

Software Design to Search Data Images of Satellites LAPAN-A2/Orari and LAPAN-A3/IPB

Rendy Kurniawan^{*a}, Agus Herawan^a, Puji Rianto^a, Bambang Sigit Pamadi^a

^aSatellite Technology Center, Indonesian National Institute of Aeronautics and Space (LAPAN), Bogor, Indonesia 16310

ABSTRACT

LAPAN-A2/Orari and LAPAN-A3/IPB satellites are LAPAN-made satellites which are successors of the previous LAPAN-made satellites, namely the LAPAN-TUBSAT satellite made in Germany, the LAPAN-A2/Orari and LAPAN-A3/IPB satellites launched with Indian PSLV rockets from the Satish Dhawan Space Center, Sriharikota, India in 2015 (LAPAN-A2/Orari) and 2016 (LAPAN-A3/IPB). As time goes by, the two satellites produced large amounts of digital camera image data, for now before software search data images of satellites designed, images results only stored in conventional folder this method makes difficult for operators to search images with certain specifications. LAPAN hoped that the imagery of the two satellites could be integrated in the storage and web-based search media, so the internal user and external user could easily access the image data. This paper describes the design of database storage media, web-based data search which have three function that is search data by location's name, date range of data retrieval, and also search data images by types of product (camera image data from LAPAN-A2 or camera image data from LAPAN-A3). With this software it is expected that LAPAN services for digital camera images data to every user will be more effective and efficient.

Keywords: Software Design, Satellite, LAPAN-A2, LAPAN-A3, Camera Digital, Storage, Database, Data Search.

1. INTRODUCTION

The LAPAN-A2 / Orari and LAPAN-A3 / IPB satellites were launched on September 28, 2015 using India's PSLV C-30 launcher, the LAPAN-A2 / Orari satellite has several missions namely AIS (Automatic Identification System), Amateur Radio Communication VR (Voice Repeater) and earth surface monitoring¹. Especially for the LAPAN-A2 satellite surface monitoring mission equipped with 2 cameras namely a video camera and a high-resolution digital camera (Space Cam). The LAPAN-A2 satellite video camera has a sensor with a size of 752x582 pixels with a resolution of 6m and swath 5km at an altitude of 630 km. While the digital camera has a sensor with a size of 2048x2048 pixels with a resolution of 4m and swath 7 km at the same height. While the LAPAN-A3 Satellite was launched also with the PSLV C-34 Rocket from the Satish Dhawan Space Aerospace, Sriharikota, India, Wednesday, June 22, 2016. The LAPAN-A3 / IPB weighed 115 kg with an orbit height of 508km^{2,3}. Similar to the LAPAN-A2 / Orari satellite, the LAPAN-A3 satellite has an optical charge in it, namely LISA (Line Imager Space Application), Space Cam, Video Camera, and Microbolometer. LAPAN-A2 / Orari and LAPAN-A3 / IPB satellites have produced many LAPAN-A2 / Orari and LAPAN-A3 / IPB Space Cam images as well as LAPAN-A3 / IPB LISA imagery. LAPAN-A2 / Orari satellites orbit equatorially while LAPAN-A3 / IPB satellites orbit polar, Illustration of LAPAN-A2 / Orari satellite movements and LAPAN-A3 / IPB satellites is presented in Figure 1 and the ground station of satellites presented in Figure 2.

The acquisition of LAPAN-A2 and LAPAN-A3 satellite imagery was obtained by using satellite earth receiving data stations located in Rancabungur, Biak, and Spitsbergen (specifically for LAPAN-A3 satellites). The results of the image that has been successfully acquired and processed are stored in a folder in hardware with a certain capacity, this makes it difficult for operators of satellites to find image data with certain specifications because the storage process is still using conventional methods, on the other hand the need for image data by external users is very much. Research conducted before about designed the LAPAN satellite imagery catalog database⁴. The e-catalog that has been designed must develop new features including searching for LAPAN-A2 and LAPAN-A3 satellite imagery data with input / keywords based on products per satellite and input / keywords based on the date range for retrieving satellite imagery data . At present, Satellite Technology Center does not have a satellite image data search system especially Space Cam imagery data which ready to operate on a web-based basis. By existence of this search engine for satellite image data searchers, the

purpose of visual search is to find images that are visually similar to a query image⁵. it is expected that Satellite Technology Center can run the function of image data services by external users and for the dissemination of LAPAN-A2 and LAPAN-A3 satellite image data.



