RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi, Accredited By NAAC, Bengaluru And NBA, New Delhi

Go, change the world

Department of Mechanical Engineering

IOT-Based Water Valve Actuator For Agriculture Applications

MINOR PROJECT REPORT

Submitted by

Gowrav M P Kannar	1RV20ME045
Jaiprakash I P	1RV20ME051
K A Sucheth Moudgalya	1RV20ME054
Mallappa	1RV20ME061

Under the Guidance of

Dr. B W Shivaraj

Assistant Professor

Dept of Mechanical Engineering

RV College of Engineering

In partial fulfilment for the award of degree of

Bachelor of Engineering in

Mechanical Engineering 2022-2023

Department of Mechanical Engineering

CERTIFICATE

This is to certify that the Minor Project work titled "IOT-Based Water Valve Actuator for Agricultural Applications" is carried out by , **Gowrav M P Kannar (1RV20ME045), Jaiprakash I P (1RV20ME051), K A Sucheth Moudgalya (1RV20ME054)** and **Mallappa (1RV20ME061)** who are bonafide students of RV College of Engineering, Bengaluru, in partial fulfilment for the award of degree of **Bachelor of Engineering in Mechanical Engineering** of the Visvesvaraya Technological University, Belagavi during the year 2022-2023. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the minor project report deposited in the departmental library. The major project report has been approved as it satisfies the academic requirements in respect of Minor Project Work (18ME64) prescribed by the institution for the said degree.

Dr.B W Shivaraj **Assistant Professor** **Dept. of Mechanical Engineering**	**Dr. M Krishna** **Head of Department** **Dept. of Mechanical Engineering**	**Dr. K N Subramanya** **Principal** **RV College of Engineering Bangalore**

External Viva

Name of Examiners	**Signature with date**
1.	
2.	

Department of Mechanical Engineering

DECLARATION

We, **Gowrav M P Kannar (1RV20ME045), Jaiprakash I P(1RV20ME051), K A Sucheth Moudgalya (1RV20ME054)** and **Mallappa(1RV20ME061)** students of Sixth Semester B.E, Mechanical Engineering, RV College of Engineering, Bengaluru hereby declare that the project titled **IoT-Based Water Valve Actuator For Agriculture Applications** is carried out by us and submitted in partial fulfilment for the award of the Degree of Bachelor of Engineering in Mechanical Engineering for the academic year 2022-2023.Further we declare that the content of the project report has not been submitted previously by anybody for the award of any degree or diploma to any other University.We also declare that any Intellectual property rights generated out of this project carried out at RVCE will be property of RV College of Engineering, Bengaluru and we will be only one of the co-authors of the same.

Place: Bengaluru
Date:

Team Members

1. Gowrav M P Kannar
2. Jaiprakash I P
3. K A Sucheth Moudgalya
4. Mallappa

Acknowledgement

The successful completion of this project work was made possible through the valuable contribution of a number of people. To say thank you to all of them is not even enough to express our gratitude.

Our first debt of gratitude and deep regards must go to our guides **Dr.B W Shivaraj**, Moderator, Department of Mechanical Engineering, for their valuable and inspiring guidance, wholehearted support, suggestions, patience and constant encouragement throughout our project work and their immense help in the preparation of this thesis. The blessing, help and guidance given by them from time to time shall carry us a long way through our journey.

Our sincere thanks to **Dr. M. Krishna**, Professor and Head, Department of Mechanical Engineering, for his valuable suggestions and support to carry out the entire project work in the facilities of the Department for their advice and encouragement throughout the project work.

We express sincere gratitude to our beloved Principal **Dr. K. N. Subramanya** for his appreciation towards this project. Lastly, our special thanks go to our **parents** for their blessings have been a great source of inspiration for us.

Abstract

For over decades, the traditional irrigation methods are ditch irrigation, sprinkler system, and drip irrigation. The traditional irrigation systems have uncontrolled irrigation practices, waterlogging, soil deterioration, wastage of water and require continuous human intervention leading to higher usage of electricity and uneven growth of plants. Introducing IoT solutions enables precise crop watering and results in increased productivity with low maintenance, optimal use of resources, and enables future harm prediction. A new sophisticated approach minimizes the problem by connecting one mother/feeder pipe to various child pipes which in turn covers the entire area for watering. The IoT-enabled control valve boxes are mounted covering a range of half-kilometer area. The system is solar-operated without the requirement of an external battery that can sustain under unfavorable conditions. Keywords: Smart control valve, solar operated, cloud computing, mesh networking, nutrients control, wireless technology, harm prediction.

The proposed system leverages the Arduino microcontroller as the central processing unit, integrating various components to enable seamless communication and control. The relay channel acts as a switching mechanism to control the valve actuator, allowing precise control over the water supply. The servo motor assists in adjusting the valve position, regulating the water flow as required. The water pump is utilized to provide the necessary water pressure for efficient irrigation.

To enable connectivity and remote control, an ESP module is employed, facilitating the integration of the system with the internet. Through a dedicated web or mobile application, users can monitor and control the valve actuator system remotely. This feature ensures that farmers can efficiently manage irrigation schedules, enabling timely and adequate water supply to crops, optimizing their growth and yield.

Table of Contents

List of Figure

List of Table

Chapter 1

Introduction

1.1 IOT-Based Valve Actutator

The IoT-based valve actuator for crop irrigation is an innovative technology that combines the Internet of Things (IoT) with precision agriculture techniques. This system enables automated and precise control of water supply to crops in a particular area based on specific timing requirements. The valve actuator is the central component of this system. It is a device that controls the flow of water through irrigation pipelines. By integrating this actuator with IoT technology, it becomes possible to control the irrigation process using a web-based application or a dedicated mobile app. The IoT-based valve actuator system typically consists of several interconnected components. These include servo motor, Arduino, globe valve, water pump, relay channel, ESP 32 and intersection pipe. Servo meter can rotate the valve actuators on side to side and valve actuators are to control the water supply to crops[1].

