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IOT Based Smart Farming for Effective Utilization of Water and Energy

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Abstract

Water is one the precious natural resource which has been over exploited by mankind in the ruthless fashion. As a result this nonrenewable resource is getting exhausted to a drastic extent and nearly 40% of earth population is facing acute water shortage. Nearly 55% of fresh water has been used for agricultural and its allied industries. So we propose a suitable method which uses the blend of technologies to effectively utilize this resource and to enhance the production of agriculture products and eventually minimize the consumption of electrical energy. This project uses raspberry pi B model to interact with the sensors and with the motor pump so that both the water and the electrical energy is minimized.
Keywords: *Smart Farming, Raspberry, temperature sensor, Humidity sensor.*

1. Introduction

The mankind is facing so many threats due to the technological advancements such as radiation, lack of precious resources and exposure to hazards. The precious resources include water, air etc. Almost every human being needs water for survival. At the same time this water is a non-renewable resource which cannot be generated once it is squandered. The water has been used for agriculture in a excessive manner. When water is used for crop cultivation in a excessive manner it also affects its yield.

The root cause for this is supply of water is manually done. There is no scientific record of water which can used for each crop and no automated mechanism exists to control the flow of water to the crop which minimizes the usage of water and eventually minimizes the usage of electrical energy [7] – [16]. So we propose a useful and effective method of smart farming technique with a intention of minimizing water usage and mitigating electrical energy. There are various smart farming techniques which has been proposed by many researchers inside and outside of the country. Minwoo Ryu et.al [1] depicted a smart farming system based on IOT which effectively services the requirements of end users.

This method utilizes various connected components to demonstrate the usage of smart farming in a efficient and effective manner. Andreas Kimilaries et.al [2] emphasized IOT frameworks can be exploited to collect and analyze data in real time scenarios to make effective decisions related to smart farming. This research work also states that weather framework components and regulations has to be imposed on Agro based industries to reap the best results from it. Miguel A.Zamora et.al [3] stated and promoted a soil less agriculture using technology. This method proposed the usage of greenhouses for cultivation using saline water.

This method uses three layer software architecture using cloud and also a exchangeable low cost hardware to implement this system effectively. The system comprises a lower plane where the physical components called sensors interact with the crops and collect sensible data far further course of action. The edge plane of the platform is in charge of monitoring and managing main PA tasks near the access network to increase system reliability against network access failures. Finally, the cloud platform collects current and past records and hosts data analytics modules in a FIWARE deployment. Oran chieochan et.al [4] reiterated that IOT sensors can be applied effectively in mushroom farming.

The sensors deployed for this system monitors the humidity and data is processed by NETPIE for taking due course of actions. The cumulative data is accessed by NET FEED which is a sub service of NETPIE and the corresponding data is displayed in the Mobile device and laptop screens. S.R.Prathiba et.al [5] proposed the usage of IOT and ways it can be utilized for smart agriculture. IoT sensors capable of providing information about their agriculture fields. The paper aims making use of evolving technology i.e. IoT and smart agriculture using automation. Monitoring environmental factors is the major factor to improve the yield of the efficient crops. The feature of this paper includes monitoring temperature and humidity in agricultural field through sensors using CC3200 single chip.

Camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi. Hemavathi B.Biradar et.al [6] proposed the how data mining can be used to utilize the water in a effective manner. This data mining techniques facilitate to utilize the water efficiently so that the yield of the crop can be enhanced. The important topic of hydrological studies is evapotranspiration which makes the water most effectively used for crop cultivation. The wireless sensor networks provide a cost effective solution by deploying sensors to monitor to measure atmospheric pressure, soil moisture and soil PH value.

The Proposed system comprises Raspberry pi B model, Moisture sensor and temperature sensor to monitor the soil moisture and temperature of the soil. This also uses the water flow control sensor to control the flow of water to avoid excess usage of water. The proposed method used comprises the architecture of smart farming which includes raspberry pi kit and connected sensors. The paper is divided into architecture of the system, working methodology and case study results.

2. Architecture Of System

Fig 1 depicts the Architecture of the system. Here Humidity sensor (DHT22) is used instead of DHT11 which can grab the moisture content in the soil accurately in high temperatures. The temperature sensor (DS18B20) is used for identifying the heat on and above the soil. There is also a water flow sensor which is attached to the raspberry pi kit to control the flow of water pump.

A python module is used to control the Raspberry pi kit based on the data extracted from sensors. The python module also intimates the farmer about the schedule of using fertilizers in the form of SMS since the raspberry Pi B model comprises a WIFI 802.11 b/g wireless module. So that the fertilizers can be fed adequately to the crops at appropriate time.

