Solar Library

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Abstract

Access to information through libraries or the Internet is a privilege that not everyone has, especially in rural areas where, due to its dispersion, it is unlikely that they will access electricity networks or telecommunications infrastructure. In Peru, according to the world bank, 24.6% of the rural population still has no electricity.

The implementation of a physical library is not very viable due to high economic and logistic costs, this work proposes the use of photovoltaic energy to power a data server (Lachal, 2018) "Solar Library" that contains abundant information in book format, audios, videos, simulators and more; which users can access via mobile devices wirelessly without installing any additional programs or applications. The system also allows you to charge the battery of these mobile devices through the solar charger

Keywords: solar library, solar charger, photovoltaic energy,

1. Introduction

Electricity is one of the modern wonders. Unfortunately, it still does not reach all people, especially in rural areas (Nicéforo, 2019), where coverage is lower, this generates delays in many aspects, one of which is access to information (Carlos,2017), it is enough to connect to the internet and look for it, but that cannot be done where there is no internet or access to electricity (Sergio,2015).

The first thing that has to be addressed is the lack of electricity, then we could build telecommunications infrastructure (Carlos,2017) that provides information to these areas where there is no access to the internet, this work presents a proposal to help solve this problem**.**

2. Methodology

The present work was developed following the following parameters see figure 1, the system consists of a photovoltaic solar panel that captures solar energy and transforms it into electrical energy that serves to power a content server (Server library) that stores the information (information, data, music, videos, simulators and more), and the remaining energy is stored in the battery or used directly to charge electronic devices.

The Server Library allows the user to browse content as if it were the Internet, but in fact access to the contents previously loaded in the system, also if he wanted to, the user can create content and leave it on the server so that another user can make use of it allowing to generate and share more information, the user can create, upload and save data, music, videos and more.

It is an interactive server that not only saves information but also allows you to interact with its contents by making learning more entertaining.

doi:10.18086/swc.2019.52.01 Available at http://proceedings.ises.org

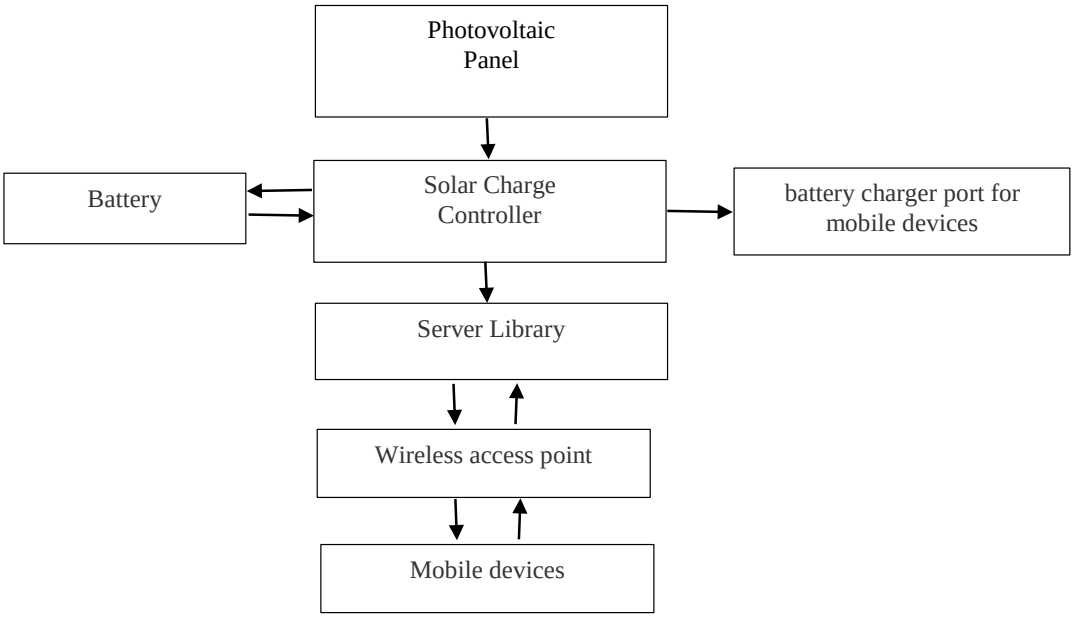

Fig. 1: General system structure

2.1. Photovoltaic panel and Solar charge controller

The photovoltaic system consists of a 200W polycrystalline photovoltaic panel connected to a pulse width modulation that manages the energy received from the panel and is responsible for charging the battery or consuming the battery according to the need for energy; This energy is delivered to server library and the charging circuit that is responsible for charging mobile devices

2.2. Energy Storage

The energy storage system consists of a 12v 50 Amp battery that allows you to have autonomy to the system for up to 36 hours.

