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Review Article

Arduino Board in the Automation of Agricultural Irrigation in Mexico, a Review

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Abstract

Since Mexico is a predominantly arid and semi-arid country, so that the use of irrigation is necessary, since irrigated agriculture helps produce almost 50% of the total agricultural production in the country. The irrigated land represented 30% of the total area of the country predestined to agriculture, generated about 50% of the value of the total agricultural production and more than 30% of the jobs in the sector. Of the irrigated area, 3.3 million hectares corresponded to 80 irrigated districts and 2.9 million to 30 thousand units of medium and small irrigation for rural development. This is of great importance nowadays because this production represents about 70% of exports of agricultural products abroad. Of irrigated agriculture, 1,300,000 have applied technology with multi-door irrigation systems, sprinkling, dripping and band; in the remaining 5,200,000 hectares, surface irrigation is used. Due to the fact that water is increasingly scarce as it is necessary to increase the area with irrigation, it becomes extremely important the more efficient use of water, this can be achieved by automating its application. In the country, various Irrigation automation systems, currently besides the water scarcity the cost of automation also it influences the installation of an automation system, the use of the automation of agriculture through the Arduino board is very used in the world and in Mexico. From the review of literature made highlights the amount of research work and design proposals for systems based on the Arduino board with application in Indian agriculture, over the other countries in which it is used. Goal why our country should accentuate this application of this low-cost and easy-to-apply technology to increase the productivity of agricultural actions that are so lacking in the current era, in Mexico it is too rare compared to other countries to use the Arduino board in the irrigation automation, a situation that should be improved by promoting the use of this technology for its benefits, and low cost.

Keywords: *Farming; Mexico; Automatization; Agronomy; Microcontroller Irrigation*

Background

Mexico since the pre-Hispanic era has made use of irrigation in its agriculture the Aztecs and other tribes had an agriculture based on irrigation, so they had high yields, with the arrival of the Spaniards this situation of using irrigation in continuous agriculture, until arriving at the current time in which irrigation is essential in food production, since Mexico is a predominantly arid and semi-arid country, so that the use of irrigation is necessary, since irrigated agriculture helps produce almost 50% of the total agricultural production in the country. The irrigated land represented 30% of the total area of the country predestined to agriculture, generated about 50% of the value of the total agricultural production and more than 30% of the jobs in the sector. Of the irrigated area, 3.3 million hectares corresponded to 80 irrigated districts and 2.9 million to 30 thousand units of medium and small irrigation for rural development [1].

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Objective of the Study

The objective of this work is to know the current state of the applications of this board in irrigation of the Mexican agriculture. Cause why our country should accentuate this application of this low-cost and easy-to-apply technology to increase the yield of agricultural activities that are so lacking in the present era [2,3].

Materials and Methods

A methodical and meticulous search was conducted for data collection in printed data bases, Internet, journals scientific, graduate and postgraduate university thesis, newspaper articles, etc.

Literature Review

Author and year	Description	Country
Yilmaz 2017 [4]	Achieve a study, greenhouse automation was performed in a hydroponic environment using Arduino. The temperature of water, EC (electrical conductivity) value of the nutrient solution in the hydroponic environment	Turquia
Diniz 2017 [5]	Involvement to Irrigation through the growth and use of free software and hardware, the sensor node was designed and built with an Arduino Nano, NRF24L01 radio, capacitive sensors type SHT20 and DHT22 in addition to FC-28 which is resistive	Brazil
Naik 2017 [6]	Projected system with various sensors like temperature, humidity, soil moisture sensors that sense the factors of the soil with Arduino, based on soil moisture value land is automatically irrigated by ON/OFF of the motor. The sensed parameters and motor status will be displayed on user android application.	India
Sanjeev 2017	System designed to tool a "Smart water sprinkler which is based on Arduino Microcontroller". The system has a soil moisture sensor which acts as a sensing element. A entrance unit which consists of Arduino Microcontroller, switching method, actuators like servo motor and pump is present.	India
Kaluse 2017 [7]	Improve a system for automated irrigation by study the moisture level of the ground. The primary applications for this project are for farmers and gardeners who do not have enough time to water crops. Using An Arduino and raspberry.	India
Nirdosh 2017 [8]	Solar motorized smart farming irrigation system not only overcomes this problem but also provide clean source of energy, take the data from five sensors- soil moisture sensor, LDR sensor, Temperature sensor, DHT 11 humidity sensor and ultrasonic sensor. These sensors deliver information to the Arduino UNO. Arduino takes necessary decision/action, and also informs about the sensor values and its necessary actions to farmer through farmer's cell phone by message with the help of GSM module	India
Simanjuntak 2017	Develop an application which is based on Arduino for watering and fertilizing corn land. The result of using e-precision agriculture based on embedded system is 100% higher than the conventional one and the risk of harvesting failure using the embedded system decreased to 50%.	Indonesia
Choudhary 2017 [9]	Designed to implement a "Smart water sprinkler which is based on Arduino Microcontroller". The system surrounds a soil moisture sensor which acts as a sensing element in the system. A gateway unit which consists of Arduino. Microcontroller, switching device, actuators like servo motor and pump is present. A program is developed in accordance with the threshold values of the sensing element and the actuators.	India
Kumar 2017 [10]	Developing an entirely automated plant/crop watering system. Solar energy is used to run the system during daytime and charge the batteries to operate at night. It uses moisture sensors to sense the level of moisture in the soil. When the moisture content of the soil goes below a certain limit for a plant/crop, the pump system is triggered and the plant/crop is watered. The plants are watered efficiently till the desired value is reached and the pump is switched off automatically. using Arduino based Technology	India
Iyappan 2017 [11]	Design and application of brushless dc (BLDC) motor based solar water pumping system for agriculture. The performance of the system has been validated using Arduino UNO.	India
Siththtikumar 2016 [12]	Present a prototype for automated water irrigation system for home gardens. Prototype includes Arduino Uno board (ATmega382p), Liquid Crystal Display (LCD) display, moisture sensors, solenoid valve, flow sensor and pipe lines. Moisture sensors array embed in garden (in soil) will sense the water level continuously	Srilanka

