Zigbee Based Energy Based Conservation in Railways

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Abstract- Current railway tunnel lighting control systems are often manually controlled, resulting in significant energy waste. This article designs a zigbee based control for tunnel lighting energy control systems. The system uses solar energy lighting, so the zigbee based system is designed for solar lights. It deals with automatic railway gate operation at a level crossing replacing the gates operated by the gatekeepers .This system has been deployed in Europe at the Antwerp North-South junction since past 4 years. The performance results show that the energy conservation system provides sufficient lighting levels and significant energy conservation and automatic gate control.

Key words: *tunnel lighting; solar energy; automatic gate control; zigbee; energy conservation.*

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I. INTRODUCTION

Railways being the cheapest mode of transportation are preferred over all the other means. Energy conservation is of prime importance nowadays. In tunnels lights are always on though there is no railway in a tunnel. There is lot of energy waste in this case. This can be avoided if a presence of railway is detected.

In the rapidly flourishing country like ours, accidents in the unmanned level crossings are increasing day by day .Our project deals with automatic railway gate operation (i.e.,) automatic railway gate at a level crossing replacing the gates operated by the gatekeepers, It deals with two things, Firstly it deals with the reduction of time for which the gate is being kept closed and secondly, to provide safety to the road users by reducing the accidents. The tunnel number and the time at which railway enters into the tunnel will be sent to the control room..

Our main motive is to conserve energy on a large scale and make maximum use of solar energy**.** In this project Solar panels are used in the tunnels to generate green energy. Control room will send a signal to microcontroller and then lights will be ON using solar panel. Energy supplied in the tunnels will be solar energy thus saving electricity and conserving energy.

This paper describes the design deployment of a set of tunnel lighting and energy conservation control systems based on Zigbee control. The system includes railway detection and throughput statistics module. The system uses solar panels for the tunnel lighting source and detection of railway through the tunnel as input parameter.

II. HISTORY

The solar radiation is the best in the entire system at Orinda which is a Bay Area Rapid Transit station in Orinda, California represented by Gail Murray. The station was earmarked for the installation of car ports with solar panels on top of them in 2008.[2]

The first green train started in Antwerp, Belgium on 6 June 2011.16,000 solar panels installed on the roof of a high-speed rail tunnel in Antwerp, Belgium have been officially entered into service. The solar installation is the result of collaboration between Belgian rail operator Infrabel, renewable energy developer Enfinity, the municipalities of Brasschaat and Schoten, intermunicipal financing companies FINEA and IKA, and solar construction company Solar Power Systems. [2] The 'tunnel' is unique as it is covered with 16,000 solar panels. The line's operator claim this provides 3300 MWh of electricity per year and cuts CO2 emissions by 2400 tonnes a year.[3]

III. SYSTEM MODEL

Railway tunnel lights are always on though there is no railway in a tunnel and hence there is a lot of energy wastage in this case. This can be avoided if a presence of railway is detected in the tunnel. The main application is large amount of energy conservation. In this project we are using infrared sensors for sensing if railway is present in the

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tunnel. Thus lights in the tunnel will be on if railway is moving through tunnel. After railway comes out of tunnel, lights will be off. Here we are using Zigbee module for wireless communication between tunnel site and control room.

RF Zigbee is used for transmission and reception. Zigbee is for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. Because of its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics, Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. The IEEE 802.15.4-2003 Zigbee specification was ratified on December 14, 2004.

Automatic gate is programmed to open and close with a wireless transmitter or a manual device. Generally railway crossing are of 2 types: Manned and unmanned. Automatic gate control provides reduction of time and provides safety in railways reducing accidents as there is no scope of human errors.

Solar panels generate and supply electricity in commercial and residential applications. It will increase countries energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise.

The working involves the detection of railway by sensor technology. As the railway is detected the message is sent via Zigbee to the controller and the gate opens automatically. As the railway enters the tunnel the lights are immediately on and as soon as the railway exits the tunnel the lights will turn off as the controller commands. Similarly the gate would be automatically closed. The lights will be working on solar panels thus saving a lot of energy**.**

The relay logic circuit forms an electrical schematic diagram for the control of input and output devices. Relay logic diagrams represent the physical interconnection of devices. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits).A major application of relay logic is the control of routing and signaling on railways. **[5]**

