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Effective Implementation of Low Cost Smart Irrigation System Using Raspberry Pi

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ABSTRACT: This research paper is about to control the engine valves Design and implementation of Smart Irrigation System by using Raspberry Pi is proposed in this study. Raspberry Pi, which is nothing but a palm-size computer and it is capable to run a machine learning process within it. Here the process of irrigation is done with automation using a machine learning algorithm that has been implemented on the system software of Mobaxterm. This system uses a handful of sensors like moisture, humidity and temperature sensors. After the data are collected from the sensors, the data is then transferred through IOT. The sensors data can be viewed by the user through IOT in real time. This study can be moved further into a large scale of crops instead using it at only residential.

KEYWORDS: Raspberry Pi Machine Learning, IOT, FC28, DHT11.

I. INTRODUCTION

These days technology is playing a huge part in our daily lives. Back when computers were introduced in Industrial Revolution 3.0, now the world is going to Industry 4.0, the name given to the growing of traditional manufacturing and industrial platforms and practices with the latest smart technology. Industry 4.0 is focusing on the use of large scale M2M (Machine to Machine) communication and Internet of Things (IOT) application that is tend to speed up productivity, it will increase automation and improving communication among devices and human as well as intellectual devices that will analyse and calculate problems without the need for the human intervention. This IOT has been applied in so many field of study, home automation is one of it. According to appliances and devices at home can be connected to control everything at our home. For someone who has a few plants to take care of at their house, it might be trouble for them to monitor the plant while being outstation. Besides, they also do not even know how much amount of water required for the plant or whether the plant needs water or not during the current time. Hence, Smart Irrigation System is proposed to solve this issue where irrigation process is automated without the human intervention. Agriculture is the one of the major backbone of Indian economy and most of the available fresh water is used in agriculture. In India most of the irrigation systems are operated manually but not automated. There are available traditional methods of irrigation in present they are drip irrigation, ditch irrigation, sprinkler system. This problem is easily solved by the use of the automated system than the traditional systems.

The current irrigation methodology adopted is uniform water distribution which is never optimal. So, accordingly these days technologies being applied towards agricultural monitoring which is required for most of the farmers. This is an standalone monitoring station been developed employing Raspberry Pi Microcontroller along with set of meteorological sensors which includes temperature and humidity sensors. In calculation with the standalone monitoring station, Wireless Sensor based monitor system been developed which is composed of number of wireless sensor nodes and a gateway. This system that provides a unique, wireless and easy solution with enhanced spatial and chronological resolutions. So towards this, “Machine learning” which is a part of Artificial intelligence plays a key role which allows devices to learn without being explicitly programmed. Machine learning got its applications in Crop Selection and Yield where many effective Machine

algorithms identify the input and accordingly output the relationship in Crop selection yielding the approximated prediction.

[1].Dynamic irrigation development system (AgriSens) based on IOT for efficient water management of irrigated crop fields. The paper provides real time, automatic, dynamic and also isolated physical irrigation method for different growth phases of a crop's life cycle using IOT. A very low-cost water level sensor is designed so that we can measure the level of water that is present in crop field. We developed an algorithm for automatic dynamic-cum-manual irrigation based on the farmer's requirements.

[2].The agricultural filed is fully changed from manual monitoring and control to Automation monitoring and control with the help of advanced technology results increased productivity and small number of human involvement. So, in this study an automatic irrigation system uses automatic watering system to monitor and control the appropriate soil moisture content in the crop field. Raspberry Pi Microcontroller is a control of this system and also it is remotely controlled through mobile phones. The accurate soil moisture content in the soil is measured by the soil moisture sensor, there is no under or over irrigation to the crops because the proper amount of the water level is given by the sensors we use. IOT technology is used to verify the humidity level present in the soil. The client can easily increment and decrement the Humidity level by using this IOT technology with assistance with solenoid valve and water locator is used to locate the water pump stream.

[3].These days' agriculture plays a vital role in the Indian economy and most of the people are dependent on it for their livelihood. In this case water is an important resource that definitely needs to be preserved by our latest accessible technologies. IOT is not only being the fundamental in history and also extends its capability to latest smart farming. In this study work proposed here is targeting to build up a low cost intelligent system for smart irrigation. They are using IOT to talk and connect to their system on their own with some of the speciality like there will be a admin mode for user interaction, one-time setup for irrigation schedule evaluation, neural base choice making for intellectual maintain and remote data monitoring. So, a sample crop test has been chosen that will present the results of the proposed system, that include irrigation schedule, neural net decision making and remote data viewing.

