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Web service system for exchanging latex trading data and predicting latex volume

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Abstract

This research developed an XML- and SOAP-based web service system that exchanges latex trading data with local latex traders in Hatyai District, Songkhla. The traders' programs send their data and receive aggregate results, including the latest average prices and total stocks in the area, via web services. They can also exchange alerts among themselves. Assuming that the system receives daily meteorological conditions via another service connected to the Thai Meteorological Department's system, it employs a decision tree classifier to predict daily latex volume and sends the prediction to client programs. The ability to monitor trading and predict daily latex volume would benefit their business. The system was evaluated by experts in web application development. The results suggested that both the usability of website and the functionality of web services were satisfying.

Keywords: web service, latex trading, latex volume, prediction

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1. Introduction

Para rubber (*Hevea Brasiliensis*) plantation and production is a major economic force in the Southern provinces of Thailand. Rubber planters tap their trees to get white milky substance or latex in the early morning, and sell it during the day. Prices of latex and rubber products are monitored and reported daily by the authorities such as Rubber Authority of Thailand (http://www.rubberthai.com) and Thai Latex Association (http://www.tla-latex.org), as well as private bodies such as http://www.rakayang.net. The prices are categorized into:

1) Average trading prices in local markets and at factories.

2) Auction prices in major Central Rubber Markets including Songkhla, Surat Thani, and Nakhon Si Thammarat.

3) Future prices in major markets including TFEX (Thailand Future Exchange), TOCOM (Tokyo Commodity Exchange), and SICOM (Singapore Commodity Exchange).

Actual trading price of latex depends directly on its concentration and the amount of latex yield in local markets. Big factories may use auction prices as guidelines for their trading and bargaining. Auction and future prices, on the other hand, are affected by factors such as global rubber demand, currency rates, future market speculation, and even oil situation [1, 2, 3].

This research had surveyed latex trading in local markets of Hatyai District, Songkhla. It found that most local traders record their trades in papers. They can hardly share information, except verbally or in small groups, and therefore it is difficult to see beyond their own trading. This leads to disadvantage when bargaining with big factories or middlemen. Although prices and relevant statistics are reported in the aforementioned websites, they are only provincial figures. Being able to monitor trading and predict latex volume in the focused area would be more helpful.

The above scenario motivated the development of web service for exchanging trading data and predicting latex volume. The proposed system consists of front-end web pages showing general information, and back-end services for exchanging data. It uses data mining to predict daily latex volume from meteorological conditions. It is scoped to local trading in Hatyai District, Songkhla. Further details are presented in the following sections. Section 2 explains materials and methods used in this research, focusing on the proposed web service system and the latex volume prediction. Section 3 presents results and discussion. Section 4 draws conclusions and suggests future works.

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Table 1 Services provided by the proposed web service system

Service Name	Description	Communication with Client
(1) Latex price service	Get latex prices from each client	Receive data at least once a day
(2) Latex daily price service	Calculate average price from all data received by service (1). Send the result to each client	Send data at least once a day
(3) Latex buying and reselling service	Get buying and reselling volumes from each client	Receive data at least once a day
(4) Latex stock service	Calculate total stock from all data received by service (3). Send the result to each client	Send data at least once a day
(5) Latex alert service	Get alerts about unusual trading from each client	Receive data throughout the day
(6) Latex daily alert service	Send all alerts received by service (5) to each client	Send data throughout the day
(7) Weather service	Get meteorological conditions from Thai Meteorological Department	Receive data at 1am, 4am, 7am
(8) Latex volume prediction service	Predict latex volume from data received by service (7) and historical data in database. Send the result to each client	Send data after 7 am

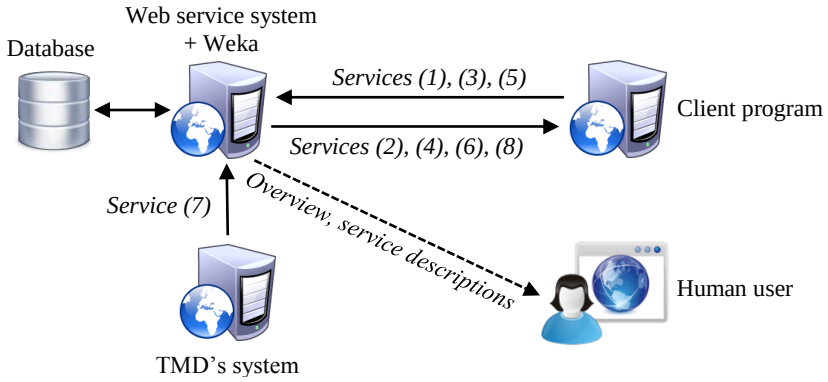

Figure 1 Overview of the proposed system

2. Materials and methods

This research opted for web service model that utilizes XML (eXtensible Markup Language) and SOAP (Simple Object Access Protocol) messaging. It allows the system to exchange data with traders' programs (i.e. clients), assuming that those programs may run on different platforms. Eight back-end services are provided as summarized in Table 1. The system relies on fair exchange. That is, a client must be connected to all 7 services except Weather service, in order to send its own data and receive aggregate results. The Weather service needs to be connected to the Thai Meteorological Department (TMD)'s system. For demonstration purpose, a mock-up program was used instead of the real TMD's system. Meteorological data, reported by TMD, were entered into the mock-up program manually. Then the program passed these data to the web service system via the Weather service.

