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Developing a Solar Calculation System

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Abstract. There is rapid increase in global warming over the years. This follows with continues campaign on reducing the energy consumption and protecting the earth against climate change. The Feed In-Tariff (FiT) program was made to encourage people to use renewable energy. The calculations of solar are based on equations from astronomical algorithms, by Jean Meeus. The sunrise and sunset results are theoretically accurate to within a minute for locations between +/- 72° latitude, and within 10 minutes outside of those latitudes. Owing to the depended of solar energy, due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary from calculations; this project is intended in developing an online application system to help the users in making a decision about installing a solar photovoltaic system. This system will help the user to calculate the size of solar system that users should use, the size of solar panel that a user should install, the amount of electricity generated from the system and the profit that user will gain after a few years in implement solar system in their premises or houses.

Keywords: renewable energy, solar PV, solar calculator.

Introduction

Traditionally designing and building a solar greenhouse is aimed at utilizing solar energy [1-4]. Fossil energy is the main source to produce electricity for all Malaysian users. Fossil energy is rising in price but still people use it. Renewable energy source can help reduce the price. There are a lot of renewable energy in Malaysia such as biomass, biogases, solar and many more. FiT is introduced to encourage Malaysians to use renewable energy [5]. Even though FiT has been introduced, most people still depend on fossil energy. This is because people do not know the benefits of having solar energy in their daily life. There are several things that user should know when dealing with fossil energy; money and resource. Knowledge about solar energy and its benefits are the main problems in encouraging people to use solar energy. The government already suggested Malaysian people to transform from using fossil energy to renewable energy (solar energy) in order to decrease their burden and gain some profits from it. There are 5 major problems which include [6]:

- Lack of knowledge about solar energy.
 - Financial problem to implement solar panel.
 - Solar energy is still rare and not so many people used it.
- Benefits and weaknesses of solar energy still not clear.

It has been a problem when people want to use the solar energy as their alternative energy but they do not have the knowledge about it. The government already suggested Malaysian people to transform from using fossil energy to renewable energy (solar energy) in order to decrease their burden and gain some profits from It [6]. Without knowledge and understanding about the benefits of solar energy, the transformation cannot be done. However, if they still have knowledge about

solar energy, this system can be realized in order to help them and guide them to gaining information about solar energy. This system is not only to decrease the bill payment but also give profits to them in certain years after installation. As the conclusion there are 5 major problems that will be stated which are:

- Lack of knowledge about solar energy.
- Financial problem to implement solar panel.
- Solar energy is still rare and not so many people used it.

Benefits and weaknesses of solar energy still not clear. The objectives of this project are:

- To give the bright picture about the benefits of solar energy.
- To promote solar energy as main source energy in producing electricity.
- To give user gaining some profits from solar panel installation.
- To encourage people to use green technology.
- To reduce the cost of electricity (fossil energy) bill payment.

This system has its own focus and target. It is can be implement by gaining some information from certain trusted agency that expertise in this field in order to has confidentiality, integrity and accountability (CIA) through the system. The limitation and the scope of this system only can be clearly seen by looking at the community that will use it.

Related Works

There are many existing online solar calculator system around the world especially in European country like United States of America and Australia. The existing system give the same basic function such as to calculate cost of electricity, energy data and etc. There are several advantages that user can get the online solar calculator system. One of the advantages is user can calculate values for the solar panel system. For the purpose of this research, the researcher selected five similar systems. The advantages for this product are that it is easy to understand, predictable and use. The interface is simple and not messy. The interface is the best compared to the other systems. The disadvantage of the system is that it is only for Australian use [6].

The advantages of this solar energy calculator are that it provides an easy to understand interface. The website also provided a description on the left hand side of the calculation form. The calculation needs just a few inputs from the users to estimate the users' solar energy cost for their usage. Somehow this calculator seemed a little more reliable than the previous one, done by Green Energy Trading Australia [7]. The disadvantage of the system is that it is only for United States residents.

This solar calculator made by the Minnesota Department of Natural Resources is a quite detailed system or product. The advantages are, it enables calculation and view of the cost used within a time frame and that a graph is provided to allow users to clearly view their solar energy usage within that provided time frame which shows greater detailed information compared to the other systems. It would allow users to be careful with their usage of the reusable energy [8]. The disadvantage of this system is that it only works for Minnesota residents only.

