Data Analysis Reporting Website Development Project with Scrum Methodology

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Abstract—**Data analysis is an important part of research in modern-day science. Current technological advances have made it possible to achieve higher levels of scientific discovery. Unfortunately, the massive amount of data that is now available has made data analysis more difficult. As a solution to that problem, we have decided to make a data analysis reports website called Data Santa, which will provide data analysis reports submitted by registered members. Our website will help users access and understand the data better. For the development, we have decided to use the Scrum Methodology. Using the Scrum Methodology, development of the website will be much faster, and a high quality is ensured thanks to the continuous feedback from stakeholders and end-users.**

Keywords— Website, Data Analytics, Scrum, Software Development Life Cycle, Data Reporting, Data Bank

I. INTRODUCTION

Data analysis is an imperative part of research in modern-day science. With current technological advances and the rise of big data, we are given new opportunities to take scientific discovery to higher levels. However, the massive amount of data brings about new computational and statistical difficulties for data analysis [1]. According to a poll conducted by *Science* on the availability and use of data, many respondents expressed their need for additional help in analyzing data [2]. Up to 23% of responders claim to not have the necessary expertise to analyze data themselves, and up to 80.3% do not have sufficient funding for data curation. While it is known that a significant number of researchers rely on existing data from previous research and most prefer data sharing [3], a lot of published data is still unavailable and inaccessible to the public, while many of those that are available may be incomplete [4].

The existence of various data banks is a way to tackle the challenges of data accessibility and data analysis. One such example of a public website is the Protein Data Bank (PDB), which stores an archive of macromolecular structural data [5]. The PDB receives new data entries and validates them before they are published to the database. Another example is the Topology Data Bank of Transmembrane Proteins (TOPDB) which provides tools to aid users in accessing the data, as well as uses a prediction algorithm which can help complete any missing data [6]. Most of these existing data bank websites also provide tools for data visualization, which helps to represent the massive amounts of data in a form that is easier to understand and analyze [7]. This is an important tool in data banks as data visualization has proven to help communicate the data better and can help in decision-making [8].

Knowing the previous benefits of data bank websites, we have proposed an idea to create a data analysis report web application known as Data Santa. While the concept of Data Santa will be similar to other data banks, the major difference is that Data Santa entries will provide more comprehensive data stories and analysis for every submitted dataset so that users may understand them better. This can aid researchers and marketers projects as there is always a high demand for data analysis in the business and research world. Researchers would create an account in Data Santa in order to submit "articles" which consist of the dataset and the data story that they have written for it. These articles will be verified by Data Santa's admins before they are published to be read by the public. With Data Santa, we hope to help students, businessmen, and other researchers with accessing and better understanding data.

When developing an application, we use a project management methodology known as Software Development Life Cycle (SDLC). The SDLC is a process that consists of steps in building and maintaining the application, one of the

well-known SDLC is Scrum Methodology [9] [10]. The Scrum Methodology is part of the agile family development methods that focus on the rapid iteration with continuous input from customers. In the Scrum Methodology, the development of the application is split into a cycle called "sprint". Sprint is a short development that usually takes no longer than 30 days and has one common goal to achieve per sprint [11]. At the end of each sprint the team reviews with the stakeholders and include their feedback as bases toward the next sprint. By using the Scrum method in developing a software, the quality and project risks are discovered quicker, quality of application is high, business change and customer feedback are discussed and visible in the final sprint, live application can be made based on the taken product backlog [9].
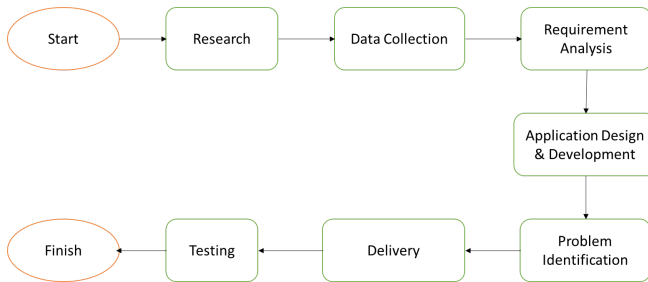
II. METHODOLOGY

Fig. 1. Framework flowchart

A. Research

According to [12] the research part is the place where we analyze and interpret the data information that we got into the suitable or fitting methodologies that has been set by specific professionals in the field and by the academic disciplines.

B. Data Collection

Data Collection is one of the important stages in the research which consist of procedures regarding the collecting, measuring, and analyzing to give us the insight about our research. The objective of data collection is to ensure we have a great deal of reliable information that we can use so that data-driven decisions can be made from statistical analysis for our research [13].

