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## Optimizing the Energy by Using BMS& HVAC System

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### ABSTRACT

The main objective of this research is to minimize the usage of Electrical Energy by using BMS (Building Management System) & HVAC (Heating Ventilating & Air Conditioner System) and control the consumption of electric power by installing a suitable system in buildings like offices, universities & also for the residency apartments. On the other hand PLC (Programmable Logic Controller) is used as a backbone Controller of system in which Schneider PLC and software Twido Suite is used for testing and simulating all the values of sensors. The result shows that system can work successfully in the environment and capable of optimizing the energy.

**Key Words :** HVAC, BMS, Energy Optimization

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### INTRODUCTION

Pakistan is the 36th largest country of the world with respect to the area having 796,095 square km [1]. Twenty electric power companies in Pakistan produced at about 21,103 MW power as

Fossil fuel – 13,637 MW – 65% of total

Hydro – 6,654 MW – 31% of total

Nuclear – 812 MW – 4% of total.

These are four major companies in Pakistan WAPDA (Water & Power Development Authority), KE (Karachi Electric), IPPs (Independent Power Producers) and PAEC (Pakistan Atomic Energy Commission) [2]. The major requirement of energy is about 23,000 MW but capable to produced only 21,103 MW. With this shortage of electricity there are many other factors that effects more power loss like line loss, maintenance loss and the biggest loss is theft loss that is very common in Pakistan. When concluded all these problems the answer is same shortage of electric power and people facing a lot of problems. What can we do to eliminate these problems? Most researchers and Engineers put their research and suggest some solutions like by improving power factor, reducing losses and use electricity smartly to save a valuable amount of power consumption. The most

suitable technique for reducing power consumption introduced in this paper by using BMS& HVAC system for optimizing the electric energy. The main vision to install BMS& HVAC systems in Karachi firstly as it is the biggest city and industrial hub of Pakistan having many multi-national companies are situated there. Besides this many huge residential, shopping and educational buildings consume extra amount of power.

HVAC and BMS system can be useful to optimize the energy with the help of occupancy sensor and other equipments by minimizing unnecessary wastage of energy. This can be done by monitoring and controlling the major instruments of the building like temperature controller, occupancy sensor and light controller. In BMS system the major energy saving instrument used in this research is Ultrasonic occupancy sensor, are light controllers that automatically turn off the unnecessary lights and fans and it is highly suitable for those places in which a line of sight is not possible, reducing energy usage and reducing energy waste. Light pollution is also controlled by turning off indoor and outdoor lighting. Occupancy sensors are best for economical purpose where scheduling is not required and approximately save energy about four to five hours when the whole space is unoccupied.

## MATERIALS AND METHODS

### Overview of Complete System

The following block diagram represents that how complete system works, implemented in G block of SSUET. In which the BMS & HVAC system individually control the different instruments of the building and both systems interlinked to each other is controlled by the main monitoring station. It would be easy to understand the overall function of the complete system.

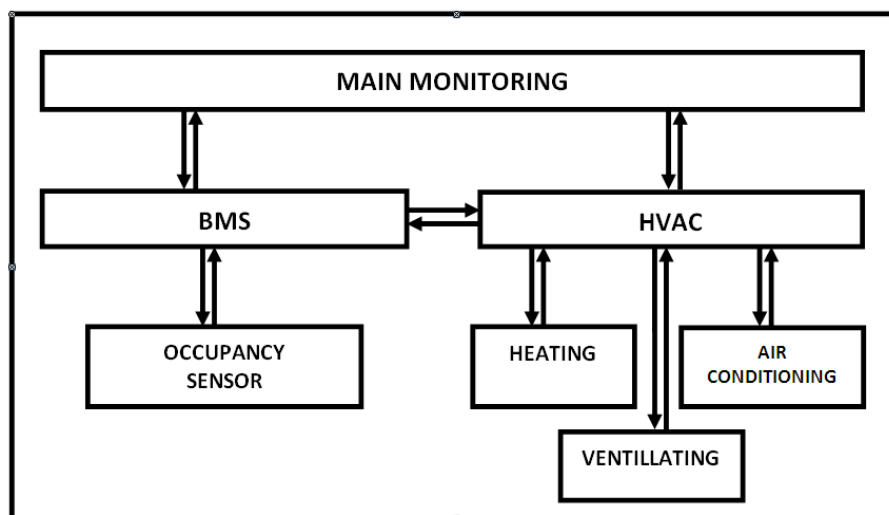


Figure 1. System Block Diagram

### Purpose of Building Management and HVAC Systems

The basic purpose of building management system is to reduce energy consumed which actually a waste of energy with manual control of the mechanical and electrical equipment interlinked with HVAC system to provide proper cooling for each room. Some basic steps helps to improve the energy

