



SMART HIGHWAY FOR A BETTER FUTURE

MANISH KUMAR

Mechanical Engineering

Rishi Institute of Engineering College Meerut

Uttar Pradesh, India

Bhanu Tyagi

Mechanical Engineering

Rishi Institute of Engineering College Meerut

Uttar Pradesh, India

Gaurav Kumar

Mechanical Engineering

Rishi Institute of Engineering College Meerut

Uttar Pradesh, India

Awadhesh Panday

Mechanical Engineering

Rishi Institute of Engineering College Meerut

Uttar Pradesh, India.

ABSTRACT

The world's most complex road networks are found in India. In recent years all the items are modified with new technology. However, highways are not. The "Smart Highway" is the concept to create roads smarter, safer, and a lot of energy economical for generating electricity. Considering the Global energy, resources, and climatic crisis, it is important to make use of environmentally friendly energy sources called Green Energy. This paper summarizes the fundamental features of smart highways for the next generation from the perspective of the interactive evolution of the automobile industry and road transport. The primary functionality includes Green Energy like Solar, Wind, and Vibration Energy; smart irrigation; hybrid source energy; smart lighting. The kind of vibration that is utterly wasted by moving vehicles on roads can generate great deal of energy. The piezoelectric road is a new energy evolution to provide a sustainable solution in terms of environment, economy, and social needs. These energies are used for charging electric automobiles, lighting, and smart irrigation system. For easily planting the plants and maintaining the natural beauty smart irrigation system has been implemented. A moisture sensor is used which gives the moisture content in the soil. If the moisture content is bellow particular level the sprinkler systems automatically gets on. So, in this paper, we attempt to throw some lightweight on techniques for utilizing inexperienced energy on road along with the smart irrigation system in a fruitful manner.

Keywords – Smart Highway, Smart Street Light,Electricity, Piezoelectric Sensor

INTRODUCTION

Highway is a fundamental component of the road transport system, which connects major cities along its route crossing all provinces and reaching nearly all of their capital cities [4]. Road development is one of the major parts of infrastructure which include projects such as highways, railways, water reservoirs, reclamation, etc [3]. The construction of roads is of major concern considering growing urbanization. Providing a good road network is very essential for the development of any country. Highway from the name it is very clear that any public street or other public paths on land. It is mainly used for major roads but also includes public ways and public routes. The Indian Road network of 33lakh Kilometres is the second largest in the world and consists of [3]:

Table 1.1: Roadway in India

HIGHWAY	LENGTH(in km)
Expressways	200
National highways	96,260.72
State highways	1,31,899
Major district highways	4,67,763
Rural and other roads	26,50,000
TOTAL LENGTH	33LAKH (approx.)

The idea of planning a brand-new system for the sensible route that does not consume a vast quantity of electricity and illuminates massive areas with the very best intensity of sunshine. Providing street lighting is one of the foremost necessary and pricy responsibilities of a town [7-10] [13-14]. Lighting will account for 10-38% of the overall energy bill in typical cities worldwide [1]. Street lighting may be a significantly essential concern for public authorities in developing countries owing to its strategic importance for economic and social stability [7-10] [13-14]. Inefficient lighting wastes vital money and resources each year, and poor lighting creates unsafe conditions. Energy-economical technologies and style mechanisms will cut back the price of road lighting drastically. Wind vitality may be a standout amongst the foremost appealing property power supply advancements on account of its high proficiency and low contamination [1]. Be that because it could, since the vitality created by wind vitality transformation frameworks changes with environmental meteorology and wind speed. The piezoelectricity in roads can be utilized to execute energy from moving vehicles. The energy is converted into electrical energy using piezoelectric technology to replace fossil fuels in street light applications. A smart irrigation system for watering the plants is programmed such that it offers the interrupt signals to the motor via the relay. The moisture sensor is connected to the Arduino board that senses the condition content gift in the soil. Whenever there is a modification inside the condition content of the soil, the sensor senses the modification, giving a signal to the small controller so that the pump(motor) is activated. The main aim of the project is an Automatic street power saving system with LDR and IR, windmill, charging station, and automatic irrigation. This can save a lot of power mechanically rather than doing manually. Automation is meant to scale back manpower with the assistance of intelligent systems.

