

Solar Roadways-The Future Rebuilding Infrastructure and Economy

¹Mr.A.Johny Renoald, ²V.Hemalatha, ³R.Punitha, ⁴M.Sasikala, ⁵M.Sasikala(B.E)

¹Assistant Professor, M.E (Ph.D), Department of Electrical and Electronics Engineering, Vivekanandha institute of Engineering and technology for Women, Tiruchengode, Namakkal District-637205

^{2,3,4,5} students, Department of Electrical and Electronics Engineering, Vivekanandha institute of Engineering and technology for Women, Tiruchengode, Namakkal District-637205

Abstract: Smart highway and smart road are terms for a number of different proposals to incorporate technologies into roads for generating solar energy. Solar roadways use solar panels, photovoltaic effect, LEDs and microprocessor chips with circuitry boards. The future of the roadways will consist of solar roadways taking energy efficiency and artificial intelligence into consideration. The renewable energy generated by solar road panels will replace the current need for fossil fuel which is used for generation of electricity as also oil used for driving the vehicles which in turn reduces the greenhouse gases nearly to half. The implementation of Solar Roadways Technology will create the clean energy boom, spurring private investment on a massive scale, with relatively little extra cost.

Keywords: Smart Road, Solar Roadway, Energy, Solar cell, grid.

I. INTRODUCTION

The Solar Roadway is a series of structurally-engineered solar panels that are driven upon. The idea is to replace all current petroleum based asphalt roads, parking lots, and driveways with Solar Road Panels that collect energy to be used by our homes and businesses. The solar photovoltaic has the advantage of direct conversion of sunlight to electricity and also well suitable for most of the regions therefore it is highly preferred when compared to other renewable energy sources. Global energy crises and environmental concerns from conventional fossil fuels have attracted more and more renewable energy developments in the worldwide.

Hearing the concerns about global warming and knowing our dependency on fossil fuels the solar roadways imagined to develop roadways with solar panels. This innovation is begun in early 2009 and later the company was established by name Solar Roadways in U.S. and awarded a contract by federal government.

IN 2006, the company was founded by scott and Julie brusaw, with scott as president and CEO. IN 2009, Solar roadways received a \$100,000 small business innovation research (SBIR) grant from the Department of Transportation(DOT)for phase1 to develop and build a solar parking lot. IN 2011, Solar Roadways received \$750000 SBIR grant from the DOT for phase

IN 2015, solar roadways started a crowd funding drive at indigo to raise money so they can get product into Production. A Solar roadway is a road surface that generates electricity by solar power using photovoltaic and includes solar panels and LED signage, that can be drive on.

1.1 SOLAR ENERGY: Solar roadways is the light and radiant heat from the sun that influences Earth's climate, weather and sustains life. In the environmental context, it is also used to refer to the process of generation of electricity by tapping the solar energy.

1.2 PHOTOVOLTAIC CELL: Photovoltaic is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductor that exhibit photovoltaic effect. The photovoltaic power generation employs solar panels composed of a no of solar cells containing a photovoltaic material. Due to the increased demand of renewable energy sources that manufacturing the solar cells and photovoltaic arrays has advanced considerably in recent year.

1.3 WHY SOLAR: Solar power generation has emerged as one of the most rapidly growing renewable sources of electricity solar power generation has other advantages over other form of electricity generation.

1.4 ENVIRONMENTAL ADVANTAGES: Solar power production generates electricity with a limited impact on the environment as compared to other forms of electricity.

1.5 MODULARITY AND SCALABILITY: As a size and generating capacity of a solar system are a function of number of solar modules installed, application of a solar technology are readily scalable and versatile.

II. WORKING PRINCIPLE

A solar roadways is a series of structurally engineered solar panels that are drive on. The idea is to replace current petroleum based asphalt roads , parking lots and driveways with solar road panel that collect energy to be used by homes and businesses , and ultimately to be able to store excess energy in or alongside the solar roadways. Thus renewable energy replaces the need for the current fossil fuels used for the generation of electricity, Which cut greenhouse gasses and helps in sustainable development. Parking lots, driveways and eventually highways are all target for the panel. If the entire united state interstate highway system were surfaced with solar roadway panels it would produce more than three times the amount of electricity currently used nationwide.

