International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Implementation of Highway Blind Turn Early Warning System Powered By Vehicular Wind Thrust

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Abstract: ***Blind turns are perhaps the basic reason for accidents in highways because it restrict the visibility of pathway due to its nature it pose major challenge in front of commuters and there are no any such early warning system available in the world which is capable to provide active warning signal for blind turn. The proposed system contains IR sensor based blind turn early warning which automated through microcontroller and independent for energy as it runs through vehicular traffic generated wind thrust powered vertical wind turbines, though the power generated from vertical wind turbines is low but as the system based upon embedded technology than it would be enough for the entire system. The system also illuminate the entire blind turn in the night tine using LDR sensor based automation. As per the review of technical advancement in India is concerned it is clear that embedded based system is very much costlier as well as expensive in maintenance. That is why in this research paper there are two distinct systems based upon embedded and analogous respectively is presented which are solely for to match the technical advancement in developing and underdeveloped nations in general and Indian scenario in particular.***

Keywords: Blind turn, illumination, early warning, wind thrust power, wind energy stock.

1. Introduction

The discovery of many more means of transport make goods and commutation easier, cheaper as well as safer but the roadways, which is the most used mode of transport is the most vulnerable for accidents which are happening due to lack of early warning systems for the obstacles such as speed breakers, blind turns, ongoing repair and patchwork of roads etc.

Besides all the reasons present in the highways which provoke accidents the Blind Turns emerges as the major reason due to its limitless presence in on the highways which demand a reliable system for their early warning. For the early warning of blind turn infrared sensors has been proposed in this research paper because of their selectiveness and capability of point to point detection. The system is also containing embedded circuitry which includes AVR microcontroller and digital circuitry which made the system user friendly and reliable.

The proposed system is installed in such a way so that the automated early warning could be possible and for those two sets of infrared sensors is being used in distinct places. To make the system more automated and user friendly the combination of audio and visual means of early warning is used and for that task piezoelectric buzzer and character LCD display is installed respectively.

Constant electric supply is emerges as another major roadblock for the system to operate independently and to rectify this vehicular wind thrust powered vertical wind turbines are installed to harness nonconventional energy.

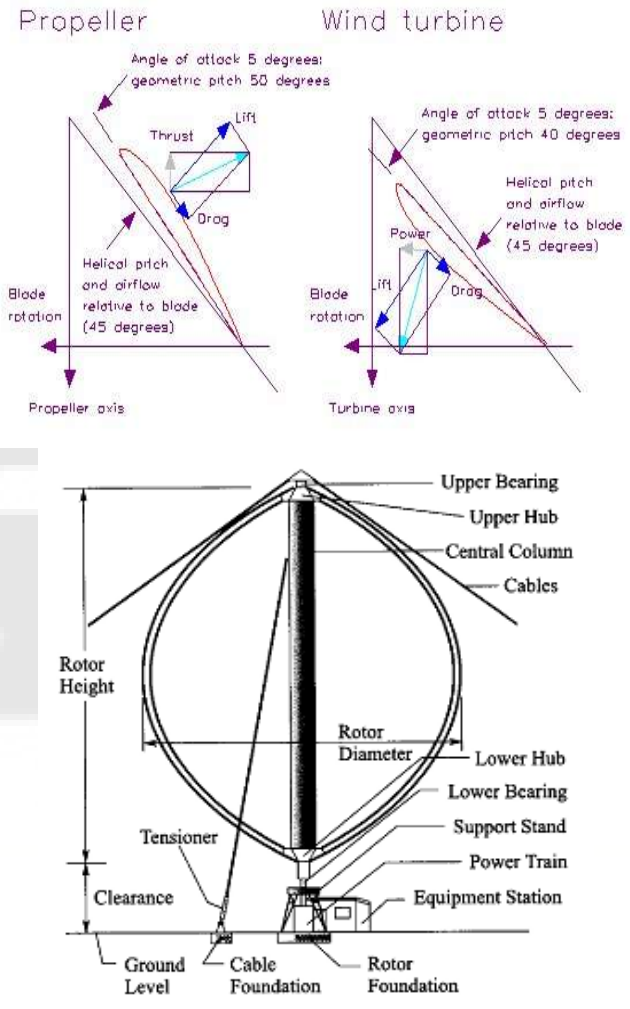


Figure 1: vertical wind turbine 3D design

The proposed concept is capable of providing dual stage protection to the commuters in which infrared sensor based vehicular traffic detector act as a system initiator and flood light automation, buzzer and LCD display automation execute the remaining task.

