Indicate & Irrigate

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Abstract

How to reduce Egypt consumption of fresh water? About 71% of earth is covered with water and about 97% of that water isn't useful for the daily use. Only 3% of this water is healthy and fresh. As resource of fresh water, we only use 1% of all the water on the universe because about 2% are freshwater that is stored into frozen glaciers that we don't have access to. Water is vital to life. It is nearly the main cause of everything. We need to make water resources more reliable. As a base to our solution, we are convinced that it is better to save water from its origin rather than spend money on ways to recycle it. We constructed a new central pivot irrigation system with electronic system to control its activity and to conquer its disadvantages. Our central pivot consists of: 2 towers: the first one is in the center of the circle of irrigation (static) the other is provided with wheels (dynamic). 5 beams that connects the towers and hold the irrigation pipes. our modification was an electronic system to tell the time to turn on & off the central pivot. open sign is when the temperature (by the sensor) is low and the stop sign is when the water level (by soil moisture sensor) exceeds appropriate limit. We worked on wheat crop and chose Sharq El-Owynat as the place and we used the clean excellent groundwater there as water resource. We found that wheat needs much less water when the temperature is low. We concluded that high temperature increases the evaporation rate thus, the plant will need more water to replace the transpired and the evaporated amount.

Introduction

Water shortage is a global crisis especially in Egypt. Some estimates indicate that Egypt will run out of water by 2044, for many reasons like Nahda Dam, over population and mainly because of sticking to old irrigation techniques.
Prior solutions were made to try to solve this problem. One of which was sprinkler irrigation system that has the pros of low rate of evaporation, but it is not applicable because it irrigates limited area of land. Another solution is drip irrigation system, it preserves the water perfectly, but it needs high quality water to function and it works on a very limited range of crops
To save Egypt from drought, the modern techniques are the solution. We chose to work on wheat by using Central Pivot Irrigation system. The most important advantages of central pivot are being suitable for a variety of crops and irrigating a very large area of the farm one time. The main disadvantages are being expensive and relatively high rate of water evaporation

Figure 1

To conquer its cons, we modified the existing irrigation system by creating an electronic system that will inform the farmer with the best time to open and close the irrigation process. The website will be like an informative notebook, so the farmer can get to know his own farm better thus, learn how to treat it.
The design requirements of the prototype are: the budget is 600 pounds, prototype must be testable, the materials are locally factorized, the soil used is like the original soil and the website is easy to be used by everyone.
The prototype meets the design requirements because we use available ,cheap materials which are found all over Egypt, we use the sandy loamy soil and we get a sample from it, the website is very easy to use because it was made in WIX.

Materials

Material	Wheat	Container	Soil	wires	Pipe
Image					
Material	Humidity, temperature sensor and resistance	Foam	Soil moisture sensor	Arduino	
Image					

Table 1 :the materials

Methods

Our project is divided into three parts which are:
1) The plant we are working on and the irrigation system.
2) The sensors that would help us save water in an easier, simpler and cheaper way.
3) The website will provide the farmer by every small detail he wants to know about the plant.
Firstly, the plant that was chosen to work on is the wheat and the used container had dimensions of:
36cm in length.
29cm in width.
37cm in height.
In order to put the soil in it.
Central pivot was chosen to work on as our irrigation system because it has many advantages compared to the other irrigation systems .A model of the central pivot was made by using small pieces of carton glued by sticky wax together to simulate the real Central pivot ,a pipe and a pump were used to pump water up to the central pivot to irrigate the crop.

Figure 2

Secondly, we are working by temperature humidity sensor and soil moisture sensor in order to help us know when does the plant specifically needs to be irrigated and when to stop irrigating the crop.
The sensors were connected to the Arduino by the Wires whose types are (male and female wires (soil moisture) male-male (temperature humidity).
Finally, a website was made using WIX that provided the farmer by every state the plant is in and all information related to the crop (wheat) that the website was provided by.

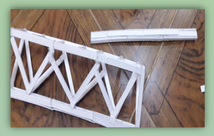

Figure 3

Test plan

Irrigation system:	The irrigation system part was used in water by providing a suitable pressure that is found in the pipe of shower to make sure that the prototype is not affected by water. After fixing the pump, the irrigation system was tested by pumping water from a bucket of water. 
Sensors:	Temperature humidity sensor was tested by exposing it to the air. After fixing the LED, its restriction code was that if the temperature was less than 20 C, the LED will enlighten. Soil moisture sensor was tested by putting it in a container with soil. It was tested in two types of soil and different amount of soil moisture. 
Web:	The web was tried in laptops or computers and mobile phone to test the front end of the website and the information in it. 

Table 2:test plan

To make sure that website is easy to be used, It is tested by five persons on mobile and laptops.
Budget:
Simple and cheap materials are used in our prototype and are available so the total cost is 200 L.E
The test plan meets the design requirements because we made sure that:
The total cost is less than 600 pounds. The sensors are available in many places in Cairo.
The website is easy to use and clear in showing information on mobile and laptops.