C. Problem Identification

Problem Identification is the stage where we determine or define the problem for our project. In this stage, we identify, prioritize, and select solutions and alternatives to solve the problem. Doing this stage is important in our research since this stage allows us to know what problem we need to solve and would make us more focused on solving the main problem while working on our application.

D. Requirement Analysis

Requirement Analysis is the stage where we define the expectations that our potential user has for our application, which is still under development. In this stage, we gather their thoughts to see what they think and expect for our application before looking at them in order to compile a coherent list of expectations that we need to meet. This stage is also important since it shows what we need to implement and reach while we develop our application.

E. Application Design and Development

At this stage, we design our application with the information that we got from the data collection and requirement analysis stage. After designing, we move on to implementing the code using the agile software development lifecycle.

1) Scrum Roles
According to [14], it is said that in scrum, there are 5 scrum roles:

a. Customer/ User
Customer or User is the one who will use the product, in other words, they are the end-user of the product. So, the customer or user will also have a responsibility inside of the scrum development, which is to give feedback to the item that has been developed regarding the feature and the functionality of the item during the scrum product development for further improvement.

b. Internal Stakeholder
Internal Stakeholder is the person who usually has the money or the person who handles the funding of a scrum development, meaning they are the one who provide all of the funding of the scrum development and if the scrum team is from outside of the company the Internal Stakeholder is the one who hires the people or the scrum team to develop the product that they want to make. Because of this, usually Internal Stakeholders in the scrum hold high authority in the company where usually they are the executive of the company. The stakeholder also has a relation to the product owner, and customer, where this means that they are the one who bridges the communication of customer or user with the product owner. So, the Internal Stakeholder is the person who is responsible for being a bridge that connects the user or customer with the scrum team through the product owner, where Internal Stakeholder here will give the idea and vision to the product owner from the customer input. Furthermore, the Internal Stakeholder is the one who is responsible in funding the scrum development of an item and the one who funds the scrum team if they are from outside of the company.

c. Product Owner
Product owner is the person that will be responsible in managing the economics in the developments of some products in the scrum. Then, the product owner will also participate in the planning of the product. Other than that they also need to be responsible in grooming the product backlog, which is used to ensure that the development will be a success. Furthermore, the Product Owner will be the one who is responsible to define what is the acceptance criteria of a product and the one who verifies if the product meets the criteria that has been defined. The Product Owner is also responsible in collaborating with the development team and stakeholders, meaning that they are the one who connects the internal stakeholder with the scrum team where the Product Owner will have a

responsibility to balance the needs of the internal stakeholders.

d. Scrum Master

Scrum Master is responsible as the coach of the scrum project, meaning that they will coach the team to help them understand, ensure them, and apply the existence of the scrum values, practice, and principle in each of their works. Then they are the servant leader meaning that they are responsible in setting up scrum as a servant process where this is not a commanding process. Process authority means that the scrum master is empowered to make sure that the scrum teams are able to do their work according to the scrum values, principle, and practice. Then another responsibility is the interference shield where the scrum master must ensure that the scrum team is being protected from outside interference to make sure the scrum team is able to focus on delivering their business value in each sprint. Then impediment remover here is to remove all the impediments to the development team progress, and finally the last responsibilities is to change agent meaning they need to mentor the scrum team as well adapting the team to the changes that happened and have a consistent effort in the product development process

e. Development Team

Development team here is the group of developers that works on the product during the sprint execution. The member of the development team will have the responsibility to develop the product backlog items by designing, building, integrating, and testing the product backlog to check and see if the product backlog is able to function as intended or not.

2) Scrum Artifacts
a. Product Backlog

The usage of product backlog here is to make a list that prioritizes the features or items that the product owner has decided when making the sprint. This product backlog will show which features are needed in the application, then knowing what features that need to be built, and how our sprint team should build in the future [15].

b. Sprint Planning

The sprint planning is the preparation before the sprint begins. The purpose of this stage is to decide which of the product backlog features will be delivered in the sprint. Then in the sprint planning, how the product backlog feature will work on is decided [16].

c. Daily Scrum Meeting

Usually, the development team held a quick daily meeting discussing their agenda on that day, their current progress, and obstacles that prevent the team from making progress towards the sprint goal. This is to reevaluate their current progress as a team and exchange information between members to plan out and adjust their sprint strategy if needed for the sprint goal.

d. Sprint Review Meeting

Sprint review is usually intended for the scrum team and stakeholder where this is an informal meeting. The meeting here will showcase or reveal the product and determine what needs to be done or what is considered has been successful or completed. This means that the main purpose of the sprint review meeting is for the scrum team to visualize their work to the stakeholder, by doing so the stakeholder is able to understand clearly what the scrum team wants to make [17].

