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DESIGN AND IMPLEMENTATION OF SOLAR E-VEHICLE

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Abstract: The face of the automotive industry is being re- shaped by concerns over oil supplies, international policy and fuel costs. The solar vehicles and rechargeable batteries, one of the oldest alternative energy transportation, has many applications to the emerging electric vehicle market. The development of a telemetry system for a solar portable bike aids in a better understanding of the energy usage of a vehicle and the aspects applicable to electric vehicles as a whole. This project can gives us better option for personal traveling, with easy handling of bike as a bag which is light weight and it has also storage space for caring wants. It helps to become green India and gives ecofriendly option to traveling and compact vehicle. The basic principle of solar portable bike is to use energy that is stored in a battery during and after charging it from a solar panel. The charged batteries are used to drive the motor which serves here as an engine and moves the vehicle. The growing interesting in charging electric vehicle (EV) using renewable resources such as solar photovoltaic (PV) offers several technical, environmental, and economic chances. The objective of this paper is to improve efficiency, reduce greenhouse emissions, and increase driving range for the EV. The designing and implementing of a supportive renewable energy source to charge the EV are presented in this manuscript. The metrological data are measured in Al Baha University at Saudi Arabia to determine the optimal design of PV panels to operate the EV. The topology and sizing of each component of the system are provided in this paper. The modelling and designing of the developed PV system involve several procedures such as evaluating the dynamic load demand, analysing the power performance, and optimizing the size of PV system.

Keywords: Solar Photovoltaic (PV), Electric Vehicle (EV)

I. INTRODUCTION

Climate change from increased concentration of carbon dioxide in the atmosphere was acknowledged already. It is however not until recent decades that discussions have emerged, and plans been developed, on how our emissions of Green House Gasses (GHG) should be reduced. The transport sector accounted for 13% of the global GHG emissions. In addition to the global challenge of GHG emissions, many cities around the world face problems with local air pollution and congestion. Decreasing air pollution on a local nod a global level can be accomplished by switching to vehicles with fuels that have lower environmental impact than fossil fuels; such as electric vehicles or bio-fuels. However, this does not directly affectcongestion.

Around a third of the trips made by car in Europe are shorter than 3 km, and half of the trips shorter than 5 km. This means that there is a potential for efficiency and air-quality improvement by switching to more energy efficient and less polluting modes of transport that can replace these short distance trips. One alternative is to increase bicycling which could reduce the need for taking car or public transport short distances as well as reduce congestion. One of the methods to increase bicycling in cities is to set up vehicle (E-Vehicle) that can be accessed by locals or tourists for a fee. There are currently more than 600 cities with BSS globally .The number of vehicle in those systems exceeds 700 000. By providing a large network of stations with shared bicycles, it is possible to supply an efficient, convenient and cheap mode of transport. These types of systems have been proven successful. In Barcelona, a maximum number of registered users per bike has been set, as well as prices increased in order to ensure an efficient system. One drawback with current BSS is that they are used for short rides in city centers and uphill rides have been seen to be avoided by users which increases the need for redistribution by truck. BSS uses commonly available trucks and cars on the market for their redistributions. They thus rely mostly on fossil fuels. Admittedly, the environmental impact from redistribution may be reduced if the car or the truck is powered by renewable power sources but reducing the need of redistribution also decreases the operating costs and congestion. Recent developments on pedal assisted Electrical vehicle (E-vehicle) and regulations surrounding them have led to a growing market of E-vehicle all around the world. Especially in China where 9 out of every 10 E-vehicle are sold. E-vehicle could potentially be one of the first type of electric vehicles to reach large-scale diffusion in Sweden (excluding trams and trains). Not only are they energy efficient, but also cheap relative other electrified transport modes. They enable rides in hilly and windy conditions where cyclists would reduce their speed significantly. Longer rides are also possible as the rider's effort isreduced. Thanks to the characteristics of E-vehicle they have a greater potential to replace car trips than regular vehicle. Introducing E-vehicle could open up their use to a broader audience. The potential for modal shift from fossil fuel powered transport modes would thus increase. Furthermore, a roof may be placed on top of the E-vehicle station that could serve as combined weather protection and provider of electric energy by installing solar panels on the roof. If the available solar energy is sufficient, it could for example keep the system off-grid which means that stations can be placed temporarily where needed, e.g. close to festival areas or sportsevents. Placing solar panels on station roofs would introduce solar energy in places that otherwise would not have been considered. An E-vehicle charged with electricity from the sun may be one of the most efficient means of transport. The main reason is because its mass is lower than a car's or a scooter's and thus less energy is required for propulsion. The second reason is that bio-fuels or regular cycling requires conversion of solar energy to chemical energy which is characterized by low energy conversion efficiencies relative a solar panel. There are several E-vehicle pools around the world. Some have been running for a few years and some are recently started. However, many questions are still to be answered as the use of E-vehicle is far from large-scale in comparison to regular E-vehicle. Also, little information has been found on the synergy between solar panels and E-Vehicle. This is thus the focus of this report in which the energy balance between the solar energy and E-vehicle energy use is studied in detail for different system designs.

