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DEVELOPMENT OF GREEN ROOM MANAGEMENT IN THE CONTEXT OF THERMAL INERTIA – AN OPTIMAL VIEW

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***Abstract*— Normally it is evident that we are focusing on energy conservation in the global level in terms of saving money, time and energy towards various applications to the maximum possible extent. It is also predicted that the heating and air-conditioning systems of buildings comprising of major energy cost. In this paper, an important observation is made in such a way that after a particular phenomenon/activity is over in a room, the inside temperature of the room will not increase all of a sudden to the outside temperature and this is referred to "thermal inertia". Therefore, if frequent activities are arranged in the same venue, then a venue that has not been used for some time, we can take the advantage of such an un-dissipated cool air or heated air and conserve energy. In this context, it is necessary to develop a green room management system in various contexts like, firstly it has a wireless sensor network to collect indoor, outdoor temperature and electricity expenses of the air conditioning devices, secondly, we can build an energy temperature correlation model for the energy expenses and the corresponding room temperature. Thirdly, we can develop room scheduling algorithms. This system is validated with an actual deployment of a sensor network for data collection and thermodynamics model calibration. Of course it is possible to conduct a comprehensive evaluation with synthetic room and activities with other configurations and it is noticed that a 30% energy saving existing with the current schedules.**

***Index Terms*— Energy conservation, sensor network, temperature, thermal inertia.**

I. INTRODUCTION

There is wide interest in developing a green building world recently and it is observed that the main objective is towards energy efficiency and energy conservation. Contribution are happening in two different contexts, such as, applying sensor networks for energy conservation in wider application (effective computing systems) and improving energy efficiency of computing systems.

For the improvement of energy efficiency of computing systems, many attempts were made on energy efficiency of data units which is generally assumed as a high energy consumer one of all such computing devices. A major portion of energy consumption is represented by commercial buildings, residential usage and transportation, manufacturing industry, while the energy cost computing industry one increasing rapidly in recent years. In particular, for the areas where the industrial sector in small, the electricity consumption by commercial buildings can be more representing the issues. For example, in India, 64.76% of the electricity in 2012 goes to the commercial sectors only.

The heating and air conditioning of commercial buildings comprising of major energy cost. In 2012, the office sectors of India consumed 56.76% of electricity which goes to the air conditioning and space conditioning as well, 16.72% electricity goes to lighting, 15% goes to the office equipment's like systems etc., Monitoring the conditions of the buildings and efficient utilization of heating, ventilation and air conditioning have been an extensive thane and technologically advanced commercial buildings can automatically turn of lights and ref/A/c systems of rooms, when human are not in presence. But as the same time, it is also observed that even though heating/air conditioning of a room is turned off, the heat or cool air will not be dissipated immediately and it is known as "thermal inertia". Normally we can consider the undissipated heated/cold air a reasonable resource that can be used, thus subsequent usage of this room can take this advantage without reheating or re-cooling the room.

Based on these observations, an optimum energy conservation management system is designed in such a way that the allocation of rooms of the building is based not only on a schedule (activity time, size of space), but also on the existing heating or air conditioning strategies of the room. In fact, room managements system falls into an optimization problem to the core in general. It is not straight forward, however to know, how much energy will be saved, if a room is scheduled.

II. AN OVERVIEW OF ROOM MANAGEMENT SYSTEM

Basically, it is necessary to set right the activities in the space in the preliminary level. This essential to develop an

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evening temperature model to precisely fix the activities in the space/room to conserve the energy in the maximum possible extent, and therefore room scheduling algorithm can be employed.

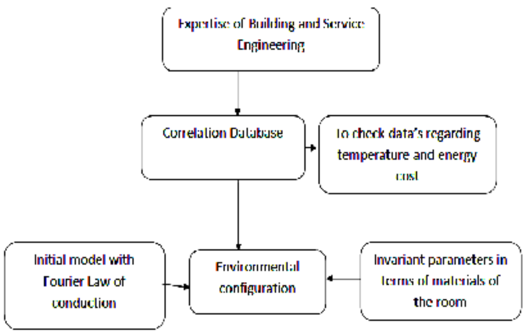

Fig. 1. Block Diagram

In particular, we need a function in such a way that the given current temperature and room environment configuration, the energy to be consumed to achieve the target temperature. There are two methods of developing such models, i.e., advanced thermodynamics theories can be applied to explicitly compute such function. Secondly, we can build a database with entries of environment parameters like indoor temperature, outdoor temperature and targeted temperature and the corresponding energy consumption. In the room scheduling algorithm, whenever an estimation on the energy expenses is needed, an entry in this database that has the most similar environmental configuration can be extracted.

