AUTOMATED WATER LEVEL MONITORING SYSTEM IN PADDY FIELDS

A Minor Project work submitted in the partial fulfilment of the requirement for the award of the award of degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS & COMMUNICATION ENGINEERING

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2020 - 2021

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CERTIFICATE

This is to certify that the Minor Project work entitled Automated Water Level Monitoring System in Paddy Fields is being submitted by Mr. Avinash Reddy Arutla (19211A0417), Ms. T Abhisarika Reddy (19211A04M1) and Ms. U Jyothi Supriya (19211A04M8) in partial fulfillment of the requirement for the award of the degree of **B.Tech.in Electronics & Communication Engineering**, by Jawaharlal Nehru Technological University Hyderabad is a record of bonafide work carried out by them under my guidance and supervision from 2020 to 2021.

The results presented in this project are verified and found to be satisfactory.

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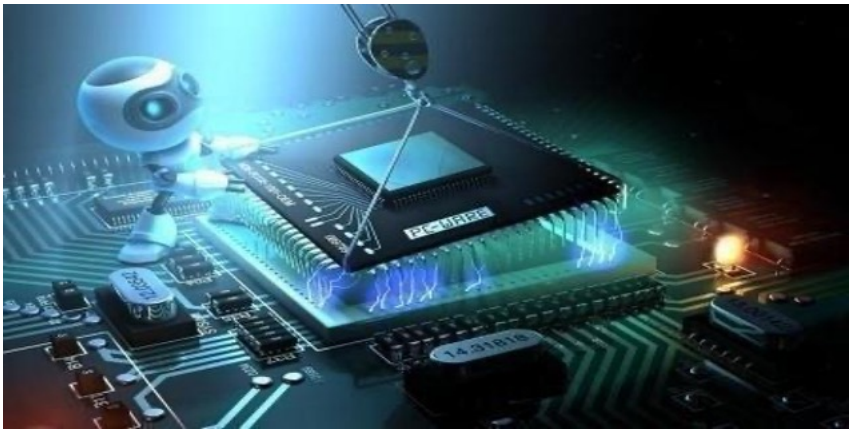

CERTIFICATE

This is to certify that Mr. Avinash Reddy Arutla , Ms T Abhisarika Reddy, Ms. U Jyothi Supriya bearing Roll Nos. 19211A0417, 19211A04M1, 19211A04M8 respectively have successfully completed his/her training on Embedded systems and Implemented a Project titled **"Automated Water Level Monitoring System In Paddy Fields "** in Centre for Embedded Systems Laboratory, B.V. Raju Institute of Technology from **2020** to **2021.**

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ACKNOWLEDGEMENT

This thesis becomes a reality with the kind support and help of many individuals. I would like to extend my sincere thanks to all of them.

Foremost I would like to offer this endeavour to our GOD almighty for the wisdom he bestowed upon me, the strength, the peace of my mind and good health in order to finish this research.

We are grateful towards our College Management and our beloved Principal **Dr. K. Lakshmi Prasad** for providing us the necessary infrastructure and facilities that ensured smooth and satisfactory execution of the project.

We would like to express out profound gratitude to our Head of the department **Dr. Sanjay Dhube, Professor & HOD**, Dept. of ECE, for his encouragement inspiration and close monitoring and guidance he gave us during the execution of the project.

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organisations. I would like to extend my sincere thanks to all of them.

I am highly indebted to our faculty co-ordinator, mentor **Ch. Vandana** and team for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards my parents & members of BVRIT for their kind co-operation and encouragement which help me in completion of this project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

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DECLARATION

We hereby declare that the project entitled **"Automated Water Level Monitoring System In Paddy Fields** " submitted to B. V. Raju Institute of technology, affiliated to Jawaharlal Nehru Technological University, Hyderabad for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering is a result of original project work done by us.

It is further declared that the project report on any part therefore has not been previously submitted to any University or Institute for the award of degree or diploma.

ABSTRACT

The project is about **Automated Water Level Monitoring System In Paddy Fields**. This project presents an automatic water irrigation and drainage system designed to increase the yield production of rice and improve water use efficiency. This water level monitoring system consists of an ultra-sonic sensor, rain sensor, water pump and a servo motor, these are the major components of the system. Basic working of the system is that it has to detect water level in the paddy field and automatically trigger the pump based on the water level. Ultra-sonic sensor is placed inside a hollow tube which is placed at a height of 1cm above the ground. The system automatically irrigates water through the entrance gate when the water level is lower than the desired level through the water pump. This system is controlled through an Arduino which closes the gate if the desired water level is attained. When the water level in the rice field is higher than the desired level, the system either opens the exit gate if the drain is empty, or switches on the pump if the drain is full of water. While researching, we learned about existing water irrigation innovations and different systems where ultrasonic sensors are used efficiently. Main application of this water level monitoring system comes into different field of water irrigation, weather sensing.

