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Electricity Load Calculative Method of an Inaccessible area of Bangladesh

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ABSTRACT: This paper is mainly addressed the electricity load calculation of a remote area of Bangladesh. Many rural areas of Bangladesh do not have access of electricity and most of the people of those areas are lived in rustic communities which are deprived from electricity connection from the power grid company of Bangladesh. The Rural Electrification Board of Bangladesh (REB) attempt to provide electricity connection to give access to electricity of rural areas in Bangladesh but approximately 400000 or 0.4 million new consumers are added per year. It will take more than 40 years to provide connection to each and every village in Bangladesh. We are committed to provide them real forecasting of electricity load of any selected area of Bangladesh whose are not to connect with electricity but get prepared for electricity connection.

KEYWORDS: Regression Analysis, Load Forecasting, Factors, Power Management System, Power Grid, Chokaria, St. Martin's Island.

I.INTRODUCTION

The energy infrastructure of Bangladesh is not sufficient and their management system of power is too much poor. The energy consumption of Bangladesh is 136 KWh per capita it's more than lowest consumption per capita ratio of all over the world.

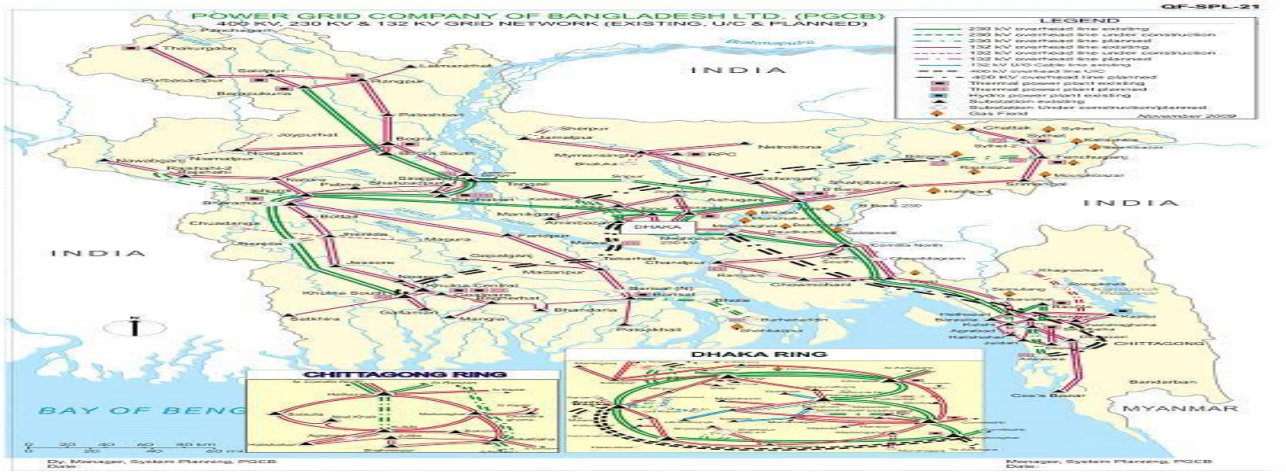

Figure 1: Map from Power Grid Company of Bangladesh (PGCB).

The figure 1 is depicted the area map from Power Grid Company of Bangladesh (PGCB). Non-commercial energy resources, such as wood fuel, animal waste, and crop residues, are estimated to account for over half of the country's energy consumption. Bangladesh has small reserves of oil and coal, but very large natural gas resources. Commercial energy consumption is mostly natural gas (around 66%), followed by oil, hydropower and coal. Electricity is the major source of power for country's most of the economic activities. Bangladesh's installed electric generation capacity was 4.7 GW in 2009; only three-fourth of which is considered to be available.
However, the cost of fuel is so much high; in order to this reason the cost of expected generating electricity is rise up dramatically in rustic areas of any site of our country. On the other hand for burning fossil fuels the number of carbon dioxide is growing drastically into the atmosphere.

