

**CHENNAI – PONDICHERRY**

**Combining Solar Energy Harvesting with Wireless Charging for Hybrid Wireless Sensor Networks**

**Abstract:**

The application of wireless charging technology in traditional battery-powered wireless sensor networks (WSNs) grows rapidly recently. Although previous studies indicate that the technology can deliver energy reliably, it still faces regulatory mandate to provide high power density without incurring health risks. In particular, in clustered WSNs there exists a mismatch between the high energy demands from cluster heads and the relatively low energy supplies from wireless chargers. Fortunately, solar energy harvesting can provide high power density without health risks. However, its reliability is subject to weather dynamics. In this paper, we propose a hybrid framework that combines the two technologies – cluster heads are equipped with solar panels to scavenge solar energy and the rest of nodes are powered by wireless charging. We divide the network into three hierarchical levels. On the first level, we study a discrete placement problem of how to deploy solar-powered cluster heads that can minimize overall cost and propose a distributed 1.61(1 + ǫ)2-approximation algorithm for the placement. Then we extend the discrete problem into continuous space and develop an iterative algorithm based on the Weiszfeld algorithm. On the second level, we establish an energy balance in the network and explore how to maintain such balance for wireless-powered nodes when sunlight is unavailable. We also propose a distributed cluster head re-selection algorithm. On the third level, we first consider the tour planning problem by combining wireless charging with mobile data gathering in a joint tour. We then propose a polynomial-time scheduling algorithm to find appropriate hitting points on sensors’ transmission boundaries for data gathering. For wireless charging, we give the mobile chargers more flexibility by allowing partial recharge when energy demands are high. The problem turns out to be a Linear Program. By exploiting its particular structure, we propose an efficient algorithm that can achieve near-optimal solutions. Our extensive simulation results demonstrate that the hybrid framework can reduce battery depletion by 20% and save vehicles’ moving cost by 25% compared to previous works. By allowing partial recharge, battery depletion can be further reduced at a slightly increased cost. The results also suggest that we can reduce the number of high-cost mobile chargers by deploying more low-cost solar-powered sensors.

**Existing System:**

Among a variety of harvesting techniques, solar harvesting through photovoltaic conversion enjoys the highest power density, which is renewable and risk-free. In practice, a solar panel commensurate with sensor’s size is sufficient to meet the energy demands of cluster heads. However, availability of sunlight is subject to dynamics in the environment. Not only weather conditions would have a direct impact on the harvesting rates, but also a series of spatial-temporal factors such as sunrise, sunset times, locations and their surroundings would affect deployment decisions of harvesting sensors.

**Proposed System:**

In this paper, we propose a hybrid framework to make use of their advantages and overcome their drawbacks. In the new framework, a majority of nodes are wireless-powered nodes (WNs) due to the low costs of charging coils. On the other hand, due to the relatively higher manufacturing and deploying costs, a small number of solar-powered nodes (SNs) are responsible for aggregating data. Normally, a fleet of MCs roam over the field to serve recharge requests from WNs and collect data from SNs. In contrast to WNs, SNs’ energy from the ambient source is self-sufficient. This scheme provides effective energy replenishment at cluster heads so that they can complete high volume data transmissions. Meanwhile, the rest of WNs can be recharged by MCs on demand.