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INTELLIGENT MONITORING AND CONTROL ON DISTRIBUTED POWER SYSTEM OF FOSSIL FUEL ENERGY AND GREEN ENERGY

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Abstract. *In this research, green energy is merged into fossil fuel energy for better power supply transmission system. Power monitoring and intelligent power deployment control are also introduced in this distributed generation system. The system utilizes Labview to design a monitoring and control system including power transmission monitoring, consumption monitoring, power analysis and intelligent control; furthermore, the intelligent power control is deployed for integrating green power into system. Labview that is a graphical language with advantages of simple operation and easy understanding is used to design the functions of monitoring, control and analysis for power generation, transmission and consuming status among different situations including if using transformer and under different load. The completing of this research, the method, theory and practical technique of power monitoring and intelligent power deployment are understood and constructed. The results of this research show this monitoring and control technique can be effectively applied into industry for decreasing fossil fuel usage and protecting our environment.*
Keywords: Power, Monitoring, Control, Intelligent, Distributed generation

1. **Introduction.** In past decades, because of human factor, green house effect cause the earth getting warmer and warmer with extreme weather conditions. Concluding the reports and literature [1,2], the main reason is the emission of green house gas after industry revolution. Looking into the factor, a large number usage of coal, fossil fuel and natural gas cause sixty million tons of carbon dioxide increasing per year [3]. Therefore, the first job to slow down green house effect is to stable atmosphere that means to decrease carbon dioxide. In order to concern safe issue, waste problem, economic development and living quality, except of decreasing energy usage or increasing energy efficiency, the green energy is encouraged to exploit such as solar power and wind power. When the possibility of complete depletion of fossil fuel in the near future and the associated environmental pollution have become a major worldwide concern at economic, environmental, and industrial levels, the crisis has led to a global awareness of renewable and green energy in an attempt to meet a significant portion of our daily energy consumption. Since existing renewable and green energy technologies cannot meet the present demand, billions of dollars are being invested worldwide in green energy related research and development projects in search for efficient, cost-effective, and reliable technologies [4]. The rapid increase in the demands for electricity, depletion of conventional energy sources, improvements in power electronic technologies and utilization of renewable energy sources for power generation

have given rise to the use of distributed generation [5-8]. These technologies are changing the structure of the present power system right from generation, transmission [9]. With the importance of environmental protection and sustainable development increasing, a clean and renewable green energy receives a great deal of attention. Therefore, distributed power system integrating renewable energy and green power are getting more important. This also makes the intelligent monitoring and control on distributed power system with green energy become a leading topic to research [10].

In this research, the virtual instrument control technology integrates solar power with fossil fuel power as a distributed power system by applying intelligent monitoring and control. The virtual instrumentation of monitoring technology combines current computer technology, graphical software and module hardware to build a practical measurement, monitoring and control system [11].

2. **System Structure.** MyGrid by Elenco is used as a simulation system. NI MyDAQ which possesses several virtual instruments is applied as interface. This combination would help better and more convenient measurement, monitoring and system construction. The system structure is shown as Figure 1.

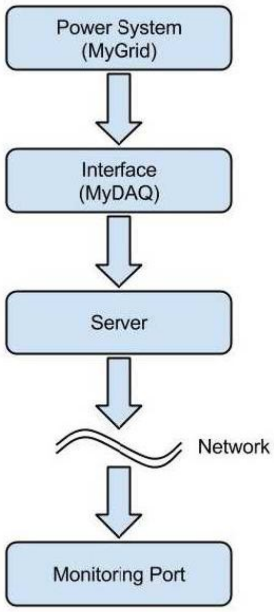


FIGURE 1. System structure

2.1. **Hardware.** Figure 2 is outlook of NI MyDAQ. (a) Part A is USB controlled bus powered. (b) Part B shows the circuit diagram of NI MyDAQ. (c) Part C is pinning out of signal inputs and outputs. (d) Part D is integrated DMM. Figure 3 is circuitry of MyGrid by Elenco. (a) Part A is fossil fuel sub-section. (b) Part B is the transformer of power generation side. (c) Part C is the transformer of the load. (d) Part D is three simulation loads. (e) Part E is solar plate. (f) Part F is two changeover switches for controlling transformer and distributed power system by merging solar power.