PREFACE

As part of the of the B. tech curriculum and in order to gain practical knowledge in the field of Electronics and Communication, we are required to make a project report on "**Automated Water Level Monitoring System In Paddy Fields**". The report is prepared with the view to include all the details regarding the project that we carried out.

In this project we have included various concepts, technology and implementation regarding Object detection. Subject to the limitation of time efforts and resources every possible attempt has been made to study the problem deeply.

Completing this project report helped us enhance our knowledge in the field we worked. Through the compiling of the report we have understood the importance of team work , role dividing and knowledge retrieval.

LIST OF FIGURES & TABLES

CONTENTS

CHAPTER 1
INTRODUCTION

1.1 Introduction to Project

Automated water level monitoring system is a abstract yet new upcoming reality in the field of agriculture and modern farming. The following project presents the following solution in a better way ,understandable and can be made easily.

This project was designed , keeping in mind the application of it in paddy fields. The components used here are completely open sourced and are currently subsidised a lot in e\the embedded industry.

The project can be installed on any type of field, but the prototype of the project is housed in a transparent box which houses the sample from the field.

A ultrasonic sensor and a rain sensor work hand in hand, for the working of the device. The test cases are well defined in the future parts of the documentation, but for an abstract idea for it, the ultrasonic sensor calculates the level of water and the rain sensor helps in deciding the let in/go of the water.

A specialised pump with a bump up relay is used for routing water in or out in the field. The microcontroller used for this project is housed on the Arduino Uno. The Arduino Uno is programmed using the Arduino IDE using native C.

1.2 Motivation

In India, at any point of time, there is always a hot topic regarding the farmers or agriculture in India. As described, there are a lot of water level monitoring systems already present in the industry. Accuracy of those is quite commendable. But, since India is a growing nation, not all the farmers are required to be financially well off for these new innovations.

This project presents a solution to these farmers who need a working water level detector at an affordable price. During the fall season in our country, the weather proves to be a barricade for farmers during the dusk. Many a farmers die of electrocution in their fields.

Our project tries to eradicate the farmers of this problem, by using a rain sensor, which automatically drains the excess amount of water in a field using the water pump present in the prototype.

1.3 Objective

In India, at any point of time, there is always a hot topic regarding the farmers or agriculture in India. As described, there are a lot of water level monitoring systems already present in the industry. Accuracy of those is quite commendable. But, since India is a growing nation, not all the farmers are required to be financially well off for these new innovations.

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CHAPTER 2
LITERATURE SURVEY

2.1 Literature Survey

Fully automatic water irrigation and drainage system for paddy rice cropping in Malaysia

[19-20 August,2013]

by Muhamad Asman Miskam; Othman Sidek

This paper presents an automatic water irrigation and drainage system designed to increase the yield production of rice and improve water use efficiency. Water level sensors are placed in the rice field and continuously measure the water level. The system automatically irrigates water through the entrance gate when the water level is lower than the desired level. The entrance gate closes after the water level reaches the desired level. When the water level in the rice field is higher than the desired level, the system either opens the exit gate if the drain is empty, or switches on the pump if the drain is full of water.

Rice production and potential for hybrid rice in Malaysia

[November,2008]

by Othman Omar

A number of approaches, including breeding a new rice variety, improving the crop management system, and applying new technologies for land preparation, fertiliser, pest and disease control, have been implemented to increase the average rice yield.

Automatic Irrigation system based on wireless networks

[9-11 June,2010]

by Genghuang Yang; Yuliang Liu

Considering the characteristic of irrigation in the rural area of China, this paper brings forward new devices based on wireless network, that are GSM (Global System Mobile) network and radio communication. Three levels are included in the system: the PC control platform or common cell phone for surveillance, the controller and the action unit. Simple GSM modules are available in the PC control platform and the controller. Orders can be sent from the PC control platform or cell phone to the controller and the information such as temperature, soil moisture and air humidity sampled by the controller can also be sent to the PC platform or cell phone by GSM

message. Emitter and receiver of short-wave radio are embedded in the controller and the action unit respectively. Radio communication works between the controller and the action units. Database of spot information sampled can be analyzed and browsed by friendly interface in PC. The devices have been installed in some farms of Mentougou district in Beijing, capital of China, and Xinjiang, northwest of China.

Automatic Irrigation System using Solar Power

[20-22 Dec,2012]

by Jia Uddin; Qader Newaz

This paper proposes a model of variable rate automatic microcontroller based irrigation system. Solar power is used as only the source of power to control the overall system. Sensors are placed on the paddy field and these sensors continuously sense the water level and give the message to the farmer informing the water level. Without visiting the paddy fields, farmers can get the information about the water level. Based on the water level, a farmer can control the motor by sending a message from his cellular phone even from a remote place. However, if the water level reaches to the danger level; the motor will automatically start without confirmation of farmer to ensure the proper water level in the site. At the end of this paper, a complete hardware implementation of this proposed automated irrigation system is presented.

