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Abstract	One of the most important variables affecting a country's socioeconomic maturity is access to electricity. Bangladesh is now suffering from a severe electricity shortage. Around 65% of people do not have access to power, and most of them live in villages. The generated electricity was unable to meet demand, resulting in load shedding of up to 1500 MW. Solar Home Systems technology can be a wise effort to fix this problem in this case by harnessing energy from the country's free-flowing renewable source. The main purpose of this paper is to make people more aware of using the solar system.

Keywords (separated by '-')	Socioeconomic maturity - Electrical shortage - Load shedding - Solar home system - Home system technology

Author Proof

Developing an Energy Cost Calculator for Solar

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Abstract. One of the most important variables affecting a country's socioeconomic maturity is access to electricity. Bangladesh is now suffering from a severe electricity shortage. Around 65% of people do not have access to power, and most of them live in villages. The generated electricity was unable to meet demand, resulting in load shedding of up to 1500 MW. Solar Home Systems technology can be a wise effort to fix this problem in this case by harnessing energy from the country's free-flowing renewable source. The main purpose of this paper is to make people more aware of using the solar system.

Keywords: Socioeconomic maturity · Electrical shortage · Load shedding · Solar home system · Home system technology

1 Introduction

According to the Department of Energy, employing conservation measures and investing in new things that enhance consumption efficiency may cut energy usage in the average home by 60%. 50% of dwelling units eligible for federal energy tax credits in 1977–1978 had some sort of conservation-related equipment or insulating material installed, according to DOE (Department of Energy – 1980) survey findings. An estimated $4 billion in energy-saving equipment, primarily related to home heating, was the subject of tax credit requests by homeowners in 1980. Analysts predict that by 1990, this rate of the investment may increase to $30 billion annually. (1981, Business Week) [1, 2]. The entire planet is experiencing this electrical crisis. Although several nations are making an effort to deal with it, Bangladesh is also included in this list.

All types of power generating have an impact on the environment, including the air, water, and land. The amount of fuel consumed to create power as well as the number of greenhouse gases and other air pollutants released is reduced through more efficient energy production and consumption. Electricity produced from renewable resources like solar doesn't contribute to global warming or local air pollution because no fuels are used. For making people more conscious of the cost difference between the usual method

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and the solar system. So, we have built software by which people can visually see the difference.

At present, making an organization or apartment fully based on a solar system is a very challenging issue. But many apartments and organization are trying their best to move on the solar system. In this scenario, our research question is:

i. How much power is consumed in our targeted building per year?
ii. How can we visualize the difference in cost?

The principal objective of this study is to make organizations and apartments fully dependent on solar systems. The central focus points are:

i. Determining the cost calculation of solar system per year.
ii. To develop a cross-platform software to visualize the difference in cost.

The focus is to make people aware of using the solar system instead of as usual wired distributors' system. We developed software to visually show the cost difference.

Our main limitations are that we didn't implement our proposed model in real life. But we have talked with a company whose sub-branch was in Dhaka named Betawatt Solar whose motive is to make every house solarize. We have taken their requirements and proposed our software model design which they liked a lot.

2 Related Work

The sun is a wonderful and abundant resource that can support life on Earth by giving all of its people access to clean, renewable energy. The sun provides our planet with more energy in a single hour than the whole human population does in a whole year. Sunlight is converted into power using solar photovoltaic (PV) modules (photo = light, voltaic = electricity). By creating and putting in large-scale PV systems, we can transition away from other harmful and unsustainable energy sources. Because the solar industry is growing, there is also a growing need for skilled workers!

In comparison to other forms of energy generation, solar panels have low ongoing expenses once installed. Solar energy may produce enormous amounts of electricity without the danger or expense of securing a fuel supply since it doesn't require fuel. But there is no visual representation of this difference between the usual method and the solar system. For this reason, we are building software to visualize this difference by which people may more conscious.

To promote the use of solar energy in the industrial sector, a lot of work is being done. A large number of international initiatives, like the International Energy.

The International Energy Agency's (IEA) SHC Task 49, "Solar Heat Integration in Industrial Processes", has long worked on evaluating the solar potential in industrial processes, developing design guidelines, defining integration schemes, or contrasting readily available design software, among other things. The majority of the results from these efforts are intended for designers, solar manufacturers, or academics, even though end users are ultimately the individuals who make the judgments.

With more than 25 GW of installed capacity built cumulatively through 2015 and 16 GW anticipated to be added in 2016, solar energy has rapidly grown in popularity as a source of power for the United States during the previous 10 years. Utility-scale solar installations have grown recently, while the usage of solar rooftop systems in the residential and commercial sectors has surged. According to recent studies, the US residential photovoltaic (PV) market increased the fastest in 2015. Falling manufacturing prices for PV modules and enticing local, state, and federal financial incentives have contributed to this surge in residential PV installations. However, even at the present deployment rates, barely 1% of the power needed in 2015 was produced.

