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Energy Saving System Using Astronomical Clock Based Street Light Controller

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***Abstract*— Currently, in the rural areas, enormous electric energy is consumed by the street lights, which are automatically turn on when it becomes dark and automatically turn off when it becomes bright. This is the huge waste of energy in the whole world and should be changed. To overcome the disadvantage of LDR and ordinary timers an astronomical timer is used. The main thought is to save the energy in twilight mode and increases durability of bulbs. Due to this energy can be saved more than existing system. This technology is more succeeded in real time.**

This paper discusses an intelligent streetlight energy-saving system based on Astronomical clock. Here we are going to implement the intelligent streetlight energy saving system based on Astronomical clock and RTC, we are controlling the Street Lights through microcontroller. ASLC system will be placed in each villages. ON & OFF signal for each Street light will be given from ASLC

Keywords—LDR, RTC, ASLC

I. INTRODUCTION

Street light controller is saving the energy conservation by using timer switch so that more energy can be saved. They come with energy conservation option in twilight mode, staggering or dimming. In this Paper the street light controllers with an astronomical clock for a particular location based on longitude and latitude of different regions are selected to set the astronomical time to give the best ON-OFF time and energy saving. A Transistor (IGBT) is used as a switch to switch ON and OFF the street light automatically. By using this system manual works are reduced also increases the durability of bulbs by minimizing switching short-circuits faults. It automatically switches ON lights when the sunlight goes below the visible region of our eyes .It automatically switches OFF lights under illumination by sunlight. The main notification is luminous is noted for public convenience. This is done by astronomical timer. The major advantage in this Paper is using an astronomical timer so that energy can be saved in twilight mode and increases the durability of whole street light systems.

II. OBJECTIVE

The main objective of this energy saving ASLC system is improving energy efficiency, durability, cost effective and saving energy on twilight mode in rural areas. This Paper 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.

III. BLOCK DIAGRAM AND DISCRIPTION

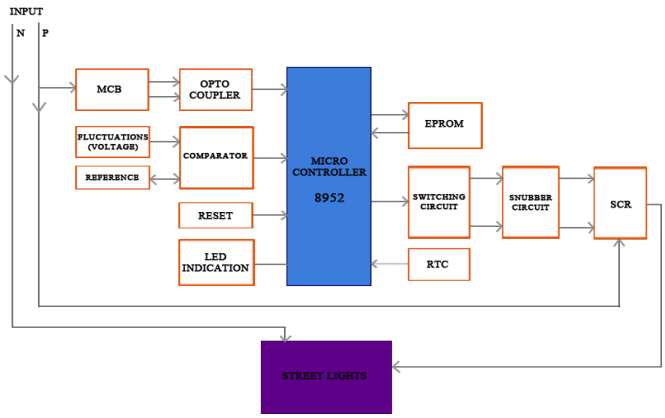

Fig 1 Block diagram of Astronomical clock based Automatic streetlight controller

- The main aim of the Paper is to consume the energy by controlling the street light.

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- In the first stage the supply is given to the microcontroller which is implemented inside the street light controller
- First the timer will send the actual time to the microcontroller. A separate battery is used for the timer to operate which will last for 3 to 4 years.
- The microcontroller will check the time with the astronomical clock time were the time which is fed inside the microcontroller.
- The microcontroller will verifies the time. If the time is matching with the astronomical clock time data then It will do the operation ON/OFF of the street light.
- Here the microcontroller is the heart of the entire system and here it is used for checking the exact time of sunrise and sunset.
- Small step-down transformers are used here for the various voltages required for different components inside the automatic streetlight controller.
- Small LED indicators are used inside the controller to know the over voltage, under voltage ,working of RTC etc.
- Since the sunset and sunrise of each locations are different there is an option in the circuit that we can input the astronomical clock time data by connecting the controller to a computer.

A. *Hardware description*

RMC-Relay Modelling Control Relay module Energy meter SMPS-switch mode power supply Contactors Rotary switch Toroidal transformer MCB MCB tripper Input and output connectors Connecting wires Box Door temper switch Buzzer Channel. RLC COMPONENTS: MC microcontroller IC-PIC-18F46K22 EPROM-24M02 RS232-MAX 232 (ENERGY METER COMMUNICATION) RELAY DRIVER-ULN 2003N SIM 900A-MODEM MOSFET -4437(MODEM on/off) REGULATOR-LM2576.