CHAPTER 3
ANALYSIS AND DESIGN

3.1 Components Used

1. Arduino UNO

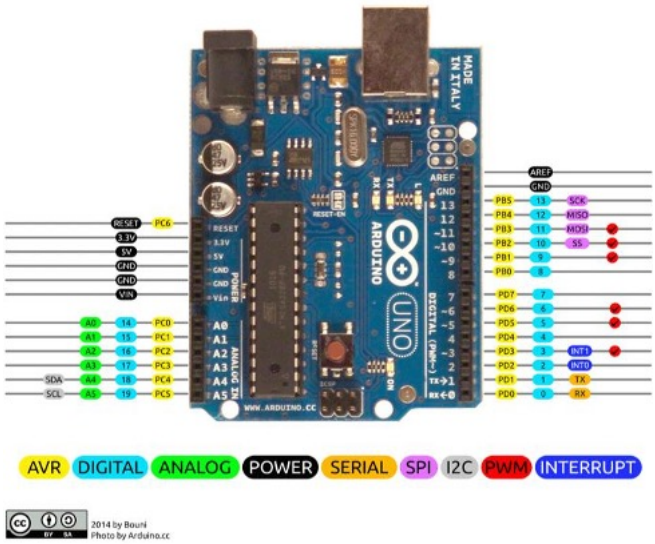


Fig 3.1

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button. Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer.

- The operating voltage is 5V
- The input voltage ranges from 6v to 20V
- Digital input/output pins are 14
- Analog i/p pins are 6
- DC Current for each input/output pin is 40 mA
- DC Current for 3.3V Pin is 50 mA
- Flash Memory is 32 KB
- SRAM is 2 KB

2. Servo Motor (SG-90)

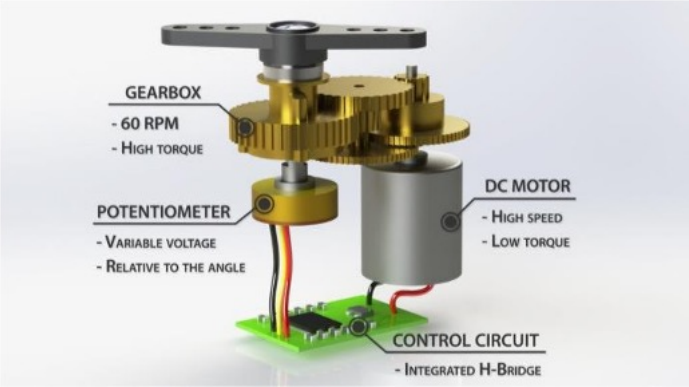


Fig 3.2

Servo motor works on the PWM (Pulse Width Modulation) principle, which means its angle of rotation is controlled by the duration of pulse applied to its control PIN. Basically, servo motor is made up of DC motor which is controlled by a variable resistor (potentiometer) and some gears. As we know there are three wires coming out of this motor. To make this motor rotate, we must power the motor with +5V using the Red and Brown wire and send PWM signals to the Orange colour wire. Hence, we need something that could generate PWM signals to make this motor work, Arduino is used in our project for that purpose.

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation : 0°-180°
- Weight of motor : 9gm

3. Rain Sensor

Fig 3.3

Raindrop Sensor is a tool used for sensing rain. It consists of two modules, a rain board that detects the rain and a control module, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems.

- Working voltage 5V
- Output format: Digital switching output (0 and 1), and analog voltage output AO
- Potentiometer adjust the sensitivity
- Uses a wide voltage LM393 comparator
- Comparator output signal clean waveform is good, driving ability, over 15mA
- Anti-oxidation, anti-conductivity, with long use time
- With bolt holes for easy installation
- Small board PCB size: 3.2cm x 1.4cm

4. Ultrasonic Sensor

Fig 3.4

HC-SR04 Ultrasonic (US) sensor is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver.

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. This works by sending the ultrasonic waves from the trigger. If an object is present, these sound waves will reflect to the echo. By the time and speed parameter we can calculate the distance at which the object is present.

Formula : “distance=time*0.032*0.5”

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 40cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

5. Single Channel Relay

Fig 3.5

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

Single-Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

6. Water Pump

Fig 3.6

A water pump is an essential tool to pump out water from the garden, pool, or under the ground. It controls the speed of the water and is incredibly useful in conserving water. The pumps come with various designs and capacities to cater to different needs of water pumping.

