

Integration of LAPAN's remote sensing ground station control and monitoring system application

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Abstract. The National Institute of Aeronautics and Space (LAPAN) - Remote Sensing has developed different website-based application systems. The application system is used to control and monitor several series of ground station processes ranging from acquisition, recording, processing, storage, to cataloguing data and remote sensing satellite products. At present these applications are still working separately which are built from various platforms both operating systems, programming, databases, infrastructure and architecture. Therefore, an application system integration solution is needed in order to facilitate and speed up ground station operators to control and monitor the processes that take place and obtain useful and valid information for decision making. The design of this system integration application is done by preparing materials and defining layouts, coding Hypertext Pre-processor (PHP), testing designs, granting domains, and providing hosting. The User Interface (UI) uses a bootstrap framework to display responsive results for each screen size.

1. Introduction

In meeting the needs of national remote sensing data, the National Institute of Aeronautics and Space (LAPAN) has remote sensing ground stations located in three locations namely Parepare (South Sulawesi), Rumpin (West Java), and Pekayon (Jakarta). The three ground stations operate to receive, record low resolution, remote, high, and very high resolution remote sensing satellite data. Then the data is processed, stored and cataloged at the National Remote Sensing Data Bank (BDPJN) [1][2].

Currently, a variety of web-based application systems have been built to support the LAPAN remote sensing ground station operational system. Application systems that have been built include control systems and remote acquisition, processing, monitoring systems, and catalog data. In the current development there are many needs to build systems to facilitate control and monitoring of ground stations. However, the systems that have been built are still fragmented, so we need a system to facilitate access without the need to open them one by one. One solution is to integrate these systems into one homepage.

The design of the integrated control and monitoring application system for LAPAN's remote sensing ground stations is one part in the process of integrating remote sensing ground stations on a virtual basis (full remote and nearly automation) [3][4]. This design must be planned properly so that the website can run well, fast, and can be accessed by various browsers and can run on various platforms. Therefore, in the design of this application system design the Responsive Web Design (RWD) concept is applied [5]. This responsive web design technique is done by implementing the



CSS Bootstrap Framework (Cascading Style Sheet) [6][7]. Some supporting tools are used to simulate the website such as Sublime Text as an editor and Mozilla Firefox / Google Chrome as a browser.

The expected results, of course, using the RWD technique, users get comfort in accessing the website system, both on computers, smartphones, and tablets still get the same appearance, even though it is accessed on different devices, which have varying screen sizes, without eliminating display quality and aesthetics.

2. Method

The method of developing the application integration system control and monitoring LAPAN's remote sensing ground station is the waterfall model method [8][9], where there are 5 stages, namely (1) Analysis, (3) Design, (3) Implementation, (4) Testing, and (5) Maintenance. The waterfall-based system development model can be seen in Figure 1.

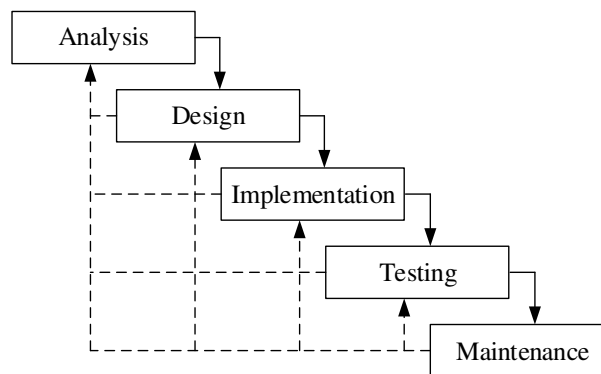


Figure 1. Development system based on waterfall model [8].

2.1. Analysis Stage

At the analysis stage, the researcher collects information using interview techniques about the existing system for analysis. By analyzing an existing system, the researcher can find out the problems contained in the system. Problems that exist in the existing system that is the built application system is still fragmented so that the ground station's control and monitoring process cannot be carried out effectively and efficiently by the operator.

2.2. Design Stage

At the design stage, researchers designed the program interface using the Sublime Text application as a text editor using the PHP programming language. The flow diagram of the LAPAN ground station control and monitoring system is explained in Figure 2. The application system that was built was to integrate various existing control and monitoring application systems into a homepage including: Acquisition control system, processing system, catalog system and monitoring system.

