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Innovative Remote Irrigation Model- Hyperparameters for Decision Making

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Abstract— *Many studies in Tunisia prove that the country recived already and still to recive clear effects over climatic changes. This impact are linked to the temperature raise ups and diminution of rains ..etc[1]. Agriculture is one of the sectors the most affected by the climatic change [1]. In this context, the climate change will have an impact on the vegetarian production due to the reduction of the quantities of water [1]. This research Ames to produce a model to be used to equilibrate the best minimum needed water quantities for irrigation.*

Keywords—IS; heterogeneous systems; Smart system; Model;

I. Introduction :

Automating the irrigation systems is a vetal need for today’s Human life, seeing the climate change day by day that clearly influouce the rain rates, especially in our country of

Tunisia discussing the rain rate in Southern areas Tunisia we see that the average rains quantity between (2013...2017) is 1378 millimeter [3] and between (2018...2022) is 513 millimeter [3].

Thus, the regional scale irrigation management is a question of life to preserve the water levels and quantities since the drain crises are nowadays clearly highlighting their symptoms [1].

Technology here would play the main role automate the irrigation water management over areas with a clear water scarcity whether raine water or even the deep underground water. In this research, a deep study has been driven to study the current environment of the south of Tunisia in order to gather the maximum number variants that usually are controlling the climate change and thus the water availability.

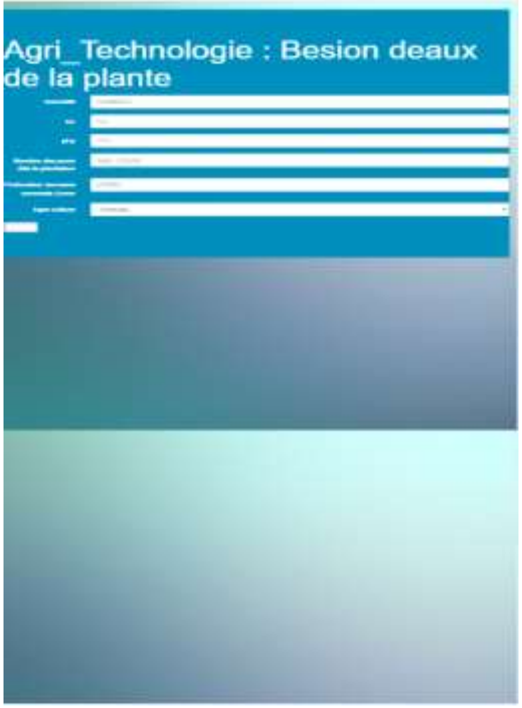
Based on the findings, an innovative automated computer base solution is proposed as a model for a better irrigation management.

II. Internet of things to automate the irrigation:

To calculate the necessary quantity of water for each set of trees [2], which will be controlled by an electro valve, humidity sensors will be installed under a few trees of each set (zone) [4][5][6][7][8].

Data will be collected in real time by RF (radio frequency) from the humidity sensors to the microcontroller-based board [4][5][6][7][8]. These values will be recorded for use by the Agri_Technologie application and inserted into scientific formulas that compare the water needs the each zones then decide which one will be irrigated and calculate the exact quantity of water needed [2]

It should be noted that these formulas require other data such as (field capacity, root depths, etc…) which are inserted via a dedicated interface called “Agri_Technology: Plant water needs”


Agri_Technologie : Besion deaux de la plante

III. *I*nnovative calculus to automate the irrigation:

Total available water: is characterized by the Useful Reserve, which represents the water retained by the soil. A soil contains even more water the deeper it is, rich in organic matter, silt and clay [2].

Real available water: represents a fraction of the RU, depending on the rooting development of the crop in place on the plot [2].

The capacity of the field: is defined as the quantity of water defined by the soil after flow by gravity of the excess water which circulates in the macroporisity and after which the flow speed significantly decreases [2].

The permanent wilting point: is the threshold beyond which the humidity of the soil no longer allows a plant to take the water it needs. [2]

The effective rooting depth is estimated for each day as follows:

$Zri=Zrmin+ ((Zrmax-Zrmin)*((Kcb-Kcbini)/ (Kcbend-Kcbini)))$;[2]

Equation (1) (1)

For $J<Jmid$ [2]

And

$Zri=Zrmax$ for $J<Jmid$ [2]

Where

Zri: is the effective depth for day i (m)

Zrmin: is the initial rooting depth at the start of the initial phase (m)

Zrmax: is the maximum depth of the root zone during the mid-season phase (m)

D: is the specific day of the growing season

Equation (1) is used in equation (2)

$TAW= (cc-pfp)*Zri$ [2]

Equation (2) (2)

Where

Zri: is the rooting depth of the crop (mm), Fc and WP are expressed in % (mass humidity) [2].

