MEASUREMENT OF SOLAR RADIATION USING SMP3-A PYRANOMETER

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Abstract: Sun is a huge energy source. This energy come as solar radiation that can be transformed in other forms of energy. The solar energy can be used in various fields as electricity or thermal energy. This paper present a possibility to measure the solar radiation using the smart pyranometer SMP3-A.

Keywords: radiation, photovoltaic, pyranometer, solar energy

1.INTRODUCTION

The development and improvement of capture and exploitation technologies of solar radiation remain a hot topic because of the advantages that the solar energy offers.
The good quality information about radiations are very important for all applications in solar energy field. The photovoltaic systems (PV) and the thermal solar concentrators can have different requirements, but exist common reasons for which they need accurate information about solar radiation [1].
To evaluate what type of installation is better for a location, the measurement on site must be independent of technology is used to generate energy.
Radiometry is a branch of metrology that studies both the identifying the radiation streams which is in atmosphere and the aspects about its quantification.
The solar radiation reaching direct from solar disk to the earth surface is called direct solar radiation.
The solar radiation reaching the earth surface in other ways than direct from the solar disk is called spread solar radiation.
All amount of energy transmitted, on all wavelengths, by direct or spread radiation, on the ground, is called total (global) solar radiation [2].
For the photovoltaic panels the most important is the direct solar radiation (fig.1[3]).

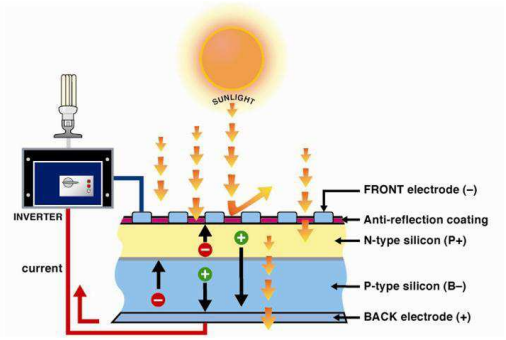

Fig.1. Photovoltaic cells operation

The solar photovoltaic energy is based on direct production of electricity through silicon cells. When the sun is shining and the weather is proper, the provided power is about 1kW/m2. The photovoltaic panels allow the direct conversion in electricity of the 10-15% from this power.

The direct measurement of the solar radiation and its components (direct and spread), is made in two basic mode: using ground instruments as pyranometers or using satellites. Pyranometers – are radiometers designed to measure the total solar radiation obtained on a flat surface from radiant streams with wavelengths between 300 nm and 3000 nm [4] (fig.2).

Fig.2. Pyranometers

2. Measurement system proposed

In modern systems are used digital form of radiation measurement. The radiation sensor used was the smart pyranometer SMP3-A, made by KIPP&ZONEN.

Based on SMP3-A sensor, the value of the solar radiation can be effectively obtained as is show in figure 3.

The information transfer from pyranometer to the digital system is made by an unified communication line (unified signals). Using the unified signal is not necessary to use a specified data acquisition system, but only a system that accept as input an unified signal and display it correspondent in W/m2.