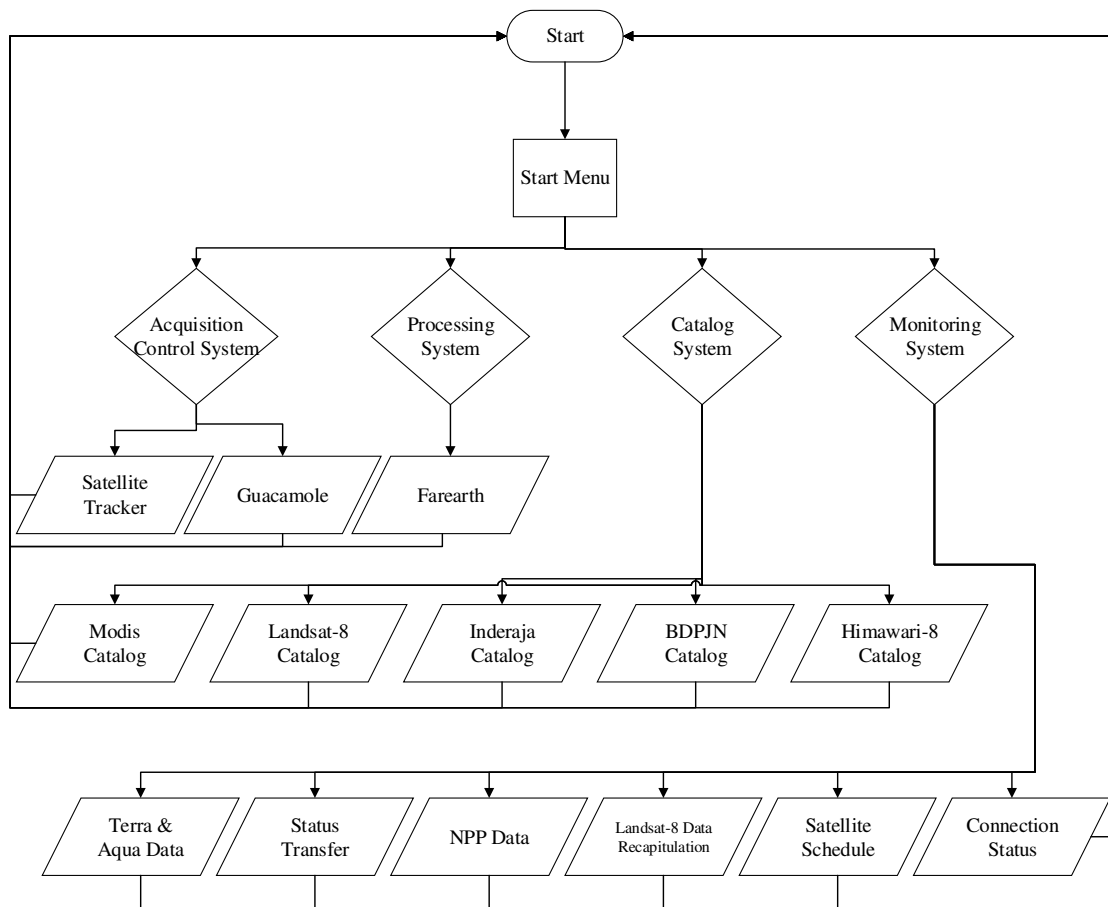


Figure 2. Website system architecture.

2.3. Implementation Stage

In the implementation stage, researchers used the PHP and HTML programming languages to translate the design into a form of language understood by computers. To support the creation of the proposed website required software and hardware as follows:

Table 1. Tools used in website development.

Component	Specification
Software	<ul style="list-style-type: none"> • Operating system: Windows • XAMPP program • Web browser: Mozilla firefox or google chrom
Hardware	Processor: Intel® Core™ i7-7500 RAM: 8 GB Hardisk: 1 TB

2.4. Testing Stage

In the testing stage, researchers conducted application testing using Google Chrome and Apache as the server.

2.5. Maintenance Stage

After being tested, to ensure the continuity of the operational system, the maintenance process is needed through the stages of operation and maintenance.

3. Results and Discussion

This activity produced a website integration system application control and monitoring of LAPAN's remote sensing ground station using CSS bootstrap framework to display responsive results for each screen size. This application can be accessed via the following link: <http://landsat-catalog.lapan.go.id/monitoringsistem/>.

3.1. Homepage

The Homepage is the first page that the user will visit. The page contains the status of hotspot distribution in Indonesia, connection status between ground stations, recapitulation of Landsat-8 data, satellite track status, and there are also some photo displays from LAPAN's ground station. The initial page display of this application on notebook and smartphone can be seen in Figures 3 and 4. It can be seen that by using the Bootstrap CSS Framework, the layout results can be run and work automatically adjusting the screen size according to the device used.