Table 1: *Review of Arduino Board uses in World agriculture Irrigation, description, author, year and country.*

The Arduino Board in Mexican Agriculture Irrigation

Author	Description	Year
Gonzales	Proposed an irrigation system to optimize the use of water the system are controlled by means of an Arduino Uno Integrated Circuit	2017
Gaona	Proposed a soil moisture system with An Arduino UNO board of free programming, a sensor of humidity Fc-28, a reader of SD and a battery was used.	2017
Lozoya	Design a model driven control strategy useful to an irrigation system	2016
Osorio	The Proposed a use the Arduino platform as an electronic element to controller actuators and read sensor data for the recognition of Fertigation solutions	2016

Table 2: *Review of Arduino Board uses in Mexican agriculture Irrigation; author, description, and year.*

Gonzales [13] established an irrigation system that goals to optimize the use of water through an automated irrigation mechanism, this expedites irrigation through a sensor that monitors the state of moisture in the land, watering the object only when you need water. If the humidity level is low, the system is turned on by means of solenoid valves, if on the other hand the humidity level is high, the system is turned off. The logistic processes of the system are controlled by means of an Arduino Uno Integrated Circuit. The main objective is to realize a considerable decrease in the use of water, and in turn generate labor savings. Also, the irrigation system can be adapted to different types of terrain, even to wavy typefaces, which do not require leveling.

Gaona [14] design a soil moisture amount system using an electronic sensor, the sensor measures the electrical conductivity of a soil. For a period of seven days, analyses delivered by the sensor were composed and, parallel, the volumetric moisture content of the soil was manually predictable and a potential type function was adjusted to characterize its behavior. The research was done in the laboratory using a container with 15120g of soil with a mass of 18007g. A potential relationship was found between soil volumetric moisture and sensor values in the evaluated soil. Gravimetric analyzes of soil samples show a correlation of R2 = 0.9094. An Arduino UNO board of free programming, a sensor of humidity Fc-28, a reader of SD and a battery was used. Additionally, the sensor readings were related to the moisture content of the soil by the gravimetric method.

Lozoya [15] design a model driven control strategy useful to an irrigation system, in order to make an efficient use of water for large crop fields, that is, applying the accurate amount of water in the exact place at the accurate moment. The projected model uses a analytical algorithm that senses soil moisture and weather variables, to regulate optimal amount of water required by the crop. This proposed approach is estimated in contradiction of a old irrigation system based on the experimental definition of time periods and in contrast to a basic soil moisture control system. Effects indicate that the use of a model predictive control in an irrigation system reaches a higher efficiency and significantly reduce the water consumption.

Osorio (2016) understood a research to automate the procedure for the recognition of Fertigation solutions where the main separate is to project a prototype and a computer program with a kindly user interface for producers or individuals who need to create Fertigation solutions. The software will cooperate with the Arduino platform as an electronic element to controller actuators and read sensor data. The actuators will be solenoid valves to approve the passage of substances to a container for the research of the solution and flow sensors will be used to determine the necessary amount of each substance in request. The free software (Java) and free hardware (Arduino) with which the prototype will be built will agree a reduction in costs [16-26].

Conclusions

It was found that in India the use of the arduino plate is quite frequent in comparison with Mexico and other countries. In Mexico it is too rare compared to other countries to use the Arduino plate in the irrigation automation, a situation that should be improved by promoting the use of this technology for its benefits, and low cost. Schools of agronomy and mechatronics should join efforts to research about this application in the irrigation of the country.

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