2.3. Server Library hardware

It is the electronic device that stores all the information and supports the web server, it has very low power consumption and small size, in addition to its maintenance it is simple since it does not carry fans, another feature is that it can work directly with the direct current not which allows you to do without a DC to AC converter, the characteristics that we can specify in table 1.

Tab. 1: Especificaciones técnicas del hardware del servidor

Specifications	
CPU	Intel Atom Cherry Trail x5-Z8300 @ 1.44 GHz
# of Cores	4
# of Threads	4
Lithography	14 nm
Cache	2 MB
RAM	DDR3L 2GB
Connections	3 x USB 2.0 - 1 x USB 3.0 microSD, HDMI, VGA, Conector mini jack stereo, RJ45
Max power consumption	15 W

2.4. Wireless access point

It is the electronic device that allows access to the server wirelessly, being able to attend simultaneously more than 30 users at the same time; It has a very low power consumption 3.5W at most per hour, and works in direct current, connects to the RJ45 port server, for more technical characteristics see table 2.

Tab. 2: Technical specifications of the server hardware

Specifications	
Product code	RB941-2nD-TC
CPU	QCA9533
CPU core count	1
CPU nominal frequency	650 MHz
License level	4
Operating System	RouterOS
Size of RAM	32 MB
Storage size	16 MB
Storage type	FLASH
Tested ambient temperature	-20°C to 70°C
Max power consumption	3.5 W
Wireless 2.4 GHz standards	802.11b/g/n
Wi-Fi generation	4
Wireless 2.4 GHz Max data rate	300 Mbit/s
10/100 Ethernet ports	4

2.5. Server Library software

The content used on this server is free to use, both software and information. We must point out that there are currently many communities around the world that develop free software and content, these communities are on the rise, Wikipedia is one of the best known examples, they are dedicated to consolidate information and facilitate its access; Ubuntu 18.04.2 (Ubuntu, 2018)was used in this project as an operating system, Vesta as a web server, the Kolibri learning suite (kolibri, 2018) that works with the content of Kan Academic see figure 2, Jellyfin multimedia server (ellyfin, 2018) that allows to share visual audio content see figure 3, Kiwix (kiwix, 2018) was also used that allows access to Wikipedia without an Internet connection see figure 4.

All this is a sign that there is a great effort to facilitate access to information in areas where there is no internet, and we want to take these efforts to areas where there is no internet or electricity.

