PC-BASED AUTOMATED DRIP IRRIGATION SYSTEM

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Abstract:
In this work, we propose a contribution to the development of greenhouse production in Morocco. The proposed solution involves the development of an integrated system for automate the drip fertilizing irrigation in greenhouse. The solution adopted involves a data acquisition card PCL-812PG controlled by PC. The irrigation is provided by a hydraulic circuit based on an electric pump. Water needs are evaluated by measuring soil water status by soil humidity sensor. A graphical interface was developed using LabVIEW to manage and monitor irrigation and fertigation. Full system was implemented in Laboratory of Electronics, Automation and Biotechnology of the Faculty of Sciences Meknes in Morocco.

Keywords: Drip irrigation management; data-acquisition card; Greenhouse.

1. Introduction
The agriculture sector is developing rapidly albeit under severe climatic conditions. Rapid development and uses of modern information technology, agriculture in Morocco has been facing profound changes for the last few years [Choukr-Allah (2000)]. The use of computers can greatly facilitate further development of the sector. Irrigation management is a tool whereby timely application of water can improve irrigation efficiencies and ultimately yields ([Baille (1997)] and [Gonzalez (1992)]). In rural medium, the irrational use of fertilizers constitutes major sources of soft pollution waters. The global irrigation scenario, however, is characterized by poor performance, increased demand for higher agricultural productivity, decreased availability of water for agriculture, increasing soil salinity and possible effects of global warming and climate change. A major challenge is to sustain or increase the yield of irrigated agriculture while reducing water consumption [Kshitij Shinghal et. al. (2010)]. A number of technologies have been developed to apply water more uniformly without excessive waste [Elattir (2005)], [Luthra (1997)] and [Serageldin (1995)]. The decision to irrigate should be based upon an estimate of crop and soil water status, coupled with some soil moisture and economic return.

The irrigation management holds account the requirements out of water for the crops. We developed at the time of a national research program a computer system for control and supervision of the drip irrigation [Eddahhak (2007)]. The system consisted of soil moisture sensor, a hardware input/output interface, a data acquisition card PCL 812-PG [Advantech (1994)] and [Ash (1999)], a computer with a software interface, and actuators. This seems fit for materials and methods. We have Avoid such words integrated an electronic soil moisture controller with hardware, so ftware and hydraulics. We have developed two graphical user interfaces using the software LabVIEW (Laboratory Virtual Instrument Engineering Workbench) [Cottef (2001)]: the first for the irrigation station monitoring and the second for the drip irrigation and fertigation managing. There is a calendar that allows irrigation to provide water at critical times.

2. Materials and methods
2.1. Drip irrigation station
The pumping station is used to pump water from a well into a reservoir (figure 1). The pump is selected according to the requirements in litters per minute and the pressure required to pipes. The operation of the pump is dependent on the water level in the reservoir. The overpressure will ensure adequate pressure for the distribution of water in the pipes. The soil moisture detector allows controlling soil water status. The manometer measures the water pressure in the irrigation system. The drip irrigation system is installed at the Faculty of Sciences Meknes in Morocco.
2.2. **PC automation system**

The data acquisition and supervision of the drip irrigation system is controlled by a micro-PC (Figure 2).

The electronic interface cards (card conditioners, protection and signalling card, power card) will be connected to a PC via a data acquisition card PCL812-PG.

2.3. **Soil moisture detector**

Soil moisture can be detected by an electronic circuit based on a capacitive probe. The circuit conditioner consists of an oscillator followed by a converter frequency-voltage (Figure 3). It is enough to measure the output voltage (V\text{out}) of the circuit conditioner to estimate the amount of watering. Depending on the ground hydrous state, an solenoid valve of the water circuit opens when the V\text{out} exceeds 3.6 V (dry soil) and is closed when V\text{out} reaches 1.8 V (humid soil) [Rahali, A. et al.(2011)].
3. **Supervision of the drip irrigation station**

We have developed a graphical user interface (GUI) for monitoring the drip irrigation station (Figure 4). The user can view the water levels in well and reservoir. The low level of the well is detected by a level sensor type float. Once the low level of the well is attained the pump should stop. The pump provides the filling of the tank and stops when the level reaches a maximum value. When the pressure in the reservoir decreases to a minimum, the pump starts and the cycle begins again. The order of irrigation is controlled by the solenoid valve. The operator can enable or disable the registration status of various equipments in time.