usage including utility management reduce costs and remove energy waste, monitoring actual consumption data then compare with the saved data, and alarm monitoring and real time response communicate with the research site and indicate with proper alarming, System Backup stores the regular data for optimization of energy consumption and for future use also [3].

The basic purpose of building management system is to supervise, control and monitor all the related mechanical and electrical equipment’s regarding HVAC. The system observes the performance of each equipment including sensors deeply as to provide all the available facilities to the building when it is needed. In the enhancement side of the system provide the accurate data to the equipment to where system needs additional amount of the row material. Finally the reporting section of the BMS system is to report all the error occurs in the running system.

**Working of System**

Mainly system divided in to two main parts.

- HVAC System
- BMS system

**HVAC**

The HVAC system stands for Heating, Ventilating & Air-Conditioning. The commercial HVAC systems is used to provide “conditioned” air for the working people inside buildings with conformability (clean) and safety (odor - free) within certain comfort ranges[4]. But in this research the basic aim to install this system for optimizing the energy usage by installing and monitoring it properly. The variations in the compressor of Air-conditioner are usually predicable in normal circumstances. Following table shows the operation of the controller upon reaching the certain level of temperature and also described by word bit. Sensor sense the required values in word bit logic and turn on and turn off the actuating devices. The heating, Ventilating and Air-conditioning values set by the temp as listed below.

**Table 1.**Temperature Data Format

TEMP	WORD BIT PLC	ACTUATING
0-10	0 < 157	Heater on
10-25	157<393	Ventilator
25-36	393<566	Ac step_1
36-47	566<739	Ac step_2
47-60	739<	Ac step_3
60-65	1023	Buzzer

**Figure 2.**Bit Word and Temperature Graph

The Controlling Structure of HVAC module implemented in Schneider PLC TWDLC4E40DRF a Digital PLC along with TM2AMI8HT the analog module used. Having an Analog input and digital outputs [5].