Solar panel consist of three layers

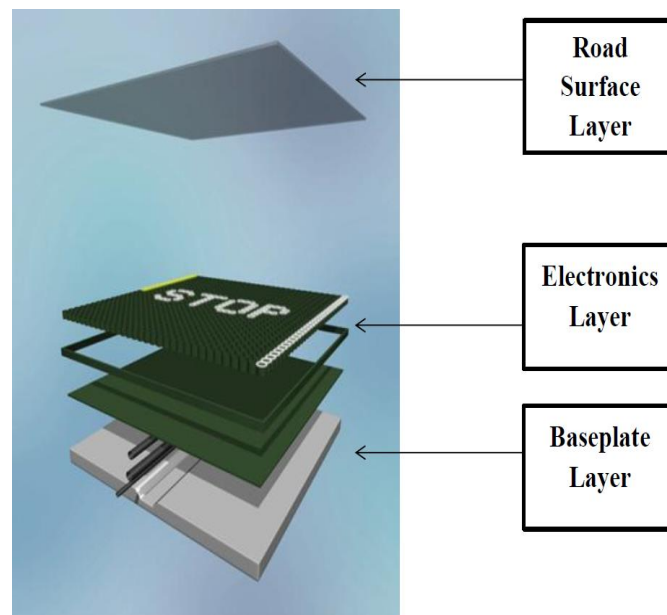


Fig .1 Three Components of a Solar Roadway

1. Road Surface Layer.
2. Electronics Layer.
3. Base Plate Layer.

2.1 Road Surface Layer:

As this is the top most layers of the assembly & also from this layer the solar rays will reach up-to the photovoltaic cells; they should be translucent and high-strength glass material. The glass will be textured in order to allow tire traction, while still remaining translucent enough to let a sufficient amount of the sun's rays reach the solar panels located in the roadways.

2.2 Electronics Layer:

Electronics Layer Contains a microprocessor board with support circuitry for sensing loads on the surface and controlling a heating element. By implementing this technology no more snow/ice removal and no more school/business closings due to inclement weather in the snow falling regions. The on-board microprocessor controls lighting, communications, monitoring, etc. which are fitted at every 12 feet distance; which can prove the Solar Roadways as an “Intelligent Highway System”.

2.3 Base Plate Layer:

While the electronics layer collects energy from the sun, it is the base plate layer that distributes power (collected from the electronics layer) and data signals (phone, TV, internet, etc.) "down-line" to all homes and businesses connected to the Solar Roadway. The base layer is made weatherproof so that it can provide the electronic layer above it.

