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Implementation New Design Charging Unit for Smart Mobility Eco Campus Vehicle

Solly Aryza Lubis
Lecturer, Universitas Pembangunan Panca Budi Medan, North Sumatera, Indonesia
Student, University Malaysia Perlis, Kampus Kubang Gajah, Arau, Perlis, Malaysia
Zulkarnain Lubis
Student, Institute Technology Medan, Gedung arca Street, Medan, North Sumatera, Indonesia

Abstract:
In Indonesia, Smart Hybrid Vehicle is an Important issue for vehicle in college. This paper presents a charging process for electric vehicles in parking lot areas University Pembangunan PancaBudi. It allows us to evaluate a Plug-in Smart Hybrid Electric Vehicles (PHEVs) and Plug-in Electric Vehicles (PEVs) charging scenarios and Stochastic models of the power that demanded by PHEVs in the parking garage and the output power of the PV panel presented. Have limited the impact of the PHEVs' charging on the utility AC grid, and a fuzzy logic power-flow controller designed. System charging solar energy can help to reduce the emissions from the power grid but increases the cost of charge. Then, it offers to be flexibility to prepare and the emergence of new technologies, which will become a reality shortly. The structure system and the advanced algorithm PHEV smart charger described a comparison between the impact of the charging process of the PHEVs on the grid and without the developed smart charging technique is presented and analyzed.

Keywords: *Smart Vehicle, Vehicle Application, plug-in hybrid electric vehicles (PHEVs)*

1. Introduction

The electric automation mobile design industry's most important parts of the world and is the subject of particular attention from governments around the world, especially for the prestige that this entails and the amount of labor that involves this sector. It should, however, be emphasized that the automotive industry, and in general the field of transport, is characterized by the fact of being an industry which over the years has failed to bring significant innovations, presenting the same technology for several decades. Only in recent years, driven by regulations regarding environmental protection and emission reduction, the scooter is evolving towards a reduction in fuel consumption and power than fossil fuels to reduce emission [1-2]. Electrical and photovoltaic technology, including energy efficiency and emissions reduction.

In this era Gasoline- and diesel-powered Internal Combustion Engine (ICE) vehicles ended up dominating transportation until 2016. Ed a PEV renaissance at the end of the 20th century.

In the past few years, smart hybrid vehicle, which is regard as one of typical IOT applications, has been paid enormous attention to by multitudinous international and domestic research institutions. The term Smart mobility is a new way of thinking about movement [3-6]. That involves managing flows about the demand for people and goods, optimizing the use and development of resources and integrated infrastructures, which often taken into account. In Italy, it is estimate at 8-10 billion euro per year, due to the impact on the health of PM10 and of the ozone. A smart mobility is an enabler to achieve the new urban models of the smart city, today's primary goal PLUG-IN hybrid electric vehicles (PHEVs) 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 not given.

Moreover, the SOCs of the PHEV's batteries not considered during the process of sustainable energy sources, such as solar energy and wind energy, 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].

If properly managed, plug-in vehicles can be charged during low demand periods of the grid which minimizes the strain on the grid and obviating major generation and transmission infrastructure additions. Charging PEV requires electric vehicle supply equipment (EVSE). EVs must be charged regularly, and charging PHEVs regularly will minimize the amount of gasoline they consume. The aggregate load in a public charging facility (e.g., public parking lot) needs to be managed carefully to avoid interruptions when several thousand PHEVs/PEVs introduced into the system over a short period (e.g., during the early morning hours when people arrive at work). A large number of PHEVs/PEVs connected to the grid simultaneously may pose an enormous threat to the quality and stability of the overall power system. The aim of this work is to highlight the potentials those we offer with the integration of the technologies, photovoltaic systems and electric vehicles applied on area Universitas Pembangunan Pancabudi Medan. The article suggests possible solutions for sustainable mobility and can take advantage of all the properties and the potentials offered by vehicles with developed a digital test bed for a large-scale PHEV/PEV enabled parking lot that integrates both an energy management module and a communications module. Fig. 1 illustrates the block diagram of the proposed charging scheme used in the car park.