[4].This paper focus on effective consumption of water resources with basic irrigation across different agricultural farms is required with the advancement of technology. This paper contains a framework based on cloud and Internet of things for implementing a smart irrigation system. On the defined framework, a case for automated smart irrigation system is developed and a skilled method is defined for effectual utilization of extreme water generated from showers to boost the groundwater levels. This case provides elasticity to farmers for monitoring the farms in real time using the farmer's ring. Here, various devices are confidently incorporated to empower smart irrigation and to monitor the system in real time. This case actuation and automation both are done based on certain obligatory constraint to react as per inputs and outputs generated by a variety of devices installed in smart irrigation system.

[5].The main essential and basic thing to live on earth is Water. In recent times rising the shortage of water due to growing in residents. So this is becoming as a universal problem. The traditional irrigation system that demands a lot of water, so it need to be replaced by smart techniques for reducing the proportion of wasting existing water for the irrigation. There is an increase of huge demand for IOT in every domain that is from tiny and easy applications to bulky and complex applications. Generally the implementation of a Smart Irrigation system is very complex method, but connection with IOT by means of Smart wireless sensors it brings a vast management system. The Humidity and the Temperature Sensors sense both the water-vapor content in the plant and temperature around the plant. The Soil Moisture Sensor sense the soil moisture content of a plant and soil, if the measured water content is under minimum necessity then water will supply from water reservoir using relay and Ultrasonic sensor. There are so many Studies have also shown via a survey format that 90% of farmers agree that better irrigation management through the use of mobile and web applications will facilitate to recover the yield and productivity of their crop field.

[6].This paper proposes and demonstrates economical and trouble-free way to use arduino based controlled irrigation system. The planned system deals with various ecological factors such as moisture, temperature and quantity of water required by the crops using some of the sensors like water flow sensor, temperature sensor and soil moisture sensor. Data of these are collected and received by means of arduino that can be linked to an interactive website that shows the real time. This method shows a absolute intelligent IOT based Automated Irrigation system prototype that is

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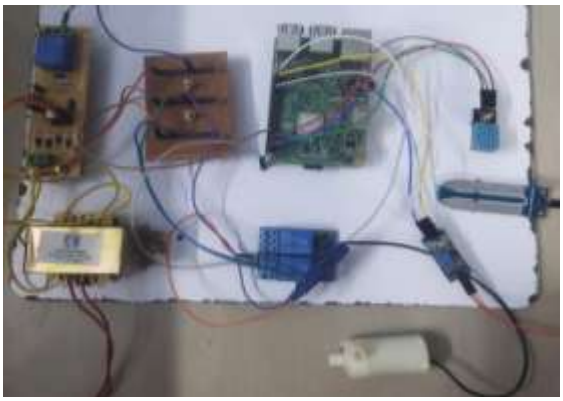
developed where intelligence developed in training the data set for predicting the soil moisture state towards watering the field or not that makes stuff simpler for cultivator of not upsetting about watering the field. There are available traditional methods of irrigation in present they are drip irrigation, ditch irrigation, sprinkler system.

II. HARDWARE OF THE PROPOSED SYSTEM



This project requires three different sensors which consists of soil moisture sensor (yl60), temperature and humidity sensor (DHT11), and Temperature sensor (LM35) to measure the Values. These given sensors that are connected to Raspberry Pi in support of machine learning procedure and these data send and gathered from the sensors to firebase database. Finally, the data from the database will be given to user to monitor. These data will be stored in the IOT for future reference from that data the analysis is made easy every time the data will be automatically stored.

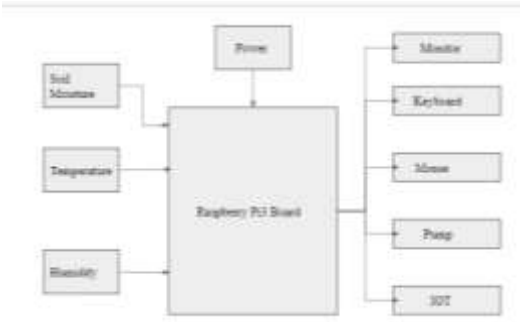
The Raspberry Pi is very new in the world and so many people actually don't know the real purpose of Raspberry Pi. Raspberry Pi is basically a low cost, credit-card sized computer which we plug into a computer monitor or TV, or laptop and it also uses a standard keyboard and mouse. This is capable of devices which enable people of all ages to learn many new things on computing, and also to learn how to program in many languages like Scratch and Python. This is capable of doing the whole thing you would expect a desktop computer to do, without browsing the internet and also playing the high definition video, to make spreadsheets, word-processing, and also playing games. This has vast bonding with the arduino and it can also do a lot with combining arduino.