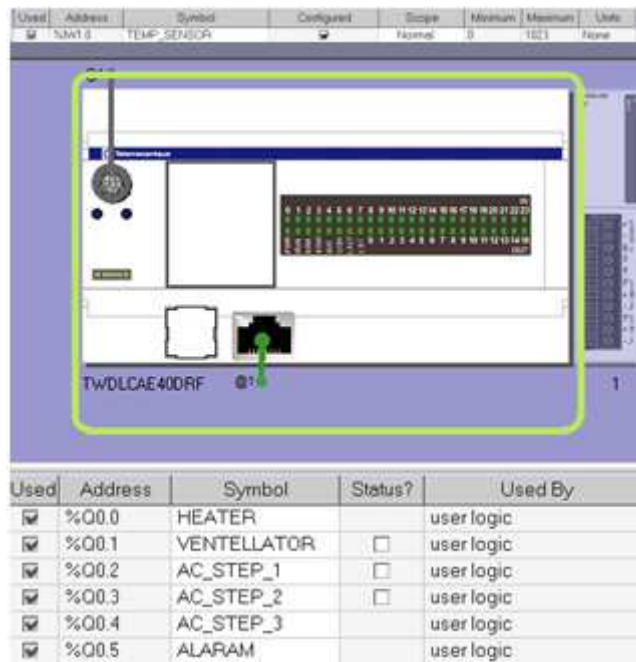


Figure 3.Implementation of the System in Schneider PLC software Twido Suite

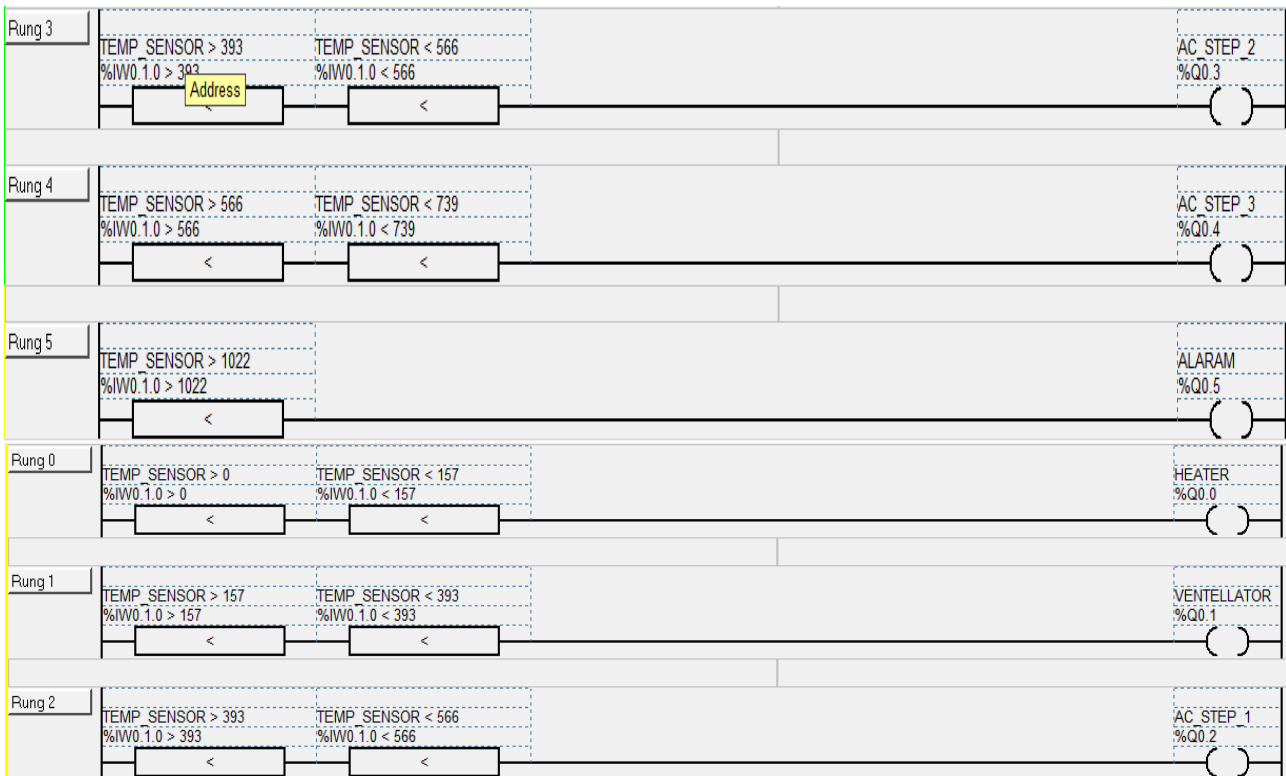


Figure 4.PLC Ladder Diagram.

**Building Management System (BMS).**

BMS is a computer-established control system mounted in buildings that controls and shows the building’s mechanical and electrical tools such as occurrence, lighting, fire systems, and security system [6]. A BMS comprises of software and hardware; the software package, usually organized in a hierarchical manner using such protocols as C-bus, Profibus recently, however, new vendors are producing BMSs that participate using Internet rules and open standards such as DeviceNet, SOAP,

XML, BACnet, Lon Works and Modbus[7].

The Building management System comprises of important instrument occupancy sensor, in the sensor's range detects the presence and absence of any type of motion, if found any motion switches on and off the lights and other devices with respect to the requirement that saves a valuable amount of energy per day. Three parameters on which the sensor works detector, control unit, and relay (switch). First the motion is detected by motion detector and sends indication to the control unit, which processes the incoming signal and sends commands to the relay to either close or open the relay which operates as a switch for lights.

To implement occupancy sensor in the class rooms of the G Block of Sir Syed University of Engineering and Technology. This block has 20 rooms, 5 laboratories, 1 conference room and 1 auditorium. This research is dealing with each room separately but the amount of consumed and optimized power represented for complete G block.