IV. PROPOSED SYSTEM

Work in this Paper is towards the design of a cost effective and energy efficient street light control system. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. By using this system energy consumption is also reduced because nowadays the manually operated street lights are not switched off even the sunlight comes and also switched on earlier before sunset so this is reduced by using astronomical times clock. By using astronomical timer switch can reduce the energy conservation by a variations in month for example: In the month of march a sunlight stays more longer so by using astronomical times switch it can be automatically switch on the light after the sunset fully this is possible for all the month. A month variation is programmed by this more energy can be saved than existing system. A GSM system is used for controlling the device and for regular checking purpose and for informing fault.

Fig. 2 ASLC 10KVA Unit

A. *ASTRONOMICAL TIMER*

i. SWITCH

Time Switches are used to control events with respect to real time clock (RTC) whereas timers are used to control processing times. Therefore RTC forms the basic difference between timer and times switch functionality. With the help of Time switches it is possible to switch ON and OFF devices like lights, heaters, etc automatically at desired time of the day / night thereby giving the advantage of convenience and reduction in power wastage or substantial energy savings. The need of automation in street light system is for accurate switching of lights at sunset or twilight sunset and switch OFF at sunrise or twilight sunrise with energy savings

ii. TWILIGHT

It is observed that there is sample amount of light available even after the sun has set or prior to sunrise. This period is around 20 minutes on an average during sunset and sunrise. This feature can be used for more energy savings. The reference time for Astro can be based on either sunrise/sunset or begin/end twilight. Reference on twilight can harvest maximum natural light throughout the year. Even 5 min saving due to twilight saves thousands of rupees over a year. Here twilight times are calculated using astronomical mathematics.

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September 2018 — Sun in Gubbi

August | September | October

Month: September Year: 2018

2018	Sunrise/Sunset		Daylength		Astronomical Twilight		Nautical Twilight		Civil Twilight	
Sep	Sunrise	Sunset	Length	Difference	Start	End	Start	End	Start	End
1	06:10 (81°)	18:33 (279°)	12:22:29	-0:42	04:59	19:45	05:24	19:20	05:49	18:54
2	06:11 (82°)	18:32 (278°)	12:21:46	-0:42	04:59	19:44	05:24	19:19	05:49	18:54
3	06:11 (82°)	18:32 (278°)	12:21:03	-0:42	04:59	19:43	05:24	19:18	05:49	18:53
4	06:11 (82°)	18:31 (277°)	12:20:20	-0:43	04:59	19:42	05:24	19:17	05:49	18:52
5	06:11 (83°)	18:30 (277°)	12:19:37	-0:43	04:59	19:42	05:24	19:17	05:49	18:52
6	06:11 (83°)	18:30 (277°)	12:18:54	-0:43	04:59	19:41	05:24	19:16	05:49	18:51
7	06:11 (83°)	18:29 (276°)	12:18:11	-0:43	04:59	19:40	05:24	19:15	05:49	18:50
8	06:11 (84°)	18:28 (276°)	12:17:27	-0:43	04:59	19:39	05:24	19:14	05:49	18:50
9	06:11 (84°)	18:27 (276°)	12:16:44	-0:43	04:59	19:39	05:24	19:14	05:49	18:49
10	06:11 (85°)	18:27 (275°)	12:16:00	-0:43	04:59	19:38	05:24	19:13	05:49	18:48
11	06:11 (85°)	18:26 (275°)	12:15:17	-0:43	05:00	19:37	05:25	19:12	05:49	18:47
12	06:11 (85°)	18:25 (274°)	12:14:33	-0:43	05:00	19:36	05:25	19:11	05:49	18:47
13	06:11 (86°)	18:25 (274°)	12:13:49	-0:43	05:00	19:36	05:25	19:11	05:49	18:46
14	06:11 (86°)	18:24 (274°)	12:13:05	-0:43	05:00	19:35	05:25	19:10	05:49	18:45
15	06:11 (87°)	18:23 (273°)	12:12:21	-0:43	05:00	19:34	05:25	19:09	05:49	18:44