Results

Test plan 1	Failed	After writing the code and connecting the sensor , we suffered from the zero problem. The temperature humidity sensor and the soil moisture sensor didn't read any result and showed zeros. The problem was an error in the connection of the pin of the Arduino, so, this problem was solved by checking the connection again. The website was perfect in laptops but after testing it in the mobile, it was not organized.
Test plan 2	Failed	When the LED was connected, no action occurred. The problem was in the code and it was solved by writing if statement in the code. If the temperature is less than 20 C the LED enlightens. Test plan of the soil moisture sensor succeeded in the second time and displayed the result on the screen. The website was organized in the mobiles and laptops and had clear information
Test plan 3	succeeded	The sensor read the temperature and the humidity and led enlightens if the temperature is less than 20 C 

Table 3:the results

Analysis

Water is life. It is being used in every field of life, from domestic showers to nuclear plants. Water is being renewed by rains, increasing the salinity in the oceans. Even with that there is not enough water for human use in the world. We started recycling the water used due to the lack of the natural resources. Instead of spending more money on the inefficient recycling, why don't we solve the problem from its origin, so The solution would be revolutionary? To do so we need to identify the spots where the water is lost in a consumptive way.
In Egypt, irrigation water consumes about (86%) of all water resources. That is about (67000 billion m^3). So, if we worked on decreasing this amount to achieve more efficient irrigation for crops, we will reach the goal of reduction of water consumption.

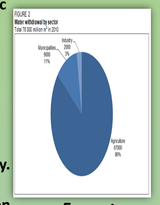

Figure 4

Figure 5

Figure 6

Technology is the face of the world. How can we apply technology as a principle for our application? That is very easy, in fact, that is exactly what we need to achieve the ultimate target. Irrigation water is lost when much water escape to Earth's bedrock between the plants or when the water is evaporated during its delivery to the plant. We need an electronic system to tell the irrigation system automatically about the best time to start and to stop the irrigation process.
What are the requirements that should be available in the irrigation system? Central Pivot is chosen as the desired irrigation system because of its many characteristics that satisfy our needs. These are:
1) Being applicable over a variety of crops' types.
2) It can adapt with different environmental conditions like high temperature, wind and Earth's curves.
3) It distributes the water in the most efficient way by spinning in a circle.
4) It irrigates an extremely wide area one time, so it suits the new developments that Egypt wants to reach.
Central pivot also has disadvantages that we are trying to overcome. They include: high evaporation rate and fuels consumption.
We are trying to overcome the problem of high-water consumption and evaporation rate by using system of electronic sensors. The "start" indication sign is when the temperature and humidity less than a certain limit that makes the water usage consumptive through much evaporation (20.00 C). The "Stop" indication sign is when the water level indicated by soil moisture sensor reaches a certain limit according to our chosen plant wheat (80 %). Wheat is a necessary crop that's why we preferred to work on it. The site of the project is chosen in one of the best sites in western desert which is Sharq el-Owynat. It has an excellent loamy soil that suits our plant (wheat) that is extremely needed by the Egyptian population. Ground water is used as water resource to the irrigation process as Sharq el Owynat aquifer is the largest reservoir in Egypt. We put all pieces together to form a whole project: we will work in Sharq El-Owynat on Wheat irrigated with groundwater crop using Central pivot irrigation system that will use hydraulic system for the fuels.
We used many scientific principles to ensure that we collect the best possible output:
Figure (8) shows that salinity of oceans increases respectively with the net evaporation of the water (evaporation – precipitation) over time. It means that along ages ocean waters will get saltier in a dangerous way.

Figure 7

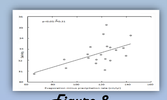

Figure 8

Figure (9) shows the relationship between the vapor pressure And the temperature. Whenever temperature increases, the Vapor pressure increases, thus the tendency of water to become vapor. Finally, the water will evaporate. This direct relationship was used to determine the best time for the central pivot to start functioning (temperature is low).

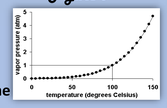

Figure 9

Figure (10) shows the area irrigated by our irrigation system the central circle is the output of the basic irrigation system. A gun shoot was added to help irrigating the rest area that makes the circle a square, so it is easier in agricultural planning.

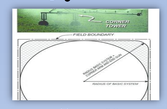

Figure 10

Figure (11) shows the effect of pumping groundwater from Sharq El-Owynat aquifer. A cone of depression of water forms.

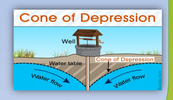

Figure 11

Conclusions

1. Decrease the consumption of irrigation water being used in wheat can be controlled by some sensors in the soil (temperature, humidity and soil moisture sensors).
2. Temperature and humidity levels help us to control the amount of water used for watering wheat and many other plants.
3. The temperature required for wheat during growing season is around 20 °C. The weather should be warm ,moist during the early stage of growth , sunny and dry in the later stages. That level was controlled by temperature sensor.
4. The soil suitable for wheat is either light clay or heavy loam.
5. The amount of rainfall required for wheat cultivation varies between 30 cm and 100 cm. That level was controlled by the moisture sensor.
6. Using central pivot system is more beneficial than the other irrigation systems because it consumes less water and can cover large area of plants.
7. A gun shoot irrigates a wide area that turns the circle of irrigation to square.
8. Using temperature, humidity and soil moisture sensors together helps to control the amount of temperature the wheat need so earlier growth will happen, and controlling the amount of moisture in the soil leads to reduce the water consumption level.
9. Showing our data and more information about wheat using website will help the famers to grow it carefully.

Recommendations

1. Making app instead of website as it would be better and easier to be used.
2. Using new clean resource of energy like (solar energy) in the mechanism of central pivot and the pumps instead of electricity in order to save energy.
3. There would be a small amount of water which will be wasted, you can get benefit from it by treating it and use it in irrigating the crop again.
4. To have the information written in the website in both languages Arabic and English.

Literature cites

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