II. LITERATURE REVIEW

T. Markel

To be presented at the MIT Energy Initiative Transportation Electrification Symposium Cambridge, Massachusetts

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Discussion

It may seem simple to "just plug in" PEVs. However, for the PEV market to expand, a broad infrastructure plan is being developed to deliver consumer value and satisfaction. Effective infrastructure enables greater use of the battery technology, as shown in (7), where recharging throughout the day provided approximately 10% greater fuel savings using 50% less battery capacity. Fully using these resources depends on the following PEV infrastructure components, which are discussed in the subsequent sections: • Energy Storage • Charger – On-board/Off-board • Cords and Connectors • Electric Vehicle Supply Equipment • Advanced Meters • Home Area Networks • Parking Lots and Neighborhoods • Buildings/Multi-unit Dwellings • Smart Grid • Aggregation Algorithms • Distributed Generation/Storage • Renewable Generation • Communications Architecture • Information Technology Energy Storage With energy storage, grid electricity is stored on-board the vehicle. Energy storage combined with lightweight vehicle design and efficient motors, creates a competitive alternative to conventional vehicles. Lithium-ion battery technology is the likely energy-storage candidate for near-term vehicles.

C.E. SANDY THOMAS:

C. E. (Sandy) Thomas has over 40 years experience in scientific research and related engineering activities. He started his career in coherent optical data processing (the subject of his Ph.D. thesis) and holography, and was the Director of the Laser and Optics Division of KMS Fusion when they were the first to successfully demonstrate a controlled thermonuclear reaction with a high power laser system on May 1, 1974, beating the Russians and the Lawrence Livermore National Laboratory. Dr. Thomas has also been involved with a project to commercialize amorphous silicon photovoltaic (PV) solar cells for SOHIO/ECD, and worked for eight years as a legislative assistant to Senator Tom Harkin (D-Iowa) handling national security, energy and environmental activities for the Senator. He was a founder and served as the only President of H2Gen Innovations, Inc. and was a member of the Board of Directors and served on the Executive Committee of the National Hydrogen Association.In May of 2010, Dr. Thomas was awarded the Jules Verne award for "superior service" by the International Association of Hydrogen Energy at the 18th World Hydrogen Energy Conference in Essen, Germany. The inscription on this award reads "for his leadership in system studies, analyses, and entrepreneurship in development and commercialization of hydrogen technologies."

III. PROPOSED WORK

A solar vehicle or solar electric vehicle is an electric vehicle powered completely or significantly by direct solar energy. Usually, photovoltaic (PV) cells contained in solar panels convert the sun's energy directly into electric energy.

You can help promote sustainable practices and lessen your carbon footprint by switching to an electric bike that runs on solar power. The Solar Powered Electric Bikes augments performance bikes with a clean, green energy source.

Solar-powered bicycles are an upgraded form of a simple bicycle that takes the help of solar energy through solar panels to supply power. Solar panels are integrated into the bicycle, which has a hub motor attached to the wheels to make it run. A battery is also mounted, which gives its supply to the hub motor, which in turn drives the motor. As fossil fuels are exhausting day by day at an exponential pace, we need to look for some other source of transportation that is plentiful, whose harnessing has not yet been done to its maximum extent, and that can also move effortlessly at a faster speed. One such method is a solar bicycle. This paper presents a review of various research done in this aspect.