e. Sprint Retrospective Meeting

Sprint retrospective is a meeting that happens after we have done the sprint review and before the next sprint planning. This meeting has a purpose to identify or to notice the past mistakes and find solutions to prevent these mistakes from happening again. For this sprint retrospective meeting it is usually being participated by the scrum team, but the stakeholders are also allowed to attend the meeting. Another part to know is that in the sprint retrospective meeting other than to notice the past mistake that happened by doing this meeting it also tells the scrum team and the stakeholders the condition of the team and knowing the condition if the teams is doing well or not and finding out what can be improved for the next sprint to have the most optimal result at the next sprint [18][15].

G. Testing

After finishing the application design and development we will test our web application and ensure that every function and code work perfectly fine without any error when doing the testing. According to one of the research[19], Testing is a process where we will test software applications using scripts, tools , or any kind of test automation framework that is available to know or identify any existing error that is available. This means that the testing will be done by covering every part which fully includes function, code, and the database.

H. Delivery

According to one of the research [20], application delivery means that it is an act of using a suite of technologies where it is making sure that the application content that has been made will ensure that the application content and functionality were able to be efficiently and reliably accessible by many clients or users.

I. *Product Roadmap*

The product roadmap is used to give an overall run-down about the incremental deployment for the future release. In this product roadmap, each of the releases should define the release goal that can explain the purposes and the target outcome for the release [14].

J. *Release Planning*

The Release planning is the long term planning which plans the detailed information about the scope of the release and how long does it take to finish a feature for each release. The purpose of release planning is to decide the next logical

action in order to achieve the product goal. In the creation of release planning, the balance between stakeholders needs and the overall quality with the scope of the product, the schedule, and the current budget must be considered [14].

III. Result & Discussion

The result of this project is a functional prototype of a website called "Data Santa". This website will contain dataset records and its summaries that researchers can look into and download for their purposes. In order to develop the website, the team implements Scrum methodology. The methodology includes product backlog, roadmap, release planning, sprint planning, sprint review, and sprint retrospective. The roles are Kenny Jingga, B.Sc., M.T, (the lecturer) as product owner, Gabriella Ryanie Setiawan as scrum master and development team member along with the rest of the authors mentioned above.

A. Product Backlog

The product backlog was made to accomodate the needs of Data Santa target users such as researchers, data analyst, product planning team, etc. The first and second versions are illustrated in Table I and Table II respectively.

TABLE I. PRODUCT BACKLOG TABLE VERSION 1

ID	User Story	Day(s) Estimate	Priority
1	Guest Register: I as a Guest wants to be able to register to the website so that I can contribute my findings	1	1
2	User Manage Article (Add, Update, Delete): I as User wants to manage all the articles that I have published and will publish so that I can share my findings and correct or delete them if there are mistakes	7	2
3	Admin Article Validation: I as an admin wants to validate the article so that I can confirm the article either they are approved or not as a quality article	5	3
4	Guest View Article: I as a Guest wants to look at the data article so that I can analyze the data that I need for my research	2	4
5	User View Article: I as a User wants to look at the data article so that I can analyze the data that I need for my research	2	5

6	Admin Manage Category (Add, Edit, Delete): I as an Admin wants to manage categories and articles so that the website's information are organized and valid	5	6
7	Admin Manage Article (Add, Edit, Delete): I as an admin want to manage article so that I can organize the published article in the website	7	7
8	User Search Article: I as a user wants to be able to search specific data article so it can saves my time in searching the article	1	8
9	Guest Search Article: I as a Guest wants to be able to search specific data article so it can saves my time in the article	1	9

TABLE II. PRODUCT BACKLOG TABLE VERSION 2

ID	User Story	Day(s) Estimate	Priority
1	Guest Register: I as a Guest wants to be able to register to the website so that I can contribute my findings	2	1
2	User Login: I as a User wants to be able to login to my account so that I can access User features	4	2
3	User Create Article: I as User wants to be able to create article so I can contribute in providing data analytics to other people	4	3
4	Admin Article Validation: I as an admin wants to validate the article so that I can confirm the article either they are approved or not as a quality article	6	4
5	Guest View Article: I as a Guest wants to look at the data article so that I can analyze the data that I need for my research	3	5
6	User View Article: I as a User wants to look at the data article so that I can analyze the data that I need for my research	1	6

