INTELLIGENT STREET LIGHT MONITORING AND CONTROL SYSTEM

BY;
VIKAS MANTRI
3RD YEAR
ELECTRICAL

Present scenario of street light lightning

- Simple timer control are installed for almost all circuits but there is no regular check up to alter regulate the time setting / irrespective of weather sensitivities to switch ON/OFF lamps leading to extra lightning hours
- Due to **absence of any control systems on the input power supply quality** especially voltage conditions. The voltage levels at light terminal vary in wide, bandwidth leading to high power consumption. high voltage levels in the range between 250 – 280 V is not uncommon in the system. This not only increases the energy consumption but also lead to premature lamp failures and hence higher O & M (operational and maintenance) cost.
- Photo switches do not function properly after some time due to settling of dust on the photo cells.

Present scenario of street light lightning

- **Inadequate / poor fault reporting mechanism** and hence delayed repair of the faulty lights and human discomfort.
- Non uniform light intensity levels due to several reasons mention above and **higher intensity levels during off peak traffic hours**, leading to energy wastage.
- **No control and/or mechanism to check the power theft** from the lines meant for street lightning supply, **causing revenue loss** to both municipalities and to the utility.

Threats and issues

- Very high energy bills for street lightning.
- Yearly steep increase in electricity tariff from electricity board.
- Rapid expansion of city will only increase the energy bill for street lightning.
- Increasingly difficult to monitor and verify the condition and health of street lights.
- Drastic increase in Labor cost or maintenance and operation of street light.
- Long term energy planning is not available history data is not maintained

Street light energy saving strategies

- Monitor and manage the electricity flow
- Improve power quality – controlled voltage system

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Darkness to Light

Intelligent street light controller (intelligent energy tracking and control system)

SLC is an **intelligent energy tracking and control system**

Which can be very efficiently used for REMOTE tracking,

Monitoring and operation of street lights in a city

How SLC will work for the street lights?

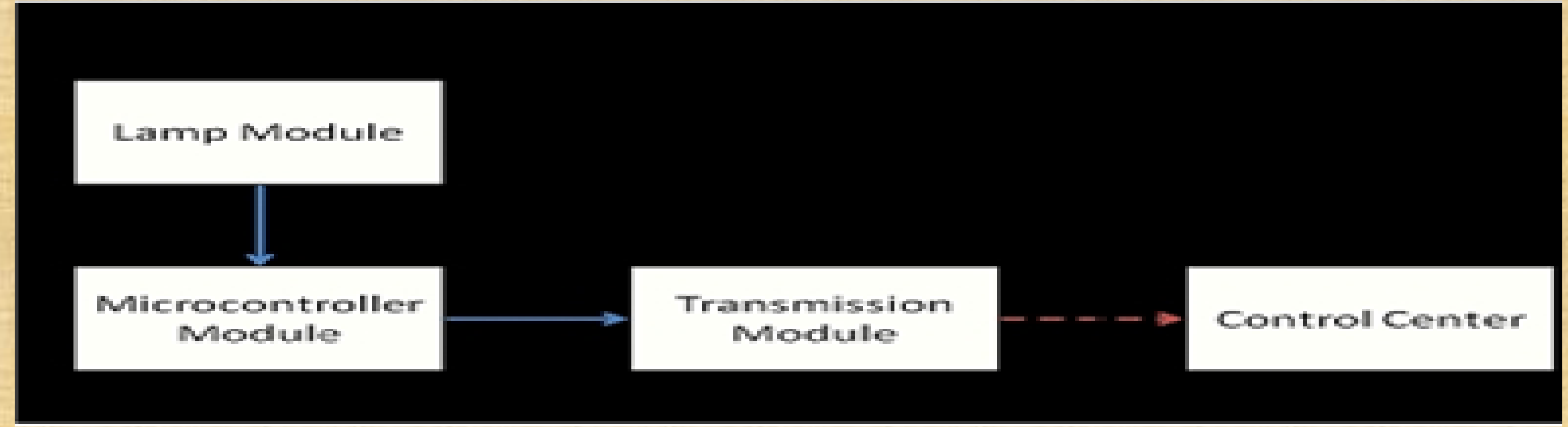
- Longitude / latitude based switching ON/OFF street lights
- Energy tracking and planning (precise monitoring of energy consumed for street lightning
- Monitoring of faulty street lights and ensuring an effective fault repair and servicing system
- Keeping a close check on maintenance contractors

OBJECTIVES

- The objective for this project is to design a smart lighting system which targets the energy saving and autonomous operation on economical affordable for the streets.
- Build an energy saving smart lighting system with integrated sensors and controllers. Design a smart lighting system with modular approach design, which makes the system scalability and expandability.
- Design a smart lighting system which compatibility and scalability with other commercial product and automation system, which might include more than lighting systems.