Click to expand for more details

September 2018 — Sun in Bangalore

August | September | October

Month: September Year: 2018

2018	Sunrise/Sunset		Daylength		Astronomical Twilight		Nautical Twilight		Civil Twilight	
Sep	Sunrise	Sunset	Length	Difference	Start	End	Start	End	Start	End
1	06:08 (81°)	18:30 (279°)	12:22:03	-0:41	04:56	19:42	05:22	19:17	05:47	18:52
2	06:08 (82°)	18:30 (278°)	12:21:22	-0:41	04:57	19:41	05:22	19:16	05:47	18:51
3	06:08 (82°)	18:29 (278°)	12:20:40	-0:41	04:57	19:40	05:22	19:15	05:47	18:50
4	06:08 (82°)	18:28 (277°)	12:19:58	-0:41	04:57	19:40	05:22	19:15	05:47	18:50
5	06:08 (83°)	18:28 (277°)	12:19:16	-0:41	04:57	19:39	05:22	19:14	05:47	18:49
6	06:08 (83°)	18:27 (277°)	12:18:34	-0:42	04:57	19:38	05:22	19:13	05:47	18:48
7	06:08 (83°)	18:26 (276°)	12:17:52	-0:42	04:57	19:37	05:22	19:12	05:47	18:48
8	06:08 (84°)	18:26 (276°)	12:17:10	-0:42	04:57	19:37	05:22	19:12	05:47	18:47
9	06:08 (84°)	18:25 (276°)	12:16:27	-0:42	04:57	19:36	05:22	19:11	05:47	18:46
10	06:08 (85°)	18:24 (275°)	12:15:45	-0:42	04:57	19:35	05:22	19:10	05:47	18:45
11	06:08 (85°)	18:23 (275°)	12:15:02	-0:42	04:57	19:34	05:22	19:09	05:47	18:45
12	06:08 (85°)	18:23 (274°)	12:14:20	-0:42	04:57	19:34	05:22	19:09	05:47	18:44
13	06:08 (86°)	18:22 (274°)	12:13:37	-0:42	04:57	19:33	05:22	19:08	05:47	18:43
14	06:08 (86°)	18:21 (274°)	12:12:54	-0:42	04:57	19:32	05:22	19:07	05:47	18:43
15	06:08 (87°)	18:21 (273°)	12:12:12	-0:42	04:58	19:31	05:22	19:07	05:47	18:42

Click to expand for more details

Considering Gubbi location and Date 10/10/2018

TABLE I.

Sun rise	Twilight	Difference
6.11.AM	5.41.00AM	30 minutes
Sun set	Twilight	Difference
6.27 PM	6.57 PM	30 minutes

ENERGY SAVING: Energy Saver guarantees 30% reduction in energy consumption under normal working conditions. It reduces the power consumption by optimizing the voltage to the lamps. While optimizing voltage, care is taken to maintain the flux as per ISI standards. AUTOMATIC SWITCHING: GPS location based switching of streetlights. WIRELESS MONITORING & CONTROL: State of the art GSM/ GPRS technology is used for monitoring and controlling the street lights.

FEATURES:

• Guaranteed operating efficiency of 97% (higher than industry standards) with the use of highly efficient Toroidal transformers

• Dynamic Voltage reduction: provides stabilized voltage to the lamps.

• Automatic On/Off based on Sunrise/Sunset or on programmed timings

• Wireless control and monitoring through sophisticated web-based software

• Automatic bypass in case of tripping with manual changeover in case of maintenance or emergency

• Reduces operational, maintenance and running cost

• Reliable and safe changeover with On-Load tap changing

• Completely remote programmable ON/OFF timings, alert and energy saving settings.

• Instantaneous alerts for critical fault conditions to your mobile phone

• Energy saving reports and lamp failure reports on daily, weekly and monthly basis for single, multiple or all devices

• Detection of Energy theft or leakage

• Maintains a high power factor of above 0.85

• Guaranteed operating life upto 10 yrs &ISI standard.

• Eco friendly and reduces public inconvenience.

V. CONCLUSION

This Paper describes a new street lighting system which integrates new technologies available on the market to offer higher efficiency and considerable savings more than existing system The energy consumed in existing system is 1000amps whereas in proposed system it is reduced to 700amps and it is economically comfort

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