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DEVELOPMENT OF HARDWARE MAINTENANCE INFORMATION SYSTEM USING MTBF AND MTTR WITH QR CODE

PENGEMBANGAN SISTEM INFORMASI MANAJEMEN PERAWATAN HARDWARE MENGUNAKAN METODE MEAN TIME BETWEEN FAILURE (MTBF) AND MEAN TIME TO REPAIR (MTTR) DENGAN QR CODE BASED WEBSITE AND ANDROID

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Abstract— *The Computer Lab of the University of 17 August 1945 Surabaya has a lot of hardware and often the staff or administrators forget to do maintenance on the hardware they have, so that when using the hardware often hangs or minor damage, even the worst thing can happen short circuit and finally the hardware cannot used because of late maintenance activities on a hardware. Things like this can slow down the performance process of an activity in the Computer Lab, Universitas 17 August 1945 Surabaya, this research has the aim of minimizing damage to a hardware with predictions based on existing data with the help of MTBF and MTTR using barcode media, besides this information system is a website and android based application using a strong framework such as Laravel on the website and Flutter on Android so that the resulting application has a longer support, while the database used is MySQL using the microservices architecture framework so it is not impossible that on this basis it will be generated a website and android-based information system application to support care management.*

Keyword— MTBF, MTTR, Laravel, Flutter, Hardware Maintenance

Abstrak— *Lab Komputer Universitas 17 Agustus 1945 Surabaya memiliki banyak sekali hardware dan seringkali staff ataupun pengurus lupa untuk melakukan maintance terhadap hardware yang dimiliki, sehingga pada saat penggunaan seringkali hardware terjadi hang atau kerusakan kecil bahkan hal yang paling buruk bisa juga terjadi konslet dan akhirnya hardware tidak bisa digunakan karena telatnya aktivitas maintance pada sebuah hardware. Hal seperti ini dapat memperlambat proses kinerja dari sebuah aktivitas Lab Komputer Universitas 17 Agustus 1945 Surabaya, penelitian ini memiliki tujuan untuk meminimalisir kerusakan pada sebuah hardware dengan prediksi berdasarkan data-data yang ada dengan bantuan MTBF dan MTTR menggunakan media barcode, selain itu sistem informasi ini merupakan aplikasi berbasis website dan android dengan menggunakan framework yang kuat seperti Laravel pada website dan Flutter pada android agar aplikasi yang dihasilkan memiliki support yang lebih lama, sedangkan database yang digunakan yaitu MySQL dengan menggunakan framework architecture microservices sehingga dengan dasaran yang cukup kuat ini akan dihasilkan sebuah aplikasi sistem informasi berbasis website dan android untuk mendukung manajemen perawatan.*

Kata Kunci— *MTBF, MTTR, Laravel, Flutter, Perawatan Hardware*

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I. INTRODUCTION

The need for hardware and software in predicting damage is very important, because automation is increasingly becoming a trend among technology and information, damage prediction is also very helpful for engineering to determine when to repair or replace a piece of hardware so that it can minimize other damage and focus more on the main goal.

Along with the development of technology, manual recording and calculations are no longer efficient. For that we need a new system to handle hardware maintenance management. This information system will be very helpful and optimize the performance of a hardware, so it can minimize the damage that occurs to a hardware and can estimate when the hardware is damaged with an indicator of how long it will take to complete repairs on the hardware based on a predetermined formula. This system exchanges data using QR Code media so that predictions will be made easily and quickly.

17 August 1945 University Surabaya is a university that has a lot of hardware so that it is not possible to record and repair at once manually, in addition to requiring a lot of time the number of engineering owned is very limited so that this action is less efficient to do, it can be concluded that the main problem of Universitas 17 August 1945 Surabaya is a manual recording and when the hardware can be damaged or maintenance is needed on a regular basis, so that the repair process from damage to normal processes can be estimated automatically using a hardware maintenance management information system.

II. RESEARCH METHOD

In the application design process hardware management information system. The system development model that used is the Agile methodology on the grounds that Agile has efficiency time in the development process so that it is possible to do immediate changes based on user requirements and ensure the product remain relevant.

In the process of designing a hardware management application. Figure 1 shows the flow of this research methodology using the Agile development methodology. Since Agile is simply a framework containing principles for adaptive problem solving, it is necessary to implement Scrum to solve these problems in a focused and fast manner.