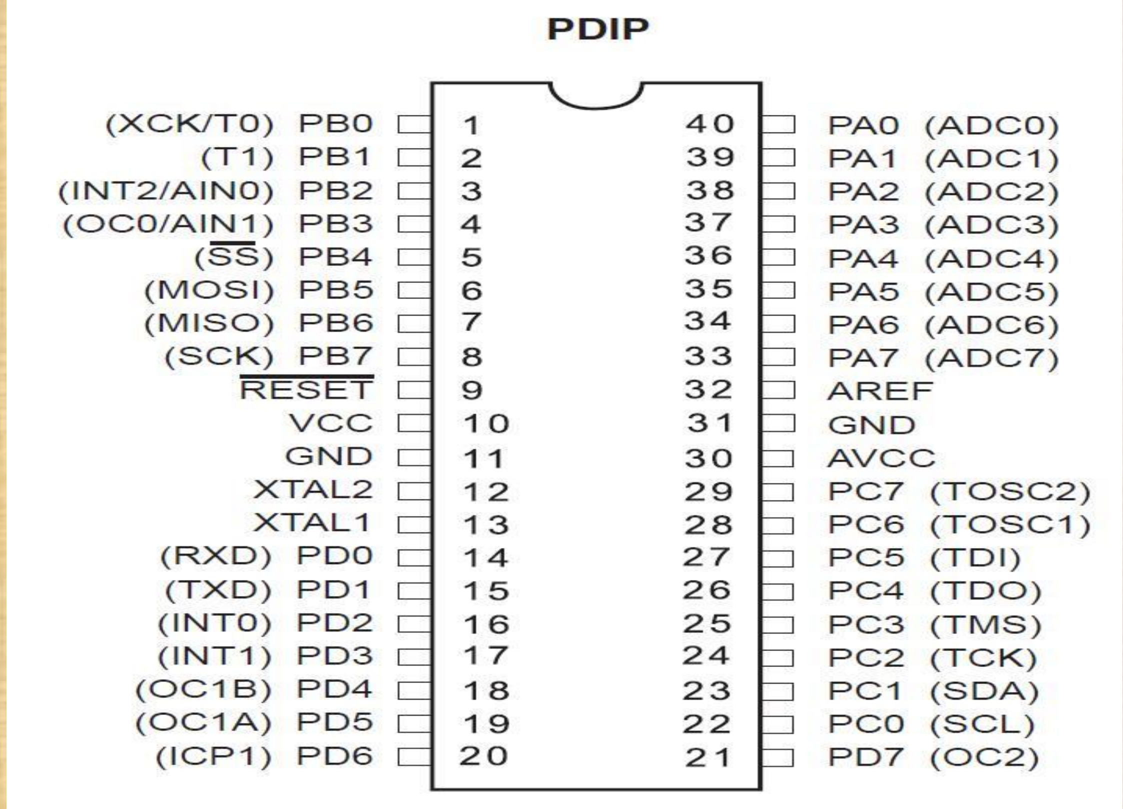
METHODOLOGY

- Firstly, Chips would be made to be installed on the lights. These chips will consist of a microcontroller along with various sensors like CO_2 sensor, fog 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. The emissions in the atmospheres would be detected along with the consumption of energy and any theft of electricity



MICROCONTROLLER

- The microcontroller is the heart of the circuit. The one which is used in this study is ATmega32.
- The port B pins are used as input pins from the LM324, where port D pins are used as a output pins for the power LEDs. The port A channel used for LDR sensor