Based on the analyzed data, the system can automatically open or close the valve actuator, adjusting the water flow to the crops. This IoT-based solution offers several benefits for farming operations. It promotes water conservation by providing precise and targeted irrigation, reducing the risk of over-watering and water wastage. Additionally, it optimizes crop growth and yield by ensuring crops receive water at the right time, which is crucial for their development. The system also reduces manual labor requirements and enables mobile app and switch control, allowing farmers to efficiently manage their irrigation processes from anywhere at any time. In the world of farming, technology continues to play a crucial role in optimizing agricultural processes and maximizing crop yields[2].

One such technological advancement is the implementation of Internet of Things (IoT) solutions. In this case, we will explore how IoT, specifically in combination with a valve actuator, can be utilized to efficiently supply water to crops in a particular area at specified timings. Traditionally, irrigation systems in farming relied on manual intervention or basic timers. However, with the advent of IoT, automation and remote control have become possible, enabling farmers to streamline their irrigation processes and enhance water management. In this system, we leverage various components such as a valve actuator, pump, servo motor, Arduino microcontroller, relay channel, water pump, and an ESP (Embedded Systems Platform) module. These components work together to create an intelligent and automated irrigation system[3].

The valve actuator serves as the core component responsible for controlling the flow of water to the crops. By integrating it with an Arduino microcontroller, the actuator can be wirelessly controlled and programmed based on specific timing requirements. The Arduino, in conjunction with the ESP module, facilitates the connection to the internet, allowing farmers to remotely monitor and control the irrigation system from anywhere. The relay channel acts as a switch to control the water pump. When the system receives a signal to activate irrigation, the relay channel triggers the water pump, initiating the flow of water through the valve actuator[5].

The servo motor can also be incorporated to adjust the position of the valve actuator, enabling precise control over water flow rates. By utilizing IoT technology, farmers can set up a centralized control system, enabling them to monitor multiple valve actuators simultaneously. This provides the flexibility to define irrigation schedules, adjust water flow rates, and monitor the system's performance in real-time. Additionally, data collected from the system can be analyzed to gain insights into water consumption, crop health, and optimize irrigation practices. Overall, implementing an IoT-based irrigation system using a valve actuator offers farmers the advantage of efficient water management, reduced manual intervention, and improved crop yield. By automating the irrigation process and incorporating remote control capabilities, farmers can optimize water usage, conserve resources, and enhance overall farming operations[6]. Water conservation: IoT-based water valve actuators can help to conserve water by only irrigating when it is necessary. This is important in areas where water is scarce[6].

Improved crop yields: IoT-based water valve actuators can help to improve crop yields by ensuring that plants receive the right amount of water at the right time. This is because plants need different amounts of water depending on their stage of growth and the weather conditions. Reduced labor costs: IoT-based water valve actuators can reduce labor costs by automating the irrigation process. This means that farmers do not have to spend time manually turning on and off the irrigation system[7].

1.2 Motivation

1.2.1 Market Motivation

The market refers to the economic environment and demand for products or services related to the valve actuator-based IoT system for crop irrigation. It involves analyzing customer needs, competition, pricing, and other factors that affect the commercial viability and adoption of such a solution.

1.2.2 Industrial Motivation

The industrial aspect relates to the application of the valve actuator-based IoT system in farming or agricultural settings. It focuses on deploying the solution at scale, considering factors such as system integration, maintenance, scalability, cost-effectiveness, and adherence to industry standards.

1.2.3 Research Motivation

Research involves the systematic investigation and study conducted to gain new knowledge or solve specific problems related to the valve actuator-based IoT system. It could include exploring efficient water management techniques, optimizing energy consumption, improving crop yields, or enhancing the reliability and performance of the system.

1.2.4 Societal motivation

The societal impact of the valve actuator-based IoT system considers its influence on the wider community. It may involve assessing benefits such as improved agricultural practices, increased crop yields, water conservation, environmental sustainability, and socioeconomic implications for farmers and local communities.

1.2.5 Knowledge Motivation

Knowledge in this context refers to the understanding and expertise required to develop, implement, and operate the valve actuator-based IoT system effectively. It encompasses technical knowledge about the components, connectivity protocols, programming languages, and data analytics relevant to IoT, as well as domain-specific knowledge about farming practices and water management techniques.

1.2.6 Environmental Motivation

He environmental aspect pertains to the ecological implications of the valve actuator-based IoT system. It involves evaluating the system's impact on water usage.

1.3 Literature Review

Literature Survey is a systematic and thorough search of all types of published literature as well as other sources including dissertation, these in order to identify as many items as possible that are relevant to a particular topic. Predicting agricultural products plays a very important role in agriculture. It helps in increasing net produce, better planning and gaining more profits. To achieve better results, we studied a few research papers related to our project topic.

1.3.1 "Smart Irrigation System for Precision Agriculture using IOT and Valve Actuators" Author: Anjali Sharma, Sumedha Mujoo

This research work explores the implementation of an IoT-based smart irrigation system using valve actuators for precision agriculture in farming. The study presents the design and development of an automated irrigation system that ensures water is supplied at specific timing and duration to cover designated land areas.The research scope covers the development of a practical IoT-based smart irrigation system that can be easily deployed in various farming scenarios. The system's scalability and flexibility enable its implementation in both small and large farms, with the capability to adjust irrigation schedules based on different crop types and environmental conditions

1.3.2 "Enhancing Water Use Efficiency in Agriculture through IOT-based Valve Actuators"Author: Carlos Kamienski, Juha-Pekka Soininen, Markus Taumberger

This study investigates the use of IoT-based valve actuators to enhance water use efficiency in agriculture. The research work focuses on optimizing irrigation schedules by employing IoT sensors to monitor soil moisture levels, weather conditions, and crop water requirements. The contribution lies in proposing an adaptive irrigation system that adjusts water supply based on real-time data, improving water utilization in farming.The scope of this research work encompasses the development of an adaptive irrigation system that utilizes IoT technology for precise and efficient water management. The study addresses the challenges of over-irrigation and water wastage in agriculture by integrating smart sensors with valve actuators to provide data-driven and targeted irrigation. The system's scope extends to promoting sustainable water use practices and increasing crop yield.

