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Building Management System and its Network Design

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Abstract - *Buildings are becoming more and more advanced and the demands on building services are increasing. A modern building is expected to provide conditions for a number of services with high security, energy efficiency and convenience. For a building with complex requirements due to the activity are even more advanced and the requirements on them are higher. Many of these services benefit from communicating with each other, sharing functions and being monitored together. To control and monitor several building services in an efficient way, a more or less advanced building automation system is required. There are advantages with using an advanced building automation system:-*

- *Monitoring of several systems from one place*
- *Sharing of alarms*
- *Interaction for more efficient control strategies*
- *Remote services, etc.*

Key Words: PLC, Sensor, Actuator, Human Machine Interface, Input, Output, Automation, Access Control.

1. INTRODUCTION

A Building Automation System, also referred to as BAS or Building Management System (BMS), is a combination of software and electronic, electric and mechanical devices, meant to automate the operation of a building. At a very high level, it can be described as a system that collects information about the building status and the factors that affect it (like the weather), processes it, stores it, informs the operators, makes decisions (based on current, historical and forecasted information, plus the operators input), and acts to control the building electromechanical equipment.

The function of the BMS is to centralize the monitoring, controlling operations, with innovations, technological or not , and skillful management of facilities within the building to achieve more efficient building operations at reduced energy and labour costs while providing a safe and quality working environment to the occupants.

An intelligent building provides a safe and productive environment. It integrates its various facilities and systems to effectively manage resources in a co-ordinated mode to maximize

- Occupant protection
- Energy and operative cost savings
- Flexibility in adapting to changes

It is one that provides a comfortable, productive and cost effective environment through optimization based on three elements:

PEOPLE (owner, builder and occupants)

PRODUCTS (materials, structure, facilities, services, etc.)

PROCESSES (automation, control systems maintenance, performance, etc.)and interrelations between them.

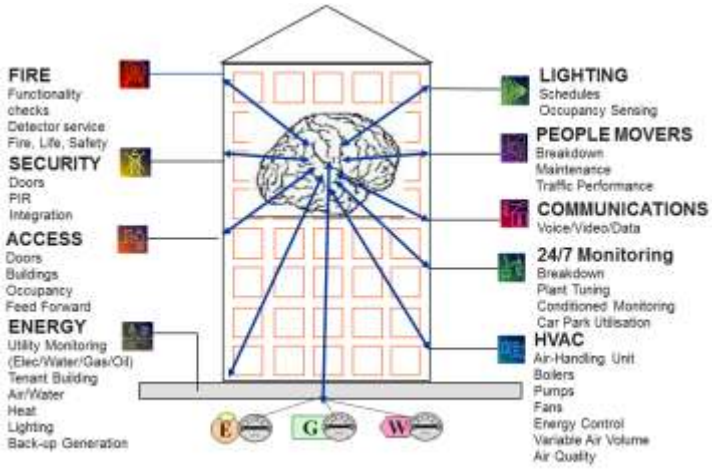

Fig -1: Sub systems of BMS

1.1 BMS Hardware and Software

The hardware is typically represented by one (or more) control and processing units and by a number of other peripheral devices (which control the operation of say, heating or cooling systems, artificial light-sources or other appliances and which can also be represented by sensors, thermostats, etc.,) connected to the control units called programmable logic controller (PLC) or Direct Digital Control (DDC). PLC is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program, to control the state of devices connected as outputs as shown in Fig 2.

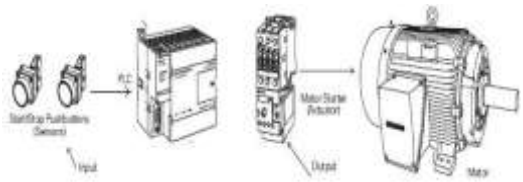

Fig -2: PLC

The software is simply the program and the instructions that allow the control unit to manage the operations of the peripheral devices and of the appliances. It is where the operator can access information, feedback or update data from the system , give commands to plants being controlled, modify on software programs from the keyboard or request printout records from the printer as shown in Fig 3.

Fig -3: Human Machine Interface

1.2 Inputs and Outputs

Building management system relies on 4 types of sensory information to make a control decision as shown in Table-1.