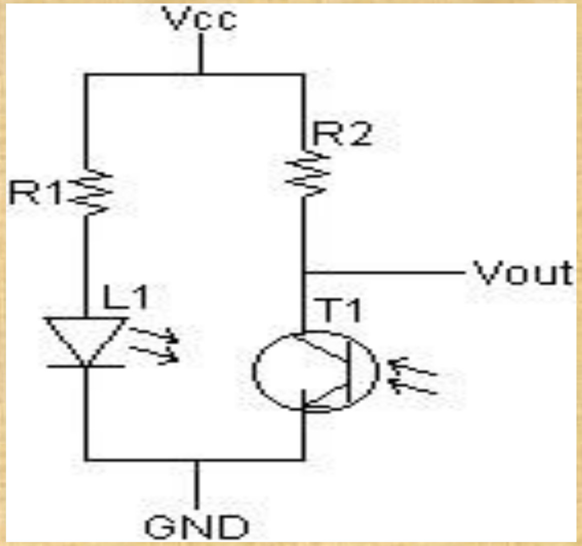


IR TRANSMITTER RECEIVER PAIR

- The purpose of the IR pair is to sense the vehicle and correspondingly light the required power LEDs
- In a practical implementation, IR sensors must have sufficient range to detect vehicles. The IR sensors are placed just before the LED post to light the street just before the vehicle reaches a particular point on the street.

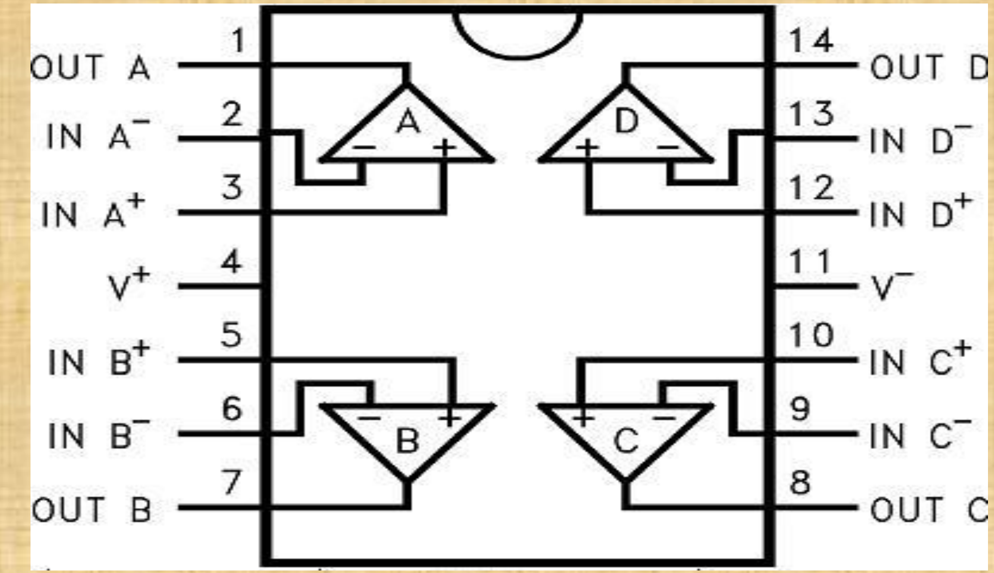
LDR CIRCUIT

- The LDR circuit is a light dependent sensor which increases resistance of path as the intensity of incident light decreases. This property is used in the project to distinguish between day and night. As the intensity of light comes down during night, the resistance thereby increases, thus, indicating it by switch OFF the indicating LED. This module gives analog output to the ADC channel of the microcontroller which digitize it and perform the required function after comparing its value with the reference set in the microcontroller program



LM324 ASSEMBLY

- It is an integrated chip (IC) which consist of quad op-amp which act as an comparator for the inputs on inverting and non-inverting terminals. The basic purpose of LM324 is to convert the analog value of output of IR sensors to the digital form.
- LM324 has a capability of handling 4 output of the sensors thereby reducing the complexity of the circuit.



CASE 1: WHEN IR PAIR SENSE THE VEHICLE

- In this case, the sensor detects the object and generate an analog output which is sent to the inverting terminal of the op-amp(LM324). It is compared to a reference voltage set at 4.1V on the non-inverting terminal of op-amp.
- Usually, when the sensor detects the vehicle, it generate a voltage less than 4.1V, which tends to give the op-amp output equal to +Vcc= 5V. This output is sent to port B of the microcontroller and the LEDs are switch on accordingly as per the program. The Port D pins which are connected to the power LEDs is set high in order to glow them at rated value.

- VOLTAGE ACROSS LEDs = 3.5 V
- CURRENT ACROSS LEDs = 290mA
- POWER CONSUMED = 1 W (Approx.)