To make solar electricity cost-competitive with conventionally generated electricity by 2020, the United States Department of Energy created the SunShot Initiative in 2011. At the time, this indicated a 75% price reduction for photovoltaic and concentrated solar power throughout the utility-scale, commercial, and residential sectors in comparison to 2010 rates. The Solar Energy Technologies Office (SETO) of the Department of Energy released the SunShot Vision Study in 2012 to analyze the effects of this lofty objective. According to the study, if the SunShot price-reduction targets are met, solar energy could supply roughly 14% of the country's electricity demand by 2030 and 27% by 2050, all while consuming fewer fossil fuels, emitting fewer greenhouse gases and other pollutants, creating jobs in the solar industry, and lowering electricity prices for consumers.

So-called "utility-scale" SPPs are typically shown in reports based on expanded indicators of the energy sector's operation as being connected to the Russian Federation's Unified Energy System and producing electric energy on a commercial scale. Numerous studies claim that low-power plants, both networked and standalone, are used for the needs of the housing and utility sector, small businesses, social and public health facilities, and recreation areas far from centralized power supply systems of farms and households producing agricultural products are currently the most promising. The aforementioned categories also include distributed generation facilities. The burden on the energy system can be reduced with the implementation of such tiny solar production facilities.

Besides, we have talked with an Australian company whose sub-branch was in Dhaka named Betawatt Solar. We have taken their requirements and proposed our software model design which they liked a lot.

3 Material and Method

3.1 Design

Our goal is to make people more conscious about using solar panels instead of regular wire-distributed lines. For that reason, we generated a business model for our proposed software. The Usual unmodernized Model and to-be models are given below:

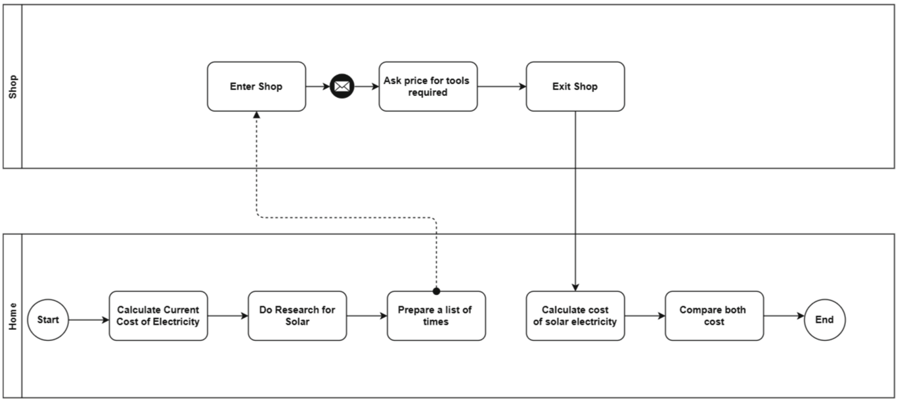

Fig. 1. As usual unmodernized model

Here is the as-usual method people usually do (Fig. 1). The to-be model is our proposed model. Before our proposed model people usually go to the market and justify the prices of the solar components but in our model, they can see the full statement easily from their homes. Here the As Usual unmodernized Model is showing how we are solarizing our daily activities in an unmodernized way. Firstly, we calculate how much power is consumed in our house. Then we go to the market and started to find the

