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Solutions to Reduce CO2 Emissions in Autonomous Robotics

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Abstract : Mobile robots can be used in many different applications, including mapping, search, rescue, reconnaissance, hazard detection, and carpet cleaning, exploration, etc. However, they are limited due to their reliance on traditional energy sources such as electricity and oil which cannot always provide a convenient energy source in all situations. In an ever more eco-conscious world, solar energy offers the most environmentally clean option of all energy sources. Electricity presents threats of pollution resulting from its production process, and oil poses a huge threat to the environment. Not only does it pose harm by the toxic emissions (for instance CO2 emissions), it produces the combustion process necessary to produce energy, but there is the ever present risk of oil spillages and damages to ecosystems. Solar energy can help to mitigate carbon emissions by replacing more carbon intensive sources of heat and power. The challenge of this work is to propose the design and the implementation of electric battery recharge stations. Those recharge docks are based on the use of renewable energy such as solar energy (with photovoltaic panels) with the object to reduce the CO2 emissions. In this paper, a comparative study of the CO2 emission productions (from the use of different energy sources: natural gas, gas oil, fuel and solar panels) in the charging process of the Segway PT batteries is carried out. To make the study with solar energy, a photovoltaic panel, and a Buck-Boost DC/DC block has been used. Specifically, the STP005S-12/Db solar panel has been used to carry out our experiments. This module is a 5Wp-photovoltaic (PV) module, configured with 36 monocrystalline cells serially connected. With those elements, a battery recharge station is made to recharge the robot batteries. For the energy storage DC/DC block, a series of ultracapacitors have been used. Due to the variation of the PV panel with the temperature and irradiation, and the non-integer behavior of the ultracapacitors as well as the non-linearities of the whole system, authors have been used a fractional control method to achieve that solar panels supply the maximum allowed power to recharge the robots in the lesser time. Greenhouse gas emissions for production of electricity vary due to regional differences in source fuel. The impact of an energy technology on the climate can be characterised by its carbon emission intensity, a measure of the amount of CO2, or CO2 equivalent emitted by unit of energy generated. In our work, the coal is the fossil energy more hazardous, providing a 53% more of gas emissions than natural gas and a 30% more than fuel. Moreover, it is remarkable that existing fossil fuel technologies produce high carbon emission intensity through the combustion of carbon-rich fuels, whilst renewable technologies such as solar produce little or no emissions during operation, but may incur emissions during manufacture. The solar energy thus can help to mitigate carbon emissions.

Keywords : autonomous robots, CO2 emissions, DC/DC buck-boost, solar energy
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