Figure 1. LAPAN-A2 and LAPAN-A3 satellites when in orbit

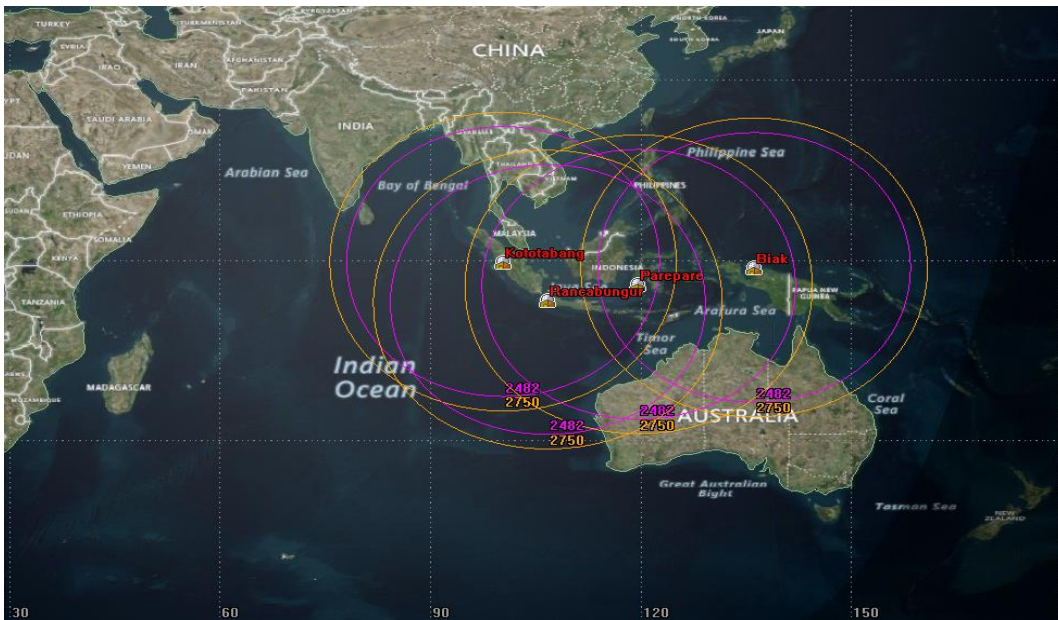


Figure 2. Ground Stations of Satellites LAPAN in Indonesia

The design of this satellite image data search engine requires a database system commonly called a DBMS (Database Management System), Advantages of the DBMS are control of data redundancy, data consistency, sharing of data, improved data integrity, improved security, economy of scale, increased productivity, and improved backup and recovery services⁶. The first phase of database design is called **conceptual database** design and involves the creation of a conceptual data model of the part of the enterprise that we are interested in modeling. The data model is built using the information documented in the user's requirements specification. Conceptual database design is entirely independent of

implementation details such as the target DBMS software, application programs, programming languages, hardware platform, or any other physical considerations. Throughout the process of developing a conceptual data model, the model is tested and validated against the user's requirements. The second phase of database design is called **logical database design**, which results in the creation of a logical data model of the part of the enterprise that we interested in modeling. The conceptual data model created in the previous phase is refined and mapped onto a logical data model. The logical data model is based on the target data model for the database (for example, the relational data model). **Physical database design** is the third and final phase of the database design process, during which the designer decides how the database is to be implemented. The previous phase of database design involved the development of a logical structure for the database, which describes relations and enterprise constraints. Although this structure is DBMS-independent, it is developed in accordance with a particular data model, such as the relational, network, or hierarchic. However, in developing the physical database design, we must first identify the target DBMS. Therefore, physical design is tailored to a specific DBMS system. There is feedback between physical and logical design, because decisions are taken during physical design for improving performance that may affect the structure of the logical data model.

Three methods above are indispensable for designing a web-based search engine, using this search engine will facilitate access to selected satellite imagery and help Satellite Technology Center to introduce its satellite products to stakeholders or to the wider public.

2. RESEARCH METHODOLOGY

The methodology to be used in this research is presented in Figure 3. There are five stages of the methodology used, namely analysis & design, Construction & Testing, Provisioning, Deployment, Execution & Monitoring. There are five stages of the methodology used, namely analysis & design, Construction & Testing, Provisioning, Deployment, Execution & Monitoring⁷.

