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Clean Energy and Resource (CleanR) for Climate Investigations in Tribal Region: Thermo-Electrical Cooling Device

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Abstract

This paper presents a new evolutionary approach to provide clean and green energy to the people. We investigated a device to incorporate this idea. This device has specifically designed for the tribal people or travellers or for places where there is no source of electricity at the time of winters. Basically, it is a type of a power bank charged with the help of heat energy instead of conventional sources of generating electrical energy. This methodology uses a microcontroller programmed in assembly language to blow LEDs which shows the battery charging condition namely; charge or low charged. Through this device people will surely have an access to energy in new and unexpected ways.

Keywords

Assembly Programming, Clean Energy, Green Energy, Material Science, Environmental Science

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1. Introduction

The needs of smart energy solutions that provide reliable and affordable electricity, contribute to a strong economy, and do not sacrifice human health or our environment. No single energy technology can accomplish all of this. The answer resides in an efficient strategy that offers the greatest potential to move the country toward a clean, sustainable energy future.

1.1. Increase Renewable Energy

Renewable energy is reliable, affordable, and beneficial for our health, economy, and environment. UCS assists in real and economic policies that promote renewable energy and lower barriers for particular option for selection. These incorporate sound renewable electricity standards, financial incentives like clean energy tax credits, and investment in a smarter electrical grid [1].

1.2. Tribal Areas

People in tribal region will be more benefitted through CleanR which remains the portable and easy to setup. Tribal lands contain enormous potential for renewable energy. Energy is an exceptionally required element in the modern world and is unlikely to decrease in value or demand. In fact, according to the Energy Information Administration (EIA), [2] energy is expected to increase in both value and demand.

1.3. People Suffering from Natural Disaster

People who are suffering from natural disasters could use this at the deed time. That can play very important role for their survival.

1.4. Mountaineers

Maximum time's hiker's needs to recharge their camera and to charge their lights with the help of woods or ice they can

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do such things.

1.5. Eco-friendly

There is no adverse effect of this device on nature. Eco-friendly alternatives, which can be widely, used with less threatening impacts to daily life factors like environment, health and economy.

1.6. Use of Solar Energy

Using solar energy which is a ultimate source converting its energy into electrical energy. A sheet of Solar panel can be used to make use of the solar energy.

2. Background

This section elaborates the foundations aspect for the cleanR need and past research data for the further investigations.

2.1. Electricity in Tribal Regions of India

There has even much dispute about the identification of the scheduled tribes than about the scheduled castes or the other backward castes or the other backward classes. The general notion is that this category should include those groups of tribal characteristics like spatial and cultural isolation etc. from the bulk of their population. Most homes lack electricity and running water. The sources of lighting in India are given in Table 1. So, living in Himalayan parks and desert places could become very disturbing in alternating seasons.

Table 1. 2011 Census: Sources of Lighting: All India [3] Source: Census 2011, Government of India.

	Absolute number			Percentage		
	Total	**Rural**	**Urban**	**Total**	**Rural**	**Urban**
Total number of households	246,692,667	167,826,730	78,865,937	100.0	100.0	100.0
Electricity	165,897,294	92,808,038	73,089,256	67.2	55.3	92.7
Kerosene	77,545,034	72,435,303	5,109,731	31.4	43.2	6.5
Solar	1,086,893	916,20	170,690	0.4	0.5	0.2
Other oil	505,571	407,919	97,652	0.2	0.2	0.1
Any other	493,291	361,507	131,784	0.2	0.2	0.2
No lighting	1,164,584	897,760	266,824	0.5	0.5	0.3

As per the figure available on 30/11/2012 from Government of India source, only 34,887 villages are yet to be electrified. We have a huge number of un-electrified households. Also, the people residing at the forest hills and isolated region treated a people of forest. Another name given to the people residing in forest as Vanya Jati (Caste of forest), Van Vasi (inhabitants of forests), Pahari (Hill Dwellers). Except these names, another term like adivasi is most extensively used and categorized as anusuchit janajati, covering all of these terms. There are many places in the world which suffers from lack of electricity like India. So, the people living in those regions suffer from this problem. CleanR is built to solve this problem as it can generate electricity by heating or freezing [4].

