GreenEve2Peace: An Advising and Scheduling Management Platform for Farming Community

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Abstract: - Advising farmers and managing schedules of farming activities by Muda Agricultural Development Authority (MADA) are manually done by publishing notices on notice boards for each area. MADA staff also broadcast farming scheduling information to farmers using mobile loud speaker while driving through each area. Currently, farmers depend on weather forecast information such as local weather websites, and TV and radio weather forecast for planning of farming activities. Weather forecast is important to farmers because adverse weather conditions would affect the farming activities. Currently, no computerized support application that can replace the manual method of helping the farming community to manage their daily farming activities and provide accurate weather forecast information is available. Our proposed platform, GreenEve2Peace is designed to advise farmers on paddy planting activities as well as to manage farming activities by providing inexpensive and fast delivery of information to farmers.

Key-Words: - communication, decision making, short messaging services technology, scheduler management

1 Introduction

Decision making in paddy planting activities has always been a main concern for the paddy farmers besides the pests. This is due to the fact that extreme weather conditions [1] such as prolonged drought and excessive moisture would badly affect the quality of grains and crops production. Sometimes, paddies with high quality seeds are all washed away and damaged in the event of heavy downpour. Therefore, it can be deduced that the quality of the grains is affected by the weather conditions as bad weather such as heavy rain [2, 3] or thunderstorm would increase the difficulty in harvesting as well as damage the crops. Furthermore, there is a shortage of rice supplies in recently due to low production of paddies. This problem is indirectly caused by the problem of unpredictable weather forecasts.

GreenEve2Peace is a project in collaboration with Muda Agricultural Development Authority (MADA). The functions of the authority are:

- To promote and undertake economic and social development in the Muda area.
- To plan and undertake within the Muda area, agriculture development as may be assigned to it by the states of Kedah and Perlis in Malaysia.

Currently, MADA uses a conventional way of delivering information to farmers such as by informing the head of the units, pinning up posters on notice boards and broadcasting information using an amplifier. The information includes farming activities such as registration activity and matters regarding information on subsidised fertilizers and seeding period. A few problems have arisen from such practices such as not all farmers receive the information on time, farmers tend to forget about the activity and it takes some times to deliver the information.

The motivations for the development of this platform is the rise in the price of the staple crop by as much as 70% in 2008 according to the UN Food and Agriculture Organization (FAO) and the price continues to increase rapidly in recent weeks. Shortages have begun to hit some rice-importing countries. Factors contributing to the hike in the price include poor harvests as a result of extreme weather condition, a rise in demand in some rice-importing countries, the expectation of further price increase, low stockpiles and lack of agricultural investment.

The main goal of the proposed GreenEve2Peace platform is to help the farming communities so that information is received at the right time and wise decision is made in managing their paddy planting activities and harvesting time. Relevant information and suggestions on a proper schedule for farming activities need to be provided. Therefore, the objectives of this platform are:
To help farmers in managing their farming activities by providing the right information directly to farmers using text messages.

To advice farmers in making better decisions on farming activities based on weather forecast information through text messages services and website.

To reduce the risk of fertilizing or seeding the paddy at the wrong time and location.

To increase the percentage of rice production by minimizing the unexpected risk such as bad weather condition, insects and plant diseases.

GreenEve2Peace collects the weather information from various sources and intelligently forecasts the weather condition based on the collected weather information a few days in advance [4]. Based on the forecasted weather information, the system administrator will automatically generate an advice and broadcast the information to the farmers of a specific area via text messages services (SMS) [5,6]. The farmers can then decide on a suitable day to perform the farming activity.

2 Technical Background

This section introduces a few algorithms and messaging technologies which are to be integrated into GreenEve2Peace.

2.1 Artificial Intelligence Algorithms

A suitable computational intelligence algorithm is required to compile a set of forecasted data and to obtain the nearest best result for farming activities. Hence, this algorithm must be able to select the best possible result and make decision on the result to be achieved. Four types of computational intelligence algorithms were evaluated for this project:

- Neural Network Algorithm
- Swarm Intelligence
- Fuzzy Logic
- Genetic Algorithm

Neural network algorithm was chosen as the algorithm to be used in the implementation of this platform since it can compare the patterns in the data, calculate the outcome of the result and minimize the error [7].

2.1.2 Swarm Intelligence

Swarm intelligence (SI) is an artificial intelligence technique based on the collective behavior of decentralized and self-organized systems. SI systems are typically made up of a population of simple agents interacting locally with one another and with their environment. The agents follow very simple rules and although there is no centralized control structure that dictates how individual agents should behave, local interactions between such agents lead to the emergence of complex global behavior [8].

2.1.3 Fuzzy Logic

Fuzzy logic is a form of multi-valued logic derived from fuzzy set theory that deals with reasoning which is approximate rather than precise. Just as in fuzzy set theory, the set membership values can range (inclusively) between 0 and 1. Besides, the degree of truth of a statement can range between 0 and 1, and is not constrained to the two truth values {true, false} as in classic predicate logic. When linguistic variables are used, these degrees may be managed by specific functions [9].