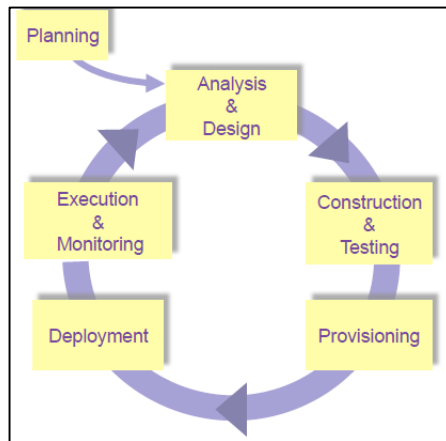


Figure 3. Research methodology (Michael P. Papazoglu Web Services: Principles & Technology rentice-Hall October 2007)2.1 Analysis & Design

2.1. Analysis & Design

Analysis aims at identifying & describing the processes in a business problem domain; on discovering potential overlaps & discrepancies between processes under construction & available system resources needed to realize services. At this stage, user requirements must be specified by the user, search engines must be easily accessed and easily understood.

2.2. Construction & Testing

Search engine design is the process of making programs including data structures, software architecture, user interfaces and coding processes. This stage realizes the results of the analysis and boundary conditions to the next stage which is a search engine program while testing is the testing phase where the output results must be in

accordance with the input that is recommended by the user. This is also to ensure that the search engine functions have been thoroughly tested and minimize errors⁸.

2.3. Provisioning

In general, provisioning means providing or making something available. The term is used in a variety of contexts in IT. For example, determine what features will be in the search engine program such as image info based on regional names, image info based on satellite products, image info based on date range of data retrieval.

2.4. Deployment

Deployment is the implementation phase of the search engine program into web-based search engine software that can be accessed easily and quickly by the user.

2.5. Execution & Monitoring

To monitor whether there are errors or additional functions that must be added to the search engine or even to update the database with the latest image data from satellites.

3. RESULTS & ANALYSIS

Search engine database design processed by ERD (Entity Relationship Diagram) and DFD (Data Flow Diagram) techniques.

3.1. Analysis & Design

This Search Engine was built with a relational database model with ERD structure and processed with MySQL. When we talk about a database, we must differentiate between the database schema, which is the logical design of the database, and the database instance, which is a snapshot of the data in the database at a given instant in time. The concept of a relation corresponds to the programming-language notion of a variable, while the concept of a relation schema corresponds to the programming-language notion of type definition. In general, a relation schema consists of a list of attributes and their corresponding domains⁹.

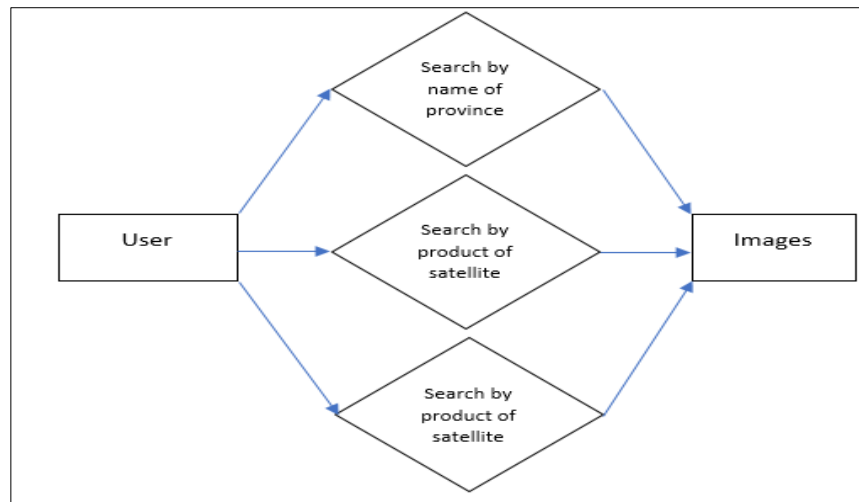


Figure 4. Entity Relationship Diagram

programming languages MySQL is called a relational database management system because its tables store not only data, but the relationships among the data^{10,11}. There are three categories of these relationships. First is one-to-one, A **one-to-one** relationship between two types of data is like a (traditional) marriage: each item has a relationship to only one item of the other type. Second is **one-to-many or many to one** (relationships occur when one row in one table is linked), the third is **many-to-many** relationship, In a many-to-many relationship,

many rows in one table are linked to many rows in another table. This third table contains nothing else, as its sole purpose is to link up the other tables. In the figure 4 explained that the interaction of the user and from the administrator into the database system, the user can search satellite image data in three ways, that is : choose the name of the city / province, choose satellite imagery products, and the last choose image results based on satellite imagery with retrieval data range. After entering one of the three methods above, the image which user wants will appear and can be seen by user.

