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Design of an energy capture system

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Abstract
An investigation by the Cooperative University of Colombia [1], related to the location of telecommunications antennas in a city in Colombia is analyzed. In the same way, important elements such as radio frequency (RF) waves are present, emitted by different devices located in different communes. Then there is the possibility of designing a system that allows the collection of energy according to the radio frequency (RF) waves emitted from a city in Colombia, the above is known as energy harvesting, which basically allows a process to be carried out. capturing small amounts of energy supplied by natural sources such as light, heat and vibrations.

The energy harvesting system takes advantage of the lost energies of the different electronic devices, to then capture electromagnetic waves through an antenna that collects the direct current, and in this way to be able to wirelessly charge low-power devices. With the design of the system, we proceed to verify the amount of easily acquired electronic elements, verify how much energy can be captured and determine the capacity to power small devices essential in different activities.

Keywords: *Energy capture; Antennas; Radio Frequency Waves; Device.*

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Diseño de un sistema de captación energética

Resumen
Se analiza una investigación por la Universidad Cooperativa de Colombia [1], relacionada con la ubicación de las antenas de telecomunicaciones en una ciudad de Colombia. De igual forma se tiene presente elementos importantes como las ondas de radiofrecuencia (RF), emitidas por distintos dispositivos ubicadas en las diferentes comunas. Seguidamente se da la posibilidad del diseño de un sistema que permita la recolección energía según las ondas de radio frecuencia (RF) emitidas de una ciudad de Colombia, lo anterior es conocido como cosecha de energía (Energy harvesting), que básicamente permite realizar un proceso de captura de pocas cantidades de energía suministrada por fuentes naturales como es el caso de la luz, calor y vibraciones.

El sistema de captación de energía aprovecha las energías perdidas de los distintos dispositivos electrónicos, para luego captar ondas electromagnéticas mediante una antena que recolecta la corriente directa, y de esta forma poder cargar inalámbricamente dispositivos de poca potencia. Con el diseño del sistema, se procede a verificar la cantidad de elementos electrónicos de fácil adquisición verificar cuanta energía se puede captar y determinar la capacidad para alimentar aparatos pequeños indispensables en diferentes actividades.

Palabras clave: *Captación de energía; Antenas; Ondas de Radiofrecuencia; Dispositivo.*

Projeto de um sistema de captura de energia

Resumo
É analisada uma investigação da Universidade Cooperativa da Colômbia [1], relacionada com a localização de antenas de telecomunicações em uma cidade da Colômbia. Da mesma forma, estão presentes elementos importantes como ondas de radiofrequência (RF), emitidas por diferentes dispositivos localizados em diferentes comunas. Em seguida, existe a possibilidade de projetar um sistema que permita a captação de energia de acordo com as ondas de radiofrequência (RF) emitidas por uma cidade na Colômbia, o que é conhecido como captação de energia, o que basicamente permite a realização de um processo de captação. pequenas quantidades de energia fornecidas por fontes naturais como luz, calor e vibrações.

O sistema de captação de energia aproveita as energias perdidas dos diferentes dispositivos eletrônicos, para então capturar as ondas eletromagnéticas por meio de uma antena que coleta a corrente contínua e, dessa forma, poder carregar dispositivos de baixa potência sem fio. Com o projeto do sistema, passamos a verificar a quantidade de elementos eletrônicos facilmente adquiridos, verificar quanta energia pode ser captada e determinar a capacidade de alimentar pequenos dispositivos essenciais em diferentes atividades.

Palavras-chave: *Captura de energia; Antenas; Ondas de radiofrequência; Dispositivo.*

Introduction

Energy is collected from natural sources to be accumulated and stored, to later be used for a special purpose. In a city in Colombia there is a proliferation of telecommunications antenna located in a different community, with significant amounts of radio frequency that is possibly affecting the health of its inhabitants. The above is considered as an opportunity to identify a type of prototype or important elements that lead to the construction of an energy harvesting system with the amount of radio frequency existing in the context that will later be reused.

