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Geographic Community Information System for Supporting Community Development

Orasa Tetiwat[1] and Vatcharaporn Esichaikul[2]
[1] *Computer Science and Information Technology Department, Faculty of Science*
Naresuan University,Phitsanulok 65000
[2] *School of Engineering and Technology, Asian Institute of Technology*
Klong Luang, Pathumthani 12120
[1*]*Corresponding E-mail: Orasat@nu.ac.th*

Abstract

The objectives of this research were to research and develop geographic community information systems for supporting community development by reviewing documents and comparing data from the data bases of relevant agencies. The survey was conducted by surveying 400 samples and then interviewing 32 key informants for verifying the data. Results showed that the requirement pattern of geographic community information systems that were important and essential consists of 15 aspects of community life. *After that the system was developed by using an agile approach. The object-oriented paradigm was used to analyze and design the system. This system developed in the form of a Web Application using Apache as the Web Server, the PHP language for development, and linked databases with MySQL. To evaluate the system, a research survey was conducted. Results showed that users were satisfied with the whole system at a high level and a highest level 65.4 percent.*

Keywords - Geographic Information Systems, Community Development, Systems Development, Agile, Object-oriented Analysis, Design.

1. Introduction

Nowadays the world is changing rapidly, especially in information technology (IT). Most organizations use information technology beneficially. Computers have become ubiquitous, and powerful personal computers and laptops are now consumer items. The Internet is now a communication network available world-wide and accessible by a significant proportion of the population. Geographic Information Systems (GIS) are computer systems that help in analyzing spatial data with different attributes. Data or information in the area studied will be provided in the form of the relationship linking each other. This will depend on the type and details of such information to obtain the best results as needed. GIS can store, organize, analyze and create models, as well as display in the form of information that can be geographically referenced. Additionally, GIS can help to solve complex planning and management of various problems for organizations.

Currently, in Thailand, there are multiple databases used for storing community information by different agencies and organizations. For example, the Department of Community Development collects data related to basic needs of households and basic information about the village; the Health Department collects data related to health for each province; the Department of Livestock collects data related to animals and pets, and so forth. Each agency and organization will collect data for their own purposes. Much of this data is redundant. Some data may not match or may contradict or disagree when comparing databases. Some data does not meet the real needs of the community and those who want to use it. Moreover, some organizations face problems with their management information systems, such as having incomplete information, difficulty of searching and retrieving the data and some information is not accessible because of the privacy concerns and other access permissions required of each user. When government or private sectors use these data for analyzing, planning and finding solutions to problems, it might result in incorrect decision making due to poor information.. However, if each community has its own database and they can manage their data, this would benefit the community.

Therefore, it is important to develop a Geographic community information system (GCIS) to help support community development. It also helps to increase communication channels to disseminate information or knowledge to people in the community. This system can also support queries to analyze and evaluate information effectively. It also helps to support decision making in community development quickly and accurately. This will be useful to agencies and the nation.

2. Concepts, theories and literature review

2.1 Geographic Information System (GIS) is a system or device used to store spatial data and descriptive information (attribute data) in order to process, analyze, and display spatial data so that it can be utilized for supporting decision making, in planning and in managing complex data. Data in GIS is spatial data and descriptive data so it can refer to geographic position on the globe by using geographic coordinates (geocode) [1].

2.2 Software Development means the creation of new systems or modifying existing systems to support the operational and business needs of the user. Computer Systems can help us process, sort, compare and store data so that we can utilize that data historically and for the future. If we want to develop a system that meets changing needs, we need to plan and select a proper approach. [2] This research used an agile development approach, which is a relatively new concept for systems development. The benefits of an agile approach include:

- The developer can focus on a small component, or specific feature, and is better able to ensure that the details of that are done more correctly, and completely.
- By doing development and testing in short iterations you will find problems at the earliest possible time.
- At the end of every iteration you will have the opportunity to verify and validate your work. This means many opportunities throughout the development activity to make sure that you are doing the correct things.
- Every iteration presents a deadline that must be met, which allows developers to focus their efforts, to meet the near deadline, and to sustain a constant level of effort during the development project.
- Every iteration presents an opportunity to learn more about the requirements of the system, as requirements emerge and the system evolves.
- You have the opportunity to continually learn more that will be valuable in the new system, by having a Just-in-Time requirements definition activity at the start of every iteration.
- You can trace the experience and ability of the team, measure how much they can do in each iteration, and use this information for planning the rest of the project (adaptive planning and estimating).
- The worst case of 'project failure' is the complete failure of one iteration. This means that perhaps 1 week or 2 weeks of effort must be written-off. This is a setback, but is not a disaster. Even the complete failure of iteration to produce useful outcomes can be a significant learning exercise.
- Iterations enable, in fact demand, regular and frequent communication between users and developers [3].

