Implementation New Design Eco Campus Vehicle Based On Solar Power

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Abstract. Indonesia once's of country use more transportation, and also state spends more population, Smart Hybrid Vehicle is an Important issue for vehicle in college. This paper presents implementation transportation eco-campus for electric scooter and recharging solar cell in parking lot areas University Pembangunan PancaBudi. It allows us to evaluate a broad range of Plug-in Smart Hybrid Electric Vehicles (PSHEVs) and Plug-in Electric Vehicles (PEVs) charging scenarios and stochastic models of the power that is the demand by PEVs in the parking garage, and the output power of the PV panel are present. To impact of the PSHEVs' charging on the utility grid, a fuzzy logic power-flow controller was designed. The charging with solar cell helps to reduce emissions from the power grid but increases the cost of charging. Moreover, it offers more flexibility to prepare for the emergence of new technologies (e.g., Vehicle-to-Grid, Vehicle-to-Building, and Smart Charging), which will become a reality shortly. The system structure and the developed PHEV smart charging algorithm are described. Moreover, a comparison between the impact of the charging process of the PHEVs on the grid with and without the developed smart charging technique is presented and analyzed.

Introduction

In this time Gasoline- and diesel-powered Internal Combustion Engine (ICE) vehicles ended up dominating transportation in this decades. However, concerns about the environmental impacts of petrol and diesel power vehicles sparked a PEV renaissance at the end of the 20th century.

In the past few years, smart hybrid vehicle, which regarded as one of typical IOT applications, has been paid enormous attention to by multitudinous international and domestic research institutions.

First, advances in electric-drive technologies enabled commercialization of electric vehicles (EVs), which integrate ICE or another type of propulsion source with the solar panel, batteries, regenerative braking, and an electric motor to boost fuel economy. Continued technological advances have spawned EVs, which integrate small ICEs and large, grid-chargeable batteries that enable 10- to 40-mile all electric driving ranges.

PLUG-IN electric vehicle (EVs) are gaining popularity due to several reasons, i.e., they are convenient, visually appealing, quiet, and produce less pollution in the environment. PHEVs have the potential to reduce fossil energy consumption and greenhouse gas emissions, and they increase the penetration.

An intelligent method for scheduling the use of available energy-storage capacity from PHEVs proposed. The batteries in these PHEVs can either provide power to the grid or take power from the grid to charge the batteries on the vehicles. However, the detail about the energy dispatch during charging and the V2G process is not given.

Moreover, the SOC's of the PHEV’s batteries are not considered during the process of sustainable energy sources, such as solar power and wind power, into our daily lives [1]–[3]. Furthermore, most personal vehicles in the North Sumatera are parked more than 95% of the day and follow the same daily schedule [4].

Figure 1 illustrates the block diagram of the proposed charging scheme used in the car park.
The charging unit consists of two types of energy used for charging of vehicles coming into the parking lot. It used the conventional means of energy as well as solar energy. In the day, the charging station charges its vehicle entering using solar power and during night hours, it uses conventional energy.

The voltage divider circuit gives a reference voltage or produces a low voltage signal proportional to the voltage to be measured, i.e., 5V required for Arduino board. The entrance to the parking area contains the controller unit for driving the vehicles after checking their battery level, entry of parking time. According to the details, the car is assigned a slot to charge. After the 100% charging level reached, the owner of the car is intimated to park his/her vehicle in a separate parking lot, allowing another ride to charge. The remainder of this paper organized as follows: Section II introduces the types of Power Electric Vehicle charger for an exciting ride in parking space. It provides the underlying platform that will simulate the future charging system in a Smart Grid System; The proposed transportation is designed and discussed in section III. Section IV and Section V describes the energy management module and communications module. In Section VI, the authors summarize the paper and briefly introduce their future work.

Modeling the Stochastic PHEVS’ Parking System

To manage the energy in the PsHEVs’ parking garage in a real-time manner, The accuracy of the decision that is made by an algorithm is affected by the accuracy of the predictive models that are used to emulate the uncertainties in the system, i.e., the PV power in this case. Hence, we count on real data to forecast the PV output power.

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The structure of the transportation system is presented in Figure 2. and contains Electric Vehicles, Docking Stations and one Control Centre, as in [10].

The Electric vehicles represent the central component of the eco-campus.. It was possible to evaluate better the own design and to compare it accurately with other campus implementations, from many points of view as the motor.
power and torque characteristics, dynamic drive organization (motor, controller, battery and auxiliaries), battery chemistry, operating facilities, extra equipment (lamps, signals, and gauges, actuators, etc.), the degree of standardization and others.

The Docking stations represent the plants, where the vehicles parked and recharged between two successive scooters. The eco-campus ride is automatically released/received to/from authorized users, charged and verified. For charging, the station uses a second source: photovoltaic panels and the power grid. When the produced power exceeds the necessary level, the panels could supply the grid. The station monitors the professional status of each vehicle: charging, availability and health.