III. BLOCK DIAGRAM

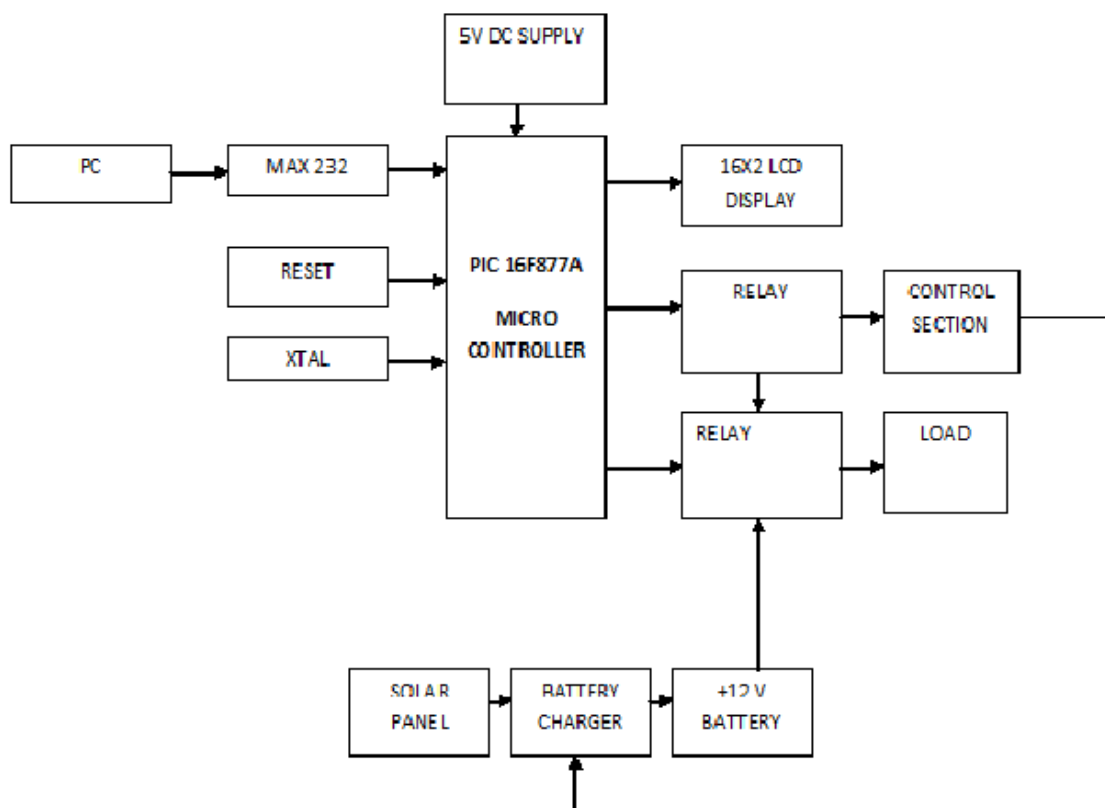


Fig.2 Block Diagram

3.1 SOLAR PANEL:

A solar panel is a collection of solar cells. Although each solar cell provides a relatively small amount of power, many solar cells spread over a large area can provide enough power to be useful. To get the most power, solar panels have to be pointed directly at the Sun.

3.2 MICRO CONTROLLER:

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination of low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques. Easy programming and Erasing are other features of PIC16F877A

3.3 RELAY:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

IV. FUTURE SCOPE

In future, normal roads can be replaced by the solar roadways but huge initial investment is required. The solar roadway alternative could be made at less cost with an energy return while phasing out the old system. As old roads are scheduled to be under maintenance, the process of solar roadway placement could occur seamlessly. The alternative of airports and parking lots are under varying timelines. Whenever fiscal dilemmas become the primary motivating factor for a state or municipal budget, the option of solar roadways should be presented and defended. With respect to solar roadways being future proof asphalt roads are a dead end. There are no redeeming features to asphalt that should hinder the progress of a new model. The ITS program seems to be begging for a concept that is readily available for the next step. Solar roadways will answer our nation's problem in the field of transportation pollution, waste pollution, coal pollution, transportation funding and energy.

How the Solar Roadways Functions as a Whole:

In order for solar roadways to be successful, the three parts need to be working in unison. The road surface layer needs to be clear enough to let the sunlight pass through to the electronics layer, the electronics layer needs to collect energy and keep the road functioning properly, and the baseplate layer needs to determine where the energy is supposed to go. Due to the fact that the road lines on solar roadways are actually LEDs, the baseplate layer needs to ensure the roadway has enough energy needed before sending the rest of the energy out towards the grid.

