Energy Saving Using MATLAB SIMULINK For Air Conditioner

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Abstract- *Now-a-days, cooling demand is increasing rapidly leading to increased use of air conditioner. The main purpose of this research is to reduce energy consumption and make the air conditioner system more efficient. For this study, we have used MATLAB software to simulate air conditioner model for the amount of energy consumed also to observe the changes in temperature and humidity. Two cases are analyzed i.e. Normal Mode and Energy Saving Mode. Finally, the results of simulink are compared with the actual instrumental measurements.*

Keywords- MATLAB Simulation, Data Logger, Energy Consumption.

I. INTRODUCTION

As per the papers referred, Air Conditioner is consuming 38% of electricity out of 126 TWH of total annual energy consumption [1]. Also, India's cooling demand is 12+ times US [2]. As per ASHRAE Standard 55-2013 Thermal Environmental Conditions for Human Occupancy [3], Human thermal comfort zone is 24-25 ^{o} C. As per BEE guidelines, there is need to use air conditioner at 24 ^{o} C [10].

The main purpose of this research is to reduce energy consumption and make the air conditioner system more efficient without affecting Human thermal comfort zone by setting air conditioner at 24 ^{o} C. The air conditioner removes heat from inside to outside with the help of refrigerant [8]. This heat in room always moves in opposite direction to heat flow [1].

II. MODELING SYSTEM FOR AIR CONDITIONER

Input Data required for MATLAB Simulation:

1. dQ/dt - air-conditioner heat flow rate outside the room (J/h)
2. c - Specific heat Capacity of air at constant pressure (J/kg.K)
3. M_{air} - mass of air inside the room (kg)
4. T_{in} - Inside room temperature (°C)
5. M_{dot} - flow rate of air mass through air conditioner (kg/h)
6. T_{aircon} – cold air Temperature coming out from air conditioner (°C)
7. T_{out} – Outside temperature (°C)
8. R_{eq} – Room Equivalent thermal resistance (K/W)

During this research, the air conditioner set temperature is 24°C. Two cases are studied:

Case I - Ordinary Mode

In this mode, AC is switched ON for 2 hour and after that the results are compared with compared with Case II results.

Case II- Conserving Energy Mode [7]

In this mode, air conditioner was switched ON for 1 hour and then switched OFF for 15min and again ON for 45min.

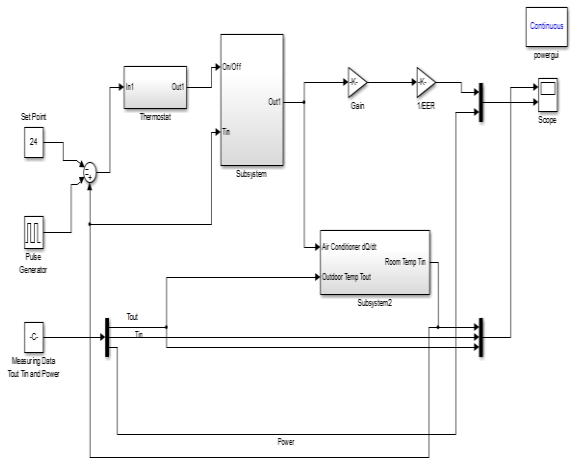

Fig1. MATLAB Simulation of air conditioner

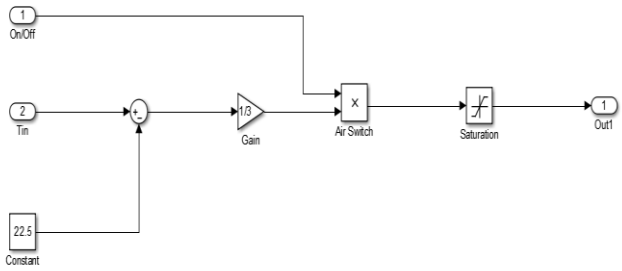

Fig2. Subsystem of Air-Conditioner

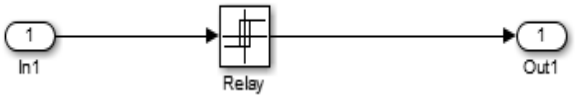

Fig3.Thermostat

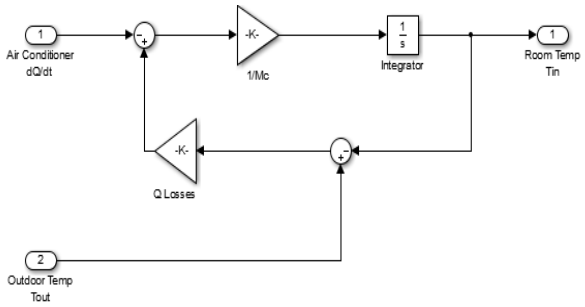

Fig4. Subsystem of Room

Using basic heat transfer equation, the thermal characteristic of building can be represented with the help of network made using capacitance and resistances [4, 5]. Air volume of the building is considered as capacitance and insulation material of building envelope used for wall, roof and window is considered as resistance. Heat and temperature in the thermal model are considered as current and voltage of electrical system respectively. In this research, Air conditioning system is modeled using thermal resistance for simplicity as shown in fig1.This simulink model is made using the reference of heating system thermal model of housing [6].

The schematic view of the room which is of dimensions 4.5 m (L) * 2.3 m (W)* 3m (H) is shown in the fig 5[9].

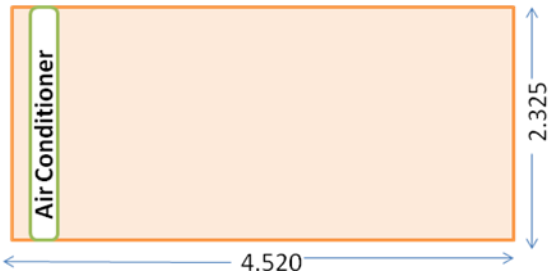

Fig5. Schematic view of Room where testing is performed.

III. TOOLS USED FOR ACTUAL MEASUREMENT

During this research, inside and outside temperature of room are measured using Data Logger [9]. Energy consumed by air conditioner is measured using HIOKI Make-PW3198 Power analyzer. Tools used for measurement are shown in fig 6 and fig 7.

Fig6. Data Logger

Fig7. HIOKI Make-PW3198 Power analyzer

The results of energy consumption and temperature, Humidity obtained from measuring tools are finally compared with the SIMULINK model results.

IV. COMPARATIVE RESULTS OF EXPERIMENTATION

The temperature is same as energy consumption in actual and simulink modeling. The energy consumed by simulink model is 20 to 25% more than the energy consumption measured by tool. The difference in average temperature from modeling is 0.06% to 0.34% less than the actual measurement. When the air conditioner was switched OFF during case II for15 min, then the temperature in room does not rise more than 26^{o}C, which is not much affecting human thermal comfort. After the research, we analyzed that Energy consumed by Case II is 5% less than the Case I. Even though, outside temperature is not in our control. Outside temperature in Case II was 1^{o}C more than Case I.

V. CONCLUSION

This MATLAB SIMULINK Model is used to find the energy consumption to cool specific room with air conditioner at set temperature 24ºC. In this research, two cases are comparatively observed: Case I: Ordinary Mode, Case II: Conserving Energy Mode. Finally from research, we analyzed that Case II Energy consumption is 5% less compared to Case I. Comparative results obtained from measuring tools and simulink model are stable with difference of 20 to 25%.

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