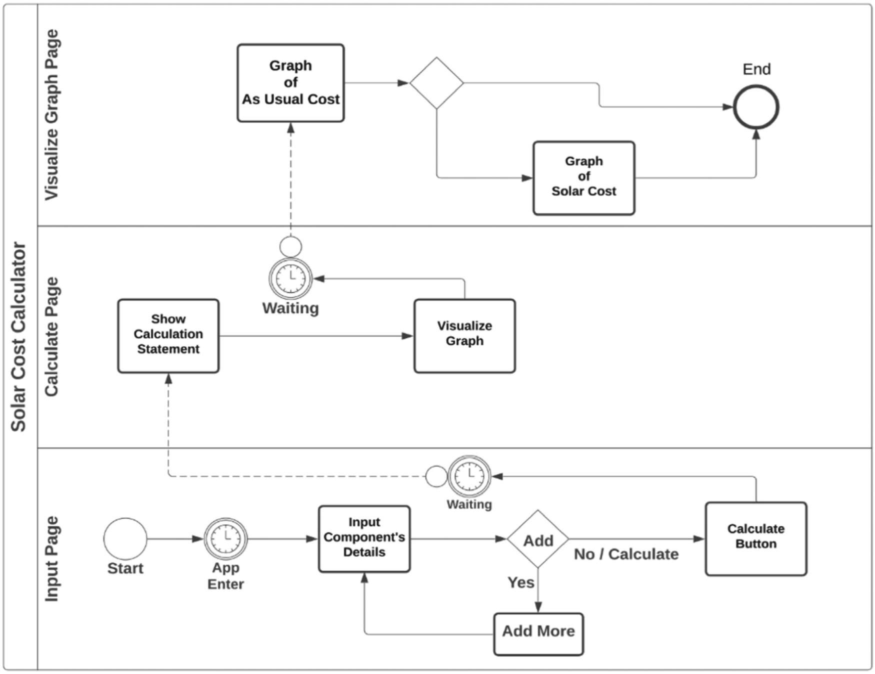

Fig. 2. Our proposed solarize model

best solar system in this competitive market. Then we have to compare manually the cost between these solar and our wired connection. In a word, we have to go through a long way to solarize our home.

Here in Our Proposed Solarize Model (Fig. 2), we do not need to calculate the power consumed manually. Users can easily calculate the power consumed by their daily activities. Users can also see the best match for that power consumer. A user can also compare the cost of the solar proposed model with wired power consumed. The comparison is also visualized through a graph which will help to visualize the cost difference easily.

3.2 Method

We had built cross-platform software (Fig. 3), which means it will run on android, iOS, macOS, windows, web, and Linux platforms. This software will visually represent the cost of the whole month of the general electricity supplier method vs our planned method of the solar system. Our software interface will look like this.

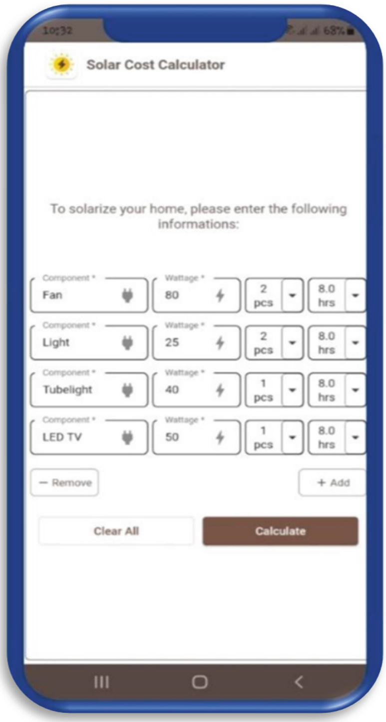

Fig. 3. Component entry Ui

First, we are taking the components' names, the wattage of each component, the number of each component, and the total running time of each component. For example, we are taking two fans, two energy lights, one tube light, and one led tv. Each electric fan consists of 80 w, each energy light consists of 25 w, tube light consists of 40 w, and led tv consists of 50 w.

We have to find out the wattage of UPS/inverter, battery size (amp hours), and the number of solar plants.

We can easily get the total of the inverter by adding the components' wattage. That means total wattage (80 * 2 + 25 * 2 + 40 + 50) = 300 w.

Then for calculating the total current we know a formula:

$$P = VI \tag{1}$$

where, P = 300 and V = 12v. (We are using 12 voltage battery). From the formula, we can get the current which is

$$\mathrm{I} = 300/12 = 25 \text{ Amp.}$$

Now, for the calculation of battery size, we know a formula which is:

$$W \times H/V \tag{2}$$

where, W = total load, H = backup time in hours and V = voltage of battery. Let every component needs 8 h of battery backup. And the voltage of the battery is 12 v. So, the multiplication of total load and backup time is 2400. So, the battery size required 2400/12 = 200 AH (Amp Hour).

Now, we have to find out the current of charging the battery. There are many chargers available in the market for fast charging. We are considering the minimal charger to make the model sustainable. Our proposed model's charger will require 10 h to charge the battery. So, the current required to charge the battery is 200/10 = 20 Amp.

Now, we need to find out the number of total solar plates. The total current required = Home Load Current + Battery Charging Current = (25 + 20) = 45Amp.

Solar power required = VI = 12 * 45 = 540 w. There are many solar plates available in the market. We are considering 125 w and 150 w. After calculating call this calculation, we get the calculated value on the mobile screen automatically (as shown in Fig. 4).

Fig. 4. Calculation screen

The price of each battery and the solar plate is taken from the online store: AliExpress [5] and India Mart [6].

After calculation of this part, we are calculating the monthly electricity bill of the calculated wattage based on the running time. (Let, the electricity per unit cost 6 taka/-) which we collect from DESCO.

After calculating the monthly cost, we have calculated the annual cost of as usual electricity system. On the other hand, the maintenance cost of a solar system is assuming around approximately 1000/- taka (which we get from online research) [7–11, 12]. After all this calculation, we are plotting a graph just to visualize the people cost of both the usual model and our proposed model (Fig. 5).

