EXPERIMENTAL PHOTOVOLTAIC SYSTEM

HRUSKA, F[rantisek]

Abstract: Laboratory experiment model marked as DE10 of system LABI is dealt with photovoltaic system. A reason is a reaction to great increasing of applications of photovoltaic technology at present time. The model will be used to university studying and as a pilot system for all extern experts. New technical means are used for measurement and control for system. There are used equipments for measurement of special parameters (global energy flow, wind direction and force, position of panel to sun) and control of position according to run of sun. In the future period new photovoltaic panels can be added into model. The user can study power of sun energy, efficiency of photovoltaic principles, dependence of position on power during day. The photovoltaic model is accessed of remote places too. Study and access are able to connection via the Internet or PDA communication.

Key words: sun energy, automation, photovoltaic system, measurement

1. INTRODUCTION

The experiment laboratory system LABI [1, 2] is extended of a new real system - photovoltaic laboratory experiment system of DE10 (Hruska, 2007, 2008). These days there are installed o lot of photovoltaic devices to product of electrical energy. The experimental model DE10 is a small photovoltaic system of area about 0,5 m^2.

The new results are in three aspects. The system is equipped a specific measurement and control subsystem. Very interested part of DE10 is a track subsystem for studying the function of rotation. The remote access is realized in the way of Internet thru PC or PDA technique.

We will plan to do as next a extension of a new kind of PV panels and a intensification of using of DE10 as a pilot plant.

2. DESCRIPTION OF DE10

The main functions of the DE10 are the control of position of photovoltaic (PV) panel according to position of sun in the day and studying of efficiency of energy production.

The scheme of the system is in fig.1. The one has three parts: solar PV cells as the PV panel, mechanical construction and measurement and control system.

At the present time there is used the PV panel with monocrystal technology and materials. The area is 1x0,45 m and the power 60 W. In the next time there is going to extend the panel area by a panel with concentrated PV cells. Then model DE10 will serve for study two kind of PV cells.

The mechanical construction is based on tracker system. It is a two axis´s rotation system. The azimuth position is from 0 to +/- 90°. The elevation position is in the range from 0 to 90°. The tracker system is set on two mechanical gearboxes for azimuth and elevation with ratio 1:80. The motors are for both axis and used step motors. The view of all mechanical system is in fig.2.

The measurement and control system is a main part of DE10. The one is used to give a measured date, to control of position in difference modes and to connect into network of Internet.
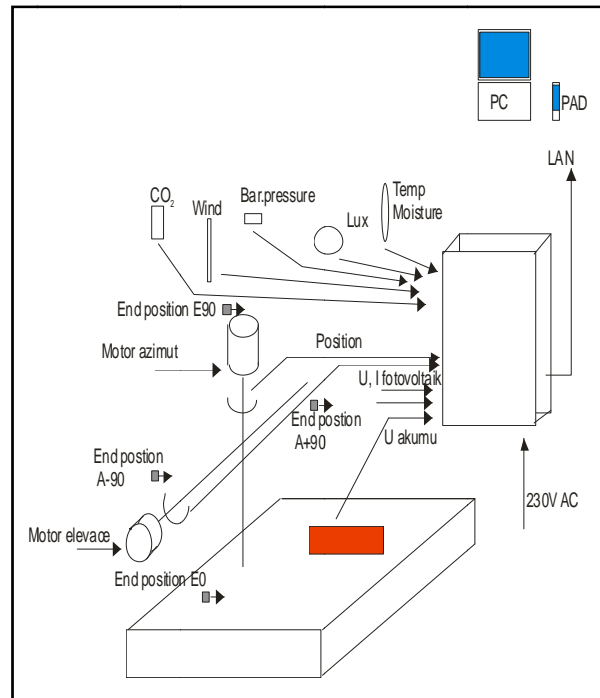

Fig. 1. Scheme of the system DE10

Fig. 2. Photo of the track system of DE10

The measured date is:
- Global energy flow from sun radiation for the panel position.
- Direction and force of wind.
- Temperature and moisture of ambient area (range -40 to +50°C and 0 to 100%).

- Azimuth and elevation position (range 0 to 360° and 0 to 50 km/h).
- End position of azimuth and elevation (range 0 to +/- 90°and 0 to 90°)
- Output voltage of panel and of input battery (0 to 25 V).
- Current from the PV panel (0 to 3A).

In the future we plan to enlarge measurement of concentration of CO_2 in ambient area and atmospherical pressure.

