AN IOT FRAMEWORK FOR EFFICIENT COOLING SYSTEM IN GREEN BUILDING

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ABSTRACT

Today Green Building is an important research area in IOT. The energy efficiency in green buildings is vital for global sustainability. However, many factors affect energy consumption by the green building and most of the green buildings are not really green due to static power policy and complete grid based power supply on devices. Here we propose a design based on environmental factors for green buildings cooling system to dissipate heat dynamically for every small seasoning changes to attain effective power efficiency.

Index Terms: Energy efficiency, intelligent buildings, Internet of Things (IoT), cooling system.

I.INTRODUCTION

Green Building is an important research area in IOT to increase energy efficiency. The energy efficiency in green buildings is vital for global sustainability. Accor-ding to general survey cooling system in green building is responsible for power consumption than other equipment's, most of the currently available green building uses grid connected power supply over the system to attain power efficiency with multiple AC to DC and DC to AC conversion. The test bed fails as multiple AC and DC convers-ion increases power wastage, to provide needed power to attain efficiency. In many green buildings centralized or distributed control of devices with event based power policies are used to control the power over the devices. This work focuses on green building power consumption, to reduce the power consumption in cooling system. Here the efficiency is attained by dynamically controlling the RPM of the ventilator fan with respect to changes in environmental parameter such as sunlight, temperature and humidity. Then two different policies were followed here to increase the accuracy in power consumption for day and Night time. The key aspects of the work are.

1) **Environmental Parameter Analysis:** By using microcontrollers and sensors environmental parameters such as sunlight, temperature and humidity were continuously monitored. Power consumption will be calculated dynamically, and policies were chosen depends on conditions.

2) **Dynamic Power Control:** As this system uses different environmental factors and power sources, here dynamic power control is used to dynamically adjust the power supply depend on environmental conditions. Then power source is also selected dynamically to increase power efficiency.

3) **Data Gathering:** Using serial monitor data measured using sensors were fetched and stored in to database for further processing.

4) **Pattern Identification:** By Processing the gathered data, pattern or detail such as effect of seasoning changes over cooling system will be analyzed to improve the efficiency with further accuracy

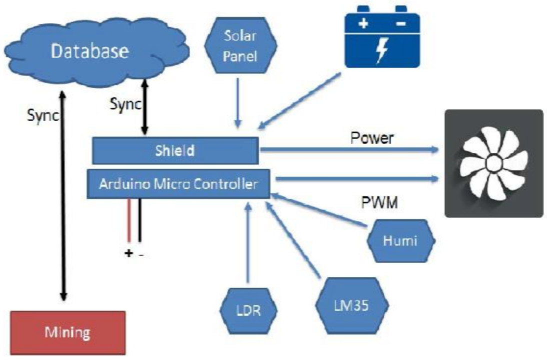

Figure 1. System Design

The figure 1 here explains the proposed system design clearly as it contains different sensors to collect data with grid and solar power source to supply electricity.

The shield here is used to amplify the power output from microcontroller and PWM signal is used to control the power to the system. Then data is mined to predict effect of seasoning over the green building. The result shows that due to changes in system dynamic policy identification with parameter analysis gives good efficiency over existing system.

II. ENVIRONMENTAL PARAMETER ANALYSIS

Here environmental parameters such as sunlight, temperature and humidity is used to calculate the amount of cooling effect needed. These three-different parameters provide better accuracy and efficient way of dynamic power supply. Two different power polic-ies such as INSIDEHOT and INSIDECOOL were used here to control the cooling system power dynamically with respect to environmental para-meter.

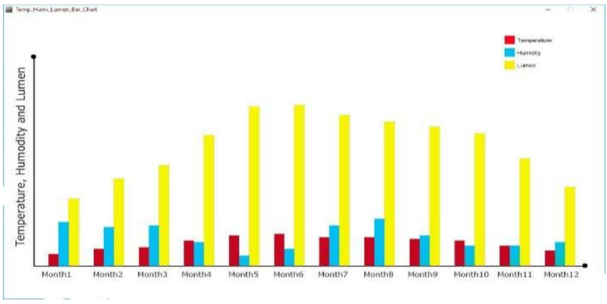

Figure 2. Environmental Parameter Analysis

The figure 2 above shows that the variation of temperature, humidity and sunlight intensity over month for a year. Here we analyzed change in environmental parameter to automatically change the power policy of the cooling system over different seasoning. So that power wastage over climatic change will be decreased.

