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Real time Data Acquisition of Solar Panel

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Abstract – *We created a real-time acquisition system to track the voltage, current and temperature changes of the solar panel as we installed it in a charging regulator with a battery. The system consists of an Arduino Uno board, the controllership, which is programmed by the Arduino IDE application, based on the C language, and sensors to capture the variables, we put the SD card to save the data and the LCD to see it currently and can be monitoring the data by connecting the Arduino Uno board to the computer and processing it with the Excel application.*

Keywords*: Panel solar, LCD, SD card, ARDUINO UNO, EXEL.*

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I. Introduction

Renewable energy sources include sunshine, wind, geothermal heat, rain, waves, living plants, and animal and plant materials. Since these resources can be replenished naturally, this sort of energy is regarded as renewable[1, 2]. Their primary benefit is that they can lessen the damaging effects of conventional sources like coal, gas, and oil on the environment [3].

Real-time data refers to data that is presented as it is acquired [4]. The idea of real-time data handling is now popular in new technologies such as tracking changes progress and knowing the problems as they occur, and by collecting quantitative data, we were able to improve the quality of processing[5]. In the world of machinery, this allows a technician to intervene quickly when there is a problem, allowing their machinery to function at peak performance [6]. Automated data entry was once carried out by hand.

Data acquisition systems employ automation, which minimizes human error and misplacement [7]. Additionally, storing information gathered digitally is cheaper, takes up less space than physical paper, and can be retrieved almost instantaneously [8]. The data is also entered faster. These things don't happen when humans are manually doing the job [9].

This paper purposes real-time monitoring changes of current, voltage and temperature of the solar panel and the battery by using the Arduino board, which stores the data obtained in the SD Card and piloted it instantaneously in an Excel spreadsheet.

II. Material and method

II.1. Elements of Data Acquisition System

In this section, we will present how to connect the hardware components to the Arduino Uno and the solar panel charging regulator, in addition to the programming code and how to work on it. We will also present how to extract and display the information obtained in real-time using the Excel program.

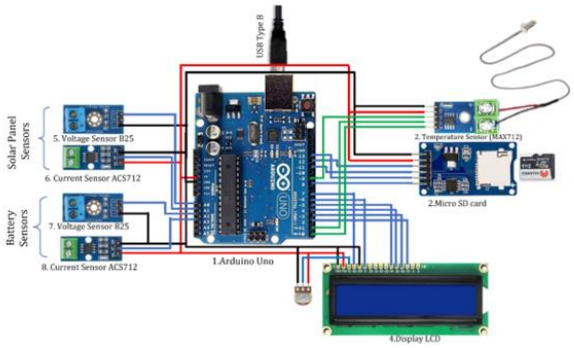


Figure 1. Real-Time Data Acquisition of Solar Panel System

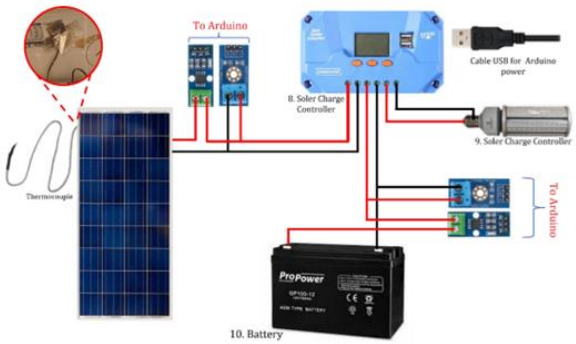


Figure 2. Schematic view of the hardware components connected to the Panel Controller

II.2. Solar Panel

A solar panel is defined as a device that converts solar radiation into electrical energy through a photovoltaic effect [10]. These cells are arranged in a grid-like pattern on the surface of solar panels**.**

Figure 3. Solar PV

II.3. Arduino Board

Arduino is an electric board with open-source hardware and software, which can be programmed by a software called Arduino IDE (Integrated Development Environment) based on C++ a programming language, which is used to write and upload the computer code to the physical board[11].

II.4. Sensors

a) **Current Sensor ACS712:** Hall Effect, when current passing creates a magnetic field which is converting it to a voltage signal[12].

b) **Voltage Sensor B25:** The division of voltage, contains two resistance 30KΩ and 7.5kΩ. which divides voltage input 5 times 1/5[12].

c) **Thermocouple Max6675:** The Seebeck effect describes the voltage or electromotive force induced by the temperature difference along the wire[13].

