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Ai And Iot Based Smart Irrigation System

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Abstract

In this paper we propose a smart irrigation system which is an advanced solution for weather monitoring that uses artificial intelligence and IoT. This system makes the irrigation system smart. With the increasing depletion of the underground water a smart irrigation system that will help farmer to irrigate his farm is designed. In this system depending on the weather conditions and the soil moisture content the smart system with the helpof AI tries to decision whether the irrigation system will be switched on or not. The AI system will decide based on the input from sensors like temperature, humidity, moisture content of soil, light intensity which are connected over IoT. So this system makes decision making of the farmer easy. Each of the system is trained as per the requirement of the field over which the system is implemented, like tea garden, or paddy field or any organised farm. ..

Keywords:

1. Introduction

The underground water resources are depleting and an efficient use of the water will help the farmers to maintain the proper soil moisture content for efficient growth of plants.In this paper we propose a system which is an advanced solution for irrigation system in combination with the weather monitoring that uses artificial intelligence and IoT. This system makes the irrigation system smart. The smart irrigation system that will help farmer to irrigate his farm is designed with AI and IoT. In this system depending on the weather conditions and the soil moisture content the smart system with the helpof AI tries to decision whether the irrigation system will be switched on or not. It is totally automated based on the real time data easily accessible over a very wide range. The system deals with monitoring weather and climate changes like temperature, humidity, moisture content of soil, light intensity. So this system makes decision making of the farmer easy. Each of the system is trained as per the requirement of the field over which the system is implemented, like tea garden, or paddy field or any organised farm. In this work we have generated ANN models to predict whether the irrigation systemshould be switched on for watering the farm as per the inputs from the sensor connected over IoT These ANN model are loaded on Thingspeak to control the devices. Hence AI takes the decision to control the irrigation system.

2.AI and IoT

Internet of Things, or IoT, a technology where billion of devices are now connected to the internet, all collecting and sharing data from each other [1]. Connecting up all these different objects and adding sensors to them adds a level of digital intelligence to devices making them smart [2].

The term "Artificial neural network" refers to a biologically inspired sub-field of artificial intelligence modeled after the brain. An Artificial neural network is usually a computational network based on biological neural networks that construct the structure of the human brain. Similar to a human brain has neurons interconnected to each other, artificial neural networks also have neurons that are linked to each other in various layers of the networks[3].These neurons are known as nodes.

The existing weather monitoring systems generally use weather stations that use multiple instruments such as thermometers, barometers, wind vanes, rain gauge etc. to measure weather and climate changes.[4] Most of these instruments use simple analog technology which is later physically recorded and stored in a data base. In this paper we have made the irrigation system smart by introducing the local temperature, moisture content of soil, humidity and predicting whether there will be rain or not and decide whether the water sprinklers have to be switched on or not. Here AI is applied along with IoT.

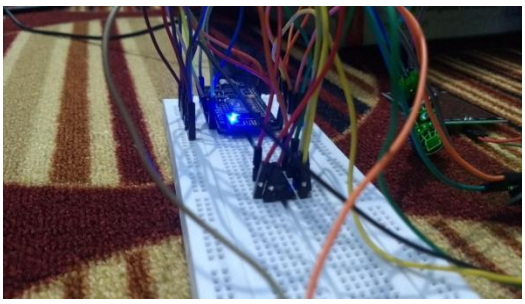
3.AI and IoT based Smart Irrigation System

The system proposed is an advanced solution for weather monitoring that uses IoT and AI to make a decision whether the water sprinklers have to be switched on or not. To design the IoT system some sensors we have used in the field like Temperature sensor, humidity sensor by using the DHT11 sensor, Light intensity using an LDR,[2] Soil moisture using Hygrometer, Ultrasonic sensor for rain water level, Raindrop sensor for detecting rainfall or snow fall.

All these sensors are used are used to detect the current climatic situation in the area and based on this prediction whether it will rain or not, Simultaneously along with that the moisture content of soil is also recorded, based on these we have decided whether the water sprinklers have to be switched or not.This is assisted by the AI model which is trained to predict whether the sprinklers have to be turned on or not.

Designed Circuit:

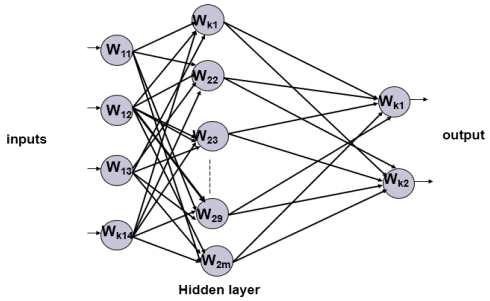
Fig: 1: Circuit with sensors



4.Basic Structure of ANNs:

The idea of ANNs is based on the belief that working of human brain. ANNs are composed of multiple nodes, which imitate biological neurons of human brain. The neurons are connected by links and they interact with each other. The nodes can take input data and perform simple operations on the data. The result of these operations is passed to other neurons.[3] The output at each node is called its activation or nodevalue**.**

Each link is associated with weight**.** ANNs are capable of learning, which takes place by altering weight