The agile process includes analysis, design, testing and documentation undertaken in an iterative manner. Each iteration is limited to 4 weeks duration, with many organizations preferring 1 or 2 week iterations. [4].

2.3 **Unified Modeling Language (UML)** is unique, which has a standard data representation. This representation is called the meta-model. The meta-model is a description of UML in UML. It describes the objects, attributes, and relationships necessary to represent the concepts and processes within a software application. This provides CASE manufacturers with a standard and unambiguous way to represent UML models. It may also make it easier to write ancillary tools for browsing, summarizing, and modifying UML models.

The UML notation is comprised of two major subdivisions. There is a notation for modeling the static elements of a design such as classes, attributes, and relationships. There is also a notation for modeling the dynamic elements of a design such as objects, messages, and finite state machines.

The purpose of a class diagram is to depict the classes within a model. In an object oriented application, classes have attributes (member variables), operations (member functions) and relationships with other classes. The UML class diagram can depict all these things quite easily. The fundamental element of the class diagram is an icon the represents a class. [5] In this study, the four diagrams in the design are:

1) Use Case Diagram for the design from the perspective of the outside,
2) Class Diagram for designing modules various processing,
3) Sequence Diagram is used to describe the work within the system and
4) Collaboration Diagram displays the relationship between the Objects.

The four diagrams mentioned above, together, they are sufficient to give users an overall picture of the system's functions and architecture.

2.4 Literature Review

Phakinee Deeratsamee and Pairoj Rawthana Chonlakun [6] apply a geographic information system in finding the location of distribution centers for OTOP products, in case studies of the Chonburi Province. This presents the concept of using geographic information system (GIS) being applied to the work of logistics companies, and general information about the

products, and to enhance capabilities in logistics and distribution to operators selling OTOP products. Choosing the right location effectively with the conditions established as a GIS information system that displays geographic details. This reduces time and cost. Database management systems will help make more effective decisions.

Methi Akasing, Chalermpol Sumranpong and Chanchai Sangchsyosawat [7] have developed a multi-criteria analysis system for use in spatial decision support. This system comprises two programs:

1) the decision making system for analyzing decisions that do not use spatial information and
2) MCDA-GIS software for spatial data situations.

The results showed that these programs together can help to support decision making for diverse situations, both in terms of their participation in decision making and the alternatives that can be used in decision making. Methods used to determine the relative importance weights and criteria used by the rules in the decision support activity.

Chanchai Sangchsyosawat, et al. [8] developed decision support systems for agriculture and resource management and planning in the Upper North area of Thailand. They focused on the classification of ecological, agricultural and land use changes. They developed a database of spatial climate data including daily rainfall (mm), daily maximum and minimum temperatures, the reference Evapotranspiration and amount of solar radiation. This information was integrated with other databases, such as climate zone and cropping data during the growing season. It is also used as a basis for information systems analysis and evaluation related projects such as the evaluation of land use, physical and economic. It is used as an evaluation system for water use efficiency of crops in irrigated areas, and land condition assessment of land degradation in central system in other projects etc.

3. Population and Samples

Population: the population related to villages and communities, including administrators and public officials and the rural populations in the village or community. The samples were therefore drawn from all walks of life in the target provinces of Sukhothai, Phitsanulok and NakhonSawan.

4. Research and Development Process

An analysis of information systems requirements in support of community development was undertaken in the lower northern area of Thailand. The survey was conducted by surveying 400 samples and then interviewing 32 key informants for verifying the data. Results showed that the requirement pattern of geographic community information systems that were important and essential consists of 15 aspects of community life. Following this initial data collection stage, the development of the system proceeded, using principles of object-oriented systems. As described above the four main UML diagrams developed were the Use Case Diagram, Class Diagram, Sequence Diagram and Collaboration Diagram.

The developed system comprised a GUI interface for data input and display, and reporting. This web application was developed using Open Source tools such as Apache Web Server, PHP language and the MySQL database. Especially relevant was the use of the Google Maps API for GIS spatial data display. The system was subsequently tested and feedback was gathered in regard to user satisfaction with the system operability and usefulness, by the distribution of questionnaires.