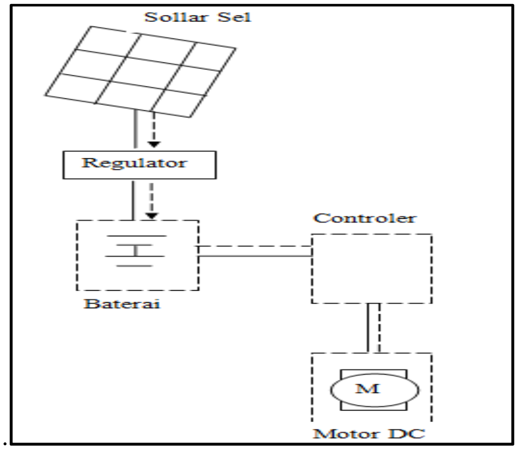

Figure 1: Block diagram of the charging scheme in the parking lot

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 was 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 of 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 commuter to charge.

2. Modeling The Stochastic Phevs' Parking System

To manage the energy in the PHEVs' parking garage in a real-time manner, the power that is available from the PV source should be predicted and considered. 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. The data forecasting process based on the PV data that collected over one year on an hourly basis for an example PV system in the Universitas Pembangunan Pancabudi, Medan. The output power data are used as the output to forecasted, whereas the day of the year (1–365) and the hour of the day (1–24) used as inputs. Different model evaluation indexes were used to validate the developed mathematical models. The forecasting model that is used to predict the PV output in this paper regenerated from the model that derived in [14] using the historical PV data described in the earlier section.

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

The Electric vehicles represent the main component of the project. For evaluation purposes of this research, different types of electric vehicles selected. The research team realized one scooter of an original design and purchased other vehicles: two electric bikes and one electric moped. In this way, that's method was possible to evaluate the own design better and to compare it accurately with other international implementations, from many points of view as a motor.

Figure 2: Transportation system structure

power and torque characteristics, electricity 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 facilities where the vehicles are parked and recharged between two successive rental periods. The vehicles are 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 special status of each vehicle: charging, availability and health. Each channel is controlled by a microcontroller and has a wireless communication with the Control Center. It communicates with the users by a keyboard panel and display. The Control Centre uses a dedicated server and wireless communications with the docking stations. It manages the users, vehicles, trips and finally could send a bill.

3. Details of Implementation

3.1. The Original Scooter Realized by the Research Team

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

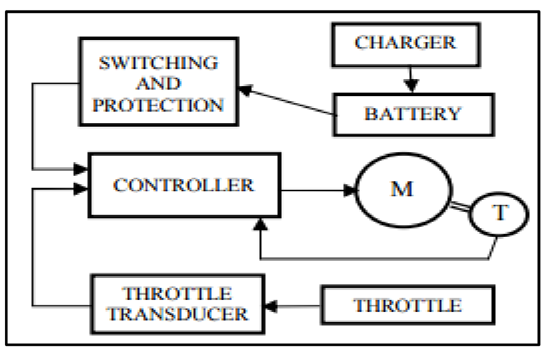

Figure 3: Electric propulsion system

The switching block disconnects the system when the vehicle is parked and protects it in case of over-current. It also monitors the charging status of the SLA (Sealed Lead Acid) battery. The controller is connected to the in-wheel motor (machine and the incorporated Hall transducers). The controller torque command is received from the original throttle (mechanical), by a cable, and a long life contact-less inductive transducer.

The electric motor, developed by ICPE Bucharest, is included in the 13" rim of the rear wheel, as in Fig.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 is normally necessary. However, for a higher dynamic, a planetary gear could be considered. The gear solution involves financial and technological difficulties which exceed the level of this project and has been denied. The specifications of the scooter, given by the motor, are presented in Table 1.