The brief description of the system is as follows-

1) Vertical Wind Turbine Design And Implementation

To develop an autonomous electrical system it is the primary need to provide sustainable and reliable source of electricity. In the blind turn early warning system, vertical wind turbine act as a constant power source which harnesses electricity from the vehicular traffic operated wind electric regenerator. Design of wind turbine is the most dominating point which requires extra effort and for that knowhow of aerodynamics concept seems inevitable.

2) Aerodynamics Concept

This aerodynamic concept shows the forces and velocities cutting in a turbine.The resultant velocity vector W is given by-

W'=U'+(-w'*r')

Where, U‟-undistributed upstream air velocity (-w‟*r‟)-velocity vector of advancing blade. Thus the oncoming velocity varies, maximum is found for θ=00 and the minimum is found for,
θ=1800(where θ is the azimuthal or orbital blade position. The angle of attack α is the angle between the oncoming air speed.)

$$\alpha = \tan^{-1}\left(\frac{\sin\theta}{\cos\theta + \gamma}\right)$$

Here

$$\gamma = \frac{wR}{U}$$

W, and the blade cords, the resultant airspeed flow and the angle of attack are calculated as follows:

$$W = U\sqrt{(1 + 2\gamma\cos\theta + \gamma^2)}$$

The blade turbine must place according to aerodynamic concept. All the variables related to this model definitely vary according to the environment in which it is going to be installed [10][11][12].

3) Dynamo Design

The transformation of mechanical energy into electric energy is seems possible through electric dynamo in which the mechanical energy rotates the armature of the dynamo and generate flux that produces induce current into the surrounding copper coiling and due to which the coil act as a temporary magnet and when the electromagnetic fields of these two magnets crosses each other the generation of electricity occurred. The electricity generated from dynamo cannot be used directly to the circuit because of the voltage fluctuation and require a voltage stabilizer circuit along with DC battery to store the generated current.

For stabilization of current the analogous circuit is used which is described in the schematic below-

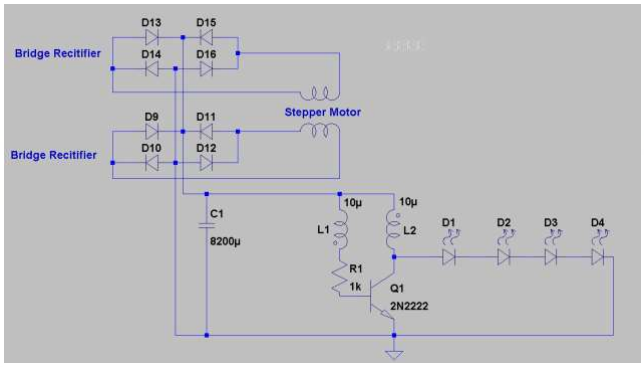
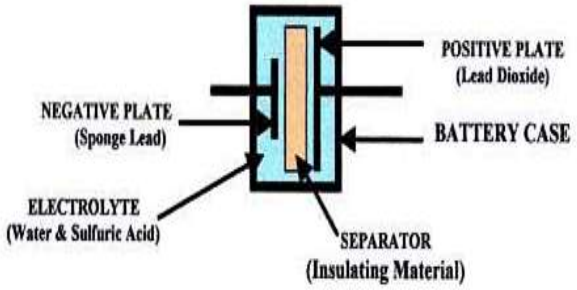


Figure 2: circuit design for stabilizing current generated form wind electric generator.

For storage of generated current we have used Lead Acid Dry batteries because of their charge storage capacity. All lead acid batteries consist of flat lead plates immersed in a pool of electrolyte. Regular water addition is required for most types of lead acid batteries although low-maintenance types come with excess electrolyte calculated to compensate for water loss during a normal lifetime.

A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between. The plates are enclosed in a plastic battery case and then submersed in an electrolyte consisting of water and sulphuric acid see in below fig. Each cell is capable of storing.



