Web Based Agricultural Irrigation Scheduling System for Batticaloa District

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Abstract— *Agrarian Services Centre (ASC) is one of the Government organizations which is located in the Vantharumoolai, Batticaloa district. ASC plays an important role in maintaining sustainability of agriculture by ensuring the cultivation in the cultivatable land according to the acts of agricultural ministry, helping farmers in irrigation water management, guiding the cultivation program according to the annual cultivation schedule and to helping farmers in obtaining loans from rural banks for agricultural production. In Agrarian Services Centre in Vantharumoolai, they do not have any meteorology related system to help the farmers who are cultivating the crops in Batticaloa District. Due to this reason farmers were facing several problems related to their cultivation or agronomic practices (especially during irrigation) throughout their cultivation period. Thus farmers cannot get high yield at the end of their cultivation in Batticaloa district. Therefore this web based system (Agro Meteorological Indicator) will provide daily and monthly updated meteorological information such as Air Temperature, Relative Humidity, Rainfall pattern, Evaporation rate, Crop water requirement and Irrigation Schedule. Unified Modelling Language (UML) was used for analysis and design. Hypertext Pre-processor (PHP) which is a server-side scripting language was used to build the system and Apache has been used as the web server, meanwhile MySQL was used to handle databases. Since this is a web based system, it could be operated in Windows environment. The web based Agro Meteorological Indicator was designed to fulfil the user and system requirements. The system will help to farmers can do their agronomic practices according to the information provided by this system. Therefore farmers can get high yield and high agricultural productivity. It could also help the ASC administration to work efficiently.*

Keywords— **Agrarian Service Centre, Meteorology, Irrigation schedule.**

I. INTRODUCTION

Agro meteorology is the study and use of weather and climate information to enhance or expand agricultural crops and/or to increase crop production. The crop water need (ET crop) is defined as the depth (or amount) of water needed to meet the water loss through evapotranspiration. Global population is expected to increase by about 30% by the year 2030, and as a result, demand for food will increase (FAO, 2000). Major constrains to meet the increasing food demands of the population, irrigation water and land scarcity (Ali, 2008). A possible approach to overcome constrains could be through improving performance of adopted irrigation systems or introductions of better ones. Owing to practical difficulties in obtaining accurate field measurements for ET_C prediction methods are commonly used. However, these methods often need to be applied under climatic and agronomic conditions different from those under which they were originally developed. Testing the accuracy of the methods under a new set of conditions is laborious, time consuming and costly. To overcome such difficulties, guidelines were formulated by FAO to calculate ET_C of crops under different climatic and agronomic conditions (Teare and Peet, 1983). Nevertheless, to calculate ET_C, the effect of the following factors should be determined (Doorenbos *et al.*, 1986). The main objective of the project is to develop a web based system to increase the agricultural production in Batticaloa district.

A. The effect of the crop characteristics on crop water requirements

Crop coefficient (KC) presents the relationship between reference (ET0) and crop evapotranspiration (ETC). The value of crop coefficient (KC) varies with crop type, developmental stage and prevailing weather conditions. ETC relates to ETO and KC as follows (Doorenbos *et al.*, 1986),

$$ETC = ET0 \times KC \quad (1)$$

The equation offers a mean value for ETC in mm per day over a specific period of time. ETO could be calculated from (Doorenbos and Pruitt, 1977) version of Penman equation, known as Penman modified formula, as follows,

$$ET_0 = C\,[w.\,Rn + (1\text{-}w).\,f\,(u).\,(ea - ed)] \quad (2)$$

Where:

ET_0 = reference crop evapotranspiration (mm/day)

C = adjustment factor

w = temperature related weighting factor

Rn = net radiation in equivalent evaporation (mm/day)

f(u) = wind related function

ea = actual vapor pressure at mean air temperature (mbar)

ed =saturation vapor pressure at mean air temperature (mbar)

II. METHODOLOGY

A. Fact Gathering Techniques

Multiple techniques were employed here to capture requirements from different stakeholder perspectives. The main methods used for fact finding process were interview and document review. Meteorological data were collected from the Meteorological Department, Sri Lanka.

B. Methodology for the proposed system

Among all other software development methodologies, the waterfall model was selected as the process model by considering a lot of advantages. According to existing systems, documentation, some of reference books and websites related with system scope, this system was developed by using Penman equation and Penman-Monteith method (Fao, 2015; CropWat, 2015; FAO. 2008; Introduction to crop evapotranspiration, 2015; FAO Penman-Monteith equation, 2015).

C. Selection of web based system

There are some reasons to choose the Web Based System. The main reason is frequently updating of weather data is necessary to measure and estimate the meteorological information and Crop water requirement.