2.2. Energy and Fuel Wood Consumption in Tribal Regions

There are two types of fuels namely: Kerosene and electricity mainly used to lighten the Indian household over a marginal urban - rural diversity. There is primarily 42 percent of household's uses kerosene for lighting. In case of urban households, 93 percent of people use electricity for lighting and 6 percent of the people use kerosene. On an average basis, rural households receive six hours of electricity supply from the grid during off peak houses like afternoon and night. If we assume that one unit is to supply to each household for a day, then 30 kWh monthly energy consumption is required in order to meet the required objective. On the other side, during peak hours a typical household uses at least one kerosene lamp for lightening up to four to five hours as backup. Thus, the final cost to enlighten the rural household includes summation of grid supply and kerosene cost [5]. A surveyed was made over 30 villages each of district covering a total of 1919. Out of these 1919 households, 1881 households were found to use electricity connection and only 108 household were not linked to power supply. Further, among these 36% receive electricity for 20 - 24 hours, 30% of the households get less than 12 hours of electricity supply, 23% households getting less than 8 hours of supply and remaining of 11% get supply less than 4 hours of supply every day. The villages getting more power supply like 20 - 24 house lies in Haryana, Gujarat and Kerala. Those villages getting less than 12 hours of supply lies in Maharashtra, Uttarakhand and Karnataka. Finally, the villages getting less than 8 hours of supply or no supply are in the state of Odisha and Jharkhand [5].

2.3. Electricity Problem in Mountain Regions of India

As far as the rural India is concerned, electricity and energy means differently. This is due to Indian electricity policies for identification of electrified villages. Also, electricity supplies to the rural areas are also responsible for the same. S, the sources of cooking and heating should be identified in Indian

households. As per the figures, 11.9% of India's households use modern cooking and heating facilities. This includes LPG/LNG, electricity and bio-gas sources. On the other side, 87.7% of household in rural areas are lagging modern cooking and heating facilities [6]. Table 2 depicts the comprehensive picture of the fuel source for cooking and heating in India. Table 2 shows the source of cooking and heating in India.

Table 2. Source: Census of India 2011. [7]

	Absolute number			%age		
	Total	Rural	Urban	Total	Rural	Urban
Fire-wood	120,834,388	104,963,972	15,870,416	49.0	62.5	20.1
Crop residue	21,836,915	20,696,938	1,139,977	8.9	12.3	1.4
Cow dung cake	19,609,328	18,252,466	1,356,862	7.9	10.9	1.7
Coal, Lignite, Charcoal	3,577,035	1,298,968	2,278,067	1.4	0.8	2.9
Kerosene	7,164,589	1,229,476	5,935,113	2.9	0.7	7.5
LPG/ PNG	70,422,883	19,137,351	51,285,532	28.5	11.4	65.0
Electricity	235,527	118,030	117,497	0.1	0.1	0.1
Biogas	1,018,978	694,384	324,594	0.4	0.4	0.4
Any other	1,196,059	1,040,538	155,521	0.5	0.6	0.2
No cooking	796,965	394,607	402,358	0.3	0.2	0.5

2.4. Clean Energy and Alternative Technology

Figure 1 depicts the comprehensive cycle for energy evaluation through reduction, reuse and recycle. Nowadays countries are investing more and more over the renewable energy sources. Germany is the leading country in the field of renewable energy.

Figure 1. Clean energy cycle.

