

# Study of PV Twin Cell Array for Solar Roadways with Wireless Charging Station and Robocop Docking Station

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**Abstract** - The Smart highway and smart road are terms for some different proposals to incorporate technologies into streets for generating solar energy, improving the operation of autonomous cars, lighting, and monitoring the road's condition, and charging Military Robocop's or Medical service Robots. On-Road Solar panels, photovoltaic effect, LEDs, and microprocessor chips with circuitry boards. The roads' future will consist of solar routes taking energy efficiency and artificial intelligence into consideration. Sunlight-based force generation has started as quite possibly the most quickly developing sustainable wellsprings of power. Sunlight-based force age has different benefits over another type of power age. Step by step, the cost of oil-based commodities is getting massive hike & resources are significantly less. There'll be not feasible material like asphalt for our existing road surfaces. Solar Roadways are replaced with solar panels; Solar Manufacture will upgrade the solar cells to the superior recent technology most recent technology, which can keep up with population growth and increased energy needs. Nowadays, the citizenry is trying to find the answers to our deteriorating highway infrastructure, crumbling power system, and climate crisis. For all such questions, the solution is SOLAR ROADWAYS. Solar energy production generates electricity with a limited impact on the environment than other sorts of electricity. The solar roadways are eco-friendly, feasible & reduce accidents.

**Key Words:** Solar Wireless Roadway, Electric Vehicles, Future Road, Renewable Source, Robocop Docking Station.

## 1. INTRODUCTION

The smart highways begin to glow with photovoltaic solar panel roads' assistance. The solar road consists of the panel numbers when it interlinks with each other. This intelligent road pays for itself through electricity replacing petroleum-based asphalt highway and enhancing highway infrastructure. Presently a day with the developing populace and energy requests, we should take a sustainable choice of fuel source. Furthermore, A Solar roadway is a road surface that generates electricity by solar power using photovoltaic and includes solar panels and LED signs that can be drive. The ultimate goal is to store more energy in or along-side the

Solar Roadways. This renewable energy replaces the need for this fossil fuels used to generate electricity. To reduces the greenhouse gases by half.

## 2. SOLAR ROADWAYS

A solar roadway may be a paved surface that generates electricity by solar energy photovoltaic cells, as shown in the figure: solar panels that including solar panels and an LED sign that provide the information to the Vehicle Driver. The concept involves rebuild highways, roads, parking lots, driveways. A layer of embedded LEDs will be wont to create traffic warnings or crosswalks. Excess electricity might be wont to charge electric vehicles or routed into the facility grid. The electrical components will be embedded between layers of extremely durable, textured Glass.

### 2.1 Selection of Panel Type

Choosing the best solar panel type has a significant role in filling the required demand. It has high-efficiency output delivery to supply efficient energy to the Devices and Vehicles.

### 2.2 Twin Cell Solar Panel

Twin Cell modules have solar cells that area unit cut in half, which improves the module's performance and durability. Traditional 60-cell and 72-cell panels can have one hundred twenty and one hundred forty-four half-cut cells, severally. Once solar cells area unit halved, their current is additionally halved. Therefore, resistive losses area unit lowered, and consequently, the cells will manufacture a bit additional power. Smaller cell expertise reduced mechanical stresses. Therefore, there's a minimized chance of cracking. Half-cell modules have higher output ratings and area unit extra reliable than traditional panels.

### 2.3 Design of Twin Cell PV System

The effect of cutting solar cells is half the current and twice the voltage. A drawback would be solar modules with twice the voltage it shown in Fig-1. The higher string voltage

would result in half the number of modules connected to the inverter per string.

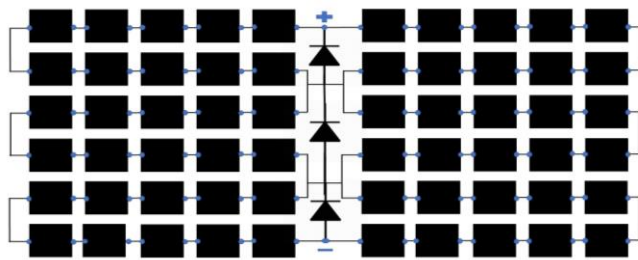


Fig -1. TWIN CELL CIRCUIT DIAGRAM

### 2.4 Twin Cut Solar Cell and Higher Efficiency

When the area of a photovoltaic cell is cut in two, the quantity of electrical current carried by every bus is reduced by half. This decrease in electric resistance inside the busbars leads to an overall increase in efficiency, particularly throughout high irradiance, driven by significantly higher short-circuit current (Isc) and Fill factor (F.F.).