D. Design Techniques

Design techniques are the methods used to model the solution domain. Among that Object Oriented design technique was chosen out of them for the main design concepts. Unified Modelling Language (UML) plays an important role in Object Orientation. Different diagrams were designed to develop the software such as use-Case diagrams, class diagrams, sequence diagrams, activity diagrams and database diagram.

E. Overall use-case of the proposed system

Fig 1. shows the overall use case diagram of this system. It is consists of three actors such as Server, Operator and Admin.

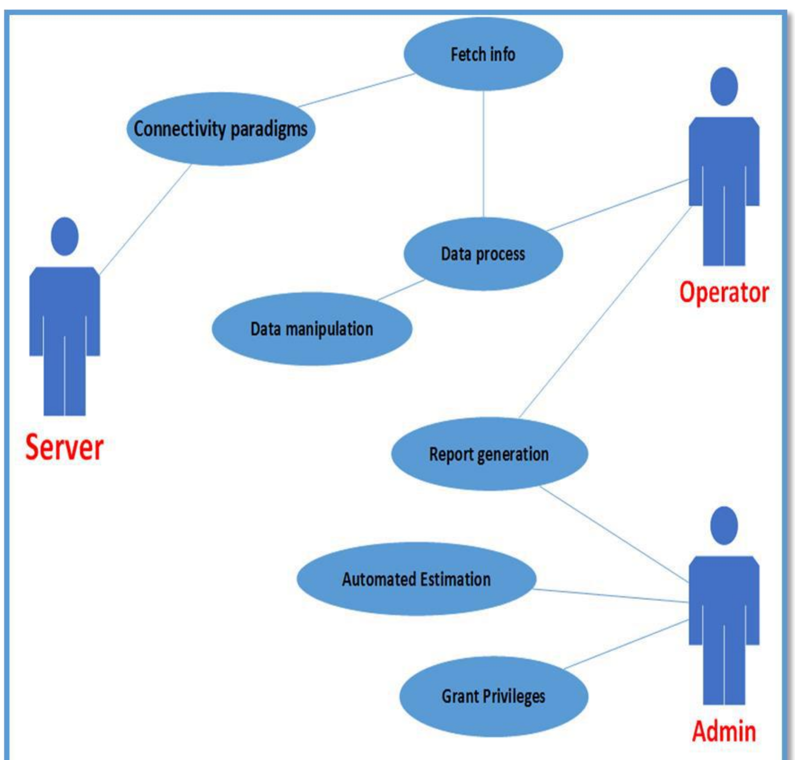


Figure 1. Overall Use case diagram

F. Database diagrams: Fig 2. shows the Database diagram of this system.

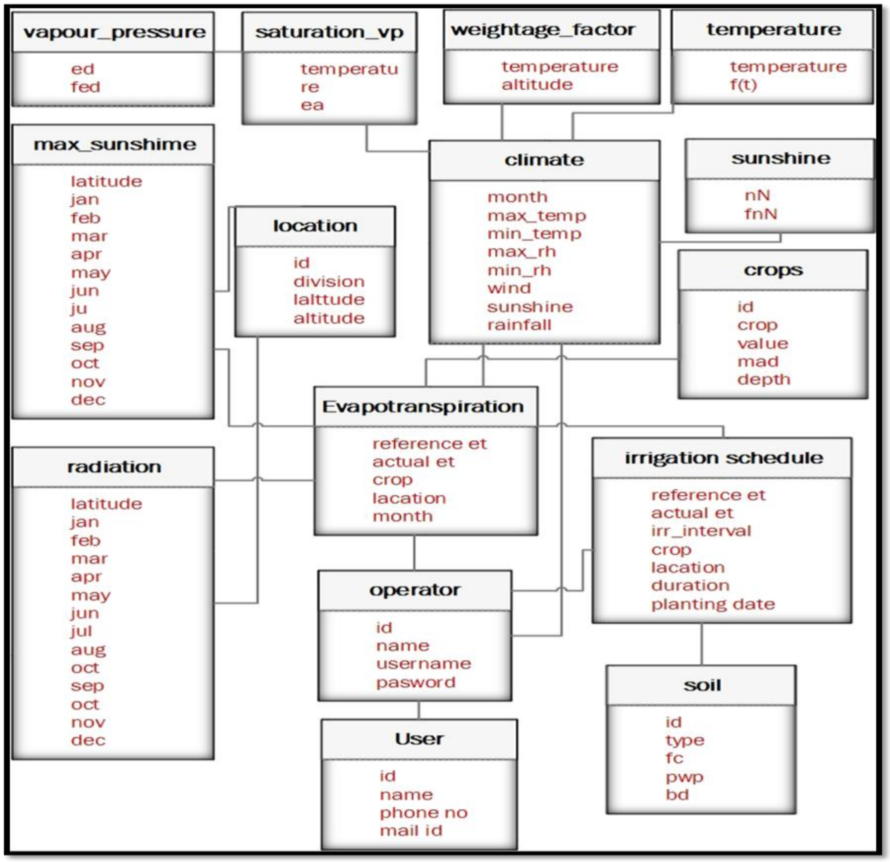


Figure 2. Overall database diagram

G. Class diagram of the system Fig 3. shows the overall Class diagram of this system

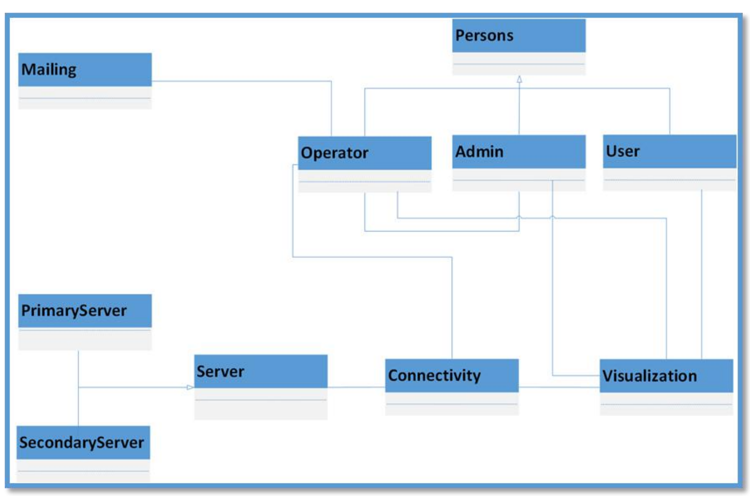


Figure 3. Class diagram of the system

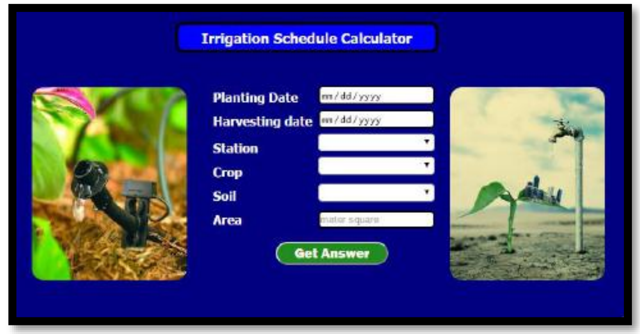


Figure 4. Home page of the system Figure 5. Irrigation schedule calculator form (Default value)

H. Implementation

I. Hardware and Software Requirements:

Software: Microsoft Windows 7 or 8 Operating System, Web Browser (Google Chrome), WAMP server 2.4 and Notepad ++ (Editor)

Hardware: Internet connection, Core i5 Processer and 500GB Hard Disk with 4GB RAM or up

II. Development Tools and Technologies:

PHP, MySQL, CSS, JavaScript, J-Query and Weather widgets

I. Testing