1.3.3 "A Review of IOT-based Smart Irrigation Systems for Sustainable Agriculture"

Author: M Greeshma, Ayushi Yadav, Abhey S. M. Aryaan, Parth Sandeep Deshpande

This review paper offers an overview of IoT-based smart irrigation systems with a focus on sustainable agriculture. The research work assesses various IoT technologies used in smart irrigation, including valve actuators, soil moisture sensors, and weather forecasting models. The contribution lies in highlighting the potential of IoT in transforming agriculture by ensuring optimal water usage, increased productivity, and reduced environmental impacts.The scope of this literature review covers a comprehensive analysis of existing IoT-based smart irrigation systems and their applications in sustainable agriculture. The paper provides insights into the integration of valve actuators within IoT ecosystems to create intelligent irrigation systems that enhance water efficiency, improve crop yield, and foster sustainable farming practices.

1.3.4 "Optimizing Water Supply in Farming using IOT-based Valve Actuators"

Author : Hira Farooq, Hafeez Ur Rehman, Anam Javed

This research work investigates the optimization of water supply in farming through the integration of IoT-based valve actuators. The authors propose a dynamic irrigation scheduling algorithm that adjusts water supply based on crop requirements and real-time environmental data. The study highlights the potential water savings and crop yield improvements achievable with this approach.The research provides valuable insights into the development of intelligent irrigation algorithms for IoT-based valve actuators. Further research can delve into the application of machine learning and artificial intelligence techniques to enhance the system's decision-making capabilities and adaptability to diverse agricultural scenarios.

1.4 Objectives

- Study of the various types of the irrigation to minimize the water wastage and implementing the most feasible solutions.
- Design and Fabricate the Valve which can be used to controll the flow from the mobile application.
- Testing Automated water delivery for crops, conserving resources while optimizing growth.
- Centralized control which implies managing multiple crop zones remotely, minimizing water waste and maximizing efficiency.

1.5 Problem Statements

- Water scarcity is a major problem in many parts of the world. IoT-based water valve actuators can help to conserve water by only irrigating when it is necessary.
- Inefficient irrigation practices can lead to water waste. IoT-based water valve actuators can help to improve irrigation efficiency by ensuring that water is only applied to the areas that need it.
- Irrigation is a labor-intensive process. IoT-based water valve actuators can help to reduce labor costs by automating the irrigation process.
- Remote monitoring of the irrigation process. IoT-based water valve actuators farmers to check on the status of their irrigation system from anywhere when they are connected to the internet. This is useful for farmers who live far away from their farms or who are traveling.

Chapter 2

Material Selection

2.1 System Requirements Specification For Water Valve Actuator

1. The primary focus was to identify issues with water valve actuators operating in different locations. The problem was analyzed from multiple angles, including the possibility of automating the water valve actuator. Following a thorough assessment, short-term and long-term solutions were developed. Ultimately, the decision was made to implement an IoT-based water valve actuator for agricultural applications.
2. Short-term solutions aimed at reducing water wastage in household activities, while long-term solutions focused on efficiently controlling multiple valves simultaneously in agricultural applications.
3. The study delved into the usage of water valve actuators in agriculture, aiming to regulate water flow at specific times to particular areas, thereby reducing water wastage and achieving efficient control over multiple valves at once.
4. During the research for suitable materials for an automated water valve actuator in agriculture, the emphasis was placed on minimizing the time required to move between different valve locations.
5. In the material selection process, the primary component considered was the valve itself, which facilitates water flow from various angles. The objective was also to ensure compatibility with different valve locations. To control the valve's opening and closing, a servo meter was chosen. By programming the servo meter, it can effectively rotate the water valve up to 180 degrees, enabling precise control.
6. For the IoT-based water valve actuator in agricultural applications, the required materials includes water valves, Arduino Uno, ESP32, a pump, jumper Wires, relay channels.

2.2 Functional Requirements

Figure 2.1: Servo motor

Figure 2.1 shows the servo motor that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller such as Arduino UNO(Figure 2.2). It is connected to the valve actuator and is used to control the opening and closing of the valve. By receiving signals from the IOT network, the servo motor adjusts the position of the valve, regulating the water flow to the crops.

Figure 2.2: Arduino UNO

Figure 2.2 shows the Arduino UNO which serves as the main control unit of the IOT system. It receives instructions from the IOT network through the ESP 32 (Figure 2.4) and coordinates the operation of the valve actuator, servo motor, and water pump (Figure 2.3) accordingly. It acts as a bridge between the digital commands and the physical components. The Arduino Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs and 6 as analog inputs), crystal oscillator (helps the serial interface to build communication with devices), USB connection, power jack, ICSP header (In-Circuit Serial Programming - these pins allow inter workings of two or more Arduino boards and also it allows us to upload our firmware), and reset button.

Figure 2.3: Water Pump

Figure 2.3 shows the water pump which pumps water from a water source and supplies it to the farming land through the valve. It ensures adequate water head and flow for efficient irrigation. The pump is controlled by the Arduino through the relay channel (or it can directly controlled by the switch).

Figure 2.4: ESP 32

Figure 2.4 shows the ESP 32 it is a module which acts as the communication link between the IoT network and the Arduino to control the servo motors to close or open the valve. It connects to the internet wirelessly (through Wi-Fi) and receives commands from the IoT platform(Mobile application), transmitting them to the Arduino for further processing. It enables remote monitoring and control of the irrigation system.The ESP 32 has integrated Wi-Fi and Bluetooth, which makes it easy to connect to other devices and networks.

