REMOTE IRRIGATION CONTROLLER UNDER PHOTOVOLTAIC ENERGY

M. L. BENZAOUI*, F. YOUCEF ETTOUMI, A. ADANE
University of Science and Technology Houari. BOUMEDIENE (USTHB)
Faculty of Electronic & Computing
BP 32, El-Alia, Bab-Ezzouar 16111, Algiers, Algeria

Fax : 213 21 21 82 14
*Email : benzaoui_m_l@yahoo.com

***Abstract*- Water is an important thing in the earth, so we must use it economically, especially in the irrigation of fields in the dry areas and in summer days. So that we present in this paper, a conception of a device which permits us to control automatically the uses of water in irrigation. This is by microcontroller. We applied this device in the Sahara of Algeria (oasis).**

And to get autonomy of the system, we have preferred to use the Photovoltaic systems as an electrical supply of the installation and a power for water pumping.

The greet problem in irrigation is to specify water needs for each plant, which depends of temperature, land humidity, air humidity, wind and the nature of the plant.

In first we have used in the controller device many sensors to get the in formations about these parameters which are used as inputs of the test conditions to irrigate.

And next an electronic device based on the microcontroller 16F877 was realised in order to get an automatic control and commands.

Finely we have tested this device to irrigate tomato, between June and July, and results were good.

Key Words: Irrigation, water pumping, Photovoltaic, microcontroller.

I. INTRODUCTION

In rural and remote area, to overcome the lack of water, the photovoltaic (PV) water pumping represents one of the best solutions. This is because solar radiation is generally high in arid zone location where the water is most needed [1].

Also, uses of water are a big problem in these days. The great consumption is in the Industrial uses and the irrigation. So we must find methods to reduce its exploitation.

In general when we irrigate plants we try to see the sol if it's dry, humid and if the climate is hot. We usually irrigate using a greet quantity of water and without taking in consideration if the plants needs really water.

In this paper we propose to use a remote device to controller the water pumping and irrigation with photovoltaic supply.

II. IRRIGATION METHODS

There are many methods used in irrigation, as example we can find [1], [2]:

- Irrigation of surface.
- Underground irrigation.
- Irrigation under pivot.
- Irrigation by sprinkling.
- Irrigation drop by drop.

In our work we have chosen the irrigation drop by drop, because it's economic and easy.

For that we need some information of the local climate (microclimate), the plant type and the soil nature [3],[4]. We stocked water in a reservoir by using an electro-valve and pump on the water supply.

An electronic devise based on the microcontroller 16F877 is used with some sensors to survey the water level at the reservoir and activate irrigation (figure1).

And to get autonomy of the system, we used a photovoltaic generator as a power supply.

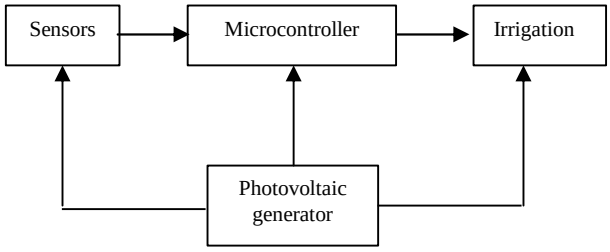

Figure 1: Irrigation System.

III. SENSORS

Information about the microclimate such as the temperature, Soil Humidity, air Humidity are important to get the best way of water uses, also we must know the water level in the reservoir. We have used for this [5]:

A. Temperature

To get the air temperature and the soil one, we have used two CTN resistors as sensors. These measures are compared with a reference temperatures Tref fixed by the user (figure 2). The comparator is a low power dual operational amplifier (LM358). The outputs are connected to the controller

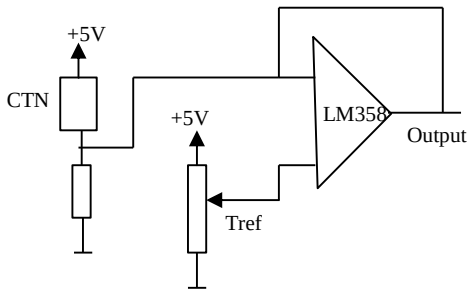

Figure 2: Temperature measurement

B. Humidity

In order to use water when it's necessary (for example the soil is dry), we have to know the humidity of the air and the humidity of the soil, so we have used tow sensors (232269190001 of Philips), which are considered as a variable capacitor depended of the humidity.