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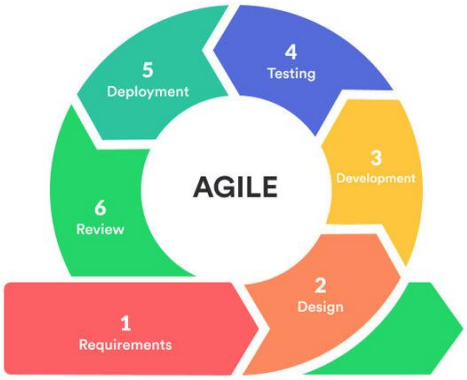

Figure 1. AGILE METHODOLOGY (SOURCE: BINARACADEMY.COM)

The heartbeat of Scrum itself is a sprint, where a number of tasks or work that has been planned must be completed by the team and prepared for review, the purpose of this sprint is to break down the project into small pieces. This allows the team to plan one Sprint at a time and adjust Sprints in the future future based on the results of the completed Sprints. You could say Sprint is work cycle in Scrum work.

MTBF is an average time the tool functions between damage or downtime that occurs, MTBF is applied to a tool that can be repaired after experiencing damage. So the company can estimate the durability of a tool and can calculate the frequency when the tool breaks using the MTBF (reability) method, to calculate the MTBF it is necessary to calculate the division of the total operating time by the number of failures. The total operating time is the difference between the total working time and the total breakdown time using hours, so the MTBF formula is:

$$MTBF = \frac{\text{Total Operating Time} - \text{Total Damage Time}}{\text{Number of Failures}} \quad (1)$$

MTTR To complete a maintenance, an MTTR is needed which functions as a prediction of the average time required to perform a maintenance until the device returns to normal (Maintainability). MTTR is a maintenance indicator to show how easy an equipment is to repair, the smaller the time prediction given by MTTR, the better the tool will work. MTTR can be calculated using the formula:

$$MTTR = \frac{\text{Total Maintenance Time}}{\text{Total Repair}} \quad (2)$$

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Availability is a general measuring tool to help the process of understanding the value of reliability. Availability is defined by 2 reliability terms, namely Mean Time Between Failure (MTBF) and Mean Time to Repair (MTTR). The formulation of availability is as follows:

$$Availability = \frac{\text{MTBF}}{\text{MTBF+MTTR}} \times 100\% \quad (3)$$

The need for a case study place, namely the University of 17 August 1945, Surabaya, which requires a system to carry out hardware management systematically and has data online using a database. This analysis was carried out by means of observation and interviews with one of the lecturers of the 17 August 1945 University in Surabaya, this implementation was carried out so that the hardware recording process and maintenance predictions along with weekly or monthly reports did not occur miscalculated. After completing interviews with users who might use the application, the next step is to determine the software requirements based on what has been engineered against the system in the future. The author has decided to use the Laravel framework with the help of the MySQL RDBMS (Relational Database Management System) database, so the hardware management system that will be run will experience a few problems, because the queries that can be accommodated by the MySQL database are very many and in terms of speed it is quite reliable. The Apache web server was chosen because it is more stable, and the security is continuously updated by Apache developers so that it can be ascertained that the resulting information system will be more secure and faster.

In designing this system design there are several diagrams that will present the system design through several diagrams such as User Interface (UX) User Experience (UX), DFD (Data Flow Diagrams), UML (Unified Modeling Language) such as Use Cases, Activity Diagrams along with ERD (Entity Relationship Diagram), Here is the system design that has been made:

User Interface or UI is a system design that functions as a bridge between the system and the user, the user interface itself is needed to describe or project an interface to the user who will use it, so the main point is to make the display as attractive as possible for a user to be more interested in using it. use it. User Experience or UX is a way of approaching users to get the needs and desires of users so that users are easy and comfortable when using a system. On the website there are several basic components that must be met when creating a UI/UX for this program, including the Authentication, Search, Result, Form, Dashboard and Pop Up pages.