This review report on solar powered bicycle aims for developing an efficient and economical bicycle which can replace gasoline powered bikes as a mode of transports. As, solar energy is clean and sustainable form of energy which is used directly with the help of solar panels placed on the bicycle. Also, solar bicycle is a convenient way as we have eight to nine months of sunny weather in India which is a good advantage of using a renewable source of energy and replacing conventional bikes as mode of transport.

Advantages:

The solar bicycle has a greater range than a conventional bicycle. The solar panel on the top of bicycle can be charged even in the rain and also from the radiation after the sun sets or before the sun rises. The running cost of solar bicycle is very less than that of a fuel powered bike especially for a city intra city travel. With the solar bicycle it is easier to climb hill when then person wants to do moderate exercise is very much suitable for aged people who had to pedal a conventional cycle. The solar bicycle design is very simple to manufacture and can be used for travelling short distances. The batteries are highly efficient when they are being charged at the same time of discharging and in case of solar bicycle there is a direct motor supply.

ELECTRICAL VEHICLE

Fig.1 Model of Solar E-vehicle

The motor is mounted on the rear wheel, the battery in the frame and the power switch on the handle. Note the lack of pedals.

One of the first patents of electrical vehicle was registered almost 120 years. An E-vehicle is narrowed down to its basics a regular bicycle equipped with an electrical motor, a battery and some electronics and switches that controls power levels. Since it is powered by two energy sources, pedalling and electricity, it can be classified as a hybrid vehicleElectrical motor may only be active while pedelling (unless speed is below 6 km/h).

IV.METHODOLOGY

The solar assisted bicycle consist of following components – pmdc motor, solar panel, voltage regulator, lead acid battery, motor controller, accelerator, bicycle

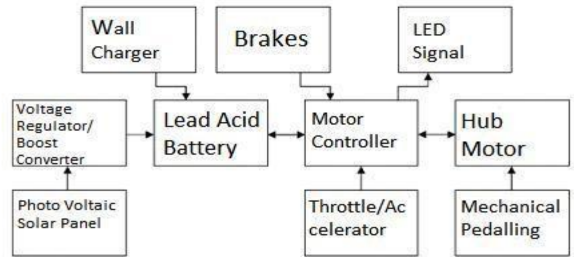


Fig.2 Block Diagram of a Solar Assisted Bicycle

SPECIFICATION OF ACCELERATOR

Supply voltage	**24V**
Return voltage	**4V**
Maximum load output current	**25 A**
Handle bar diameter	**22 MM**
Three wires red. green. black	**24 V SUPPLY**

Accelerator/Throttle

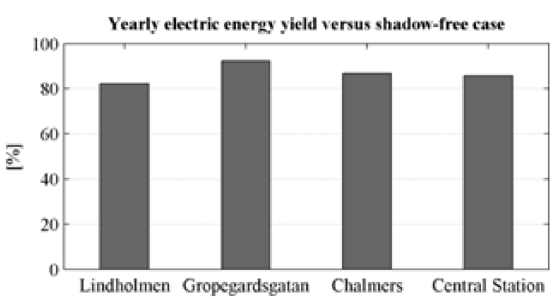
The maximum speed of a bicycle is 30 kmph. It is required to vary the speed depending upon the road conditions & traffic. Therefore an accelerator or a throttle is necessary. Throttle allows us to drive the motor from zero speed to full speed. The throttle is fitted on right side of the handle bar and is connected to controller.

The throttle converts DC voltage from battery to an alternating voltage with variable amplitude and frequency that drives the hub motor at different speeds. It consists of MOSFET transistors and a small microprocessor. This throttle is technically referred to as a Hall Effect type. The throttle has three wires contains a black, red, and green. The supply voltage is via red and black wires and is usually around 4 volts. Green wire voltage increases as the throttle is turned

