Optical Wireless Power Transmission for Small Equipment to Mobility

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The power supply for electric equipment is remained as wired, including battery charging. Wiring restricts the installation of equipment, the functionality of devices, and the creation of new applications and services. Wireless power transmission technology is expected to bring significant changes to society. There are various wireless power transmission (WPT) technologies, however these conventional methods have disadvantages of short transmission distances, electromagnetic interference (EMI), and so on. The recently activated optical wireless power transmission (OWPT) method promises to grow in applications due to its attractive features [1].

By using light beams, the expected advantages are long-distance power transmission, small transmitter and receiver module due to light wavelength and semiconductor devices, and DC circuits that enables simple circuit and no-EMI. Although the basic configuration is simple, practical system requires the integration of various functions from optical systems to control systems. In practical service, the capability of continuous power supply is indispensable because efficient power transmission of high power intensity light is restricted by entering of various objects. When a person enters the beam area, it causes a serious safety hazard. Therefore, as shown in Fig. 1, a multi-beam system is proposed as a highly-functional OWPT system.

Figure 2 shows a demonstrations of a two-beam OWPT system. By using a 3D-depth camera and a direction movable light source, several functions were operated by preparing a deep-learning based solar cell recognition, PID controlled beam direction, and light switching sequences. In this case, an LED light source was used for a temporal operation. When the two light source systems recognize a solar cell, the light source closer to the solar cell is turned on. When some restriction object enters the beam line, another light source is turned on. Other several functions are also considered and demonstrated.

Such high functionality can be applied from small equipment to high power mobilities. As a basic demonstration of mobility, a hobby car with solar cell was operated by a laser light, as shown in Fig. 3. 30 W laser power and a Si solar cell module were installed. A 7.5 F electric double-layer capacitor was used to operate the car during no-light irradiation. In this case, a laser beam is advantageous to reduce the infrastructure of the light source systems. Such dynamic power transmission is attractive for a variety of mobilities of electric-vehicles, drones, robots.

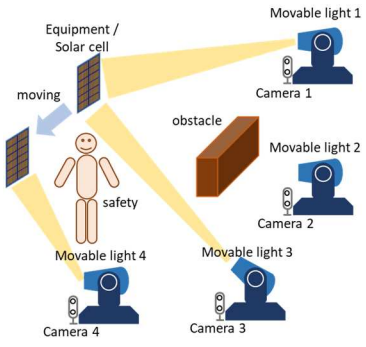

Figure 1. Schematic configuration of multi-beam OWPT system.

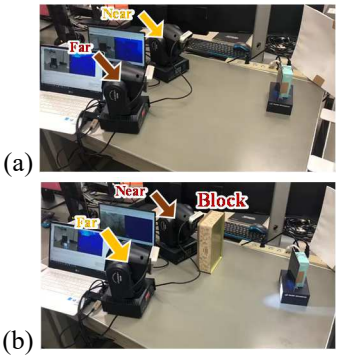

Figure 2. Demonstration of multi-beam OWPT.

Figure 3. Dynamic power transmission to a hobby car by OWPT. The line shows the beam position.

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References

[1] T. Miyamoto, “Optical wireless power transmission using VCSELs,” Proc. SPIE, 10682, April 2018, 1068204, doi:10.1117/12.2309436.