2. Normal Calculations

Here is some calculation which can easily predict the interlink between wind and turbine-
Power provided by wind:
P=0.5×ρ×A×V3
P= 0.5× (1.225kg/m3) × (3×0.5×0.1016 m×0.0762 m) × (8.9408m/s)3
P=5.084 Watts

Power produced by generator:
P= (voltage) (amperes)
P= (2 V)(.5 A)
P=1 Watt
Efficiency: % eff = (Power produced by device/Power of wind) ×100
% eff = (1 Watt / 5.084 Watts) ×100
% eff = 19.7%

Another major problem was to select sensors which can efficiently sense vehicles and respond as fast as possible to start the system. For this I select infrared sensors due to its point to point range, low cost, high efficiency and low power consumption. These sensors can be installed in both of the sides of the road and can actively participate in the system[7][9][5].

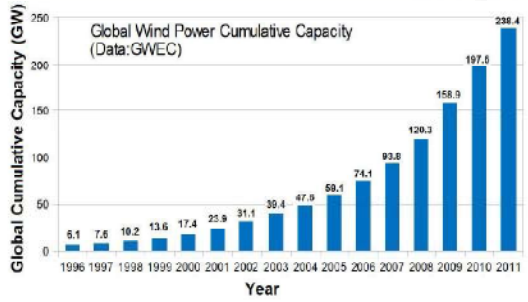


FIGURE 1: GLOBAL TREND IN WIND ENERGY, DATA FROM THE GLOBAL WIND ENERGY COUNCIL

3. Principle

The proposed system is designed for providing early warning through sensor based detection and programmed automation which required highly sophisticated sensors and compact circuitry. The infrared sensors which work on the principle of object oriented deflection into the generated frequency and the receiving frequency at the end of receiver. When any object come between the sensors, the light of specific wavelength reflected by the object and provide a large jump into the regulated intensity and this large jump in theintensity of the light is nothing but the signal which activate the circuit and then the whole programmed event predesigned for early warning of blind turn.

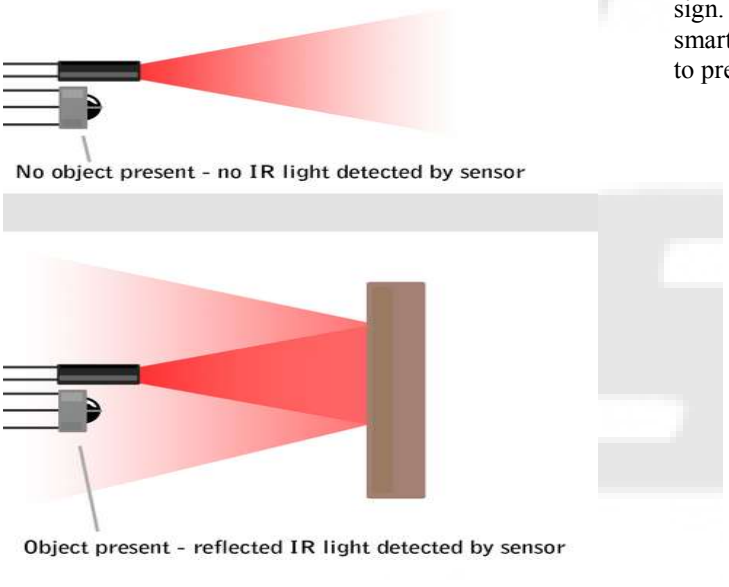


Figure 3: Representation of the working of IR sensors

4. Methodology

Highway blind turn early warning system is capable to trickle down the graph of road accidents happening due to unavailability of early warning. The proposed system based upon the simple infrared wavelength deflection occurred due to vehicular traffic and triggers the system to function according to the programming.

According to the systematic methodology the infrared sensors provide low voltage current input to the microcontroller which operate the red light sign, piezoelectric buzzer and character LCD display to provide audio visual warning along with the edges of blind turn start illuminating via LEDs if the LDR sensor senses the dark and un appropriate LUX level into the environment. The entire system get its power from vehicular wind energy powered vertical wind turbine. This proposedmethodology of the system provide additional advanatge and ultimately enhances system effeciency.

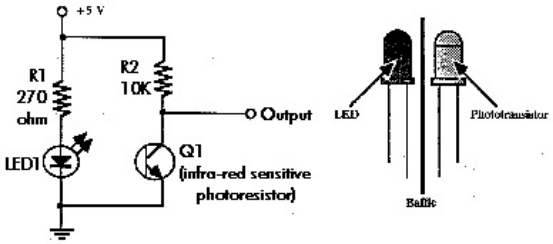


Figure 4: IR transmitter and receivers

5. Implementation Set-Up

Blind turn early warning is fruitful only when a commuter gets indication of upcoming blind turn as early as possible through visual and audio form because a still and non-working warning sign boards are remain unseen. The major reason behind installing audio visual early warning system is the nature of human behaviour as human body response depends upon the environment and it senses any dynamic warning more efficiently than any non-functional warning sign. That is the sole reason behind design and developing smart IR sensor based early warning system for blind turns to prevent commuters from any vehicular mishap.