This is a locally made solar energy calculator. The advantages of this system are it can be used internationally, it is easy to understand and use, it provides options to not enter some information if the user doesn't know them and no registration is required to use the system. This system is the most practical compared to the other systems. The disadvantage of the system is that it is a little dull regarding the interface [9].

Advantages of this system are that it is easy to understand and not so many particulars have to be given, it can be used internationally and that it doesn't require users to register before using the calculator. The disadvantage of the system is that it requires some complicated data for the input such as the degrees of the solar panel that is fixed to the ground and not forgetting some technical jargon that might not be understandable by some normal people [10]. This system is somewhat slightly difficult to deal with compared to the other systems.

Development Approach

The proposed system is developed using the rapid prototyping development cycle. The system will be divided into administrator's view and customers' point of view. However, both parties will have the same view except the register list and delete functions that can only be viewed and used by an administrator.

Table 1. Requirement of the Specification

Requirements	Descriptions
Administrator	Admin can add, modify and delete the data on the system and change the coding if necessary.
User	User can read all the information stated on the website, use the solar calculator system by add some value on it and view the result.
Calculator	User can enter their electricity usage here and calculate the appropriate size of the solar panel that they have to install, as well as to calculate the profits they can earn from selling the energy and
Calculation Result Form	This page will show the results based on the data provided in the calculator page.

Logical Design: Logical design (Figure 1) shown is concerned with the processes to be performed. It describes what is to be done by the system or the functions required by the system.

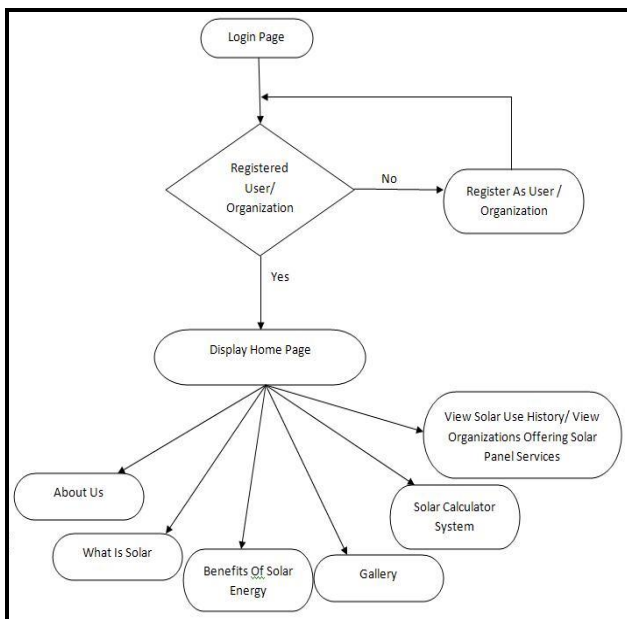


Figure 1 : Logical Design

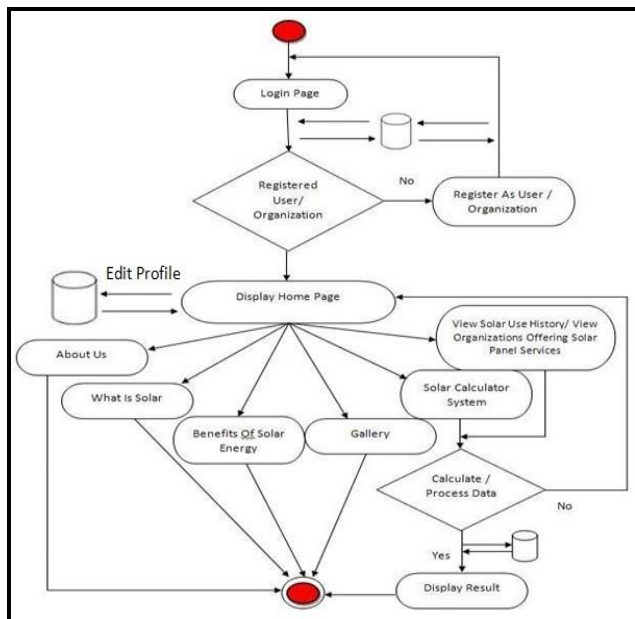


Figure 2 : User activity diagram

Activity Diagram: This is user activity diagram (Figure 2). Activity diagram is a graphical representation of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modelling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. It also shows the overall flow of control.