3.2 Software Tools Used

1. Arduino IDE

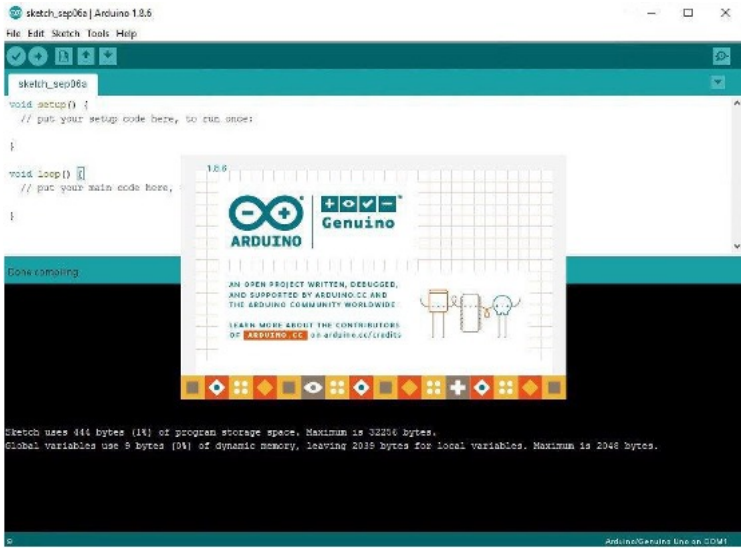


Fig 3.7

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++.

It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2.[4] The Arduino IDE supports the languages C and C++ using special rules of code structuring.x

The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program

stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, avrdude is used as the uploading tool to flash the user code onto official Arduino boards.