2.1.4 Genetic Algorithm

A genetic algorithm (GA) is a search technique used in computing to find exact or approximate solutions to optimization and search problems. Genetic algorithms are categorized as global search heuristics. Genetic algorithms are a particular class of evolutionary algorithms (also known as evolutionary computation) that use techniques inspired by evolutionary biology such as inheritance, mutation, selection, and crossover (also called recombination) [10].

2.2 Messaging Technologies

An evaluation is performed for the purpose of deciding whether to use GSM Modem or GSM Mobile Phone to connect to the SMS gateway in the platform. Table 1 shows the comparison between GSM Modem and GSM Mobile Phone.

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<tr>
<th></th>
<th>GSM Modem</th>
<th>GSM Mobile Phone</th>
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<tr>
<td>High cost</td>
<td>Moderate price</td>
<td></td>
</tr>
<tr>
<td>Complicated to use</td>
<td>Easy to use</td>
<td></td>
</tr>
</tbody>
</table>

This devices can be used to broadcast information to the farmers in the forms of advises and suggestions to optimize the paddy farming activities.
3 Implementation Plan

Based on a discussion with the manager for MADA C-IV area, the text messages (SMS) service for the community is the most important service and needed urgently. The SMS service can be used by MADA to deliver fast information on paddy planting activities to the right farmers at the right area. There are 12 units (areas) in C-IV area and approximately 2000 farmers will benefit from this project.

The prototype of the platform was completed in April 2009 and was introduced to MADA in July 2009. This platform was presented to the farmers as a pilot test in April 2010. GreenEve2Peace is expected to be fully deployed in the following season this year (around April 2011). The followings are the implementation steps:

1. Enhancement and modification of the platform to suit the local requirements by MADA and farmers. This step involves:
   i. Modifying an interface of the current prototype to suit the level of computer knowledge of MADA staff and farmers
   ii. Modifying the current prototype to comply with the current computers/hardware and operating systems that are available at MADA/C-IV area

2. Setting up the platform for the farming community and MADA staff. Due to the lack of facilities in MADA and the C-IV area, the platform will be installed and hosted in the School of Computer Science in Universiti Sains Malaysia (USM). As such the followings are required:
   i. Special equipments such as server and text messages gateway
   ii. Fee for text messages service for 18 months

3. Conducting training to selected farmers and MADA staff on the platform.

4. Launching ceremony.

   The purpose of the launching ceremony is to create awareness among the public especially the farming communities with regard to the proposed solution. USM will be the first university in Malaysia which provides this service to the farming community.

   The platform monitors and manages farming activities for the benefit of the farmers and MADA staff. An interview session or survey with the farmers and MADA staff will be conducted a few months after the implementation of the platform in order to gain feedbacks from the related parties on the effects and benefits of GreenEve2Peace.

4 GreenEve2Peace Platform

GreenEve2Peace focuses on farmers working in paddy fields. This system assists farmers using both online and offline applications in solving various problems that may affect their farming activities. Online application refers to a web-based application in which farmers can retrieve the required information such as farming scheduling information through a web browser. Furthermore, the online application also provides the location of paddy fields in each area through a map.

In the offline application, an administrative monitoring system retrieves the weather forecast information from various sources of weather information websites. The system will intelligently decide on the prospect of weather condition (e.g. the possibility of raining) and broadcast the weather information to the farmers through text message services (SMS). Text message services are chosen as a medium to deliver the information as cell phones are widely used within the farming community in Malaysia. It is also the most powerful medium and easiest way to communicate. The system provides two-way communication between the farmers and the administrative monitoring module. The administrator will also provide scheduling information on farming activities for a particular season to the farming community for each area. Farmers will be informed on the activities at the correct and suitable time. Moreover, farmers can inform MADA on problems such as paddy diseases and insect attacks through text message services (SMS). Then, MADA can take appropriate action such as informing immediately the affected farmers on the problem and giving an appropriate advice to the farmers pertaining to the problem. For example, MADA will advice on a suitable pesticide/herbicide to fight certain disease.

GreenEve2Peace consists of four main modules namely SMS Broadcast Information module, Weather Forecast module, Data Scheduler module, Admin Monitoring module. Figure 1 shows an overview of GreenEve2Peace application and Figure 2 shows the architectural design of GreenEve2Peace.
Web-based application is further divided into Online Data Schedule sub-module and Weather Forecast Viewer sub-module. The Online Data Schedule sub-module handles the function that allows MADA administrator to manage farming schedule through the websites. The Weather Forecast Viewer sub-module handles the display of weather forecast information for a particular day and time.

Figure 3 shows the overall system modules for GreenEve2Peace and the modules are as follows:

- **Interface** – This module provides the interfaces of all the modules in GreenEve2Peace. Every single module in GreenEve2Peace has their own interface and these interfaces define this module.

- **Weather Forecast** – This module is concerned with the retrieval of weather forecast information from various sources as well as using an Artificial Intelligence (AI) algorithm to process the information and produce accurate weather forecast information.