2.2. **Software.** This system uses Labview to design power monitoring and intelligent power control system. Not only the software itself can program required functions but it also possesses remote control, fast update, low cost and is able to connect with other instruments. Moreover, the data processing is the major advantage for using Labview, such as saving, calculation, gathering statistics and analysis. Figure 4 is front panel and block diagram for the system.

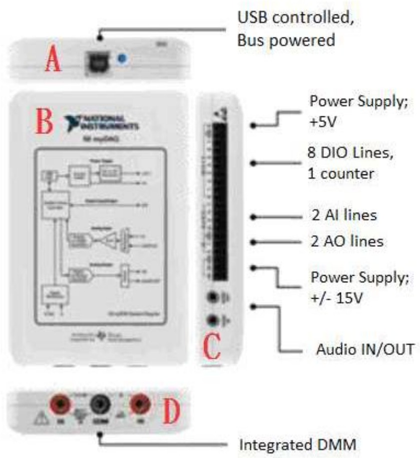


FIGURE 2. NI MyDAQ

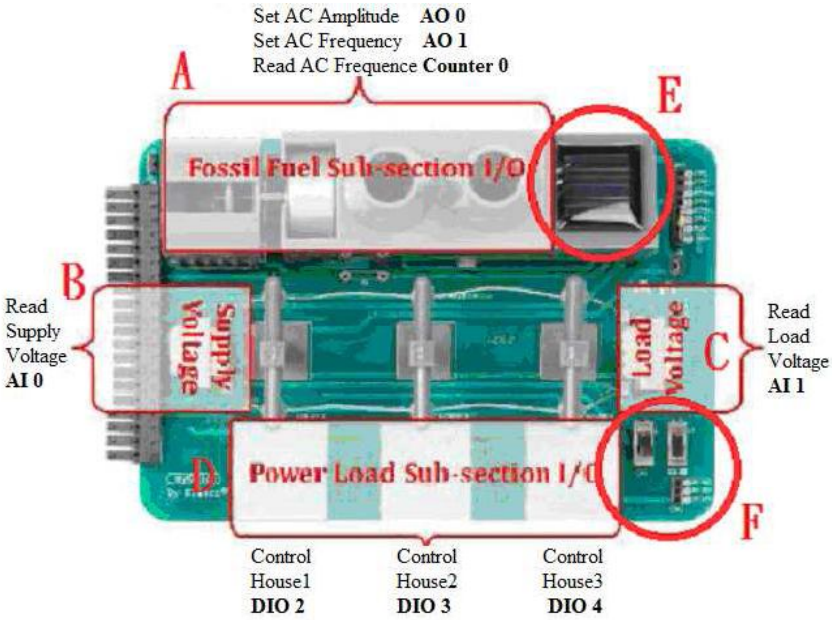


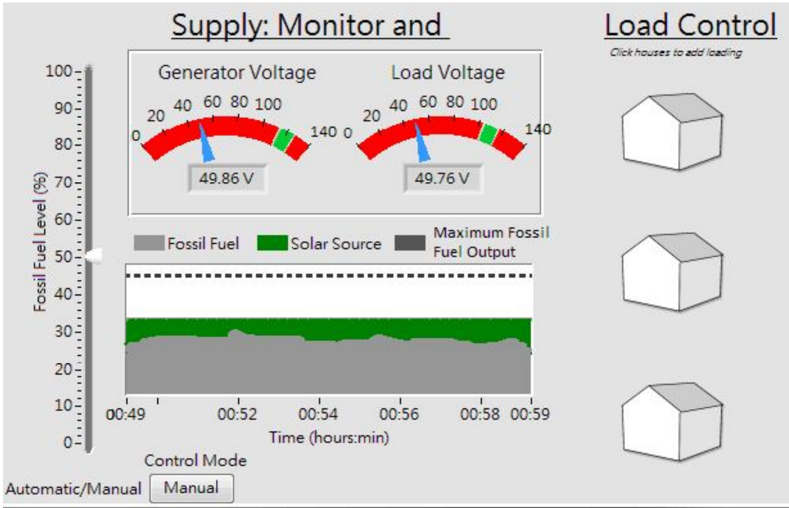
FIGURE 3. The circuitry of MyGrid by Elenco