3.3 Block Diagram

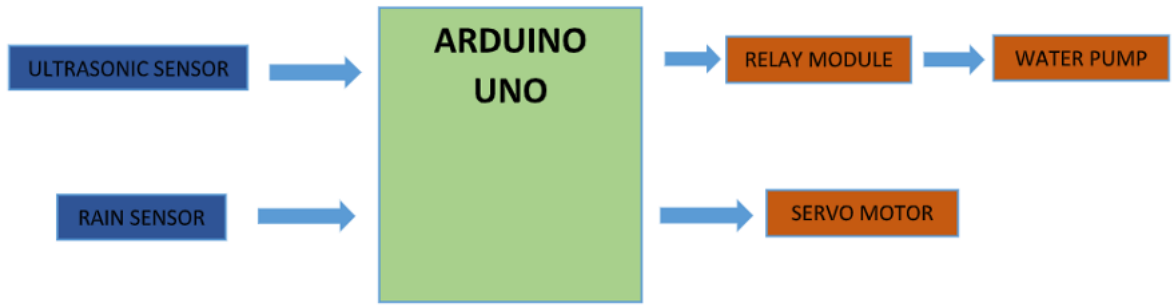


Fig 3.8

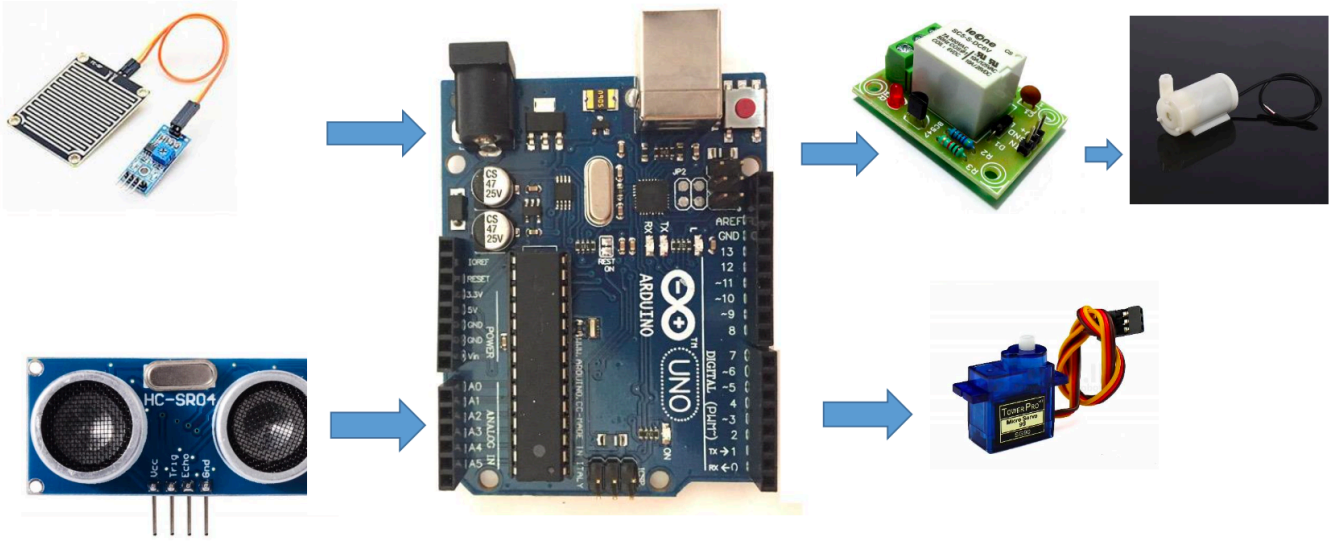


Fig 3.9

CHAPTER 4
IMPLEMENTATION

4.1 Working

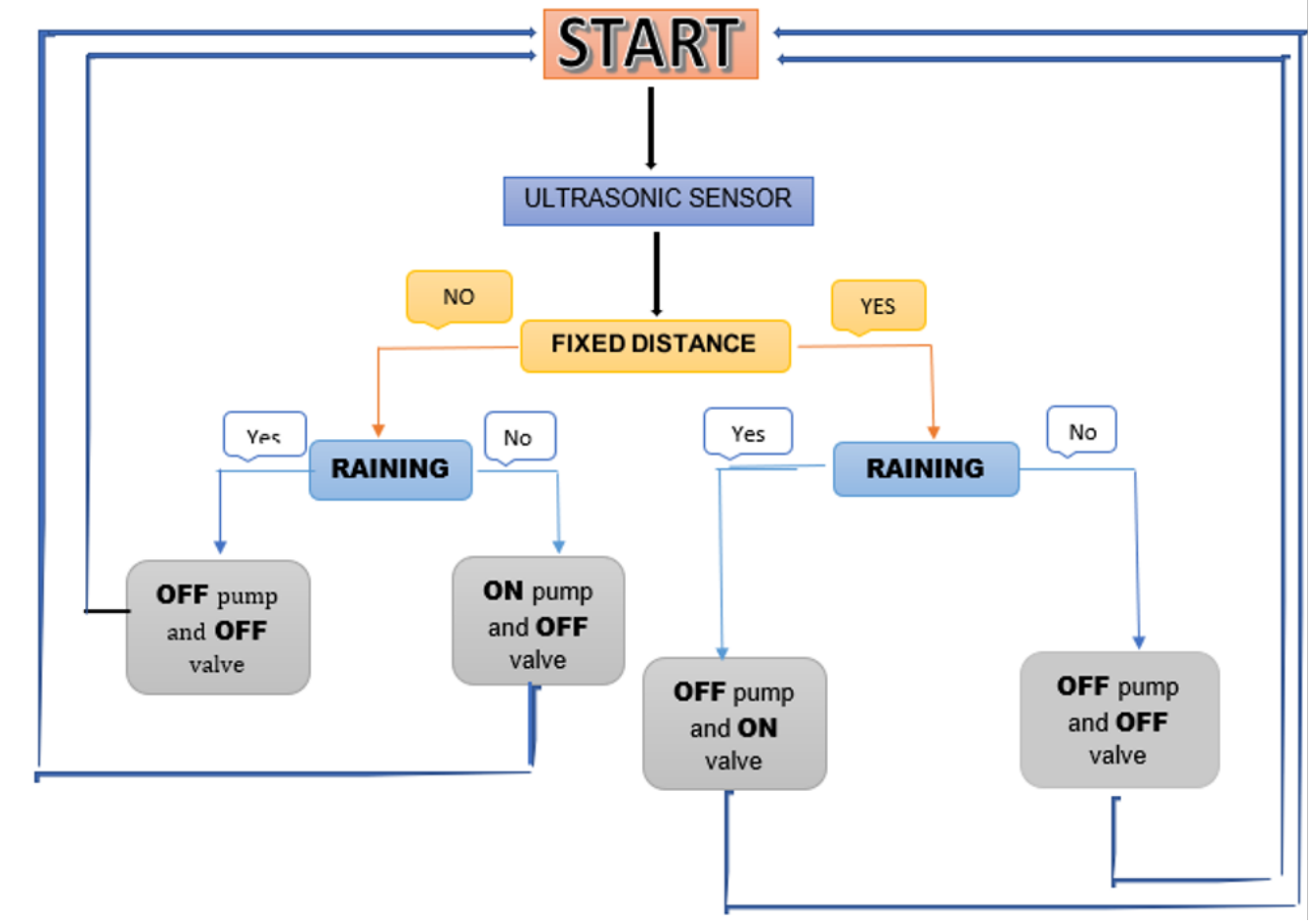
Initially, the connections are made as follows:

Ultrasonic sensor:
Vcc - 5V
GND - GND
trigger - pin 2
Echo - pin 3

Rain sensor:
Vcc - pin 7
GND - GND
Digital - pin 8

Relay module :
Vcc - 5V
GND - GND
Sensor pin - pin 13

Servo motor :
Vcc - 5V
GND - GND
Control pin - pin 9



Flowchart 4.1

Stage of Crop	Depth of Water (cm)
At Transplanting	Shallow (2-3)cm
After Transplanting (5-20) days	(4-5)cm
During Tillering (22-42) days	Shallow (2-3)cm

Table 4.1

Initially the ultrasonic sensor will measure the distance. In the flow chart the fixed distance is calculated as follows. First the paddy field will be filled with water based upon the stage of the crop (the level of water to be filled is given in the table). After this then the ultrasonic sensor will be fixed at one end of the hollow tube and other end of hollow tube will be fixed 1cm above the ground. Now we have to measure the distance between the ultrasonic sensor and top level of the water. This distance is the fixed distance.