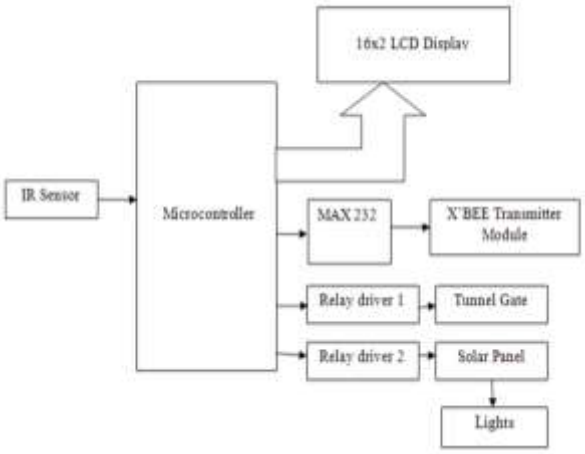

Fig 1. Transmitter section

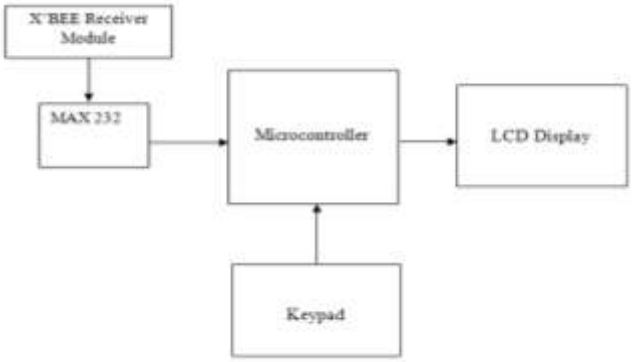

Fig 2. Receiver Section

IV. SYSTEM SPECIFICATIONS

1. **Size**:1ft by1ft [control room and tunnel system]
2. **Weight**: 2 kg [tunnel system], 1.5kg [control room], 800g[solar panel]
3. **Battery**:12V, 1.2A
4. **Zigbee**:2.4 GHz, low power consumption, 30m range
5. **Solar panel**-12V, 3W
6. **Controller**- 80s51

V. SYSTEM FLOW

1. Transmitter flow

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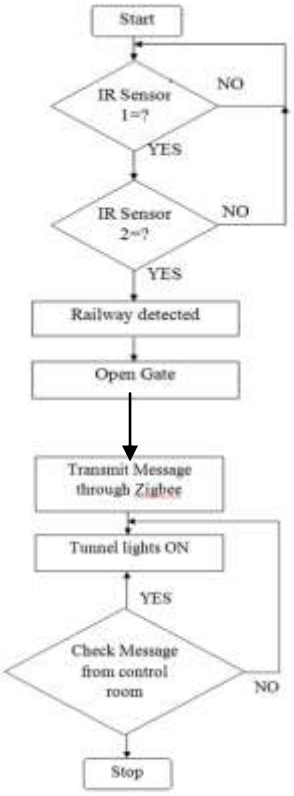
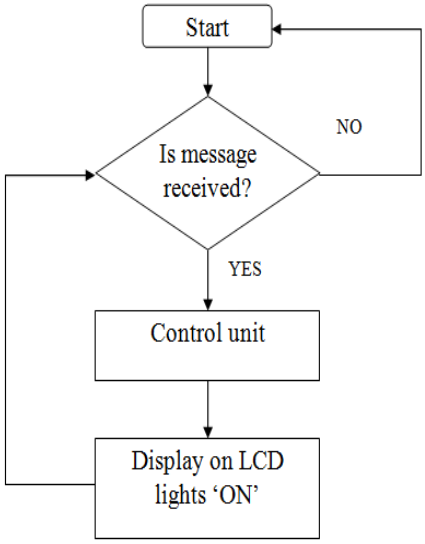


The flow goes with the detection of railway by IR sensors. The first IR sensor will detect the presence of railway and similarly on the detection by second sensor the railway is opened automatically. If no detection noticed the flow goes back to the start. As the gate is opened the message is transmitted through Zigbee and the tunnel lights are on. The microcontroller on the tunnel side checks continuously whether it gets a signal from the receiver. This signal indicates if repairs are ongoing in the tunnel and if tunnel lights are to be turned on in the absence of train. This is like polling process.