LITERATURE REVIEW

Mankind has started its journey to cover long distance by foot, slowly they invented wheel and that gives mankind the speed and power to shorten the long distances the travel time was cut down to days and month from months to year [5]. After this, the second best idea was to develop roads on which the vehicle can travel easily as the advancement of time we have fast moving vehicles all over the world and world class highways to ride on it. Now, there is a need to make the highways a smart highway. Energy effective for generating electricity using solar energy, vibration energy, wind energy, for charging the vehicles using these powers, for lighting, and for covering the condition of the road [10][12]. The vehicles moving on roads generates large quantum of energy in form of vibration that's fully wasted also they produce hothouse feasts which eventually leads to global warming and depletes ozone sub caste [3]. So, there's a need to make some revolutionary changes in conception of roadways. Previously many papers had been showing the implementation of the new and better smart highways by including many new things and techniques. In this paper we are doing the same thing by implementing advance version of the existing techniques. The worldwide concern to mitigate the

soaring energy crisis introduces us to the small-scale renewable energy generation as a preferred enabling source for highway lighting [1]. We are using the vibration energy produced by vehicles that is converted into electricity. Also, by using different Ways, wind energy, solar energy and other type of green powers produced on trace are also converted into electricity. Everything in the world vibrates at some speed. Nobody is exactly stationary. Large scale vibrations are produce due to movement of vehicles on the road. So here we are using vibration energies, generated by vehicles on the highway [5]. A smart irrigation system for watering the plants is programmed such that it offers the interrupt signals to the motor via the relay. Whenever there is a modification inside the condition content of the soil, the sensor senses the modification, giving a signal to the small controller so that the pump(motor) is activated. The extensive cost and performance inconsistency of the pure solar panel based solutions further motivate efforts in designing a hybrid energy solution for highway. Highway lighting is controlling multiple energy sources to provide an effective environment for such a small-scale application context and improving the battery performance [5][14]. More specially, we consider the solar panel and Vertical Axis Wind Turbine (VAWT), which utilizes energy from the aerodynamic losses produced by vehicles in the highways, as two main sources for energy generation. This hybrid system allows for generating uninterrupted energy by solar during the day and by VAWT at all day and night times whenever a vehicle passes the lamppost [3]. The result demonstrates withdrawal of solar dependency followed by a less energy requirement in the hybrid lighting system according to different busyness level of the highway. Wind energy is obtainable with none price and it doesn't emit any greenhouse gases. This makes it a good supply of energy production for any developing state. Asian country has the second quickest growing economy of the planet. India's substantial and sustained economic process over the years is inserting huge demand on its energy resources [1].

METHODOLOGY

TYPES OF GREEN ENERGY UTILIZED ON SMART HIGHWAY

In this paper we are going to discuss numerous techniques to convert an ordinary highway into smart highway based on green energy concept.

- (i) **SOLAR ENERGY:** The solar energy is an uninterrupted renewable and clean source available for the entire nation at least for a few hours. Solar power is available from 9am to 6pm during the day hours. We can use this energy on highways. There is none street lights placed in a shady area, but only in the middle. Though the solar panel is in middle there will no fluctuation in the power generated by panel it will remain as a default output.
- (ii) **VIBRATION ENERGY:** Vibration energy means the energy generated from vibration of molecules. Everything in the world vibrates at some speed. Nobody is exactly stationary. Large scale vibrations are produce due to movement of vehicles on the road. So here we are using vibration energies, generated by vehicles on the highway.
- (iii) **WIND ENERGY:** Wind energy is one of the oldest sources of energy used by mankind. Wind represents the kinetic energy of the atmosphere. Wind is caused by a force developed due to differences in atmospheric pressure. The energy which is generated by the flow of wind using wind turbines is called wind energy. It is a renewable source of energy which can be used as an alternative to fossil fuels. Wind energy is a clean energy which does not create pollution or releasing any harmful gases i.e. greenhouse gases [5]. Wind Power depends on the quantum of air (volume), the speed of air (haste), the mass of air (viscosity), flowing through the area of interest (flux)- Kinetic Energy Description Kinetic = $\frac{1}{2} mv^2$,Power is KE per unit time. $p = \frac{1}{2} mv^2$, Fluid mechanics gives mass inflow rate (viscosity * volume flux) $dm/ dt = \rho * A * v$. Therefore $P = \frac{1}{2} pAv^3$ here Power ~ cube of velocity Power ~ air density Power ~ rotor swept area, $[A= \pi r^2]$.