View of Raspberry Pi in the Model

III. EXPERIMENTATION

The Block Diagram of our proposed system having Raspberry Pi as the Micro controller connecting the sensors in the input side of the board. And power supply is given to the board after this the output side consists of pump monitor IOT. Circuit Diagram of our proposed system is given below this circuit consists of Raspberry Pi board, DTH11 Sensor, Soil Moisture Sensor, Temperature sensor, Power supply and pump motor. The soil moisture sensor and DHT11 sensors are connected in the GPIO PIN of the Raspberry Pi board. The equal 5V from the hub is given to Raspberry Pi board and relay to switch on the motor pump. These connections have made and then connect the Raspberry Pi to power supply connect everything in the same network so that it need not to be connected manually. This is fully wireless connection through the network.

The transformer work is to step up or step down the input line voltage and that will isolate the power supply from the power line of the system. The RECTIFIER of the system section converts the alternating current that is AC input signal to a pulsating direct current that is DC. On the other hand, as you proceed in this chapter you will learn that pulsating DC is not desirable. For this reason a section called FILTER is used to convert the pulsating DC to a pure, and extra.



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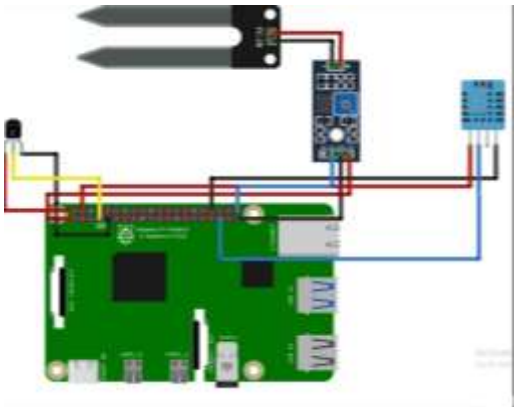
BLOCK DIAGRAM OF THE PROPOSED SYSTEM USING RASPBERRY PI AND IOT



CIRCUIT DIAGRAM OF THE SYSTEM

This is the Circuit Diagram of the Proposed system this circuit consists of main Microcontroller board called Raspberry Pi and thus we are connecting the sensors in the GPIO pins in the board and having the power supply given to the board and relay and then the relay is connected to the pump that will work when the moisture is not detected. The whole process is connected and monitored using the IOT that is fully connected through the internet no other connections are made to the laptop or monitor.

SOURCE CODE:

```
import time
import RPi.GPIO as GPIO
import numpy as np
import os
import sys
import requests
import math
import random
TOKEN = "BBFF-tbre1YbfbcI3yutvMnJQ8lRZMjJC4V"
DEVICE_LABEL = "RPI"  # Put your device label here
VARIABLE_LABEL_1 = "temperature"  # Put your first variable label here
VARIABLE_LABEL_2 = "humidity"  # Put your second variable label here
VARIABLE_LABEL_3 = "moisture"  # Put your second variable label here
print ("Processing...")
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO_Moisture = 26
GPIO_RELAY = 6
GPIO.setup(GPIO_Moisture, GPIO.IN)
GPIO.setup(GPIO_RELAY, GPIO.OUT)
GPIO.output(GPIO_RELAY, False)
#GPIO.setup(GPIO_METAL, GPIO.IN, pull_up_down = GPIO.PUD_UP)
def build_payload(variable_1, variable_2, variable_3):
    # Creates two random values for sending data
    value_1 = random.randint(-10, 50)
    value_2 = random.randint(0, 85)
    # Creates a random gps coordinates
    lat = random.randrange(34, 36, 1) + \
        random.randrange(1, 1000, 1) / 1000.0
    lng = random.randrange(-83, -87, -1) + \
        random.randrange(1, 1000, 1) / 1000.0
    payload = {variable_1: value_1,
               variable_2: value_2,
               variable_3: {"value": 1, "context": {"lat": lat, "lng": lng}}}

    return payload

def post_request(payload):
    # Creates the headers for the HTTP requests
    url = "http://industrial.api.ubidots.com"
    url = "{}/api/v1.6/devices/{}".format(url, DEVICE_LABEL)
    headers = {"X-Auth-Token": TOKEN, "Content-Type": "application/json"}
    # Makes the HTTP requests
    status = 400
    attempts = 0
    while status >= 400 and attempts <= 5:
        req = requests.post(url=url, headers=headers, json=payload)
        status = req.status_code
        attempts += 1
        time.sleep(1)
    # Processes results
    print(req.status_code, req.json())
    if status >= 400:
        print("[ERROR] Could not send data after 5 attempts, please check \
              your token credentials and internet connection")
        return False

    print("[INFO] request made properly, your device is updated")
    return True

if __name__ == '__main__':
    while True:
        try:
            file1 = open("temp_hum.txt","r")
            temp_hum = file1.readlines()
            temp_hum = temp_hum[0].split(' ')
            temp_ = temp_hum[0]
```