So we placed these sensors in a Timer (NE555), to generate a cycle of time depended on humidity (figure 3). We use the microcontroller to activate the Timer and calculate the humidity by the measure of $\tau=f(C_H)$.

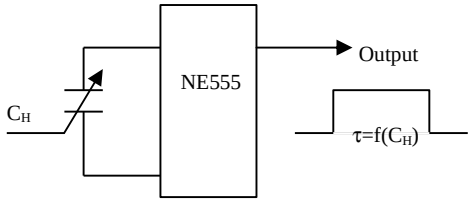

Figure 3: Humidity measurement

C. Water level

When we use the water from the reservoir we can fill or empty it, so we must know the level of the water in the reservoir. For this we have used 4 opto-transistors with 4 LED. In order to measure the 4 water levels.

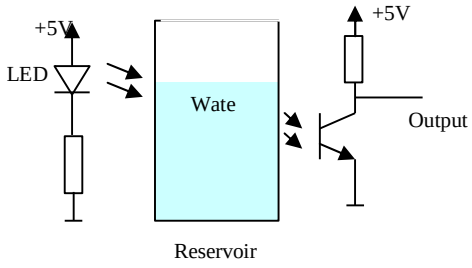

Figure 4: Water level measurement

D. Microcontroller

All these measures are used as inputs of a microcontroller, to get the right time for the irrigation and fill the reservoir. This microcontroller is the PIC 16F877 of MICROCHIP [6]. It has the advantage that it's easy to use and cheaper and sufficient to our application.

IV IRRIGATION

For irrigation we have to use a pump (P1) and a solenoid-valve (EV1) activated by the microcontroller to fill the reservoir. A second one (EV2) used to evacuate water from the reservoir (irrigation) and an other pump (P2) used in irrigation when the reservoir is empty.

We added a state where the reservoir is nearly empty in order to reduce the quantity of water used in irrigation to get more time when the water is enough.

So we have used 4 water levels:

- Full 100%: turn Off EV1 and pump1 and turn On EV2, the irrigation is normal.
- Half empty (50%): turn On P1, EV1 and we have to turn On EV2 in an economical irrigation.
- Nearly empty (20%): turn On P2, EV1 and EV2 used in the necessitate irrigation.
- Empty (0%): turn Off the pump P2 and EV2, turn On EV1 we can not irrigate.

The pumps used are a PP/MH-809-12V (5.5 gal/mn). And the solenoid-valve are EV1L280 [7].

All the irrigation installation is presented in figure 6.

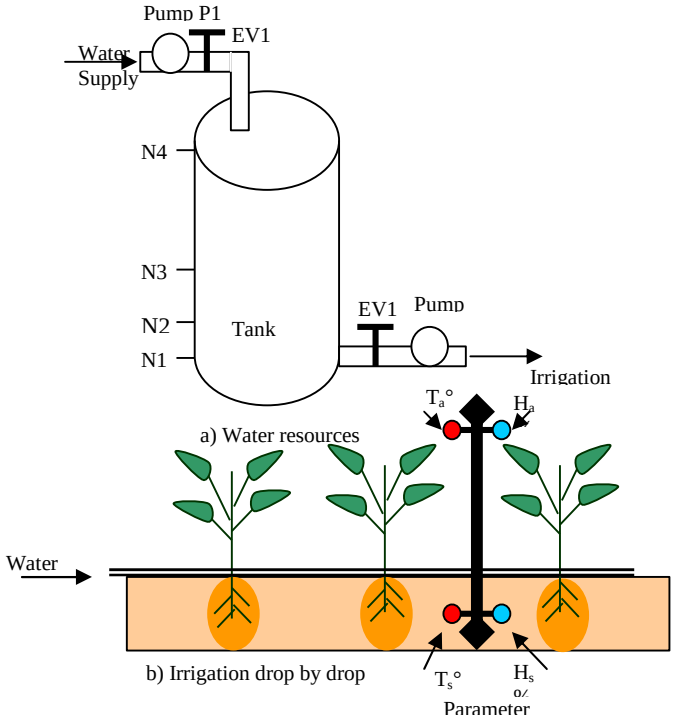

Figure 6: Irrigation system.