5. Analysis and Design Artifacts

The design of the system, as UML diagrams, is illustrated below in Figures 1 to 4.

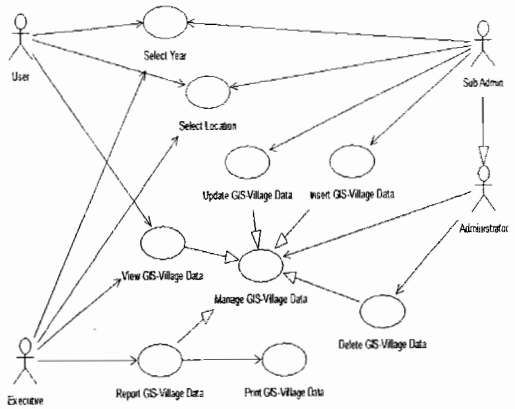

Figure 1. Use Case Diagram.

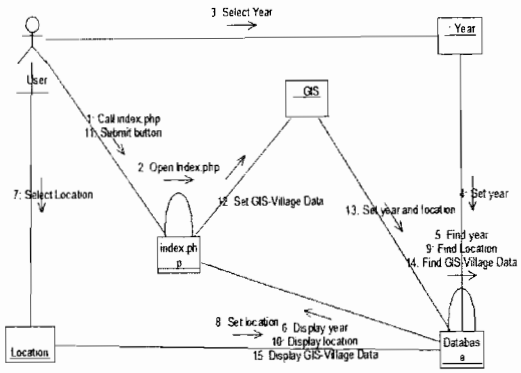

Figure 2. Collaboration Diagram

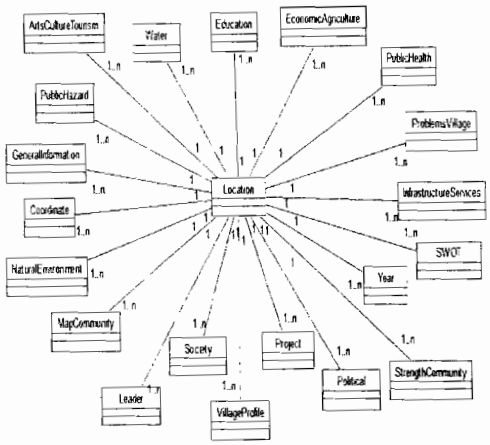

Figure 3. Relationship between the Classes

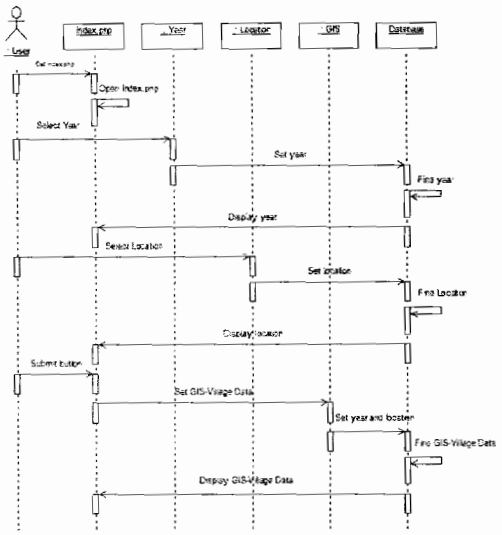

Figure 4. Sequence Diagram

6. The GCIS Development Outcomes

The system comprises first a web application. Usage of the system is in three main modules where:

1) Members of the general public can access information on demand over the Internet.
2) Local Government administrative staff who can manage the database and information content.
3) Senior executive and management staff of Government or Local Government departments, seeking information about the various communities for funding or other policy requirements.

Figure 5 illustrates the main menu of the system, where the members of the general public can request information display.

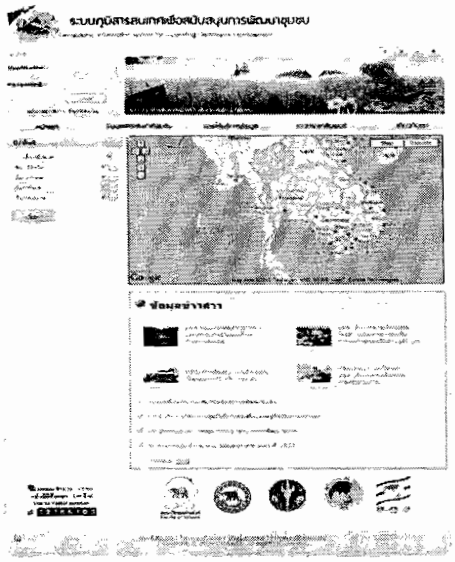

Figure 5. Main Page of the system.