Table -1: Inputs and Outputs

INPUTS	e.g
Analouge (varying-reading) AI	Temperature, Humidity, Water Flow , Air Flow , Tank Level, Energy KW, Voltage, Current, Pressure, pH, Conductivity
Digital (Binary-ON or OFF) DI or BI	Status (on/off, airflow , run, open/close) Alarm Trip
OUTPUTS	**e.g**
Analouge (varying-positioning) AO	Fan Speed regulating (0 to 100%) Chilled water valve control (0 to 100%)
Digital (Binary-ON or OFF) DO or BO	Command (on/off, open/close) Example- would be to turn on the parking lot lights when a photocell indicated it is dark outside

1.3 Working of BMS

A BMS is a "standalone" computer system that can calculate the pre- set requirements of the building and control the connected plant to meet those needs. Its inputs, such as temperature sensors and outputs, such as ON/OFF signals are connected into outstations around the building. Programmes within these outstations use this information to decide the necessary level of applied control. The outstations are linked together and information can be passed from one to another. In addition a modem is also connected to the system to allow remote access. The level of control via BMS is dependent upon the information received from its sensors and the way in which its programmes tell it to respond to that information via Actuators. Occupancy times for different areas are programmed into the building management system such that the plant is brought on and off to meet the occupier requirements as shown in Fig 4.

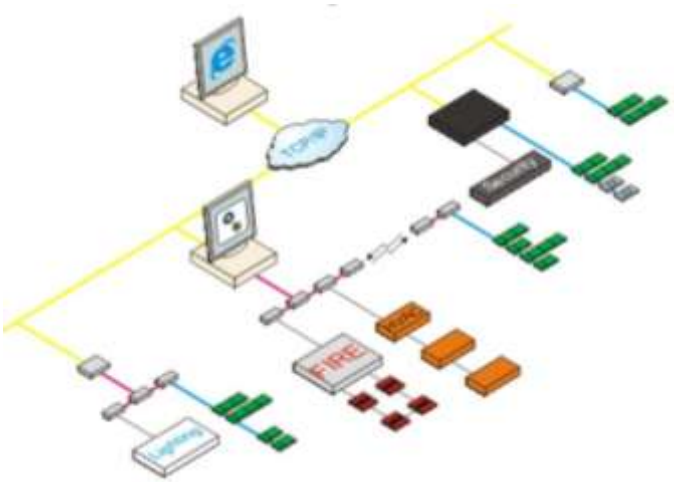

Fig -4: Working of BMS

1.4 Live Case Study

Observation of intelligent services in Bharat Sanchar Bhawan, Janpath, New Delhi.

- BMS room located centrally on ground floor consisting of DVR, NVR, Public Address System, Fire Control Panel by Siemens, Electrical Panel, Elevator monitoring area and various controls.
- Addressable Fire Detection and Alarm with Voice communication system
- Access control system with Biometrics card reader and Electromagnetic Doors
- Security through Metallic doors and Bag scanner
- Surveillance through IP CCTV Dome and Bullet type Cameras

- Automated logic pump controllers in basement.
- Back -Up Generators with auto control
- Substation with Automatic controllers in Switchgears
- VFD by Danfoss company in Chilled Water Plant
- AHU's provided with various Automatic Controls for air flow, water flow, humidity, pressure and temperature control.
- Basement Ventilation and Shaft Pressurization
- Lighting Control System
- Elevator system connected to BMS provided by Otis.
- BMS controls the START/STOP of basement, ventilation system, in order to maintain the CO level below 50ppm.

2. PROPOSED SYSTEMS

ADDRESSABLE FIRE DETECTION AND ALARM WITH VOICE COMMUNICATION SYSTEM –

An important element in fire prevention is the time between fire detection and intervention. The shorter this time that be keot, the less the immediate damage and consequential damage. Intelligent, high-speed evaluation models of advanced fire detection systems, such as detectors with (Advanced Signal Analysis) technology enable smoke and fire to be detected immediately and clearly, no matter how difficult the environment conditions. These detectors can be programmed optimally for the conditions at the location of use. Loop Diagram of proposed system for Addressable Fire Detection and Alarm System is shown in Fig-5.

