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Multi Power Generation Methods from Railway Traction System with Energy Conservation

Gayathri Devi Ramaraj[1], Bhoopesh Harikrishnan[2], Karthikeyan Kalimuthu[2] and Sreenath Deenadayalan[2]

ABSTRACT

Shortfall of power is one of the major problems in developing country. The power consumption is increasing on large scale to meet the growing demands. This paper outlines an idea which can be used to solve this problem by using an Embedded Technology. This proposal greatly reduces the manpower, saves time and operates efficiently without human interference. An idea is proposed to generate power using different renewable energy sources for the train. The different sources are solar energy, wind energy, energy from train vibration. Another concept is also incorporated in this proposal describing about energy conservation system in the compartments of the train. This proposal ends in the usage of the renewable energy and also saves the energy which is used unnecessarily, leading to an effective substitute method for the non-renewable energy which is currently being used in railway network.

Index Terms: Solar energy, Wind Energy, Piezo-electric effect, Energy conservation.

I. INTRODUCTION

Ours being a developing country the power consumption is increasing on large scale to meet the growing demands. Power generated at the present is insufficient to satisfy the growing demands in the country. This leads to a major problem in the growth of the country. Power generation is widely based on the non-renewable resources, and these resources are being depleted at a rapid rate. An alternate method for generating power which also has to be an efficient method has to be found out. The utilization of energy differs from each and every sector. More than 41% energy is consumed by the buildings, 30% by industry and 29% by transportation. Thus small improvements in any sector will widely hold the potential for significant impact [1].

The usage of renewable energies can be a perfect substitute for the depletion of fossil fuels since these energy resources, are abundant in nature and it can be used widely. This usage of power is pollution free form of energy and renewable energy facilities generally require less maintenance than the conventional sources and also provide a lot of economic benefits.

II. LITERATURE REVIEW

In this paper a literature review is carried out related to the generation of the renewable energy from various sources for the train and conservation of energy in it.Number of authors/researchers has presented the various issues, challenges and their possible solutions in the context of generation of renewable energy from various sources and conserving energy from various sources. Solar energy is radiant light and heat

[1] Assistant Professor, Dept. of Electrical and Electronics Engineering, Sri Sai Ram Engineering College, Chennai 600044, India, *E-mail: gayathridevi.eee@sairam.edu.in*

[2] Students, Dept. of Electrical and Electronics Engineering, Sri Sai Ram Engineering College, Chennai 600044, India, *E-mails: Bhoopesh35@gmail.com, karthisanjay7@gmail.com* and *sreenathdeenadayalan@hotmail.com*

from the sun harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar architecture and artificial synthesis [2]. The solar energy is an important source of renewable energy. It is the conversion of sunlight into electricity either directly using photovoltaic (PV), or indirectly using the concentrated solar power (CSP). Photovoltaic which has solar cell is a device that converts light directly into electricity using the photoelectric effect. The early solar cells cost 286 USD/ watt and reached efficiencies of 4.5-6% [3]. By 2012 available efficiencies exceed 20% and the maximum efficiency of research photovoltaic is over 40% [4].A method to maximize power tracking control for PV energy harvesting using current ripple free module is proposed by Ching *et al.* 2015 [5]. The system has a passive ripple canceling circuit to eliminate the output power reduction effect using photovoltaic (PV) systems that are caused by the current ripple of the PV converters. The special features of the system include the low-cost simple modular structure and being independent of the duty ratio control of the main power circuit. This is easily integrated to the main power circuit to achieve zero input current ripples, yielding less filter size, loss and fast response.

Another power used is from the wind. Wind power, as an alternative to burning fossil fuels, is plentiful, renewable widely distributed, clean produces no greenhouse gas emissions during operation, and uses little land [6]. Onshore wind is an inexpensive source of electricity competitive with or in many places cheaper than on land coal or gas plants [7] [8].

In India 2.5% of total power is required for train. When the train runs because of unlevelledtrack, the bogies are continuously having upward and downward motion. This relative motion is also used forgenerating the power. This mechanism doesn't have any effects in the displacement of bogies. Rotational motion obtained from this mechanism is unidirectional whose speed of rotational are generally depends on rate of movements of bogies in upward and downward movements [9].

An infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They work entirely by detecting the energy given off by other objects [10]. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye because it can be detected by electronic devices. These sensors don't detect or measure heat, instead they detect the infrared radiation emitted or reflected from an object [11].

