# **PROJECT REPORT**

**ON**

## **“MODERN IRRIGATION SYSTEM”**

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**“It is not possible to prepare a project report without the assistance & encouragement of other people. This one is certainly no exception.”**

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**CONTENTS**

1. ABSTRACT

2. INTRODUCTION

3. LITERATURE SURVEY

4. TYPES OF SENSORS

5. ARCHITECTURE

6. REFERENCES

**Abstract**

The smart water irrigation system developed by our team is an adaptive plants and crops irrigation system. The purposes of our smart water irrigation system are to provide a water delivering schedule to the crops to ensure all the crops have enough water for their healthy growth, to reduce the amount of water wasted in irrigation, and to minimize the economic cost for the users. Our system takes in real time data of the water content of the plant as input argument, combines it with other parameters such as water cost schedule and precipitation on the crop field, runs the designed linear optimization system periodically and outputs the most efficient amount of water the plants need, which is translated by a specific actuation time of the water pumps. The linear optimization system, which is essentially the brain of our system, is able to make decisions for the users when to distribute water into the crops fields and how much water should be delivered. Given the number of factors to take into account and the different crop requirements to take into account for each type of plant, this problem because much too complex to solve through simple management methods and has to be supported by automated systems such as the one provided by our group. In the droughty California nowadays, utilizing our smart water irrigation system not only supports the environmental sustainability of the regional area, but also significantly lowers the expense of water usage for the farmers.

**INTRODUCTION**

The **Internet of things** (**IOT**) is the network of devices such as vehicles, and home appliances that contain electronics, software, sensors, actuators, and connectivity which allows these things to connect, interact and exchange data.

The IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally *dumb* or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

[](https://en.wikipedia.org/wiki/File:Internet_of_Things.jpg)

Drawing representing the Internet of things (IOT).

IOT applications in farmingsuch as collecting data on temperature, rainfall, humidity, wind speed, pest infestation, and soil content. This data can be used to automate farming techniques, take informed decisions to improve quality and quantity, minimize risk and waste, and reduce effort required to manage crops. For example, farmers can now monitor soil temperature and moisture from afar, and even apply IOT-acquired data to precision fertilization programs.

**LITERATURE SURVEY**

Irrigation is most important for high yield of the farm. Today, by using WSN technology it is possible to monitor and control the environmental conditions as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity etc for irrigation.

[1] M.Nesa Sudha et al., 2011 proposed a TDMA based MAC protocol used for collect data such as soil moisture and temperature for optimum irrigation to save energy. MAC protocol plays an important role to reduce energy consumption. Two methods used for energy efficiency as Direct Communication method and aggregation method. Direct Communication method provides collision free transmission of data, because all the sensor nodes send data directly to the base station without the need of header node. This method is better where the base station is near but it is not optimum where the base station is far because sensor nodes consume more energy during transmission of data and if there is much data to the sensor node, sensor nodes quickly damaged. The data aggregation method is better to use rather than direct communication method. The sensor node senses the data and send to the head node. The head node collects data from the entire sensor node, performs aggregation using various aggregation techniques, and then sends data to the base station. Thus by using aggregation method overall energy consumption reduce of the network. The simulation result show that aggregation method provide better performance rather than direct communication method. It provides 10% increase in residual energy and 13% increase in throughput. Sensor nodes consume more energy while transmitting data.

[2] Man Zhang et al., 2012 analysis the temporal and spatial variability of soil moisture for the realization of variable irrigation and for improve yield in the farm. Temporal variability adopts the changes of soil moisture at the place where the sensor nodes installed and analyze soil moisture variation at different times according to season. Spatial variability analyses calculate all parameter of soil moisture as average, maximum, minimum in whole area. The temporal variability curve has drawn according to measure data. It showed that the corn was in severe water stress state during the completely monitoring period.

