Android based maintenance information system for machining workshop in polytechnic high education

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Abstract. There are six state polytechnics aged 36 years old in Indonesia. The six polytechnics have machining workshops with the same number and machines. The problem that arises in Semarang State Polytechnic is the maintenance system that has not been integrated into a system, even though the electronic maintenance and repair activities have been carried out. The purpose of this study is to develop a maintenance information system that can control all of its activities well. The system is built with an object-oriented approach implemented by android. Research results include: database systems, web application systems, and android application systems that have delivered output correctly.

1. Introduction
Vocational higher education in Indonesia with the names of polytechnics in the cities of Medan, Palembang, Jakarta, Bandung, Semarang and Malang has been running since 1982. One of study programs includes mechanical engineering. This study program has the same type and number of machine tools, such as: lathes, milling machines, surface grinding machines and CNC machines that are used as practical facilities. The use of these machines is more in the form of non-productive practicum with a usage load up to 14 hours/day. The characteristics of the maintenance carried out are routine maintenance in the form of inspection, replacement of lubricants, cleaning, and replacement of spare-part. Characteristics of improvement are incidental, that is, if damage occurs, repairs will be carried out. If the handling of damage is beyond the ability of the existing technical staff, then the work will be tendered to the parties outside the campus. This thing definitely will disturb the student practicum activities. Technical staffs who handle the maintenance of machine tools are not experts, but are constantly getting training.

The machine tools maintenance and repair in Machining Laboratory of Mechanical Engineering Department Semarang State Polytechnic, has the following characteristics:

- There is no machine manual,
- Maintenance and repair are done based on the requests that users upload via the web. The web application is a type of general interference complaints, not specifically for logs maintenance and machine repair.
- There is no database record, the record is in the form of manual notes based on the work statement form that have been completed.
- HR (Human Resource) expertise is limited by training and certification efforts.
The conditions of maintenance and repair activities such as this require improvement to meet the principles of modern maintenance and repair management. Table 1 shows the machine tool data owned by the Machining Laboratory of the Mechanical Engineering Department Semarang State Polytechnic.

Table 1. Types of machines in Polines machining laboratories.

| No | Class of Machine     | Brand          | Type               | Units | Year of Prod/Use | Conditions |
|----|----------------------|----------------|--------------------|-------|------------------|------------|
| 1  | Center Lathe         | Modiale 81     | Celtic 14          | 4     | 1978/1982        | Function   |
| 2  | Center Lathe         | EMCO           | Maximat V13        | 12    | 1982/1982        | Function   |
| 3  | Vertical Drilling    | Wilson         | VSG 20             | 1     | 20012001        | Function   |
| 4  | Vertical Drilling    | Rockwell       | 420M               | 2     | 1981/1982        | Function   |
| 5  | Vertical Drilling    | Rockwell       | 420M               | 8     | 2013/2013        | Function   |
| 6  | Vertical Drilling    | Arfa           | RF-31              | 2     | 2003/2003        | Function   |
| 7  | Vertical Drilling    | Krisbow        | KW1500             | 2     | 2014/2014        | Function   |
| 8  | Universal Drilling   | Aciera         | F3/F4              | 9     | 1981/1982        | Function   |
| 9  | Surface Grinding     | Prazision Swerkezug | Compact 600   | 2     | 1981/1982        | Function   |

Based on the information contained in the background, the following problems can be identified:

- There is absolutely no database relating to machine data, maintenance and repair activities, or maintenance schedules.
- No maintenance plan before damage occurs (mean time before failure),
- No estimates and stock of spare-part that are predicted to be often damaged or will soon be damaged.
- Not applying maintenance and repair system management.

Problems set in this study are: What kind of Android-based maintenance and repair information system needed by the Machining Laboratory of Mechanical Engineering Department in polytechnics above? The purpose of this study is to build an Android-based maintenance and repair information system needed by the Machining Laboratory of Mechanical Engineering Department in polytechnics above.

2. Literature

Choiril et al. create Preventive Maintenance Information for Small and Medium Industries using the SDLC (System Development Life Cycle) method and have tables: Mesin (kode_mesin, nama_mesin, lokasi_mesin), spareparts (nomor_spareparts, nama_spareparts, lokasi_spareparts), pegawai: id_pegawai, nama_pegawai, jabatan), jadwal (jadwal_inspeksi, cleaning, pelumasan, overhaul) [1].

