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Agrotona

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Abstract: *Agriculture is the production of food and fibre from the world's land and waters. It is the foundation of civilization and economy. But, agriculture is an occupation of jeopardy as it mainly depends on monsoons. Therefore, irrigation is important for agricultural growth.*
Irrigation is the artificial application of water to land for the purpose of agricultural production. In a world with limited water resources, it is necessary to utilize water modestly. Irrigation and water management play a key role in defining water conservation for agriculture.
Effective irrigation will influence the entire growth process from seedbed preparation, germination, root growth, nutrient utilisation, plant growth and re-growth, yield and quality. The key to maximize irrigation efforts is uniformity. The producer has a lot of control over how much water to supply to the crops, and when to apply it, but overall, it is the irrigation system that determines the uniformity. Deciding which irrigation system is best for the agricultural operation requires knowledge of equipment, system design, plant species, growth stage, root structure, soil composition, and land formation.
Irrigation systems should encourage plant growth while minimising salt imbalances, leaf burns, soil erosion, and water loss. Losses of water will occur due to evaporation, wind drift, run-off and water (and nutrients) sinking deep below the root zone.
Proper irrigation management requires careful consideration and vigilant observation. Our project is important in defining these terms.
In the present work we have developed a system called Agrotona which can be employed to manage the water resources effectively whenever required by the plants for irrigation, and alsoto improve the overall yield of cultivation and reduce the requirement of human effort. It is also possible to get live notifications or recordings to monitor the humidity in soil. Therefore by using this we can easily analyze the requirement of water. This can be implemented into large forms such as paddyfields and arecanut farms etc.
Keywords: *Irrigation, Water management, Wireless data*

I. Introduction

We all know that for proper nourishment of crops certain amount of water is required. If rainfall is insufficient there will be deficiency in fulfillment of water requirement. Irrigation tries to remove this deficiency caused due to inadequate rainfall. Thus, irrigation comes to the rescue in dry years. But, different irrigation methods have their own disadvantages.Generally, growth conditions for the best crop is associated with high uniformity since each plant has an equal opportunity to access applied water. Irrigation methods are often linked with non uniform supply of water which eventually result in soil erosion and evaporation.One of the main types of irrigation used is Surface Irrigation, where water is led to the point of infiltration,

directly by surface of soil. The major disadvantages of this type of irrigation are erosions and loss of water by percolation.

Another type of popular irrigation method is Localized Irrigation where the water is applied in the area occupied by the roots of the plants forming a wet circle. The major disadvantage of this type of irrigation is decreased root depth due to constant availability of water which can decrease plant stability. Sprinkler irrigation uses spraying of water on crops and hence reduces soil erosion ,but are not economical, and in high wind conditions and temperatures, application efficiency is poor. The schematic arrangement of sprinkler irrigation system is shown in fig 1.1