3. Main Results.

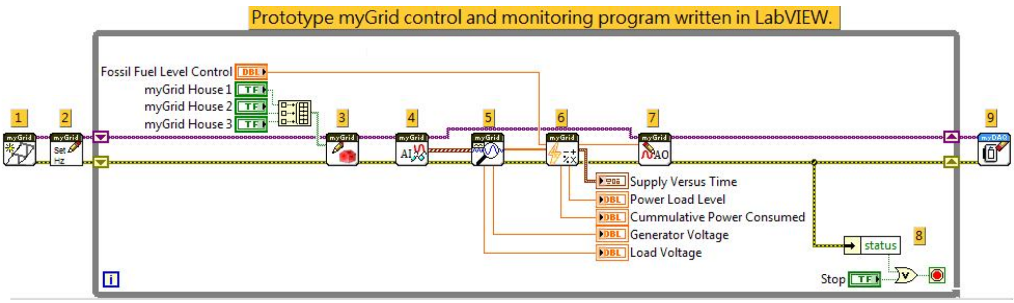
3.1. System calibration. Figures 5(a) and 5(b) show the system test page that shows how the system connects and calibrating status.

3.2. Simulation status. Figure 6 shows two changeover switches for operating transformer and if integrating solar power into the system.

3.2.1. *The power transformer is off with using only fossil fuel power during light load.* Figure 7(a) shows the change over condition that the power transformer is off with the source switch in on AUX side when the system stays in light load. The monitoring status shows the generator voltage is a little bit higher than the load voltage which means there is loss during the power transmission. In Figure 7(b), the grey part means the fossil fuel power and the green part means the solar power. Therefore, no solar power is added into this power transmission.



(a)



(b)

FIGURE 4. (a) System front panel, (b) system block diagram

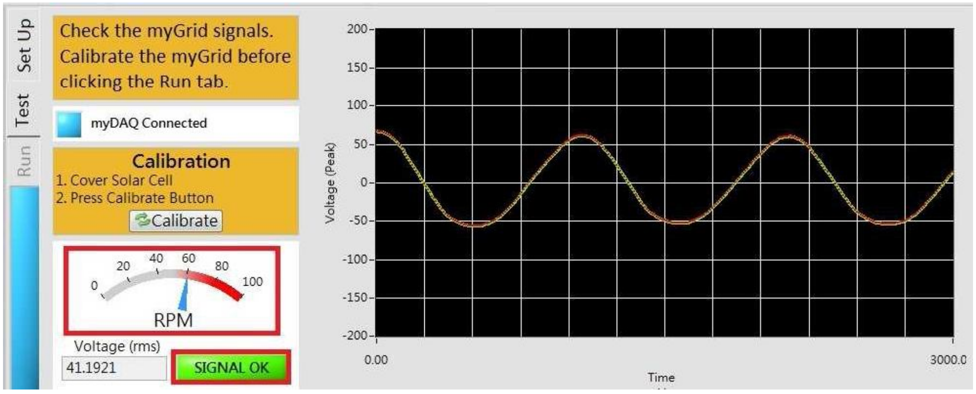
3.2.2. *The power transformer is off with using only fossil fuel power during heavy load.* Figure 8(a) shows the change over condition that the power transformer is off with the source switch in on AUX side when the system stays in heavy load. The monitoring status shows the generator voltage is also a little bit higher than the load voltage which means there is loss during the power transmission. In Figure 8(b), the generator voltage and load voltage are a little higher than the ones in Figure 7(b).