[3] Joaquin Gutierrez et al., 2013 proposed an irrigation system that uses photovoltaic solar panel to power system because electric power supply would be expensive. For water saving purpose, an algorithm developed with threshold value of temperature and soil moisture programmed into a micro controller gateway. The system has a full duplex communication links based on internet cellular interface using GPRS based on mobile data for graphically display and stored in a database server. The automation irrigation system consists of two components were WSU and WIU. Wireless Sensor Units (WSU) components were used for minimize power consumption because microcontroller is well suited by its lower power current in sleep mode. Wireless Information Unit (WIU) transmits soil moisture and temperature data to a web server using GPRS module. The WIU identify recorded and analyzed received temperature and soil moisture data collected by WSU. WIU functionality is bases on microcontroller that programmed to perform different task as to download the date and time information from web server and compare the temperature and soil moisture value with maximum soil moisture and minimum temperature value so that irrigated pumps activated.

[4] Sherine M.Abd El-kader et al., 2013 proposed APTEEN (Periodic Threshold oldsensitive Energy-Efficient sensor Network) protocol. APTEEN is a Hierarchical based routing protocol in which nodes have grouped into clusters. Each cluster has a head node and head node is responsible for broadcast data to the base station. APTEEN broadcast parameters attribute, which is a set of physical parameters, in which the user is interested to obtain info, Thresholds value as Hard Threshold and Soft Threshold, Schedule as TDMA schedule uses to assign slots to save energy, which provide collision free transmission. It controls the energy consumption by changing threshold values and count time. The performance of proposed protocol is better than LEACH on average 79% and by LEACH-C on average 112%.

[5] Anuj Nayak et al., 2014 describe that sensor nodes batteries are charged by using harnessing wind energy. A routing algorithm named DEHAR is proposed to extend overall batteries power. The proposed method is efficient where the amount of sensor nodes very low because of latency experienced due to synchronous sleep scheduling. A small band belt used to harness wind energy to sensor nodes. Wind belt is aero elastic flutter, which is capable for harnessing wind energy. Harnessing wind energy is a renewable energy source. However, the main problem using harnessing wind energy is the unreliability as the power of the wind is not permanent.

[6] Yunseop Kim et al. represents real time monitoring and control of variable rate irrigation controller. The sensor nodes measure environmental parameter and transmit data to base station where base station process data through a user-friendly decision making program and all data commands send to irrigation control station. The Irrigation control station sends machine location using GPS to the base station.

[7] B. Balaji Bhan et al., 2014 proposed a system to develop WSN based soil moisture controllers that determine the water requirement by comparing soil moisture with predefined threshold value. An intelligent remote system consists of wireless sensor nodes and computer system in which data is transmitted to a server system from where the data accessed by individuals for decision making for automated control of irrigation for the yield productivity. Field validation tests routinely performed on different soils to measure the soil moisture, water amount in soil for efficient irrigation system. If the stored data does not match with the soilmeasured data, an interrupt sent to the pressure unit and stop irrigation automatically.

[8] Sbrine Khriji et al., 2014 describe different type of sensor nodes for real monitoring and control of irrigation system. Each node consists of TelosB mote and actuator. TelosB mote is an ultra low power wireless module for monitoring applications. Soil nodes used to measure the soil moisture weather nodes used to measure environmental parameter and actuator used for controlling the opening of valves for irrigation. The system has cost efficient and reduce the power consumptionThe experimental result shows that the plants are well irrigate and if there is any change in threshold value the system alert to farmer about the problem to take the appropriate decision.

[9] T.C. Meyer et al., 2015 represents the design of smart sprinkler system using mesh capable WSN for monitoring and control of field irrigation system. This system provides accuracy by controlling the soil moisture level between the thresholds. Sensor nodes send data to base station every time the timer variable overflows. Base station has an actuator interface to control solenoid valve using GUI. GUI provides system feedback to user and allows changing the parameter and initially setup the system. Air temperature, soil temperature and humidity greatly influence the tomato crop. Certain disease occurs in tomato crop due to high humidity and warm temperature such as gray mould and leaf mould.