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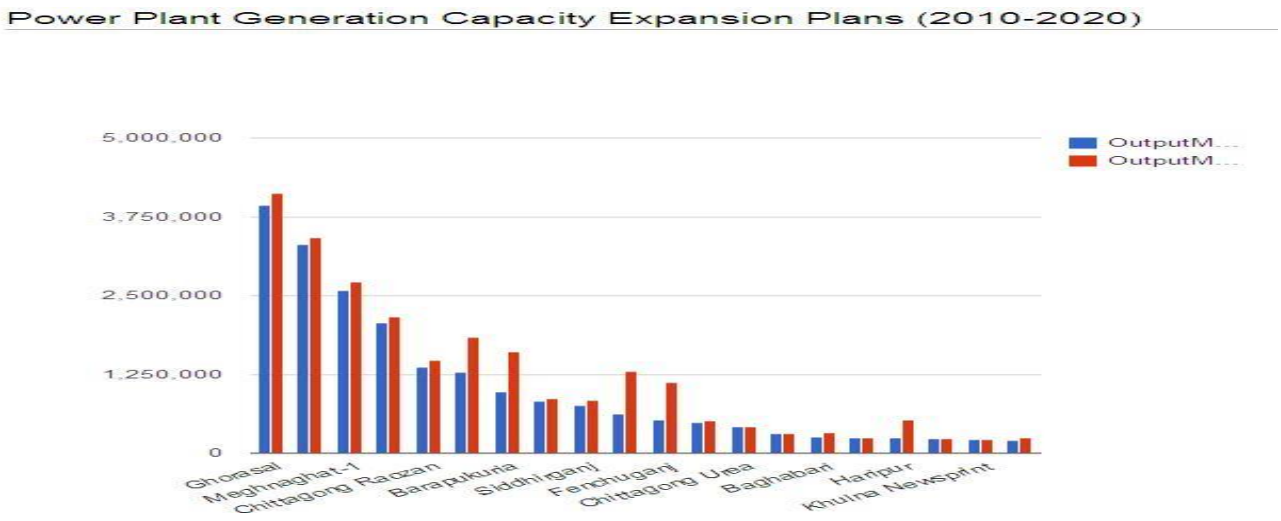

Figure 2: Generation of power grid capacity development plans for Bangladesh.

It has raised national and also the international anxiety and efforts to install alternative source of primary energy such as solar, biomass, wind, hydro and other types of green energy sources. This paper also mentioned how will be the implemented green power source of a remote area of Bangladesh.

II. BACKGROUND OF THE PROJECT

Only for these types of research project a survey was done in a pastoral area of Bangladesh named kutubdia, chakaria, moheskhali and Saint Martin which are situated in Chittagong at Cox's Bazaar district. The kutubdia upozilla is consisted of an island in the Bay of Bengal, off the beach near Chakaria, Cox's Bazaar. The area map of the proposed site is mentioned given bellow. The power connections are available from power plant at Kutubdia and Moheskhali. So our research is based on the area of Chakaria and Saint Martin. The analytical data of the proposed area are given below

2.1. Chakaria Upozila:

Chakaria is an upozila of Coz's Bazaar district at Chittagong division in Bangladesh which is an a area of 643.46 Km2 is surrounded by Lohagara, Banshkhali and Lama upozilas on the north of the Cox Bazaar sadar and ramu upozilas on the south. Lama and naikhongchhari upozilas on the east also moheskhali and kutubdia upozila are on the west. The Chakaria upozila with a death of toll of 16705 persons in the year of 1991 caused a serious damage to the upozila.

Figure 3: The site map of this research project named Chakaria Upozila.

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2.2. Geological Data of Chakaria:
However, Chakoria upozila is located at 21.7861°N 92.0778°E . It has 63671 units of house hold and total area 643.46 km². Once there was a mangrove forest named Chakaria Sunderban here. But now it is no more.

2.3. Demographics:
As of the census of Bangladesh in 2012, Chakaria has 474320 populated areas, where the amounts of males are 51.87% of the population, and females are 48.13%. This chakaria has an adult literacy rate of 47.6%, per capital income 4854.69tk, in land communication strength 180.7km, agricultural land 27142 hectors and distance from main land is 49km.