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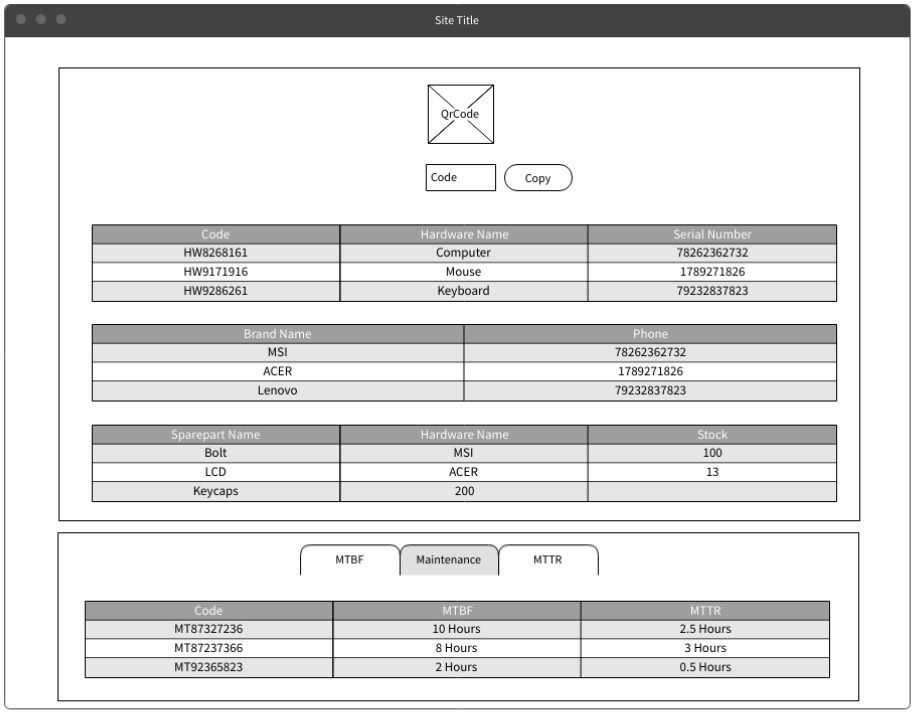

Figure 2. MAINTENANCE RESULT

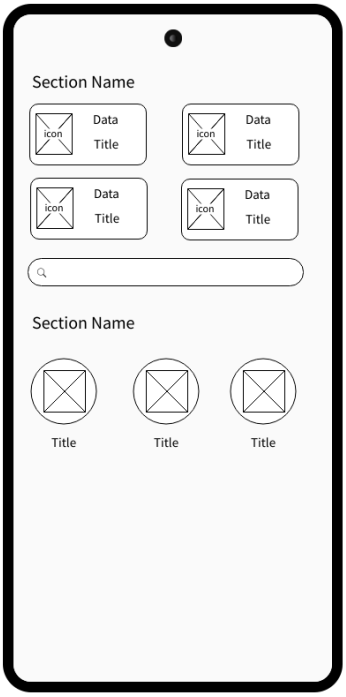

Figure 3. HOME PAGE MOBILE

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DFD or Data Flow Diagram is a flow of a system which describes a flow of data and information on a system in order to facilitate developers in the process of making an information system.

