

Smart Highway and Energy Management System

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Abstract— Highways are a nation's backbone. They handle huge number of passengers and thus are expected to be safe, robust, economical and eco-friendly. But this is not the case in some countries of the world, Highways are slow, unreliable and non-eco-friendly. Automated highway system is a newly developed idea which uses different sensors and microprocessors for automation design process. The automated highway is the design concept introduced to enhance energy efficiency and other vehicular as well as user characteristics of highways.

This paper looks into the details of this case that what ideal expectations could be held from highways of the future, how can we make use of the relevant technologies that we have currently and how can we use a combination of these technologies to make systems that can be implemented to create truly smart highways of the future.

The paper therefore offers a bird's eye view of this extremely dynamic sector and discusses some of their criticality and strengths allowing for optimization of energy and development of a smart highway improving energy efficiency and promoting social, economic and environmental sustainability.

I. INTRODUCTION

Due to increase in environmental concern, lighting control systems will play an important role in reduction of energy consumption of the lighting without impending comfort goals. The energy is the single most important parameter to consider when assessing the impacts of technical systems on the environment. In this particular project we show that how we can provide multiple benefits at the same time with the smart highway system. It is an Iot based Energy management system which utilises the renewable energy resources that is solar energy and wind energy. The hybrid energy produced will be stored in a battery source. And this energy will be used for 3 different causes-lighting of poles, charging stations, and irrigation system.

II. SMART HIGHWAY SYSTEM

In this project we are using an IR Sensor, LDR Sensor, ARDUINO UNO, LED Lights, Solar plate, Battery, Poles, Switches, Jumper wires. Due to increased environmental concerns lighting control systems will play an important role in reduction of energy consumption of the lighting without impending comfort goals. And the energy is the single most important parameter to consider while assessing the impact of technical systems on the environment. Lighting is also the largest electrical loads in the offices. So, the idea of this project is based on this problem. In this project, when there is day light, the lights will be switched off. At night, all the lights will glow with 30% intensity. There are IR sensors on each pole which will detect any obstacle passing through it. IR sensors will detect an approaching vehicle and the nearest pole light will glow with 100% intensity. And as the vehicle passes by the trailing light will be switched back to 30% intensity.

The saved energy will be used for three different causes:

1. Lighting of poles
2. Charging stations
3. Panic buttons

This project is providing reduction in energy consumption which will maintain the cost system which is totally adjustable to the user needs. There will be increased public safety from this improved smart highway. Measurable environmental impact due to reduced energy consumption. As we are using the renewable energy resources so it will lead to a sustainable development as well as economic development.



Fig.1: Highway System

III.LIGHTING OF POLES

Here, the main idea is to maintain the lamp's brightness at their minimum allowable level in a certain segment of the street that is compatible with national/regional standards and/or safety limits for both vehicular and pedestrian traffic. These aspects have been widely dealt with in many studies where various, from simple to more elaborated, brightness reductions strategies have been proposed. These strategies can be very sophisticated and can modulate the minimum allowable brightness on different levels depending on if a single or many vehicles are present in the street segment of interest, while also taking into account the presence of bikers or motorcyclists along with cars or trucks. The lamp brightness should be so that the minimum allowable level is compliant with the security standard.

Street lights will be operated by 2 means-automatic or manual.

Automatic-There are LDR sensors on top of poles. When there is day light, the lights will be automatically switched off. At night all the lights will glow with 30% intensity. When a vehicle will pass the lights will glow with 100% intensity.

Manual-We will control the lights through app in phone or computer systems.



Fig. 2

IV.CHARGING STATIONS

It is a need of the hour to ban the vehicles running on petrol and diesel. Every country has given its time period up to which they will be able to ban those vehicles. Britain will ban the sale of new petrol and diesel cars and vans from 2030, five years earlier than previously planned, as part of what prime-minister Boris Johnson is casting as a "green revolution" to cut emissions to net zero by 2050.

However, a complete ban on the petrol and diesel vehicle is not possible very soon in our country. India has mandated that sale of new petrol/diesel cars will be banned from 2030, which is just nine years away. The petrol – diesel stations in India are over 60000 whereas there are only about 450 charging stations which means there is a major need of charging stations to successfully implement electric vehicles in India. So, this project is also providing the benefit of charging stations which is a major need of the hour.