Now if the ultrasonic sensor measures exactly same as the fixed distance, then this implies their is no need of filling water in the field. After this it will checking whether it's raining or not through rain sensor. If it's raining then water pump will be turned off and the valve will be opened because due to raining the crop will be overwatered, so to avoid this the valve which is placed at the corner of the field will be opened until extra water is drained out. Here the motor is in OFF condition and valve is in ON condition.

If it is not raining then both the valve and pump will be in OFF condition.

If the ultrasonic sensor measures more than the fixed distance then this implies that there is need of fill water in the paddy field. Next it will be checking whether it is raining or not. If it's raining then there is no need of ON ing the pump as the field will be filled with rain water and the valve will be turned off. Here both pump and valve will be in OFF condition. If it is not raining then water pump will be automatically turned ON and the valve will be in OFF condition.

4.2 Arduino Source Code

sketch_sep07a | Arduino 1.8.13

sketch_sep07a

```
#include <Servo.h>
#define sensorPower 7 // interfacing rain sensor power pin at pin 7
#define sensorPin 8 // interfacing rain sensor digital pin at pin 8

#define echoPin 2
#define trigPin 3

int waterpump=13; // interfacing relay module at pin 13
Servo myservo;

long duration;
int distance;
void setup(){
  digitalWrite(sensorPower, LOW);//keep the rain sensor low

  Serial.begin(9600);
  pinMode(trigPin,OUTPUT);
  pinMode(echoPin,INPUT);
  myservo.attach(9);//interfacing servomotor at pin 9

 }
void loop(){

  int val = readSensor();
  digitalWrite(trigPin,LOW);
```

/Users/burpcat/Desktop/sketch_sep07a/sketch_sep07a.ino

1 Arduino Uno on /dev/cu.usbmodem142301

sketch_sep07a | Arduino 1.8.13

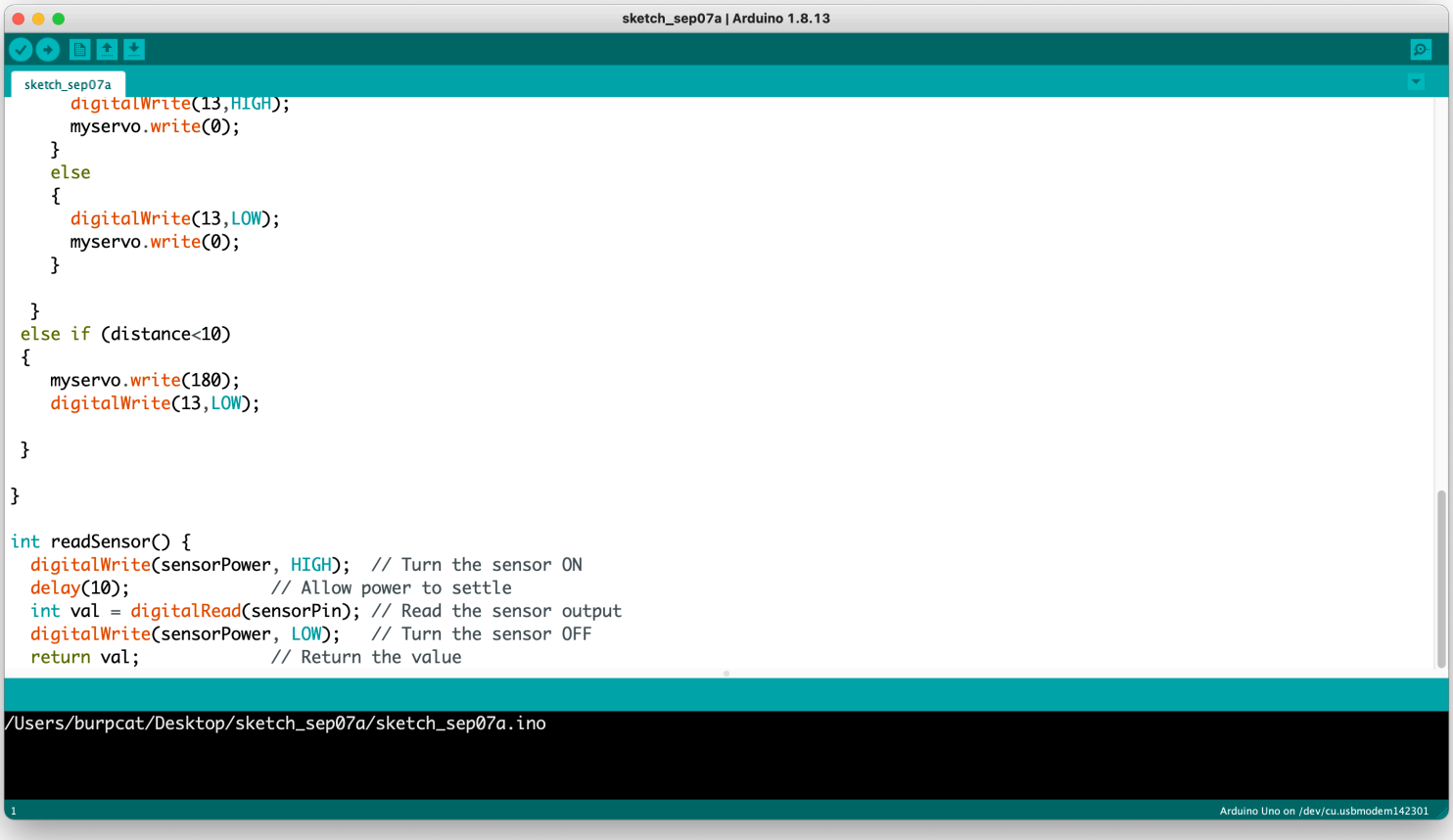
sketch_sep07a

```
void loop(){

  int val = readSensor();
  digitalWrite(trigPin,LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin,HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin,LOW);

 duration=pulseIn(echoPin,HIGH);
  distance=(duration*0.034/2);
  Serial.print("Distance : ");
  Serial.print(distance);
  Serial.println(" cm ");
  delay(1000);
  if (distance==10) //fixed distance is 10cm
  {
    if (val)
    {
      digitalWrite(13,LOW);
      myservo.write(0);
    }
    else
    {
      digitalWrite(13,LOW);
```

