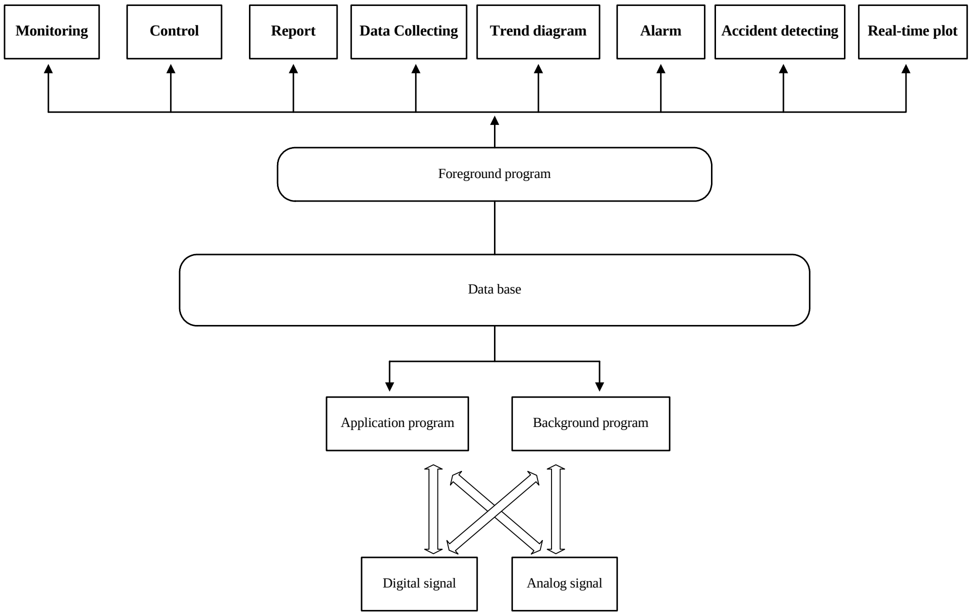

Fig. 3 Framework of the employed PLC's system software

The decision-making hardware framework is shown in Fig. 4. The arrangement of the implemented complete hardware is shown in Fig. 5.

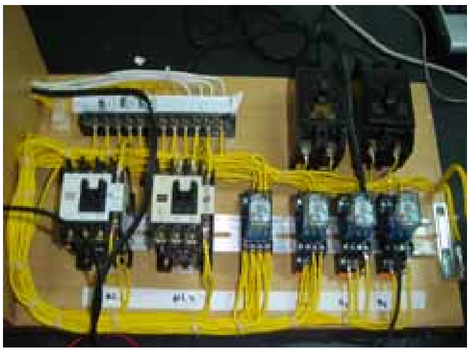

Fig. 4 Photo of hardware framework for decision-making control.

3 System Model

This section introduces the model of a photovoltaic energy conversion system, where the system model is of independent power supply. It deduces the linear and nonlinear mathematical equations of this system model in order to complete the dynamic characteristics of the system.

3.1 Mathematical model of solar cell

The solar cell is a photoelectric semiconductor device that uses sunlight to directly generate power. A semiconductor containing an electric field generates electric power when there is a light source, and the potential difference occurs in the interface by means of such characteristics. The principle of solar power generation is that, when the sunlight irradiates the solar panel, the positively charged holes move towards the p-type region, and the negatively charged electrons move towards the n-type region, thus, electric power is generated. A solar panel is composed of many solar cells, and each solar cell consists of a P-N junction semiconductor that directly converts light energy into electric energy. It is assumed that the solar panel generates an independent current source for a load in sunlight. Fig. 6 shows the equivalent circuit of a solar cell [12], where the is the current of solar energy, junction diode, equivalent series resistance inside material , and parallel resistance , and and are the output current and voltage of solar cell, respectively.

Fig. 5 Photo of the arrangement of the studied complete system.

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