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Wireless Sensor Network based Energy Harvesting and Wireless Power Transfer

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Abstract **- In this paper, the smart energy generation and distribution system is implemented by the use of wireless sensor network. The heat energy generated by the mobile (moving) vehicles is converted into electrical energy using peltier sensor. And the generated voltage is stored in the battery; stored energy is transferred to the local substation using WPT technology. The cost of the stored electrical energy is added to the user account and the user can only use the money for filling up fuel in any petrol bunk.**

Keywords:Wireless Sensor Networks, rechargeable sensor networks, Approximation algorithm, periodic charging cycles, Wireless power transfer.

I. Introduction

Wireless sensor networks (WSNs) have played an important role in many monitoring and surveillance applications including environmental sensing, target tracking, structural health monitoring, as conventional sensors are powered by batteries, the limited battery capacity obstructs the large-scale deployment of WSNs. Although thereare many energy-aware approaches developed in the past decade to reduce sensor energy consumptions or balance energy expenditures among sensors the lifetime of WSNs remains a main performance bottleneck in their real deployments, since wireless data transmission consumes substantial sensor energy. To mitigate the limited energy problem in sensor networks, researchers proposed many different efficient approaches. One method is to enable sensors to harvest ambient energy from their surroundings such as solar energy, vibration energy and wind energy. However, the temporally and spatially varying nature of renewable energy resources makes the prediction of sensor energy harvesting rates very difficult. For instance, it is shown that the energy generating rates in sunny, cloudy and shadowy days can vary by up to three orders of magnitude in a solar harvesting system. Moreover, the harvesting energy sources are intermittent and not always available. Such unpredictability and intermittency pose enormous challenges in the efficient usage of harvested energy for various monitoring or surveillance tasks

II. Network Model

We consider a wireless sensor network consisting of sensors, which are randomly deployed in a 2-D space. Let V be the set of sensors. Each sensor vi ∈V generates sensing data with a rate of bi (in bps). Also, each sensor vi is powered by a rechargeable battery with energy capacity Bi. There is one stationary base station in the network. We assume that there is a routing protocol for sensing data collection that relays sensing data from sensors to the base station through multichip relays. For example, each sensor uploads its sensing data to the base station via the path with the minimum energy consumption. Assume that the entire network monitoring period is T (typically is long, e.g., several months, even years). Since each sensor consumes its energy on data sensing, processing, transmission and reception, it is required to be charged multiple times to avoid its energy depletion during T.

III. Energy Consumption Model

Each sensor will consume its energy on data sensing, data transmission, and data reception, and the energy consumption models for these three components are shown in (1)–(3),

$$P_{sense} = \lambda \times bi \qquad (1)$$

$$P_{Tx} = (\beta 1 + \beta 2 d_{ij}{}^{\alpha}) \times b_i^{Tx} \qquad (2)$$

$$P_{Rx} = \gamma \times b^{Rx} \qquad (3)$$

Where bi (in bps) is the data sensing rate of sensor vi, Tx and Rx are the data transmission rate and the reception rate of sensor vi, respectively, dij is the Euclidean distance between , α is a constant that is equal to 2 or 4, and the values of other parameters are as follows :

λ=60×10−9J/b

β1 =45×10−J/b

β2 =10×10−12J/b/m2

when α=2 or β2 =1×10−15J/b/m4

when α=4γ =135×10−9J/

Table 1.Wireless Energy Transfer

Wireless energy transfer technique	RF energy transfer

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Field region	Far-field
Propagation	Radiative
Effective distance	Depend on distance and frequency and the sensitivity of RF energy harvester (typically from several meters to several kilometers)
Efficiency	0.4%, above 18.2%, and over 50% at –40 dBm, - 20 dbm and -5 dBm input power, respectively
Applications	Wireless sensor network, wireless body network.