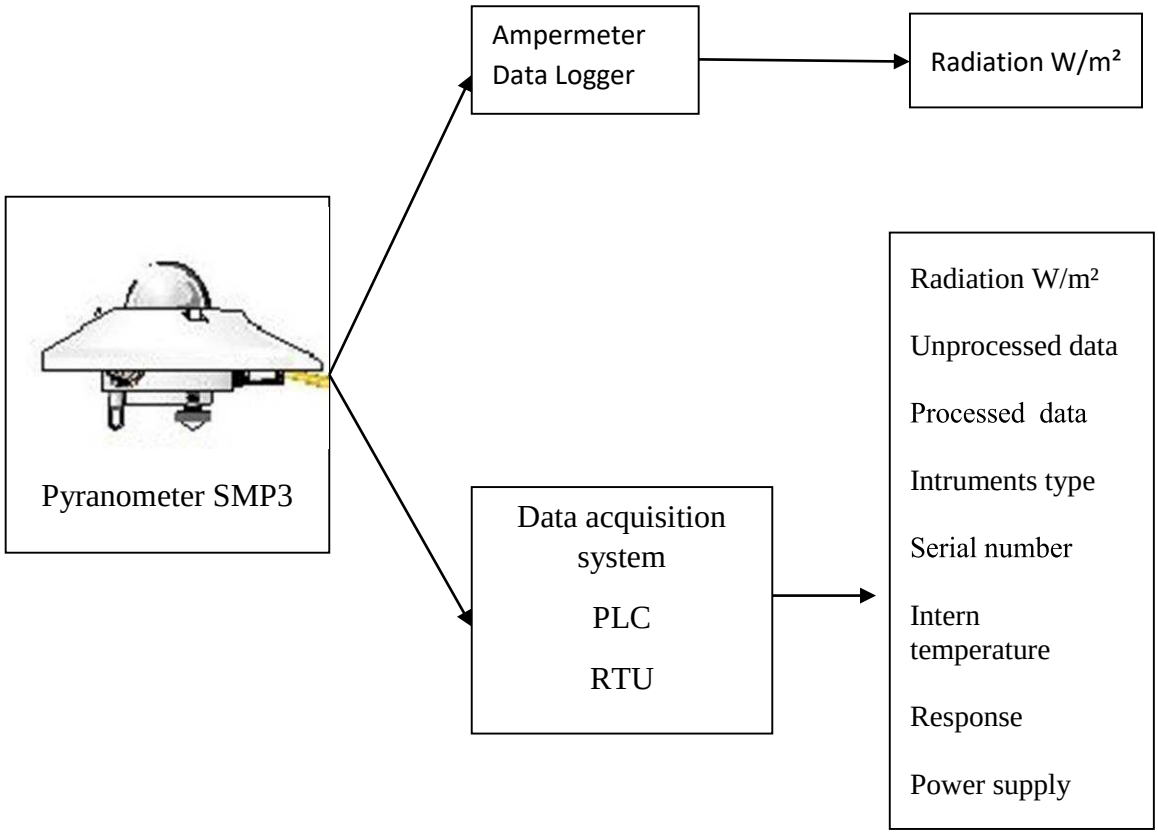

Fig.3. Data acquisition possibilities

The SMP3 pyranometer schematic is presented in figure 4 [5].