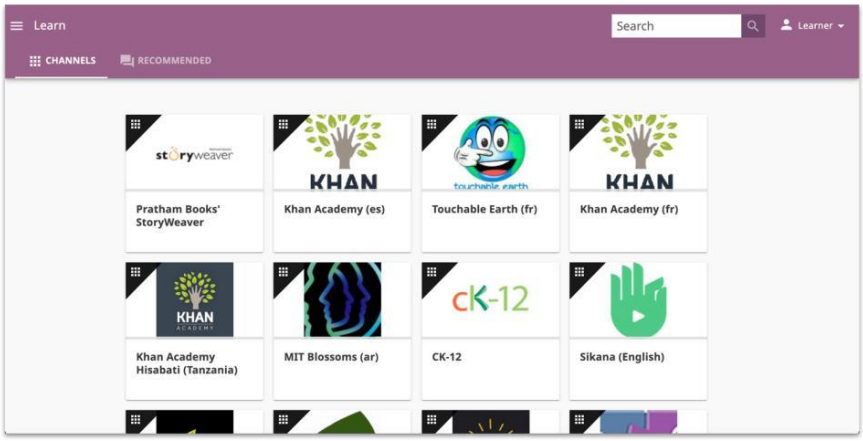

Fig. 2: Kolibri learning suite

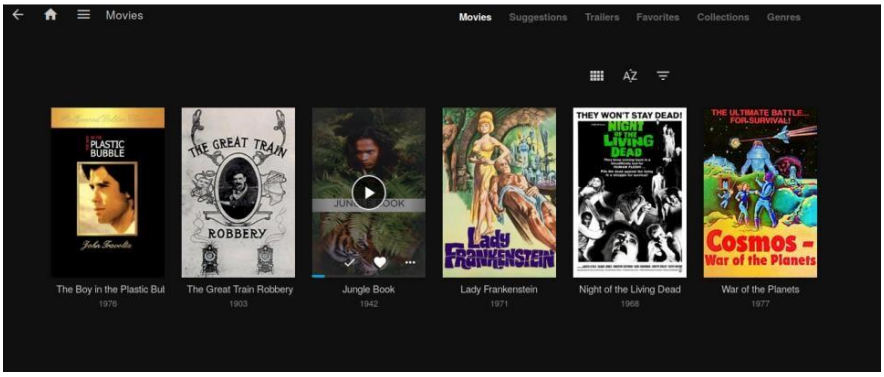

Fig. 3: Jellyfin multimedia server

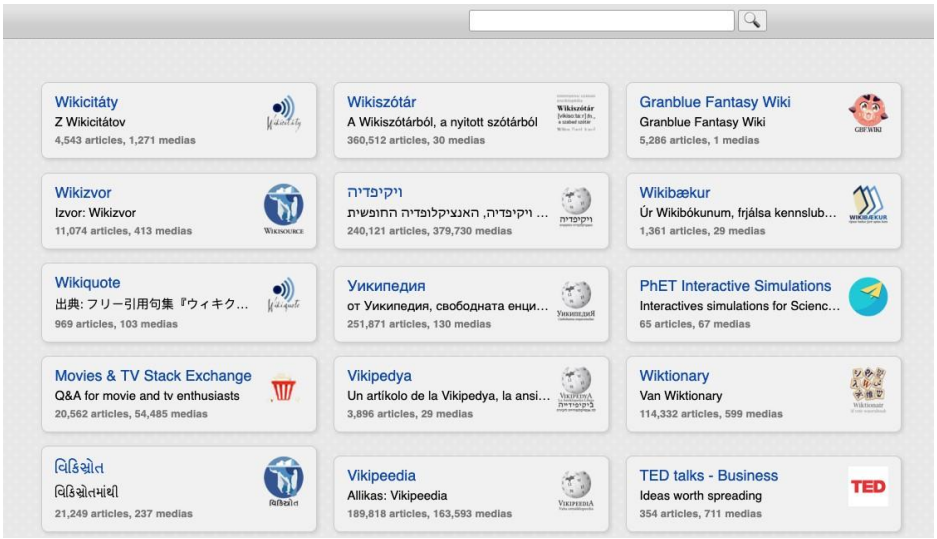

Fig. 4: Kiwix

2.6. Usability

To use the Solar library, just have any electronic device that has Wi-Fi and a web browser, it could be a tablet, cell phone, laptop, etc.
No additional software or application is required, just connect to the server and start enjoying the content.

3. Results

3.1. Modulo solar library

The construction process of the Solar Library is as follows see figure 5, there we can see that the system consists of a hexagonal wooden bench with a central axis surrounded by a circular table, with access to 4 charging ports of battery of mobile devices, above is a box where the charge controller, the content server, the access point and the energy storage are located; higher up as a roof we have a rectangle that serves as an umbrella and in turn contains the photovoltaic solar panel.

