An electrical distribution panel for DC and AC currents or voltages

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Abstract:

With the advance of green energy; many properties and houses installed solar panel for electricity generation either to reduce the cost of the electrical bills or to prevent the global warming or environmental protection reasons. It is supposed to be more convenient to connect this power source to all the appliances in the house or property, because the cost of connecting this power source to operate few appliances is not a desirable to households. Since these sources like solar panels, wind turbines, hydropower from water turbines,…etc. need batteries to store the energy when they used by end-users to provided energy when the source of alternate to the down state (cannot generate power). For example, when the sun set, or the winds and the water current calm.

Introduction:

Electricity by its nature of generation is alternating. For example, generating power from winds, water current, sun,…etc. at a time the source of generation is available and at another is alternating and is not available. When the generation of power transferred from enterprise to the consumer it must be stored in batteries because the enterprise links the power sources to the transmission lines; if a source is alternating to the down state, the other source is alternating to be in operating state and up to generate power. Thus, the extra cost of batteries is not needed as in the case of the consumer or the leaf of the tree in the network (end-user).

Electricity generation nowadays is not limited to be done in enterprise corporations or governmental sectors due to the low cost of solar panel and the solar systems. However, new connections for this power source adds up on the cost of installation; if the premises are ready with distribution panels that get the power from many sources with different types. For instance, DC current or voltage, AC current or voltage then convert the power source that need to be converted (The DC) to the standard that the appliances need in each region such as 110V for the US and 220V for Europe. A panel that has this feature will also help the residents in many premises to be supplied by the power without discontinuity because it has an indicator that checks the power in the batteries and when the batteries died, and need to be charged by the environmental sources (solar panel); the panel should get

its power from the electricity provider either an enterprise corporates or the governmental sectors.

The second scenario is changing the existence electrical system in the buildings and in manufacturing appliances, devices, machines. Change the system to be distributed as DC in buildings and convert the power from provider from AC to DC. Machines, appliances, and devices replace their extra circuits for converting electricity from AC to DC by circuits that notify the outlet (electricity socket) with the needed DC voltage and DC current.

Limitation:

Different region that the experiment can take a place at. The devices and appliances that are using DC directly from the outlet (socket) without power converter (AC to DC).

Methodology:

A descriptive research that classify the available systems commercial for the use of hyper systems and a suggestion of improvements.

Literature Review:

Power was generated in early centuries by burning things like coal, Peat, Fuel oil, Natural gas, Oil shale,…etc. Later, Wind farm, Hydroelectric such as Conventional and Run-of-the-river were the new way of generating a renewable power. When the science advanced in physics nuclear power was another method of non-renewable energy by generating heat from nuclear reactions to generate electricity. Exploring more options for power generation [1], were introduced to the world when the photovoltaic cell was invented in 1946[2].

There are many types of outlet (electrical socket) Type A – Type O. In addition, most of the devices use additional circuits to convert electricity from AC to DC such as the laptop that I use to write this document is using an adaptor that convert AC power input (100V-240V ~ 1.7A 50-60Hz) to (20V ⎓ 2.25A) DC power output. This adapter and the protection circuit inside the laptop can be replaced by a circuit (A small storage that stores the values of the voltage and current requirements) that send the values in the storage of the power requirements to the variable outlet(electrical socket) and the socket that receives its maximum DC power from the DC distribution panel can be designed in a manner similar to the Adjustable Digital DC Power Supply with Automation. The Automation can be at

the socket level (smart socket that adjust the maximum power it receive to many levels) or at the distribution panel level (smart distribution panel that receive the sockets power needs and send it to them) and socket only sends the power requirements to the distribution panel when a device is connected. Scaling the voltage to the desired value can be achieved by different ways, one of them is using converters as described in [3]. The method is a reverse of the achieved method in [4].

Discussion:

The proposed solutions to reduce the cost of supplying buildings with continues power are:

1) Installing an electrical distribution panel that converts DC power source such as solar power to AC.

This solution is the one that is achievable nowadays. In many existing buildings, when solar power is introduced by engineers; the introduced solar system is installed to supply few machines and appliances that use separate power network. Thus, the system needs to use batteries to store its power to be used when the source is in the down state.

The solution that is proposed to utilize the needs of the building occupants. Either, reduce the cost of the electricity bill, linking the solar system to the distribution board without the use of batteries; or the non-stoppable electricity supply by making the batteries the source of power to the distributed panel and charge them by the available power sources. In both cases, an electrical distribution panel that accepts AC and DC as input and supply the building by AC power as output is required. A board similar to one in Appendix A. In such a board, the building is supplied by power from batteries until the power storage in the batteries is exhausted. When the power storage in batteries is exhausted, the sensor will send this information to the microcontroller or the board logic which will make the board changes the supplying input to the AC line that is from the electricity company (the meter).

An alternative solution is using an electrical distribution panel that accepts only AC as an input. Supply this board from batteries after the batteries power is converted by a converter. Link the solar power source and the AC power source coming for electricity company (the meter) after it converted to the batteries for charging them. This solution adds extra cost for extra batteries and converters.

2) Adopt a new method for DC cabling in building with DC electrical distribution panel and DC electrical sockets.

This solution requires more time until manufacturers introduce the first machine, appliance, or device that uses this method.

By using this solution, the long-term cost will be reduced since an AC to DC converter that converts the power coming from electricity company is needed but the existing buildings will face an overhead cost from changing their legacy power system.

The different types of electrical sockets (Type A – Type O) that are used over the world will be considered obsolete since the new electrical socket uses extra feature (reading data from the connected load) a USB like connector, in addition to the positive, negative, and ground(or earth) connectors.

The logic (Microcontroller or CPU) that change the voltage is preferable to be at electrical distribution panel to reduce the cost of electrical sockets (outlets).

Results:

To methods of improving the power supply at the end-user level were introduced. The first one is the one that is more achievable and the second one requires a cooperation from many parties over the world. If we take a look at the number of electrical socket types and the standard voltages and frequencies over the world, we will know that achieving this solution cannot be in the near future.

Conclusion:

In conclusion, a panel similar to the one in Appendix A, is required to improve the supply of power to homes or add complexity to electrical system that has many different types of sources, transmissions, loads, and sockets.

Future research can be conducted in a new electricity world that uses DC as supplying method, from power generation to end-user by challenging ideas such as receiving DC electricity for the power companies.

References:

[1] Lashkaryov, V. E. (1941) Investigation of a barrier layer by the thermoprobe method.

[2] "Light sensitive device" U.S. Patent 2,402,662 Issue date: June 1946.

[3] How to Dynamically Adjust Power Module Output Voltage (Application Report SLVA861–December 2016), TEXAS INSTRUMENTS, available online https://www.ti.com/lit/an/slva861/slva861.pdf

[4] "Methods and systems for operating a power generation system", U.S. Patent US8614525B2 Issue date: December 2010. Online (https://patentimages.storage.googleapis.com/1d/00/ea/816b4afe2c7311/US8614525.pdf)

Appendix A