2.4. Organizational:
In this paper, the number of Unions/Wards in Chakaria upozila is 17, 66 Mauzas or Mahallas, and 340 villages. The name of a new Pourashoba chairman is Nurul Islam Hider 1no and the name of Ward commissioner is Nurul Husain.

III. UNRUFFLED DATA FROM CHAKARIA

- Population Density = 4,74,320
- Adult literacy rate =47.6%
- Per capital income =4854.69 per month
- In land communication strength =180.7km
- Agricultural land =27142 hectors
- Distance from the main land =49km
- Distance from door to door is = 105 CM (on an average value)

3.1. St. Martin's Island:
St. Martin's Island is a small island area is only 8 sq. kilometer long of the northeastern part of Bay of Bengal. During the British occupation the Island was named as St. Martin's Island. The populated name of the mentioned Island is "Narical Gingira", also spelled that "Narical Jinjira or Narical Jinjera" it unfolded 'Coconut Island' in Bengali and also spelled "Daruchini Dip". It is only one coral island in Bangladesh.

Figure 4: The area map of the proposed area named ST. Martin's Island.

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IV. ENVIRONMENTAL DATA OF ST. MARTIN'S ISLAND

The Bangladesh census of the required area that is St. Martin's has discovered the density of population is 6703. The males constitute of the island are 53.54 percent of the population and females are 46.46 percent. The life expectancy rate of men and women is around 65 and 60 years. This has an adult literacy rate of 18.6 percent, per capital income ratio is 4671.45BDT, in land communication strength 5.570 km, agricultural land 116 hectors and distance from main land is 115 kilo meters.

4.1. Inhabitants lifestyle:

The total number of population of the proposed area is approximately 6703 and almost 5500 people are earned their living by fishing. Besides, the other staple crops are rice and coconut. Being very common in the island, Algae is collected, then desiccated and in conclusion exported to Myanmar. Between October and April, the fishermen from neighbouring areas bring their caught fishes to the island's temporary wholesale market. As the centre and the south are mainly farmland and makeshift huts, most of the strenuous things are around the far north of the island.

4.2. Transportation and electricity crisis:

Do not expect to find taxis, tarred roads or electricity here. Except for the larger hotels that run on generators, there is no electricity supply from National grid in the island. The island is all about sun, sea and palm trees. During the day, the island comes alive with water and beach sports, with beach parties and bonfires lighting up the evening skies.

4.3. Tourist attracted place:

St. Martin's Island is going to be a popular tourist place. At present, five shipping liners run daily trips to the island, named Shahid Sher Niabat, L C T Kutubdia, Eagle, Keari Cruise & Dine and Keari-Sindbad. Tourists can book their ticket either from Chittagong division or from Cox's Bazaar district. The surrounding coral reef of the island has an extension named Chera Dip. A small bush is there, which is the only green part of Chera Dip, enhancing the beauty of this island. People do not live on this part of the island, so it is advisable for the tourists to go there early and come back by afternoon. In the past 5 years St. Martin's visitors has increased significantly.

4.4. Collected Data from Saint Martin:

- inhabitants= 6703
- grown-up literacy rate=18.6%
- Per capital income=4671.45 per month
- In land communication strength=5.57km
- Agricultural land=116 hectors
- Distance from the main land=115km

4.5. Load Forecasting:

The load forecasting depicted minimizes the utility risk to predict the future consumption of commodities for transmitting and delivering the utility. The techniques are included price elasticity, load analysis and renewable generation predictive modelling. Distribution load is forecasting must be resigned with the distribution network pattern as a part of the distribution circuit load measurement.

Three types of load forecasting are there, which is mentioned and describe about factors of forecasting is given bellow

a) Short-Term Forecasts
b) Medium Forecasts
c) Long-Term Forecasts

4.6. The necessary factors of forecasting:

In the short-term load forecasting method some factors should be considered such as time factors, weather data and the classes of possible customers. For the medium forecasting method and long-term forecasting method take the account, historical load and weather data, the number of customers in various sorts of categories, appliances in the area and their characteristics including age, economic or demographic data or other factors.