There various methodologies to gain heat and electricity from renewable sources. Germany has increased its production of renewable energy at the national electricity production level from 7% to 24% corresponding to year 2000 and 2013 respectively. Also, Germany becomes able to turn off its many nuclear plants in the some of the last years. This created initially fear of infrequent amount of renewable energy. Germany proved this assumption wrong and now become able to supply power to different countries from renewable energy sources. This shows that energy from the renewable sources remains highly efficient and advantageous to producers, consumer and nature. This should also be focused that the need of infrastructure is the major concentrating point for the production of energy using renewable energy resources. Many developing countries are lagging to provide renewable energy to households due to lack of strong power networks. The major sources of renewable energy are sun, wind and water power. There are special ways in capturing the mentioned natural energy and transforming it into energy we can actually use at home.

3. Methodology

One of the novel approaches towards comprehensive evaluation of cleanR is shown in figure 2. It constitute of the various components namely: Power supply, microcontroller pin description, embedded C, testing circuit board, light emitting diode, female USB hub, resistor, thermo-electric cooler, heat sink. The details description of these components is given in following subsections.

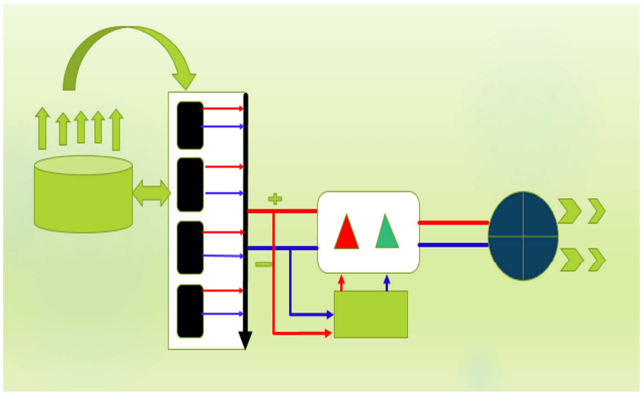

Figure 2. CleanR methodology.

3.1. Power Supply

A microcontroller works on 5 volts dc. We can supply any voltage above 5 volts up to 18 volts. A voltage regulator is used to set power to 5v which is to be supplied to microcontroller.

3.2. Microcontroller

Microcontroller is based on AVR's Atmega 8. It is a 28 pin device out of which 23 are programmable input/output lines.

It has 8 kb programmable flash memory and 1 kb RAM.

Figure 3. Circuit of the micro controller.

3.3. Pin Description

This component constitutes similar features on the consistent pattern of ATmega32. It has less number of features as compared to ATmega32, but these features are sufficient for its working. In order to collect knowledge at the same time with less cost that the ATmega32, another variant ATmega8 can be used. The description of one of the salient feature *i.e.* JTAG interface, is shown in figure 4. Rest of the features is shown in figure 4 and works on the consistent pattern of this IC [8].

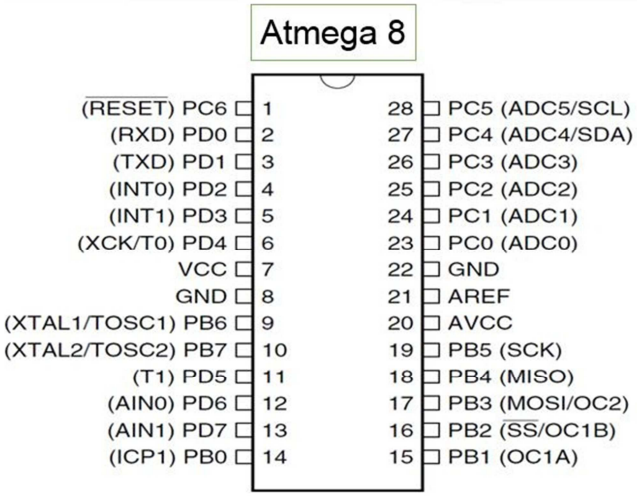

Figure 4. Pin diagram of Atmega8 microcontroller.

