in a day.	Application's User
As a user of the diet tracker application, I am able to track the total score for the fitness tracker on the application, so I can balance my fitness effort and meal consumption to achieve my goal.	Application's User
As a user of the diet tracker application, I am able to track the remaining score for daily goal on the application, so I know how much effort needs to be done to complete my daily goal.	Application's User
As a member of the development team, I am responsible for resolving any technical issues, so the application's user is able to access the application without encountering any problems.	Development Team
As a member of the development team, I am responsible for updating the application, so the application is continuously updated with a newer version.	Development Team

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Fig. 11 Application Prototype

(A)   (B)

Fig. 12 Application Layout (A) For Diet Tracker (B) For Tracker Result

The programming behind the web app development consists of HTML, CSS, and JQuery. Depending on the product backlog items, the development team was able to implement key functions in each sprint. The application is divided into three different sections. The application is divided into three calorie sections: daily target, intake and activity.

Users were able to navigate the total score on the bottom to a score page.

The home or main screen will collect all the user data. The goal will be the first entry and it will stay the same on the score page. The user has control by adding calories consumed and also subtracting calories burned by adding their fitness activity to calculate the figure. Lastly, the simple navigation has two buttons, the Tracker and Score. The Tracker button will bring the user to the main page. The Score page will show a calculation of the total daily input, so the user can know if

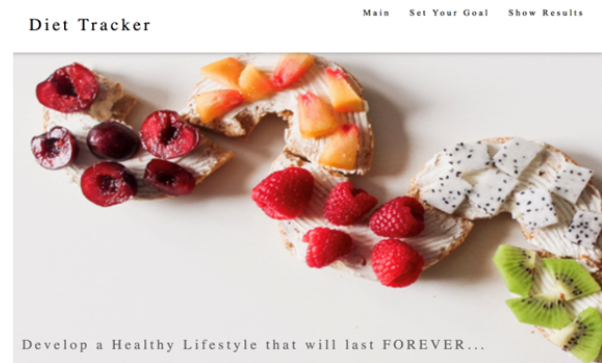they reached their goal.

Fig. 13 Main Page Application Picture adopted from Doan [19]
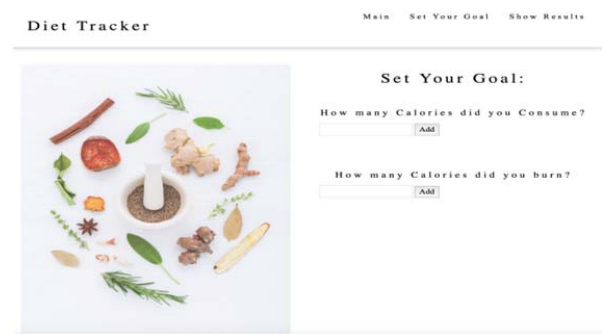

Fig. 14 Goal Feature. Picture adopted from Pixabay [20]
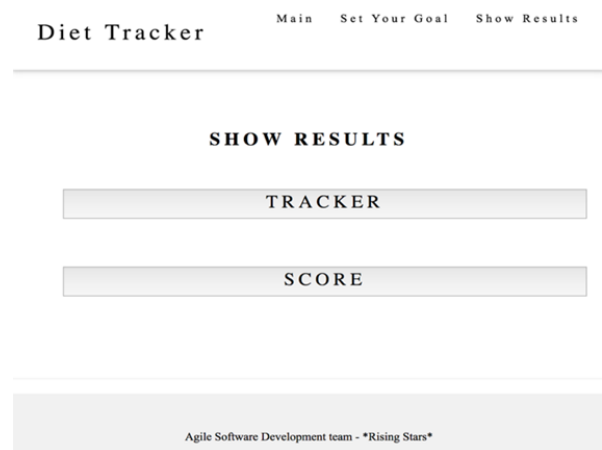

Fig. 15 Set Goal Feature

After completion of the development of this application, there was one essential process that needs to be executed, namely the testing phase. Before shipping the product for all three sprints, the test was conducted to ensure that there are no defects. Testing was conducted to raise the reliability of the program by finding and removing errors, and this phase started with the assumption that the program contained errors and the main purpose of this phase was to find as many of the errors as possible [21].

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V. CONCLUSION

This paper summarizes the development of a diet tracker application with an agile software development approach. The diet application was developed during this project. In conclusion, the project was successfully completed on time based on the project scope and estimation. The team members learned many things during the development of this application; most importantly were the four skills developed during this project, namely: communication, time management, team work, and problem solving. The regular scrum meetings, conducted for 15 minutes every day, allowed each team member to build on their communication skills, as they were each responsible to explain their daily work progress to the rest of the team. The agile software development using scrum methodology approach taught the group to communicate effectively and accurately to all team members in order to successfully complete the project. In addition, team members were able to learn to better manage their time in order to be prepared for the important daily meetings. The skill of team work was well established in the group, as the project demanded the full cooperation of all involved. Finally, problem solving was an essential skill to help the team to solve any problems that occurred during the completion of the project.

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