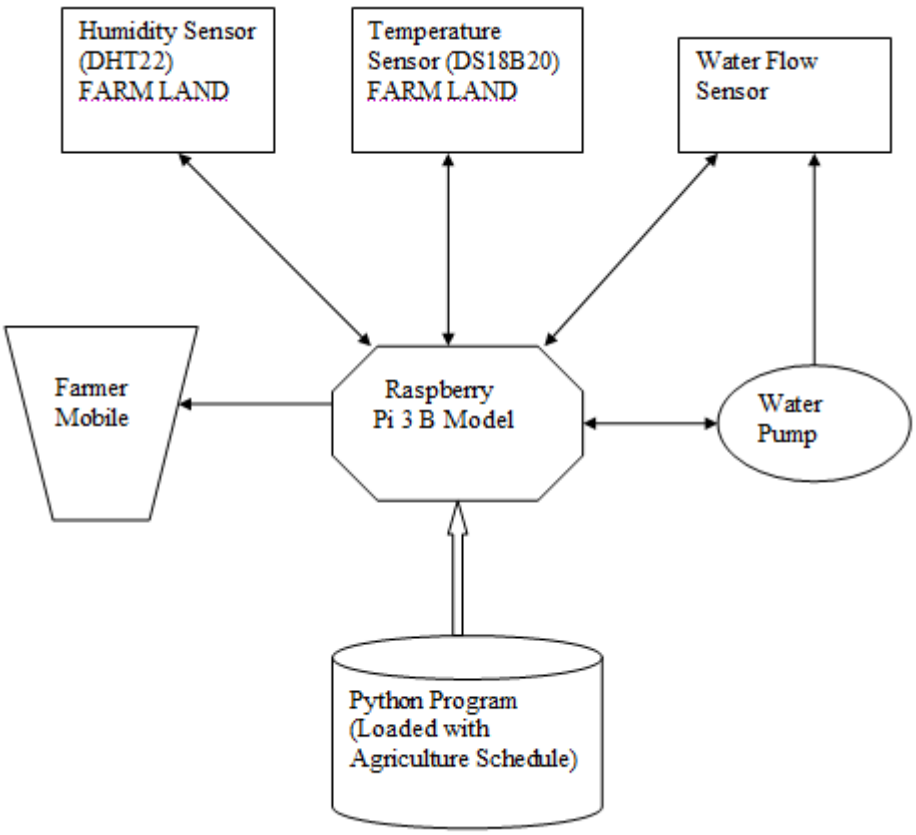

Fig 1. Architecture of System

3. Working Methodology

Smart farming for the groundnut crop is done with the assistance of Internet of Things (IOT) and Raspberry pi 3 B model kit. The temperature is monitored with the assistance of DS18B20 temperature sensor and connected with Raspberry Pi kit. The ideal temperature for Groundnut is 27 degree celcius to 32 degree celcius. If the temperature goes beyond 32 degree celcius. The Moisture sensor REESS2 soil sensor is used to indicate the level of moisture for Groundnut crop. The ideal temperature required for Groundnut is 30cm to 65cm.

This sensor measures the moisture content and intimates to raspberry pi Kit. This sensor will be housed in the farm land. If the moisture content measured is below 30cm then the python program which operates raspberry pi will send a ON signal and the Motor pump will be switched on and continues to run until it reaches 65cm moisture content. Once it reaches the maximum threshold the raspberry pi will send the OFF signal which eventually switches off the pump. If the moisture content reaches beyond 55cm the water flow sensor will be limiting the flow of water in order to conserve water

The cultivation and yield of Groundnut crop is also determined by supplying appropriate fertilizers for crop. The proper fertilizers required for Groundnut crop is 20 kg of Nitrogen, 15kg Phosphorus pentoxide and 12kg of Potash after the sowing the crop within 2 days and 15kg of nitrogen is required as a top up after 20 to 30 days of crop growth. This is programmed in python and intimation is given to the Farmer in the form of SMS in appropriate time frame so that to ensure proper yield of the crop with effective time frame.

4. Sample Case Study Results

The proposed system has been done and experimented on case study basis in a 25cents land for the period of two months with 10 foot water. The 25cents land is dominated by groundnut crop and remaining 25cents land has ground nut in which the irrigation is made without automation.3HP jet pump is used for irrigation. The growth of groundnut is for the period of three months. The statistics is tabulated with power consumption statistics with and without automation. The same 3HP water pump is used with IOT system and without IOT system. The power consumption and Yield are mentioned as below.

Table 1. Statistics of power consumption and Yield

Motor type	**With IOT System**			**Without IOT System**		
3HP Motor	Land	Power consumed for months(in units)	Yield for groundnut (in mg)	Land	Power consumed for months(in units)	Yield for groundnut (in mg)
	25 cents	165 units	7400 mg	25 cents	213 units	5750 mg

The above statistics which has been taken for experimental basis has revealed that the energy consumption under IOT system is very less and Yield of ground nut is more in contrast to its counterpart.

5. Conclusion

The proposed IOT system has proved as a better system when applied in practical scenario in a limited and constraint fashion. However the results have to be analysed for this system when it is applied in large agriculture farms and when different crops are applied in farming. It is also recommended to apply this system in small level agriculture rural areas since it has good results in micro level performed on case study.

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