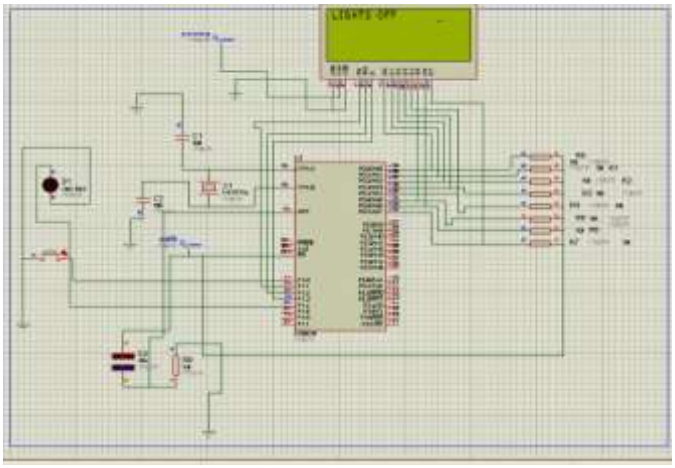
2. Receiver flow

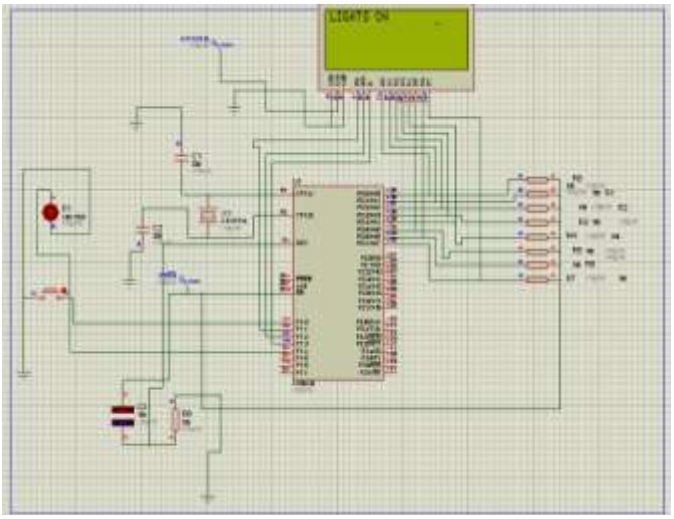


The receiver is located at the control room. As the message from the transmitter section is received by the control room it is immediately displayed on the LCD. This helps to monitor the status of tunnel lights and railway gate from the control room. A key is available in the control room to order lights on or off in the tunnel in the absence of train. This key signal is checked at the transmitter section.[4]

3. Simulation results

We have simulated a section of microcontroller unit using PROTEUS software. The first expected results are display of the project title "Energy Conservation System". Another expected result is displaying Lights ON and OFF inside the tunnel after sensing the train whether it is present or not which is directed by the control room.





VI. RESULT AND DISCUSSION

This project is implemented in Europe since 4 years. The idea is beneficial for unmanned systems which reduces human errors and accidents. Our main motive is conserving energy in tunnels which is wasted otherwise as these lights are ON all the time. By using solar panel for harnessing

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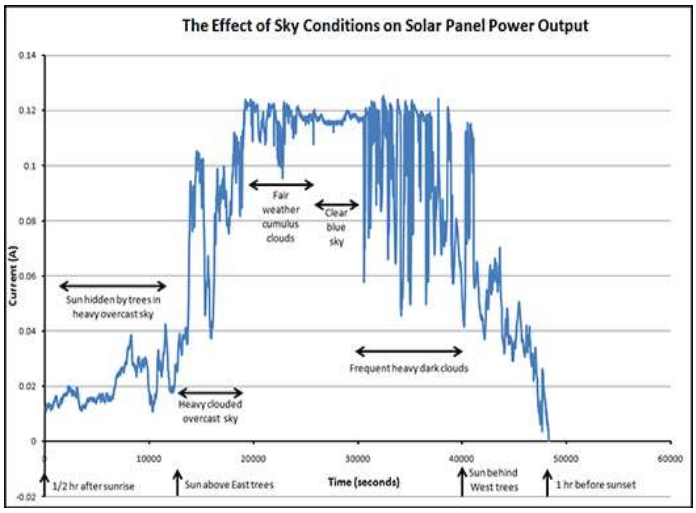
solar energy and reducing tunnel lighting costs by using LED lights. The installation should generate an estimated 3300 MWh of electricity per year, equivalent to the average annual electricity consumption of nearly 1,000 homes, and decrease CO2 emissions by 2,400 tons per year. Looking ahead, 4,000 trains per year – equivalent to one full day of rail traffic – will be able to run entirely on solar energy.[1]



VII. CONCLUSION

This paper presents a Zigbee control railway tunnel lighting control system with automatic gate open. The control system monitors the railway flow, the natural illumination and the solar energy. The system has been implemented in a railway tunnel for 4 years and has reduced energy use by 87%.[1]

The key characteristic of tunnel lightening is that long-term operation may not necessarily require full power illumination. Therefore, the system must consider the main parameters affecting the lightening, which are the outside lightening and the rail flow to control the solar energy. When there is no railway or during the night, the solar panels automatically adjust to their minimum illumination and during no sunlight there is backup provided by system.[1]

VIII. REFERENCES

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