II.5. Solar Charge Controller

a) **voltage regulator DC/DC PWM:** convert a direct current source from one voltage level input to another Voltage level output.

b) **Battery:** The battery must be available in the installation of the solar energy system in order to regulate the load alimentation and ensure its continuity in the presence and absence of the sun or the supply of the solar panel. We used the ProPower battery 12V100Ah model.

c) **Load (Lamp):** A lamp load/load lamp is simply a standard light bulb connected in series with the equipment being evaluated. It can be used to control the load's power.

II.6. View and extract data from the system

Data can be extracted and displayed in three different ways, which we will present as follows:

a) **LCD display:** LCD displays are taking the Data from the Arduino board in real-time, and display it in that order: The Panel voltage and current in the first line and the temperature and battery current to know if it was charging or discharging in the second line.

Figure 4. LCD DISPLAY

b) **Excel program:** We can also get the data in real-time by connecting the Arduino to the computer via a USB cable and defining it in the Excel 2021 program as shown below:

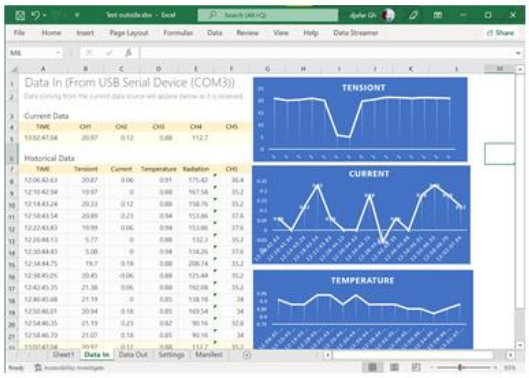


Figure 5. Data in Excel

c) **SD card:** The Data is stored in the Micro SD card in that order: panel voltage, Panel current, Battery voltage, battery current, temperature, into a file in the form ".txt", Must be placed comma between the parameter or escape to be able excel application Differentiate between them, set a dividing line" ###" whenever restart the Arduino board.

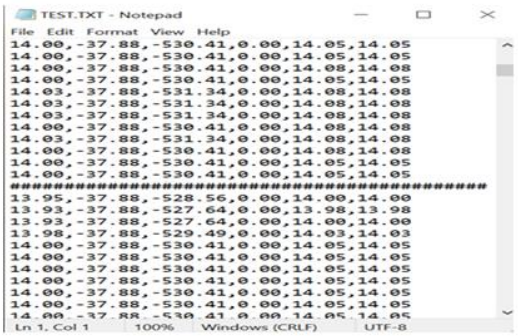


Figure 6. Text Data file.

We explained how to install the hardware components of the system and program the Arduino board, in addition to how to extract and display the data obtained.

II.7. Experimental data

We did this experiment in the Institute of Applied Sciences and Techniques -Ouargla on Wednesday 01/06/2022.

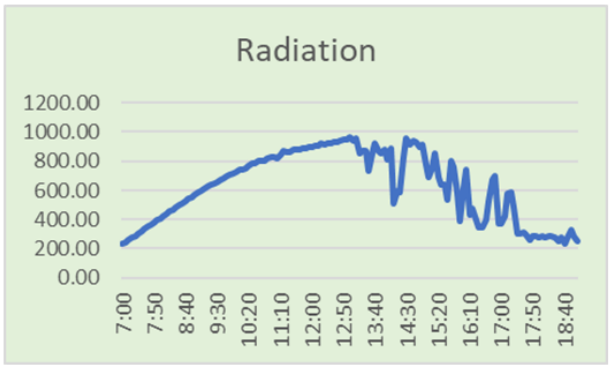
Figure 7. Test bench

Through this cheap cost project, we designed a system to monitor the data of the solar system (solar panel + battery), we took into account the characteristics of the solar panel and the characteristics of the UNO Arduino board. We have provided the Arduino Uno board with the following: a MAX6675 temperature sensor, two B25 voltage sensors, two ACS712 current sensors, a micro-SD card adapter, and an LCD screen.