Although rail is commonly regarded as an energy-saving travel pattern, the operation of a rail transport system consumes in fact a huge amount of energy every day. For example, the weekly electric cost of merely one railway station of Hong Kong Mass Transit Railway Corporation reaches 230 megawatt hours [12]. Such huge energy consumption sometimes may have a serious energy waste. For instance, it is astonishing that the energy cost per passenger trip of a transport completed by the metro system in New York is even much higher than the EC of the same trip by car on average, mainly due to the low utilizations of the passenger capacities of the metro trains [13].

Different from the viewpoints of aforementioned studies, many works pay much attention to for example, motor flux, weight, mass distribution, electricity supply effectiveness, traction power output, start stop frequency, carrying capacity utilization rate, and so forth of a train for the improvement of its traction energy cost efficiency [14].

Various attempts have been made to minimize energy consumption of rail vehicles by means of regenerative power from electric braking of traction motors. Shafighy *et al.* [15] describes energy efficiency methods in electrified railways based on recovery of energy. Direct recovery methods that return regenerative power to electrified networks, and recovery methods based on energy storage systems are elaborated.

III. PROPOSED SYSTEM

An idea is proposed to generate power using different renewable energy sources for the trainwith energy conservation.The different sources are solar energy, wind energy, energy from train vibration.

A solar panel is incorporated at the top of the train to obtain the solar energy. A wind model is fixed on the train to obtain the wind energy. While the train moves at its intended speed, high level energy will be obtained from the wind model and it is converted to DC using a rectifier and a filter to discard the ripples and it is stored in the battery, where the solar power is also stored. While the train is in motion, high level vibrations will be occurring, using this vibration; the energy can be taken out using piezoelectric transducers which can be used as another source of power. These obtained energies will be stored in a battery with an inverter and can be used for functioning of the train and for appliances in the train.

Another concept is also defined in this proposal describing about energy conservation system. In this system an IR Transceiver is used to detect the presence of the commuters inside each and every compartment [4]. The appliances will be switched ON at the places where the commuters are present and will be switched OFF once they exit the place.

This proposal ends in the usage of the renewable energy and also saves the energy which is used unnecessarily, leading to an effective substitute method for the non-renewable energy which is currently being used in railway network.

IV. SYSTEM MODEL

Figure 1 shows the block diagram of the proposed system. The system is designed using AT89S52 microcontroller with supporting peripherals like IR transceiver, solar panels, wind model, train wheel assembly, piezo-electric sensor assembly, ADC section, relays, LCD display, and storage battery.