$RAW=p*TAW$ [2]

Equation (3) (3)

Where

P: is a fraction of TAW that a crop can extract from the root zone without the appearance of hydrisue deficiency, TAW and RAW are expressed in mm [2].

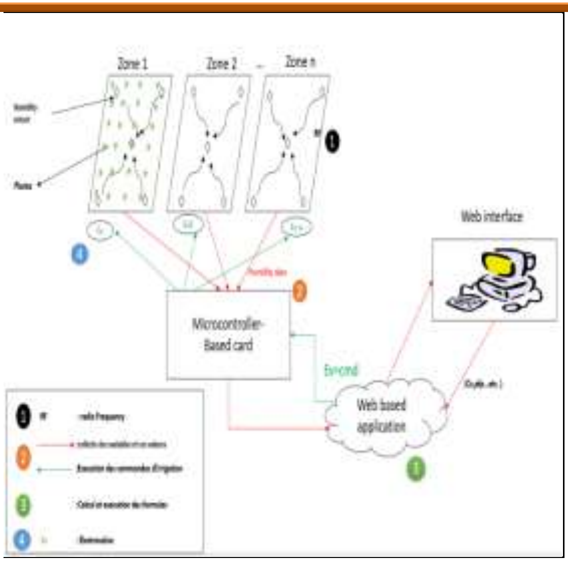
$Dri=TAW-((humidity-pfp)*Zr)$[2]

Equation (4) (4)

The duration of irrigation by the drip system is calculated as follows [2].

$D\ minute= (Dri*60)/13.3$[2] Equation (5) (5)

IV. Smart irrigation Model :



Technology-Agriculture-w Model

Conclusion

Smart cities are dominating the technology of today when delivering smart services to end users .In this research a smart model on the basic of well-studied variants and theorems that calculate and control the irrigation needs as the quantities of water and the timings.

A shortage also was seen that would be tackled to go farther with this research in terms of the full remote irrigation control.

V. *Better hyperparameters for an* system *innovative information*

In the context of information systems in the irrigation sector, hyperparameters refer to the parameters that are set prior to the training or operation of the system and are not learned from the data. These hyperparameters play a crucial role in determining the performance and behavior of the information system. Here, we'll discuss some potential hyperparameters relevant to information systems in the irrigation sector:

Sensor Configuration:

Placement: Determine the optimal placement of sensors within the irrigation system. This includes decisions on the number of sensors, their locations, and the types of data they will collect (e.g., soil moisture, weather conditions).

Data Acquisition Frequency:

Sampling Rate: Set the frequency at which data is collected from sensors. This hyperparameter is critical for balancing the need for real-time information with considerations of power consumption and data storage.

Communication Protocols:

Wireless vs. Wired: Decide on the communication protocols for transmitting data from sensors to the central system. This involves choosing between wireless and wired communication based on factors like range, reliability, and cost.

Data Storage and Retention:

Storage Duration: Determine how long collected data will be stored. This involves deciding on the retention period for historical data, considering factors such as analysis needs, regulatory requirements, and available storage capacity.

Thresholds for Action:

Decision Thresholds: Define the thresholds for various parameters (e.g., soil moisture levels) that trigger specific actions, such as activating irrigation or sending alerts. Setting these thresholds involves a trade-off between avoiding false alarms and ensuring timely responses.

Control Strategy:

Decision Logic: Specify the decision logic or algorithm that dictates when and how irrigation adjustments are made based on sensor data. This may involve rule-based systems, machine learning algorithms, or a combination of both.

Energy Management:

Power Saving Modes: Choose power-saving modes for sensors to optimize energy consumption. This is particularly important for remote or solar-powered sensor installations.

User Interface Design:

Visualization Parameters: Determine how data will be presented to users. This includes decisions on the type of graphical representation, dashboard design, and the level of detail provided to different user roles within the irrigation system.

Weather Forecast Integration:

Forecast Update Frequency: If incorporating weather forecasts, set the frequency at which forecast data is updated. This impacts the accuracy of predictions used in irrigation decision-making.

Security Measures:

Encryption and Authentication: Establish security measures such as encryption protocols and authentication mechanisms to protect data integrity and prevent unauthorized access to the information system.

Maintenance Scheduling:

Routine Maintenance: Define the schedule for routine maintenance activities, including sensor calibration, software updates, and system checks.

Cost-Benefit Trade-offs:

Resource Allocation: Consider the costs associated with different configurations and functionalities. Make decisions based on a trade-off analysis between system performance, reliability, and implementation costs.

It's essential to note that the optimal hyperparameter values may vary based on specific environmental conditions, crop types, and irrigation system requirements. Regular monitoring, evaluation, and adjustment of hyperparameters contribute to the continuous improvement of information systems in the irrigation sector.

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