Parameter	Value	Parameter	Value
Mass	175kg	Load	100kg
Rated speed	45km/h	Range	60km
Rated power	3.5kW	Rated torque	54Nm
Rated voltage	60V	Charging time	5-7h
Climbing ability	15%	Maximum torque	115Nm

Table 1: Scooter Parameter

The controller is realized by Technosoft International. 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 was implemented. The battery has 5 VRLA (Valve Regulated Lead-Acid) unites 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 was selected for charging, so that only the standard 220V/50Hz power supply is necessary for all vehicles.

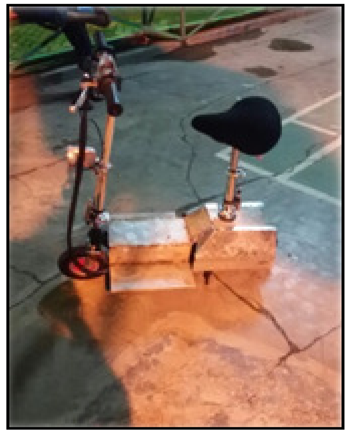

Figure 4: Vehicle Implementation

4. Assessment Considerations

The system has tested on 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 area) Technical properties: a1) the electrified scooter respects with acceptable deviations the estimated parameters. However, it has some drawbacks as - the vehicle is heavy, especially due to the frame which 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 a low state of charge (SOC). The dead-weight is high Fig.5. Docking Station. Fig. 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 critical and the physical effort is practically zero, especially in the maximum assistance level. The torque is enough to ride a 9% slope without problems with an 80kg rider. The range was excellent at the beginning, more than 30km, but degraded after one year to 10-20km. a4) the solar panels have low power. With a very good 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 frame is heavy and has to be redesigned. The LEDs light is not very strong and can be seen with difficulty, especially when the sunlight is strong and directed to LEDs. The docking station display is quite small and can be seen with difficulty in the sunlight. The wireless transmission between station and Control Centre is sometimes affected by noise. a6) the graphical interface in the Control Centre should be improved. b) Exploitation considerations: b1) the security problem is imperative for this system. On the one hand, the equipment is quite expensive and could be a temptation for some people. For the other hand, the equipment is quite sensitive and could be damaged very quickly.

No	Sample	Weight	Time	Leight	Speed
1	Student 1	73 kg	5,60 menit	1 km	178,5 m
2	Sudent 2	65 kg	5,50 menit	1 km	181,8 m
3	Student 3	57 kg	4,47 menit	1 km	223,7 m
4	Student 4	65 kg	5,50 menit	1 km	181,8 m
5	Student 5	50 kg	4,22 menit	1 km	236,9 m
6	Student 6	60 kg	4,52 menit	1 km	221,2 m
7	Student 7	72 kg	5,60 menit	1 km	178,5 m

Table 1: Results of the scooter speed test using body weight

To overcome this problem, in this project the docking station was placed at the entrance of the Faculty of Transportation and was continuously guarded by a security officer. However, after a week, some accessories were damaged and had to be replaced. Consequently, the vehicles were parked at the docking station only during the active phase of experimentation. Even more, the university campus is a recreation place for many students. Unfortunately, they play foot tennis next to the docking station and the solar panels can be damaged by the ball. So, it was necessary to protect the panels with a metallic net, which reduced in some extent the panel efficiency. b2) the reliability of the vehicles was also a problem. After six months, the moped controller was damaged and was replaced. 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 (-30o 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 added 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. At 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 electric vehicles, the authorized users expressed the totally satisfaction concerning the vehicles and the transportation system. They had also suggestions, which were an important aid for the project.

5. Conclusions

The implementation in University Pembangunan PancaBudi North Sumatera Medan. campus demonstrated the technical advantages of this transportation system. It was also appreciated by students and staff. ACKNOWLEDGMENT This paper describes the results of the project "Electrocampus", supported under the programme "Go green " by the Rector of University Pembangunan Pancabudi for Education, Research, Youth and Sport, see [13]. The partners coordinated by the author were University Pembangunan PancaBudi North Sumatera Medan.

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