7	Admin Manage Category (Add, Edit, Delete): I as an Admin wants to manage categories and articles so that the website's information are organized and valid	6	7
8	Admin Manage Article (Edit Article Category, Delete): I as an admin want to manage article so that I can organize the published article in the website	6	8
9	Guest Search Article: I as a Guest wants to be able to search specific article using keywords so it can save my time in searching the article	2	9
10	User Search Article: I as a User wants to be able to search specific article using keywords so it can save my time in searching the article	1	10
11	User Search Article By Category: I as a user wants to be able to search article by category so I can discover more related analytics that I need	2	11
12	Guest Search Article By Category: I as a guest wants to be able to search article by category so I can discover more related analytics that I need	1	12

The priority of the product backlog is based on an order of how the users use the website. Thus, the priority order starts from creating a user access system, the article creation process from user creating the article until the article is validated, the website visitors can see the article, adding more admin functionality, the search functionalities, and restricting posted articles from being edited to ensure the analysis integrity of the article over years.

An update was made for the product backlog to ensure that the website is comfortable to use. The first change is to explicitly describe the login feature and the second one is to add an article searching feature based on categories. The last change is to also put estimation on testing time.

B. Roadmap

TABLE III. ROADMAP

Date	December - 2021	January - 2022
Version	1.0	2.0
Goal	Defining	Finishing UI, adding
	requirements, database structure, UI design, website user access, basic article features.	more searching features, and article management for admin
Features	Database structure, login, register, create article, view article, admin article validation.	Admin article and category management page, search page, search category page, finishing UI
Metrics	Product backlog, ERD, UI Draft, unit testing passed.	User test

The roadmap shown on Table III is separated into two entries based on the state of Data Santa website itself. The first roadmap entry for December 2021 focuses on the basic functionalities for users such as register, login, article management, etc. whereas the January 2022 entry is about improvements of the website and the admin needs.

C. Release Planning

TABLE IV. RELEASE PLAN

Version	Product Backlog	Day(s) Estimate	Number of Sprints
1.0	Guest Register	2	2
	User Login	4	
	User Create Article	4	
	Admin Article Validation	6	
	Guest View Article	3	
	User View Article	1	
2.0	Admin Manage Category	6	1
	Admin Manage Article	6	
	Guest Search Article	2	
	User Search Article	1	
	User Search Article by	2	

	Category		
	Guest Search Article by Category	1	

The release plan displayed on Table IV is an elaboration of the roadmap on Table III. As it can be observed, the product backlog items included in release version 1.0 is also centered on the user functionalities, the same as the roadmap for version 1.0. The release plan for version 2.0 then is for the website improvements and admin features.

D. Sprint

Sprint 1
1. Defining Requirement
   - Create use cases (1 day)
   - Create user stories (2 days)
2. ERD
   - Create ERD draft of database (1 days)
3. Web UI Design
   - Create UI visualization (2 days)
   - Evaluation (1 day)
4. Establish Database
   - Code database in Laravel and MySQL database (2 day)
   - Testing (1 day)
5. Guest Register
   Story: **I as a Guest want to be able to register to the website so that I can contribute my findings.**
   - Code UI & backend logic (1 day)
   - Testing (1 day)
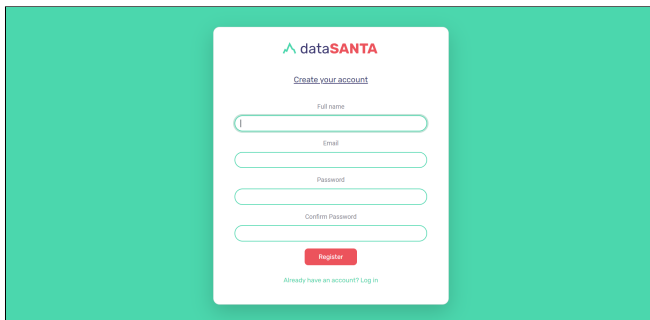
Fig. 2. User registration page