/Users/burpcat/Desktop/sketch_sep07a/sketch_sep07a.ino

1 Arduino Uno on /dev/cu.usbmodem142301


sketch_sep07a | Arduino 1.8.13
sketch_sep07a
else
{
digitalWrite(13,LOW);
myservo.write(180);
}
}
else if (distance>10)
{
if (val)
{
digitalWrite(13,HIGH);
myservo.write(0);
}
else
{
digitalWrite(13,LOW);
myservo.write(0);
}
}
else if (distance<10)
{
myservo.write(180);
digitalWrite(13,LOW);
/Users/burpcat/Desktop/sketch_sep07a/sketch_sep07a.ino
1
Arduino Uno on /dev/cu.usbmodem142301


sketch_sep07a | Arduino 1.8.13
sketch_sep07a
digitalWrite(13,HIGH);
myservo.write(0);
}
else
{
digitalWrite(13,LOW);
myservo.write(0);
}
}
else if (distance<10)
{
myservo.write(180);
digitalWrite(13,LOW);
}
}
int readSensor() {
digitalWrite(sensorPower, HIGH); // Turn the sensor ON
delay(10); // Allow power to settle
int val = digitalRead(sensorPin); // Read the sensor output
digitalWrite(sensorPower, LOW); // Turn the sensor OFF
return val; // Return the value
/Users/burpcat/Desktop/sketch_sep07a/sketch_sep07a.ino
1
Arduino Uno on /dev/cu.usbmodem142301

CHAPTER 5
RESULTS

5.1 Simulation Results

The following images represent the state of the project when it is being simulated as per the set parameters.

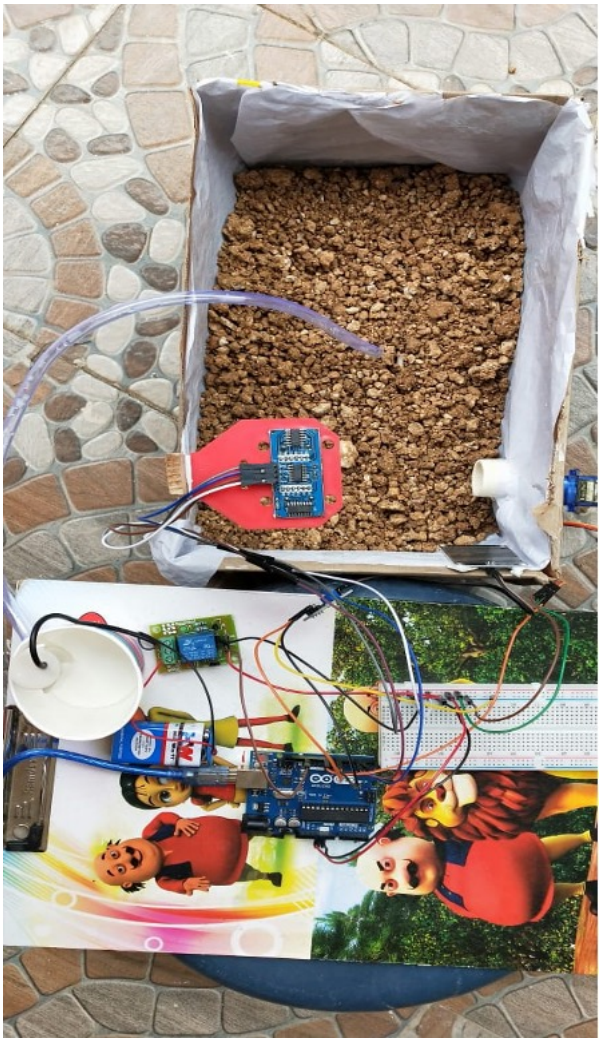


Figure 5.1

The above image shows how the prototype of the project is being implemented creating the scenario of a paddy field. Here, the ultrasonic sensor is required to be placed at an elevated surface for the fixed distance calculation, hence it is placed on a stick.