[10] Ravi Kishore Kodali et al.,2015 represents the overall history of spices as black pepper, cardamom and clove in different states where these spices are cultivated and exporters of spices and the problem faced by farming community related to pest and irrigation. Therefore, WSN used to measure different soil and environmental parameter and the presence of pests among crops and provides measures value to the user to take appropriate decision to improve crop yield. MEMSIC eko nodes used for real time monitoring of parameters and control of irrigation system.

[11] Nelson Sales et al., 2015 proposed cloud based WSAN communication system, monitoring and control of a set of sensors and actuators to measure water plant needs. Cloud computing provide high storage capacity and high processing capability. The proposed architecture divided into three components such as a WSAN component, a cloud platform components and a user application component. WSAN contain three types of nodes are a sink node, a sensor node and an actuator node. Cloud computing provide attractive solution to large amount of data. In addition, the web application provides user interfaces that allow the user to visualize the location of the network nodes to access historical data.

[12] Shaik Ameer et al., 2015 describe the use of solar power for an automatic irrigation system to supply required water to the pump set. Solar module used to convert sunlight to electricity. The electricity produced from sunlight can be stored in batteries. Humidity sensors used to sense the wet and dry conditions of the soil. After sense the data, the sensor node sends signal to microcontroller and microcontroller give signals to relay which is an electrically controlled switch for on and off to turn on the motor if the soil is dry and off the motor in wet conditions.

[13] Joaquin Gutierrez et al., 2015 represents that the sensors use Smartphone to capture and process images of soils. Images can be capture to estimate the water content of the soil. The router node is used to forward collected values to the gateway that provide automatically pump the water to the crop in a field. An Android app used for connectivity such as Wi-Fi. Android app wakes up the Smartphone by using given parameters. In-built camera takes an RGB picture of the soil through an anti-reflective glass window to take estimation of wet and dry area. The mobile app enables the Wi-Fi connection of Smartphone to transmit the estimation value to the gateway via a router node for control an irrigation water pump.

[14] You-zhu et al., 2016 proposed support vector machine to forecast water consumption and genetic algorithm is used to select parameter of SVM. GA-SVM is more robust and accurate because of its strong global search capability. Experimental result shows that GA-SVM can achieve greater forecasting accuracy then ANN (Artificial Neural Network) in forecasting the water consumption used in agriculture.

[15] Jaume Cosadesur et al., 2016 proposed an algorithm using feedback mechanism that gives response about the effect of applying the schedule it generate for the crop water needs. The goal of this algorithm is to schedule irrigation according to requirements of each grove and to the variability during the season caused by weather conditions and other factors. The algorithm performs seven different tasks as firstly it measures the amount of water given each day to the farm depending on weather conditions and crop growth. It implements the installation of the water management system to manage the amount of water delivered to the crops in the farm, execute the irrigation schedule, and measure the effects of the schedule on the crop and the data collected by the sensors processed to extract meaningful information for decisionmaking. The algorithm detect an event will trigger the execution of specific procedures for that type of event and at last implement the feedback mechanism for close the loop of the algorithm. The result shows that the simple water balance gives fast response rather than feedback mechanism for weather conditions.

[16] P. Alagupandi et al. proposed a simple and cost effective smart irrigation system. The system is modeled in outdoor environment using Tiny OS based IRIS motes to measure the moisture level of the paddy field. Moisture sensors measure the soil moisture level. The system set a threshold value and if the voltage exceeds that threshold then it represents the driest soil. Proposed system has better visualization and monitoring GUI. The motor automatically switch on by pressing the button task of visualization panel. AIS work with the help of MOTEWORKS visualization tool.

[17] Anurag D et al., design a WSN to remotely monitor the agriculture parameter and automated control the irrigation and fertigation for a precision agriculture. Static routing algorithm develops to prevent the wastage of address space and using tree-based structure maintains efficient routing. When the threshold value increases, the system can be generate an automated alert message on the console about which appropriate action performed. The valves automatically open according to the value to start irrigation and fertigation according to the need.

