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Topic of Research: Optimal Conversion of Noise Pollution Into Electricity

Findings:

Key Words: Noise Pollution, Sound Pressure Level, Energy Conversion, Controller, Intelligent Techniques.

Noise pollution is the unwanted sound energy present in the environment. The activities related to transportation, construction, and gatherings indirectly cause sound pollution. Noise pollution is the sound louder than a certain loudness level, creating stress and strain on the hearing. The loudness of the sound is the measure of noise pollution. The noise is determined as sound pressure level. Sound pollution is a by-product of modernization and urbanization.

Noise is a pervasive environmental concern that has a harmful impact on human well-being, the ecosystem, and quality of living.

Harvesting noise pollution as a renewable source of energy is a novel and sustainable solution to address the global energy demand and mitigate noise pollution to a certain level. Harnessing noise pollution from the environment for energy harvesting to compensate for the increased electricity requirement involves various processes such as energy collection process, electrical energy conversion process, optimization of the electrical energy, and energy storage.

In the presented work, a system is designed to utilize the sound pressure level of the noise pollution present in the environment and transform it into usable electrical energy. The noise pollution energy conversion system (NPECS) changes noise pollution in electrical signal, which can be utilized to power small-scale appliances, street lighting, and remote area surveillance. The process involves the collection and conversion of the sound pressure signal into a low-level electrical signal, and amplification and rectification of the electrical signal to improve the signal's quality. The development of the NPECS involved various types of energy transduces in different configurations and at various environmental conditions the results are collected and analyzed.

The main concern of the sound pressure signal is the nonlinearity and uncertain occurrence of noise pollution. The nonlinearity of the transformed electrical signal increases as the energy conversion takes place. It becomes necessary to implement a controller to reduce the

nonlinearity and improve the electricity generation. To optimize the performance of the NPECS system, the nonlinearity of the SPL signal and the weak intensity of the generated electrical signal must be taken into consideration. The optimal conversion of noise pollution into electrical energy involves the application of intelligent techniques for reducing the nonlinearity from the noise pollution signal as well as optimizing energy production.

ANN (Artificial Neural Network) is a software technique that imitates the human brain's structure and functions. It is used to recognize, classify, and extract the data from the dataset. The ANN controller is used to optimize the performance of the NPECS system. The ANN controller improves the output level and reduces the nonlinearity as compared to the conventional NPECS model.

A distributed behavior algorithm inspired by the bird-flock movement, and known as Particle Swarm Optimization (PSO) is used for controlling the presented model. A Poisso-PSO (Particle Swarm Optimization) controller is developed to optimize the performance of the NPECS. The Poisso-PSO controller is a combination of the Poisson distribution and the PSO algorithm.

The occurrence of noise pollution is unpredictable over time and is similar to the Poisson distribution. The mean and variance of the Poisson distribution are equal. This feature of the Poisson distribution can provide stability to the NPECS system. The optimization of the noise pollution energy conversion system is a multi-objective optimization. The Poisso-PSO controller addressed the problems of the energy conversion process and provided improved outcomes as compared to the ANN controller and conventional approach. The electrical signal generated from the noise pollution is optimized using the developed controller. The integration of the wireless sensor network and Internet of Things with the NPECS system can be utilized to power the remotely located surveillance system, lighting system, and monitoring systems, such as air-quality monitoring systems, over-speed monitoring systems, biomedical devices, etc.