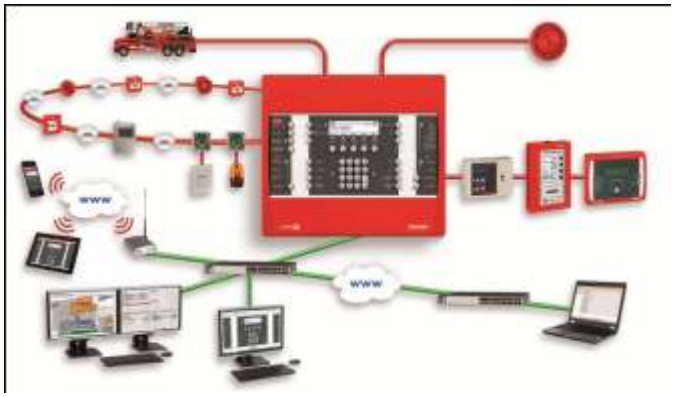

Fig -5: Control Loop for Fire Detection and Alarm System

SECURITY SYSTEM WITH CCTV SURVEILLANCE-

Video motion detection systems transform the viewing only ability of CCTV cameras into a tracking and alarm system. A detection field is created that can locate and track possible threats within the camera's perimeter zone. Moving targets such as intruders speed and direction can be tracked and logged while anomalous static targets, left by an intruder can be flagged as a threat and appropriate alarm is sent to the operator.

Video surveillance enables us to-

- Capture images of unauthorized facility access
- Visually confirm who is at door before giving them access to the facility
- Visually confirm critical environmental conditions assist technicians at remote facilities
- Check the weather status of remote sites

Loop Diagram of proposed system for Surveillance through IP CCTV Dome and Bullet type Cameras is shown in Fig-6.

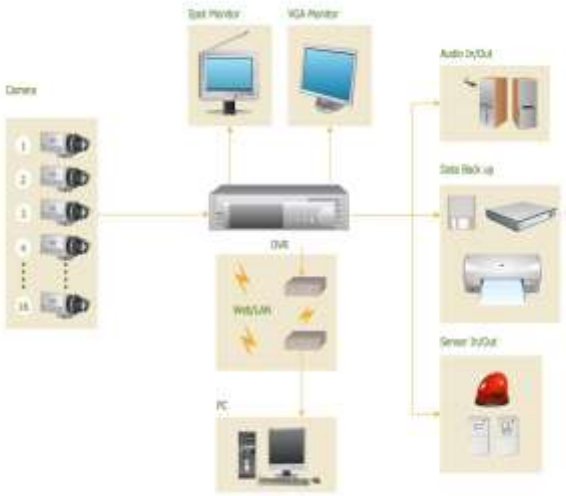

Fig -6: Control Loop for CCTV Surveillance

ACCESS CONTROL IN ELEVATOR SYSTEM-

Elevator control can be provided in one of two ways. Simple elevator control is accomplished by providing a card reader at the elevator lobby. To call the elevator to the lobby, an access card is presented to the card reader, activating the elevator call button. Once the elevator has responded to the lobby, the person may enter and travel to any floor served by the elevator as shown in Fig-7.

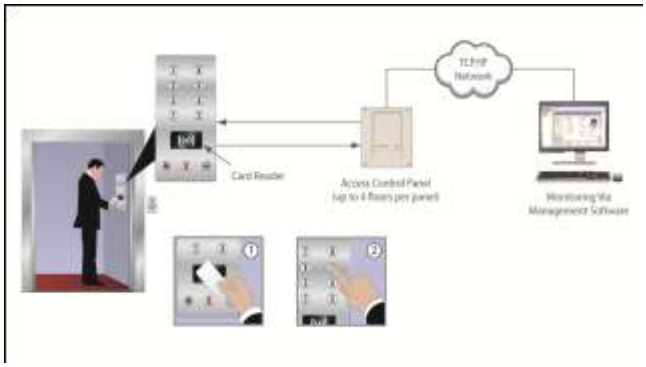

Fig -7: Control Loop for Lift Control Card

In some cases, it is necessary to restrict access on a floor by floor basis. To accomplish this, a more sophisticated form of elevator control is required. This method requires that a card reader be installed in the cab of each elevator; and that a special electronic interface be made to the elevator controllers. As an example, in an Commercial building shared by several companies, the company that occupies the second floor may wish to prevent employees and visitor of other companies within the building from accessing their floor as shown in Fig-8.