Information can be selected from the menu, by year and location of the information. When users visit the main page they can select by Year, City, Sub-district or village. Data relevant to these selection criteria includes fifteen information categories, including village or community history, infrastructure and services, social, economic, agricultural statistics, local politics, education, health and health support facilities, culture and tourism, water resources, natural resources and environmental data, disaster history and probability, and other data. It also includes SWOT Analysis of the community. Examples of this are showed in Figures 6 and 7.

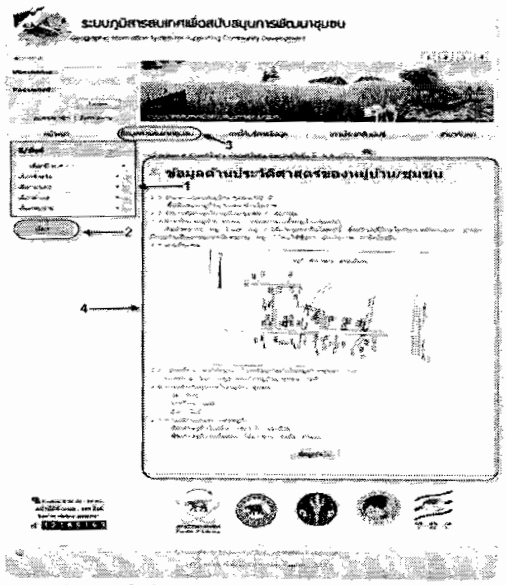

Figure 6. Screen for Map of the Village

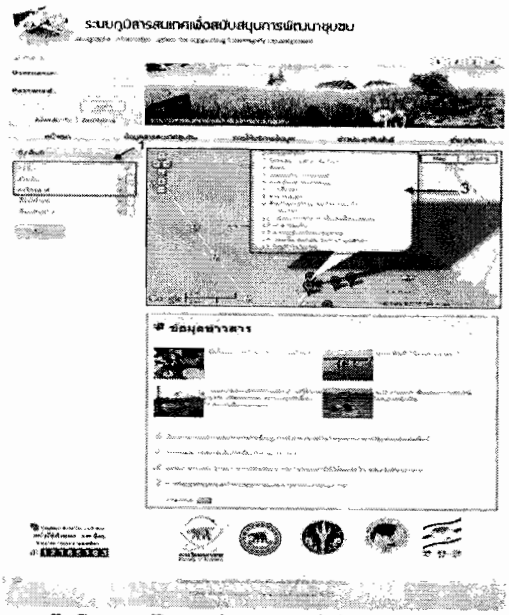

Figure 7. Screen Browsing and Links to Google Maps

Local government administrative staff can register in the system, and subsequently sign on to the system for the purpose of managing the database content (adding, deleting, editing new data). Figure 8 illustrates this capability.

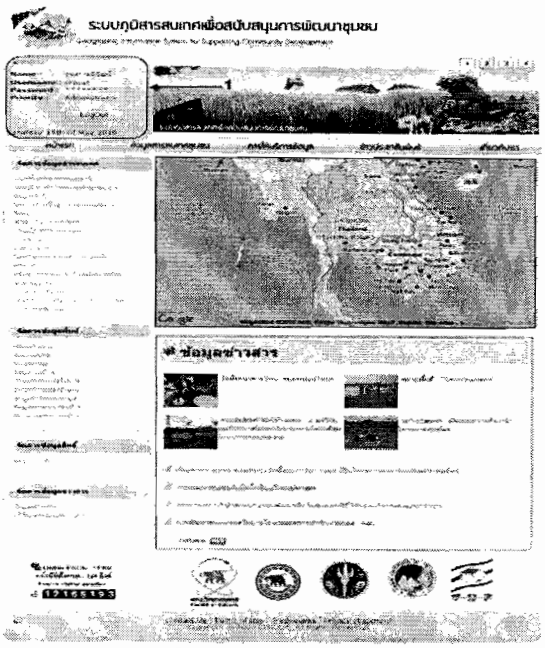

Figure 8 Main Data Administration Screen.

Data management in each of the 15 information categories as exampled in the following Figures 9.