3.2.3. *The power transformer is on with using only fossil fuel power during light load.* Figure 9(a) shows the change over condition that the power transformer in on with the source switch is on AUX side when the system stays in light load. The monitoring status shows the generator voltage is lower than the load voltage which means the increasing voltage offset the loss during the power transmission. In Figure 9(b), the grey part means the fossil fuel power and the green part means the solar power. Therefore, no solar power is added into this power transmission.

3.2.4. *The power transformer is on with using fossil fuel power during heavy load.* Figure 10(a) shows the change over condition that the power transformer in on with the source switch on AUX side when the system stays in heavy load. The monitoring status shows the generator voltage is lower than the load voltage which means the increasing voltage also offsets the loss during the power transmission. In Figure 10(b), the grey part means the fossil fuel power and the green part means the solar power. Therefore, no solar power is added into this power transmission.

3.2.5. *The power transformer is off with using fossil fuel power and solar power during light load.* Figure 11(a) shows the change over condition that the power transformer is

(a)



(b)

Figure 5. (a) System test page, (b) system measurement calibration

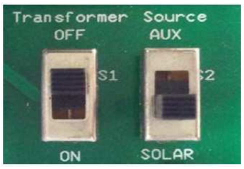
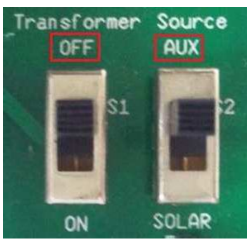
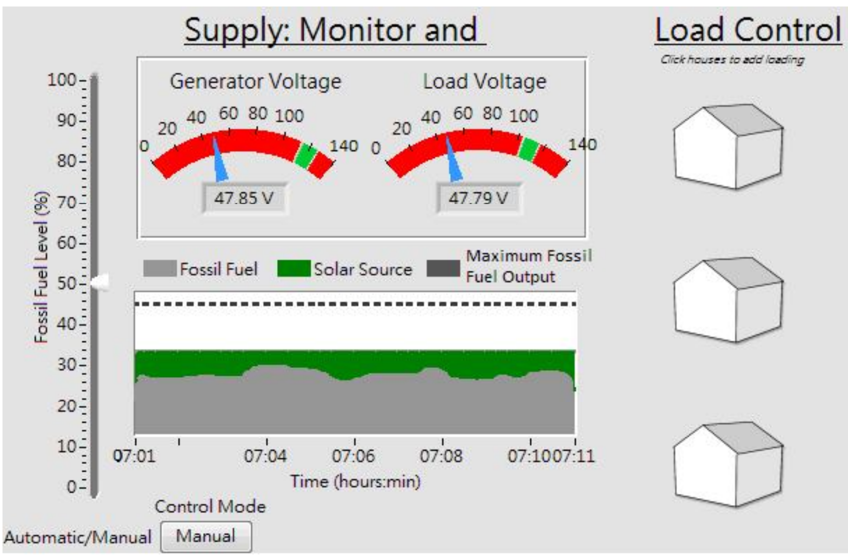