Software testing is performed to verify that the completed software package functions according to the expectations defined by the requirements/specifications. The overall objective to not to find every software bug that exists, but to uncover situations that could negatively impact the customer, usability and/or maintainability.

J. Types of Testing:

Unit testing, Integrated testing, Validation testing, Output testing, User acceptance testing and Unit testing

III. RESULTS AND DISCUSSION

A. Home Page

The home page interface which is displayed by fig 4.This home page consists of seven main menus with several sub menus. Among all this menus Crop water need menu and Irrigation schedule menus are very importance menus to fulfil the scope of the system. Addition to that this page has Google search engine link to get many ideas about meteorology, crop water need, and irrigation schedule etc.

B. Irrigation schedule calculator form (Default value)

Fig 5. represent the Irrigation schedule calculator form which has five selection boxes. This form is used calculating the irrigation schedule for particular crop, location, and soil type, planting date and harvesting date when farmers do not know the values of monthly average climate.

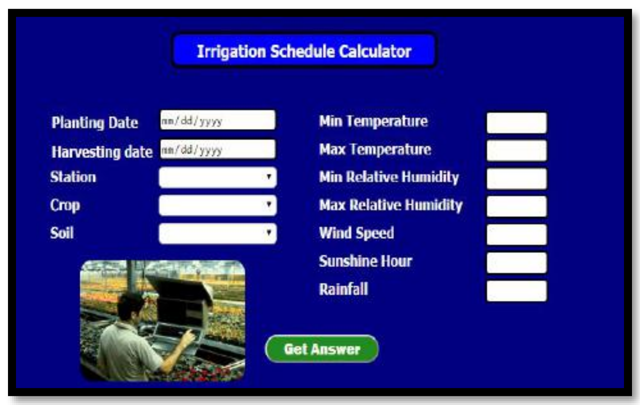


Figure 6. Irrigation schedule calculator form (Known value)

C. Irrigation schedule calculator form (Known value)

Fig 6. represent the Irrigation schedule calculator form which has five selection boxes with seven fields. This form is used calculating the irrigation schedule for particular crop, location, and soil type, planting date and harvesting date when farmers do know the values of monthly average climate.