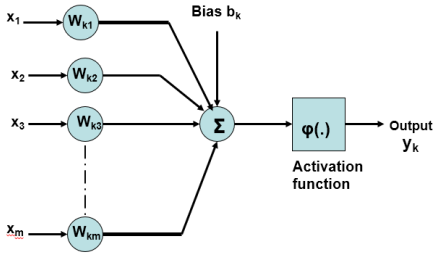


values. The following illustration shows a simple ANN –

5.Working of ANNs:

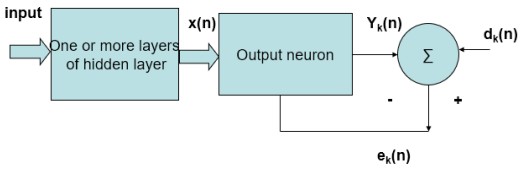
In the topology diagrams shown, each arrow represents a connection between two neurons and indicates the pathway for the flow of information. [3] Each connection has a weight, an integer number that controls the signal between the two neurons.

If the network generates a “good or desired” output, there is no need to adjust the weights. However, if the network generates a “poor or undesired” output or an error, then the system alters the weights in order to improve subsequent results.



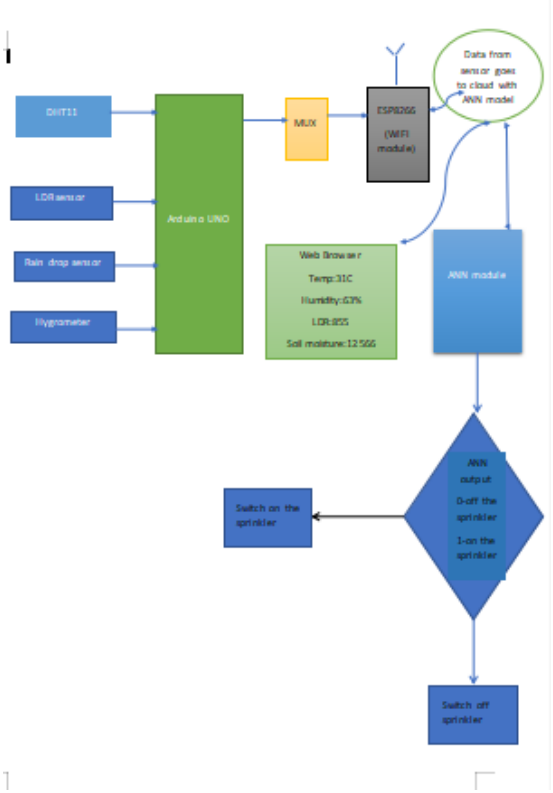
6.ANN training to make the system intelligent:

ANNs have emerged in recent years as a powerful technique for modeling general input/output relationships.[3] The distinguished characteristics of ANNs, such as learning from data, for generalizing patterns in data and modeling nonlinear relationships ,makes them a good candidate to apply for many branches of engineering This is treated as a mapping formation problem and is accomplished by a multilayer perceptron (MLP) trained in the backpropagation mode. The neural network training is the most crucial step in model development.



7.ANN model on the THINGSPEAK Platform

The ANN model is trained many times and we got the weights and bias of the neurons that are optimized . The weights and bias are extracted and a code on Thingspeak[4] is written in order to perform the decision making. The optimized weights and bias structured in the form of the ANN model give the desired output of the IoT based weather prediction system.



Flow chart: AI and IOT based smart irrigation system

8.Data Generation and training:

The generation of data is a very important part of the whole process.The input to the ANN are the humidity sensor, temperature sensor, moisture sensor. These parameters are used for training the ANN model. and when the humidity of atmosphere is less , temperature is more and the soil moisture content is low then irrigation system will run the motor to water the plants else the sprinklers need not be switched on . These inputs are given to the ANN model and the ANN is trained to predict whether irrigation system should be turned on to water the plants. The ANN model I designed front the weights and bias and put on the Thingspeak platform

The training Parameters **Table.1**

Parameters	Value
Number of input neurons	5
Number of output neurons	1
Number of hidden layers	1
Number of hidden layer neurons	5
Learning rate (η)	0.1
Training tolerance	1×10^{-3}

We took 1000 readings of temperature, humidity ,sun intensity and soil moisture from previous year's weather record and used them to train our ANN module.

9. Final Result:

Temperature °C	Humidity of Atmosphere %	Sun Intensity	Soil Moisture in %	Rain drop Sensor output	Sprinkler On/Off	Expected Output	Actual Output
17	87	0.22	12.56	1	1	1	1
17	63	0.22	34.56	0	0	0	0
16	77	0.2133333	23.56	1	0	0	0
15	55	0.2	11.78	0	1	1	1
17	67	0.2266667	9.23	0	1	1	1
16	78	0.213333	10.55	0	1	1	1
12	65	0.16	25.67	0	0	0	0

10.Conclusions:

From this innovative system design and analysis, we are able to deduce that creation of a low budget smart irrigation system As it is very exhausting to manually monitor the factors of weather change in a particular area, it is very complicated to conclude when to conduct certain activities as watering the crops. Hence we developed the AI and IoT based smart irrigation system to reduce the efforts of farmers and optimize the watering system of plants..

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