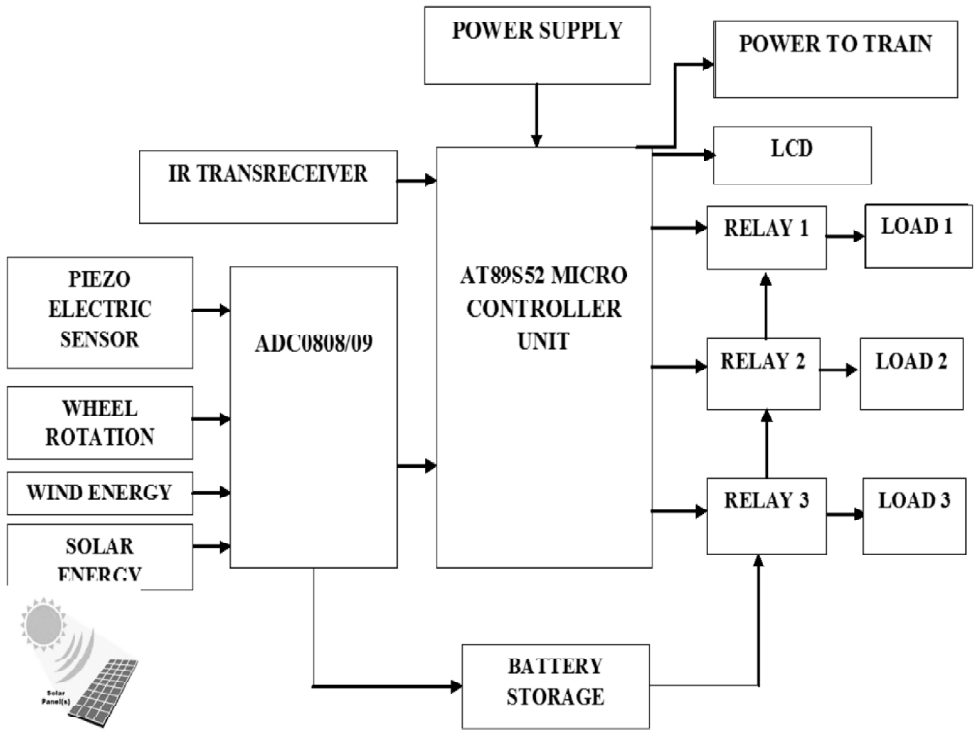

Figure 1: Block diagram of the proposed system

The photovoltaic cells receive the solar energy directly and the output of all the solar cells are allied and then stored in a single battery. Since the output of solar is in DC it is feasible to store the power in a battery.The wind model is fixed at the train to obtain the high level of energy. Since the output of the wind model is an alternating current, the conversion to direct current is done byusing a rectifier and a filter. This

energy is stored along with the solar power in the battery.While the train is in motion high level vibration will be occurred. Using this vibration the energy can be taken out using piezo-electric transducers which works on the principle of the piezo-electric effect. These energies together are stored in the battery and it is used for powering the train and the appliances in it.

Another application is implemented in this project describing about energy conservation system. In most of the compartments of the train all the appliances will be in ON status even in the absence of the commuters. These results in the wastage of power, this power can also be used valuably.In this system an IR Transceiver is used to detect the presence of the commuters inside each and every compartment. The appliances will be switched ON at the places where the commuters are present and will be switched OFF once they exit the place.

V. SIMULATION RESULTS

Figure 2 shows the circuit diagram of the proposed system. The simulation shows an approximate output of the proposed system when given inputs at a small quantity

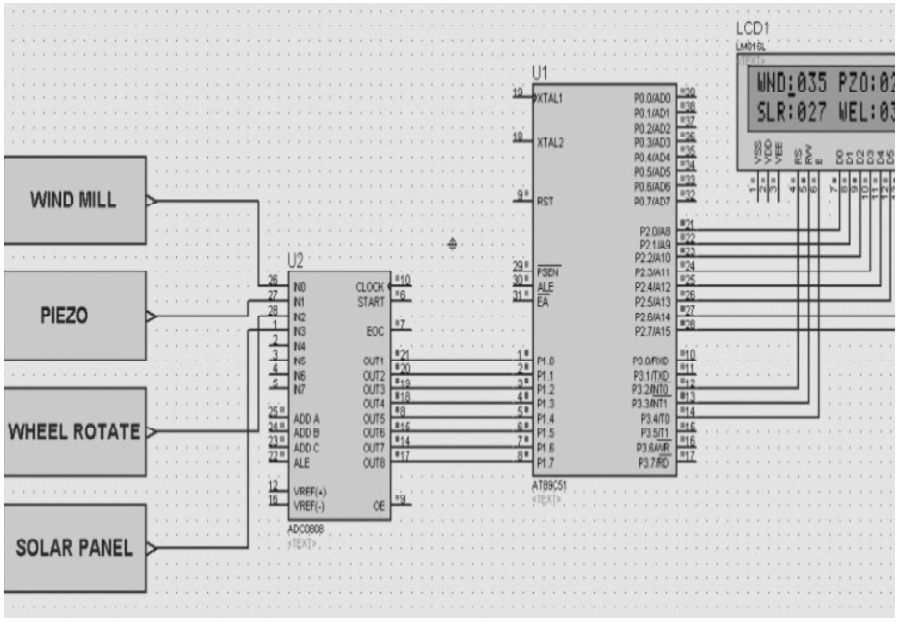

Figure 2: Simulated Diagram of the Proposed System

The solar panel of three photovoltaic cells in parallel and twophotovoltaic cells in series, gives the output shown as in such an output LCD display for the solar power. The solar power is less fluctuating and its output depends on the number of photovoltaic cells connected across it, as per the output needed. The vibrations in wheel rotation and the vibrations caused due to the movement of the people in the train are collected by the piezo-electric transducers, which gives the maximum output of 12v each strip. In the simulation, 3 piezo-electric transducer strips were used for the movement of people in the train and 4 electric transducer strips were used to get the vibrations of the wheel rotation and the obtained voltages are showed in LCD display. These strips are efficient that their output is same irrespective of the input. The wind model was given a tentative input and the output is obtained from it. The problem with the wind source relies more on the sea breeze and land breeze. During sea breeze the movement of the wind is more which occurs during the day while in case of the land breeze the movement of the wind is considerably less when compared to the former and it occurs during night. This is the only drawback of the wind energy as it fluctuates during the entire day; still a threshold output can be achieved from that source. Fromthe results of the simulation it is inferred that it can be implemented for the train by using the resources in large scale.