Figure 3. Homepage display of the bootstrap website on notebook.

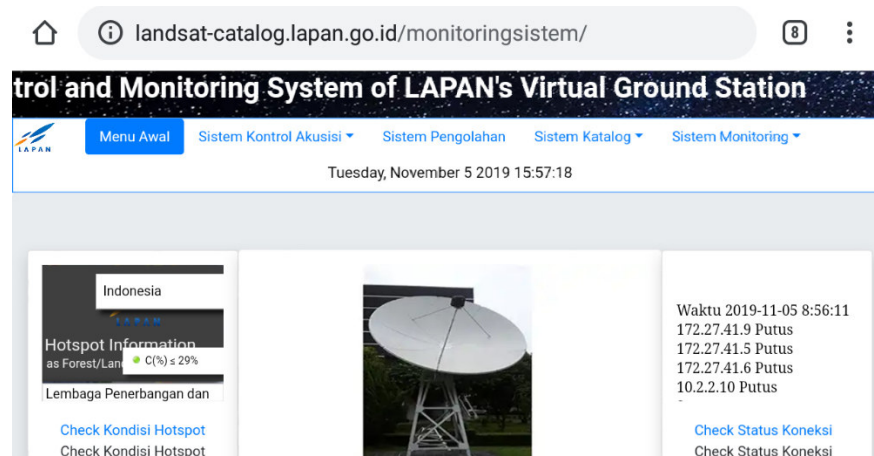


Figure 4. Homepage display of the bootstrap website on smartphone.

3.2. Bar Menu

The bar menu is a horizontal strip that lists the menus available for certain programs. On the ground station control and monitoring system application bar menu, as shown in Figure 5, there is the result of an integrated system in the form of an acquisition control system, a processing system, a catalog system, and a monitoring system.

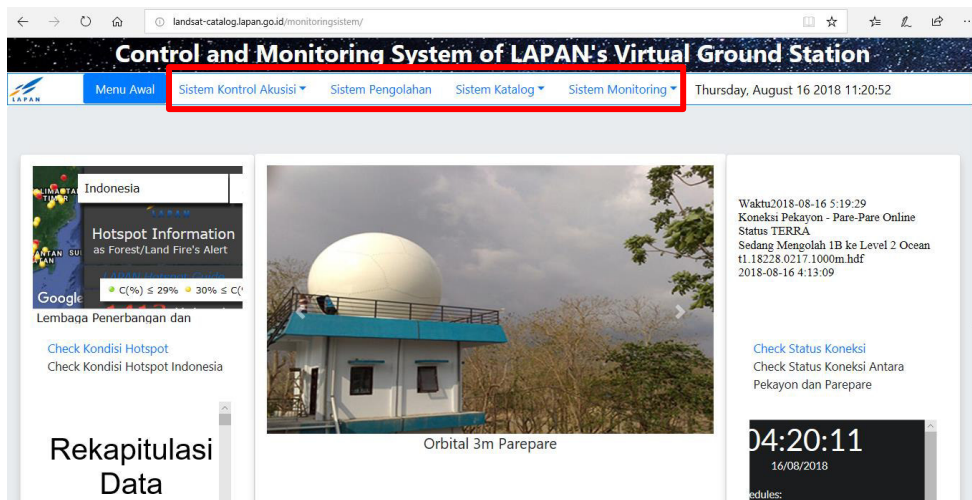


Figure 5. Website bar menu.

3.3. Bar Sub-menu

Sub-menus can be raised when the user selects one of the bar menu options. This sub-menu makes it easy to group the system according to the type of use. In the Acquisition Control System menu, there are Satellite Tracker sub-menu, as shown in Figure 6, which contains notifications about the scheduling of the acquisition of several satellites such as NOAA19, LANDSAT8 and TERRA and Apache Guacamole sub-menu, as shown in Figure 7, is a collection of devices connected to each other on a server which devices can be remote.

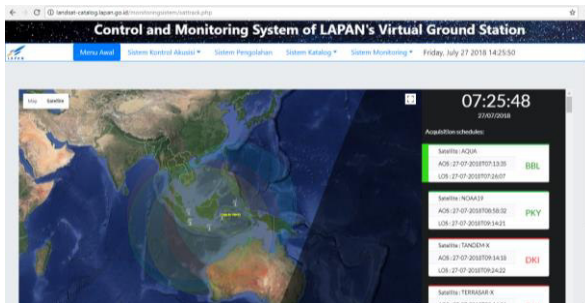


Figure 6. Satellite Tracker sub-menu.