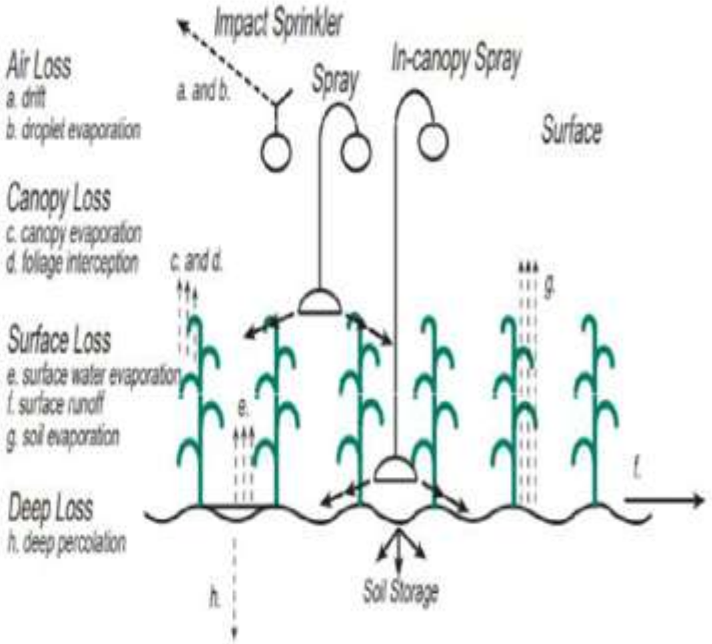

Fig 1.1 Schematic Arrangement of water losses in irrigation

Air losses include drift and droplet evaporation. Air losses can be very large if the sprinkler design or excessive pressure produce a high percentage of very fine droplets. Drift is normally considered to be water particles that are removed from the target area, while droplet evaporation would be the loss of water by evaporation directly from the drop of water while in flight as shown in figure 1.2. Surface irrigation losses include runoff, deep percolation, ground evaporation and surface water evaporation. These problems posed by different irrigation methods are solved by Agrotona.

The average design application depth is represented by the solid green line above the soil surface. The dotted black line that moves above and below the design depth represents what actual measured results might look like. If the soil surface is sloped and the application rate of water exceeds the soil intake rate and surface storage capability, then water movement in the field will occur.If this water moves off the field as runoff, water application efficiency is reduced. Within the field, water movement can cause non-uniform storage, resulting in under-watering on slopes and overwatering in flat areas. Slope, surface condition, and infiltration capacity all affect the depth and uniformity of water delivery to the roots.

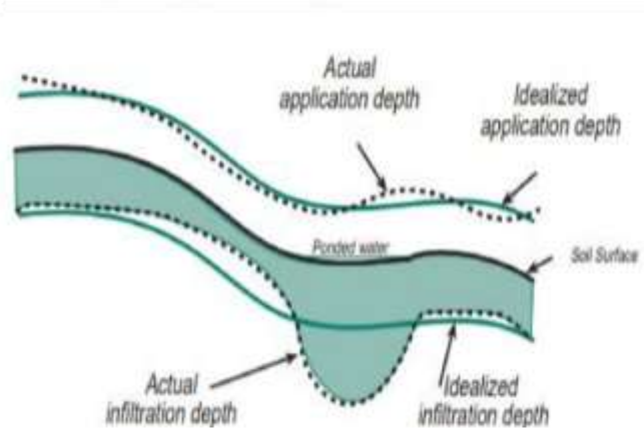

Fig 1.2 Water Distribution vs. Infiltrated Water Distribution in soil

Achieving an idealized application depth and infiltration depth is operose, but with different sensors embedded in Agrotona like soil moisture, humidity and temperature sensors to monitor the soil, it is possible to apply ample amount of water and hence achieve these ideal conditions

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II. Specification of components

A general purpose integrated PCB, metalcan transistor, operational amplifier, capacitors, photo-diodes, DC Motor, propeller, IC base, multi-stand wires, Solenoid valves, Solar panels & Cuplar are the components used for the present work.

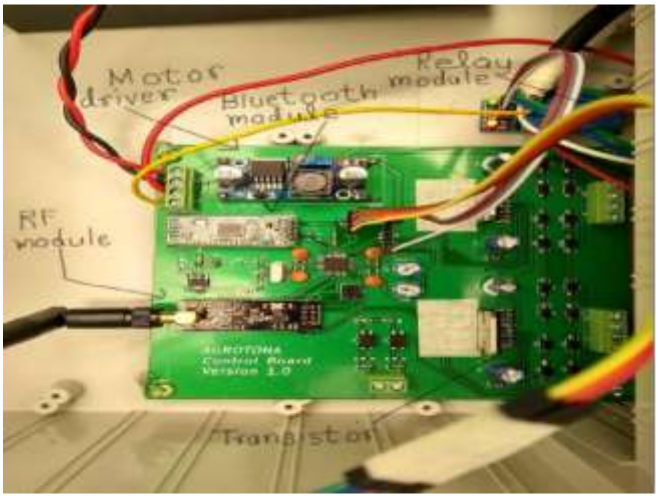

Fig 2.1 Electronic circuit of Agrotona.