### 2.5 Internal Link of Solar Panel

A Solar-Panel is a combination of multiple cells that along outline the ability of the P.V. system.

The cells are connected within the kind of either series or parallel.

### 2.6 Effect of Shadowing in Non-Parallel Connection

In a series connection, up to 50% of the power loss is faced due to the shadow effect.

### 2.7 Effect of Shadowing in Parallel Connection

Shadow effect in parallel-connection results in up to 90%

### 2.8 Shadow Effect Analysis

In analyzing the effects of shades made by the vehicles moving over the solar panels, as shown in fig-2, the vehicle's swiftness and the vehicle's duration are the two most essential elements to be considered for calculating the time for which the tincture will be present over the solar panels. In the current analysis, three vehicles are considered, namely, a tractor semi-trailer, an intercity bus, and a full-size automobile. All three Vehicles are considered traveling at a steady speed of 13.889 m/s (31 mi/hr.). At the beginning of the simulation, solar irradiance is assessed at 1 K.W., the standard test condition parameter. As the vehicle begins to travel over the solar panels, the solar panel area covered with shade will increase. When the solar panel is entirely hidden by the car, solar irradiance received by the solar cells

is believed to arrive at a value near to zero. The solar irradiance value remains at zero for a few seconds as the vehicle's duration is larger than the solar panel time considered. It is expected that the condition will cause a sudden fall in power output from the solar panel. When the vehicle begins to run off from the solar panel, the solar panel area covered with shade is expected to decrease. The corresponding solar irradiance value received by the solar cells is expected to increase and reach the value of 1KW. When the vehicle moves away from the solar panel, the solar panels' power output is expected to increase and reach its full output level.



Fig-2. Moving Car on the Solar Roadways.

## 3. DESIGN OF SOLAR TWIN PANEL AND CONSTRUCTION

The Solar panels are divided into four superficial layers.

- (a) Glass Layer
- (b) Embedded LEDs Layer
- (c) Electronics Layer
- (d) Base Plate Layer

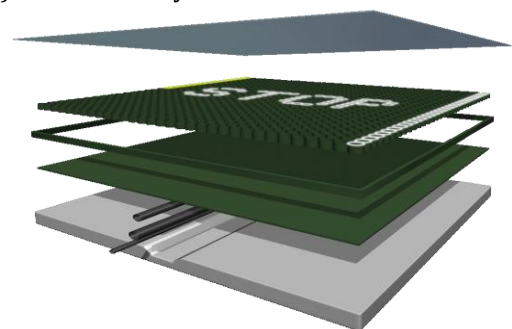


Fig-3. Panel entirely constructed with layers.

### 3.1 Road Surface Glass Layer

The material is used Glass. It is made waterproof to prevent Electronic layers, as shown in fig-4. It Contains a microprocessor board with support circuitry for excellent

loads on the surface and controlling with a heating element. By implementing this technology, no more ice and snow removal and no more school/business closings due to inclement weather in the snow-falling region. The on-board microprocessor controls lighting, Charging stations, communications, etc.

These are fitted for every 12 feet distance, proving the Solar Roadways as an Intelligent Highway System. As this is the topmost layer of the assemblage, Acrylic's material has been selected for production, as embedded with a solar cell; from this layer, the solar photon will hit the photovoltaic cells; the surface layer should be transparent and high-strength. Also, this is done in such a material that it is rough enough to provide excellent traction to avoid skidding the vehicles; the sunlight passes through it to the solar collector photovoltaic cells embedded within it, along with fitting Install LEDs and heating elements. And it's extreme to withstand today's heaviest load in harsh, waterproof conditions to maintain a concrete electric roof.