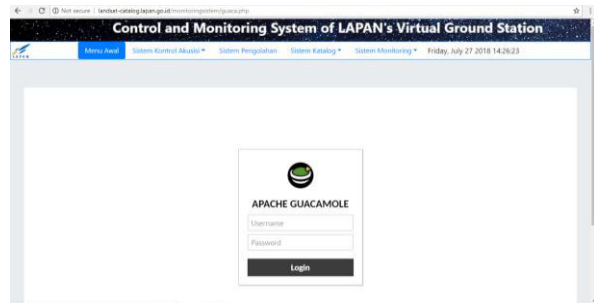


Figure 7. Apache Guacamole sub-menu.

On the Processing System menu, there is a Farearth page sub-menu, as shown in Figure 8, which tells the results of the acquisition by looking at the process for the status of its processing, and the final result will be displayed in the catalog.

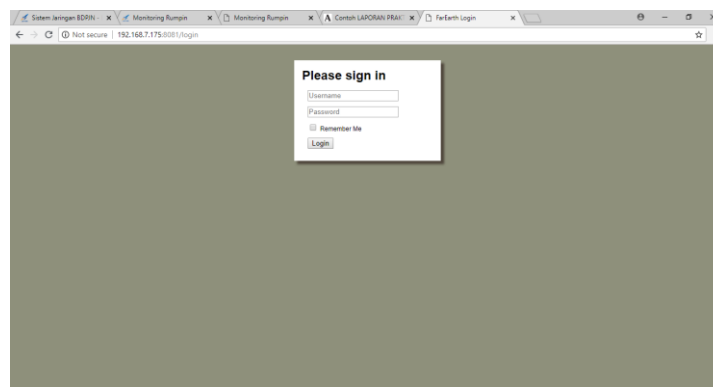


Figure 8. FarEarth processing system sub-menu.

On the Catalog System menu there are several types of catalogs sub-menus based on the type of data, such as the MODIS, Landsat, Inderaja, BDPJN, and Himawari-8 catalogs. Figure 9 is a catalog that shows a number of hotspots in Indonesia at a certain time by showing the coordinates of the heat source. Figure 10 is a catalog of Landsat images acquired by LAPAN's remote sensing ground station. Figure 11 is a remote sensing catalog that contains notifications of all satellite products in LAPAN. Figure 12 is a catalog containing Indonesia's national remote sensing data bank. Figure 13 is a catalog that displays the results of the cloud coverage that serves as a benchmark for rainfall in Indonesia.



Figure 9. MODIS catalogue sub-menu.



Figure 10. Landsat catalogue sub-menu.

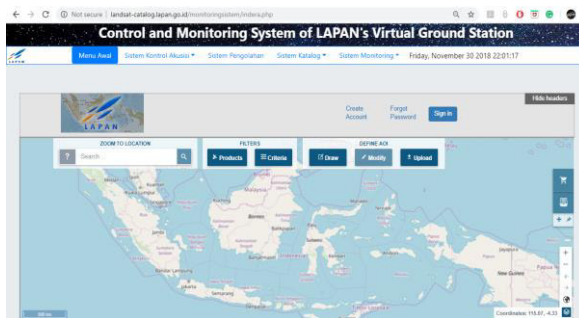


Figure 11. Inderaja catalogue sub-menu.

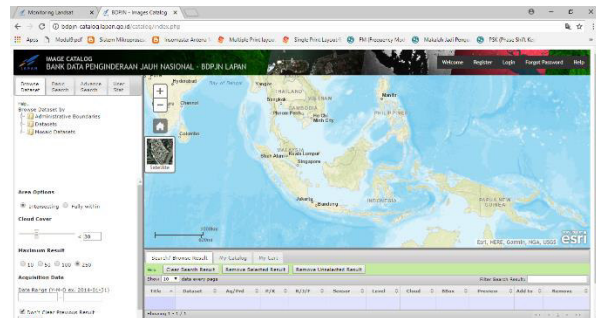


Figure 12. BDPJN catalogue sub-menu.

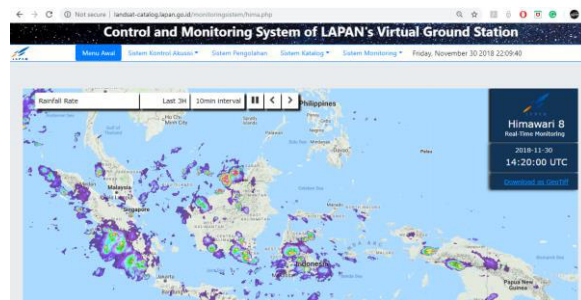


Figure 13. Himawari-8 catalogue sub-menu.