Each channel is controlled by a microcontroller and has a wireless communication with the Control Center.

**Details of Implementation**

A. The Original Scooter Realized by the Research Team

The technical and financial limitations of the research team imposed to electrify an existing scooter. The Greek propulsion system (engine, transmission, tank, etc.) replaced, keeping only the throttle and its cable, based on a dynamic model of the ride, as in [11]

The switching block will disconnect the system when the eco-campus ride is the park and protects it in the case of over-current. It also monitors the charging status of the battery. The controller connected to the in-wheel motor (machine and the incorporated Hall transducers). The driver torque command received from the original throttle (mechanical), by a cable, and a long life contactless inductive sensor.

The electric motor, developed by HME, is included in the 7" rim of the rear wheel, as in Figure 3. It is a permanent magnet brushless DC motor (PM-BLDC) with outer rotor and neodymium (NdFeB) permanent magnets. The motor has the Hall and temperature sensors included. It was designed to produce high torque, and no gear necessary. However, for a superior dynamic, a planetary gear could be considered. The speed solution involves financial and technological difficulties that exceed the level of this project and has denied. The specifications of the scooter, given by the motor, are presented in Table 1.
Technosoft International realizes the controller. It is set to match the electric scooter motor. A three-phase inverter, DSP-controlled, with specific, short-circuit, over and under voltage, motor and drive over temperature and I2 t protections implemented. The battery has 5 VRLA (Valve Regulated Lead-Acid) units of 12V/24Ah produced by BSB. The battery covers the motor necessities. It corresponds to a range of at least 60km. The gross mass of battery is 40kg. The next step to improve the vehicle performance will be to change the batteries to lithium chemistry. A standard 220VAC/60VDC selected for charging so that only the standard 220V/50Hz power supply is necessary for all vehicles.

### Assessment Considerations

The system tested in the campus of University Pembangunan Pancabudi. The selected users were ten students of the Faculty of Engineering, participants to the course “Electric and Telecommunication”. The key findings of this assessment are:

- **Technical properties:**
  - a1) the electrified scooter respects with acceptable deviations the estimated parameters. However, it has some drawbacks as:
    - The vehicle is dark, especially due to the frame that is not unique, including the protective cap of the old transmission; some solutions are not optimized, such as the throttle transducer (a complex solution with cable and inductive sensor instead of a modern Hall throttle), the heavy lead batteries which have high internal resistance, etc. a2) the moped with lead batteries has not enough power and torque to carry well the rider, especially on uphill roads, or if he has a high weight. The lead batteries have a high internal resistance, which produces an import degradation of torque at the low state of charge (SOC). The dead-weight is great Figure 5. Docking Station. Figure 4. Vehicle implementation and if the battery discharged, despite it has pedals, there is tough to move the moped. After 1 1/2 years of testing, the range is almost the same, between 20 and 30km, depending on the rider weight and the cruising speed. Recently, a cell of one battery unit gets down. a3) the bike having an aluminum frame and a lithium battery is quite light and is convenient to handle. The electric assistance is imperative and, the physical effort is practically zero, especially in the maximum support level.

  - a4) the solar panels have little power. With an exquisite irradiance, at noon on a summer day, the panel controller gives 8.7A at 28VDC (244W of power). On the AC side, this means, considering the...
typically declared efficiency of the inverter (86%) a maximum available power of 210W. The moped needs for charging at 218V, 0.37AAC, and the bike 0.7AAC, that is an apparent power of 81VA and 153VA respectively.

The scooter needs about 180VA. The conclusion is that the solar system can charge only one vehicle and the moped at a time, and this was the case in our application. With all vehicles charging and lower solar irradiance (during the afternoon) the power grid is necessary. a5) the docking system is simple. The electric plug, separated by the docking frame is a supplementary action which is not difficult, but the docking structure is massive and has to redesign.

The aluminum multi-speed bikes are appropriate for individuals, but for this intensive use are sensitive and very often it was necessary to adjust or to fix something. b3) the docking station resisted well during the winter with very low temperatures (−30°C) and snow, wind and rain. b4) the software in the Control Centre and docking station was satisfactory for a first evaluation, but some functions have to be add or improved. c) Users’ considerations c1) the students and staff were very attracted by this system.

The vehicles were also tested by many people, not only by authorized users. In the beginning, it was curiosity and many people regarded it as an exotic novelty. After that, the majority was impressed by the electric vehicles and some decided to buy one, especially a bike. Having a more extensive experience with the exciting rides, the authorized users expressed the total satisfaction concerning the vehicles and the transportation system. They also had suggestions, which were an essential aid for the project.

Conclusions

For implementation in University Pembangunan PancaBudi North Sumatera Medan. Campus demonstrated the technical advantages of this transportation system. Students and staff also appreciated it and illustrates with full details how to built a control circuit and power circuit, for DC scooter purpose, by using 36v DC voltage source across 0.5KW PMDC motor with starting, braking and all directional motions to have the ability to drive the scooter in a desired and safe manner.

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