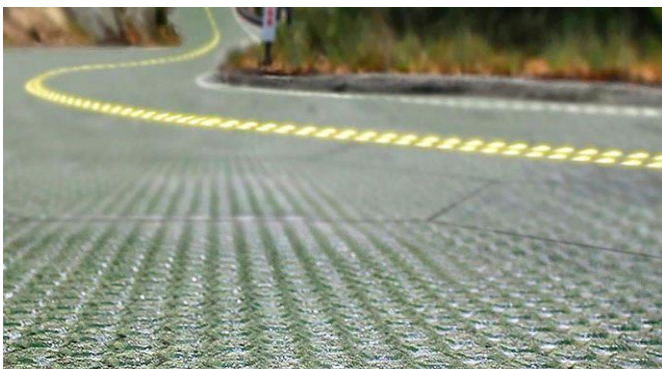


Fig-4. Surface Layer of Glass.

### 3.2 Embedded LEDs Layer

In this layer, the photovoltaic cells absorb solar energy. It also includes a microprocessor board with support circuitry for sensing loads on the surface and controlling a heating element to reduce or eliminate snow and ice removal and school and business closings due to inclement weather. The microprocessor controls lighting, communications, monitoring, etc. With a communications device every 12 feet, a solar roadway can be an intelligent highway system.

### 3.3 Electronics Layer

In this layer also photovoltaic cells are present, which absorb solar energy. It also includes a microprocessor board with a support circuit for sensing loads on the surface and controlling a heating element to reduce or eliminate snow

and ice removal and schools & business closings due to weather the microprocessor in this layer that contains lighting communication and monitoring, etc.

### 3.4 Base Plate Layer

It needs to be weather-proof to protect the electronic layer above it. Through the surface layer, the sun photon reaches the electronics layer. Therefore, energy is gathered from the sunlight by the solar cell collector. Solar Power would channelize the harvested energy to the power station via the base plate layer; the steel material has been selected to produce the base layers supporting all the other two layers above. The base layer also distributes D.C. power and data signals down-line to all homes. The base layer is made weather-proof to carry the electronic and surface coatings.

### 3.5 Working Principle

Photovoltaics straightforwardly convert sun-powered energy into power. They work on the guideline of the photovoltaic impact. When certain materials are presented to light, they retain photons and deliver free electrons. This wonder is called the photoelectric effect. The completed road is shown in fig-5. A solar highway could be a series of structurally designed solar panels driven. The thought is to switch current petroleum-based asphalt roads, parking lots, and driveways with solar road panels that collect energy to be utilized by homes and businesses and store excess energy in or aboard the solar roadways. Thus, renewable energy replaces the necessity for these fossil fuels used for generating electricity, which cut greenhouse gases and helps in property development, Parking lots, driveways.

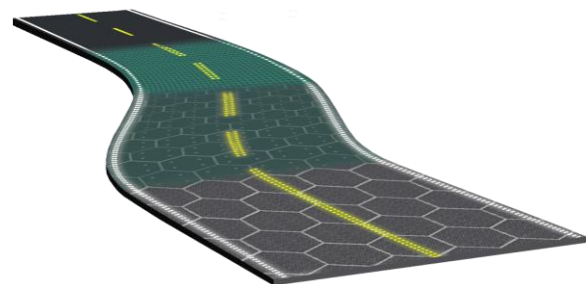


Fig-5. Upgraded Roadways with the latest solar panel.

## 4. ANNUAL POWER GENERATED OUTPUT OF PV CELL

Global Formula to estimate the electricity generated from P.V. Cell System

$$E = A * r * H * PR$$

$E$  = Energy (kWh)

$A$  = Total Solar Panel Area ( $m^2$ )

$r$  = solar panel yield (%)

$H$  = Annual average solar radiation on tilted panels (shadings not included)

$PR$  = Performance ratio, coefficient for losses (range between 0.5 and 0.9, default value = 0.75)

### 5. WIRED & WIRELESS CHARGING FOR VARIOUS ELECTRIC VEHICLES

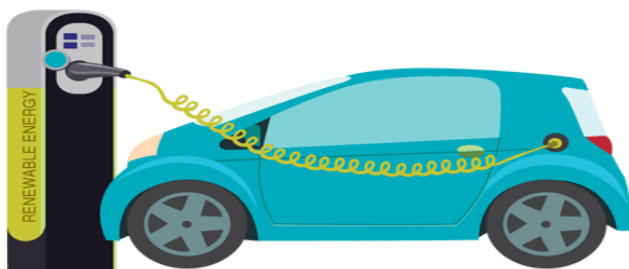


Fig-6. Wired Charging Station for Various E.V.