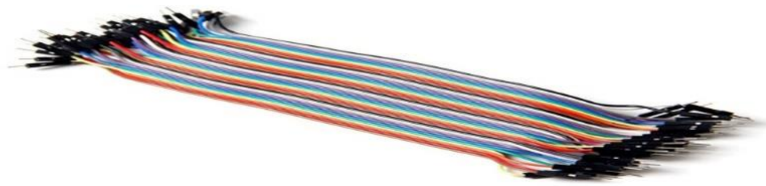

Figure 2.5: Jumper Wires

Figure 2.5 shows the Jumper wires it is used for making connections between items on the breadboard and Arduino's header pins.

Chapter 3

Methodology

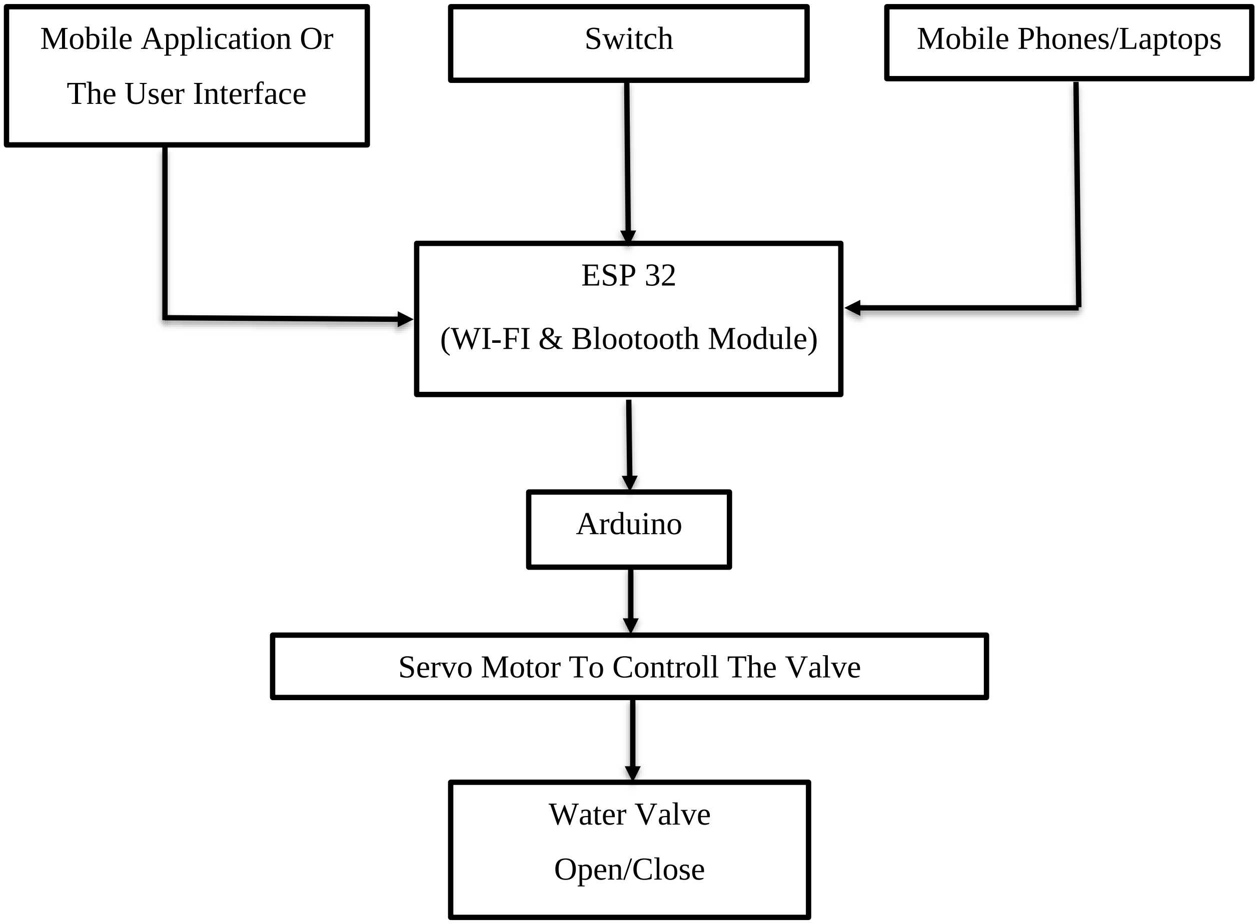

Figure 3.1: Block diagram of the experiment

Figure 3.1 shows the block diagram of the experiment flow consists of a servo motor to operate the globe valve, jumpers , Arduino, ESP 32 Wifi module and mobile/laptop to monitor the values.

To connect the servo motor to the Arduino, the required program code is uploaded to the Arduino to enable its operation. The Arduino is then linked to the ESP32 Wi-Fi module. By inserting the program on the Arduino using a laptop, the entire system can be controlled. The servo motor is connected to the globe valve, allowing for precise control over its opening and closing.

The globe valve's function is essential for flow control in agricultural fields.The Arduino receives the command from the farmer through the mobile application and determines if the water valve should be opened or closed. The Arduino sends a signal to the servo motor to open or close the water valve. The mobile phone or laptop can be used to monitor the system and send commands to the Arduino.

This system is an example of an IoT-based water valve actuator. IoT-based water valve actuators are becoming increasingly popular in agricultural applications, as they can help to conserve water and improve crop yields and also decrease the dependence of the farmer on the labour to irrigate their fields.