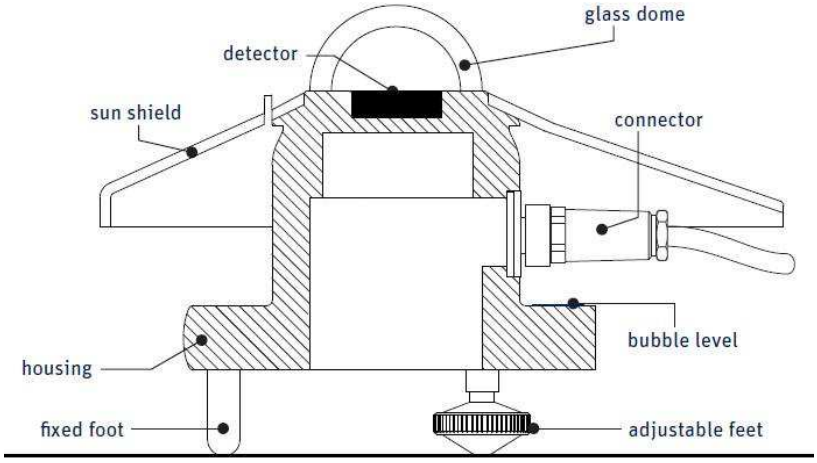

Fig.4 The SMP3 smart pyranometer

Specification	SMP3-A
ISO 9060:1990	Second Class
Response time (63%)	< 1,5 s
Response time (95%)	< 12 s
Zero offsets	
(a) thermic radiation (200 W/m²)	< 15 W/m²
(b) temperature change (5 K/hr)	< 5 W/m²
Nonlinearity (0 on 1000 W/m²)	< 1 %
Directional error (until 80° with 1000 W/m² stream)	< 20 W/m²
The influence of temperature over the sensitivity	< 3 % (-20 °C to +50 °C)
	< 5 % (-40 °C to +70 °C)
Tilt error (on 1000 W/m²)	< 1%
Other specifications	
Analog output	4 to 20 mA
Analog output range	0 to 1600 W/m²
Digital output	RS-485 cu 2 fire
Maximum range of the digital output	-400 la 2000 W/m²
Digital communication protocol	Modbus®
Accuracy of horizontality	1 °
Operation temperature	-40 °C to +80 °C
Protection class (IP)	67

The numeric system used to display and record the measurements was the KD-7 datalogger (fig.5).
The KD7 is a remarkable instrument designed originally as a paperless chart recorder, it has grown to become much more[6].

Fig.5. KD7 datalogger

The application field of this datalogger are various, it include an multi-channel display which can be used in one of the 4 formats: analog display, digital display, bargraph and diagram. It can be used as monitoring display and it can implement alarms for different limits overflow.
The KD7 datalogger can record both digital and analog values, and by the RS-485 and Ethernet interfaces can communicate with other devices or to send the data over the internet. Within software modules it can convert every 4-20 mA or 0-10 V signal in other engineering units and also can implement some mathematical functions[6].
All the connectors have removable screw for an easy install and maintenance. (Fig.6)

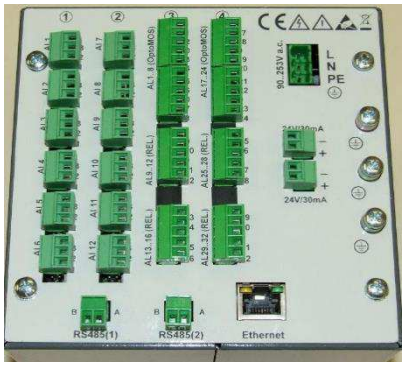

Fig.6. The connection panel of KD7 datalogger

The software application
The KD7 Connect program is destined for the communication between the PC computer and the KD7 recorder by means of the USB interface (fig.7).