Problem

There are 71 telecommunications antennas located in different communes in a city in Colombia, with the concern that it does not use the budget for decree 0162 of 2014. On the other hand, the research by Tovar (2015), carried out at the Cooperative University of Colombia in The city of Neiva has 83% of those that fail to comply with the decree to be implemented in the city. With the foregoing, the increased risk to health is logical, due to non-compliance with the standard, the generation of non-ionizing radio-frequency electromagnetic fields (EMF-RF) is evident [1]. Worldwide, people require electronic devices for their daily activities, interacting with electromagnetic fields constantly and without realizing they are experiencing a type of invisible pollution that radiates from their bodies. In the case of mobile devices such as smartphones, they require radio frequency (RF) waves. These RF waves are different from the types of radiation (ionizing), such as X-rays, gamma rays, ultraviolet light, which break chemical bonds in DNA. RF waves at high levels can heat the tissues of the human body.

Objective

Design of an energy capture system for use in the surroundings of the communes that present concentration of Radio Frequency (RF) waves in a city in Colombia.

Methodology

For the development of the research process, a qualitative methodology is used, and as part of the information gathering techniques, a technical sheet and the design of a prototype for energy collection are used. The collection of energy occurs in small amounts as a product of light, heat and vibrations, thus improving the use of energy available in the environment, to be accumulated and stored [2].
Sunlight and mechanical vibrations are fundamental elements for collecting RF signals obtaining clean energy through electromagnetic waves radiated from various communication systems, finding that RF and microwaves receive a great impulse [3].
Free energy is the energy found in the environment but in quantities that cannot be used in work, for its collection an energy capture system is used to then condition, store it and be able to use it as shown in Figure 1, RF-based energy harvesting architecture takes advantage of the large number of antennas located in the different communes of the city as shown in table 1. The trend is to be able to collect energy by RF with the designed prototype that uses electromagnetic waves using an antenna and converts it into direct current that will be charged wirelessly in different low-power devices.

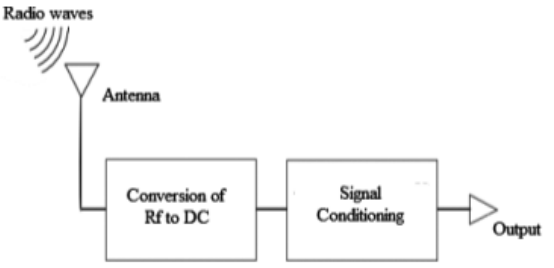

Figure 1. Based energy harvesting system RF [6].

Table 1. Antennas by commune.

Commune	Amount of antennas	Owner
1	7	Tigo, Movistar, ETB and claro.
2	3	Claro.
3	9	Tigo, Movistar, ETB and claro.
4	14	Tigo, Movistar, ETB and claro.
5	7	Tigo and claro.
6	8	Movistar and claro.
7	6	Tigo, Movistar and claro.
8	6	Movistar and claro.
9	6	Movistar and claro.
10	5	Claro.

Next, the electronic devices that make up the circuit shown in figure 2 are described.

Antenna: it is a normally metal conductive device, designed with the aim of emitting and / or receiving electromagnetic waves from the air to process them until a direct current is achieved. The RF is in a range of 30 Hz to 300 GHz. Therefore, it is convenient to use an antenna that captures VHF (Very High Frequency), frequencies that occupy the range of these frequencies [4].

Capacitors: a capacitor is a passive electronic component in an electrical circuit that connected to other electronic devices is responsible for storing energy. Capacitors together with the help of a diode can convert alternating voltage signals into direct voltage [5].

Diode: a diode is a semiconductor-type electronic component that is essentially used as a switch to the current in only one direction. Its function in an electrical circuit is to allow current to flow in one direction, but it does not allow current to flow in the opposite direction. Diodes are also known as rectifiers because they change signals from alternating current (AC) to pulsating direct current (DC) [6].