WHEN IR PAIR DOES NOT SENSE THE VEHICLE

- in this case, when there is no traffic flow across a street, the sensor does not detect any object and hence the output of the sensor is higher than the reference voltage of 4.1V. this tends the output voltage of op-amp to be -Vcc=GND. This output is sent to port B of the microcontroller and the LEDs are switch on accordingly as per the program.
- The special attribute here is that when there is no object detected power LEDs will glow at very less value than its rated value. This is achieved by setting the port D pins a PWM signal. The voltage level can be set by varying the duty cycle of the PWM signals.

- VOLTAGE ACROSS LEDs = .5 V

- CURRENT ACROSS LEDs = 10mA

- POWER CONSUMED = 1 mW

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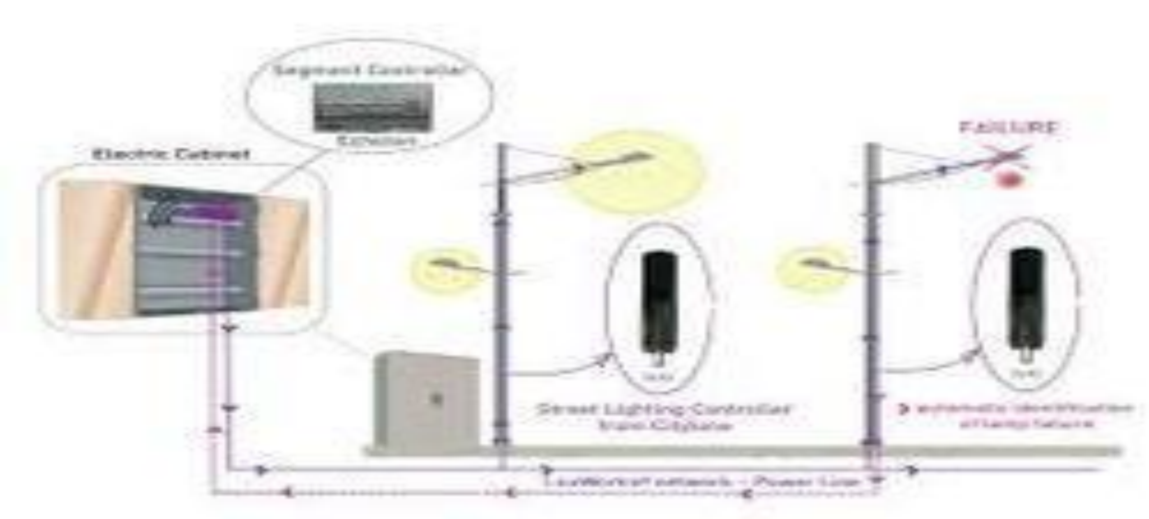
Darkness to Light

Power quality control of street light

Due to **absence of any control systems on the input power supply quality** especially voltage conditions. The voltage levels at light terminal vary in wide, bandwidth leading to high power consumption. high voltage levels in the range between 250 – 280 V is not uncommon in the system. This not only increases the energy consumption but also lead to premature lamp failures and hence higher O & M (operational and maintenance) cost.

Voltage levels individual or a bank of street light can be controlled to give optimum light intensity levels during low traffic periods.



Benefits to municipal corp.

- Huge energy savings annually
- Excellent central operation and maintenance of street lights
- Centralized monitoring of all street lights
- Less labor costs
- Less capital expenditure on lamps and fittings
- Less contract charges and better contractor’s monitoring
- Improved public image as a conscious and efficient public service provider

Benefits to General public

- Improved street lightning
- Less complaints
- Better light management
- Fast monitoring of complaints from public
- Lesser pollution

Payback and return on investment

- Present consumption (@12 hour per day)

  250Kw * 4380 hr/year * Rs. 5/unit = Rs. 5475000
- Consumption on installation of SLC

  250Kw * 4100 hr/year * Rs. 5/unit = Rs. 5125000
- Consumption on installation of SLC and power LEDs

  15Kw * 4100 hr/year * Rs. 5/unit = Rs. 3075000

TOTAL SAVING IN INR / YEAR = Rs. 2400000

Unit cost recovered in approx. = 1 year

NOTE: CONSIDERING UDAIPUR HAS AN AVERAGE OF 1000 STREET BULB

SUMMARY

INTEGRATED ENERGY MANAGEMENT SYSTEM

EFFICIENT ENERGY TRACKING & CONTROL

LONG TERM ENERGY PLANNING POSSIBLE

COST SAVING, RELIABLE AND PROFITABLE

CO_2 EMISSION REDUCED

END OF PRESENTATION – THANK YOU