3.4. Embedded C

One of the popular extensions of C programming language is Embedded C. It was developed by the C standards committee to resolve the issues pertaining to different embedded systems. From the past, it has been observed that C language requires some non-standards extensions to support exotic features like arithmetic operations, memory based functions and routine input/output procedures [9]. One of the initiatives to standardize the C language to cope up with these types of problem was taken in 2008 by C language standard committee. This initiative includes number of feature including arithmetic, address spacing and general input/output hardware addressing. For measuring the charge availability, following code can be used. The emdeded source ocde used in our work is shown in figure 5. The output of the source code and generation of HEX code as shown in figure 6.

Table 3. Embedded code in C language.

```
#include<avr/io.h>
#include<avr/delay.h>
Void main()
{
DDRD &= 0<<PIND0;
PORTD |= 1<<PIND0;
DDRD |=1 <<PIND7;
While (1)
{
If(bit is clear (PIND,0)
PortD |= 1<<PIND7;
else
PortD &= (1<<PIND7);
_delay_ms(100);
}
}
```

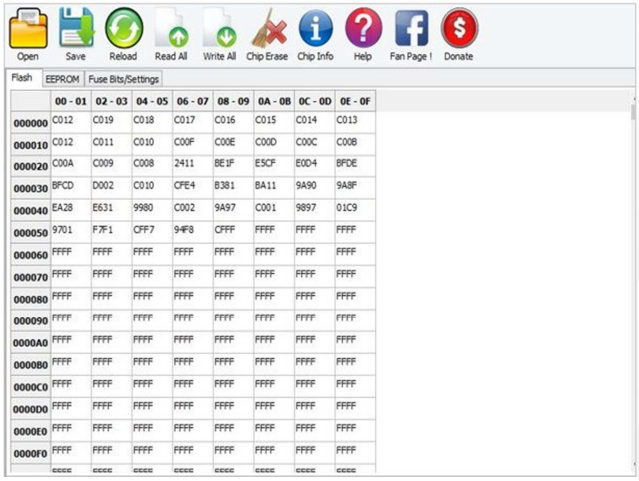

Figure 5. Hex code generated by AVR studio.

3.5. Testing Circuit Board

The pictorial representation of testing circuit board deployed in our work is shown in figure 6.

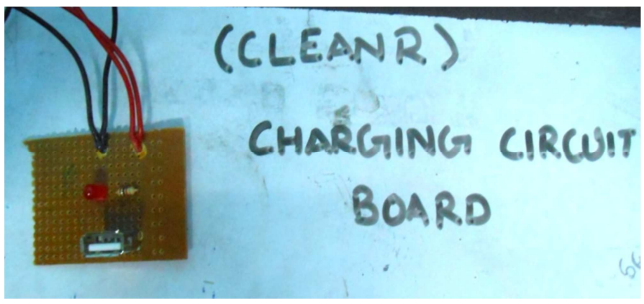

Figure 6. Testing circuit board.

3.6. Light Emitting Diode

The most common example of two head semiconductor light

source is a light emitting diode (LED). Basically, it is a PN-junction diode emitting light during activation. The principal is that when leads get suitable voltage the electrons club together in the device and releasing energy in photons form. This phenomenon is refereed as electroluminescence [10]. The light color is evaluated by the semiconductor's energy band gap.

3.7. Female USB HUB

USB-A female is the peripherals plugged into it. It is also possible to find extension cables with a female [11]. A connector and a male A connector on the other end. Standard "host" connector type. This is found on computers, hubs.

3.8. Resistor

A register may be referred as a passive two-terminal electrical component using electrical resistance as a circuit component. The major function of register is to reduce current flow and simultaneously lowering the circuit's voltage level. Generally in the electronics domain, registers limit the current flow, signal level refinement, discriminate active elements and transmission line termination with other uses. One factor associated with high power register is dissipation of high electrical power in terms of heat. It may be applied to control the motor in power distribution or in generation of test loads. Register can affect the system in slight manner through temperature change and time or voltage [12].

3.9. Thermo-Electric Cooler

The schematic diagram of the thermo electric cooler is shown in figure 7 as below.