SENSOR NETWORK FOR SMART HIGHWAY

- (i) **LDR SENSOR:** A photoresistor is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light-activated and dark activated switching circuits [11]. The electrons are liberated when the light falls on the detector. The photons absorbed when the light intensity exceeds a certain limit. For these

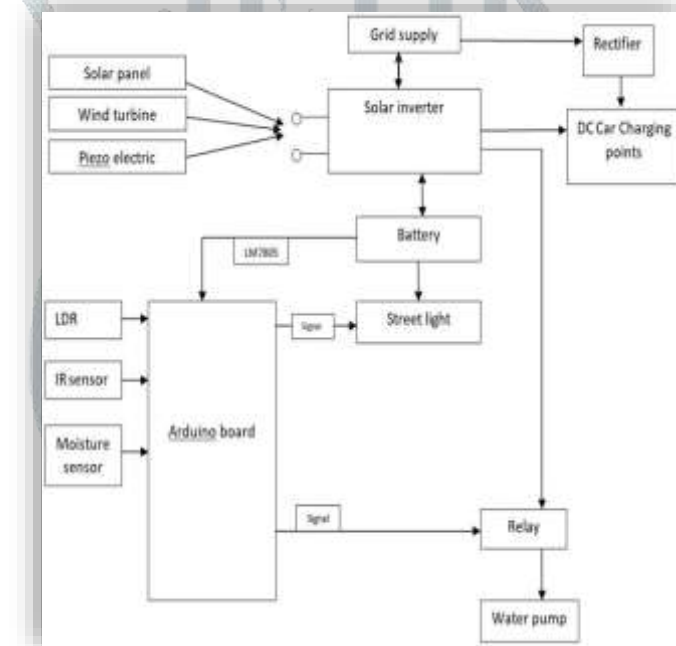
reason lots of free electrons and hole are released and resistance is dropped dramatically. The equation to show the relation between resistance and illumination can be written as $R = A * E_a$.

- (ii) **IR SENSOR:** An infrared sensor is an electronic device, which emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called as a passive IR sensor.
- (iii) **MOISTURE SENSOR:** A moisture sensor is used which gives the moisture content in the soil. If the moisture content is bellow particular level the sprinkler systems automatically gets on. Normally dielectric permittivity of the surrounding medium can be measured by moisture moisture sensor using capacitance. The dielectric permittivity in soil is a function of the water content. In proportion to the dielectric permittivity a voltage is created by the sensor, so that the moisture level in water can be measured. The water content over the entire length of the sensor can be averaged by the sensor. The extreme edges have no or little sensitivity.

RELAY MODULE

A relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V.