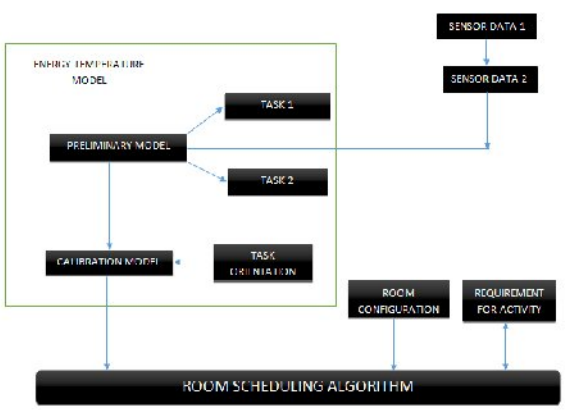

Fig. 2. Energy Temperature Model

For a multi-space, in each room, it is required to build an energy temperature correlation model to be used for scheduling algorithm. A sensor network is deployed in each room. In this sensor network, these should be a sensor to record electricity usage to air conditioning the room and it is also necessary to record the temperature. Since the temperature in different location of the room may not be uniform, a set of temperature sensor is suggested. Of course sensor network is only used for the construction of energy temperature condition model for each room. After the model is fixed, we can predict the energy consumption using the model.

III. Design Of An Electricity Meter

System requires computing the energy consumption for air-conditioning the room to a focused temperature. It is extended to use Imote2 with a power bay SSCVC to record electricity current. Power Bay SSCVC also becomes a power supply to Imote2. In operation, Power Bay SSCVC, will be recording the power in watts and such data will be digitized and output to I mote 2. Then the data can be transmitted by I mote 2.

A. *Development of Sensor Network*

The sensor system in Tiny DS is implemented, and collect Tree Protocol is used for data routing among the sensor modes. The temperature and electrically data are sent to a base station mode. The durability of sensor system is determined by Telos B nodes if battery power is used. In practice, each node gets the temperature and transmits 32 bytes every ten seconds. The projected life time of our sensor network can reach 2000 hours. It is found that this is for enough to collect data and calibrate the energy temperature correlation model.

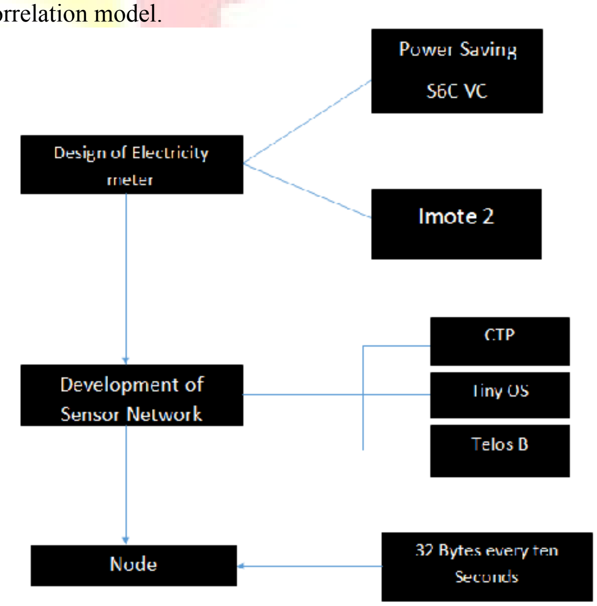

Fig. 3. Sensor Network

IV. Energy-Temperature Model

$$Q = \frac{kA}{L}(T_0 - T) \qquad (1)$$

K = Conductivity of the material

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Q = Heat transfer rate from indoor to the room
m = mass of the air in room

$$\lambda = \frac{kA}{L}$$

c = Heat capacity of air in the room

$$\frac{dT}{dt} = \frac{Q+P_e}{mc} \qquad (2)$$

Indoor temperature change, $T(t) = T_0 + P_e$

$$= \frac{1}{\lambda} + C_0 e^{-\frac{\lambda}{mc}t}$$

Where C_0 is initialization parameter determined by T(0) the temperature at time zero.

$$C_0 \begin{cases} T(0) - T_0 & \textit{for air conditioner not in operation} \\ T(0) - T_0 - \dfrac{P_e}{\lambda} & \textit{for air conditioner in operation} \end{cases}$$