Ultrasonic sensors use the Doppler principle to detect occupancy through emitting an ultrasonic high-frequency signal throughout a space, sense the frequency of the reflected signal, and interpret change in frequency as motion in the space. These sensors do not require a direct line of sight and instead can "see" around corners and objects, although they may need a direct line of sight if fabric partition walls are prevalent. In addition, ceiling-mounted sensor effective range declines proportionally to partition height. They are more effective for low motion activity, with high sensitivity to minor (hand) movement, typically up to 25 feet [8].

When no one presents in the room, the sensor respond a suitable signal but when the room is fully or partially filled then sensor's signal is processed by control unit through PLC.

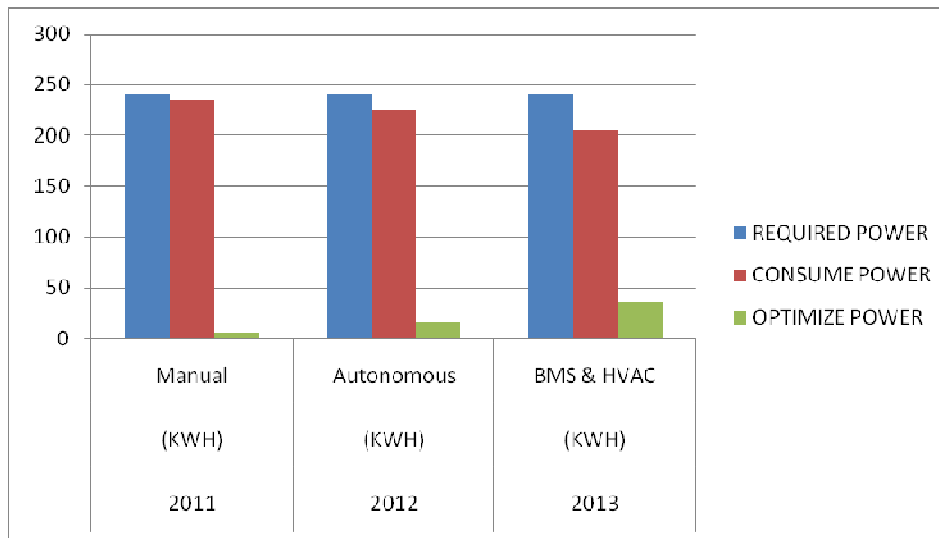
### Consumption and optimization of Power

The mechanical and electrical devices in the BMS designed to monitor and control the mechanical, fire and flood safety, security and emergency, lighting, humidity control and ventilation systems in a building[9].. The following table shows the saving of power through newly designed BMS system.

**Table 2.**Optimization table of BMS

YEAR	2011 (KWH) Manual	2012 (KWH) Autonomous	2013 (KWH) BMS & HVAC
REQUIRED POWER	240	240	240
CONSUME POWER	235	225	205
OPTIMIZE POWER	5	15	35
OPTIMIZED ENERGY %	2.08	6.25	14.58

From above table it observed that the power consumption is reducing per year but BMS and HVAC system affected more for reducing waste energy.



**Figure 5.** Optimization Graph of BMS and HVAC

## RESULT AND DISCUSSION

### Results of BMS and HVAC System

Estimate the energy savings possible using the defined HVAC strategies for each location and controlling via BMS system. The research project BMS and HVAC system installed in Sir Syed University G Block building. Results take into account the fan, pump, heating, and cooling energy consumption of the building. This system plays a vital role to optimize the energy consumption in SSUET G Block building by variation the compressor values directly relates to the energy consumption and saving about 14.58% energy approximately twice as autonomous and seven times as manual.

Mount a Building Management System to control and display your building's apparatus and provide energy consumption data, and give you one point consolidated maneuver. Its provides real time data and critical information if there is any smoke indication, fire alarm indication and light control etc. sent to emailed or sent via sms. Display HVAC A main application of a BMS is to governor and equipment.

## CONCLUSION

Implemented BMS and HVAC system in SSUET optimized the valuable amount of energy through the monitoring of the system in the building by suitable technique gives to control the minimal amount of electric power by Schneider PLC and software Twido Suite used for testing and simulating all the values of sensors. The above result shows that the optimization of the energy which successfully work in the environment of SSUET.

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