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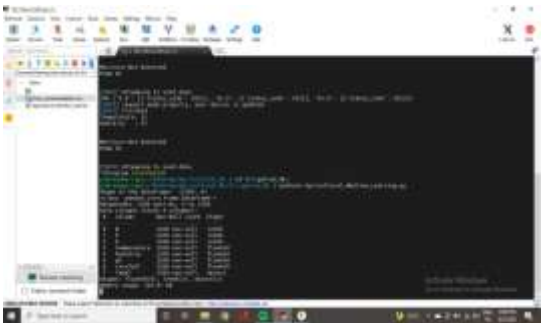
```
        hum_  = temp_hum[1]
        print('Temperature: ' + temp_)
        print('Humidity   : ' + hum_)
        file1.close()
        time.sleep(0.5)
        print('\n')
        Mositure_set = 0
        if GPIO.input(GPIO_Moisture) == False:
            print('Mositure Detected')
            Mositure_set = 1
            GPIO.output(GPIO_RELAY, False)
            print('Pump Off')
        else:
            print('Mositure Not Detected')
            Mositure_set = 0
            GPIO.output(GPIO_RELAY, True)
            print('Pump On')
        print('\n')

        payload = build_payload(
            float(temp_),float(hum_),
float(Mositure_set))

        print("[INFO] Attemping to send data")
        post_request(payload)
        print("[INFO] finished")

    except KeyboardInterrupt:
        print('Program Terminated!')
        sys.exit(0)
```

IV. OBESERVATIONS OF THE PROPOSED SYSTEM

Using MobaXterm Software for Linux OS

After the connections are made and then the software called mobaxterm is installed for operating the Raspberry Pi in the linux os. After successfully logging in to the session we have to type the password and open the Raspberry Pi. Then open the folder and run the python program the temperature and humidity is detected and the pump is in on condition for the recorded value. Then the data is stored in IOT hub that created in Ubidots. If the moisture is not detected the pump will be in on condition and the data is given in the screen.

If the Moisture is detected then the pump will be in off condition and then the data is still noted and stored in the IOT for the future reference. This will give the clear cut idea of the soil moisture content and will get to know the soil temperature and rainfall level. For operating this we need the linux operating system in this project we are using the mobaxterm software there are so many software readily available for the linux os in windows.



This module is for running the code that will give us the previously stored data and will give us the output in the graphical representation. Mobaxterm is the very important toolbox for remote computing these days. In a very particular Windows application, it will provide the loads of functions and operations that are adapted for programmers, webmasters, IT administrators and pretty much for all of the users who need to switch their remote jobs in a more simple and effective method with fashion.

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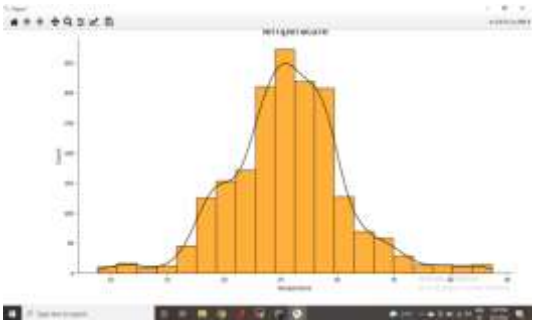

Temperature level is recorded in the soil at the real time. X axis is the level of Temperature and Y axis is the count. When temperature is low this includes cucumber, pumpkin, bitter gourd, etc. This graph shows the temperature that is observed by the system and the graphical representation of that. The data that observed will be automatically saved in the IOT hub. Every time the data will be saving here for the future reference. Create an account in ubidots and then use the same network connection as Raspberry Pi so that this will automatically collects the observed information from the Raspberry Pi. Ubidots is an Internet of Things (IOT) data analytics and visualization company.

V. CONCLUSION

A Smart Irrigation System has been proposed to predict not only the irrigation time in small scale crops but also the accurate time when the water is given to the crops. The system mainly consists of three type sensors, which is moisture sensor, temperature sensor and Humidity sensor to measure the level of water inside the tank. IOT is used to view all the sensors data and integrate it for user to view the real time data. The data that we collect consist of moisture level of the soil data, humidity level of the soil data, temperature level of the soil data and also the nitrogen, potassium, phosphorous and rainfall data is collected. Through this project it can be concluded that there can be considerable development in irrigation with those of IOT and automation. Due to automatically handling, user requires less man power. With the help of the given sensors, it can accurately measure and predict the soil moisture levels. It can also easily detect and control the temperature, humidity, solar radiation of the soil using these sensors.

SOME OF THE ADVANAGES FROM THE ABOVE RESULTS

a) Ability to save water
b) Time efficient and easy to develop
c) Raspberry Pi is small size computer that we can work easily.
d) Storing the every data in IOT for future reference
e) Easy and compact
f) Can use in large agricultural fields for irrigation.

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