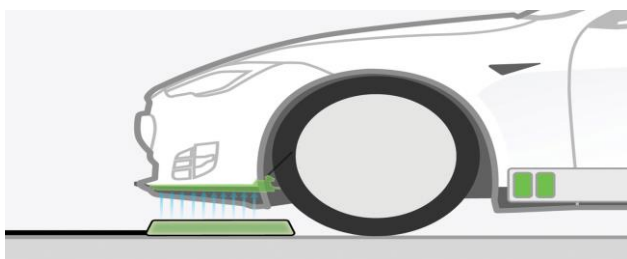


Fig-7. Wireless Charging Station for Various E.V.

### 6. DOCKING STATION FOR FUTURE ROBOCOPS AND MILITARY ROBOTS

Future will entirely on Artificially intelligence change the way of living style, and Robots has inbuilt with the A.I. it can think like the human brain. It takes decisions with some Rules and Regulations to protect humans and humanity.

#### 6.1 Laws of Robot

A robot might not injure an individual's being or, through inaction, allow an individual's being to return to harm.

A robot must obey orders given by personalities except where such orders would conflict with the primary Law.

A robot must protect its existence as long intrinsic protection doesn't conflict with the primary or Second Law.



Fig-8. Charging Station for Robots.

#### 6.2 Military and Rescue Assistance

The 'Robocop,' launched on Dec 30, 2017, by the Telangana Information Technology Secretary Jayesh Ranjan, can help police handle Law and order and traffic management. If deployed autonomously, it can even take security at selected spots at malls or airports and public places.

In India First 'Robocop,' it has named "KP-BOT," are introduced robots at the Police Headquarters (Kerala) in the time of Feb 20, 2019. Chief Minister Vijayan Welcomed the Sub Inspector (SI) ranked robot in the service with an honorary Salute, and the Robocop responded with a perfect salute.



Fig-9. Military Robot with Soldier.

In the time of the environmental disaster, Robocop charging, military emergency, solar roadways should provide power when needed. As solar energy is renewable, it required no external to an artificial power source.

Military Robots that already exists

- Boston Dynamics robot dog.

- Saffir robot.
- Bomb disposal robot (us military 2018).
- Avatar tactical, avatar EOD, avatar hazmat robot.
- Dogo robot.
- Guard bot.



Fig-10. Soldier with Boston Dynamics robot dog.

## 7. FUTURE SCOPE

In the Future, Robots will serve humans to help in protection, and as well as the Robocop will be ready to work with the military and the police quarters. Robots are also work in dangerous places like toxic gases present and the nuclear station to work 24/7 in a week to continue the work without any tiredness.

Solar roadways are the smartest ways to expand our market and multiply the job requirements. A day tracking the vehicles, i.e., high-risk cars, is difficult. Still, by an assistant of solar roadways, we can track high-risk vehicles that we want to follow by installing radio frequency tags on these vehicles. Solar energy can recharge all-electric vehicles in this solar road while in motion on top of these roads with embedded induction plate assistance.

## 8. ADVANTAGES

1. Lifespan 20-25 years: The life span of solar panel road is much greater than compared to asphalt roads
2. Road: Solar street lights up the road in the night properly.
3. Safe travel: It keeps the road illuminated at night time and makes travel safer.
4. Intelligent Highway System: It uses a new way of technology in highways.
5. Reduce dependence on fuels: As we can charge our electric vehicles on the go, Solar Energy will reduce petrol and diesel cars.

## 9. DISADVANTAGES

1. Maintenance cost: It requires yearly maintenance
2. Seasonal efficiency: It does not generate as accurate electricity as it creates in the summer season.
3. Needs more revenue: The initial setup cost of the road is high.

## 10. CONCLUSIONS

Replace ordinary asphalt by replacing the regular asphalt with solar panels. Produce electricity: Solar roads produce electricity, which power can use to supply our houses and industries. Designed with LED lights: It is designed with inbuilt LED lights to indicate the roadways Job vacancy for society creates a vacancy for jobs as solar roads fixing requires high skilled persons and engineers. Good for the environment: It does not pollute our environment as it is eco-friendly and does not have any effects on human health.

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## BIOGRAPHIES



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