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4.7. Method of Forecasting:

In the previous few decades there is a number of forecasting methods had been developed. The development of the mathematical tools will lead to improvements of more accurate load forecasting techniques. Two categories of mathematical models are most important such as additive models and multiplicative models. The additive models can differ the load forecast in the weather from sum of number of components or a number of products. On the other hand the multiplicative models can differ the load forecast in the climate from sum a number of factors.

For an example, in the additive models the predicting loads are as the function of four components.

$$L = L_n + L_w + L_s + L_r$$

Where L is the total load, Ln illustrated the normal part of the load, L_w is depicted the weather sensitive part of the load, L_s is representing a special event component that create a substantial deviation from the usual load pattern and finally L_r shows a complete random term like the noise.

To exemplify the multiplicative models may be of the form given below:

$$L = L_n \bullet F_w \bullet F_s \bullet F_r,$$

Where L is mentioned the total load, Ln is showing the base load, Fw is illustrated the correction factors (these corrections are based on current weather), Fs and Fr are depicted positive numbers of the overall load that can add to or reduce the total load (Fs is mentioned special events and Fr represents the random fluctuation).

Description of the appliances are used by customers, the size of the houses, age of the equipments, technological changes, customer behavior and population dynamics are usually included in the statistical and simulation models are based on the so-called end-use approach. In addition the economic forecasts like as per capita incomes, employment levels and electricity prices are included in econometric models. These kinds of models are often used in combination with the en-use approach. The long-term forecasts are consisting the forecasts on the population changes, economic development, industrial construction and technological development.

V. LOAD FORECASTING USING REGRESSION ANALYSIS

There is a growing tendency towards unbundling the electricity system of Bangladesh that is continually confronting the different sectors of the industry like generation, transmission, and distribution with the increasing demand on planning management and operations of the network.
The operation and planning of a power utility company requires an adequate model for electric power load forecasting. Load forecasting plays a key role in helping an electric utility to make important decisions on power, load switching, voltage control, network reconfiguration, and infrastructure development.
Electric load forecasting is the process that is used to forecast future electric load, given historical load, recent weather information and forecasted weather information.

VI. REGRESSION ANALYSIS

FHS, i.e., Regression analysis is a statistical technique for estimating the relationships among variables. It includes many techniques for modelling and analysing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables.

In this kind of analysis off grid area is indicated as dependent variables while on grid area is taken as independent variables. So in this analysis Kutubdia is indicated as dependent variables and Moheskhali indicated as independent variables.
In linear regression, the model specification is that the dependent variable, is a linear combination of the parameters .For example, in simple linear regression for modelling data points there is one independent variable: x_i , and two parameters, β_0 and β_1

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Straight line: $$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i, \quad i = 1, \ldots, n.$$

This is still linear regression; although the expression on the right hand side is quadratic in the independent variable, it is linear in the parameters β_0, β_1.

In both cases, is an error term and the subscript indexes a particular observation? Given a random sample from the population, we estimate the population parameters and obtain the sample linear regression model:

$$\widehat{y_i} = \widehat{\beta_0} + \widehat{\beta_1} x_i . \quad \ldots\ldots\ldots\ldots (1)$$

The residuals, $e_i = y_i - \widehat{y}_i$ is the difference between the value of the dependent variable predicted by the model, $\widehat{y}_i$ and the true value of the dependent variable is y_i.

Minimization of this function results in a set of normal equations, a set of simultaneous linear equations in the parameters, which are solved to yield the parameter estimators, $\widehat{\beta}_0, \widehat{\beta}_1$

$$\widehat{\beta}_1 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2} \text{ and } \hat{\beta}_0 = \bar{y} - \widehat{\beta}_1 \bar{x}$$

Where $\bar{x}$ is the average value of the x and $\bar{y}$ is the mean of the y values.

So from this equation we will find the value of $\widehat{\beta}_0, \widehat{\beta}_1$and then from equation (1) we will find out the value of y_i.

6.1. Collected data:

Data is collected in 2 stages. At first we went to Moheskhali and Kutubdia UNO office to collect the time invariant data such as population, per capital income, adult literacy rate, Agricultural land, distance from the main land and in land communication strength. Then we went to Rural Electrification Board of Bangladesh (REB) office of Moheskhali to get the maximum load and average load of Moheskhali. The collected data of time invariant variables are given below

Table 1: the data we collected from REB of Moheskhali.