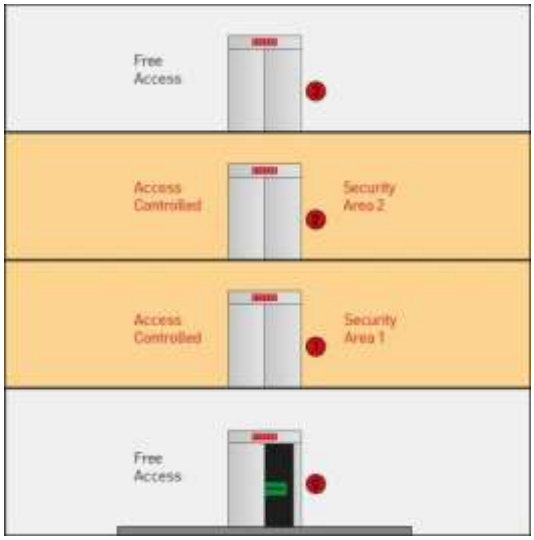

Fig -8: Lift Control System

ACCESS CONTROL ELECTROMAGNETIC LOCK--

Electromagnetic lock installed at the entrance door, which is operated by a sensor/card Reader at outside and exit switch at inside office space. A sensor is provided on the egress side arranged to detect an occupant approaching the doors. The doors are arranged to unlock by a signal from or loss of power to the sensor. Loss of power to that part of the access control system which locks the doors shall automatically unlock the doors. The doors are arranged to unlock from a manual unlocking device located 4 feet vertically above the floor and within 5 feet of the secured door .ready access shall be provided to the manual unlocking device, and the doors shall remain unlocked for a minimum of 30 second. Wiring Diagram shown in Fig-9.

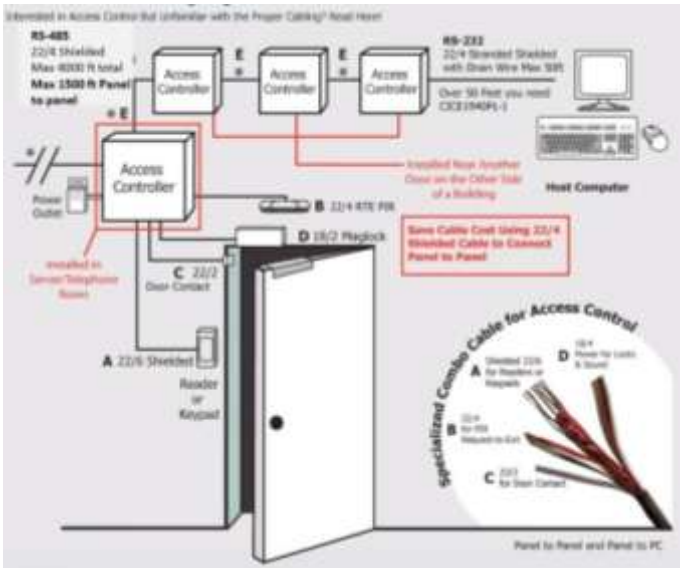

Fig -9: Access Control Wiring Diagram

3. CONCLUSIONS

This system proposed has been a very reliable system of the cause. These systems enable facility managers to intelligently reduce cost, increase security, improve alarm response times and achieve better energy efficiency. Building management system has the power to do more, with cost-effective and scalable integration of all control, monitoring and operational needs. The essential functions of the system are as follows:

-Centralized operation of the plant (remote control)

-Dynamic and Animated Graphic details of Plant and Building

-Early recognition of faults

-Faults statistics for identification

-Trend register to identify discrepancies, energy consumption, etc.

-Preventive maintenance and plant servicing

-Optimum support of personnel

-Control optimization of all connected electrical and mechanical plant

-Prevention of unauthorized or unwanted access

-Own error diagnosis integrated

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