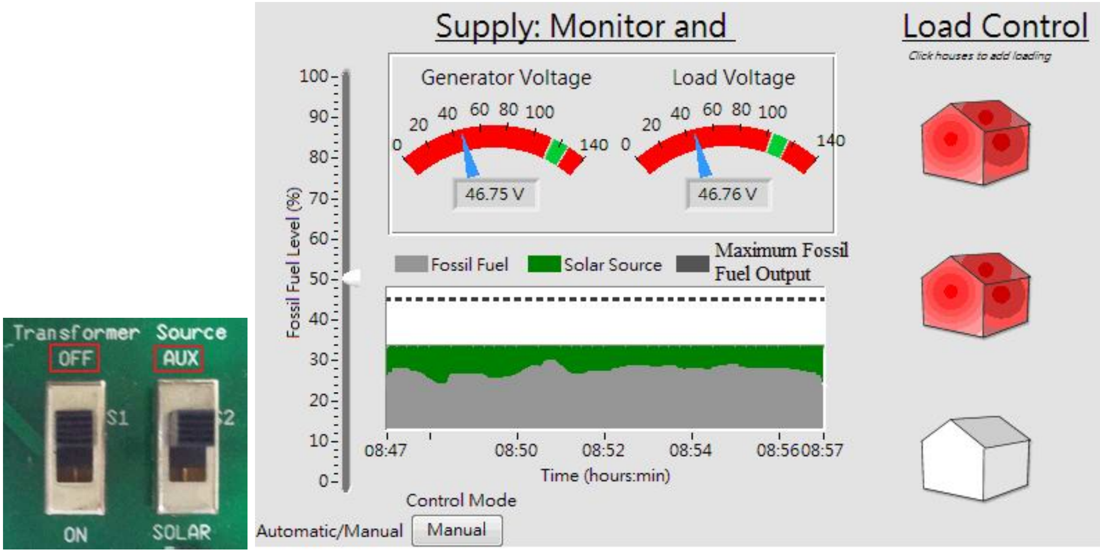
Figure 6. The change over switches





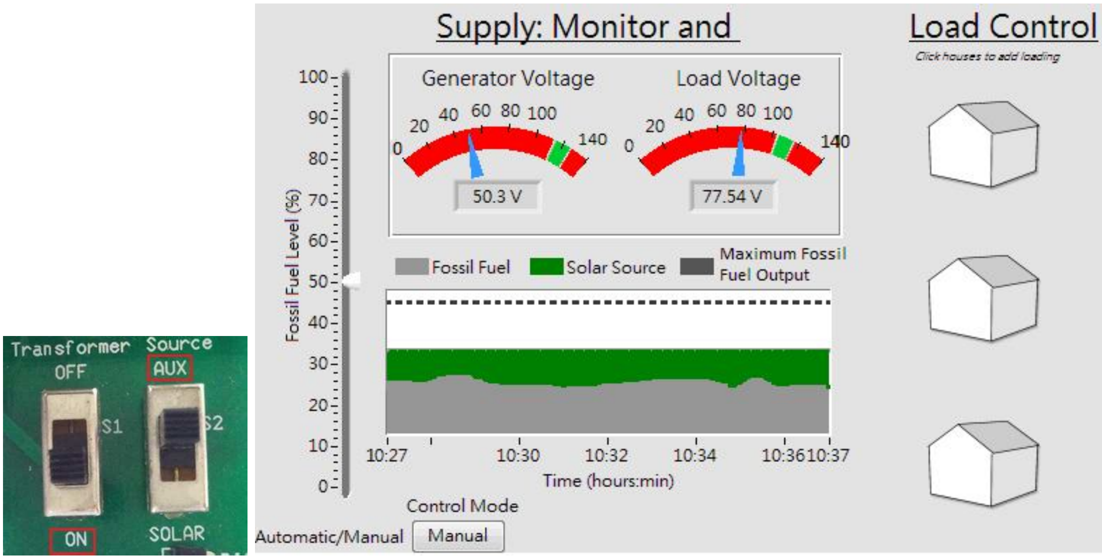
(a) (b)

Figure 7. (a) The change over condition, (b) the system simulation



(a) (b)