Data	**Moheskhali (on grid)**	**Kutubdia (off grid)**
Population	321218	125279
Adult literacy rate	30.08%	34%
Per capital income	4808.69 taka	4884.29 taka
In land communication strength	284.75 km	245.03 km
Agricultural land	5275.36 hectors	8903.28 hectors
Distance from main land	89.1 km	90 km

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Table 2: Average Demand/Load of Maheshkhali Upazila (Cox's Bazar) from 2008-2011 by month.

Month		Average Demand/Load		
	2011	2010	2009	2008
January	1647	1528	1302	1170
February	1610	1500	1353	1270
March	1582	1470	1366	1372
April	1653	1608	1370	1476
May	1562	1604	1454	1466
June	1733	1460	1554	1382
July	1678	1595	1576	1407
August	1660	1500	1420	1431
September	1400	1648	1458	1513
October	1688	1708	1462	1483
November	1558	1536	1426	1406
December	1570	1520	1309	1384

Table 3: Maximum Demand/Load of Maheshkhali Upazila (Cox's Bazar) from 2008-2011 by month.

Month		Maximum Demand/Load		
	2011	2010	2009	2008
January	3660	3396	2894	2600
February	3576	3334	3007	2824
March	3514	3267	3037	3049
April	3674	3574	3045	3280
May	3469	3566	3232	3258
June	3853	3243	3253	3072
July	3731	3545	3503	3128
August	3689	3335	3157	3182
September	3109	3663	3242	3364
October	3751	3796	3250	3296
November	3460	3415	3169	3125
December	3490	3380	2909	3076

Table 4: Regression table of Moheskhali and Kutubdia.

M	K	M^2	MK
321.2	125.279	103181	40241.9
30.08	34	904.806	1022.72
64.98	66.004	4222.66	4289.07
176.5	151.919	31168.1	26820.5
20.37	34.376	414.855	700.17
89.1	90	7938.81	8019
∑M=702.293	**∑K=501.578**	**∑M^2=147830.272**	**∑MK=81093.301**

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Calculation of Load forecasting using regression analysis for the proposed site

M = Moheskhali K= kutubdia
Population in = (1000)
Adult literacy rate in = %
Per capital income = $
In land communication = mile
Agricultural land =mile^2
Distance from main land = km

$K=\alpha+ \beta M$

$\beta= (\sum MK- \sum M\sum K/n)/ \sum M^2-(\sum M)^2/n$

= (81093.301-702.293*501.578/6)/ 147830.272-702.293^2/6 =0.34

$\alpha=\sum K/n- \beta \sum M/n$

= 83.596-39.797

= 43.8

$K=\alpha+ \beta M$

K= 43.8 +0.34M

When M= 1647 Average load of January of Moheskhali

K= (603.78)

Table 5: Estimated average load of Kutubdia.

Month	Average Load	Month	Maximum Load
Jan	603.78	Jan	1288.2
Feb	591.2	Feb	1259.6
March	581.68	March	1238.6
April	605.82	April	1293
May	574.88	May	1293
June	633.02	June	1353.8
July	614.32	July	1312.3
August	608.2	August	1298.1
September	519.8	September	1100.9
October	617.72	October	1319.1
November	573.52	November	1220.2
December	577.6	December	1230.4