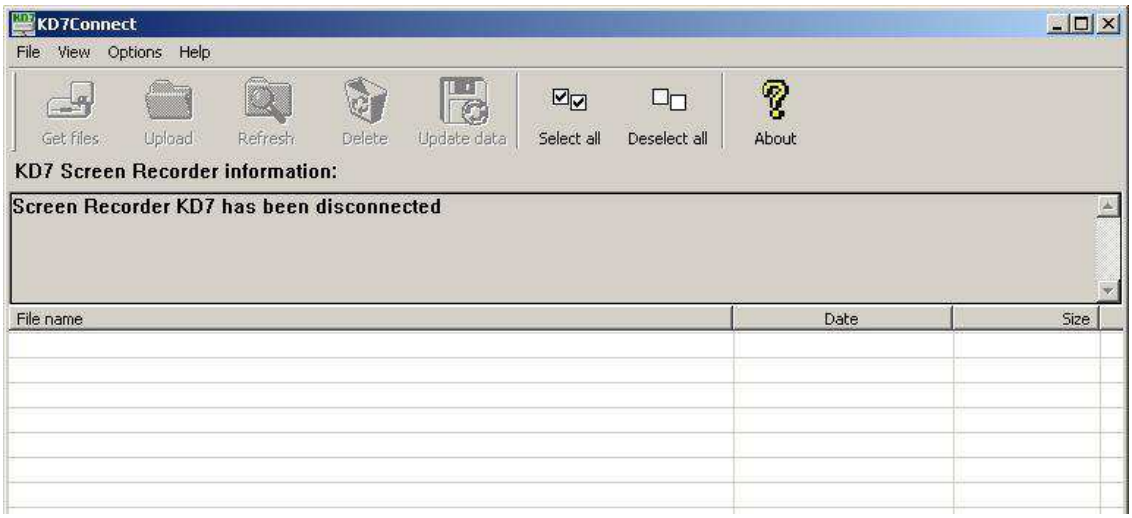

Fig. 7 The main interface of the KD7 Connect

The KD7 Connect program enables to carry out following operations:
• copying of files from the CompactFlash card, directly from the recorder into the PC computer (e.g. data files, screen dumps),
• uploading of files from the PC computer into the CompactFlash card in the recorder (e.g. file with the updated KD7 software)
• deletion of stored files in the recorder CompactFlash,
• sampling of current systemic information of the KD7 recorder (among others, system
version, current configuration, degree of the CompactFlash filling).
The KD7 recorder renders accessible its own WWW server for the remote monitoring of measuring values and the device state.
(Fig.8) .

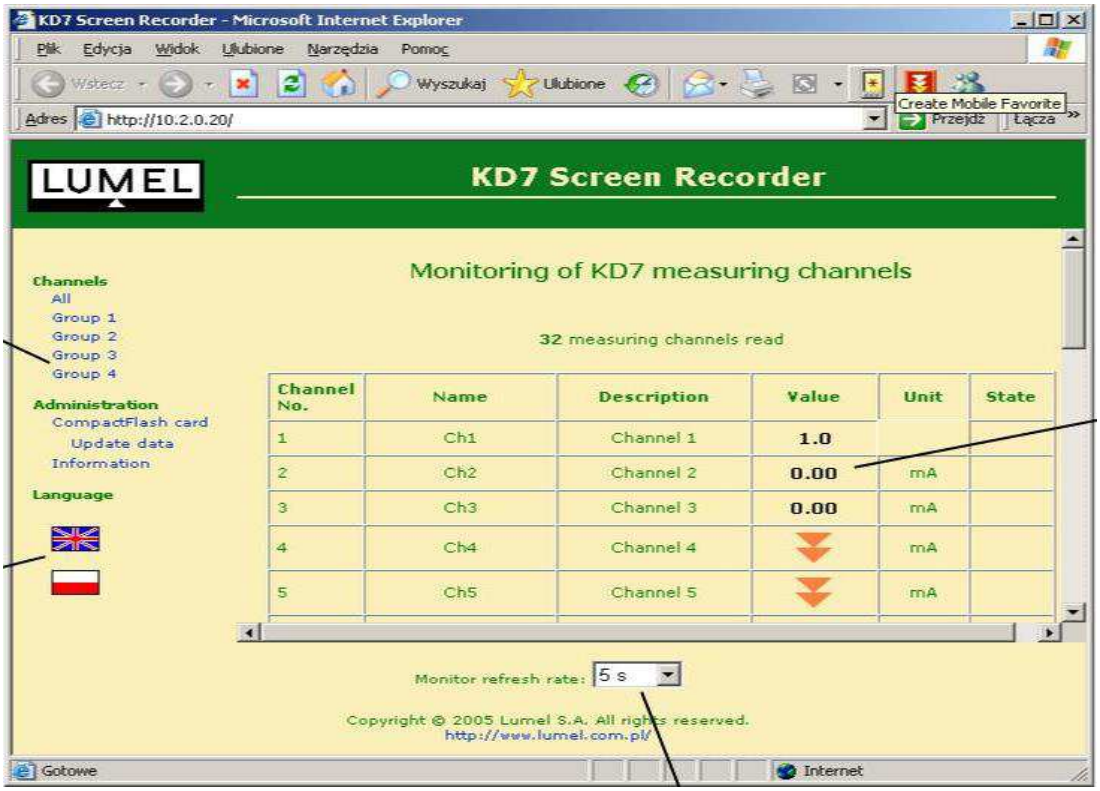

Fig.8 The datalogger WWW page

CONCLUSIONS

Using high quality measurements of the solar radiation it can be made a database which can allow forecasts about energy production in future and the financial profits.

Pyranometers are the best choice for prospecting sites, technological researches and high quality monitoring of the solar radiation in application based on solar energy.

They are mainly used in photovoltaic station based on solar tracking devices.

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