IV. TRANSMITTER SECTION

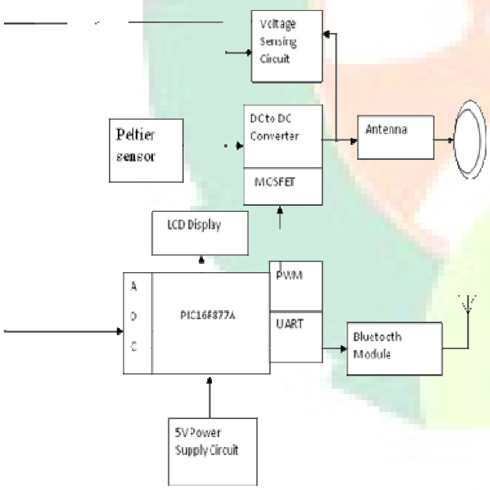

Figure 1: Transmitter Section

V. RECTANA SECTION

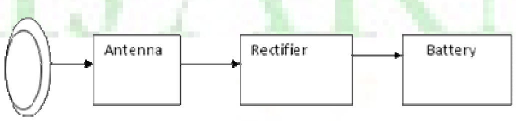

Figure 2: Rectana Section

VI. IOT SECTION

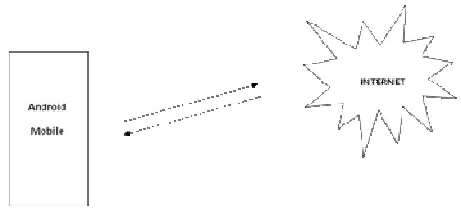

Figure3: IoT representation

VII. BLOCK DIAGRAM DESCRIPTION

In this project peltier is used for generation of energy from the engine heat. The generated energy is very low, so the boost convertor is used to increases the voltage level by using PWM generator from microcontroller the boost convertor required to input one is PWM and another one is source input the boost convertor is ready to increase the source voltage level. And increase voltage is stored in battery for energy transfer to another end of the coil. And the generator voltage range is updated to server via Bluetooth module so the server maintain the data details and converted to the money for cost free fuel fill up Here PIC microcontroller is used for monitoring and controlling entire section WPT concept is include for exchange the energy from source to destination coil.

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN),are partially distributed distributed autonomous to monitor physical or environmental conditions, such as temperature ,sound, pressure, etc., and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

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VIII. WIRELESS POWER TRANSFER

Wireless power transfer (WPT), wireless power transmission, wireless energy transmission, or electromagnetic power transfer is the transmission of electrical energy from a power source to an electrical load, such as an electrical power grid or a consuming device, without the use of discrete human-made conductors. Wireless power is a generic term that refers to a number of different power transmission technologies that use time-varying electric, magnetic, or electromagnetic fields. In wireless power transfer, a wireless transmitter connected to a power source conveys the field energy across an intervening space to one or more receivers, where it is converted back to an electrical current and then used. Wireless transmission is useful to power electrical devices in cases where interconnecting wires are inconvenient, hazardous, or are not possible.

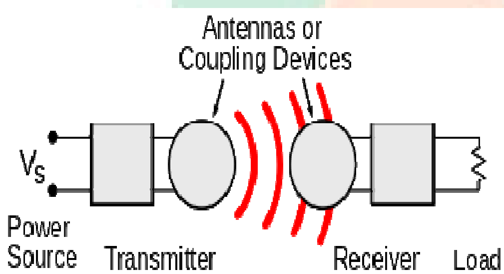

Fig 4 : Transmitter- Receiver Model

Table 2. Experimental Data Of RF Energy Harvesting.

SOURCE POWER	FREQUENCY	DISTANCE	ENERGY HARVESTED RATE
4W	902-928MHZ	15M	5.5μW
1.78W	868MHZ	25M	2.3μW
1.78W	868MHZ	27M	2μW

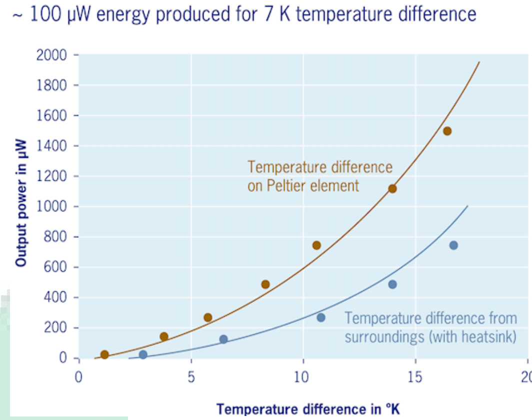

Figure 5: Performance Curve

IX. IOT SECTION

IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to the areas such as smart cities.

X. CONCLUSION

In this paper, we studied the use of multiple mobile chargers to charge sensors in a wireless sensor network so that none of the sensors runs out of energy for a given monitoring period, for which we first formulated a novel service cost minimization problem of finding a series of charging schedulings of the mobile chargers to maintain the perpetual operations of sensors so that the total travelling distance of the mobile chargers for the period is minimized. As this optimization problem is NP-hard, we then devised an approximation algorithm with a provable approximation S ratio if the maximum charging cycle of each sensor is fixed in the given monitoring period. Otherwise, we developed a novel heuristic solution through modifications to the approximate solution. We finally evaluated the performance of the proposed algorithms through extensive experimental simulations and experimental results showed that the proposed algorithms are very promising.

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