In an INSIDEHOT power policy the temperature inside the green buildings environment in higher than the outside. This will happen at night time where lot of electrical equipment like PC, Servers and LED's were used simultaneously to consume more power.

Similarly, in an INSIDECOOL power policy the temperature outside the green buildings environment in higher than the Inside. It will mostly occur during day time more exactly at cloudy days. Both power policies will be explained in detail on another session of this paper.

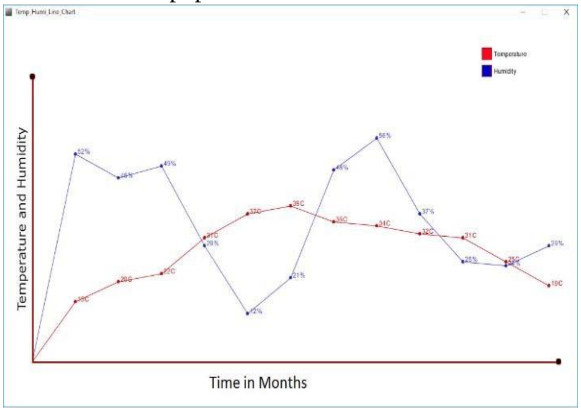

Figure 3. Relation between Temperature and Humidity

In figure 3 above it shows that the variation temperature and humidity over months. It shows us both parameters are strongly depending on each other. As the temperature increases the humidity always decreases and vice versa and changes in these parameters affects the power consumption. There exists a higher impact on this system design for fewer changes in environment.

As it is too sensitive to environmental changes effect of seasoning over the green building is able to analyze accurately even for changes occurring between days.

III. DYNAMIC POWER CONTROL

Here dynamic power control is done by analyzing the changes in environmental parameters depend on two different power policies. As here we are using two different policies it is important to switch over the policy at time. Here we use policies such as

1. Inside Cool (IC) policy
2. Inside Hot (IH) Policy

In both power policies, the power is used from the solar panel or the grid. Then cooling system power is adjusted depend on the environmental parameter inside and outside the building.

In Inside-Cool policy the green building temperature is lower than the outside. So, the ventilation fan rotors will be rotated forward, if the green building temperature is greater than green building humidity.

Similarly, in Inside-Hot policy the green building temperature is higher than the outside. So, the ventilation fan rotors will be rotated backward to bring cool air inside, if the green building temperature is greater than green building humidity. By this way the green building will be maintained with adequate conditions as not too cool or hot.

III. DATA GATHERING

Table 1. Model Database

Year	Month	GBTemp	ETemp	GBHumi	EHumi	ELumen	DRN	Power	Direction	Status
2015	1	14	12	52	53	111	Day	Solar	Forward	InsideHot
2015	2	9	7	51	56	21	Night	Grid	Forward	InsideHot
2015	3	12	15	56	53	234	Day	Solar	Backward	InsideCool
2015	4	23	26	36	39	34	Night	Grid	Backward	InsideCool
2015	5	14	12	52	53	321	Day	Solar	Forward	InsideHot
2015	6	9	7	51	56	43	Night	Grid	Forward	InsideHot
2015	7	12	15	56	53	123	Day	Solar	Backward	InsideCool
2015	8	23	26	36	39	21	Night	Grid	Backward	InsideCool
2015	9	14	12	52	53	223	Day	Solar	Forward	InsideHot
2015	10	9	7	51	56	34	Night	Grid	Forward	InsideHot
2015	11	12	15	56	53	323	Day	Solar	Backward	InsideCool
2015	12	23	26	36	39	43	Night	Grid	Backward	InsideCool

For gathering data, a test bed is designed to provide the same environment of green building which allows us to gather different set of data such as environmental temperature, humidity, light intensity and green buildings temperature and humidity. Here a set of LDR, temperature and humidity sensors are connected with the microcontroller to observe the changes inside and outside the environment. Data obtained through sensors are stored in database for future analysis.