Husain et al. made Computer-Based Information Systems for the Management of Industrial Facilities in Ship Manufacturing using the SDLC approach. The built system is used in the shipyard industry which has 6 workshops with 162 machines. The built system is equipped with a warning facility, i.e. when the activity schedule reaches the implementation date, a warning code will appear [2].
Lubis et al. examined the Effect of Implementing Office Equipment and Machine Maintenance Information Systems on Efficiency. The Maintenance Information System is built with Visual C Sharp and uses a MySQL database. Information on maintenance of Office Equipment and Machining is stored in maintenance history which includes: date of incident, damage, replaced spare-part, length of maintenance and costs. In addition, the system also provides information on the frequency of machining and office equipment maintenance. The method is SDLC [3].

Melladya et al. developed a Group-Technology-based Machine Maintenance Management Information System Design for coachwork industries in the method of Prototyping. The tables include: data_umum_mesin (depatemen, jenis, merek, tahun), hirarki_komponen (komponen, sparepats), atribut_inventori (lokasi, letak, nomor) [4].

Salim built a Production Machine Maintenance Information System for the steel pipe industry. The system was built using the SDLC method, a system that provides facilities to manage the production of machine maintenance information in a simple and fast manner, reporting breakdown production machine, a function to display the schedule of monthly maintenance activities, meet the need for data maintenance and breakdown in more detail, ease access, system protection, ease of making reports, and easy data search [5].

William built a Computer-Integrated Machine Maintenance System at Crumb Rubber Factory with SDLC approach. The tables are: jadwal_perawatan, data_mesin, data_komponen, perbaikan, daftar_komponen_stok, supplier, aktivitas [6].

The development of the maintenance information system (Si-Main) uses the approaches: use case / class-object, etc.), programming language (Java), database (Firebesa), based on Android platforms.

3. Materials and research methods
This research was carried out in in the machining workshop of Semarang State Polytechnic using Object Oriented [7,8] method. Developing stage of Maintenance information system (Si-Main) aims to provide an overview of what is done and produced at each stage until it is complete. The data acquisition were: observing part of maintenance and repair, ensure maintenance and repair part & users are fully covered, compile application specifications, either software or hardware, making UML diagrams, preparing the program code, prototyping, and testing. The installation is done by uploading Si-Main through the Google Play Store and downloading via smartphone. Training is a way to socialize all users. Implementation is the time when Si-Main can be used fully and independently.

3.1. Inception system
The first step taken at the inception stage of the system is to identify problems by observing the repair maintenance unit and machining workshop users. After that, validation is done by ensuring that the needs of the repair maintenance unit and machining workshop users are fully covered. The final step is to compile specifications for both software and hardware. The design of a maintenance information system architecture consists of:

- Online database server that provides data processing capabilities and can be accessed through Android and Web application platforms.
- The android application is needed for technicians because of the flexibility of entering data in each lab. Checker / Technician can enter Maintenance & Repair data.
- The Si-Main web application provides the feature to view data as a whole or report data that has been entered in the Android application.

The design is seen as follows:
3.2. Elaboration system
The elaboration stage / design of the maintenance information system that will be built consists of the design use case diagram, entity relationship diagram (ERD) and Graphical User Interface (GUI).

3.3. Use case diagram design
Figure 4 shows the use case diagram design which consists of 2 actors, namely admin and technician and 3 large use cases (Maintenance Data, Machine Data, Spare-part Data and Report Print).

| Use Case          | Actor         | Specification                                                                 |
|-------------------|---------------|-------------------------------------------------------------------------------|
| Maintenance data  | - Admin       | Admin and technician can perform an operation to save, modify, search and delete machine maintenance data. The automatic system gives notification to technicians about the maintenance schedule that will be carried out next. |
|                   | - Technician  |                                                                               |
| Machine Data      | - Admin       | Admin and technician can perform operations to save, modify, search and delete machine data and there is a maintenance information system application. |
|                   | - Technician  |                                                                               |
| Spare-part Data   | - Admin       | Admin and technician can perform to save, modify, search and delete spare-part data in the application system. |
|                   | - Technician  |                                                                               |
| Report Print      | - Admin       | In this feature, only admin who can perform report print operation in the form of maintenance, spare-part and machine data. Data report print can only be done through a computer due to the large computer resources. |

This design is based on the interaction of actors with the application system made in this study, with descriptions as in the following table.
3.4. Entity Relationship Diagram (ERD) design
Before the data in the machining lab is translated into database tables, it is necessary to design ERD in advance. ERD is used to model each the relationship between data and relationship between ERD in the machining lab. Machining lab entity has several machines that contain code information, name, brand, vendor etc. Each machine has several maintenance and repair records such as the repairing officer, maintenance description, treatment date and duration of treatment entered by the technician. When performing maintenance, spare-part information in the form of codes, names, suppliers and spare-part specifications are entered into the system.