Illustrated by Figure 1, the system automatically receives latex prices and volumes from each client via services (1) and (3). It calculates average price and total stock, and sends the results back via services (2) and (4). Each client can submit alerts (such as contaminated latex from a certain dealer) via service (5), and all alerts will be sent to all clients via service (6). When and how often a client communicates with the system is upon the agreement of usage in practice. But the current setup is to exchange data about prices and volumes once a day, while alerts can be sent throughout the day. The system also receives meteorological conditions via service (7) at 1am, 4am, and 7am. It calculates daily weather forecast, predicts daily latex volume, and sends the prediction to each client via service (8). The prediction process will be explained next.

The front-end web pages of the system contain service descriptions of all services, terms and conditions for using services, as well as some statistics retrieved from other web sites.

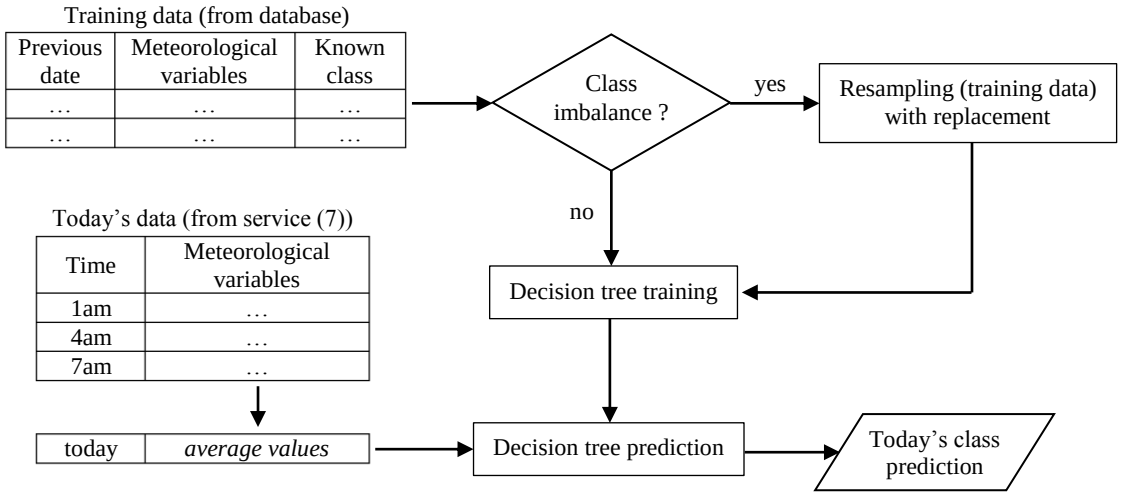

Figure 2 Latex volume prediction service

There have been attempts to predict latex or rubber yields from weather conditions. For example, Rao *et al.* [4] used multiple regression model, Golbon *et al.* [5] used statistic-based classifier, and Lerkmongkolwit [6] used neural network for the prediction. All of them reported high accuracy.

The proposed system receives data from the TMD's system 3 times a day. In each time, the data consist of 9 variables: wind speed (knots), relative humidity (%), vapour pressure (hPa), pressure (hPa), visibility (%), cloudiness (score 0 - 10), rainfall (mm), temperature (°C), and dew point (°C). The values at 1am, 4am, and 7am are averaged for each variable, yielding a record of today's weather forecast.

As shown in Figure 2, decision tree classifier predicts today's latex volume from these 9 meteorological variables. There are 3 class values for the latex volume: LOW (less than 500 kg per trader), MEDIUM (less than 1500 kg per trader), and HIGH (at least 1500 kg per trader). This research could collect real data from only few traders. So as to demonstrate the idea, volume per trader is used instead of total volume. In the training phase, the classifier builds a prediction model, i.e. a decision tree, from records of meteorological variables and known class (determined from the actual latex volume) of previous days. Then, it applies this model to predict today's class.