Sl No.	Components Used in Agrotona			
	Reference	**Value**	**Footprint**	**Qty**
1	C1, C2, C3, C4, C9, C12, C15	0.1uF	Capacitor_SMD:C_0805	7
2	C5, C6	22pF	Capacitor_SMD:C_0805	2
3	C7	4.7uF	Capacitor_SMD:C_0805	1
4	C8	10uF	Capacitor_SMD:C_1206	1
5	C10, C13	100uF/25V	Capacitor_THT:CP_Radial	2
6	C11, C14	220uF/35V	Capacitor_THT:CP_Radial	2
7	D1, D2, D3, D4, D5, D6, D7, D8, D9,	M7	Diode_SMD:D_SMA	16
	D10, D11, D12, D13, D14, D15, D16			
8	IC3, IC4	L298N	IC_THT:MULTIWATT-15	2
9	J1	02x03	Header_THT:02x03	1
10	J7, J8, J9, J10, J11, J14, J15	01x02	Connector_Terminal_Block:01x02	7
11	J12	01x04	Header_THT:01x04	1
12	J13	HM-10 Bluetooth module	Header_THT:01x06	1
13	J16	01x08	Header_THT:01x08	1
14	M1	LM2596 5V regulator module	Module:LM2596_regulator_module	1
15	M2	NRF24L01+ RF module	Header_THT:02x04	1
16	R1, R3, R6	10K	Resistor_SMD:R_0805	3
17	R2	1M	Resistor_SMD:R_0805	1
18	R4, R7	4.7K	Resistor_SMD:R_0805	2

III. Methodology

The methodology of Agrotona unit is shown in figure 3.1.The output from the sensors are considered and accordingly ample amount of water is liberated to the crops. This is done by limit switches and motor drives, using an anti wilting mechanism. The anti wilting mechanism allows for water application efficiency and better yield. The Limit Switch enables the signalling of a control system as to the opening position of a control valve. Understanding and capturing water influx behavior is crucial for correct reservoir management. Water injection efficiency is highly influenced by fault pattern,and transmissibility characteristics. With Agrotona, efficiency is increased.

Agrotona is powered by a 12V battery which is charged by a solar panel with a battery charge controller to control the output voltage from the solar panel to the battery as shown in figure3.2. Agrotona is equipped with many sensors which are Light Intensity Sensor, Temperature sensor, Humidity Sensor and Soil moisture Sensor to keep track of the soil conditions and plant nutrition requirements.

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Light will directly affect the photosynthesis of plants, thereby affecting the development and growth of plants, production of crops, CO2 concentration, and humidity. The Light Intensity Sensor, using a LDR measures the amount of light falling on the crops and hence it is possible to calculate the ideal amount of light for plant growth. Similarly the soil moisture sensor, temperature sensor and humidity sensor reflect crucial readings which are helpful to optimize the growth of plants.

Plants require the proper environmental conditions for optimal growth and health. If the mixture of temperature, humidity and light are incorrect, the yield can be affected. With Agrotona's wireless sensors, it is possible to have 24/7 monitoring of agricultural greenhouses and to have the ability to track environmental changes, allowing maximum energy efficiency and growing of healthier crops with a higher yield. The crops are connected to a motor driver and servo motor which utilize tilting mechanisms to maximize water permeability and increase efficiency.