VI. CONCLUSION

In this paper in response to the power crisis, the feasible solution is provided for thenon-renewable energy which is currently being used in railway network. The different renewable sources generate enough power which assists in the operation of the train. The proposed system also concentrates on the conservation of energy which has to be given a lot of importance as the wasted energy when conserved, can power the train. As the renewable energy powers the railways, the conventional energy generated for the railways can be used in for the domestic purposes. In the view of the cost aspect, these renewable sources installation seem to be high-priced but these sources installation are carried only a time and does not have a great amount of maintenance like in for the non-renewable energy sources. With future advancements in the renewable energy field, these sources can be obtained at a much cheaper rate.

REFERENCES

[1] Aditya Mishra, David Irwin, Prashant Shenoy, Jim Kurose, and Ting Zhu, GreenCharge: Managing Renewable Energy in Smart Buildings , IEEE Journal on Selected Areas in Communications, Vol. 31, No. 7, pp. 1281-1293, July 2013.

[2] Agrafiotis, C.; Roeb, M,; Konstandopoulos, A.G.; Nalbandian, L,; Zaspalis, V.T.; Sattler,, C,; Stobbe,P,; Steele,A.M. (2005).” Solar water splitting for hydrogen production with monolithic reactors”. Solar Energy79(4):409-421

[3] Perlin (1999). P. 29-30, 38 .

[4] Antonio Luque,”Will we exceed 50% efficiency in photovoltaics?” .aip.org

[5] Ching-Tsai Pan, Ming-Chieh Cheng, Ching-Ming Lai, and Po-Yen Chen, Current Ripple Free Module Integrated Converter with More Precise Maximum Power Tracking Control for PV Energy Harvesting , IEEE Transactions on Industry Applications, Vol. 51, No. 1, pp. 271-278, Jan/Feb 2015.

[6] Fthenakis, V.; Kim, H. C. (2009).” Land use and electricity generation: A life-cycle analysis”. Renewable and sustainable Energy Reviews 13(6-7):1465.

[7] “Wind power is cheapest energy, EU analysis finds”. the guardian. Retrieved 15 October 2014.

[8] David Richard Walwyn, Alan Coli Brent, Renewable energy gathers steam in South Africa. In: Renewable and Sustainable energy reviews 41, (2015), 390-401.

[9] Mrunali J. Panse, Manoj Bobade, Radhika Appalwar, and Shraddha Ramteke, Electricity Generation from Relative Motion of Two Bogies of Train , IORD Journal of Science and Technology, Vol. 1, Issue 1, pp. 22-28, Nov-Dec 2013

[10] “Home Alarm PIR Tech”. Venice Locksmith—Home Security Technician’s Notebook. Steve’s Lock, Safe and Alarm. Retrieved 2012-06-24.

[11] “How Infrared motion detector components work”. Noncommercial research page. Glolab Corporation. Retrieved 2015-05-31.

[12] P. C. M. Leung, and E.W. M. Lee, Estimation of electrical power consumption in subway station design by intelligent approach , Applied Energy, Vol. 101, pp. 634–643, 2013.

[13] C. Winston, and V. Maheshri, On the social desirability of urban rail transit systems, Journal of Urban Economics, Vol. 62, No. 2, pp. 362–382, 2007.

[14] Xuesong Feng, Hanxiao Zhang, Yong Ding, Zhili Liu, Hongqin Peng, and Bin Xu, A Review Study on Traction Energy Saving of Rail Transport , Discrete Dynamics in Nature and Society, Hindawi Publishing Corporation, pp. 1-9, 2013.

[15] M. Shafighy, S. Y. Khoo, and A. Z. Kouzani, Energy Efficiency Methods in Electrified Railways based on Recovery of Regenerated Power , Electrical Engineering and Control, LNEE 98, Springer-Verlag Berlin Heidelberg, pp. 69-77, 2011.