Chapter 4

Design Procedure

4.1 Componensts List

Table number 4.1: Component List

Sl no.	Name	Quantity
1	Water pump	1
2	Aurdino UNO	1
3	Servo Motors	3
4	Jumper Wires	3
5	ESP 32	1
6	Valves	3
7	Bread-Board	1

4.2 Specifications of the Components Used

4.2.1 Water Pump

- Supply Voltage Range 12V

4.2.2 Aurdino UNO

- Microcontroller: atmega328p
- Clock speed: 16 mhz
- Operating voltage: 5v
- Input voltage: 7-12v
- Digital i/o pins: 14 (of which 6 can be used as PWM- Pulse Width Modulation outputs)
- Analog input pins: 6
- Dc current per i/o pin: 40 ma

- Dc current for 3.3v pin: 50 ma
- Flash memory: 32 kb (of which 0.5 kb is used by the bootloader)
- Sram: 2 kb

4.2.3 Servo Motor SG90

- Torque: 2.0kg/cm(4.8V), 2.2kg/cm(6V)
- Speed: 0.09s/60°(4.8V), 0.08s/60°(6V)
- Rotate angle: 180°
- Operating voltage: 4.8 ~ 6V
- Dimension: 22.8mm × 12.2mm × 28.5mm

4.2.4 Jumper Wires

- Male to Male
- Male to Female
- Female to Female

4.2.5 ESP 32

- Microcontroller: Dual-core Xtensa LX6 microprocessor
- Clock Speed: Up to 240 mhz
- Operating Voltage: 1.8-3.6 V
- Input Voltage: 2.7-5.5 V
- Digital I/O Pins: 34
- Analog Input Pins: 12
- DC Current per I/O Pin: 12 ma
- DC Current for 3.3V Pin: 150 ma
- Flash Memory: 4 MB (of which 0.9 MB is used by the bootloader)
- SRAM: 520 KB
- EEPROM: 40 KB

4.2.6 Valve

Figure 4.1 : Valve

- Connector size: 8mm
- Connector type: Globe valve
- Fitting type: Push-in
- Application: Pneumatics, air tools, water hoses, etc.
- Maximum pressure- 10 Bar
- Maximum Temperature- 60 °C

4.2.7 Softwares Used

- Arduino IDE (For coding and for uploading the code in arduino-uno)
- Solidworks (to design the Valve)

4.3 Program Code

4.3.1 ESP 32 Code

```
#define BLYNK_TEMPLATE_ID "TMPL3TKJPZjGz"
#define BLYNK_TEMPLATE_NAME "Valve Control"
#define BLYNK_FIRMWARE_VERSION  "0.1.0"
#define BLYNK_PRINT Serial
#define APP_DEBUG
#include "BlynkEdgent.h"

BLYNK_WRITE(V0)
{ int pinValue = param.asInt();
  digitalWrite(15,pinValue);
}
```

```
BLYNK_WRITE(V1)
{ int pinValue = param.asInt();
  digitalWrite(2,pinValue);
}

BLYNK_WRITE(V2)
{ int pinValue = param.asInt();
  digitalWrite(4,pinValue);
}

BLYNK_WRITE(V3)
{ int pinValue = param.asInt();
  digitalWrite(5,pinValue);
}

void setup()
{ pinMode(15,OUTPUT);
  pinMode(2,OUTPUT);
  pinMode(4,OUTPUT);
  pinMode(5,OUTPUT);
  Serial.begin(115200);
  delay(1000);
  BlynkEdgent.begin();
}

void loop()
{
  BlynkEdgent.run();
}
```

4.3.2 ARDUINO UNO CODE

```
#include<Servo.h>
#include <Relay.h>

const int espa = 2;
Servo s1;
const int espv1 = 3;
```

```
Servo s2;
const int espv2 = 4;
Servo s3;
const int espv3 = 5;

void setup()
{
  pinMode(2, INPUT);

  s1.attach(8);
  pinMode(espv1, INPUT);
  pinMode(11, OUTPUT);

  s2.attach(9);
  pinMode(espv2, INPUT);
  pinMode(12, OUTPUT);

  s3.attach(10);
  pinMode(espv3, INPUT);
  pinMode(13, OUTPUT);
}


void loop() {
  int espaState = digitalRead(espa);
  if (espaState == HIGH){
    s1.write(90);
    s2.write(90);
    s3.write(90);
    s1.write(0);
    for (int i = 0; i <10 ; i++){
        digitalWrite(11, HIGH);
        delay(500);
        digitalWrite(11, LOW);
        delay(500);
      }
    s2.write(0);
    delay(200);
    s1.write(90);
```

```
  for (int i = 0; i <10 ; i++){
    digitalWrite(12, HIGH);
    delay(500);
    digitalWrite(12, LOW);
    delay(500);
  }
  s3.write(0);
  delay(200);
  s2.write(90);
  for (int i = 0; i <10 ; i++){
    digitalWrite(13, HIGH);
    delay(500);
    digitalWrite(13, LOW);
    delay(500);
  }
  s3.write(90);
  delay(200);
}

int espv1State = digitalRead(espv1);
if (espv1State == HIGH) {
  s1.write(0);
  digitalWrite(11, HIGH);
  delay(500);
  digitalWrite(11, LOW);
  delay(500);
} else {
  s1.write(90);
  digitalWrite(11, LOW);
}

int espv2State = digitalRead(espv2);
if (espv2State == HIGH) {
  s2.write(0);
  digitalWrite(12, HIGH);
  delay(500);
  digitalWrite(12, LOW);
  delay(500);
} else {
```

```
    s2.write(90);
    digitalWrite(12, LOW);
  }

  int espv3State = digitalRead(espv3);
  if (espv3State == HIGH) {
    s3.write(0);
    digitalWrite(13, HIGH);
    delay(500);
    digitalWrite(13, LOW);
    delay(500);
  } else {
    s3.write(90);
    digitalWrite(13, LOW);
  }

}
```