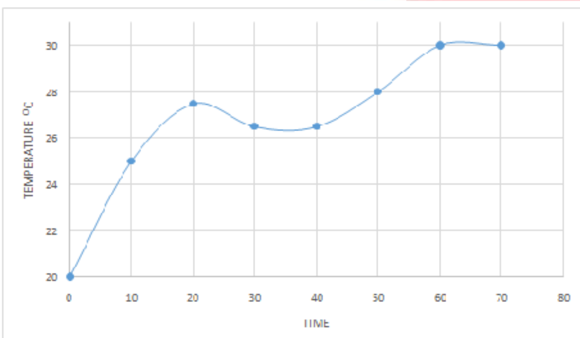

Fig. 4. Characteristics Graph I

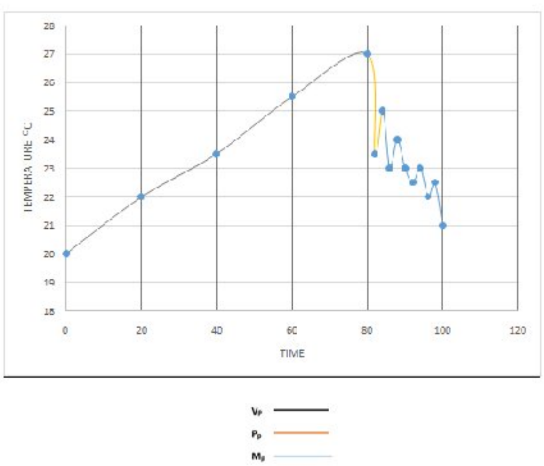

Fig. 5. Characteristics Graph II

V. Experimental Validation

The experiment was conducted in a room of a restaurant in Chennai, India. The configuration of the room and sensor network is shown in the figure. There was 13 sensors to collect temperature and an electricity meter connected to the air conditioner.

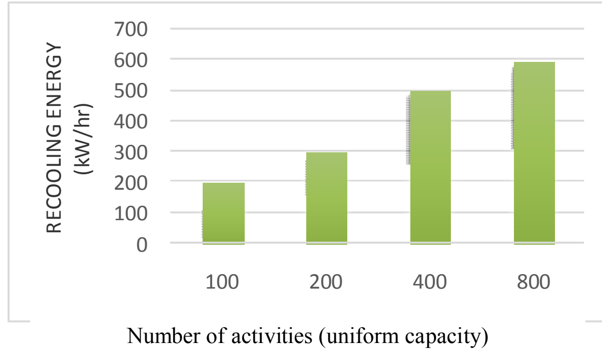

Fig. 6. Characteristics Graph III

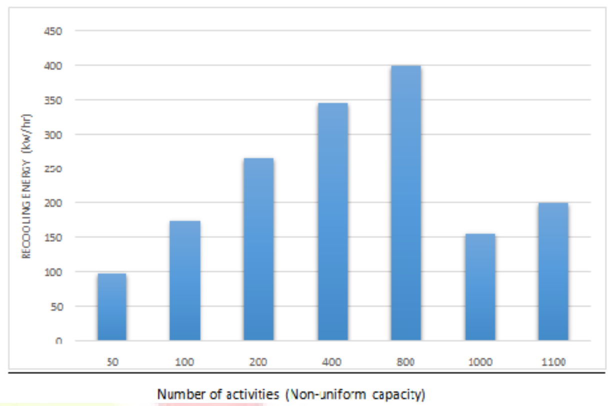

Fig. 7. Characteristics Graph IV

VI. Performance Evaluation

Performance evaluation is carried out for both uniform and non-uniform cases and it depends on the particular type of group of actions in a domain of actions. From the simulation results, it is observed that the performance of dissipating the temperature after the activity is over may lead to get some sort of opinion about the advantage of modeling a room management system within adequate case for optimality.

VII. Conclusion

In this paper, it is noticed that after the activities are even in a room, the cool air will not be exhausted as it is immediately. By keeping this advantage, an optimum room management system is designed for every conservation. It is also extended sensor hardware and a two ties sensor network is designed to consolidate necessary information about electricity charges and indoor and outdoor temperature as well. An energy temperature model is developed and the corresponding model is validated with a reasonable sensor network in active necessary experiment. A room scheduling algorithms are also developed and the effectiveness of this system is compared with simulation results.

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REFERENCES

[1] K. Lin and R. Gupta, "Towards Automated Building management through co-operative sensor" – actual networks, in Proc. Hotpower'09, Big slay, M.T. Oct, 2009.

[2] L. Parolini, B. Sinopoli and B.H Krogh, "Reducing data centre energy consumption via coordinated cooling and load management, in Proc. Hot power of San Piego, CA, Dec, 2008.

[3] H. Sancer, R. Honcell, W. Load, "Principles of heating, ventilation and air conditioning", Action 2.4.2001.

[4] J. Lienhard IV and J. Linenhard V. "A Heat Transfer Text Book", 3rd edition, p.p. 12 -18, 2003.

[5] Y. Shang, Dan Li and Mingwei XU, " Energy aware routing in data centre network", in Proc. ACM SIGCOMM workshop on Green Networking to, New Delhi, India, Aug, 2010.

BIOGRAPHIES

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