Package Diagram: This Figure 3 shows which element of the website is private and public. A public element is denoted by '+' sign and '-' for private.

Sequence Diagram: This Figure 4 shows the flow of the website. Where it begins with login and ends up with log out.

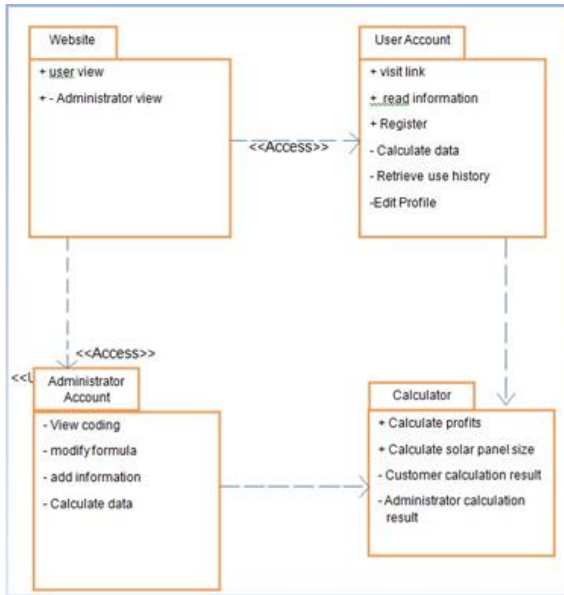


Figure 3 : Package Diagram

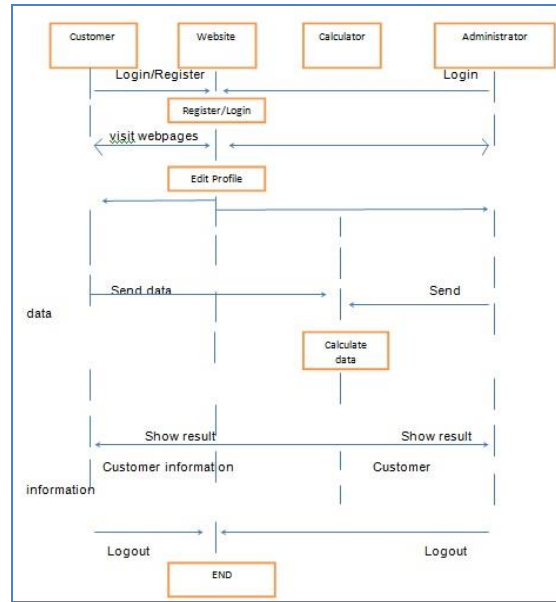


Figure 4 : Sequence Diagram

The outcome of the development yielded a product. The system is implemented and tested. The programming language, database, web designing and content of solar energy are all tested. The components of this system are created by using multimedia flash, php, html and also MySQL database. Figure 5 shows the page where it gives an introduction to solar power, while Figure 6 shows the page where benefits of solar energy are explained. Figure 7 shows the solar calculator page, this is where the main event happens, where users can use the calculator to calculate how big their solar panel should be and also how much they would earn from the FiT initiative. Users can also save their calculations. Figure 8 shows the page where users would choose what table they would want to view.



Figure 5 : What Is Solar Energy Page



Figure 6 : Normal user home page



Figure 7: Solar Calculator Page



Figure 8: Solar Calculator Page

Conclusion

This paper presents a solar calculator. The motivation for the project comes from the fact that people still not aware about the benefits of solar energy since there is still lack of information provided in virtual and real world [11- 12]. An online solar calculator has been designed using generic software development process. The system is tested and proved efficient in calculating solar energy. Although some limitations were observed, yet the system still works very well. In the future, this system could be enhanced by adding some more functions that are related to solar energy. There are some limitations that can be improved in future and some weaknesses but will not affect the main process. It is hoped that this system can improve the development of solar energy user in order to gain some knowledge and investment about solar energy.

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