FIGURE 8. (a) The change over condition, (b) the system simulation



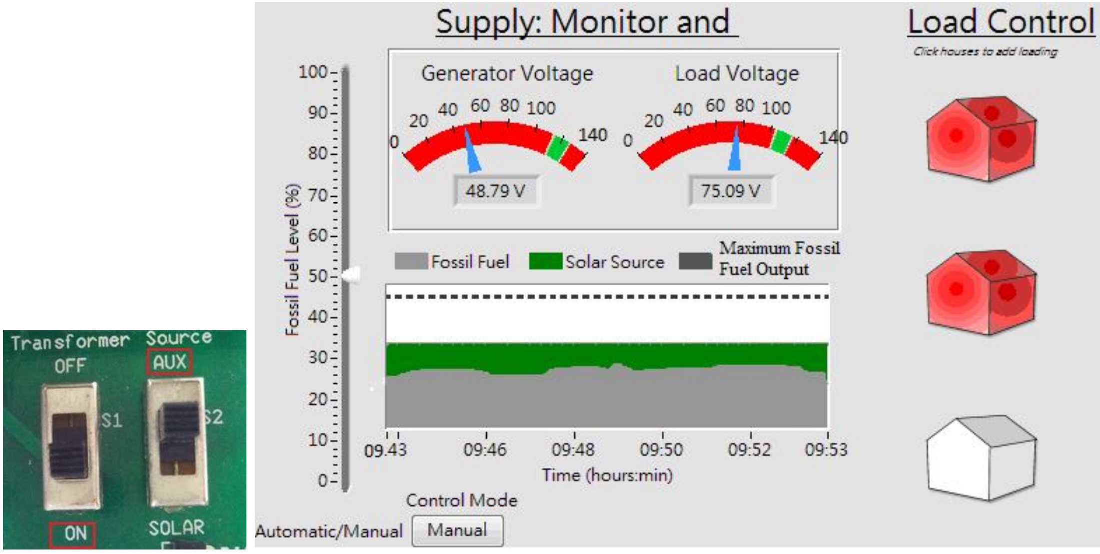
(a) (b)

FIGURE 9. (a) The change over condition, (b) the system simulation

off with the source switch in on SOLAR side when the system stays in light load. The monitoring status shows the generator voltage and load voltage are all higher than the voltages of only using fossil fuel power. Figure 11(b) is the case simulation.

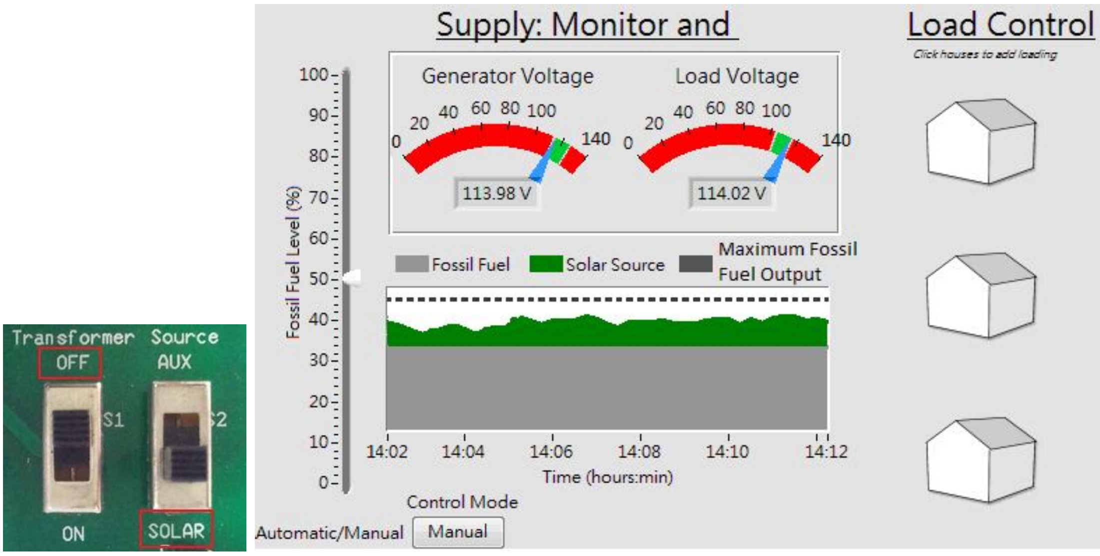
3.2.6. *The power transformer is off with using fossil fuel power and solar power during heavy load.* Figure 12(a) shows the change over condition that the power transformer is off with the source switch in on SOLAR side when the system stays in heavy load. The monitoring status also shows the generator voltage and load voltage are all higher than the voltages of only using fossil fuel power. Figure 12(b) is the case simulation.