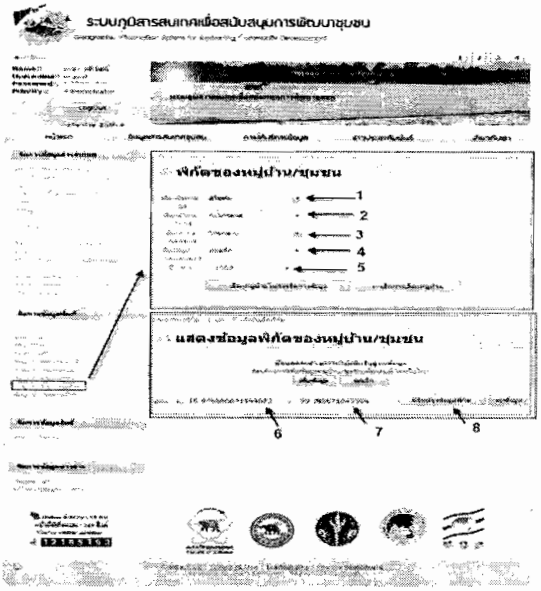

Figure 9 Screen for Village Map Coordinates

Figure 10 shows the report available for the senior government executives, enabling them to browse reports to support their policy and funding decisions in aid of the communities. Information can be presented at various levels of detail and summary, and can be drilled down to greater detail as requested.

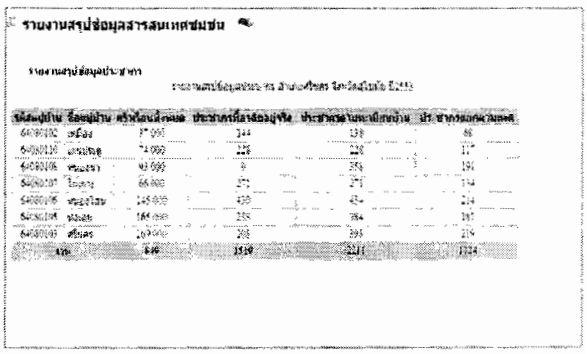

Figure 10. Screen for Summary Report of District Level Population Data

8. Evaluation of User Satisfaction

To evaluate the system, a research survey was conducted. Results showed that users were satisfied with the whole system at a high level and a highest level; 65.4 percent. When considering the benefits, design, contents, and usages, users were satisfied at a high level and a highest level estimated at 75.4, 66.9, 62.4 and 56.8 percent ordering respectively.

9. Conclusion

System development resulted in the implementation of demand patterns of geographic information systems community. To support community development. The analysis. The researcher developed a technique that is an Agile development methods that emphasize flexibility and agility to change quickly to all situations. Focused on the communication between the user and system as well. And most importantly focus on satisfaction with the system mainly And application of concepts and theories of object-oriented design. Applied in the analysis and design by selecting the four diagrams in the design are: *Use Case Diagram* for the design from the perspective of the outside, *Class Diagram* for designing modules various processing, *Sequence Diagram* is used to describe the work within the system, and *Collaboration Diagram* which shows the relationship between the Object Diagram. These four diagrams used in this study together describe the data transfer operations.

The system was developed as a web application, using Open Source software, including Apache as the web server, the PHP language, and the MySQL DBMS. The Google Maps API was used for processing spatial data. Applications with a Web Browser interface were developed to publish information in regard to the village / community via the Internet. As a model to manage and disseminate information to interested agencies the system is divided into three different parts:

1) the user, which is the general public, can access information on demand via the Internet,
2) the administrator and management staff, to manage the community information.
3) the executive, who can browse the various reports of the community.

The system was evaluated as to the satisfaction of the user community when using the system by surveying a sample of 400 users. The results showed that the overall satisfaction was high, with 51% responding at the highest level, when considering the individual aspects. It was found that all participants were satisfied at a high level.

9. Future Research

The following recommendations arise from this study, and would be useful for those who want to do further study and related research:

1) This research was limited to studying GCIS (Geographic Community Information Systems) in the lower northern region of Thailand. Future research should focus on all provinces and districts in Thailand, or other similar and appropriate communities outside Thailand.
2) Presentation of spatial data is limited to information at the Housing Sub-district level of the province only. There was no information available about the spatial location of key information about the community. For those who are interested to conduct research about spatial data should provide important information at the level of the village
3) Presentation of GCIS to support community development should also provide comparisons on an annual basis for development planning to continue.

10. Acknowledgment

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