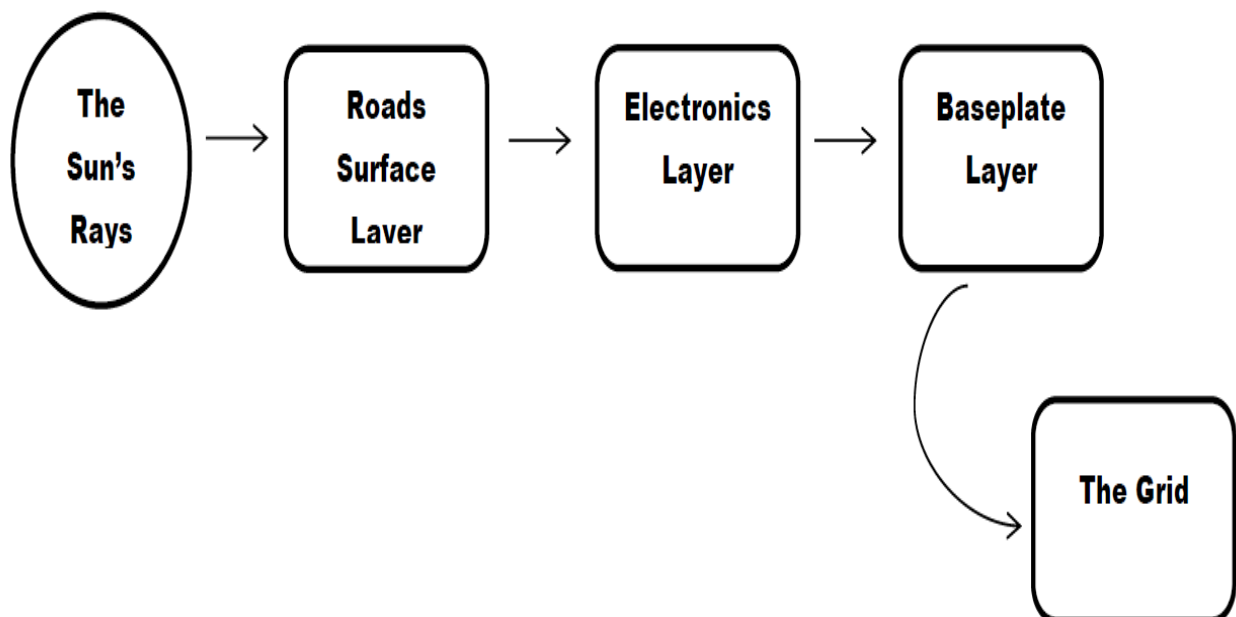


Fig.3 The path of energy in solar roadways

Accidents can be avoided:

- The Solar Roadways can protect wildlife and motorists.
- Load cells in the Solar Road Panels can detect if something is on the surface of the panel.
- Load cells work like weight machines.
- In the event that an animal does get onto the Solar Roadway, oncoming drivers will be warned via embedded LEDs of the danger ahead and will be given plenty of time to slow down.



Fig.4 Multi-Protection

V. ADVANTAGES

5.1 Renewability and life-span:

The main advantage of the Solar Roadway concept is that it utilizes a renewable source of energy to produce electricity. It has the potential to reduce our dependence on conventional sources of energy such as coal, petroleum and other fossil fuels. Also, the life span of the solar panels is around 30- 40 years, much greater than normal asphalt roads, which only last 7-12 years.

5.2 Roadways already in place:

Another advantage of solar roadways is that they do not require the development of unused and potentially environmentally sensitive lands. This is very controversial issue with large photovoltaic installation in the south western us and other places.

VI. CONCLUSION

In developing countries the major part of the geographical area is to be explored in terms of road connectivity. So instead of implementing the higher targets roads to be developed per day such countries can reduce the target and develop solar road so they could improve economy with infrastructure. However installation cost is very high this new technology is capable of replacing the costly fossil fuel system and can give us clean energy without any climate change.

Generally the Solar Roadways will:

1. Create an intelligent, secure highway infrastructure that pays for itself.
2. Create an intelligent, secure, decentralized, self-healing power grid.
3. Eliminate the need for coal-fired or nuclear power plants. 4. End our dependency on oil and other fossil fuels (oil, coal and natural gas).
5. Cut our nation's greenhouse gas emissions by over 50%. 6. Provide safer driving conditions.
7. Wild life protection
8. National security
9. Usage of recycled material

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