[18] Hema N. et al., propose a technique to predict real-time local weather parameter of interpolation using Automated Weather Station. Using sparse WSN with soil moisture sensor, this paper provide error correction and accuracy about 99.59% for real time interpolated data. This system provide past, present predict and future predict using nearby ASW data and control the irrigation in conditions like rainfall. For irrigation control, soil moisture and AWS data used and for error correction, interpolated data is comparing with soil moisture data.

[19] Bhushan G. Jagyasi et al., proposed agro- adversary system which provide an event based querying modeling which helps to query the history of events and their linkage in spatialtemporal dimensions. mKRISHI mobile phone application can be used by farmers to raise a query using text, voice, picture and video. All the information stored in the form of events in EventBase. In mKRISHI architecture various events defined such as sensor based events, an event occur when any parameter observed by a sensor is abnormally high or low, any query made by farmer is an event and responses of experts o the query is an another event. Many actions like irrigation performed by the farmer also an event and many other events occur. The event-based approach provides past experience to improve decision-making. This approach provides the history of agriculture experience to agricultural experts, to improve responses of the farmer’s query. For the mKRISHI agro-advisor system the model provides an experience sharing platform between different experts.

**SENSORS**

Sensor Is an input device which provides an output (signal) with respect to a specific physical quantity (input). Another unique definition of a Sensor is as follows: It is a device that converts signals from one energy domain to electrical domain

TYPES OF SENSORS USED:

1. DHT11

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a highperformance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

1. IR

Infrared technology addresses a wide variety of wireless applications. The main areas are sensing and remote controls. In the electromagnetic spectrum, the infrared portion is divided into three regions: near infrared region, mid infrared region and far infrared region.

The wavelengths of these regions and their applications are shown below.

* Near infrared region — 700 nm to 1400 nm — IR sensors, fiber optic
* Mid infrared region — 1400 nm to 3000 nm — Heat sensing
* Far infrared region — 3000 nm to 1 mm — Thermal imaging

The frequency range of infrared is higher than microwave and lesser than visible light.

The basic concept of an Infrared Sensor which is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include an LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector.

1. ULTRASONIC SENSOR

As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves.  
The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head. The distance can be calculated with the following formula:

### Distance L = 1/2 × T × C

where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.)

1. RAIN SENSOR

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features, a rain board and the control board that is separate for more convenience, power indicator LED and an adjustable sensitivity though a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to 5V power supply, the LED will turn on when induction board has no rain drop, and DO output is high. When dropping a little amount water, DO output is low, the switch indicator will turn on. Brush off the water droplets, and when restored to the initial state, outputs high level.

1. MOISTURE SENSOR

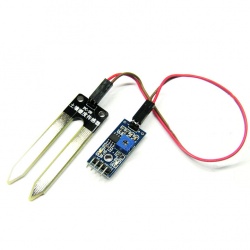
* The **Moisture sensor** is used to measure the water content(moisture) of soil.when the soil is having water shortage,the module output is at high level, else the output is at low level.This sensor reminds the user to water their plants and also monitors the moisture content of soil.It has been widely used in agriculture,land irrigation and botanical gardening.
* Working Voltage:**5V**
* Working Current:**<20mA**
* Interface type:**Analog**
* Working Temperature:**10°C~30°C**
* There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges.The Soil Moisture Sensor is used to measure the loss of moisture over time due to evaporation and plant uptake,evaluate optimum soil moisture contents for various species of plants,monitor soil moisture content to control irrigation in greenhouses and enhance bottle biology experiments.