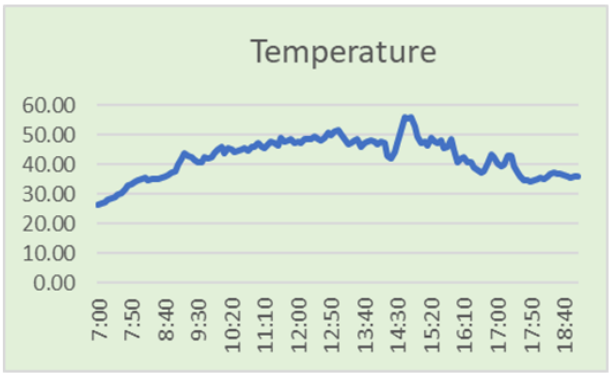
III. Results and discussion

We will present the results of tests performed by a real-time solar panel data monitoring system, as previously described. The various results obtained and their scientific interpretation is presented in the following. We note that the temperature and radiation are the same as the curve at the beginning of the day was 26° at 7:00 AM, corresponding to 232w/m², the temperature reached a maximum value of 14:48 57°, and the light intensity also reached 963W/m² at 13:00 s shown in Figures 8a and 8b.

Weather fluctuations affect the results of the stability of temperature radiation at 13:00 and it affects the power of the solar panel.



(a)



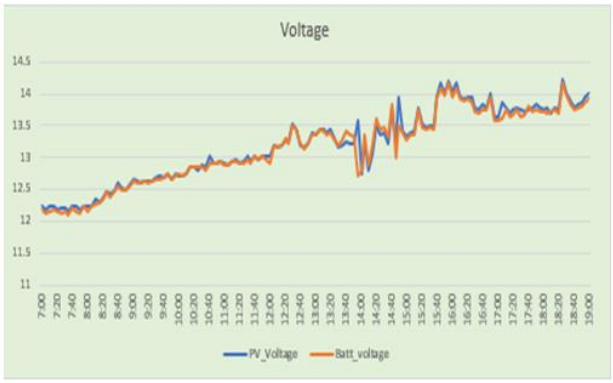
(b)

Figure 8. Results for (a) radiation profile, and (b) temperature profile

In the voltage curve Figure 9a, we notice that the battery is increasing from 12v to 13.8v because the battery is charging, while the Soler Charge Controller sets the battery the appropriate voltage for charging.

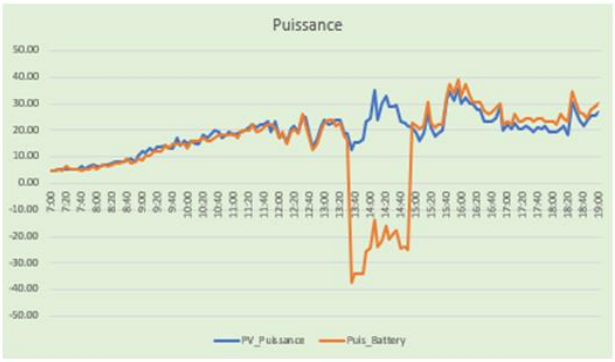
For figures 9b and 9c, We notice that the PV current increases from 0.37A at 7:00 to 1.6A at 12:00, with increasing the load lamp, then it becomes almost stable. We turned on the 48W lamp from 13:40 to 14:55. We notice that the current of the battery has become negative -2.74A because it is discharging, and there is also an increase in the PV current to 1.18A.

We notice that the PV Power is the same curve as the current. It was 5W at 07:00 then becomes stable at 30W from 12:00 to 19:00.



(a)

(b)



(c)

Figure 9. Results for panel and battery (a)Voltage Curve, (b) Current Curve and (c) Puissance Curve

IV. Conclusion

Through this installation, we aim to measure (the temperature of the solar panel, the voltage of the solar panel, the battery voltage, the current strength of the solar panel, and the strength of the battery current) and present it on the LCD screen and the Excel program. In order to monitor the performance of the solar panel, the results we get are excellent, the system works well and it is scalable.

In the modern world, collecting data has become necessary to Improve the Efficiency and Reliability of Machinery and Processes, the data acquisition devices, used in laboratories and companies to evaluate and monitor parameters. The information gathered by data acquisition devices can then be used to make sure that machinery operates safely, specific processes are performed efficiently, and there are reliable outcomes. Where is possible to take measurements and display the information in real-time.