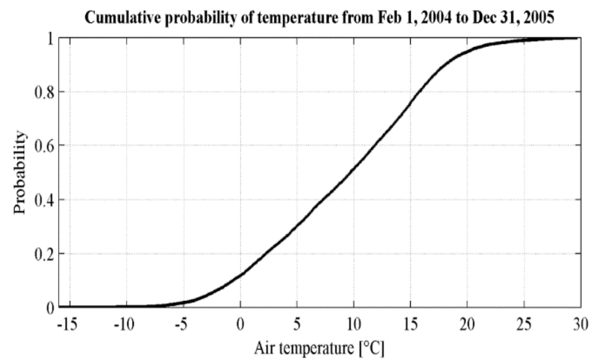
Fig.3 Throttle/ Accelerator

V. RESULTS

This section shows the result of the calculations on an E-BBS. The section is divided into three subchapters for the solar calculations, E-vehicle calculations and system modelling respectively. To reduce the length of this chapter only the shadow-free case and the station at Lindholmen will be presented. Results from the other stations can be found in appendix referred to in each chapter.



However, the characteristic is more or less the same as for the irradiation. Yearly electric energy yield for the investigated station locations relative the shadow-free case. It shows the maximum electrical energy yield for the solar panels relative the optimal fixed orientation for a shadow-free surface. What can be seen is that about 15% of the yearly irradiation is lost. This means that even though there are buildings present, there is still good potential for solar panels in the urban environment. A way to further increase the incoming irradiance – and hence the electric energy yield – is to follow the sun. It was shown that tracking in the azimuth direction could increase the yearly irradiation by about 7% relative the optimum fixed orientation and 2-axis tracking, about 37%. However, tracking may not possible in an urban setting where space is limited and tilting may reduce the panels ability of weatherprotection.

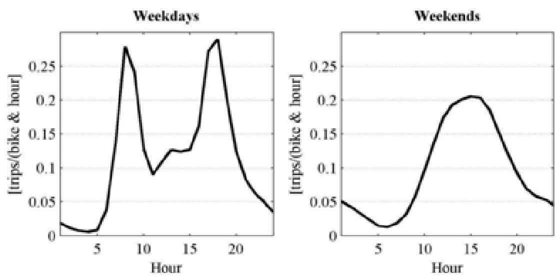


The air temperature will have an effect on the use of the E-vehicles but also the battery charging. It can be seen that the temperature drops below 0°C around 10% of the time during which no charging is possible without battery heating. The charging current should be reduced below 5 °C and that corresponds to 30% of the time. If operation should be possible throughout the year it is thus important to include battery heating in someway.

E-vehicle electric energy use

It shows the energy required from the battery (Wh/km) for different sets of speed, wind speed and slope. The colour notes the effort by the rider in each condition and the values are computed for a 1:1 torque setting, meaning that the same amount of human and electrical power is used in each time instant. The remaining constants are noted below the table. Missing values indicate conditions where the calculated average motor power exceeds the limit and is thus not possible to obtain for long periods of time. If that occurs, the rider would simply lower the speed. The electric energy usage varies depending on the external factors. Values between 3-18 Wh/km were computed but around 5-10 Wh/km can be seen for typical cycling at high- speed. Note that these values are computed for constant speed. Including accelerations would increase the energy provided from the battery.

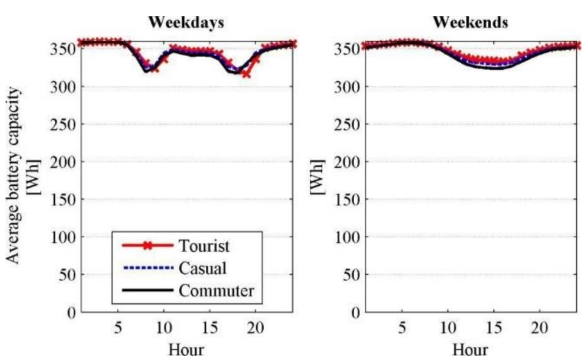
The computed energy use from the rider profiles. The underlying assumptions were high total mass (100 kg), 5 km trip length with different steep segments, energy for full stops, etc. 00E-Vehicle energy results



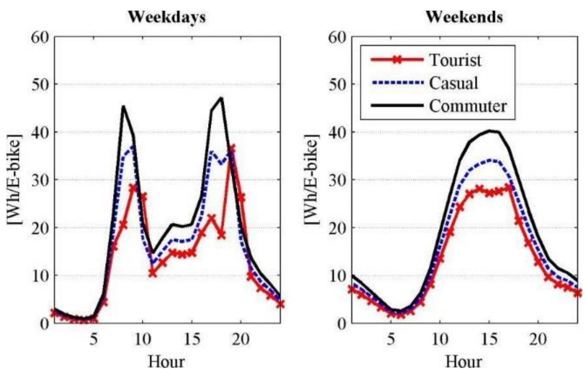
Average hourly bike usage for weekdays and weekends.