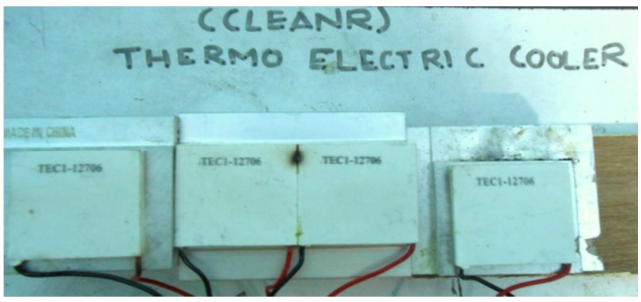

Figure 7. Thermo electric cooler.

The reason behind the thermoelectric cooling is Peltier effect which creates heat flux between two junctions of the different materials. A Peltier cooler / heater / thermoelectric heat pump transfer heat from one side of the solid heat pump to the another side. This pump consumes electrical energy as per the direction of the current flow. This instrument may be refereed as Peltier device or Peltier heat pump or solid state refrigerator or thermoelectric cooler (TEC) [13]. It can be used for heating / cooling, but the major goal of the Peltier device is cooling. This device can be used to regulate temperature depicting heating or cooling.

3.10. Heat Sink

In electronic domain, a heat sink may be refereed as a heat exchanger which cools a particular device by extracting heat from the surrounding areas. In the computers domain, heats sinks are use for central processing unit (CPU0 cooling. The major use of high power semiconductor devices like power transistors and optoelectronics are associated with lasers and light emitting diodes (LEDs). In these devices, heat dissipation ability remains very low for its temperature moderation [14]. For the development of a heat sink, the surface area should be as maximum as possible to attain better cooling with air. The cooling depends on the factors like air velocity, material selection, protrusion design and surface handing factors affecting the heat sink performance. The attachment method and interfacing material used for heat sink also affects the integrated circuit temperature. The reason for the cooling is based on thermal adhesive or thermal grease by air gap filling between heat sink and heat spreader on the particular device. Following equations (1) to (3) represent the heat transfer principal.

$$Q = mc_{p,in}(T_{air,out} - T_{air,in}) \quad (1)$$

$$Q = \frac{T_{hs} - T_{air,av}}{R_{hs}} \quad (2)$$

$$T_{air,av} = \frac{T_{air,in} + T_{air,out}}{2} \quad (3)$$

In case of the short heat sink, the use of mean air temperature is a valid assumption. On the other hand for compact heat exchanger, the logarithmic mean air temperature serves the purpose. Let m is used as air mass flow rate (kg/s) [15], the following equation (4) shows the Peltier assumption.

$$Vmax = \frac{1}{r1} + \frac{1}{r2} + r3 + r4 \quad (4)$$

4. Conclusion

This section made comprehensive investigations over the clean heat and environmental friendly aspects for the tribal region. We developed and explored a newer strategy to address the CleanR device. This device converts heat from a fire or ice into electric power. This device does not use any battery unit to store energy for recharging electronic devices. This reflects the idea of USB recharging during the fire burning event. The efficiency of the burn can be regulated by the growing ash pile, amount of fuel in the stove and the resulting heat produced by the flame. Hot ashes alone do not generate enough heat and a raging flame is required to generate the extra energy required for recharging. If you want

to cook with wood in the backcountry, get yourself a decent wood stove or make your own. If you're looking for a way to recharge USB enabled devices, we recommend you use batteries or a rechargeable power brick instead of the CleanR. This works may serve as a benchmark for the renewable power generation designers.

Conflict of Interests

The authors declare that they have no conflict of interest regarding publication of this paper.

Acknowledgement and Citations

Cases various discoveries and invention of the technologies have made a cloud of various variables that is an important part of my research. This is because all these variables are extremely important for me as these composed a diverse raw data. The inter relationship of the raw data will be extremely helpful for calculating the meaningful information. All the given information aims to new study towards seeing the future in this techno world.

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Biography

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