On the System Monitoring menu, there are sub menus to view conditions or monitor the process and results of a system. There are such systems for viewing the status of Terra and Aqua satellite data, the status of transfers between Pekayon and Parepare ground stations, and the results of the Landsat 8 data recapitulation. Figure 14 gives the status conditions for changes in Terra and Aqua satellite data from raw, level 1, and level 2. Figure 15 gives the status conditions for changes in S-NPP satellite data from RDR, SDR, and EDR levels. Figure 16 provides the connection conditions between the Pekayon and Parepare ground stations and the ongoing data acquisition. Figure 17 contains a page that tells the condition of servers between ground stations in several regions such as Parepare, Pekayon and Rumpin which are based on IP. Figure 18 contains the monitoring site of Rumpin Ground Station.

Figure 19 provides information on recapitulation of Landsat 8 data. Landsat 8 satellite will reach the same point in a period of 16 days. In the details of the data, there are data processing and acquisition each year starting from 2015 to the present. Figure 20 contains the satellite schedule that passes and which ground station will receive the data.



Figure 14. Terra and Aqua data status sub-menu.

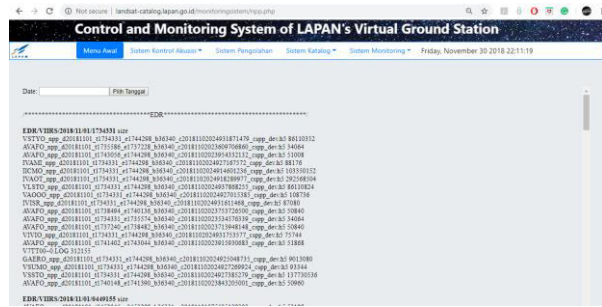


Figure 15. S-NPP data status sub-menu.



Figure 16. Transfer status monitoring sub-menu.



Figure 17. Connection status monitoring sub-menu.

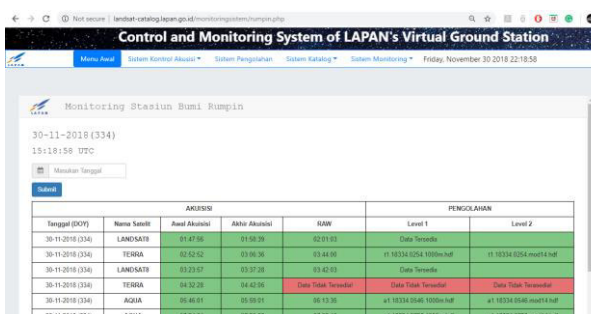


Figure 18. Rumpin GS monitoring sub-menu.

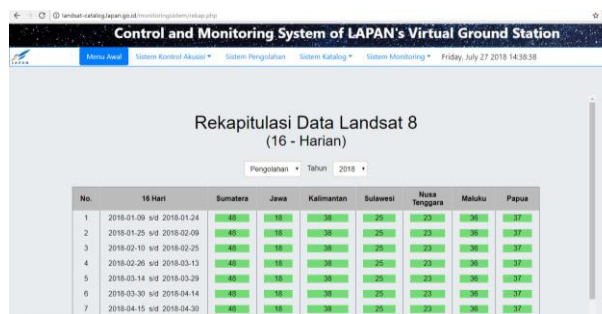


Figure 19. Landsat-8 data recapitulation sub-menu.

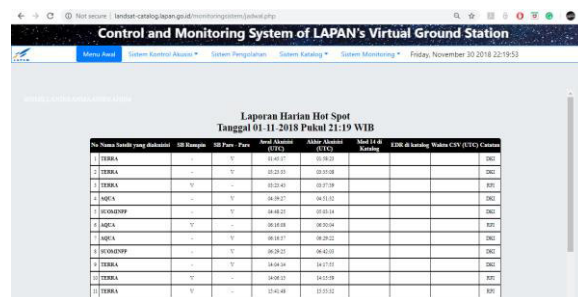


Figure 20. Satellite schedule monitoring sub-menu.

4. Conclusion

The integration of control and monitoring application system of LAPAN's remote sensing ground station has been successfully designed, built and run well. By implementing responsive web layout technique, operators and users can easily access built system integration applications, with several advantages including: layouts can adjust multiple devices at once, can display and show certain parts differently on devices, no need zoom as the text can be seen clearly, easy to navigate, efficient and effective as developers don't have to make the web on many devices separately.

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