4. **Management of the irrigation and fertigation**

We have developed a second graphical user interface for the drip irrigation and fertigation management (Figure 5). This interface meets at a time dependability, flexibility and interactivity. The user can view, in real time [Testezlaif (1997)], the status of ground water through detector soil moisture. The operator can also set the duration and frequency of the irrigation and fertigation. The developed interface allows to uniform inject water and fertilizer. The below guidelines have been prepared as a guide for irrigation and fertigation:

- Irrigate at the right time, when the plant needs water and the soil water is Insufficient
- Watering in the morning and avoid watering in late afternoon. The risk of developing disease comes when the amount of foliage plants remain wet overnight
- Irrigate in quantity just sufficient to avoid that excess water which is normally lost in depth resulting in the development of certain undesirable residues
- After fertigation, you must clean the pipes of the irrigation system.
5. Results and discussion

The daily water requirements were estimated to climatic conditions. For example, the average density of greenhouse tomato crops is 18000 plants/ha, the water requirements of tomato conduct irrigation drip attain 7000 m³/ha [El Attir (2005)]. The tomato plant is fairly sensitive to both water deficit and excess water. In stages of growth where water needs refer to critical range between flowering, fruit set and fruit enlargement, the developed computer system can allows splitting the daily dose over time. The program developed can adjust the duration of irrigation and fertigation during the day. The quantity of irrigation water has to be adjusted during nemagation (Table 1). Computer based drip Irrigation control can reduce water consumption by 20 to 30%, stabilized production from one year to another and diversify crops. We must also note the strong positive impact of this type of irrigation on the environment.

<table>
<thead>
<tr>
<th>Period</th>
<th>Dose (L/plant/day)</th>
<th>Dose (L/plant/period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>August - September</td>
<td>2</td>
<td>2*60 = 120</td>
</tr>
<tr>
<td>October - November</td>
<td>1.5</td>
<td>1.5*60 = 90</td>
</tr>
<tr>
<td>December - February</td>
<td>0.5</td>
<td>0.5*90 = 45</td>
</tr>
<tr>
<td>March - April</td>
<td>1</td>
<td>1*60 = 60</td>
</tr>
</tbody>
</table>

Vegetable crops do not respond all to the same fertilizer, it is therefore necessary to adapt the fertigation program to every need. Tomatoes respond very strongly to a fertilizer and any excess will reduce the quality of fruit. In case you fertilize with each watering, the nitrogen concentration should be 100 ppm. This can be increased if the concentration is less frequent fertilization.

6. Conclusion

A PC-based automated system has been developed to manage the drip irrigation/fertigation. The process of irrigation consists of introducing water into part of the soil profile that serves as the root zone, for the subsequent use of the crops. A well-managed irrigation system is one that optimizes the spatial and temporal distribution of water, so as to promote crop growth and yield, and to enhance the economic efficiency of crop production [Howell (2001)] and [Liaquat (2007)]. Irrigation that is automatically and precisely tailored to the plants needs and weather conditions dramatically reduces over-watering. A soil moisture sensor is designed for measuring moisture inside the soil to control the irrigation as per need of the crop. Drip irrigation is the greatest aid to use water efficiently for deep percolation or evaporation. Here is an attempt made by using drip irrigation control system with remote data acquisition system to improve the results i.e. optimum crop growth is achieved and in which soil moisture is controlled within the thresholds. Drip irrigation and fertigation management enable
efficient irrigation with small amounts of water, limiting evaporation and water wastage, reducing the application of fertilizers and chemicals and enhancing its capacity to effectively control plant disease. Best management for the use of irrigation water can help increase efficiency and uniformity and reduce contamination of water resources. The irrigation system drip-irrigation system is the most used, but during planting, the system is insufficient to develop an adequate humidity and therefore allow the plants a good start.

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