**Title: Module 2 Assignment - Annotated Bibliography**

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**Abstract**

I am writing this Annotated Bibliography based on the reference taken and cited below. As we all know that Studer Innotec is an energy solutions company that mainly focuses on manufacturing its inverters, chargers, and controllers in Switzerland. The products that are developed by this company are being used and applied for various uses like off-grid, onboard maritime, self-consumption, and safety. Their equipment is built in a sleek way that is easy to plug in and backed by rick customer support. The device is required to meet unique needs in addition to the fundamental capability of recharging batteries. It has to provide resilience in the event of equipment damage and operate at heights of over 7000 meters. Studer technologies have been shown to operate in the harshest environments, making them the obvious choice for our application. Studer also gave extensive expert advice in calculating the instruments' functionality under severe environments.

**Research Findings**

Muller (2014) found "that the renewable energy is critical in all off-grid operations due to the battery capacity and expenses. To develop a stable and cost-effective network, all conceivable measures to minimize power demands and boost part performance must be implemented" (p. 4); The performance of the solar PV is dramatically reduced due to the non-linear properties of solar PV and environmental circumstances. As a result, the full power production of a solar PV system varies as irradiance and weather patterns change. The researchers of [2] explain several maximum power tracking approaches in-depth to reach maximum power. Furthermore, a charger adapter with a power converter is essential for maximizing the transmission of electricity powered by solar PV to a large battery. Series, parallel, PWM, and MPPT charge regulators are by far the most prevalent kinds of solar PV power systems. The series controller makes use of a control system that is wired in series seen between the PV array and the batteries. Due to the obvious present limits of parallel controllers, this form of charge controller is commonly employed in tiny size PV systems, although it could also be used for bigger systems. Through short-circuiting the PV array inside the controller, the shunt charge controller controlled the charging of batteries from the arrays. The controller's function is efficiently examined by analyzing multiple experimental situations, and the particular information demonstrates the system's usefulness. The properties of the suggested controllers are also discussed in the text, as well as the advantages and disadvantages of current techniques. The suggested charging controllers are designed with a low-cost alternative in mind, and it simplifies the circuitry.

Renewables generation systems have been used to address rising electricity needs while also reducing climate change. Solar is the most viable option among the numerous renewables. However, when compared to alternative sources, the photovoltaic system only transforms 30–40% of direct solar radiation into electricity. For a long period, a substantial study has been conducted to verify the effectiveness of PV systems and study the different difficulties associated with the optimal utilization of solar PV systems in process of extracting the most yield from them. Due to the closed-loop system monitoring of solar light, the MPPT controller's tool generates oscillations. The use of filter circuits can prevent this. The resulting signal is fed into energy electrical equipment such as DC-DC converters and inverters. A solar (PV) network is a combination of solid-state semiconductor technology that produces electricity when illuminated. A photovoltaic cell is a component that makes up a solar panel. A solar component is made up of several solar cells connected in series and parallel. PV arranged in series to obtain optimum electrical output, and in parallel to reach the optimal output.

Khatibi (2017) found “that when incorporating storage resources, the systems become ever more dependable in periods of low production. Furthermore, a charge controller, which can control the charge/discharge cycle, ensures the program's proper operation. These systems should be capable of storing extra energy into electricity during periods of high output and give the required amount of electrical energy during periods of poor output" (p. 1). A quality current battery controller must be able to preserve the current battery controllers against severe draining and overcharge, which would be a critical component in extending the current battery controller's lifespan. The PV state's power generated fluctuates with changes in temperature and irradiance. It is critical to increasing the charger's effectiveness. To run the PV system at MPP, a variety of MPP monitoring (MPPT) technologies are available. The P&O approach measures MPP consistently and calculates the operational level at which the batteries can produce peak energy while irradiation and temperatures are stable or result in a variety.

To discover this forever evolving MPP, the Maximum Power Monitor employs an incremental algorithm. The hill ascending algorithm is the name for this incremental way. To accomplish MPPT, the key enabling the voltage from the solar panel by a tiny portion and monitor’s power; if the power is increased, the controller tries more changes in the directions until power no more rises. The voltage to the solar panel is raised at first, and if the output increases, the voltage is raised again until the power output begins to decrease. The voltage to the solar panel was reduced as the output fell until the power factor was achieved. This procedure is repeated until the MPPT is reached. Increased dependability – Fans are frequently the sole element on a controller with mechanical components. By removing the fan, you are removing among the most shared spaces of failures. Extended life — Fans attract debris, grit, or even bugs, which jam the charging controller's internal components and limit its lifespan. Improved efficiency — Fans require power to operate, which is provided by the solar energy streaming through the cells. Fans in the network are a "parasitic load," draining and using electricity that could go to.

Programmable charging parameters are common on small controllers. If such presets do not meet the recharging needs, a controller with much more programming possibilities might be chosen. Simple tweaks to voltage breakpoints, applications, or surroundings are examples of customized configurations. For instance, a device that does not cycle frequently can be established with a shorter everyday absorbing period, or the period first before batteries are put into floating. Studer Innotec’s Varia Track MPPT solar charging controller adds a VariaTrack charge controller with maximum power point tracker (MPPT) to any solar panel system to optimize the total energy. VariaTrack is a solar charge controller that uses Algorithms to continuously track the MPP and recharge as efficiently as possible with all accessible solar power.

Kroposki (2007) found that, “In lesser, small mini-grids with centralized generating, these systems are often the simplest to deploy. The issues get more difficult when energy levels rise and the network grows bigger and much more distributed regionally. A decrease in the accessibility of off-the-shelf products and parts heightened effective communication between network components increasing concerned about maintaining voltage control over the mini-grid” " (p. 5). More R&D of control components and systems for massive, dispersed mini-grids is required. New data analysis techniques frequently lead to algorithms that can aid in the prediction of energy utilization and off-grid systems.

Advanced analytics is producing a lot of excitement amongst scholars and scientists, and it's being used in a multitude of sectors at a quick pace. I want to investigate new predictive analytics innovations and how they impact decision-making in energy firms like Studer Innotec. Power systems companies are switching to predictive modeling to gain new knowledge from data. Out of little data to large processes, data mining may aid in the investigation of new pathways for efficiency and expansion, the development and preparation of plans and practices, the strengthening of the quality of service and procedures, the enhancement of durability, and the minimization of losses. This will be simple for Studer Innotec to analyze and assess vital strategic data, which can advance its services and goods.

**References**

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[3] Kroposki, B.; Pink, C.; Lynch, J.; John, V.; Daniel, S.M.; Benedict, E.; Vihinen, I.; "Development of a High-Speed Static Switch for Distributed Energy and Microgrid Applications," Power Conversion Conference - Nagoya, 2007. PCC '07, Conference Record, pp.1418-1423, 2-5 April 2007