The computer centre of system is DataLab. It is a IPC type of industry compatible personal computer. The decision about the using of IPC was done according to new trends automation technique. The structure of central part of system has two parts: central IPC and I/O´s part for inputs from measuring loops and outputs to action units.
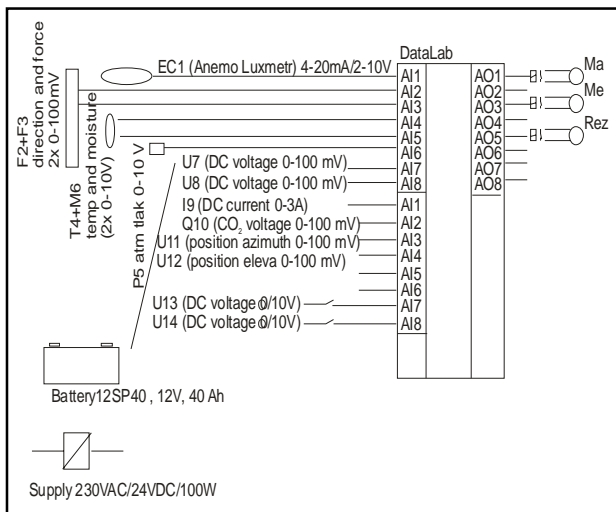

Fig. 3. Scheme of DataLab system in DE10

Position solar system realizes the basic parameters of DE10. It is a two axis tracker system to change of position of PV panel in azimuth ratio and in the elevation. Control of position is done according to radiation of sun (extreme control into maximum of radiation and calculation of the position) or control of position for given position (according to azimuth 0-+/-90°and elevation 0-+/- 90°). Maximal rotary moment is to 20 Nm.

Power output of electrical energy is saved into accumulator. There is used a special battery for solar system with a special controller. The capacity is 55 Ah.

Software of system DE10 is developed with a SCADA system, it is a Control WEB (CW) software. The CW system helps to write the programs for remote measurement, acquisition, control, visualization, archiving and connecting on the Internet.

3. USING OF THE DE10 SYSTEM

The system DE10 offers the user to study of photovoltaic principle, to test of efficiency of production of electrical energy, to learn the track system according to theoretical side and to practical realization.The all offer is accessed via the Internet.

Combination of hardware and software give the possibility of remote using. The web side www.labi.fai.utb.cz is prepared to access of user.

The first step gives generally information about the system, see fig.4. The user sees the view the automatical regime. It is, the system works automatically according to algorithm of external control.

In the screen the user shows measured date of PV system in the currently time. The one can see two graphs of measured

date. There are the time graphs of all value. The date of the automatical function are seved in the system too. The user can download its in his computer and post evaluate in the Excel. The file in format *.cvs is transformed in Excel, date can be calculated in tables, in graphs, according to statistic parameters etc. The results will use in education, in advertising by pilot using.
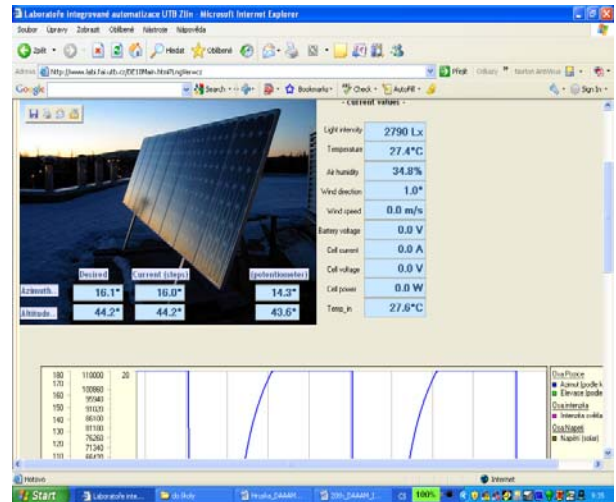

Fig. 4. The first side of www.labi.fai.utb.cz

The second form of using is seting of selectable position. The user can set the azimuth and elevation of position and get the information of energe power.

4. CONCLUSION

The experimental laboratory system is a result of development and solving the experiment laboratory photovoltaic system. Next the local control system is the possibility to connect into the Internet and to remote access. The realized project has using as a pilot plant. The photovoltaic system is built as a new next model DE10 in the system LABI, it is very suited to education of problems of technical means and automation theory. The system will be used in professional field. These days there are very positive experiences of laboratory exercises with remote access.

The experiment DE10 has solved several special problems. In the first position there is two axis tracker system for set position of photovoltaic panel according the position of sun. A special development was used for measurement of direction and force of wind. The remote access has developed other function and uses connection in PDA clients.

5. ACKNOWLEDGEMENT

6. REFENCES

Hruska, F. (2007). The Internet and the Integrated Automation Laboratory. *JEMNÁ MECHANIKA A OPTIKA,* 2007, č. 2, pp 64-66. ISSN 0447-6441

Hruska, F. (2008). Experimental Model of Photovolataic Systems. *Proceedings of the 12th International Research/Expert Conference "Trends in the Development of Machinery and Associated Technology" TMT 200*8, pp 645-648, ISBN 978-9958-617-41-6. August/2008, Istanbul, Turkey