![Entity relationship diagram of SiMain.](image)

3.5. System construction
At the construction system stage there are 3 stages of application construction: (1) Construction of the database, (2) Construction of Web Application and (3) Construction of Android Application.

The software database uses MariaDB 10.1.24-MariaDB-coll-ive - MariaDB Server version 10 which is installed on a shared hosting web server. The construction of a maintenance information system website application uses Laravel 5.4 php framework programming language and CSS bootstrap Framework.

The construction of the dashboard web page can be accessed in the url http://simain.silemper.xyz/dashboard or the start page after the user enters a username and password.

The construction can be viewed on http://simain.silemper.xyz/machine or access the machine menu on the left. The machine maintenance data page construction results can be seen when accessing the machine data. On the machine data page there is a menu to access maintenance information according to the machine code listed.

The machine spare-part data web page construction can be found on http://simain.silemper.xyz/sukucadang or access the parts menu on the left. Spare-part page is taken from spare-part table data on the database server.

3.6. Report construction
The results of the report page construction can be seen on the page http://simain.silemper.xyz/ or access the report menu on the left. The code snippet to display parts data can be seen in Figure 5.
The report page displays a print menu for the report of machine and its maintenance. Report data is displayed in ready-to-print PDF form.

As shown in Figure 6, the front page of the android application contains information about the SiMain maintenance information system application. The results of the notification of maintenance schedules for each machine and stock of spare-part are displayed on the dashboard page. Android programming implementations use the WebView component to display data on certain web addresses.

3.7. Android application construction
In the application construction stage, the interface design which becomes an Android application program is created by using Android studio software 2.2.2.

The specifications targets are Android Marshmallow SDK 6.0 and Android API 23. The construction of the Android application consists of 4 main pages namely the application splash-screen front page to display information, notification dashboard page, Machine Data and Maintenance Page. The SiMain application can be accessed at the address https://play.google.com/store/apps/details?id=id.web.proditi.polines.imimain.

4. Conclusions and suggestions

4.1. Conclusions
The Android application for the Machining Laboratory of the Mechanical Engineering Department Semarang State Polytechnic can be built by using software development method of Object Oriented. Application features are in the form of summarized machine maintenance schedule information,
machine and spare-part data in a dashboard that making it easier for technicians to see and control machine maintenance.

4.2. Suggestion
Based on input by mechanical engineering lecturers and technicians of UPT PP (Research and Development Unit) Polines, suggestions that can be used in the development of subsequent research:

- Development of automatic reporting by machines using IoT technology,
- UPT PP (Research and Development) technicians welcome this application and are asked to develop similar applications for different workshops in the scope of Polytechnic.

Table 3. Testing result of SiMain.

| Maintenance Information System (SiMain) | Output Testing (Y/N) |
|-----------------------------------------|----------------------|
| A. Database System                      | Processing data on Android and Web platform | Yes |
| B. Web Application System               | B1. Notification Dashboard Retrieves data from information board web server and displays television | Yes |
|                                         | B2. Machine Data Provides machine maintenance information and is able to add, search, modify, and delete the machine data | Yes |
|                                         | B3. Machine Maintenance Data Provides machine maintenance information and is able to add, search, modify, and delete the machine data | Yes |
|                                         | B4. Spareparts Data Provides machine maintenance information and is able to add, search, modify, and delete spare-part data | Yes |
|                                         | B5. Report Displays the machine data report, print feature, prints spare-parts data, and maintenance report | Yes |
| C. Android on System Application        | C1. Notification Dashboard Display maintenance schedule information and spare-part stock | Yes |
|                                         | C2. Machine Data Displays machine data information, adds machine data and prints machine data reports | Yes |
|                                         | C3. Machine Maintenance Data Displays machine maintenance data information prints machine maintenance report data | Yes |

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