The usage profile for E-vehicle is shown in Figure for weekdays and weekends. What can be noted for weekdays are two distinct peaks when people commute to and from work.

It was computed that the average daily use was 2.6 trips/(bike and hour) for the studied period and that the maximum was 5.6 trips/(bike and hour).



Average battery capacity (Wh) for an E-vehicle during weekdays and weekends for three different rider profiles and usage at 10.8 trips/(hour and day). The calculations are assuming that energy is available for charging when needed, i.e. a grid connected system. Note that the values represent the average battery level at the end of each hour, i.e. after the battery has been charged the time possible.It shows the result of the average battery capacity from simulations on a grid- connected system (with or without a stationary battery). Note that the values represent the value at the end of each hour. The battery level will thus be the lowest just after the trip has finished. Note also that this is the average battery level, which means that individual vehicle will have even lower battery levels after a trip has finished.



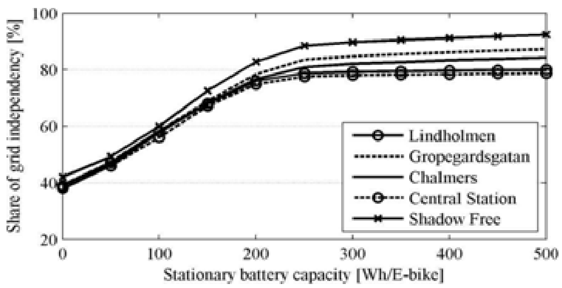
Average energy supplied from the power supply per E-vehicle during weekdays and weekends during high usage at 10.8 trips/ (hour & day).

It shows the average energy supplied from the power supply per E-vehicle during weekdays and weekends. What can be noted is that most of the charge energy supplied is during daytime since the E-vehicle are most used then. The implication from this is that the energy needed for charging matches quite well with the solar irradiation

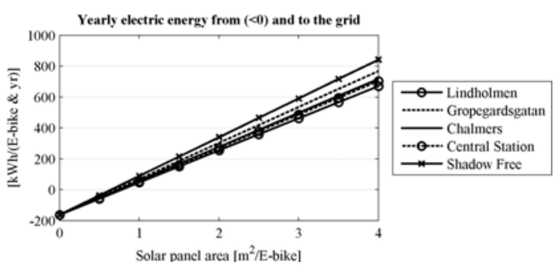
Share of the time there is no energy flow from the grid dependent on the size of the stationary battery. The rider profile used in all cases were commuter and the solar panel area was set to 2 $m^2$and the assumed use 10.8 trips/(vehicle & day).

By introducing a stationary battery to a grid-connected system, it is possible to reduce the power flow from the grid. This result can be useful if the system should be designed to operate as much as possible without power exchange with the grid.

An application of such a system can be to inform the users when their ride is 100% powered by the sun. It can be seen that the grid independence flattens out for larger stationary battery capacities.

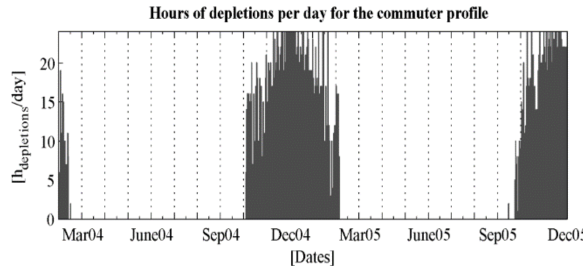


This is due to that the electrical energy from the solar panels is limited. To reach higher grid independence it is thus better to consider larger panel area instead of more batteries. This is also good from a resource perspective since the panels actually generate electrical energy whereas the batteries just act as a buffer.