3.2. Construction

Search Engine LAPAN-A2 and A3 satellite image data search engine is designed with PHP and SQL, the reason for using PHP as an interface to MySQL is to format the results of SQL queries in a form visible in a web page. Querying in relational databases requires prior knowledge of storage structures and of the syntax of a structured language, such as SQL^{12,13}. As long as you can log in to your MySQL installation using your username and password, you can also do so from PHP. However, instead of using MySQL's command line to enter instructions and view output, you will create query strings that are passed to MySQL. When MySQL returns its response, it will come as a data structure that PHP can recognize instead of the formatted output you see when you work on the command line. Further PHP commands can retrieve the data and format it for the web page^{14,15}. The main appearance of the search engine opening is presented in Figure 5.

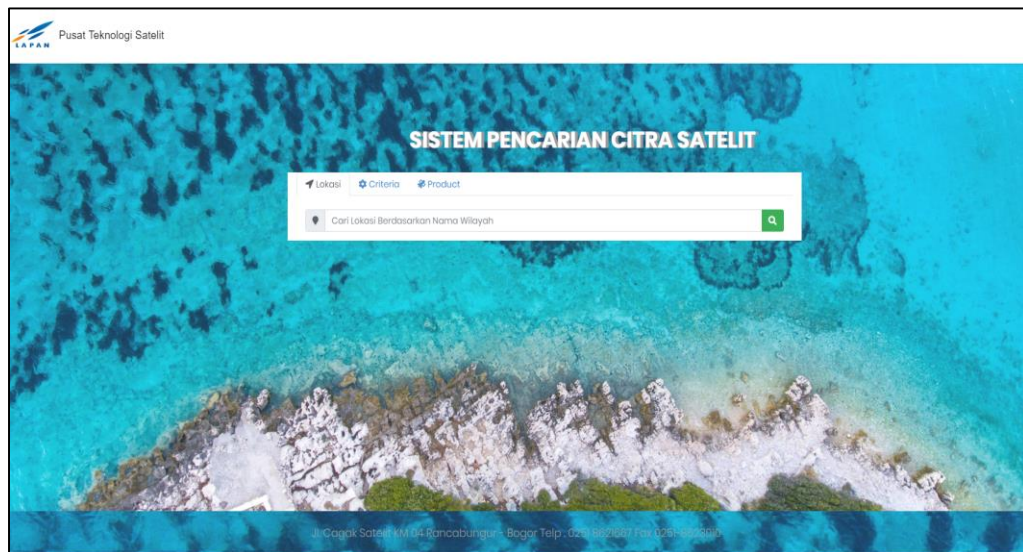


Figure 5. Display of Home Search Engine Satellite Imagery LAPAN-A2 and LAPAN-A3

After the user enters the home search engine page, then the user is given the option to enter keywords based on the location of the region (city / province), Criteria (data collection based on the date range of image data), and finally based on product satellite.

3.3. Testing

Furthermore, on the location tab the user can enter the location keyword (City / Province), the search engine will nail down the connection to the database, then the system will search for data related to that keyword, and the last feature is on the product tab, on the product user feature is directed to select satellite images based on the type of satellite, the user can see all the data generated by each satellite (LAPAN-A2 or LAPAN-A3). The appearance of this search engine testing is presented in Figure 6, Figure 7, Figure 8.