Result

The result of this project was a low-cost prototype that allows us to capture the free energy found in the environment and transform it into useful energy to power other electronic devices. Figure 1 shows the architecture of the device used for energy harvesting, takes advantage of the electromagnetic signals that are captured by an antenna which takes the energy to the electronic prototype where the conversion of rf signals to direct current pulsating CD that is stored in capacitors is carried out to later be used. Table 1 shows that there are 71 antennas located in the different communes of a city in Colombia. Figure 2 shows the electrical circuit of capacitors and diodes that constitute the main elements of the device used for the capture of the energy “energy harvest” that transport the electromagnetic waves of RF that are captured by an antenna, the function of the first condenses.

Figure 3, shows the developed circuit where electronic devices are used, 2 input capacitors to store energy, a circuit of 4 current rectifier diodes, and 2 electrolytic capacitors to store the output energy. Capacitors can vary in value, their value can be about 100 microfarads running at 16 volts, diodes must be of the following nomenclature 1N34, OA70, 1N4148 low voltage drop.

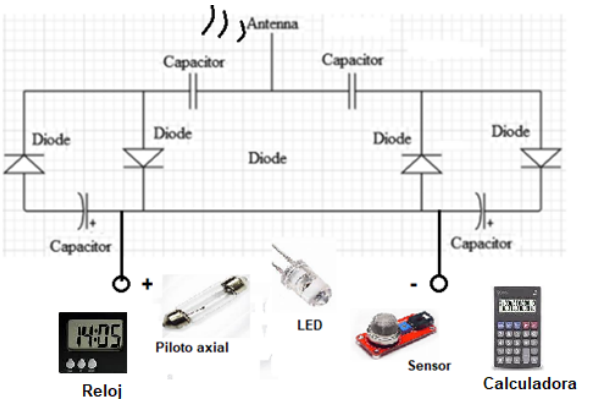

Figura 2. Electric circuit - prototype.

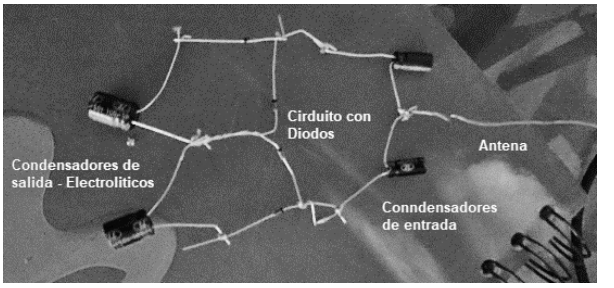

Figure 3. Energy harvesting system.

The circuit serves to take advantage of the energy carried by the RF electromagnetic signals present in the environment and convert them into a useful voltage, we know that we are surrounded by a multitude of electromagnetic waves, there are television, radio, wifi, cell phones, telecommunications antennas, among others and all these signals carry energy which can be converted into electrical energy.

The circuit works by collecting the RF electromagnetic waves through an antenna, the energy of the waves is stored in two input capacitors that after a certain time is discharged through the diode circuit that rectify the current and convert it into pulsating direct current stored in the two output electrolytic capacitors.

The energy stored in electrolytic capacitors is used to activate very low consumption devices, probably an axial pilot, an LED, a clock, a calculator or a sensor.

Conclusion

It can be said that the technological advances that have allowed the construction of many equipment for the emission and capture of rf electromagnetic signals have turned our living space into an ocean

through which many radio frequency signals travel simultaneously.
Aware of the above, a prototype of an electronic device was designed and elaborated for the capture of the energy “energy harvest” carried by these RF electromagnetic waves to later take advantage of it for the benefit of humanity in the activation of light signals or very low power devices such as sensors. In addition, the prototype benefits the environment because it is one of the many ways to generate clean energy.

Originality

This work of design and development of the low-cost prototype to store energy was carried out by a community of researchers concerned about contributing to the generation and subsequent use of clean energy in Colombia. The device can be used in places where the energy carried by radio frequency signals is evident.

Limitations

Lack of knowledge about the RF electromagnetic signals emitted and picked up by electrical devices used in the home, in the company, in industry, as well as the little appropriation of the community for their use.

Where:

RF: Radio frequencies.
VHF: Very high frequency.
EMC: Electromagnetic fields.
CD: Direct current. AC: Alternating current.

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