V PHOTOVOLTAIC SYSTEM

All the components of our system are chosen to be used under 12V DC, this is in order to use battery and a Photovoltaic (PV) installation.

The photovoltaic generator used is a 12V/50W (PWX500-50 of PHOTOWATT), and the battery is 12V/65AH (VARTA SOLAR) [8].

So the power supply is as in figure 7.

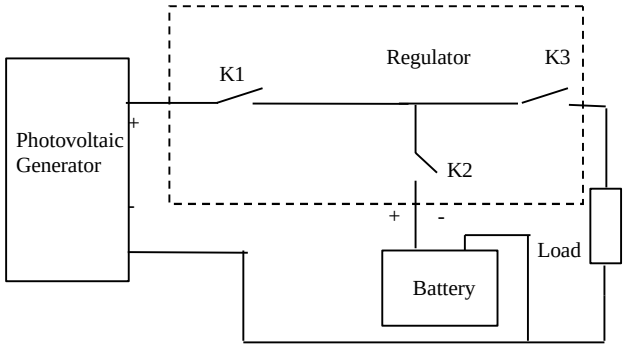

Figure 7: the photovoltaic power supply systeme.

A REGULATOR

In this installation Fig 2, the major problem is in the uses of battery, because it can be damaged easily by the charging currant, the cycle of charge's number, and if we charge it up to its limit (charge exceed) or to discharge it under its limit (profound discharge). These thresholds are fixed by the battery characteristics [1]. To resolve these problems, we use a regulator which can be considered as controlled switches K1, K2 and K3 [9]. These have to keep the battery by disconnecting it from the photovoltaic generator if the battery potential is up to its limit, or to disconnect battery from uses if its potential is under its limit [1],[9] and to prolong the battery charge and discharge state and eliminate the quick commutations of switches [9].

Finely we have tested this installation to irrigate tomato, in summer (between June and July), at *Djamaa* a town in the Sahara of Algeria, where there is luck of water, the weather is very hot and dry. We have not used the green houses in order to get the real climate.

The results were good and the plants of tomato has resisted to the climate.

VI CONCLUSION

The aim problem at the Sahara and the Arab countries is water resource, so we have to use it economically especially in the industry and in irrigation. We always, use pump in these regions, which need power supply, so photovoltaic become one of the best solutions to electrify arid areas. We can say that our application is very important to generate it to conserve our reserve of water.

References

[1] Med. L. BENZAOUI, F. YOUCEF ETTOUMI and A. ADANE, "Modelling of Photovoltaic Regulator with MPPT". Proceedings of the International Conference on Modeling and Simulation (MS'07 Algeria) July 2 - 4, 2007, Algiers, Algeria

[2] CEMAGREF, Guide pratique d'irrigation, Dunod 1992

[3] Zairi A., Mailhol J. C., Nasr Z., Slatni A., & Ruelle P. 1999. Surface irrigation strategies and their impacts on yield and water consumption - The Tunisian case. 50th International Executive Council Meeting, 17th International Congress of ICID. Q 48/1.31, September 11-19, 1999, Granada, Spain. pp. 42-50

[4] I. Broner, Drip Irrigation for Home Gardens Gardening series no. 4.702.

[5] G. ASCH Les capteurs d'instrumentation industrielle. Dunod 1989

[6] C. Travenier Application industrielles des PIC. Edition Dunod 2000

[7] International Product Catalogue, A Siebe Group Company.

[8] Natural Resources Canada, Photovoltaic Systems: A Buyer's Guide, catalogue N° : M92-28/2001F ISBN : 0-662-86306-2.

[9] Med. L. BENZAOUI, F. YOUCEF ETTOUMI and A. ADANE, "Simulation of water pumping using photovoltaic energy". Proceedings of the International Conference on Electrical Engineering Design and Technologies ICEEDT'08 HAMMAMET, TUNISIA November 8-10, 2008

.