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SMART STREET LIGHTS

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***Abstract*— Being an energy saving era, it is prior to save energy effectively. The paper explain how the energy can be saved from the street lights through effective management using GSM technology. The key objective is to design an intelligent system that takes decisions for luminous control (ON/OFF/DIM) considering the light intensity during day and night simultaneously. System enables anti-thefting of power and it is easily adoptable to the present street lights using single computer module. The intelligent system is suitable for solar cell installations.**

***Keywords*— PIC microcontroller, GSM module, Wireless sensor systems, Single computing, Supporting softwares**

I. INTRODUCTION

Supply of electricity to the consumers continuously is not happening now a days due to rise in demand and less energy production. This can be overcome either by increasing the power production or by saving the electrical energy. Saving is economical than producing more power. Lighting solutions consume large power than any other devices. According to study, global grid based electricity consumption for lighting was about 2700 TW in 2005, which was an equivalent of 19% of total global electricity consumption. Intelligent lighting control and energy management system is the perfect solution for saving energy, particularly in public lighting systems. It aims at remote ON/OFF/DIM of lights which can save energy costs by 40% and maintenance costs by 50% and increases the life of lamp by 30%. This system can be realized in the street lights in which intensity can be varied based on the frequency of the people in the street.

Based on the environmental and economic factors, cities need smart energy management systems urgently for energy saving, maintenance cst reduction and CO2 emission reduction. This system consists of spatially using autonomous devices embedded along with sensors which monitor the environmental parameters like fog, mist, carbonmonoxide emission.

A. Main Function

- Remote on/off, Dimming and on-site Status Check.
- System Fault Detection/Alarm. Anti-theft
- Detection/Alarm. Date Management (energy consumption report).
- 24-hours online Monitoring.
- Reduce energy use by up to 40 autonomous devices embedded along with sensors which monitor the environmental parameters like sound, fog, temperature, carbonmonoxide emission.

B. Features of Intelligent System

The system compromises of server, GUI to display and nodes which are micro controlled processed with embedded sensors measuring different parameters. Each node in the network is linked to the main server via a protocol. The analog data sensed by the sensor is converted in digital form, processed by microcontroller and then sent to the server. The master controls all the slaves .The other nodes sends the data to master and the master collects the data and further sends to concentrator and server where the data is monitored and on necessary alterations process it to switch ON/OFF the nodes devices. This scenario will bring out all the above advantages specified.

II. SURVEY MODULES

A. IEEE References

- WSN for intelligent street lighting system
- Design of new intelligent street light control system
- An intelligent driver for Light Emitting Diode Street Lighting
- Integrated System for Intelligent Street Lighting

C. Company Working on Similar Technology

1) IoTcomm Technologies, China: IoTcomm Technologies develops communication technologies for the Internet of Things (IoT), including but not limited to Power Line Communication (PLC), GPRS, Zigbee and WIFI. By integrating PLC and wireless communication technologies seamlessly, IoTcomm has developed an intelligent street lighting control and management system, which provides its customers with the least expensive and the most reliable solution to significantly reduce power consumption, operating costs and environmental impacts. IoTcomm also offers power line communication modules and wireless communication modules, which are readily to be integrated into smart automation systems including lighting, heating and cooling, security, fire detection, access control, or energy monitoring equipments for both commercial and residential buildings.

D. Field Survey in Mettur Dam Locality

TABLE 1
STREET LIGHT EXPENDITURE

Identity	Quantity	Expenditure
G.I pole	1	4200INR
Foundation(erection of pole)	1	2100INR
Foundation(erection of pole)	1(9m)	1100 INR
Junction Box	1(6m)	620INR
Cable 41*6 3	5	7700INR
Internal wire	1	500INR
Bracket	1	800INR
Sodium fitting	5	500INR
Sodium Lamp	1	800INR
Earthing	1	850INR
Evacuation for Laying cable	N/A	3000INR
	Total	27120INR

E. From Mettur Substation

Bulb Used:

- Mostly sodium vapor bulb of 250W or 150W.
- 250W is used for main roads.
- 150W is used for internal roads.

Types of Bulb:

- Sodium-yellow color- Steady nature
- Mercury-white color- Not used usually
- Metal halide-white color- Power consumption is quite high, hence not normally used.

Height of Street Light: 7m, 8m, 9m, 10m

Power:

- 70 Watts for 7m & 8m poles
- 150Watts for 9m pole
- 250 Watts for 10m pole

Distance Between Successive Street Pole:

- 19-20m (between 7-7m and 8-8m poles)
- 24-25m (between 9-9m and 10-10m poles)

(Distance between poles depends on width of the roads.)

Phase: Single phase (230V) and Three Phase (440) Used together

Lamps: Sodium Vapor Lamps

Network: Arranged in parallel network

Linear Control: No linear control available on lamps.