3.2.7. *The power transformer is on with using fossil fuel power and solar power during light load.* Figure 13(a) shows the change over condition that the power transformer is on with the source switch in on SOLAR side when the system stays in light load. The monitoring status shows the generator voltage and load voltage are all higher than the



(a) (b)

FIGURE 10. (a) The change over condition, (b) the system simulation



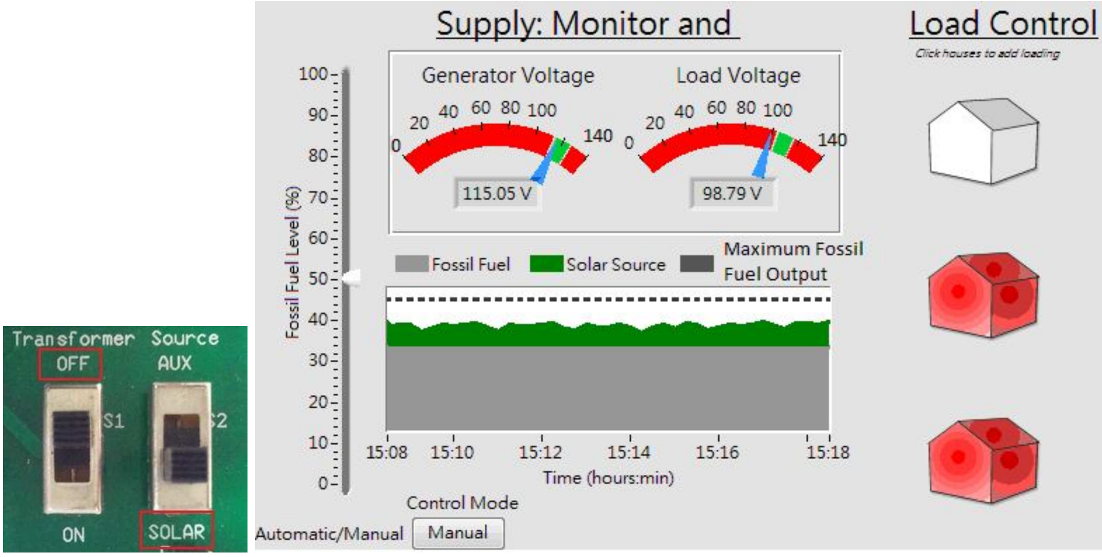
(a) (b)

FIGURE 11. (a) The change over condition, (b) the system simulation

voltages of only using fossil fuel power. Moreover, the load voltage is the highest value in all types of simulations. Figure 13(b) is the case simulation.

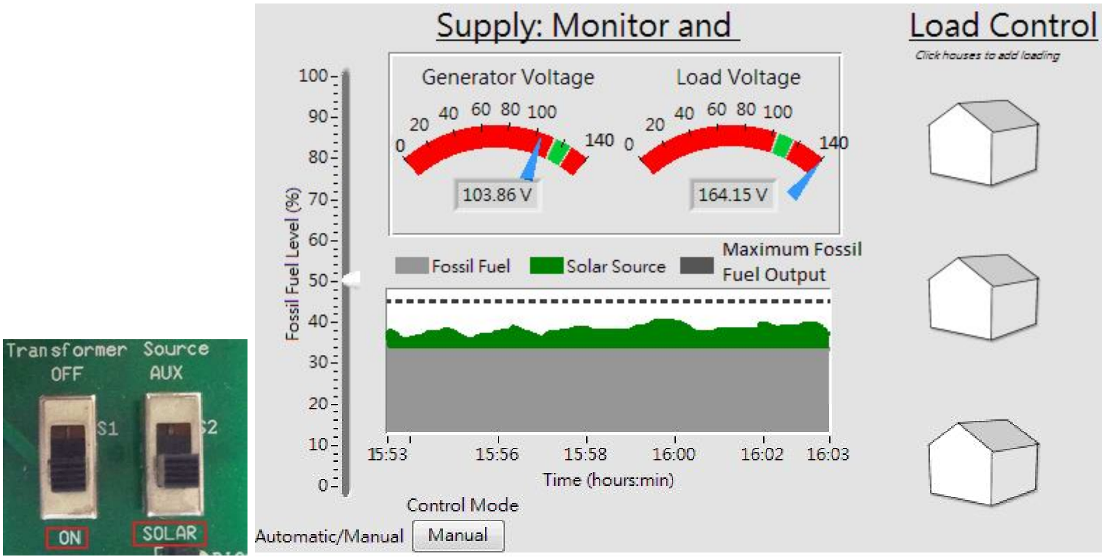
3.2.8. *The power transformer is on with using fossil fuel power and solar power during heavy load.* Figure 14(a) shows the change over condition that the power transformer is off with the source switch in on SOLAR side when the system stays in heavy load. The monitoring status shows the generator voltage and load voltage are all higher than the voltages of only using fossil fuel power. Moreover, the load voltage is only lower than the simulation case 3.2.7 in all types of simulations. Figure 14(b) is the case simulation.

