FOREST FIRE INFORMATION SYSTEM (ForFIS): TOOLS FOR FOREST FIRE INFORMATION DISSEMINATION

M.H. Siti Atikah, A.P. Norizan, I. Adnan, H. Hasni, C.M. Norhayati**
Researcher, Malaysian Remote Sensing Agency,
No. 13, Jalan Tun Ismail, 50480 **KUALA LUMPUR**.
Tel. + 6 03 26973400 Fax: +6 03-26973350
atikah@remotesensing.gov.my
** Presenter: norhayati@remotesensing.gov.my

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ABSTRACTS:
In any disaster event, any information which can be used for quick decision-making is greatly needed for the authority. This information can either be in digital or analog form and most probably scattered within different departments or agencies. Retrieval of this information then is of the utmost importance. With the advent of high-speed Internet and its wide usage and penetration, information dissemination now has changed - data availability is now at the touch of a button. Integral to all these is dissemination via the Internet through the use of online data repository. Among the most useful are spatial-data applications developed with the integration of Geographic Information System and the Internet. This paper will present an outline of the Forest Fire Information System (ForFIS), an online geographic information system developed by Malaysian Remote Sensing Agency (ARSM) for monitoring and retrieving real time hotspots and forest fires. HIS not only contain information on hotspot and forest fire locations through satellite imagery, but it also monitors the Air Pollutant Index (API), which is retrieved from Department of Environment (DOE), and wind directions, retrieved from Malaysian Meteorological Department (MMD). Wind and API together with hotspot and forest fire imagery will eventually complement each other in understanding haze conditions in Malaysia. ForFIS is available online at http://fmrs.remotesensing.gov.my/his and currently being used by relevant agencies responsible in the management of forest fire and monitoring haze under the coordination of National Haze Committee.

1.0 Introduction

Forest fires can occur due to many reasons such as prolong dry periods in an area or due to human land clearing activities. When forest fire occurred, not only we are facing biodiversity lost but also cause regional health problems and economic loss. A classic example is the 1997 forest fire and haze episode that had hit ASEAN region. During that time, many schools were closed due to hazardous air condition.

The National Security Council (NSC), focal point for disaster in Malaysia, had produced a Standard Operating Procedure for forest fire. In this SOP, task for each departments related to forest fire were drawn upon clearly. Malaysian Remote Sensing Agency (ARSM) was given the task to provide the active fire imagery real time or near real time to relevant agencies including the Department of Environment (DOE), Malaysian Meteorological Department (MMD), Fire and Rescue Department and NSC. The active fire imagery shows the location of the fire occurrence and the extent of these fires.

Since 2000, ARSM had given the forest fire information and active fire daily to relevant agencies. Mainly the media for information dissemination are using email, fax and also printed maps showing the fire activities and fire extent. In 2011, ARSM had moved forward with the development of Forest Fire Information System (ForFIS) using internet as the media for information dissemination tools. With ForFIS, information can be transferred faster and registered user can directly get the information on the web.

The objective of this paper is to demonstrate how the ForFIS had been benefited the relevant agencies related to forest fire. First, this paper will explain the system development process followed with operationalization of the forest fire system. The last chapter will gives summary and future development of the system.

2.0 System Development Methodology

This ForFIS system is developed in three stages, which are database design, GIS map preparations and customizations of web GIS. When designing the database, an entity relationship diagram is built to describe overall relationship of tables and spatial data and its logical structures. Oracle 9i and ArcSDE 9.3 software's were used for data management and spatial integration.

GIS map preparation for web application is using the ArcGIS Server. Daily hotspots maps and forest fire imagery were processed and being pushed to the ArcGIS Server. With the help from ArcGIS API (Application Programming Interface) for JavaScript, interactive map application can be deploy through web. Simple interactive tasks such as zoom in/zoom out maps to more complex GIS task such as query and find map attributes can be executed. Using Internet Information Service (IIS) as the web server, GIS data integration with web is built using PHP, HTML and JavaScript.

The system architecture mainly comprises of spatial database, a server and a web application. Based on three-tier architecture, the first tier is the front end, which is the user interface that can be reached through the web browser. The second tier is the application layer, which takes care of the locating resources, accessing and gathering the results [1]. This second tier will gather and process the command from first tier (user) and perform the logic procedure to produce the results, by taking all the necessary information from the third tier. The third tier consists of the database server, which is the resource management, and in this case the Oracle database and ArcSDE software.

Users can perform designated queries from the web to access the hotspots daily data. As of today, 3 days data from system date are accessible through the website. When user choose a date, the JavaScript code executed on the client side, using the API's map data and table consisting of hotspots information will be populated through the web browser. Users can perform queries and also print the result in form of map and table.

Other supporting maps such as Air Pollutant Index map and satellite images also presented through this web.
Besides queries, hotspots summary for the coverage area also obtainable, using the PHP code and Structured Query Language (SQL), most recent daily data for each states of the covered area from Oracle is populated to the web in table form.