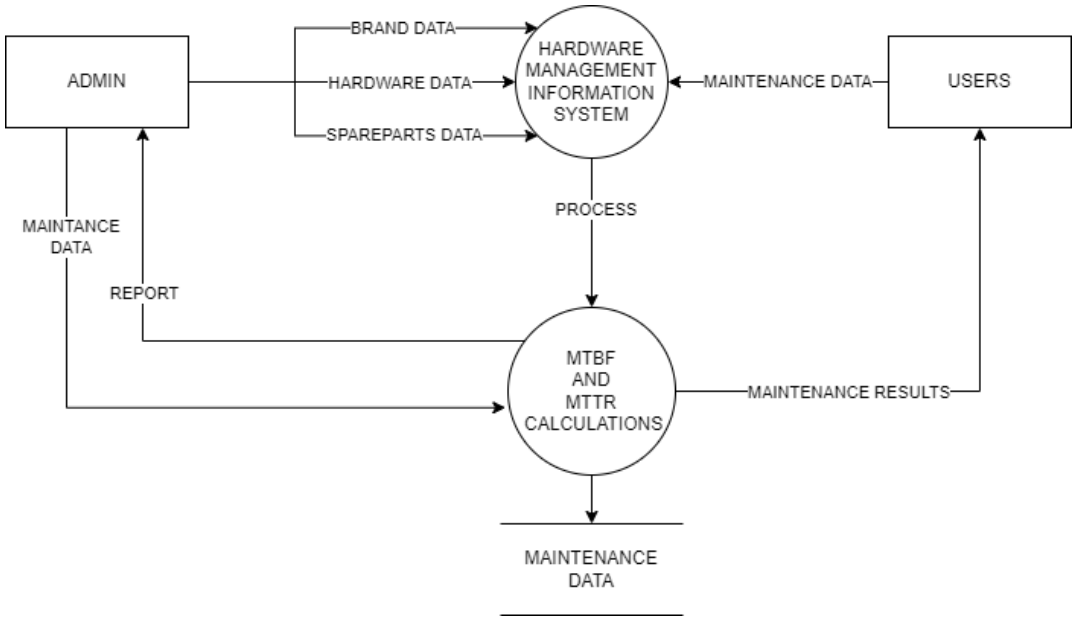

Figure 4. DATA FLOW DIAGRAM

Use Case is one of the types of UML (Unified Modeling Language) which describes the relationship between the user and the designed system, by using a Use Case the sequence of business processes can be described more clearly and transparently to prevent errors in the system to be built. the design of this program which can be seen in Figure 3.

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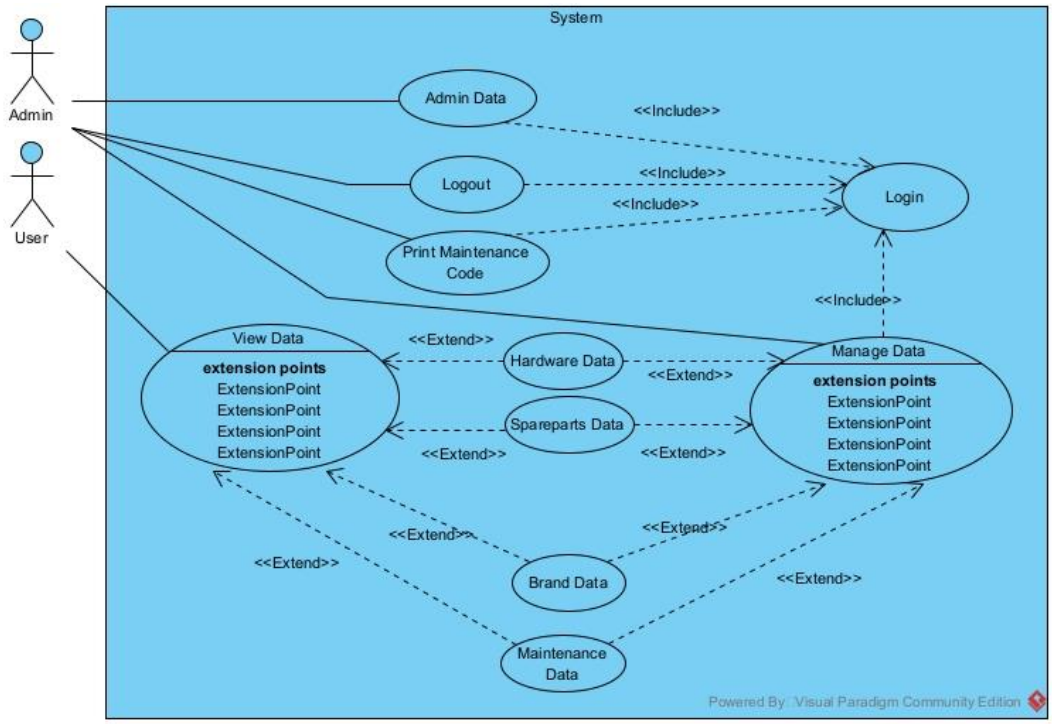

Figure 5. USE CASE

The Entity Relationship Diagram in Figure 2 has 9 entities that are interconnected using relationships, each entity has several attributes to model the structure of an entity itself, so that the relationship between entities will look more complex.