Expenditure: Use of Intelligent Timer

Lamps/Timer: 3Kw-5Kw load per timer (20 -30lamps)

No of Timers: 2500

Number of Lamps: 62500 (25 Lamps per Timer)

Number of Energy Units Utilized: 4166000 per month approximately

Monthly Bill of 1.25 crores (Rs.3 per unit)

III. PROBLEM CITED

This system resolves the faulty street lamps issue, where people are rarely taking the initiative to report faulty street lamps in their locality. With this device, it able to track whenever there is faulty lamps and sends the data to the control centre. Thus, technician will be able to acknowledge the faulty street lamps at the first moment and head for the repair. Another benefit of this system is the cost saving in terms of wiring. The Xbee module will allow the streets lamps communicate to the control system via wireless. With the wiring method, the high cost of the construction and material makes the system uneconomical; moreover, the reliability of the system will reduce too. Although this system monitors the health of the street lamp status, it did not have other smart feature whereby controlling the street lamps by automatically turning ON or OFF the lamps. If this feature is apply to this system, this allow another great energy saving.

In addition, any faulty lamp will be automatically turning OFF which avoid more energy wastage causes by the faulty lamps. With the application of the lamp illumination control on the system, the lamps are able to turn ON the lights with low illumination when the surrounding condition needs the low light illumination of the lamps (e.g. rainy or cloudy day).

There are no data of the return of investment (ROI) of this system, but it may believe that the ROI will be in less than 8 years. One of the main weaknesses of this system is the device are placed at outdoor, thus, precaution steps need to be taken whereby the case of the devices must be designed carefully. It must be sealed or isolated probably to avoid the environmental that could affect the lifespan of the devices.

IV. PROPOSED INTELLIGENT SYSTEM

A. Assumptions and Prerequisites

The user is at Control Station i.e. the Master Node, which is the governing device of wireless sensor network. The user must be aware of working wireless sensor network based application. User must provide proper network setup parameters for WSN based application. Environmental Conditions such as rain, snow, storms etc.can affect the System performance. The Master node must function properly during entire working, i.e. it should not fail in the due procedure.

B. Implementation Details

Initially a microchip must be installed on the pole lights. These chips consist of a micro-controller along with sensors

like CO2 sensor, smoke sensor, light intensity sensor, noise sensor and GSM modules for wireless data transmission and reception between concentrator and PC.

The data from the chips would be received on a remote concentrator (PC) and the PC would also transmit the controlling action to the chip. According to the survey of variation in the intensity of light in the field area, efficient programming would be done to ensure minimum consumption of energy.

Separate automatic mode will be provided that will have timing considerations in addition to surrounding light conditions.

C. Modes of Operation

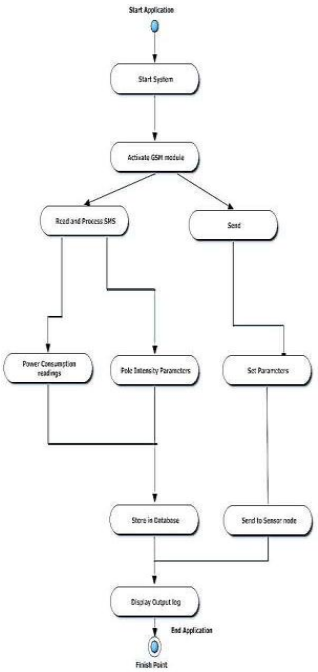
1) Auto Mode: In auto mode, according to the light intensity, slot of times and also monitoring the weather conditions the nodes are being switched on/off. It monitors the complete locality and thus saving power.

TABLE 2
AUTO MODE CASES

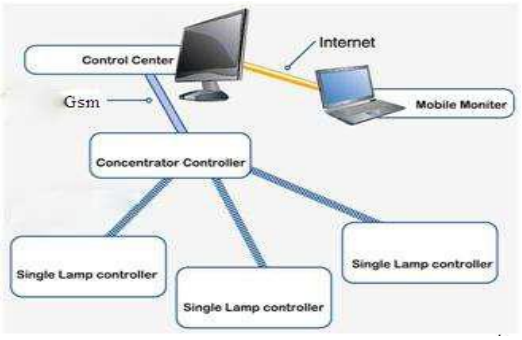
6 pm – 8 pm	Alternate street lights with low intensity
8 pm – 9 pm	All street lights ON with full intensity
9 pm – 11 pm	Alternate lights with full intensity.
11 pm – 6 am	Alternate street lights with low intensity

2) Manual Mode: In Manual mode, system stores the parameters in computer about changes in environmental conditions continuously like heavy rain visibility, faults , more or less traffic congestion or during foggy conditions. User can manually define each node with specific intensity factor as per the requirement and can take any suitable corrective measure.