Data management is the heart for this Forest Fire Information System. Two types of data stored in Oracle, vector data model and raster data model. Vector data model consists of daily hotspots map of MODIS and NOAA, base map data Malaysia, Brunei, and Indonesia and Peninsular Malaysia land use map. The vector data also stored daily Air Pollution Index Map generated from the DOE. Raster data model stored the satellite imageries for the system. This system uses the SPOT data that shows active or most recent forest fire event and the fire extent. It also stored lower resolution satellite data of MODIS.

Besides these two data model, other information also stored in Oracle database such as authorized user and agencies.

3.0 Operationalization

ForFIS is currently used by relevant agencies such as DOE, MMD, Fire and Rescue Department and Forestry Department. Only authorized users with the correct login and authorization can browsed through the web. Login page build on PHP code, will check on the user ID's and password. Successfully logged in user info will be stored in database as further reference for administrator.

There are two types of data used in this forest fire project. First is the regional data set and the other is detailed GIS data layer for Malaysia. For regional setting, we used the NOAA and the MODIS data to generate daily hotspots distribution maps. The hotspots distribution maps gives the insight of possible fire locations throughout Malaysia and Indonesia. Furthermore with the daily MODIS data, which had at least 4 passes passing through this region, regular updates of hotspots distribution maps can be done.

Higher resolution satellite imagery was used to further confirm the existence of fire in this region. Based on the Air Pollution Index (API) from DOE and increasing number of hotspots detected, request for the SPOT data were send to the satellite operator to monitor areas which is possibly on fire. Sometime, if the extent of the fires were large, it can also be seen on lower resolution satellite such as MODIS. If the SPOT data of active fire were available, this data were later being processed as soon as we received the data. The standard time frame for processing the data until publish to the ForFIS is about three hours or less. Therefore, the user will receive latest data within the next three hours on the net. Thus the authority is being able to make arrangement and planning how to combat the forest fire soonest.

For analyzing the hotspot distribution, ForFIS allow only registered users to query latest and the last three days hotspot information available. Information incorporated with this hotspots distribution map will allows users to identify possible fire location, nearest town to the hotspot and distance from the hotspot to the nearest town. This

additional information is useful for the fire and rescue members to easily locate the hotspots location and subsequently put off the fire if any.

The reason of having both MODIS and NOAA hotspots map available in the system is to alert users of the possible fire occurrences. It is understandable that hotspot does not mean actual fire but rather 'possible fire' until it was confirmed with higher resolution satellite imagery. However, if the hotspots were detected continuously at the same place, therefore there is possibility of forest fire occurred is high. These MODIS and NOAA hotspots acts a a simple monitoring tools for forest fire. Furthermore, on each hotspots time of satellite acquisition is recorded for user to be able to continuously monitor it.

On each hotspot, information on exact location is recorded together with the State, District and nearest town the hotspots location. Therefore, the fire and rescue department at the designated district level can take immediate actions to run the field checking at the hotspot location. There are also map shows road network and town as guide to the authorities to run the field check. There are also river network data, which allows the fire, and rescue member to tap water supply nearby in the case of actual forest fire happened.

ForFIS also being developed to gives the summary of hotspots distribution for the day. There are summary for each country, state and district where the hotspots were detected or recorded. If higher resolution satellite imageries are available, the users are able to zoom to area of the active fires and able to understand the source of the fire and haze.

Currently the operator updates the system twice a day which is around 5.30 pm and 8.30 am the next day (Malaysian time).