## **download (1).jpg**

## **ULTRASONIC SENSOR**



**INFRARED SENSOR**

****

**MOISTURE SENSOR**

## **download.png**

## **RAINDROP SENSOR**



RPI ZERO W

**Code Used:**

import RPi.GPIO as gpio

import Adafruit\_DHT

import sys

import time

import string

import threading

import os

import cayenne.client

MQTT\_USERNAME = "2cae3460-7932-11e8-99f5-3323ff570d09"

MQTT\_PASSWORD = "94cd831d9aa4699704bdb2f2d3fb545c9a9c2751"

MQTT\_CLIENT\_ID = "07e26c10-7a03-11e8-861b-e79eceb83d4e"

client = cayenne.client.CayenneMQTTClient()

client.begin(MQTT\_USERNAME, MQTT\_PASSWORD, MQTT\_CLIENT\_ID)

gpio.setwarnings(False)

gpio.setmode(gpio.BCM)

#sensor=Adafruit\_DHT.DHT11

#dht=2

#gpio.setup(2,gpio.IN) #add additionally

rain=3

gpio.setup(3,gpio.IN)

soil=4

gpio.setup(4,gpio.IN)

#motor\_n1=14

#motor\_n2=15

#en=18

#gpio.setup(18,gpio.OUT)

#gpio.setup(14,gpio.OUT)

#gpio.setup(15,gpio.OUT)

trig=23

echo=24

gpio.setup(23,gpio.OUT)

gpio.setup(24,gpio.IN)

gpio.output(23,False)

#def dht():

# print("\nInitializing DHT sensor...\n")

# time.sleep(2)

# while True:

# client.loop()

# humidity, temperature=Adafruit\_DHT.read\_retry(11,2)

# if humidity is not None and temperature is not None:

# client.celsiusWrite(1, temperature)

# client.luxWrite(2, humidity)

# print('Temp:{0:0.1f}\*C Humidity: {1:0.1f}%'.format(temperature,humidity))

# time.sleep(2)

# else:

# print("\nFailed to get reading...\n")

def rain():

print("\nInitializing Rain Sensor...\n")

time.sleep(2)

while True:

if (gpio.input(3)==False):

print("Raining")

time.sleep(0.2)

else:

print("Not raining")

time.sleep(0.2)

def soil():

print("\nInitializing Soil Moisture Sensor...\n")

time.sleep(2)

while 1:

if (gpio.input(4)==False):

print("Wet Soil")

time.sleep(0.2)

else:

print("Dry Soil")

time.sleep(0.2)

#def motor():

# print("\nInitializing Motor...\n")

# time.sleep(2)

# while True:

# if(gpio.input(22)==True and gpio.input(27)==True):

# gpio.output(18,True)

# gpio.output(14,True)

# gpio.output(15,False)

# else:

# time.sleep(1)

# gpio.output(14,False)

# gpio.output(15,False)

def ultrasonic():

print("\nInitializing Ultrasonic Sensor...\n")

time.sleep(2)

while True:

time.sleep(2)

gpio.output(23,True)

time.sleep(0.00001)

gpio.output(23,False)

while gpio.input(24)==0:

pulse\_start=time.time()

while gpio.input(24)==1:

pulse\_end=time.time()

pulse\_duration=pulse\_end-pulse\_start

distance=pulse\_duration\*17150

distance=round(distance,2)

print("Distance",distance,"cm")

print("\n====================== Starting ======================\n")

print("\nInitializing the system...\n")

time.sleep(5)

print("\nSystem is Ready\n")

time.sleep(2)

try:

while True:

#t1=threading.Thread(target=dht)

t2=threading.Thread(target=rain)

t3=threading.Thread(target=soil)

#t4=threading.Thread(target=motor)

t5=threading.Thread(target=ultrasonic)

#t1.start()

t2.start()

t3.start()

#t4.start()

t5.start()

#t1.join()

t2.join()

t3.join()

#t4.join()

t5.join()

except KeyboardInterrupt:

print("\n\nForcely Stop System\n\n")

time.sleep(4)

gpio.cleanup()

time.sleep(1)

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