4.4 Assembled parts and components

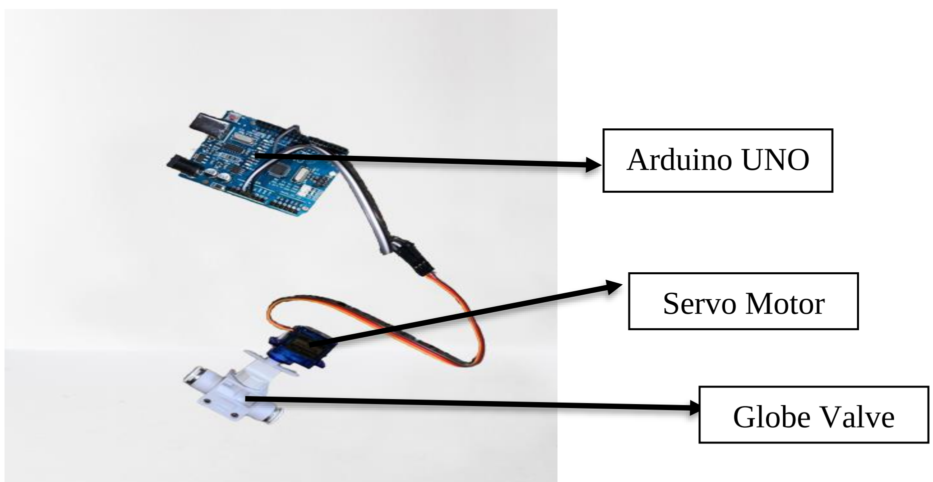

Figure 4.2: Shows assembly of servo motor, globe valve and Arduino uno

Figure 4.2 Shows assembling of servo motor, globe valve and Arduino uno which plays major role in controlling valve remotely. Program code has been inserted to Arduino which operates servo motor by control signals which operates servo to rotate at 90 degree clockwise or 90 degree anticlockwise. The servo motor connected to valve and thereby by rotation of servo motor opens and closes the valve. The whole system helps in controlling the valve through the mobile or other kind remote devices which helpsthe user in easy operation of water lines of their agriculture land which intent reduces the time of farmer to manual operation of valve in farm. Connect the servo motor to the Arduino Uno board. The servo motor has three wires: red, black, and yellow. The red wire is the power wire, the black wire is the ground wire, and the yellow wire is the signal wire. Connect the red wire to the 5V pin on the Arduino Uno board, the black wire to the ground pin, and the yellow wire to the digital pin 9 on the Arduino Uno board.

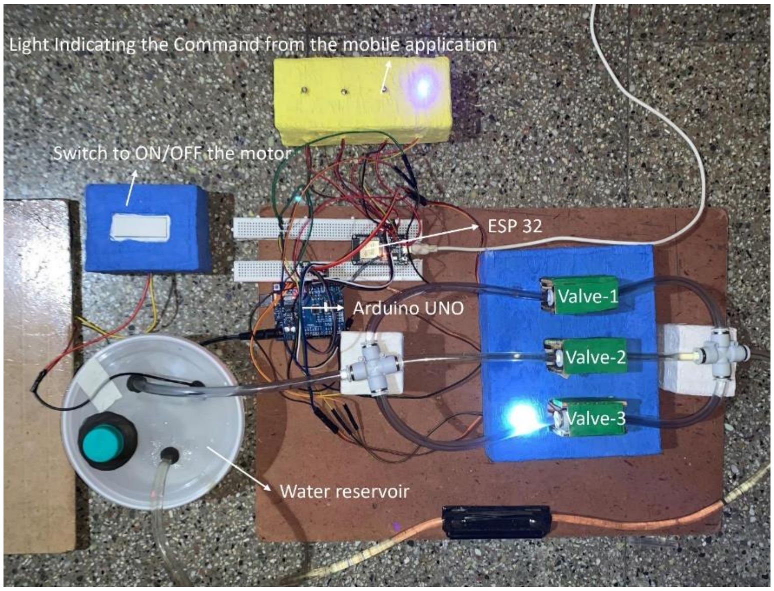

Figure 4.3: Final assembled Parts

Figure 4.3: Shows final assembled Parts this helps in controlling the multiple water valve at one particular time. Which creates the connection between the mobile device or any remote devices and according to command of user it sends the signal to different servo motor which allows to open the valves. The light indicating the command from the mobile application is connected in the meter board where the switch for the motor is given this light is required because the user can have a track on the command weather his command is being executed or not.

If the motor is switched on and all valves are closed which leads to rise in pressure and breakage of pipe in this system this can be avoided by sensing the valves openings and closings if all the valves are closed it automatically opens one default valve which avoids the pipe damages. Perfect operation this device reduces the time and damaging of pipelines and also accurate control of pipelines through mobile devices. Ithelps to reduce the water wastage. breadboardhelps a allows for easy and quick creation of temporary electronic circuits or to carry out experiments with circuit design.

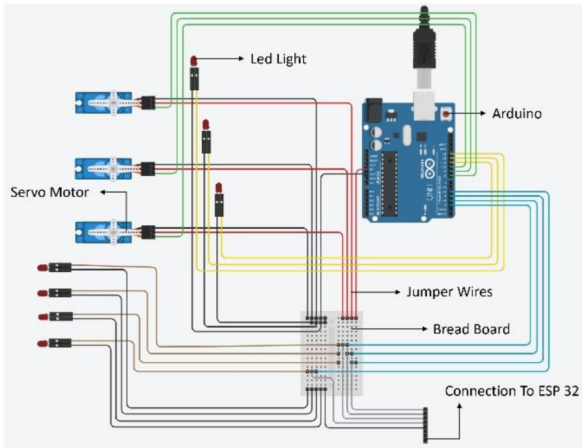

Figure 4.4: Circuit Diagram of the Water valve actuator

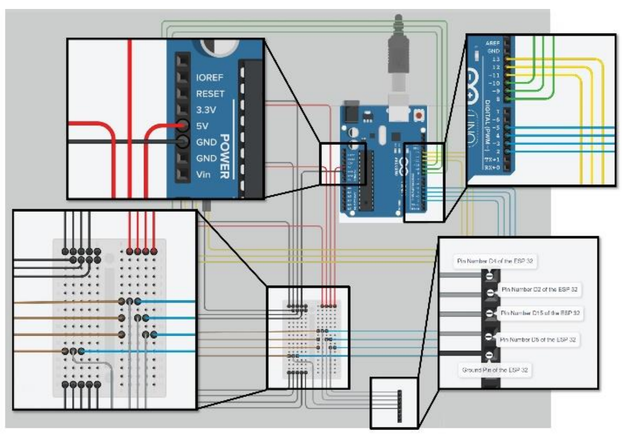

Figure 4.5: Circuit Diagram Showing the Enlarged Photo of the Connections between the components

Figure 4.4: shows Circuit Diagram of the Water valve actuator which shows a servo motor connection to an Arduino. The servo motor has three wires: red, black, and orange. The red wire is the power wire, which should be connected to the 5V pin on the Arduino. The black wire is the ground wire, which should be connected to a ground pin on the Arduino. The orange wire is the signal wire, which should be connected to a PWM pin on the Arduino.