6. User Login and Logout
   Story: **I as a User wants to be able to login to my account so that I can access User features.**
   - Code UI & backend logic (1 day)
   - Testing (1 day)
   - Homepage Code UI & backend logic (1 day)
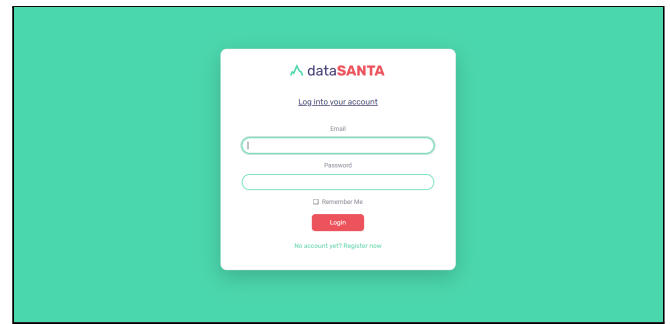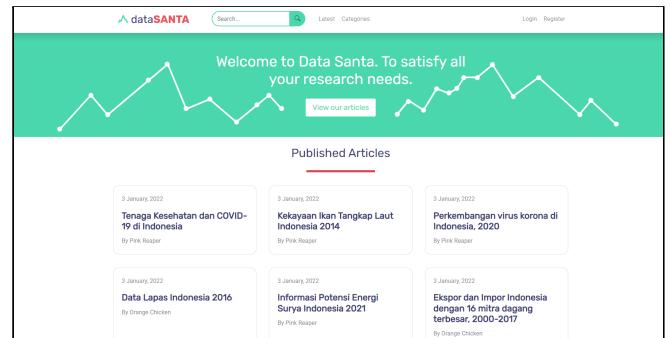   - Homepage Testing (1 day)

Fig. 3. User login page

Fig. 4. Homepage

Fig. 2 shows the registration page that guests will see when they want to register as a user for Data Santa, while Fig. 3 shows the login page in which existing users can log into their account.
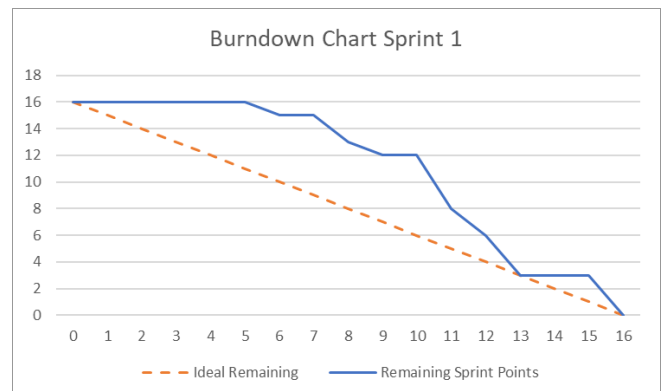

Fig. 5. Sprint 1 burndown chart

Fig. 5 illustrates the rate of the sprint being completed. The blue line is the actual remaining sprint points whereas the dashed orange line is the ideal rate of the remaining sprint points. It can be observed that in the start the sprint points did not decrease at all. This is because the team is still learning and getting used to the tools. However, it still managed to be finished just in time on day 16.

Sprint 2
7. User Create Article
   Story: **I as a User want to be able to create articles so I can contribute in providing data analytics to other people.**
   - Code backend logic (2 days)
   - Code UI (1 day)

● Testing (1 day)

Fig. 6. User's New Article page

When a user wants to create a new article, they will do so on the New Article page shown in Fig. 6. Here, all information about the article will be filled in by the user before clicking submit.

8. Admin Article Validation
Story: **I as an admin want to validate the article so that I can confirm the article either they are approved or not as a quality article.**
● Code backend logic (3 days)
● Code UI (2 days)
● Testing (1 day)

Fig. 7. Admin article validation

Admins will validate a pending article by clicking either "Accept" or "Reject", as shown in Fig. 7.

9. Guest View Article
Story: **I as a Guest wants to look at the data article so that I can analyze the data that I need for my research.**
● Code backend logic (1 day)
● Code UI (1 day)
● Testing (1 day)
10. User View Article
Story: **I as a User wants to look at the data article so that I can analyze the data that I need for my research.**
● Connect to guest view article & testing (1 day)

Fig. 8. View article page

Fig. 8 shows the page for when a specific article is clicked. Full information of the chosen article will be displayed on this page so that guests, users, and even admins can read the article.
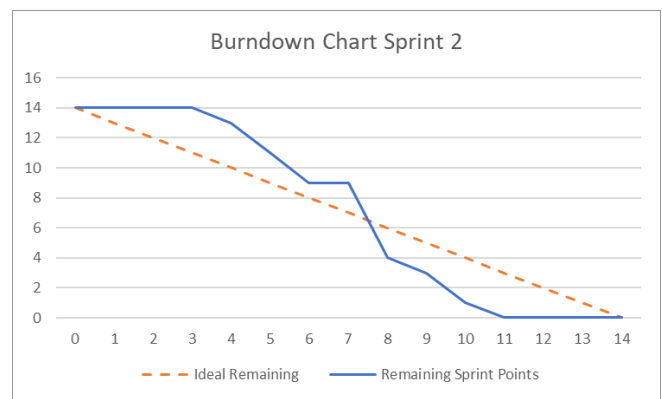

Fig. 9. Sprint 2 burndown chart

For sprint 2 that starts at the beginning of early December 2021, the burndown chart is pictured in Fig. 9. According to the graph, the sprint finished earlier than the estimated days. This is because the team is more used to the tools and most of the tasks, such as creating different pages, can be done parally. Thus, instead of the projected 14 days of sprint completion, the sprint ends in 11 days.