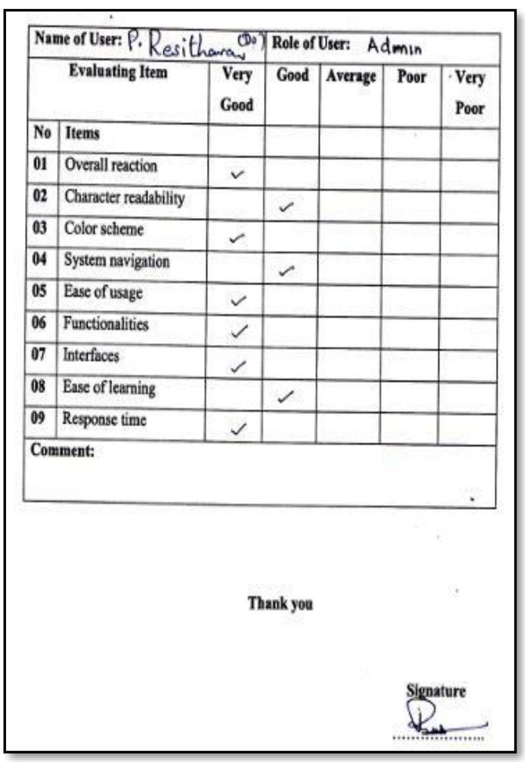
D. Irrigation schedule answer screen

Fig 7. represent the Irrigation schedule answer screen which display the particular month, station and crop and which display the daily actual crop evapotranspiration for onth, station and crop and soil type based on monthly climate data.

E. Test case for Irrigation schedule Calculator (Default value)

Table 1. Test case for Irrigation schedule Calculator

No	Test case	Expected output	Actual output	Status
1	Select all 5 option fields	Go to evapotranspiration answer form	Go to evapotranspiration answer form	Pass
2	Select only 4 or 3 or 2 or 1 option fields	Alert message "Select all fields"		Pass



Name of User: P. Resitharan (Dr)		Role of User: Admin				
Evaluating Item		Very Good	Good	Average	Poor	Very Poor
No	Items					
01	Overall reaction	✓				
02	Character readability		✓			
03	Color scheme	✓				
04	System navigation		✓			
05	Ease of usage	✓				
06	Functionalities	✓				
07	Interfaces	✓				
08	Ease of learning		✓			
09	Response time	✓				

Comment:

Thank you

Signature

Figure 8. User evaluation questionnaire form

particular month, station and crop and net irrigation requirement as well as irrigation interval for particular m

Figure 7. Irrigation schedule answer screen

F. User evaluation

After implementing the system it was tested in the client environment to get the user acceptance testing. The system was tested by the client to identify the functionality provided by the system, whether it can satisfy the operational needs of the organization. After completing the user acceptance testing, a positive response was received from all the users requesting for minor modifications. With the newly developed system the organization could function efficiently and smoothly rather than continue using the old method, the client stated. According to the user evaluation, this system was accepted by the organization. Feedback and questionnaire format is show in the Fig 8.

IV. CONCLUSION

The proposed computer model offered a simple and effective tool for calculating irrigation schedule using the modified Penman equation. It estimates irrigation requirements for crops i.e., Field crops, vegetable and fruit crops, for different time intervals for daily and monthly. It uses long-term historical climate databases of daily ET and rain, from different locations to calculate daily water budgets of the crop root zone. Through this system farmers can get climatic data and forecasting weather data by email or hardcopy from Agrarian service centre. Along the various stages of this project, whatever work done, was checked along with the client requirements to make sure that those requirements have been addressed during those phases. This constant checking with the requirements made sure that the developed system met the goals and objectives that were devised at the beginning of the project. By reviewing the functional and non-functional requirements that were discovered during the analysis phase and checking back with the functionalities implemented in the developed system, it can be said that all the requirements of the user have been satisfied. The simple and intuitive user interface that was designed and developed was easy to learn and use proved to be satisfactory for the user. Furthermore working on the project helped me to improve technical skills as well as intellectual skills by collaborating with many individuals from collective fields. The system could in the future be connected to all Agrarian Service Centres with additional functional and non-functional requirements. In future application can be sent online with agricultural people, this will be more effective and efficient method for getting good agricultural productivity to farmers.

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