Graphical diagram

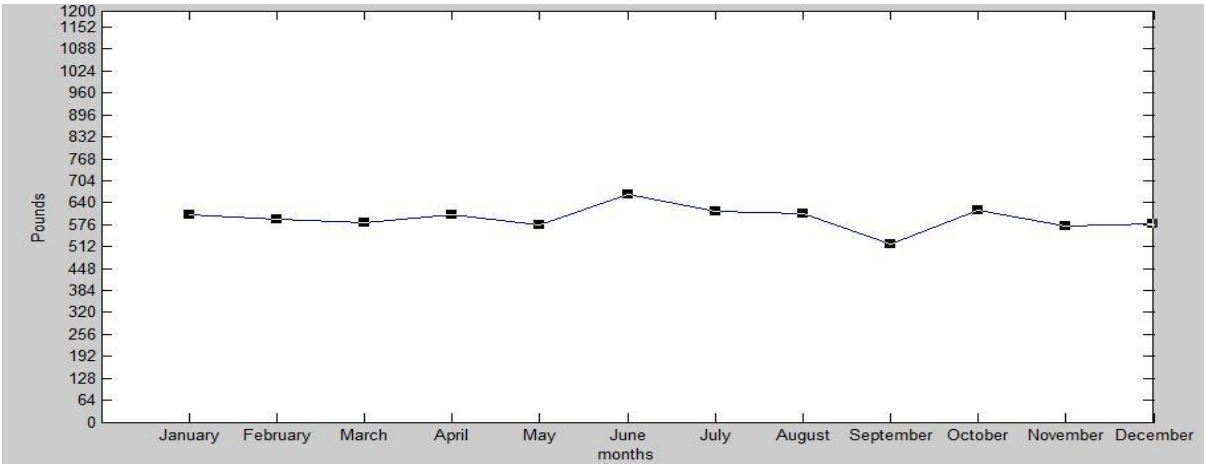

Figure 5: The graphical line diagram of estimated average load Kutubdia.

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VII. RESULTS AND CONCLUSION

In this research regression analysis method has been applied successfully to forecast load of an isolated area using different vector groups to estimate average load and maximum load of that isolated area. That is why if government wants to install a power plant at proposed location or site the government must have an estimated idea of load. This research paper showed an appropriate amount of load of these areas by using regression analysis. As it can be seen that two methods of results shown almost same which can prove the method we use is correct.

The MATLAB code which has been used when we use matrices analysis is only depend on the collected data from UNO office which was a statistical data. The more precise this data is the more accurate data can present. When we went to UNO office to collect those data we face some unexpected problem which is not helpful in any way. At first the data we received is almost a decade old and had no use in modern day. Then UNO office of that area still use hardcopy in the case of data store which is not except in the modern world. They are not familiar with computer works. In the case of REB office they are almost opposite of UNO office of same area. They are highly trained, well organized and cope up with modern world. Bangladesh government should take some steps to improved and trained UNO officers otherwise it will carry a bad recognition of our country.

In the case of regression analysis the data should be closely related otherwise it shows negative value which is not acceptable for load forecast. It also provides complexity when the collected data big and when data is compare to area occupied with huge population.

REFERENCES

1. Hesham K. Alfares, Mohammad Nazeeruddin Electric load forecasting: literature survey and classification of Methods, 2002; 33: 23-34.
2. Engr. Badar Ul Islam, Comparison of Conventional and Modern Load Forecasting Techniques Based on Artificial Intelligence and Expert Systems by IJCSI 2011; 8: 3.
3. Kyung-Bin Song , Young-Sik Baek, et al. Short-Term Load Forecasting for the Holidays Using Fuzzy Linear Regression Method, IEEE, 2005; 20: 96 – 101.
4. Jennifer Hinman, Emily Hickey, Modeling And Forecasting Short-Term Electricity Load Using Regression Analysis. 2009.
5. MA Mahmud, Isolated Area Load Forecasting using Linear Regression Analysis: Practical Approach, 2011; 3: 547-550.
6. Shu Du, Graduate Student Mentor: Kwang Y. Lee, Professor and Chair, Short-Term Load Forecasting Using System- Type Neural Network Architecture, 2009.
7. JP Rothe, AK. Wadhwani, et al. Short Term Load Forecasting Using Multi Parameter Regression, 2009; 6: 303-306.
8. Muhammad Buhari, IAENG, et al. Short-Term Load Forecasting Using Artificial Neural Network, 2012; 1: 14-16.
9. Kathleen Ann Cullen, Forecasting Electricity Demand using Regression and Monte Carlo Simulation under Conditions of Insufficient Data, 2011.
10. Saeed Badran, Ossama Abouelatta, Neural Network Integrated with Regression Methods to Forecast Electrical Load 2012.
11. Alimul Haque Khan, Anisur Rahman, et al. A Noble Design of a DC Micro Grid of a Rural Area of Bangladesh, IJTEEE, 2015; 3.

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