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Low Cost Wireless Monitoring and Decision Support for Water Saving In Agriculture

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ABSTRACT: *These days, in the agriculture sector farmers are facing major problems regarding irrigation. Due to over- irrigation and under-irrigation, the crops can be damaged. This work development of an IoT instrumented smart agricultural monitoring and irrigation system. In this paper, an IoT platform based on Thing Speak and Node MCU is demonstrated, which will help the farmer to control the irrigation by using a PC or smart phone from anywhere and anytime, to monitoring the moisture and temperature parameter and reduce his efforts and also to optimize the use of water. Sensors value is sent to the IoT platform and if a value is below the threshold a notification will be sent to the user through the MESSAGES (APP) in the mobile to take suitable action.*

Key Words: *Wireless sensor network, smart actuation, fuzzy logic, decision support system.*

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I. INTRODUCTION

In the current age of high competition and risk in markets, technological advancements are a must for better growth and sustainability. The same applies to the agriculture industry. Every farmer has high stakes on the crops, their yield and quality. Rising water issues and need for proper methodologies for farm maintenance is a hot issue that needs to be tackled at utmost propriety. The proposed solution will be developed by establishing a distributed wireless sensor network (WSN), wherein each region of the farm would be covered by various sensor modules which will be transmitting data on a common server. Machine learning (ML) algorithms will support predictions for irrigation patterns based on crops and weather scenarios.[1]

In a peninsular country like India, agriculture contributes about 16% of total GDP, so irrigation system has been given a high priority in economic development. With the advancement of wireless sensor network, cloud computing and IoT in the field of irrigation, this paper aims at conventional usage of water by providing adequate amount of water to the crops at the right time and conserving the excess run-off water from the farmlands. The excess runoff water will be saved in a tank for future use.[2] In a peninsular country like India, agriculture contributes about 16% of total GDP, so irrigation system has been given a high priority in economic development. With the advancement of wireless sensor network, cloud computing and IoT in the field of irrigation, this paper aims at conventional usage of water by providing adequate amount of water to the crops at the right time and conserving the excess run-off water from the farmlands. The excess runoff water will be saved in a tank for future use.[3] These benefits are easier to apply in commercial farms due to advances in technological areas, which offer the opportunity of integrating a variety of sensors and accumulated knowledge into a decision support system (DSS). IRRIX, is a web platform hosted in the cloud and not requiring human intervention, that allows automated irrigation, resulting from an algorithm derived from a combination of water balance with a feedback adjustment mechanism using soil moisture sensors. Therefore, the main objective of this work was to analyze the IRRIX automatic irrigation system, for the automatic management of irrigation in the cultivation of plums and its suitability to form part of RDI strategies.[4] The Humidity and Temperature Sensor sense the both water vapor content and temperature around the plant. The Soil Moisture Sensor sense the soil moisture of a plant, if water content is below minimum requirement then water will supply from water reservoir using relay and Ultrasonic sensor measures the water level of reservoir after that sends the data to ESP8266 Node MCU. ESP8266 Node MCU is a Microcontroller gets the data from smart wireless sensors, process the data and send to destination through A Message Queue Telemetry Transport (MQTT)protocol.[5] The Humidity and Temperature Sensor sense the both water vapor content and temperature around the plant. The Soil Moisture Sensor sense the soil moisture of a plant, if water content is below minimum requirement then water will supply from water reservoir using relay and Ultrasonic sensor measures the water level of reservoir after that sends the data to ESP8266 Node MCU. ESP8266 Node MCU is a Microcontroller gets the data from smart wireless sensors, process the data and send to destination through A Message Queue Telemetry Transport (MQTT)protocol.[6] Machine Learning allows systems to learn and improve automatically from experiences without hand-coding. Thus, in recent years, many technology companies have been developing such application if Artificial Intelligence, from face recognition by Face book, to the Alpha Go program by Google.

The irrigation systems in the market nowadays mostly allow users to set them to a certain amount of water and at specific time intervals. However, there are usually more than one type of plants in a garden, and each species requires different amount of water. In order to resolve this issue, in this paper, we have developed an irrigation system, with the use of deep learning, that is able to adjust the amounts of water foe each type plant through plants recognition. There are two main parts of the solution, the software and the hardware. The prior is connected with cameras to undergo plant recognition, and utilizes database to find the suitable amount of water; the latter controls the amount of water that is able to flow out.[7].

II. SMART PLANT IRRIGATION SYSTEM

The irrigation learning model simple prototype IoT system. This system has three main parts. The first one is the sensors and actuator part, which acquires sensor data from the environment. Besides, it actuates the water pump motor when the system decides irrigation using the proposed model. In this part of the system, we use sensors, motor actuators, and a Node MCU module. The second part performs the proposed irrigation decision model on a cloud server and outputs a decision result. This server collects the sensor data into a database and periodically makes an irrigation decision using the proposed model. Besides, it interacts with the client users of the system. The third part is the end user part in which a mobile device can send manual irrigation requests and visualize the monitored irrigation data. The overall interactions in the system. A Sensors and Actuator Part We connect all sensors and motor actuators to an edge device, named as Node MCU. This device acquires data from the environment, timestamps them, and sends them to the central server over its WI-FI module. Also, as depicted in the process scheme of the firmware . it periodically checks the irrigation decisions made by the proposed model performed in the server. If any irrigation decision is made from the server, it actuates the related motor and irrigation process starts. B. Server Part As mentioned earlier, the necessary environmental data are collected into a centralized server for the decision making process and data visualization. This server is the core of this decision-making process, which follows the proposed smart irrigation model. It collects the time stamped data coming from Node MCU into its database, and with using these data, in every 10 minutes period, it makes an irrigation decision. Besides, this server interacts with system users to get manual irrigation requests and provide the necessary data to them. C. System User Part Users can interact with the server part of the system with a web panel or mobile phones. With the web panel, the user can visualize the data, add/change any plant information such as irrigation type, irrigation time needed for the plant**.**

III. WIRELESS DECISION SUPPORT SYSTEM

The proposed system has been designed in order to support the end-user answering to the following main questions: • Does the crop need irrigation water? The binary answer yes/no is inferred from the real-time monitoring of the crop status and is used to trigger the successive steps of the decision; • how much water is required? The optimal volume of water is estimated according to the specific properties of the soil and to the crop typology; • how to irrigate the crop? Besides the water quantity, the proper computation of the temporal and spatial distribution of the estimated water volume throughout the monitored field is fundamental to ensure the maximum absorption of the water and to reduce the percolation waste. The answers to the above questions have been provided to the farmers through the innovative combination of the three main logical components described in the following sub-sections: (i) a low-cost wireless architecture for distributed sensing and actuation (ii) an inference decision engine based on the fuzzy theory mimicking the farmers’ experience and (iii) a set of numerical models of the soil and of the crop to estimate the status and the growth of the plants.

IV. CONCLUSIONS

In this study, we propose a smart irrigation model based IoT system that gradually learns the watering nature of a plant without any pre-prepared data initially given to it. As a proof of concept, we implemented a prototype application. This application adapts itself to the conditions necessary for the irrigation after a couple of manual irrigations. To evaluate its performance, we devised tests both for manual and automatic irrigations when different ML algorithms are used. The results show that the model performs with high accuracy in making irrigation decisions.

V. FUTURE WORK

We will investigate the performance of the proposed model with long-term irrigation tests with more plants. Our initial tests were conducted in an indoor environment where temperature changes are negligible. Additionally, we will extend our test bed to outdoor environments to observe the behaviour of the model in different environmental condition.

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