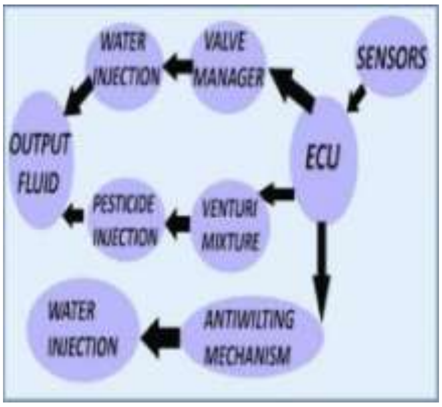


Fig.3.1 Methodology of Agrotona

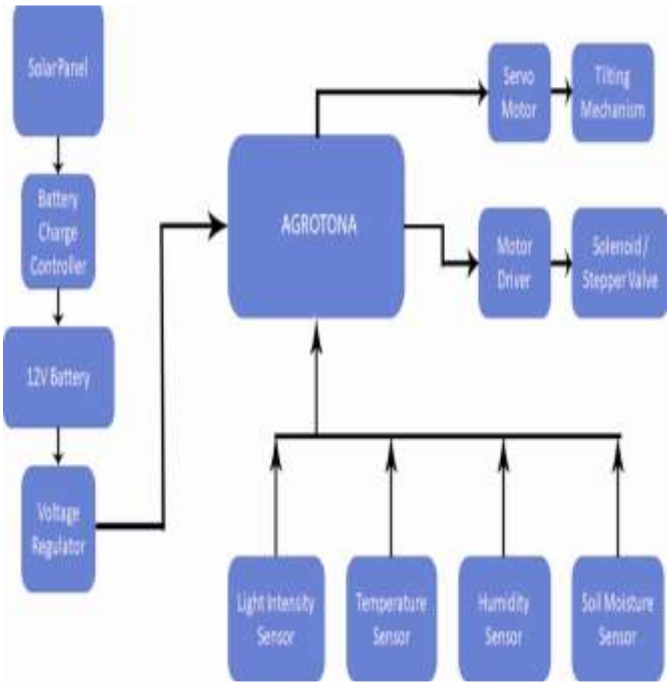


Fig 3.2 Block diagram of Agrotona

IV. Results & Discussion

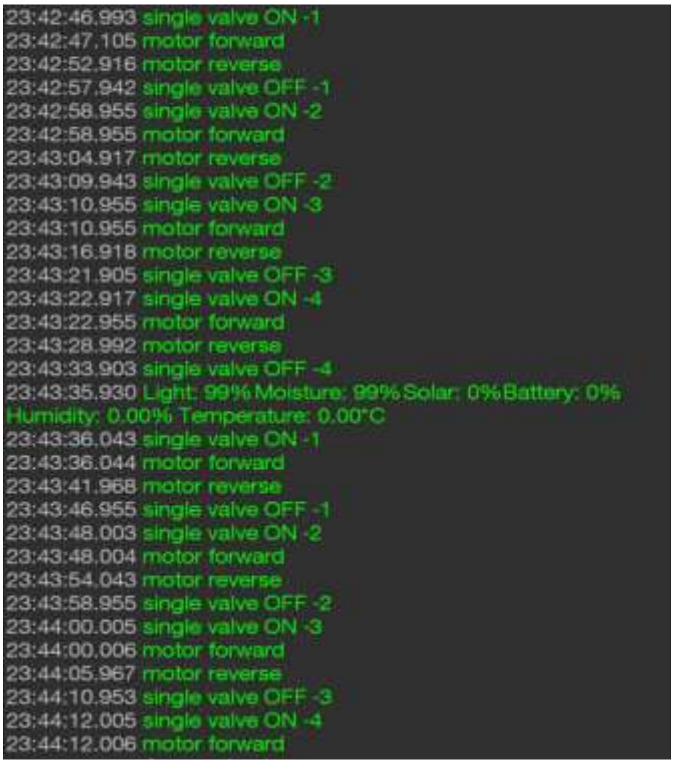
The water requirement for agriculture varies based on the cultivated crop, its location and the weather season in a year. The effective management of water for irrigation is very crucial in the near future owing to the continuous depletion of water resources. By making proper water management in cultivation effective growth in yield can be seen with limited supply of water at right time and at right place.

The Agrotona device is implemented in agricultural fields in such a way that it calculates the amount of water required for each plant when the evaporation rate is increased and moisture rate is decreased, this gets activated and in turn waters the plants according to the requirements of each individual plant.

The developed Agrotona unit is installed in the college premises and tested for different plants. The results such as soil moisture, humidity, temperature and rate of evaporation for different plants are monitored continuously, A sample of data obtained during testing is shown in figure 4.1 and 4.2 respectively.

In the following figures, the data from the sensors are obtained and analysed in real time. These data can be obtained wirelessly and the ideal conditions are maintained for the optimum growth of the plants.