Figure 6. Display Satellite Imagery with location keywords (city / province)

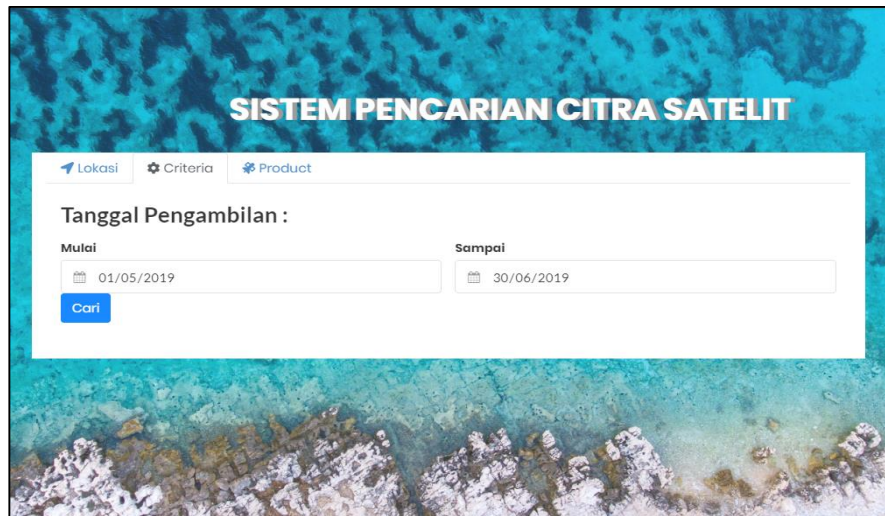


Figure 7. Display of Satellite Imagery with Retrieval Data Range

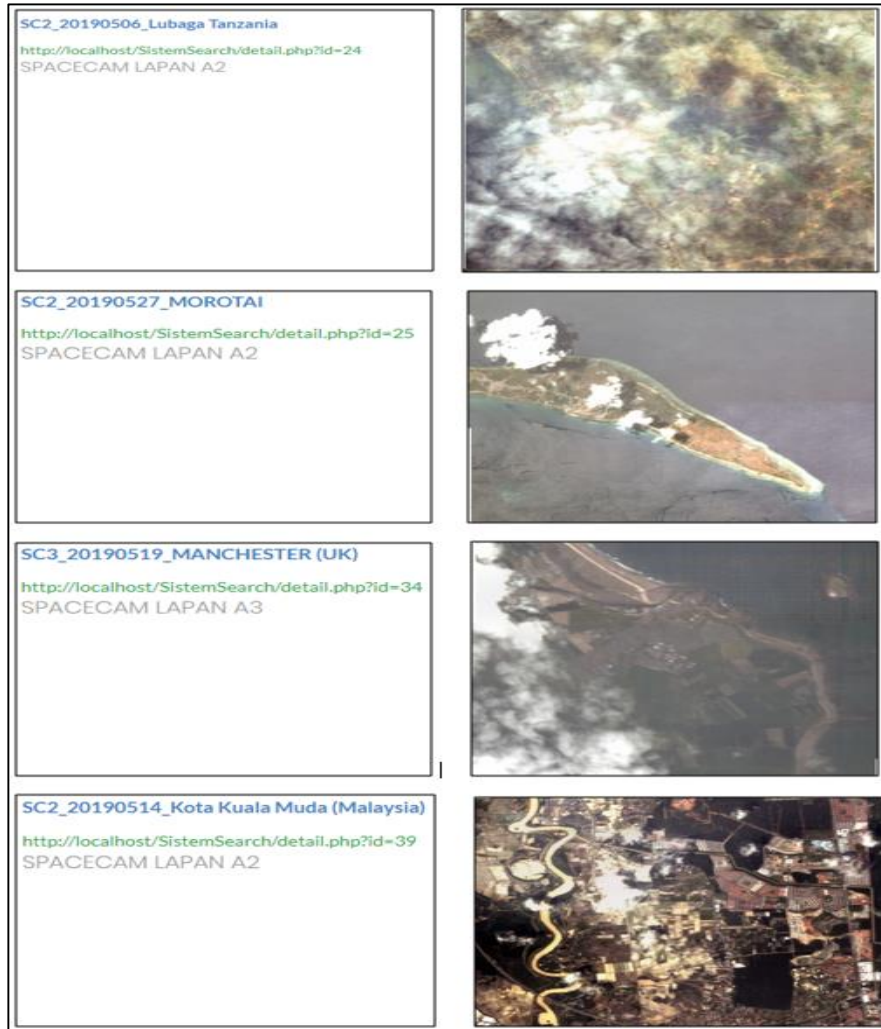


Figure 7.1 Results of Satellite Imagery with Retrieval Data Range

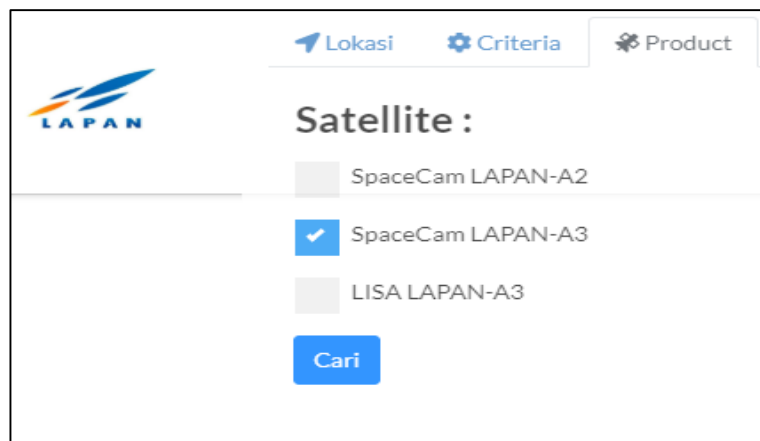


Figure 8. Display Satellite Imagery with input based on the type of satellite product



Figure 8.1 Results of Satellite Imagery with input based on the type of satellite product

3.4. Deployment & Monitoring

This Search Engine is designed with expectations that it can develop further, especially in terms of database updating and database monitoring. The database will be added when new data is available which has been processed by the image data processing operator. In the process of deployment and monitoring the administrator can login to page of username and password for the database addition process. Figure 9 and Figure 10 present the administrator login page and the database addition page.

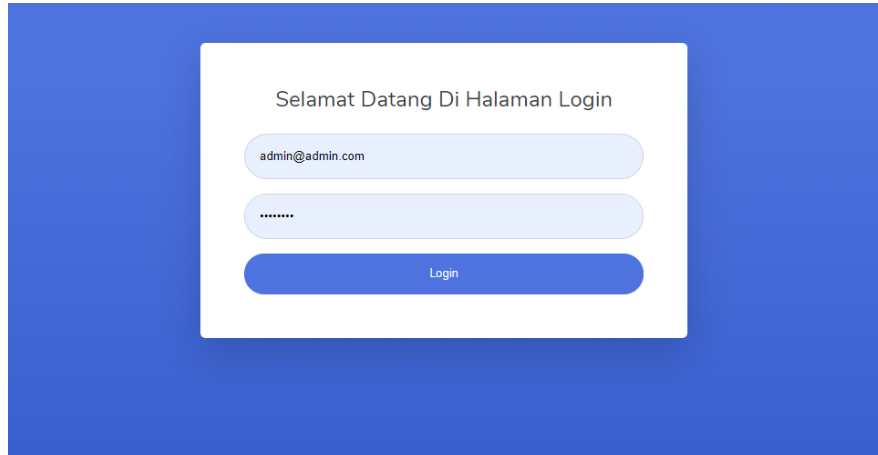


Figure 9. Administrator search engine login page

















No	Metadata	Aksi
1	SC2_20190211_Sebatik	2019-06-17 00:00:00  
2	SC2_20160226_Jurong	2019-06-17 00:00:00  
3	SC3_20180411_Laut Merah	2019-06-17 00:00:00  
4	SC2_20190111_Kuala Lumpur	2019-06-18 00:00:00  
5	SC2_20190225_Mongkoinit	2019-06-18 00:00:00  
6	SC2_20190227_Balikpapan	2019-06-18 00:00:00  
7	SC2_20190304_Cirebon	2019-06-18 00:00:00  
8	SC2_20190211_Aceh	2019-06-18 00:00:00  

Figure 10. Database processing search engine page

3.5. System Test Results

The design and testing process has been carried out and the search engine functions have been fulfilled properly. The test results are presented in a test scenario which can be seen in Table 1.

No	Searching keywords	Testing Result
1	by name of the city / province	OK
2	by satellite imagery products	OK
3	by satellite imagery with date range of data retrieval	OK

Table 1. System Testing

4. CONCLUSION

Based on the description above, it can be concluded that the problem of accessibility and interaction problems with users can be overcome by making satellite image data search engine LAPAN-A2/Orari and LAPAN-A3/IPB, as well as image data search facilities with three specific categories (search image by location's name, search by date range of data retrieval, and also search image by type of satellites product) become an advantages of this search engine. The next research will be read the image that has been generated by satellite with KML / KMS format, so that the image will be displayed into a map in accordance with the latitude and longitude of the images.

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