Brief explanation of how the circuit works:

- The power wire from the servo motor is connected to the 5V rail on the breadboard. This provides power to the servo motor.
- The ground wire from the servo motor is connected to the GND rail on the breadboard. This grounds the servo motor.
- The signal wire from the servo motor is connected to the respective pin on the Arduino. This is a PWM pin, which means that it can output a signal with a variable duty cycle. The duty cycle of the signal controls the position of the servo motor.
- The positive wire from the LED light is connected to the 5V rail on the breadboard. This provides power to the LED light.
- The negative wire from the LED light is connected to the GND rail on the breadboard. This grounds the LED light.

When the Arduino outputs a PWM signal on the respective pin, the servo motor will rotate to the corresponding angle. The angle of rotation is determined by the duty cycle of the signal. A duty cycle of 100% corresponds to a 180-degree rotation, while a duty cycle of 0% corresponds to a 0-degree rotation.The LED light will turn on when the Arduino outputs a high signal on the 5th pin. The LED light will turn off when the Arduino outputs a low signal on the 5th pin.

Below shows the connection of the arduino to the servo motor and ESP 32

Signal pin of the Servo Motor (Orange Wire)	Arduino UNO Pin No. 8,9 & 10
ESP 32 Pin No. D15, D2, D4 & D5	Arduino UNO pin No. 2, 3, 4 & 5

Chapter 5

Results and Discussions

The utilization of an Arduino UNO board, along with relay and globe valve automation, facilitated by the Blynk Application on an Android device, and connected through an ESP32 Wi-Fi module, monitors and controls parameters such as servo motors using ON/OFF switch buttons on the Blynk interface.

In agriculture, IoT revolutionizes irrigation by automating systems. Traditionally, manual control of valves led to time-consuming tasks and errors. Leveraging IoT, sensors measuring soil moisture and actuators adjusting valves based on these readings enable precise watering, potentially increasing yields by up to 30% and reducing water wastage by 20-50%.

Furthermore, IoT-managed irrigation mitigates waterlogging and salinization risks. Excessive water saturation can damage crops, but IoT systems prevent this with tailored water flow. Additionally, salinization risks, which affect about 20% of irrigated lands globally, can be reduced by optimizing water delivery through IoT-based systems.

Chapter 6

Conclusions And Future Scope

6.1 Conclusion

In this project, wireless control of irrigation system is done for precision agriculture. The major application of this project is for the farmers, who want to water their crops during their absence in the field. It was found that this system is cost effective and feasible. It can be used in the areas where there is water scarcity thereby improving the water sustainability. In future, this prototype can be extended to various purposes such as feeding the animals without any human intrusion from anywhere.One of the key advantages of this IoT-based system is the ability to automate the irrigation process based on specific timing requirements. Farmers can set schedules for water supply, ensuring that crops receive water at the appropriate times for optimal growth. This eliminates the need for manual intervention and reduces the risk of over- or under-irrigation.

6.2 Future Development & Scope

- Integrate AI-driven automation to detect and respond to potential valve actuator malfunctions or water leakage promptly.
- Implement predictive analytics to optimize water usage and scheduling based on weather patterns and soil moisture levels in real-time.
- Integration of smart sensors and predictive analytics in IoT-based valve actuators, enabling proactive water management and reducing water wastage in farming practices.
- Enable remote monitoring and control of valve actuators through secure mobile applications for enhanced accessibility and convenience.
- The leakage from the pipe can be detected by using the flow meter and also we can moniter the valve using the camera which can be connected to the internet.

References

[1] Muangprathub, J., Boonnam, N., Kajornkasirat, S., Lekbangpong, N., Wanichsombat, A., & Nillaor, P. (2019). IoT and agriculture data analysis for smart farm. Computers and Electronics in Agriculture, 156(December), 467–474. 10.1016/j.compag.2018.12.011

[2] Nageswara Rao, R., & Sridhar, B. (2018). IoT based smart crop-field monitoring and automation irrigation system. 2018 2nd International Conference on Inventive Systems and Control (ICISC), 478–483.

[3] Padalalu, P., Mahajan, S., Dabir, K., Mitkar, S., & Javale, D. (2019). Smart water dripping system for agriculture/farming. 2017 2nd International Conference for Convergence in Technology, I2CT 2017, 659–662. doi:10.1109/I2CT.2017.8226212

[4] Rani, D., Kumar, N., & Bhushan, B. (2020). Implementation of an Automated Irrigation System for Agriculture Monitoring using IoT Communication.10.1109/ispcc48220.2019.8988390

[5] Rasooli, M. W., Bhushan, B., & Kumar, N. (2020). Applicability of WSN& IoT in saffron & wheat crops: A smart agriculture perspective. International Journal of Scientific and Technology Research, 9(2), 2456–2461.