In table.1 it shows that the value gathered from sensors like LDR and Temperature and humidity sensor with the date and current state of the whole system etc.

The data is gathered for different seasons and years to predict the effect of temperature and humidity over the green building power consumption. This will help to improve the accuracy of the autonomous cooling system depend on the surrounding conditions. It is observed that power consumption varies during different seasons over different years. The collected data is stored in the cloud or centralized database so that administrator can track the power consumption pattern regularly through the stored data.

IV. PATTERN IDENTIFICATION

In Pattern Identification, the correlation between data will be mined to obtain some interesting pattern and similarities between data. So that

1. Critical point of power consumption will be detected

2. The % energy consumption for upcoming year will be calculated early as possible.
3. Need of change in product design depend on environment is identified

To Identify Critical point of power consumption and power production:

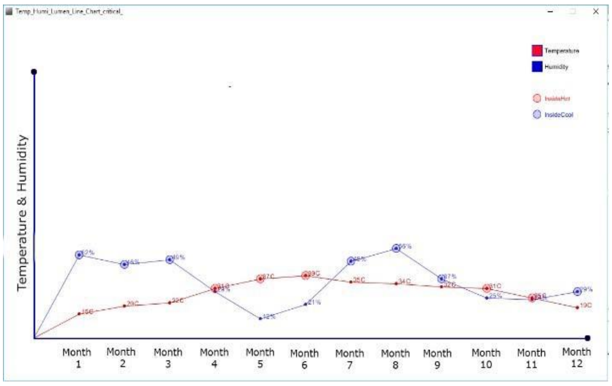

Fig 4. Critical point power consumption analysis Here

critical point of power consumption will be analyzed based on the temperature, Lumen and Humidity values. As here we neutralize the temperature with humidity to make the cooling system efficient in power consumption.

The above figure 4 we can analyze the critical point as the difference between the humidity level and temperature level is maximum the power consumption will be more. If the difference between humidity and temperature is less the power consumption will be minimum.

The red mark (Inside Hot) and blue circle (Inside Cool) shows the current status of the whole system. Then by using the lumen curve the average power production for the days can be analyzed perfectly

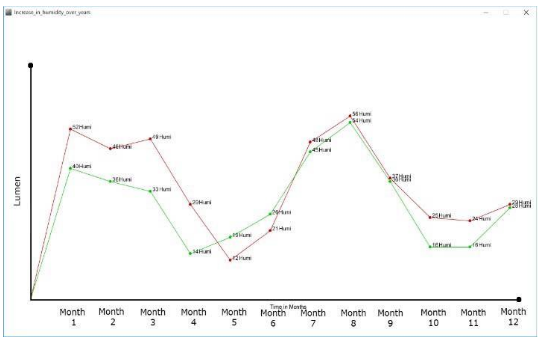

Figure 5 Critical point of power production analysis

Based on amount of sunlight radiation critical point of power production will be analyzed. Figure 5 above shows that there is highest rate of solar power production during the 5th and 6th month of the year.

Analysing Environmental parameter over year:

Environmental parameters were analyzed over the years with different season to observe the pattern over different seasons. So that we can able to change the power policy if needed.

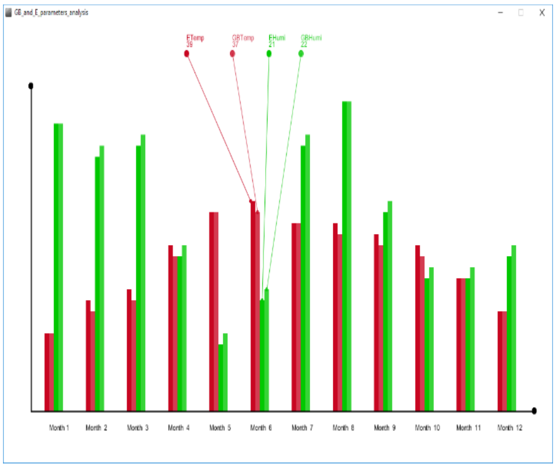

Fig 6. Analysing Environmental parameter

The figure.6 shows that the manual graph analysis of data over the year with different seasons so that we can understand the changes over months to change the power policy manually over days at any time.