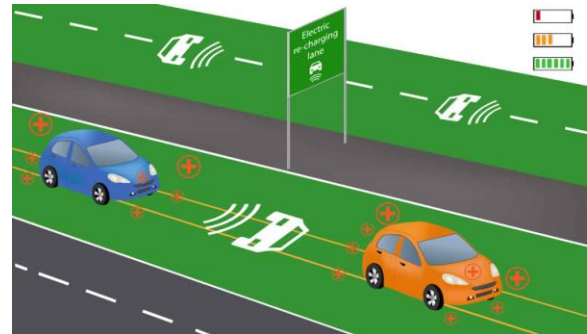


Fig. 3: Charging of Vehicles at Highways

V.PANIC BUTTONS

A panic button is provided on every pole of the smart highway system to serve the following purposes:

- In case of emergency situations like accidents or the vehicle not running due to some sort of damage or any other cause the panic button of the nearest pole can be pressed to summon help.
- The help message will be received on phones or the computers in the control rooms so that immediate help can be reached.

VI.APPLICATION DESCRIPTION

1. We can use the wide space of highway for electricity generation through solar panels and windmills.

2. By using the sensors we can lighten up the streets of particular section through which vehicle passes.
3. As all these vehicles are running on non-renewable fuels generating pollution so green energy is the best substitute.
4. Fossil fuels are used these days but limitedly available in nature and also causes air pollution. So electric vehicles are best option to make environment free from vehicle pollution and for which charging stations are being provided.
5. There are several emergency situations, like accidents. Panic buttons are provided on each pole which can be pressed to summon help.
6. Lights will glow with 30% intensity when there is no vehicle passing through the poles, and with 100% intensity when any vehicle passes through the pole so ultimately, we are saving a large amount of energy which can be used for different purposes.
7. Smart irrigation systems.

VII. WORKING PROCEDURE

Automation is the use of machines and technology to make processes run on their own without manpower. The lights of the poles will be operated by 2 modes- automatic as well as manual.

There are IR sensor or motion sensor on each pole which will detect the motion of object and hence connected to Arduino for turning on the lights with 30% or 100% intensity.

Sensors are acting as an input for Arduino and hence drives the Led lights.

When a vehicle passes through any particular pole motion sensor detects the motion and enable the pole lights to glow with 100% intensity.

There are LDR sensors which will turn on the lights during night time, and will turn off the lights during day time.

Pole lights can also be turned on/off manually.

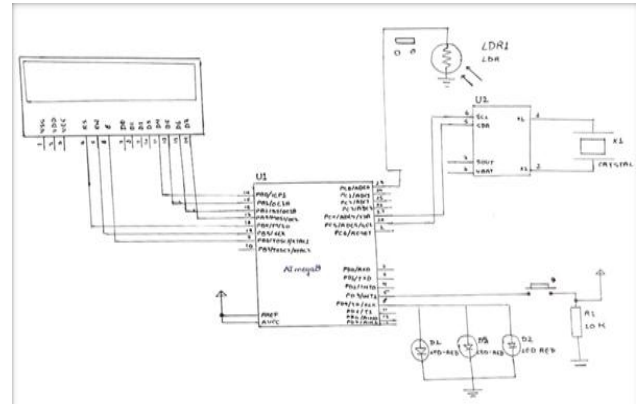
It is an iot based energy management system which utilizes the renewable energy i.e Solar energy and wind energy.

The hybrid energy produced will be stored in a battery source.

The saved energy will be used for 3 different causes that is for charging stations, panic buttons and lighting of poles.

In this way this project is providing the multiple benefits.

VIII. CIRCUIT DIAGRAM



IX. RESULT

- The smart pole lights provide a solution for energy saving which is achieved by sensing an approaching vehicle using the IR sensors and then switching on the nearest light ahead of the vehicle with 100% intensity.
- As the vehicle passes by, the trailing light switches back to 30% intensity.
- Thus, we save a lot of energy.
- This project aims towards a sustainably developing environment.
- The panic buttons on the poles will be used for an emergency situation.
- The charging stations will help to successfully implement electric vehicles in India which will lead to less pollution.

X. CONCLUSION

An Arduino based smart highway system has been successfully developed. The prototype of the system provides several advantages upon standard method of energy consumption reduction and using renewable energy resources for various purposes.

The system has smart lighting system and panic buttons for emergency situations. The prototype developed in this work is closely packed and efficient.

It consumes renewable energy resources like solar and wind energy.

X. FUTURE WORK

Roads now no longer remain as a medium to travel from one place to another. We can now use it to charge electric cars and harness solar energy due to its large exposed surface area. There is also technology to keep portions of the roads well-lit with more energy-efficient and environment friendly technology and methods.

Future scopes of this project are:

- 1 To generate electricity through running vehicles
- 2 alerts if lights of the poles are damaged.
- 3 Smart irrigation system

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