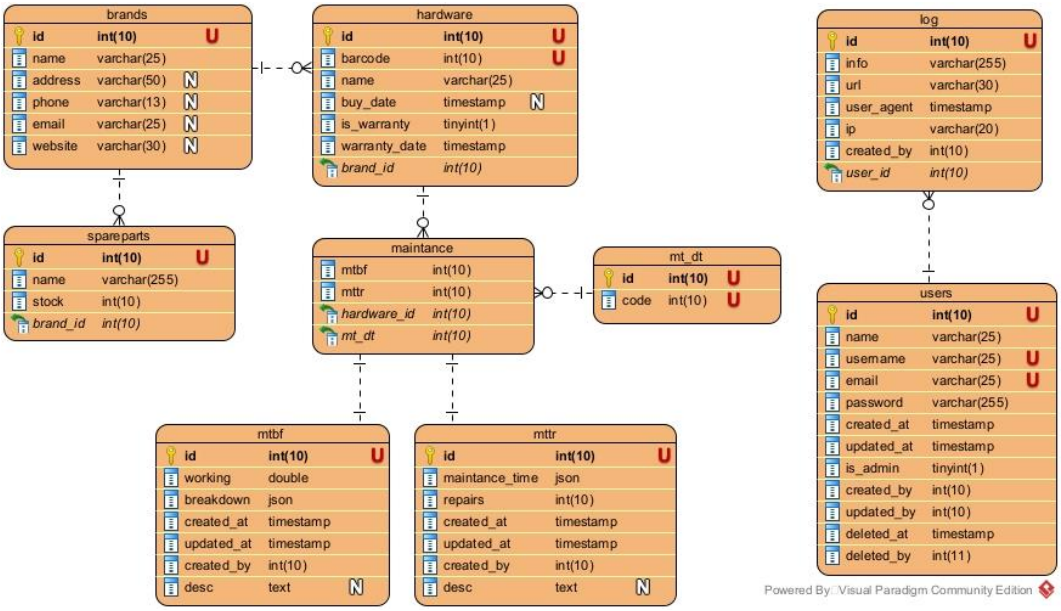

Figure 6. ENTITY RELATIONSHIP DIAGRAM DESIGN

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III. RESULT AND DISCUSSION

After doing quite a long research on the methods in this research, the results obtained are 2 output platforms, namely a website and android which can be accessed online. this platform can be used properly and easily by local users, to be precise at the University of 17 August 1945 Surabaya. With this management information system, it can make it easier for a technician or staff to manage their hardware so as to minimize future damage.

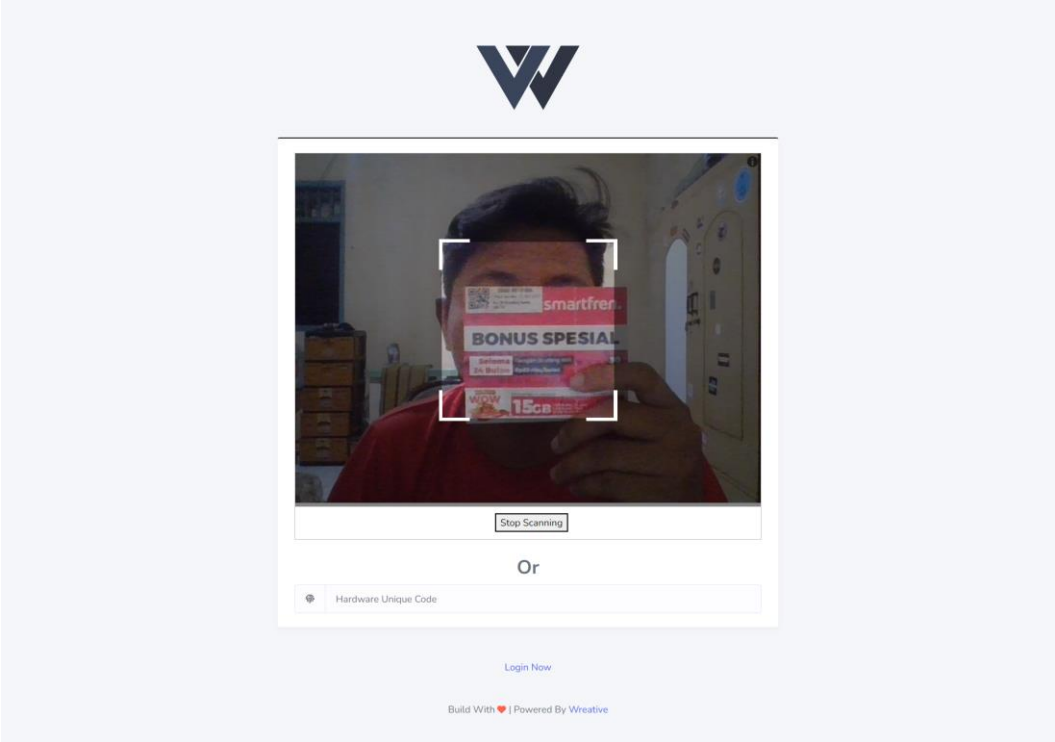

Figure 7. QR CODE SCANNER

There is a dashboard user interface that functions as a data center in the application such as the total existing data and the activities carried out by the admin each time using the application, on this page also, there is an action to print a QrCode based on the hardware code that can be printed or downloaded. The Maintenance page also functions as a statistic for hardware uptime and hardware maintenance in units of weeks or months, this page also contains some information that has been done regarding the maintenance itself, such as MTBF, MTTR and availability data.