- **Data Scheduler** – This module is concerned with firstly the production of a summary report based on the weather forecast information from the weather forecast module and the farming activities information for a particular season from the MADA website. Then, based on the information, it will generate an advice to the farmers and then trigger text messages broadcast module in order to send the information to the farmers of the specified area.

- **SMS Broadcast** – This module is concerned with firstly the creation of an SMS database server which stores all the messages that include the in-coming messages from the farmers and the messages that are going to be sent to the farmers. Next the messages which are going to be sent to farmers will be broadcasted via SMS.

- **Admin Monitoring** – This module consists of two primary interfaces, namely login interface and centralized interface. The login interface prompts the user for password and username for access to the second interface, which is the centralized interface. The centralized interface, on the other hand, integrates all other modules and provides a platform for the user to view and maintain them.

**Fig. 3. Overall System Module**

The followings are the hardware and software requirements for this platform:

a) **Hardware**
- Basic text message gateway
- Low-cost server

b) **Software** (see Figure 4)
- Visual Studio 2008 (C#)
- Microsoft SQL Server 2008
- Silverlight platform
- Zam3D
- Window Presentation Foundation (WPF)

**Fig. 4: Software Used**

**5 Discussion and Evaluation**

This section discusses the comparison of the features offered by GreenEve2Peace with other
solutions. The aim of the comparison is to show how GreenEve2Peace contributes to the niche area. The other solutions included in the comparison are E-Paddy [12], SPA and RC-Mail Msg. The comparison shows that the features in GreenEve2Peace support all criteria and are suitable for the farming community in Malaysia by taking into consideration the affordable cost, the level of IT knowledge and the ease of use of the platform.

There is a service in Japan called “rain cloud mail messaging” alert service [13] which alerts the subscribers to this service of the impending bad weather condition via mobile phones. Dubbed as real-time weather forecasts for mobile phones, this service keeps the users notified of the bad weather based on the location as well as the degree of the rain clouds provided as the input. The subscriber to this service will have to pay monthly service charge of about $1 to subscribe to those services. Meanwhile, those users with GPS mobile phones can take advantage of the new service that offers a rain forecast in 10 minute intervals based on the user’s current location. Table 2 describes the advantages and disadvantages of “rain cloud mail messaging” alert service.

| Table 2: Advantages and Disadvantages of “Rain Cloud Mail Messaging” Alert Service |
|----------------------------------|----------------------------------|
| **Advantages**                  | **Disadvantages**                |
| This system forecasts the       | This system cannot predict       |
| weather condition in real-time. | the weather condition a few      |
| Therefore, it is more           | days in advance.                 |
| accurate.                       |                                  |
| Users will be notified via      | This system might not be         |
| SMS. Therefore, it is very      | suitable for farmers although it |
| convenient to the users          | provides real-time weather       |
| since nowadays mobile phone is   | forecast because farmers might   |
| quite affordable in terms of     | not have enough time to do       |
| price.                           | necessary preparation.           |
| The system can only alert       |                                  |
| on the rain. Therefore, it is   |                                  |
| not very useful for farmers      |                                  |
| as rain is only one of the      |                                  |
| many elements that can          |                                  |
| damage the crops.               |                                  |

Based on our review of the three (3) existing systems, we incorporate all their features into our proposed platform so that a solution with high scalability and robustness can be developed. Table 3 distinguishes the features provided by the existing systems and GreenEve2Peace.

<table>
<thead>
<tr>
<th>Table 3: Systems Comparison</th>
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<tbody>
<tr>
<td><strong>Features</strong></td>
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<tr>
<td>Daily Schedule Management</td>
</tr>
<tr>
<td>Instant Messaging</td>
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<tr>
<td>AI Decision Making</td>
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<tr>
<td>Feedback based on user</td>
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<tr>
<td>request</td>
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<tr>
<td>Share information</td>
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<tr>
<td>Weather Forecasting</td>
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6 Challenges and Lessons Learned

There are a number of challenges encountered in introducing the platform among the farmers. Although mobile phones are extremely successful as communication tools, the wider usage of mobile community support systems is still an exception. From the farmer’s point of view, complicated user interfaces, quality of the content and significant privacy concerns have been major barriers for broader acceptance. Some early versions of mobile community report systems were simply ported to mobile devices and realized as SMS based communities.

However, the porting of desktop systems to mobile devices can only be successful if the offered mobile community services take into account of the specific features of the device. Small screen size, memory limitations, reduced processing power, limited battery life time and low bandwidth connections have to be considered for the design of mobile community services.

7 Conclusion and Future Work

We can conclude that based on our experience GreenEve2Peace has the potential in providing an m-community infrastructure that is instant, cheap and fast among the members.

GreenEve2Peace uses SMS based commerce platform as a medium for conducting mobile activities rather than the wireless data channel used by Internet browsers and data services. GreenEve2Peace services can be provided to any users who possess a mobile phone because it is not dependent on any telecommunication providers.

In future, we hope to improve the services provided by GreenEve2Peace so that it can be used by a wider range of users. Besides, we would also like to enhance the current algorithms in order to provide better
accuracy in attaining the best paddy harvesting and planting time for farmers.

8 Acknowledgement
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