Reasons for choosing the decision tree classifier are based on preliminary findings of this research [7]. In [7], C4.5 decision tree, neural network (multilayer perceptron), and support vector machine with polynomial kernel were compared. Because the data collected from local traders exhibited severe class imbalance, sampling with replacement was applied in order to adjust the sizes of the biggest and the smallest classes. The adjustment depended on bias factor whose value was between 0 (original distribution) and 1 (uniform distribution). But one side effect was that the classifiers may over-learn the smallest class, whose size was synthetically increased, and ignore the others. Experimental results showed that, out of the 3 classifiers, decision tree was most robust to this side effect and gave highly accurate prediction. On average, its accuracy was over 80% while the F-measure of each class was close to 0.8.

Therefore, prior to the prediction, the latex volume prediction service checks whether the training data exhibit class imbalance. If any class is twice as big as another, sampling with replacement is applied with bias factor 0.5. Then, the service calls J48 of Weka [8] for the decision tree classifier. Results from this service are a predicted class together with accuracy estimated from the training data.

3. Results and discussion

The proposed system was evaluated by 5 experts who had experience in web application development:

1) Evaluator 1 was a senior programmer in a private enterprise.

2) Evaluator 2 was a Chief of Management Information System (MIS) in the computer center of a university.

3) Evaluator 3 was an instructor in web programming in a university.

4) Evaluator 4 was an engineer (professional level) in the computer center of a university.

5) Evaluator 5 was an IT manager in a private enterprise.

Each evaluator was presented with the web service system and a small client program, also developed by this research for testing service connection. Examples of the system's and the client's pages are shown in Figure 3 and Figure 4, respectively.