Figure 7 also explains Scanning QR Code on the web browser platform, on the main display there is also a column for manual input with a maximum of 10 digits with HW prefix, if scanning

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using QR Code has difficulty or fails. On the additional maintenance page, this is the main page of the application, where maintenance data will be entered based on predetermined parameters and accurate calculations are carried out to find maintenance data using the MTBF and MTTR methods. In addition, this page can also add dependence on other hardware so that maintenance data will be more and more accurate.

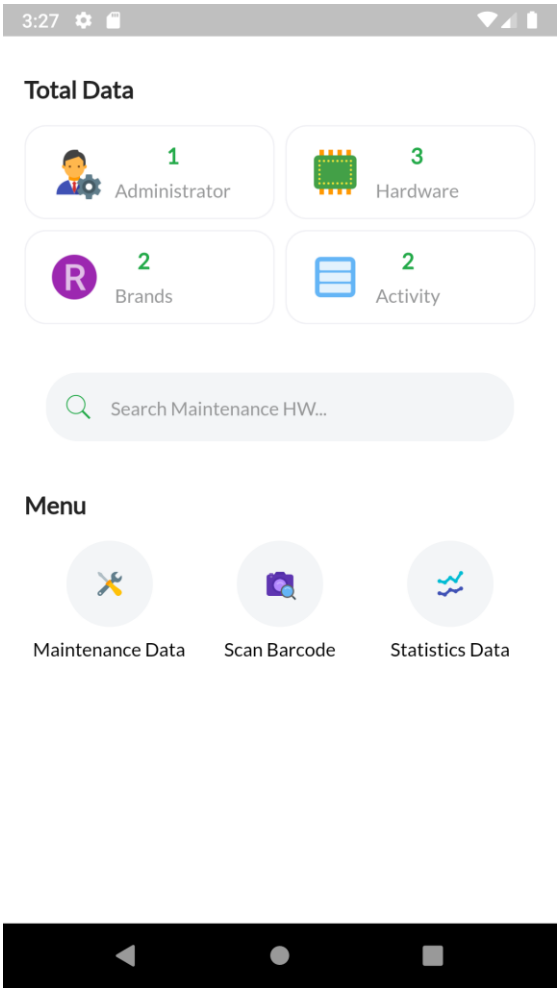

Figure 8. DASHBOARD MAINTENANCE MOBILE

In Figure 8 above is a simple display of a mobile application which later on at home will be filled with total data such as brand, spare parts, etc., while the maintenance menu is for displaying maintenance data, it also applies to the statistics menu as monitoring hardware for uptime and damage. In the mobile application there is also a maintenance menu and explains maintenance data such as on what date, what percentage of uptime to the total maintenance that has been carried out.

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After scanning using the camera feature on the mobile application using the QrCode media or typing the hardware code manually, what happens if the code is found is the result of maintenance which directs the android page into the webview but will produce an error if the hardware code is not found.