Declaration

- The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

- The authors declare that this article has not been published before and is not in the process of being published in any other journal.
- The authors confirmed that the paper was free of plagiarism.

References

[1] S. Motahhir, A. Chalh, A. El Ghzizal, A.J.J.o.C.p. Derouich, "Development of a low-cost PV system using an improved INC algorithm and a PV panel Proteus model, ", Journal of Cleaner Production, Vol.204, pp. 355-365, 2018. DOI: 10.48084/etasr.1675

[2] T. Singh, R.J.I.J.o.C.S. Thakur, Engineering, "Design and development of PV solar panel data logger, ", International Journal of Computer Sciences and Engineering , Vol. 7 ,2019. https://doi.org/10.26438/ijcse/v7i4.364369

[3] C. Chen, Y. Hu, M. Karuppiah, P.M.J.S.E.T. Kumar, Assessments, "Artificial intelligence on economic evaluation of energy efficiency and renewable energy technologies, " , Sustainable Energy Technologies and Assessments, Vol. 47, pp. 101358,2021. https://doi.org/10.1016/j.seta.2021.101358

[4] S. Lee, S.J. Nam, J.-K.J.J.o.m.s. Lee, technology, "Real-time data acquisition system and HMI for MES, " Journal of Mechanical Science and Technology, Vol. 26, No.8, pp. 2381-2388, 2012. https://doi.org/10.1007/s12206-012-0615-0

[5] H. Hamdani, A.B. Pulungan, D.E. Myori, F. Elmubdi, T.J.J.o.A.E. Hasannuddin, T. Science, "Real Time Monitoring System on Solar Panel Orientation Control Using Visual Basic, " Journal of Applied Engineering and Technological Science , Vol. 2,No.2 ,pp112-124,2021. https://doi.org/10.37385/jaets.v2i2.249

[6] N.S. Reddy, C. Gowthami, E. Mounika, S. Harshad, R.P.J.I.J.o.R.A.i.M.T. Kumar, "Real-Time Data Acquisition to Excel and Monitoring Characteristics of Solar Panel Using Arduino, " International Journal of Recent Advances in Multidisciplinary Topics, Vol.3,No.5, pp.15-20,2022.

[7] D. Girardeau-Montaut, M. Roux, R. Marc, G.J.I.A.o.P. Thibault, "Change detection on points cloud data acquired with a ground laser scanner, " Remote Sensing, S.I. Sciences, Vol.36, No.3, W19.2005.

[8] V. Gupta, M. Sharma, R. Pachauri, K.D.J.E.S. Babu, "Performance Analysis of Solar PV system using Customize wireless data acquisition system and novel cleaning technique, " Energy sources, Vol.44, No.2, pp.2748-2769, 2022. https://doi.org/10.1080/15567036.2022.2061091

[9] V. Voicu, D. Petreus, R. Etz, " Data Acquisition system for Solar panels, " , 2019 42nd International Spring Seminar on Electronics Technology (ISSE), IEEE, pp. 1-6, 2019.

[10] M.F. Rabbe, M.S. Bepari, " Residential Electricity Consumption and Load Pattern Analysis, Doctorat theses 2021. http://dspace.daffodilvarsity.edu.bd:8080/handle/123456789/8122

[11] M. Papoutsidakis, A. Chatzopoulos, C. Drosos, K.J.I.J.C.A. Kalovrektis, "An Arduino family controller and its interactions via an intelligent interface, " International Journal of Computer Applications, Vol.179, No.30, pp.5-8,2018. DOI: 10.5120/ijca2018916684

[12] A. El Hammoumi, S. Motahhir, A. Chalh, A. El Ghzizal, A.J.R.w. Derouich, water, solar, "Low-cost virtual instrumentation of PV panel characteristics using Excel and Arduino in comparison with traditional instrumentation, " Renewables: Wind, Water, and Solar, Vol.5, No.1, pp. 1-16, 2018. https://doi.org/10.1186/s40807-018-0049-0

[13] S.P. Nalavade, A.D. Patange, C.L. Prabhune, S.S. Mulik, M.S. Shewale, "Development of 12 Channel Temperature Acquisition System for Heat Exchanger Using MAX6675 and Arduino Interface, "Innovative Design, Analysis and Development Practices in Aerospace and Automotive Engineering (I-DAD 2018), Springer, pp. 119-125, 2019.