The rain sensor is placed at a corner, where the rain can be observed by the sensor and it is placed at a angle , so that no water stagnation will be observed. The water pump is connected with the help of a single channel step up relay because the Arduino only outputs +5V, whereas the pump needs a +9V input.

A servo is also implemented here as the gate control for the flow of water either as drain or sump.

Case - 1

At Transplanting (12 cm)

	INPUT		OUTPUT	
S.NO	ULTRASONIC SENSOR READINGS (CM)	RAIN SENSOR READINGS R-RAINING NR- NOT RAINING	WATER PUMP (ON/OFF)	VALVE (ON/OFF)
1	12	R	OFF	ON
2	10	R	OFF	OFF
3	17	R	OFF	ON
4	11	NR	ON	OFF
5	12	NR	OFF	OFF
6	15	NR	OFF	ON
7	6	R	OFF	OFF
8	8	NR	ON	OFF
9	14	NR	OFF	ON

Table 5.1

Case - 2

After Transplanting (10 cm)

	INPUT		OUTPUT	
S.NO	ULTRASONIC SENSOR READINGS (CM)	RAIN SENSOR READINGS R-RAINING NR- NOT RAINING	WATER PUMP (ON/OFF)	VALVE (ON/OFF)
1	10	R	OFF	ON
2	12	NR	OFF	ON
3	14	R	OFF	ON
4	10	NR	OFF	OFF
5	6	NR	ON	OFF
6	8	NR	ON	OFF
7	15	R	OFF	ON
8	7	R	OFF	OFF
9	9	NR	ON	OFF

Table 5.2

Case - 3

During Tillering (12 cm)

	INPUT		OUTPUT	
S.NO	ULTRASONIC SENSOR READINGS (CM)	RAIN SENSOR READINGS R-RAINING NR- NOT RAINING	WATER PUMP (ON/OFF)	VALVE (ON/OFF)
1	12	R	OFF	ON
2	10	R	OFF	OFF
3	17	R	OFF	ON
4	11	NR	ON	OFF
5	12	NR	OFF	OFF
6	15	NR	OFF	ON
7	6	R	OFF	OFF
8	8	NR	ON	OFF
9	14	NR	OFF	ON

Table 5.3

CHAPTER 6
APPLICATIONS, ADVNATAGES, LIMITATIONS

6.1 Applications

1.Used to monitor water level in any other type of crops.

2.It can also be used detect water level in tanks and automatically turn off the motor.

3.With the help of IoT, we can interface number of these units and deploy them in fish farm for water maintenance.

4.When the scale of the application is increased, it can be used to measure the depth of lakes and ponds.

6.2 Advantages

1. Low Cost of Implementation

We use the very basic materials like a microcontroller, ultra-sonic sensor etc. So, our cost of making the product is very less as compared to many other existing object detection systems. This gives an an opportunity of easy affordability and usage by end users. Also getting good results by implementing this system is our main aim with lowest price possible.

2. Less power consumption:

As we know that we are in an era where "Power management" plays a main role in today's world. As we are getting shortage of power these days it's very important to use low power consumption devices. Compared to many other irrigation systems which uses sensors, where a lot of power is required to process ,our system manages to do the task with fraction of that power. Because we use ultrasonic sensor and few other sensors takes very few amount of power and last longer. This comforts the end users (farmers)not to bother about power backup.

3. Less Manual Input and reduced risk factor

As we know farmers faces the issues of controlling the state of motor during nights and rainy seasons by this we can reduce the rate of electric shocks.As it requires the less manual input ,by this automated system, we can control almost all aspects of irrigation like ON and OFF states.

4. Improves Water Efficiency

By this crops receives the right amount of water at the right time and also any under water watering and over watering issues will be eliminated and it optimise water consumption.

5. Easy to design

Designing of a product for an application is one of the major thing . Generally it needs a lot of time and effort. But in our "Object detection system" design part is a lot easier as it takes only a few days to do so . First we write software for the working as per our requirements then we assemble the hardware and link the physical and software parts with an IDE.

6.3 Limitations

Each and every system will have both advantages and limitations. But it is important to note that there are significantly more advantages and very limited number of limitations. By considering all the above-mentioned advantages and to meet the applications the following are the limitations posed by our system.

- During power cuts, we cannot use the system
- Rain sensor may not work accurately in drizzle rains.

CHAPTER 7
CONCLUSION & FUTURE SCOPE

7.1 Conclusion

- Simplifies the Irrigation System
- Optimises Water consumption
- Minimises manual intervention
- Increases agricultural yield

7.2 Future Scope

- The power supply for the system can be replaced with a solar power system for uninterrupted power supply.
- With the usage of IoT, if the system can be implemented on a larger scale, a probable coalition of such water level monitoring systems can be formed under this schema.

CHAPTER 8
REFERENCES

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