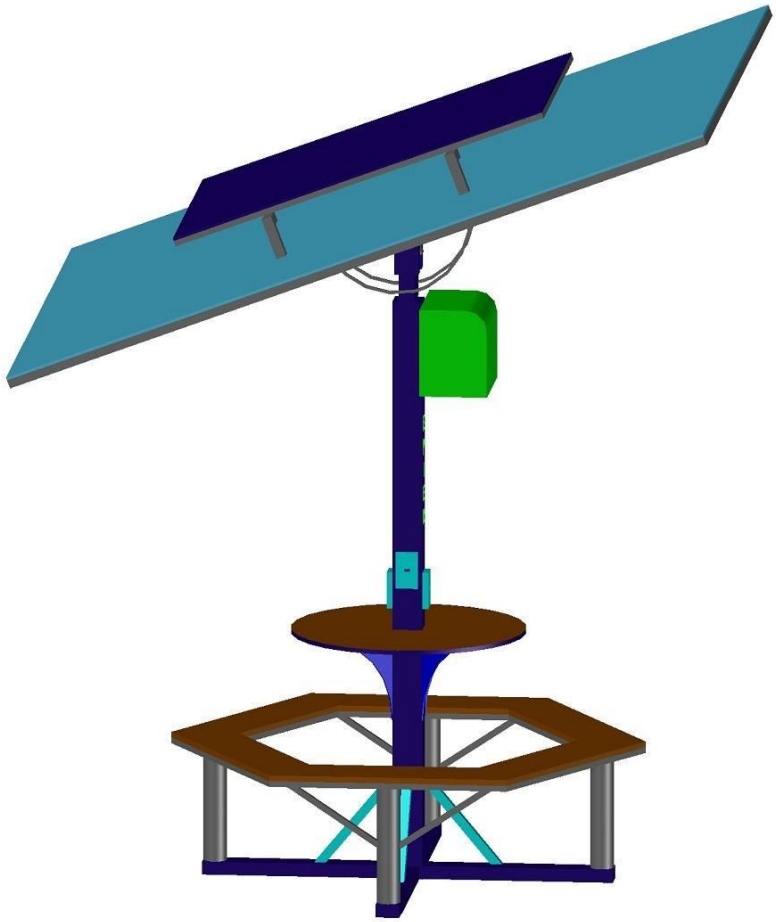

Fig. 5: Modulo solar library

3.2. Energy performance

The system has been tested for several months, although the harvest of solar energy through the solar panel is fluctuating with a maximum of 1276W per day, a minimum of 541W per day and an average of 971W per day; the energy consumption by the server and access point has been relatively constant, with a maximum of 361W per day, a minimum of 323W and an average of 342W per day; See figure 6.

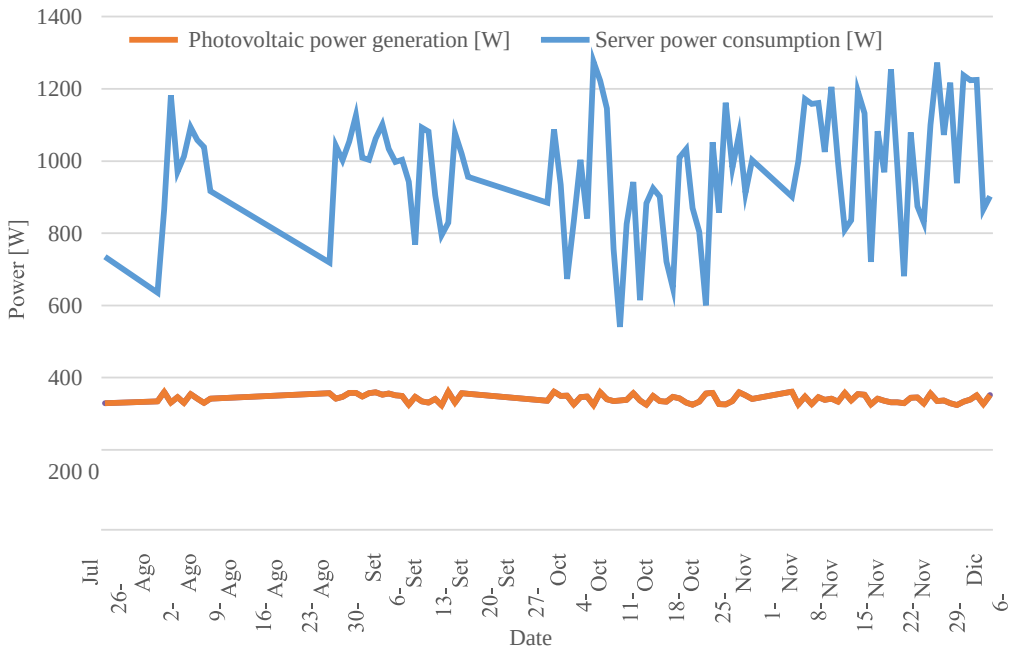

Fig. 6: Energy performance of Solar Library

4. Conclusions.

The Solar Library uses photovoltaic solar energy to operate, the 200W module that has enough energy to operate, in addition to the surplus it produces, allows you to charge cell phones and tablets from the Library users, this module has data content, videos, music, simulators and more free license, also allows users to feed the library by adding more motivating content to increase the community, the module also has a seating system that allows the user to stay for long periods.

5. Acknowledgments

Our thanks to the communities that develop free access content, also to our dear students of the professional school of engineering in renewable energies of the Universidad Nacional de Juliaca.

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