Sprint 3
11. Admin Manage Category
Story: **I as an Admin wants to manage categories so that the website's information is organized and valid.**
● Code backend logic (3 days)
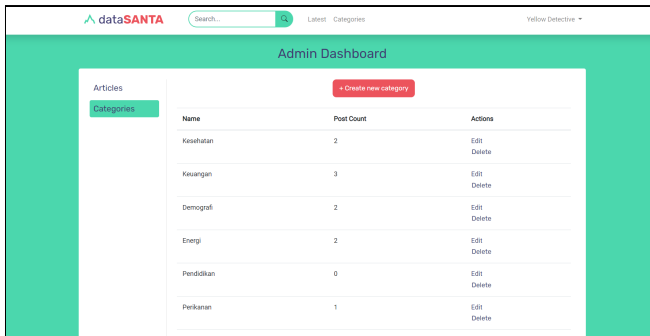● Code UI (2 days)
● Testing (1 day)

Fig. 10. Categories section on the Admin Dashboard

12. Admin Manage Article
    Story: **As an admin, I want to be able to manage articles so that I can organize the published articles on the website.**
    ● Code backend logic (3 days)
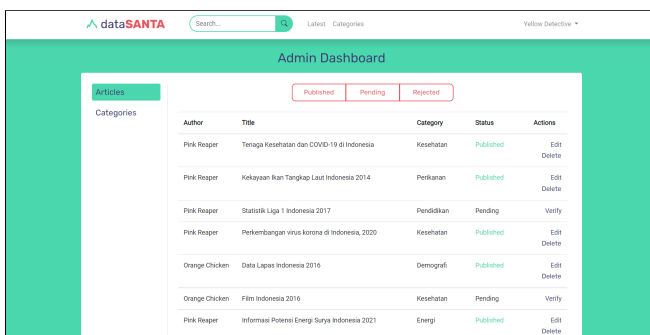   ● Code UI (2 days)
    ● Testing (1 day)

Fig. 11. Articles section on the Admin Dashboard

Admins are provided with an Admin Dashboard, which has two sections, one for managing articles and the other for managing categories. Fig. 9 shows the categories section, in which a list of the existing categories is displayed. There are buttons to "edit" or "delete" each category. There is also a button to "create new category".

Fig. 11 shows the articles section of the dashboard, in which a list of published, pending, and rejected articles are displayed. There is a filter option on top to filter the articles by its current status. There are also action buttons for the articles which depends on their status. Admins can "edit" or "delete" published articles, while they can "verify" pending articles. As for rejected articles, there are no available actions.

13. Guest Search Article
    Story: **I as a Guest wants to be able to search specific articles using keywords so it can save my time in searching the article.**
    ● Code backend logic & UI (1 day)
    ● Testing (1 day)

14. User Search Article
    Story: **I as a user want to be able to search specific articles using keywords so it can save my time in searching the article.**

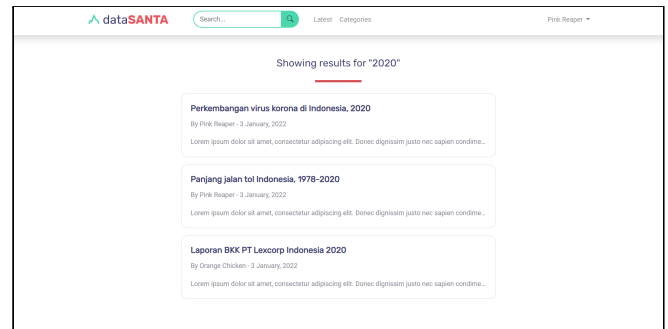● Connect to Guest Search Article page & testing (1 day)

Fig. 12. Search results page

Fig. 12 shows the search results page, in which any article whose title contains the keyword from the search query will be displayed in a list.