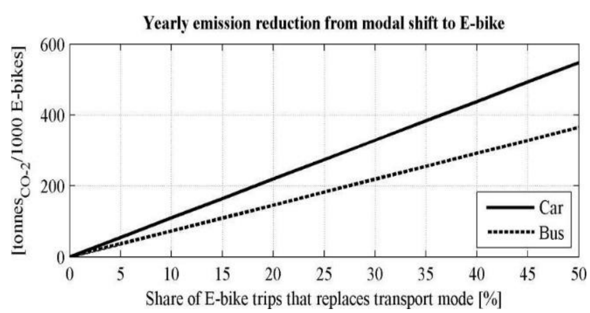
Yearly electric energy from (<0) and to the grid depending on solar panel area. Energy use was computed for the commuter profile at an assumed use of 10.8 trips/(vehicle & day).

The solar panel area needed to supply the yearly energy demand from the simulated E-Vehicle is around 0.8 m^2/E-vehicle for the studied locations at high system usage at 10.8 trips/(Evehicle& day). If the use is decreased to 3 trips/(vehicle & day), which is the use in BSS, the solar panel area needed for yearly energy self-sufficiency is 0.2-0.3 m^2/E-vehicle).The computed solar panel area is well below the assumed maximum area at 3-3.8 m^2/E-vehicle. If the solar panel area is larger than 0.8 m^2/E-vehicle for the system it will be a net generator of electrical energy. The yearly amount of energy fed to the grid for different solar panelareas.This is independent on stationary battery size as the average energy from a battery during a charge-discharge cycle is ideally zero.



Hours of depletions per day for an off-grid system without any buffer battery. Simulation is performed for a solar panel area at 2 m^2, the commuter profile and high system use at 10.8 trips/(vehicle & day).

If the E-Vehicle is off-grid, careful consideration is needed in the design process to ensure that the energy supplied by the solar panels is enough for the demand. It shows the average hours of E-vehicle battery depletions per day for an off-grid system without any buffer battery. Including a buffer battery would essentially smooth the curve out but it cannot make the system function during as it does not supply any energy to the system, it just acts as a buffer. The system could perhaps be operating without major disturbances from mid April to the end of August if a buffer battery of sufficient size would be introduced. To enable full- year operation however, the solar panel area would have to be increased. A drawback with this compared to the on-grid case is that the system efficiency will be low as a lot of solar energy summertime will beunused.



Yearly emission savings when introducing a system of 1000 E-vehicle depending on the share of trips replaced by either car or bus.

Shows the yearly emission reductions when introducing an E-Vehicle on large scale and replacing trips with either gasoline car or diesel city bus. It is assumed that the system is grid-connected and consists of 1000 E-vehicle which is a similar size as Gothenburg's current E-Vehicle. The total reduction would thus be the sum of the respective modal shift. If for example 30% of the trips replaces bus and 10% replaces car, about 300 tonnes CO2/1000 E-vehicle would be reduced annually. In addition to that, around 300 MWh/year of solar energy would be fed into the grid. The emission savings would be lower in the future as busses and cars are getting more efficient each year. The amount of energy fed to the grid would however be the same.

Fig. 4 Final design of solar E-Vehicle

Calculation:

Formula:

$$k = d \times r \times 0.001885$$

Where,

k = Kilometer Per Hour (km/ph)

d = Wheel Diameter (Cm)

r = Revolution Per Minute(RPM)

K = 26*3000*0.001885

K = 147.03

Battery discharge time = 6 hrs

Battery charge time = 2 hrs.

CONCLUSION

A solar powered bicycle is practically designed and developed with an electrical efficiency is 80%. And the maximum speed of solar assisted bicycle is 30kmph,can be travelled upto35 to 40km's with full charge of battery. It can be used by any age group people up to the weight of (80-100kg's).By using this type of solar bicycles, pollution can be reduced and mainly fossil fuels can be protected. This solar bicycle is also cost effective when compare to conventional bikes. The total cost of this solar bicycle is around rupees 25000 approximately. The payback period is around is 6 years.

FUTURE SCOPE

This Research may extend for implementation of the solar vehicles such as cars, trucks, buses, trains, ships etc.… with latest Technologies.

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