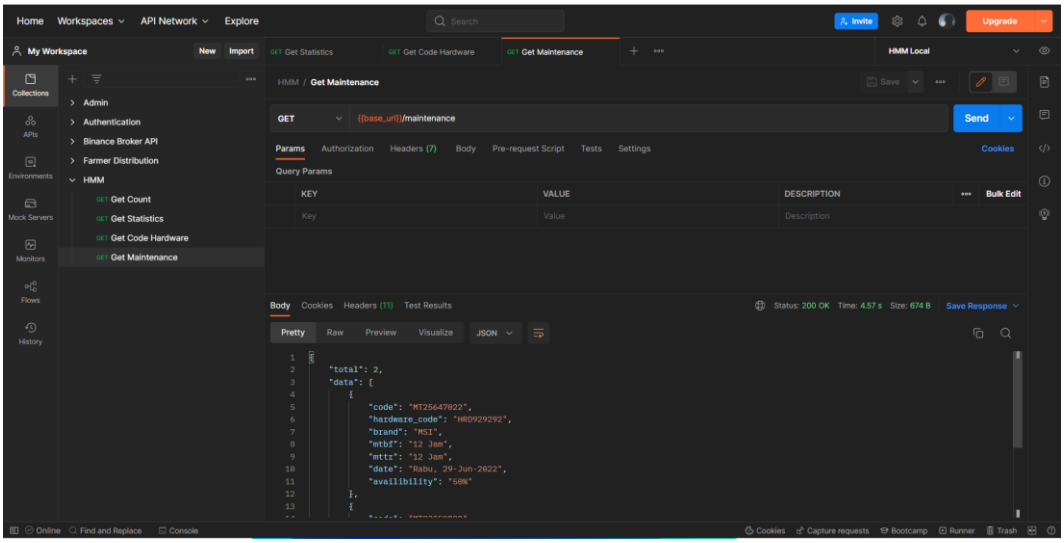

Figure 9. API STRUCTURE POSTMAN

To facilitate the process of data consumption or data exchange between the mobile and the website, an API is needed to support these needs, in Figure 7 there is an API endpoint to perform maintenance data retrieval using the GET method so that other applications such as mobile applications that will later be used can be easier to use. perform data consumption. In Figure 7 there are also 4 API endpoints that will later be used in mobile use, such as endpoint count to get total data, endpoint statistics to obtain recap data based on month, endpoint code hardware functions to search data based on hardware code that has been inputted or scanned using QRCode, and the last one is a maintenance endpoint that functions to get all data from hardware maintenance that has been carried out.

To do the test I use Blackbox Testing or Behavioral Testing is a method for testing a software, this time the author will test using the Google Chrome web browser with the *All pair testing* technique or also known as pairwise testing. This test is used to test all possible combinations of all pairs based on the input parameters. From the results determined there are 5 valid test data with several actions or settlement methods to solve the problem.

For system testing, the writer uses the System Usability Scale method. System Usability Scale is one way to find out whether users can use the system easily, and how effectively and

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efficiently a system can help users to achieve their goals. Variable measurement refers to the Likert Scale (Likert Scale), which is a research scale to measure opinion. The Likert scale has 5 scale options, STS (Strongly Disagree/Very Unfavorable), rated 1, TS (Disagree/Not Good), rated 2, CS (Simply Agree), rated 3, S (Agree/Good), rated 4, SS (Strongly Agree/Very Good), rated 5

By using the System Usability Scale testing method, getting a score of 80 from a total average of 30 people filling the questionnaire so that the information system created is classified as easy to understand and operate. With this testing process, the feasibility of a system does not need to be questioned again because it has been tested using appropriate techniques.

IV. CONCLUSION

Based on the implementation results that have been implemented, this Hardware Maintenance Management Information System can receive hardware maintenance data properly, Hardware Maintenance Management Information System can search Maintenance data using QRCode media The 3 methods used to find maintenance data are MTBF (Mean Time Between Failure) and MTTR (Mean Time To Repair), Hardware Maintenance Management Information System makes it easier to manage hardware maintenance and monitor hardware availability based on the availability concept, The results of the black box test show that the input data on the Hardware Maintenance Management Information System has been completed, and can function properly, and there are no errors or bugs.

Based on the implementation that has been done, this system still has some shortcomings. Therefore, for further development, the researcher will put forward some suggestions such as a feature for storing images on the hardware is needed to track objects on the hardware and maybe in the future it can be developed by adding more complete features to the mobile application by making something similar like a website. less efficient so we need a method to make it easier and the addition of maintenance features is still classified as 1 day, flexible time is needed to input data

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REFERENCES

[1] A. A. Pratamaputra and A. Habib, "SISTEM INFORMASI MANAJEMEN DATA TAHANAN SEMENTARA BERBASIS WEB & ANDROID STUDI KASUS DI SATRESKOBA POLRESTABES SURABAYA," 2019.

[2] A. Habib and B. al Kindhi, "Rancang Bangun Sistem Informasi Manajemen Keuangan Sekolah Design of School Financial Management Information System," Online, 2018.

[3] Lestari Puji Krisna and Habib Ahmad, "RANCANG BANGUN SISTEM INFORMASI MANAJEMEN PERJALANAN DINAS DENGAN METODE PIECES (STUDI KASUS PADA PT DUA KELINCI)," *KONVERGENSI*, pp. 32–46, Aug. 2021.

[4] A. dwi Hariyanto and D. I. Handayani, "TOTAL PRODUCTIVE MAINTENANCE PADA CHIPER AREA (Study Kasus di PT. Kutai Timber Indonesia Particle Board)," *WAKTU: Jurnal Teknik UNIPA*, vol. 13, no. 2, 2016, doi: 10.36456/waktu.v13i2.57.

[5] A. K. Aggarwal, S. Kumar, and V. Singh, "Performance modeling of the serial processes in refining system of a sugar plant using RAMD analysis," *International Journal of Systems Assurance Engineering and Management*, vol. 8, 2017, doi: 10.1007/s13198-016-0496-1.