15. User Search Article By Category
    Story: **I as a user want to be able to search articles by category so I can discover more related analytics that I need.**
    ● Code UI & backend logic (1 day)
    ● Testing (1 day)

16. Guest Search Article By Category
    Story: **I as a guest want to be able to search articles by category so I can discover more related analytics that I need.**
    ● Connect to User Search Article by Category page & testing (1 day)
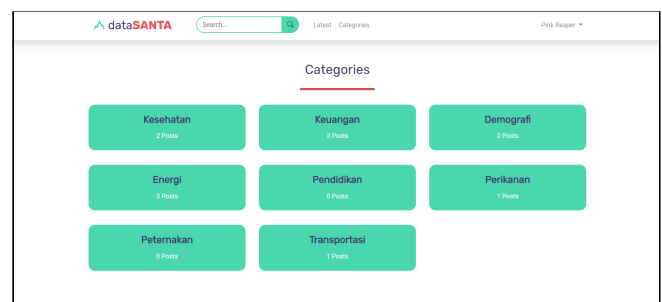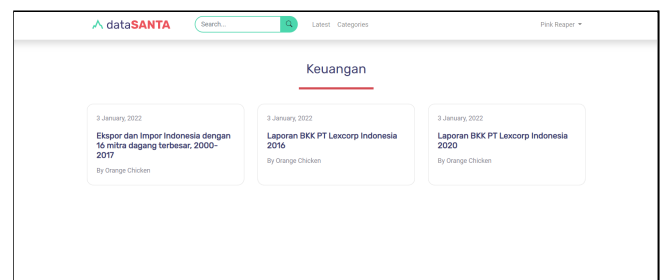

Fig. 13. Categories list page

Fig. 14. Article list based on category page

When a guest or user clicks on the "Categories" button on the website header, they will be taken to the categories

page, which lists all the existing categories as shown in Fig. 13. Then, any one of the categories can be clicked, and then the website will be redirected to a page showing a list of all articles under that chosen category as shown in Fig. 14.
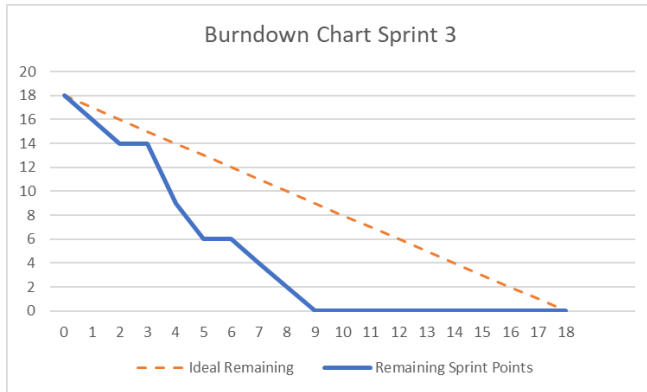

Fig. 15. Sprint 3 burndown chart

The last burndown chart is for sprint 3 that is displayed on Fig. 15. Similar to the burndown chart for sprint 2 in Fig. 9, sprint 3 also completed earlier than the expected time which is only 9 days instead of 18 days. Those are because the team executed most of the task parallely, is adept in using tools needed, and the team has less classes at the early January.

E. Sprint Retrospective & Review

TABLE V. SPRINT RETROSPECTIVE AND REVIEW TABLE

	Sprint 1	Sprint 2	Sprint 3
Review	Change the product backlog to include login and category search	Minor bug on homepage after integrated with other components, but solved.	Middleware bugs discovered on some controllers.
Retrospective	The team took a lot of time on learning the tools needed and cannot do daily sprint meeting as the team needs to keep up with their studies	The schedule got delayed as the team members who are students have a lot of exams in November. However after that, the sprint is faster as	The team members do not have any difficulties in finishing the project. Instead it is faster as some tasks are paralleled, the team is adept in using the

		the team is able to understand the tools at a faster rate, and many tasks can be paralleled.	tools, and there is more time available for the team to develop the website.

Table V illustrated the sprint review and retrospective of the whole three sprints. Based on the sprint reviews, the obstacles that were encountered is the change in product backlog as can be seen from Table I and Table II, and a bug on the homepage. The sprint retrospectives is more on how the team is getting used to the tools and impediment regarding the scheduling due to each member's studies. Additionally, speed up in the effort given in a sprint is seen as the team are more skillful and used to the tools used and the team paralleled the tasks. In total the team managed to complete all three sprints in 36 days.

F. Testing

To test our web application, we have performed two testing methods: unit testing and user testing. For unit testing, we have tested each feature of the website individually to ensure that it performs as required. As for user testing, we have ensured that the final product of the website satisfies and fulfills all the user needs and requirements.

TABLE VI. UNIT TESTING RESULTS

Unit	Test result
Registration feature	Successful
Login feature	Successful
Article Management	Successful
Category Management	Successful
Article Search feature	Successful
Article view	Successful

Table VI shows the results of the unit testing, in which all developed units are tested on their own and performed successfully.