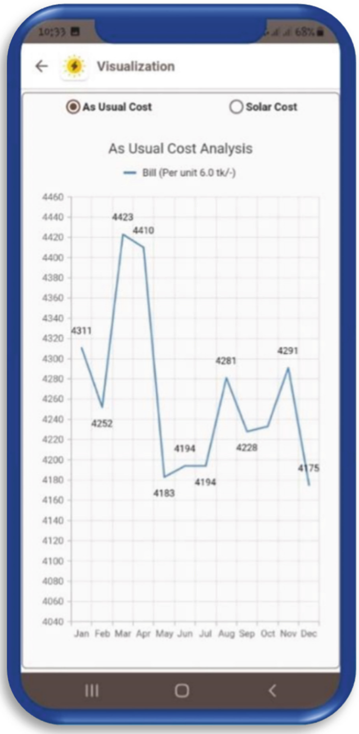

Fig. 5. Graph visualization

4 Result and Discussion

The main purpose of this paper is to make people more aware of the sustainable energy system. We have taken two steps to make our motive successful. We had built software to make this more attractive. First, we have shown people the cost calculation part of solar then we have visualized the cost difference by a graph.

We have already taken a survey (Fig. 6) in our own house and among relatives. The most interesting matter is we have got a mixed review. Some of them are not supported because of the initial cost. But most of them support our model because of the annual cost maximization.

We have already taken a survey in East West University's Data Center. We taught with the Mahfujur Sir of the ICS Department, and he help to get the components details of east west university's data center's logistics. In the data center, there is a total of 30 servers of 730 w, 15 switches of 350 w, 2 AC of 7000 w, 10 lights of 25 w, and 4 enviers of 350 w. The graph of those components in our proposed model is shown below (Fig. 7).

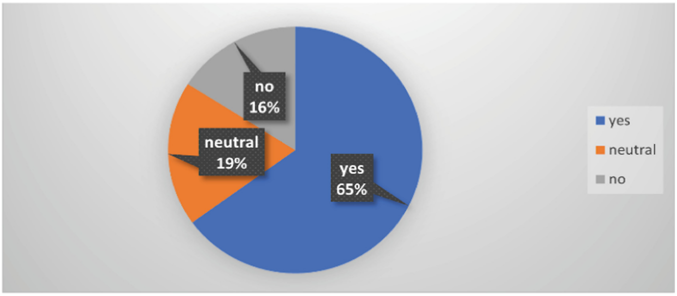

Fig. 6. Survey result

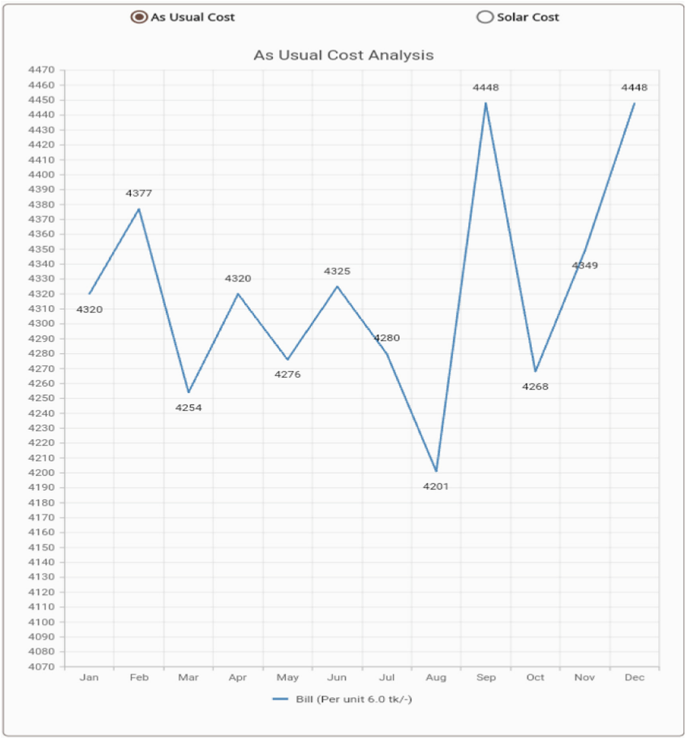

Fig. 7. Wired bill statement

We have also made this source code open. So that people can also contribute to this project. The GitHub Source Code Repository Link:

https://github.com/sabikrahat/solar_cost_calculator.

People can also download the app by scanning this (Fig. 8):

Fig. 8. Scanner to download the app

5 Conclusion

By using this software, we can easily measure the power consumption of a building. We can get the visualization of the difference between the solar system and the usual system. Our main limitations are that we didn't implement our proposed model in real life. We will try to implement our model in real life in the future so that people can be moved toward the solar system as much as possible.

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