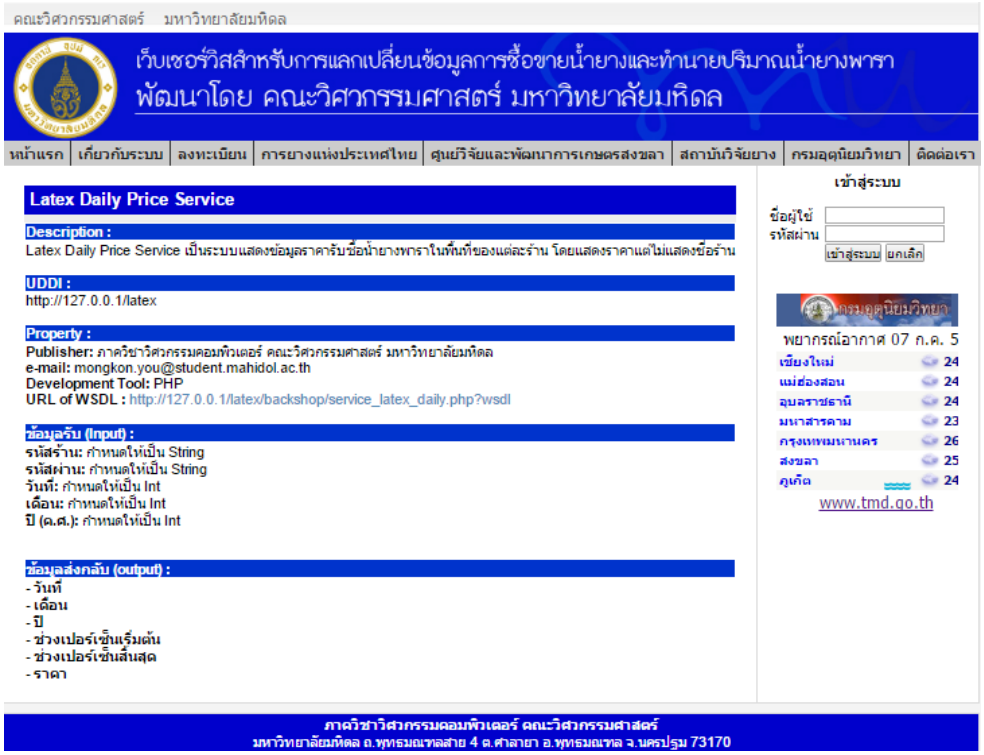

Figure 3 Proposed system showing the description of latex daily price service

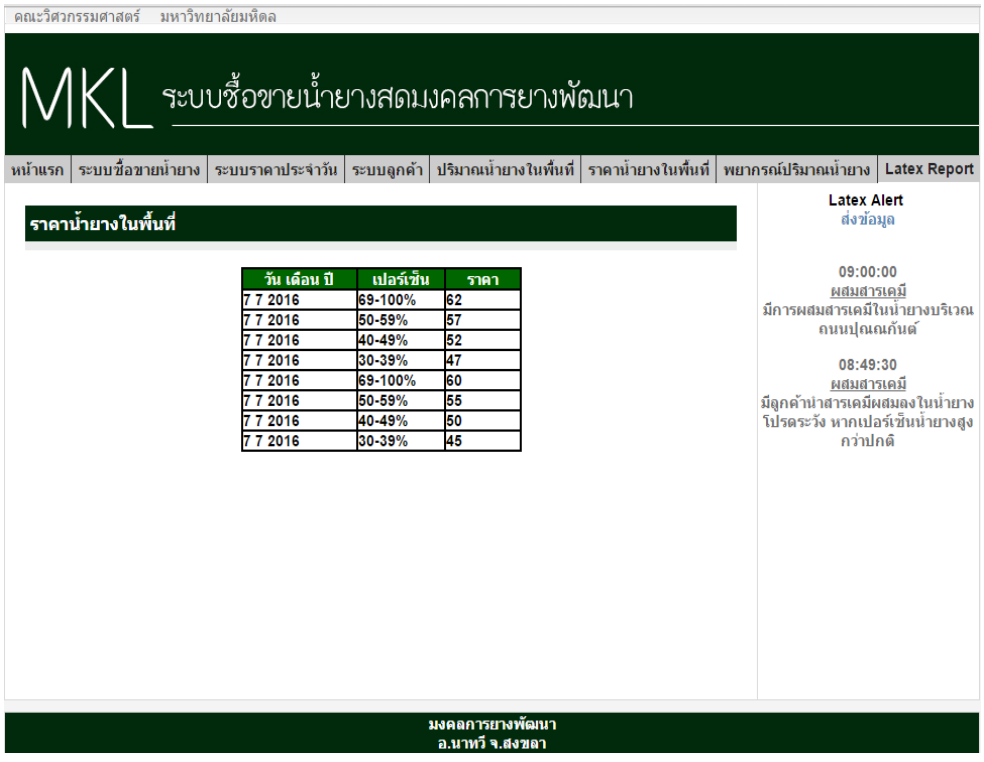

Figure 4 Client program showing data received from latex daily price service and alerts received from latex daily alert service

Table 2 Summary of evaluation results

Criterion	Average Score	Standard Deviation
1. Usability of website		
1.1 The website is easy to access	4.20	1.905
1.2 Fonts are clear and easy to read	3.80	0.837
1.3 Color scheme is appropriate	4.00	0.707
1.4 Images in the website are appropriate	3.80	0.447
1.5 The provided information is sufficient	3.80	0.837
Average	**3.92**	**0.573**
2. Functionality of web services		
2.1 Terms and conditions for using web services are clear	3.60	1.140
2.2 Service descriptions are easy to understand	3.80	1.095
2.3 The provided services are sufficient	4.00	0.000
2.4 Service processing is fast	4.00	1.000
2.5 Results from web services are accurate	4.20	0.837
2.6 Results from web services are useful for business	4.60	0.548
Average	**4.03**	**0.691**

Two aspects of the system were evaluated: the usability of website, and the functionality of web services. Each criterion was rated one of the following scores: (1) very poor, (2) poor, (3) neutral, (4) good, and (5) very good. Results are summarized in Table 2.

Overall, the usability of website and the functionality of web services were both satisfying. There were some feedbacks concerning the presentation of terms and conditions for using services and the clarity of service descriptions. Modifications were made accordingly, and the system's complete version is as shown in Figure 3. Another feedback was about tightening up web service security. But this required much extension, and thus was left for future works.

It should be noted that the proposed system does not interact directly with local traders. It only provides services that will be called by the traders' programs. The web development experts were asked as if they were to develop these programs, but they may not fully understand the traders' requirements. It would be helpful to also get evaluation from the traders or developers who develop the real traders' programs.

4. Conclusions

This research developed a web service system to exchange latex trading data with local traders in Hatyai District, Songkhla, and predict daily latex volume from meteorological conditions. The XML- and SOAP-based implementation enables the system to communicate with the traders' and the Thai Meteorological Department's programs that may run on different platforms. It helps the traders monitor the latest average prices and stocks in the focused area, as well as exchange trading alerts among themselves. Moreover, daily latex volume prediction can help them plan for trading and bargaining.

Possible extensions to this system are as follows. First, the system should provide services for multi-level data exchange. Average price and total stock can be calculated in district, province, region, and country levels. Trading alerts can be grouped or expanded. Besides the total stock, the system can calculate demand and supply upon receiving buying and reselling data from the client programs.

Second, there should be data exchange schemes to ensure cooperation from traders. For example, a client will receive aggregate results only after submitting its own data. Security support may be needed to authenticate the client and authorize it for using any service. From a non-technical point of view, though, it would help if the traders see the benefit of cooperation.

Finally, the growing popularity of mobile websites and applications makes lightweight JSON (JavaScript Object Notation) more favourable than unwieldy XML messaging [9]. Adding JSON-based services or support would enhance the interoperability of the system.

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