BLOCK DIAGRAM



SYSTEM DEVELOPMENT

This project is using three kinds of green energy for charging a battery. We are using a solar panel (monotype material) of 6W generating total of 18v which is connected with a diode to control the flow of the current towards battery of 12v (2.5A), a wind mill having a DC gear motor of 300 rpm which produce energy up to 12V. A voltage regulator (LM7805) is also be used for converting 12V to 5V as other components are working on 5V of energy. Talking about roads we have installed piezoelectric sensors that use vibration energy, generating through vehicles which always wasted but in this project “smart highway” we are using this energy for electricity generation, it produces energy in MV but it will convert in to volt by using op-amp. Afterwards street lights that have LDR sensors for controlling light intensity as in day time the lights would be off and lights will lighten with 30% of intensity at night time. IR sensor is sensing the movement of the vehicles that will direct the LDR sensor to make the street light to glow 100% intensity. In addition to this our project is saving the manpower by installing moisture sensors to the area having flora, moisture sensor will direct the water pump to get start if soil is dry and cut off when soil get moist, motor is controlled by a relay that helps to switch the motor to on/off. All the sensors are controlled by Arduino board. Arduino board directing the water pump, IR sensor and LDR sensor to work accordingly.

RESULT AND DISCUSSION

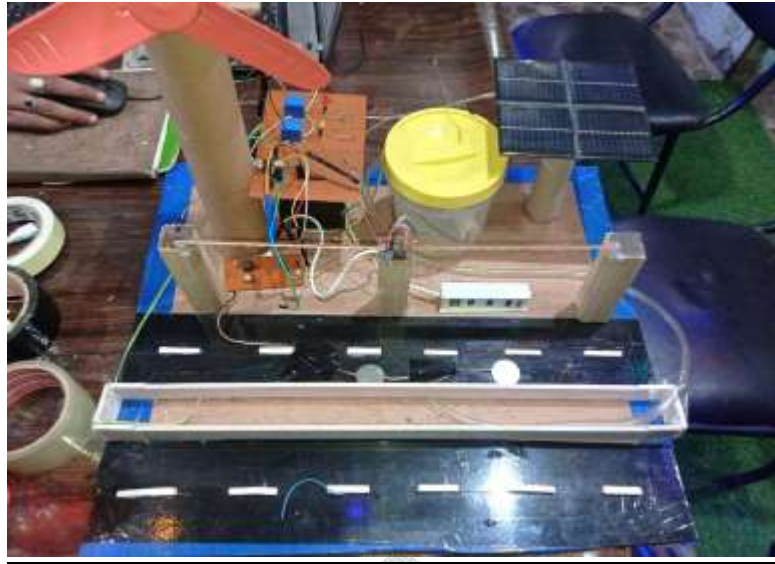


Figure 1: Prototype smart highway

- In this project smart system has been implemented for the highway system which uses concept of a controller.
- In this, we have used Green energy like solar energy, vibration energy, and wind energy.
- Solar panel and wind turbine is used for generating electricity and store the charge in the battery.
- Solar receives 4 – 7 kWh of solar radiation per square meter and one turbine can reportedly produce near about 1 kilowatt per hour, which is the equivalent of the hourly electricity needs of two households.
- The electricity generated is used in many applications on highways such as for charging vehicles and street lighting.
- This project includes use of various sensors like LDR, Relay, and soil moisture sensor for detecting the light signals, humidity in the soil.
- Soil moisture sensor is check soil is dry or wet if the soil is dry then the soil sensor sense send pulses to a controller and water pump is ON until the soil wet.
- The system is to reduce power consumption during the night times. At night time, street lights will be ON with 30% intensity, and when the vehicles are detected through the IR sensor then the intensity of street light will be 100%.
- In the daytime, the street light will be automatically turned OFF.
- Charging Station has been given at the poles for charging Electric Vehicles.

CONCLUSION

By conducting different tests and from the obtained results and also from the study; we come to the conclusion that the unlimited energy use for the generation of electricity can be possible on highways; Renewable energy production and supply is continuously increasing on the global level; The use of sensors on the street lights reduces loss of electricity; Use of green energy gives less production cost of electricity; The Highways makes Smarter; Electric vehicles have the potential to be used for power generation; The smart irrigation is working properly and can replaced the existing watering systems; The system has been tested to serve automatically. The Aim to scale down the aspect effects of the street lighting system is also accomplished by successfully increasing the intensity up and down, thus saving lots of power.

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