[6] Saraf, S. B., & Gawali, D. H. (2018). IoT based smart irrigation monitoring and controlling system. RTEICT 2017 - 2nd IEEE International Conference on Recent Trends in Electronics, Information and Communication Technology, Proceedings, 815–819. doi:10.1109/RTEICT.2017.8256711

[7] Sharma, B. B., & Kumar, N. (2020). Internet of things-based hardware and software for smart agriculture: A review. Lecture Notes in Electrical Engineering, 597, 151–157. doi:10.1007/978- 3-030-29407-6_13

[8] Vaishali, S., Suraj, S., Vignesh, G., Dhivya, S., & Udhayakumar, S. (2018). Mobile integrated smart irrigation management and monitoring system using IOT. Proceedings of the 2017 IEEE International Conference on Communication and Signal Processing, ICCSP 2017, 2164–2167. doi:10.1109/ICCSP.2017.8286792

[9] Yashaswini, L. S., Vani, H. U., Sinchana, H. N., & Kumar, N. (2019). Smart automated irrigation system with disease prediction. IEEE International Conference on Power, Control, Signals and Instrumentation Engineering, ICPCSI 2017, 422–427. doi:10.1109/ICPCSI.2017.8392329

[10] Hardik Soni, Shubham Kahar, "Design IoT based Smart Irrigation System Using Arduino", published by International Journal of Advanced Research in Computer and Communication Engineering, Oct 2019. [10] Zhang, Z., Wu, P., Han, W., & Yu, X. (2017). Remote monitoring system for agricultural information based on wireless sensor network. Journal of the Chinese

Institute of Engineers, Transactions of the Chinese Institute of Engineers, Series A/Chung-Kuo Kung Ch'eng Hsuch K'an, 40(1), 75–81. 10.1080/02533839.2016.1273140

[11] yaz, M., Ammad-Uddin, M., Sharif, Z., Mansour, A., & Aggoune, E. H. M. (2019). Internet- of-Things (IoT)-based smart agriculture: Toward making the fields talk. IEEE Access: Practical Innovations, Open Solutions,7, 129551–129583. doi:10.1109/ACCESS.2019.2932609

[12] Barkunan, S. R., Bhanumathi, V., & Sethuram, J. (2019). Smart sensor for automatic drip irrigation system for paddy cultivation. Computers & Electrical Engineering, 73, 180–193. doi:10.1016/j.compeleceng.2018.11.013

[13] Basu, D., & Ghosh, S. (2016). Smart Farming using IoT using solar panel. Alliedelec, 278–280.

[14] Benyezza, H., Bouhedda, M., Djellout, K., & Saidi, A. (2019). Smart Irrigation System Based Thingspeak andArduino. Proceedings of the 2018 International Conference on Applied Smart Systems, ICASS 2018. doi:10.1109/

ICASS.2018.8651993

[15] Bhatt, H., Bhushan, B., & Kumar, N. (2019). IOT: The Current Scenario and Role of Sensors Involved in Smart Agriculture. International Journal of Recent Technology and Engineering, 8(4), 12011–12023. doi:10.35940/ijrte.D9285.118419

[16] elijah, O., Rahman, T. A., Orikumhi, I., Leow, C. Y., & Hindia, M. N. (2018). An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges. IEEE Internet of Things Journal, 5(5), 3758–3773. doi:10.1109/JIOT.2018.2844296

[17] Faisal, R. H., Saha, C., Hasan, M. H., & Kundu, P. K. (2019). Power Efficient Distant Controlled Smart Irrigation System for AMAN and BORO Rice. 2018 21st International Conference of Computer and Information Technology, ICCIT 2018, 1–5. doi:10.1109/ICCITECHN.2018.8631927

[18] Gulati, A., & Thakur, S. (2018). Smart Irrigation Using Internet of Things. Proceedings of the 8th International Conference Confluence 2018 on Cloud Computing, Data Science and Engineering, Confluence 2018, 819–823. doi:10.1109/CONFLUENCE.2018.8442928

[19] Hate, M., Jadhav, S., & Patil, H. (2018). Vegetable Traceability with Smart Irrigation. 2018 International Conference on Smart City and Emerging Technology, ICSCET 2018, 1–4. doi:10.1109/ICSCET.2018.8537253

[20] Kamelia, Ramdhani, Faroqi, & Rifadiapriyana. (2018). Implementation of Automation System for Humidity Monitoring and Irrigation System. 10.1088/1757-899X/288/1/012092

[21] Kondaveti, R., Reddy, A., & Palabtla, S. (2019). Smart Irrigation System Using Machine Learning and IOT. Proceedings - International Conference on Vision Towards Emerging Trends in Communication and Networking, ViTECoN 2019, 1–11. doi:10.1109/ViTECoN.2019.8899433

[21] Kumar, N., & Sharma, B. (2020). Opportunities and Challenges with WSN's in Smart Technologies: A Smart Agriculture Perspective. Advances in Intelligent Systems and Computing, 1132, 441–463. doi:10.1007/978-3-030-40305-8_22

[22] Kumar Navinay, M., & Gedam, R. (2017). A Review Paper on Internet of things based Application Smart Agricultural System. International Journal of Latest Engineering and Management Research, 2(4), 69–71.

[23] Li & He. (2019). Design of rice intelligent water-saving irrigation system based on agricultural internet of things. 10.1088/1742-6596/1176/5/052068

[24] Math, A., Ali, L., & Pruthviraj, U. (2019). Development of Smart Drip Irrigation System Using IoT. 2018 IEEE Distributed Computing, VLSI, Electrical Circuits and Robotics,

DISCOVER 2018 - Proceedings, 126–130.10.1109/DISCOVER.2018.8674080

[25] Mishra, D., Khan, A., Tiwari, R., & Upadhay, S. (2018). Automated Irrigation System-IoT Based Approach. Proceedings - 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages, IoT-SIU 2018, 1–4. doi:10.1109/IoT-SIU.2018.8519886

[26] Moinak Bose;, Sourodip Ghosh "A Study on Smart Irrigation System using IoT & Machine Learning", Published by International Research Journal of Engineering and Technology (IRJET),

March- 2022

[27] Hardik Soni, Shubham Kahar, "Design IoT based Smart Irrigation System Using Arduino", published by International Journal of Advanced Research in Computer and Communication Engineering, Oct 2019

[28] Shawhney A.K, "A course in Electrical and Electronic Measurements and Instrumentations", Edition 6, Published by Dhanpat Rai & Co, Sudip Misra, "Introduction to Internet of Things" , presented by IIT Kharagpur, 2021

[29] Pavankumar naik,Arun Kumbi, "Automation of irrigation systems using IOT"presented at International Journal of Engineering and Manufacturing Science. ISSN 2249-3115 Volume 8, Issued Number 1 (2018) pp