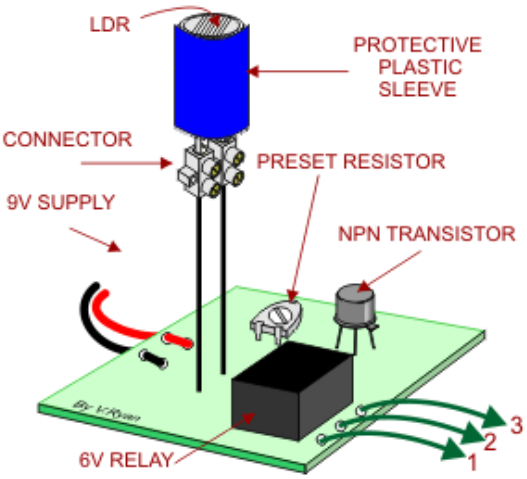


Figure 5: LDR sensors.

In the system the first infrared sensor pair installed between 20 to 50 meter before the blind turn which senses vehicles

and provides an electric signal to initiate programmed function predefined in microcontroller then following functions occurs:

1) The sign of blind turn illuminate through red LEDs,
2) A piezoelectric buzzer provide loud warning tone,
3) A character LCD displaying the status of upcoming blind turn,
4) LIGHT DEPENDENT RESISTOR senses the environmental light status and accordingly put the blind turn LED illumination ON or OFF.
5) Second Infrared sensor pair sense the vehicle after it crosses the blind turn and temporarily inactivate the functioning of the system till the time next vehicle not come into contact with first infrared sensor pair.

The system is very much energy efficient because entire illumination purpose get solved by using LEDs and rest functions are solved by using embedded approach which again emerges as energy efficient system because after the use of microcontroller the complexity of circuit remain no more.

6. List of Components

1) ATMEL AVR ATMEGA8
2) L293D
3) CAPACITORS- 0.1 UF, 22 UF, 1 UF, 100 UF, 1000 UF
4) LM7812 VR
5) CARBON FILM RESISTANCE- 1K,10K
6) 5 MM IR Tx Rx
7) LDR SENSOR
8) IN4007 PN DIODE, etc.

7. Conclusion

As per the law prescribed in the Indian constitution, insuring public safety is the sole responsibility of government that is why there are so many sign boards and other conventional signs are present to warn the commuters towards upcoming hurdles in the highways but though these boards are the passive means of early warning, more of the times these boards remain unseen by the commuters and accidents are occurred. But the proposed system for active and early warning of blind turn is capable to change the picture of present scenario altogether and apart from providing early warning if blind turn the very same system can be installed to provide early warning of any other natural or man-made obstacles such as speed breakers, U turns, Repair work and patchwork etc. by applying simple alteration into the programming while keeping the circuitry intact.

The system is installed in a prototype scaled model of highway blind turn made up of medium density fiberboard and routine testing has been done for several times to note down results. The point wise summary of results is as follows:

1) The IR sensors used in autosensing and early warning is capable to sense up to 30 feet which is enough for single & two lane highways.
2) Wind thrust powered vertical wind turbine installed in scaled model is providing 2.1 volt to 6 volt in the input rpm range from 30 rpm to 120 rpm.
3) ATMEGA8 microcontroller is functioning efficiently as the program generated for the system is compact.
4) LDR sensor based illumination provides advantage of daylight savings as it automates highway blind turn illumination system with respect to sunlight.
5) The estimated life of the entire system is 12 years with timely maintenance in every 3 months [1] [3] [7] [8].

But as described in the beginning of the research paper, the analogous system is best suited for most of the Indian highways due to their remote locality and rural intellectuality. That is why in the research work, I m going to reinvent the described blind turn early warning system using analogous circuitry solely to develop the system more realistic and purpose oriented as well as best suited to Indian terrain.

8. Acknowledgement

We would like to thank our project guide who is helping us to accomplish our project work as soon as possible.

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