Fig 4.3 Sensor units of Agrotona



23:42:46.993 single valve ON -1
23:42:47.105 motor forward
23:42:52.916 motor reverse
23:42:57.942 single valve OFF -1
23:42:58.955 single valve ON -2
23:42:58.955 motor forward
23:43:04.917 motor reverse
23:43:09.943 single valve OFF -2
23:43:10.955 single valve ON -3
23:43:10.955 motor forward
23:43:16.918 motor reverse
23:43:21.905 single valve OFF -3
23:43:22.917 single valve ON -4
23:43:22.955 motor forward
23:43:28.992 motor reverse
23:43:33.903 single valve OFF -4
23:43:35.930 Light: 99% Moisture: 99% Solar: 0% Battery: 0%
Humidity: 0.00% Temperature: 0.00°C
23:43:36.043 single valve ON -1
23:43:36.044 motor forward
23:43:41.968 motor reverse
23:43:46.955 single valve OFF -1
23:43:48.003 single valve ON -2
23:43:48.004 motor forward
23:43:54.043 motor reverse
23:43:58.955 single valve OFF -2
23:44:00.005 single valve ON -3
23:44:00.006 motor forward
23:44:05.967 motor reverse
23:44:10.953 single valve OFF -3
23:44:12.005 single valve ON -4
23:44:12.006 motor forward

Fig 4.1 Wireless results of Agrotona's sensors

11:32:09.355 Connecting to AGROTONA ...
11:32:14.677 Connected
11:32:15.179 Light: 95% Moisture: 1% Solar: 72% Battery: 71%
Humidity: 56.20% Temperature: 32.30°C
11:32:16.201 Light: 95% Moisture: 1% Solar: 67% Battery: 71%
Humidity: 56.20% Temperature: 32.30°C
11:32:17.273 Light: 96% Moisture: 0% Solar: 77% Battery: 68%
Humidity: 56.30% Temperature: 32.60°C
11:32:18.347 Light: 95% Moisture: 1% Solar: 69% Battery: 71%
Humidity: 56.30% Temperature: 32.60°C
11:32:19.371 Light: 95% Moisture: 0% Solar: 77% Battery: 69%
Humidity: 56.30% Temperature: 32.60°C
11:32:20.452 Light: 96% Moisture: 0% Solar: 70% Battery: 67%
Humidity: 56.30% Temperature: 32.60°C
11:32:21.503 Light: 95% Moisture: 1% Solar: 72% Battery: 71%
Humidity: 56.30% Temperature: 32.60°C
11:32:22.555 Light: 96% Moisture: 0% Solar: 75% Battery: 66%
Humidity: 56.30% Temperature: 32.60°C
11:32:23.604 Light: 95% Moisture: 1% Solar: 64% Battery: 70%
Humidity: 56.30% Temperature: 32.70°C
11:32:24.653 Light: 95% Moisture: 1% Solar: 61% Battery: 69%
Humidity: 56.30% Temperature: 32.70°C
11:32:25.742 Light: 96% Moisture: 0% Solar: 71% Battery: 67%
Humidity: 56.30% Temperature: 32.70°C

Fig 4.2 Results of different parameters monitored using Agrotona unit

V. Conclusion

In practice various techniques exist for the irrigation of crops, but it is important to decide the best irrigation method for effective water management. In the process of agricultural production, the growth, development and yield of crops are closely related to the soil moisture temperature. Suitable soil temperature and humidity can not only improve the crop yield, but also the quality and taste of crops.

With Agrotona, it is possible to increase water application efficiency and maximize the yield by analysing the various important parameters such as soil moisture content, lumens intensity, humidity and soil temperature using sensors embedded in the system.

Agrotona can be integrated with smart phones and other software technologies to make live notification of water level in reservoir and amount of water consumed by plants etc.It can be employed to effectively manage vast irrigated lands for farmers to effectively manage their water resources to increase their yield. The system can also be utilized in research activities in companies or organization to grow the plants in a controlled environment.

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