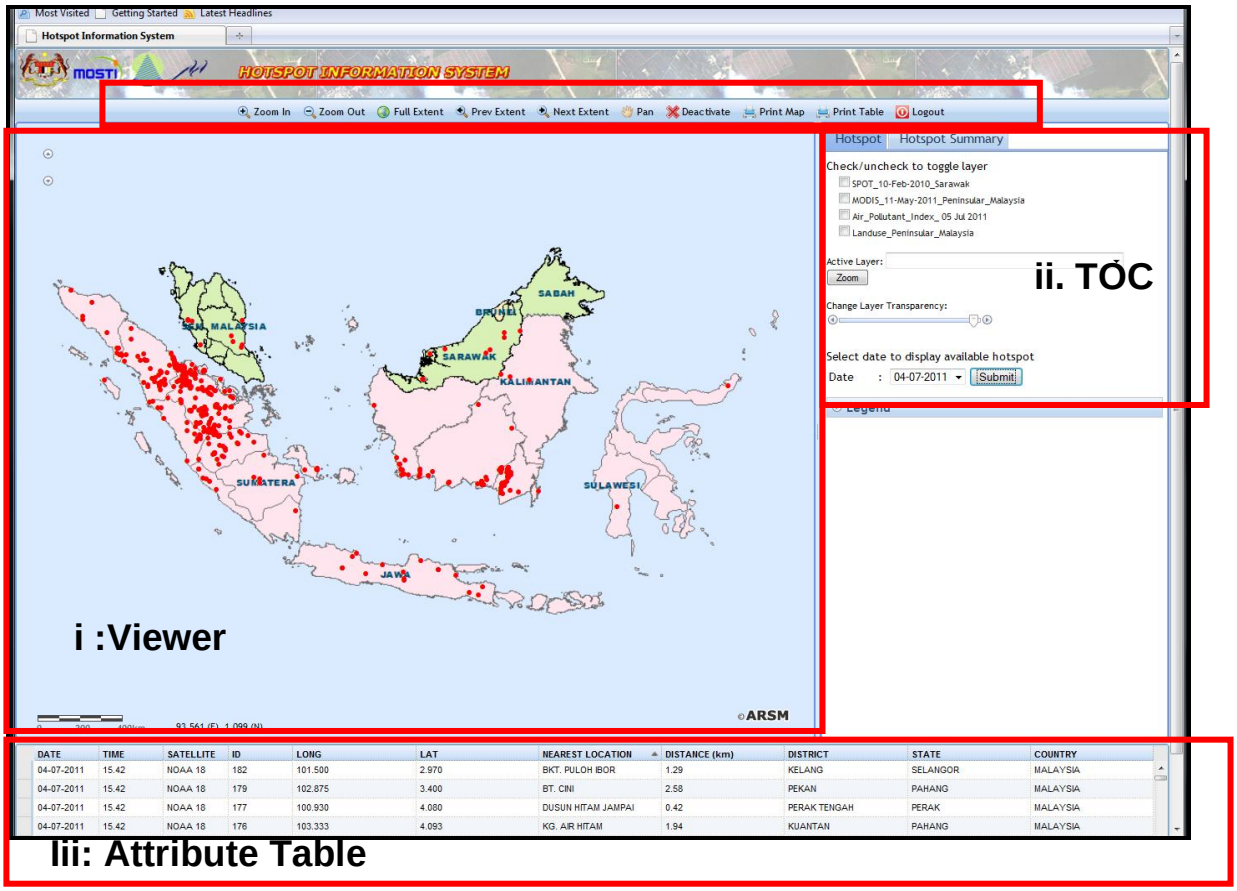

Figure 1 showing the main page of the ForFIS, which contain the viewer, Table of Content, Attribute Table and interactive menu for zoom capability.

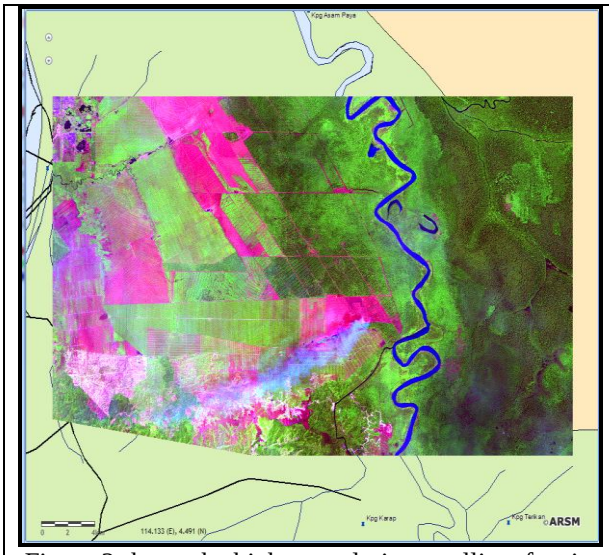

Figure 2 shows the higher resolution satellite of active fires.

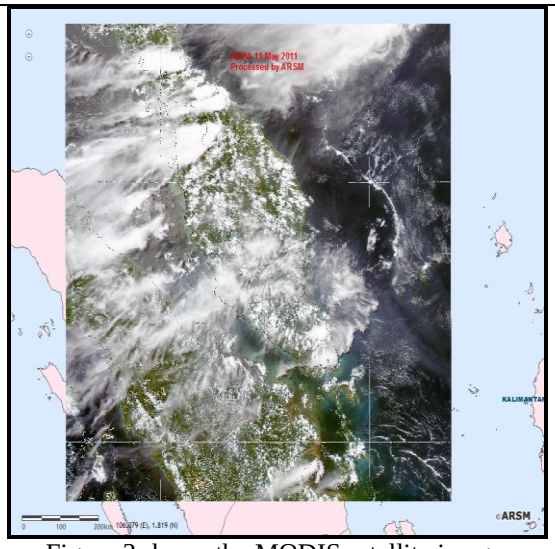

Figure 3 shows the MODIS satellite imagery.

4.0 Benefit

The main objective of the system is to give timely and accurate information of forest fires. At the moment, those hotspots occurred in Malaysia had information on State, District, nearest town and distance incorporated into each hotspots. Such information shows the importance for relevant geospatial data to the public as well as the disaster officers especially. By pointing out nearest city/area to the forest fires event, authorities can make quick decision and extra precautions/warning to civilian nearby. Besides location, forest fires data given also comes with the time frame of the occurrence, accumulated three days data shows can be used to make prediction of the incoming forest fires in the same area. In addition, information dissemination is quicker and user can save time and cost since they do not have to rely on manual information dissemination such as fax, email and telephone conversation.

For future development, some statistical report will be added to the system such as summary on weekly/monthly forest fire occurrences. And more designated queries such times base events will be develop later.

[1] Kenneth M. Anderson, Web Services, Lecture 02: Distributed Information Systems. http://www.cs.colorado.edu/~kena/classes/7818/f06/lectures/02.index.html