[6] K. Daniewski, E. Kosicka, and D. Mazurkiewicz, "Analysis of the correctness of determination of the effectiveness of maintenance service actions," *Management and Production Engineering Review*, vol. 9, no. 2, 2018, doi: 10.24425/119522.

[7] S. V. S. Rajaprasad, "Investigation of reliability, maintainability and availability of a paper machine in an integrated pulp and paper mill," *International Journal of Engineering, Science and Technology*, vol. 10, no. 3, 2018, doi: 10.4314/ijest.v10i3.5.

[8] E. Saari, J. Lin, L. Zhang, and B. Liu, "System availability assessment using a parametric Bayesian approach: a case study of balling drums," *International Journal of Systems Assurance Engineering and Management*, vol. 10, no. 4, 2019, doi: 10.1007/s13198-019-00803-y.

[9] H. H. Azwir, A. I. Wicaksono, and H. Oemar, "Manajemen Perawatan Menggunakan Metode RCM Pada Mesin Produksi Kertas," *Jurnal Optimasi Sistem Industri*, vol. 19, no. 1, 2020, doi: 10.25077/josi.v19.n1.p12-21.2020.

[10] H. Almomani and N. Almutairi, "Vehicles maintenance workshops layout and its management to reduce noise pollution and improve maintenance quality," *Journal of Environmental Treatment Techniques*, vol. 8, no. 4, 2020, doi: 10.47277/JETT/8(4)1356.

[11] S. Shaaban and R. Romero-Silva, "Performance of merging lines with uneven buffer capacity allocation: the effects of unreliability under different inventory-related costs," *Central European Journal of Operations Research*, vol. 29, no. 4, 2021, doi: 10.1007/s10100-019-00670-9.

[12] J. Li, "Reliability Calculation for Dormant k-out-of-n Systems with Periodic Maintenance," *International Journal of Mathematical, Engineering and Management Sciences*, vol. 1, no. 2, 2016, doi: 10.33889/ijmems.2016.1.2-008.

[13] J. Lozano, J. C. Saenz-Díez, E. Martínez, E. Jiménez, and J. Blanco, "Methodology to improve machine changeover performance on food industry based on SMED," *International Journal of Advanced Manufacturing Technology*, vol. 90, no. 9–12, 2017, doi: 10.1007/s00170-016-9686-x.

[14] F. Najari, M. A. Sobhanallahi, and M. Mohammadi, "Improving maintenance strategy by physical asset management considering the use of MFOP instead of MTBF in Petrochemical," *International Journal of Supply and Operations Management*, vol. 5, no. 4, 2018.

[15] A. Shahin, N. Aminsabouri, and K. Kianfar, "Developing a Decision Making Grid for determining proactive maintenance tactics: A case study in the steel industry," *Journal of Manufacturing Technology Management*, vol. 29, no. 8, 2018, doi: 10.1108/JMTM-12-2017-0273.

[16] P. Anggradewi, Aurelia, S. Sardjananto, and A. D. Ekawati, "Improving quality in service management through critical key performance indicators in maintenance process: A systematic literature review," *Quality - Access to Success*, vol. 20, no. 173, 2019.

[17] F. Nurprihatin, M. Angely, and H. Tannady, "Total productive maintenance policy to increase effectiveness and maintenance performance using overall equipment effectiveness," *Journal of Applied Research on Industrial Engineering*, vol. 6, no. 3, 2019.

[18] P. Daruka, T. Agarwal, and V. Sharma, "Productivity improvement using MTTR and MTBF methodology," *International Journal of Mechanical Engineering and Technology*, vol. 8, no. 7, 2017.

[19] S. M. Mortazavi, M. Mohamadi, and J. Jouzdani, "MTBF evaluation for 2-out-of-3 redundant repairable systems with common cause and cascade failures considering fuzzy rates for failures and repair: a case study of a centrifugal water pumping system," *Journal of Industrial Engineering International*, vol. 14, no. 2, 2018, doi: 10.1007/s40092-017-0226-6.

[20] A. Rahman, "Total Productive Maintenance pada Mesin Cetak Offset Printing SM 102 ZP (Study Kasus di PT. XYZ)," *STRING (Satuan Tulisan Riset dan Inovasi Teknologi)*, vol. 4, no. 1, 2019, doi: 10.30998/string.v4i1.3614.