4. **Conclusion.** In this paper, literature research is performed for green energy, green house effect and distributed power system. Labview software is applied to design an intelligent monitoring and deployment control strategy for power transmission system. The developed system possesses system monitoring, control, analysis, calculation and



(a) (b)

FIGURE 12. (a) The change over condition, (b) the system simulation



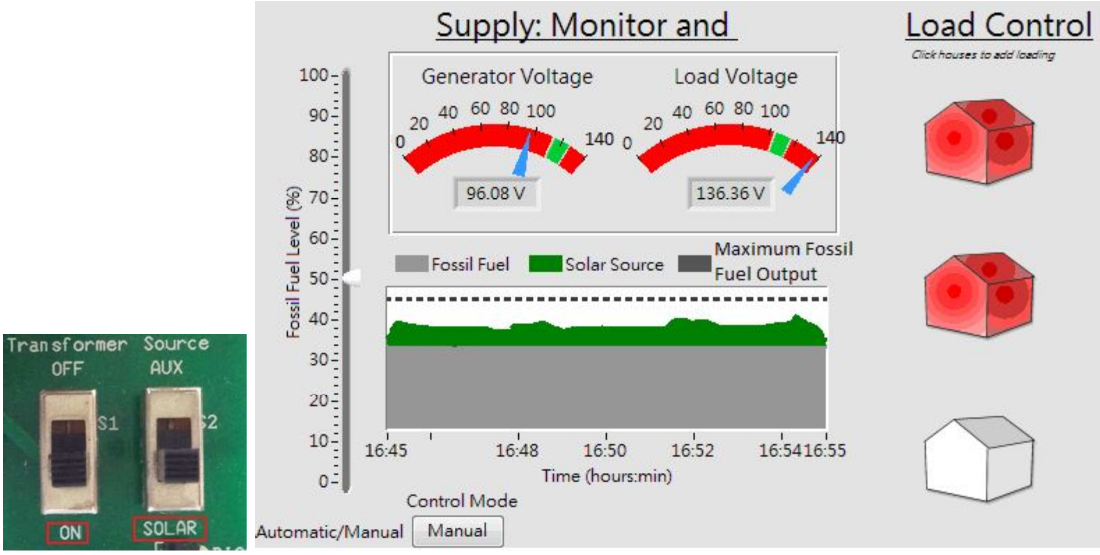
(a) (b)

FIGURE 13. (a) The change over condition, (b) the system simulation

gathering statistics under different situations such as if using power transformer and if merging fuel power and solar power. Such a software design can help to deploy fossil energy and green energy in a power supply and transmission system which is the often mentioned distributed power system.

From the results of simulations, when fossil fuel power and solar power are both used in same power demand system, the consumption of fossil fuel power can be effectively decreased; during the power transmission with power transformer assistance, due to the power $P = VI$ and loss power $P_L = I^2R$, increasing voltage on the generation power side can decrease the power transmission loss. Therefore, the power transformer on the generation side is reasonable and required for power transmission system. Moreover, the power transformer can also help to provide enough power for system load.

The developed technique of power monitoring and deployment control can help to monitor the power distributed transmission system which contains green energy and fossil



(a) (b)

FIGURE 14. (a) The change over condition, (b) the system simulation

fuel energy. By merging green energy into our life use, not only decrease fossil fuel energy usage but help avoid green house effect in earth. Such a technique can meet the demand for distributed power deployment control and is widely used in current power systems.

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