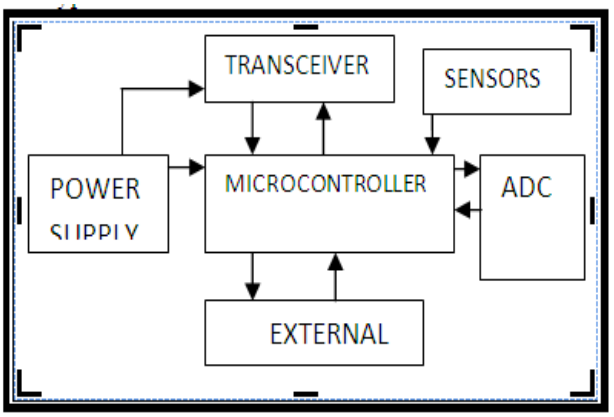
D. System Flow Chart



V. ARCHITECTURE



A. Block Architecture



B. Block Diagram

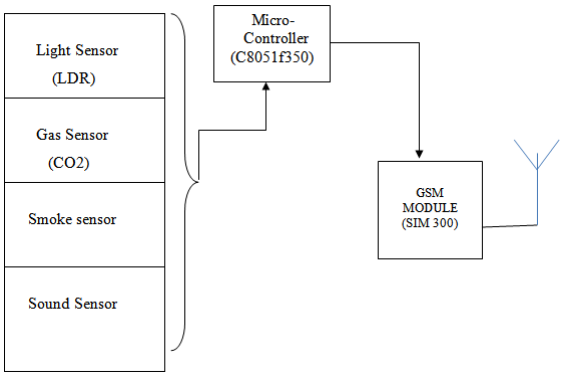


Fig. 1 Transmission side

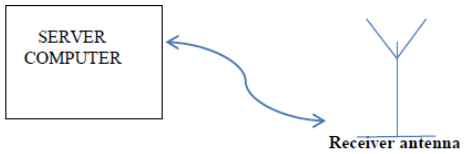


Fig. 2 Receiving side

These arcing faults can raise the temperature of nearby conductors by 2500 degree Celsius. No wonder it will result on high cost losses.

VI. ENERGY UTILIZATION

Works on profile basis i.e. all street lights are ON from 6:00pm to 6:00 am, in other words street lights are functioning completely for 12hrs a day. Assuming 20 nodes to be working power consumed by them will be given as:

Bulb used = 150W

Number of nodes = 20

Number of working hours per day = 12

Power consumed per day = 20*12*150/1000 = 36 units

i.e., 36*30=1080 units per month

Monthly bill for 20 nodes (3 INR/unit) = 1080*3= 3240INR per month

Expected power saving in various ways

- 0% consumption say from 7am to 7pm.
- 97% saving at the time of dusk say from 7pm to 8pm.
- 7% energy saving because of voltage correction say from 8pm to 11pm .
- 55% consumption because of dimming technique used say from 11pm to 1am.
- 34% consumption because of dimming as well as staggering technique say from 1am to 2am.
- 55% consumption because of dimming technique used say from 2am to 6am.
- 96% savings at the time of dusk, say from 6am to 7am

VII. REQUIREMENTS

A. Software Requirement

- Microsoft Visual Basic for user interface.
- SQL for database.
- Embedded C for microcontroller chip.
- Eagle software for circuit layout.

B. Hardware Requirement

On Road

- GSM SIM300 module for wireless communication.
- Microcontroller C8051F350 for controlling various sensors.
- PLC module.
- A PC for observation and running of controlling software.
- Various sensors for sensing external parameters.
- Beta-LED fixtures.
- Camera for street surveillance

Prototype

- GSM SIM300 module for wireless communication.
- Microcontroller C8051F350 for controlling various sensors.
- A PC for observation and running of controlling software.
- Various sensors for sensing external parameters.
- LED's as street-light lamp.
- Power supply unit.
- PCB
- Thermacol for visualization of streets and street light vicinity.
- Five small rods as a street light poles

VIII. CONCLUSION

Thus the proposed system is described that integrates new technologies offering ease of maintenance and energy savings and it is appropriate for street lighting in remote as well as urban areas where traffic is low at times. Wireless Sensor networks may present a new solution to bring the installed cost down and to ensure energy efficiency. Over the past 10years many new RF solutions have been developed into our every-day life.

IX. FUTURE SCOPE

Once this Intelligent System is implemented, we could directly go for Wireless Power Transmission which would further reduce the maintenance costs and power thefts of the system, as cable breaking is one of the problems faced

today. In addition to this, controlling the Traffic Signal lights be another feature that we could look into after successful implementation of our system. Depending on the amount of traffic in a particular direction, necessary controlling actions could be taken. Also emergency vehicles and VIP convoys can be passed efficiently. Moreover, attempts can be made to ensure that the complete system is self-sufficient on nonconventional energy resources like solar power, windmills, Piezo-electric crystals, etc. We hope that these advancements can make this system completely robust and totally reliable in all aspects.

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