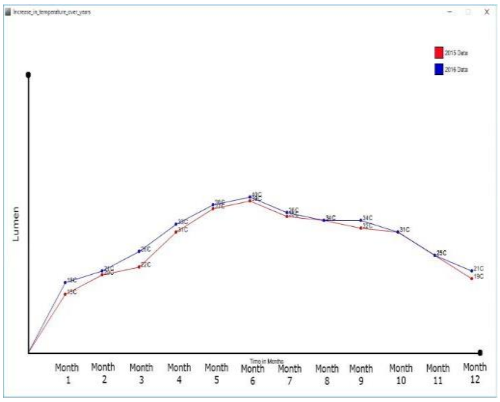

Fig 7. Temperature analysis over years

In the above figure.7 temperature over green building was analyzed over different years to predict the rate of change of environment. Here it shows the temperature data for year 2015 and 2016 and it shows that there is peak increase in month of December to march. From the data, it is analyzed that temperature changes are higher in the year winter season of the year.

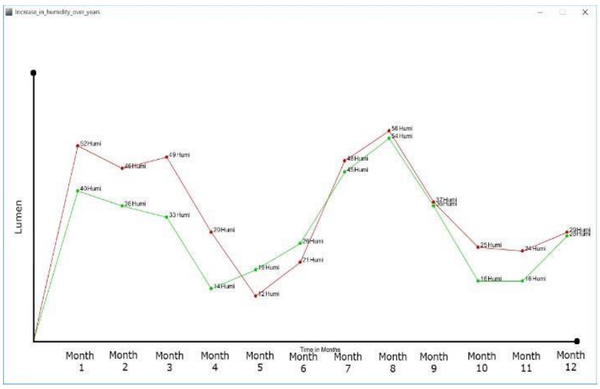

Fig 8. Humidity analysis over years

The above figure 8 shows that there is decrease in humidity over years as a result of global warming and there exists increase in humidity in the month May and June than previous year.

The below figure 9 shows that the increase in light intensity of environment over year. This clearly shows that solar power production increases every year.

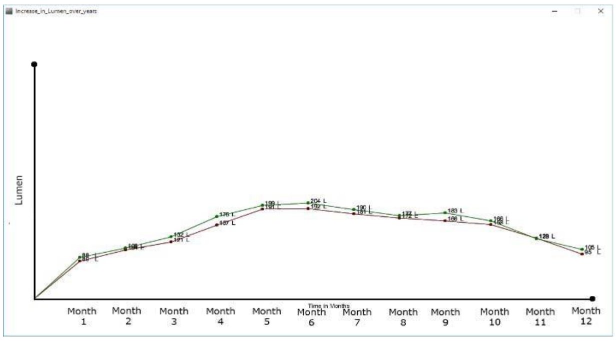

Fig 9. Lumen analysis over years

That way environmental parameters are analyzed inside and outside the building to made physical changes to increase the power efficiency as parameter threshold varies over different places over the world for different seasoning. Year wise data has also been analyzed to improve accuracy

Future power consumption prediction:

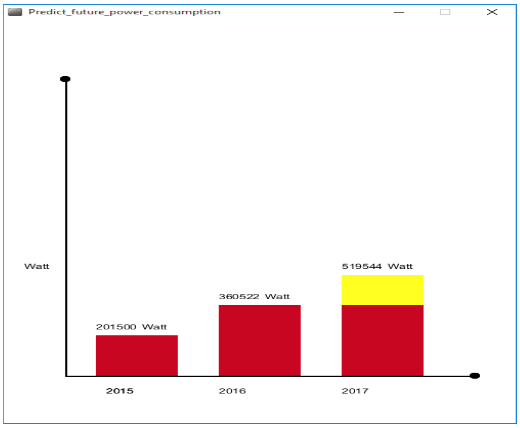

Figure 10. Future power Consumption Prediction

The above figure 10 shows that the power consumption over past years and expected power consumption for the next year. The future power consumption is calculated by analysing rate of increase in power consumption for previous years. So that power requirement problem will be be solved easily as we know the requirement early.

VII. CONCLUSION

In this paper, a new design is proposed and implemented to increase the power efficiency of cooling system in a green building based on the environmental parameter analysis. Then future power requirement is also identified depend on the previous year data. Thus, carbon emission is minimized.

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