G. Conclusion

To conclude the research, A data reporting website was developed to aid researchers, marketers, and other people who require numerous available data analysis reporting for their line of work. During the developing process, the Scrum method was used to produce a high quality website that can accommodate the user requirements in a flexible manner by

involving all members of the Scrum team, product owner, and stakeholders from the beginning until the end of the process. Additionally, implementing a time-boxed sprints and performing frequent communications help in improving the website quality and its delivery speed. Thus, the features, the website, and the testing were able to be delivered and completed within 3 sprints.

REFERENCES

[1] J. Fan, F. Han, and H. Liu, "Challenges of Big Data analysis," *Natl. Sci. Rev.*, vol. 1, no. 2, pp. 293–314, Jun. 2014, doi: 10.1093/nsr/nwt032.

[2] "Challenges and Opportunities," *Science (80-.).*, vol. 331, no. 6018, pp. 692–693, Feb. 2011, doi: 10.1126/science.331.6018.692.

[3] C. Tenopir *et al.*, "Changes in Data Sharing and Data Reuse Practices and Perceptions among Scientists Worldwide," *PLoS One*, vol. 10, no. 8, p. e0134826, Aug. 2015, doi: 10.1371/journal.pone.0134826.

[4] L. Tedersoo *et al.*, "Data sharing practices and data availability upon request differ across scientific disciplines," *Sci. Data*, vol. 8, no. 1, p. 192, Dec. 2021, doi: 10.1038/s41597-021-00981-0.

[5] Berman, H., Henrick, K., & Nakamura, H. (2003). Announcing the worldwide Protein Data Bank. *Nature Structural & Molecular Biology*, *10*(12), 980–980. https://doi.org/10.1038/nsb1203-980

[6] Tusnády, G. E., Kalmár, L., & Simon, I. (2008). TOPDB: Topology data bank of transmembrane proteins. *Nucleic Acids Research*, *36*(SUPPL. 1), 234–239. https://doi.org/10.1093/nar/gkm751

[7] Sadiku, Matthew & Shadare, Adebowale & Musa, Sarhan & Akujuobi, Cajetan & Perry, Roy. (2016). DATA VISUALIZATION. *International Journal of Engineering Research and Advanced Technology (IJERAT)*. 12. 2454-6135.

[8] Al-Kassab, J., Ouertani, Z. M., Schiuma, G., & Neely, A. (2014). *Information visualization to support management decisions. International Journal of Information Technology & Decision Making, 13(02), 407–428.* doi:10.1142/s0219622014500497

[9] P. Adi, "Scrum method implementation in a software development project management," *International Journal of Advanced Computer Science and Applications,* vol.6, 2015, doi: 10.14569/ijacsa.2015.060927

[10] D. Ma'arif, M. Yusnorizam, M.F. Hafifi Yusof, and N. S. Mohd Satar, "The Challenges of Implementing Agile Scrum in Information System's Project,"*Jour of Adv Research in Dynamical & Control Systems,* vol.10, 2018.

[11] J. Sutherland and K. Schwaber,"The Scrum Paper: Nuts, Bolts and Origins of an Agile Process", 2007.

[12] `What is Research? (n.d.). Retrieved July 01, 2021 from Https://www.hampshire.edu/dof/what-is-research.

[13] Data Collection: Definition, Methods. Example and Design. (n.d.). Retrieved December 19, 2021 from https://www.questionpro.com/blog/data-collection/

[14] Rubin, K. S.(2013). *Essential Scrum: A Practical Guide to the Most Popular Agile Process. Addison-Wesley Professional.*

[15] Thomas, S., Nino Miserni, Olin Bartlome, Michael Klippel, and Borja Garcia de Soto. Implementation of scrum in the construction industry. Creative Construction Conference (CCC), 20 December 2016. Https://doi.org/10.1016/j.proeng.2016.11.619

[16] D. West. (n.d.). "Sprint Planning". Retrieved December 24, 2021 from https://www.atlassian.com/agile/scrum/sprint-planning `

[17] Schwaber, K., and Sutherland, J. (2017). The Scrum Guide. Retrieved December 20, 2021 from https://scrumguides.org/docs/scrumguide/v2017/2017-Scrum-Guide-US.pdf

[18] Zayat, Wael and Ozlem Senvar. Framework study for agile software development via scrum and Kanban. International journal of innovation and technology management, vol. 17 no 04, 2020. Https://doi.org/10.1142/S0219877020300025

[19] Unadkat, J.. Beginner's Guide to Software Application Testing. (n.d.). Retrieved December 23, 2021 from https://www.browserstack.com/guide/learn-software-application-testing .

[20] What is Application Delivery? (n.d.). Retrieved July 02, 2021 from Https://www.nginx.com/resources/glossary/applicationdelivery/ .