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BEng (Hons) Electrical & Electronic Engineering

Final Year Project

Automatic Irrigation System on Sensing Soil Moisture Content for Paddy Fields in Sri Lanka

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Abstract

For the past centuries, the water management was done using man power according to traditional methods. In many cropping systems like rice cultivation, the water management system should be kept at a high level, with the aid of these traditional methods it is not easy to keep a proper water management system unless wasting of too much of time as well as man power. However, like other countries in the world, Sri Lanka is also looking for new methods that can increase the efficiency of water management system.
Automatic irrigation system on sensing soil moisture content is introduced instead of existing traditional manual irrigation system. In this project, I expected to find a better method for making an automatic irrigation system and I have developed a much efficient system that can use for paddy cultivation in Sri Lanka.

You will see at the beginning of report I have briefly explained about the background and history of cultivation systems in Sri Lanka. I have also mentioned about the literature review, designing of the automatic irrigation system and the methodology of the implementation. This report also includes a comparison between automatic system, which I have designed, and traditional system with its advantages and disadvantages.

Acknowledgement

First, I shall mention my deep sense of appreciation for my supervisor Dr. Indrajanaka Mahakalanda for all encouragements, support and all the guidelines. That would be so much help for me to come this far. I would like to express my gratitude to Ms. Asha Pushpika, student coordinator at ICBT campus for all given support and the all given resources from ICBT.

Especially I would like to express my sincere appreciation to Mr. Nisal Hewagamage, who helped me in making the simulator. In addition, I would like to thank all farmers and villagers in *Polonnaruwa* agricultural area. They gave me valuable support in collecting the facts for my project. Finally, I would like to thank everyone who helped me in any other way for making my project "Automatic Irrigation System on Sensing Soil Moisture Content for Paddy Fields in Sri Lanka" a success.

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1.1 Background

Rice, the staple food of Sri Lanka, in all districts of the country, paddy crops are planted. At the present about 708,000 Hectares (34 percent of the total cultivated area) is devoted for paddy cultivation and over 1.8 million famers are employed by the paddy cultivation. Currently 2.7 million tons of rough rice is produced annually and this amount fulfills around 95 percent of the domestic requirement. Because of these reasons paddy is considered as the staple cultivation in this country.

In Sri Lanka there are 2 nos. of cultivation seasons called, *Yala* and *Maha*. These the particular seasons are defined according to the two monsoons.

- ✓ Maha Season - From September to March, falls during "North-east monsoon"
- ✓ Yala season – From May to August, falls during South-west monsoon.

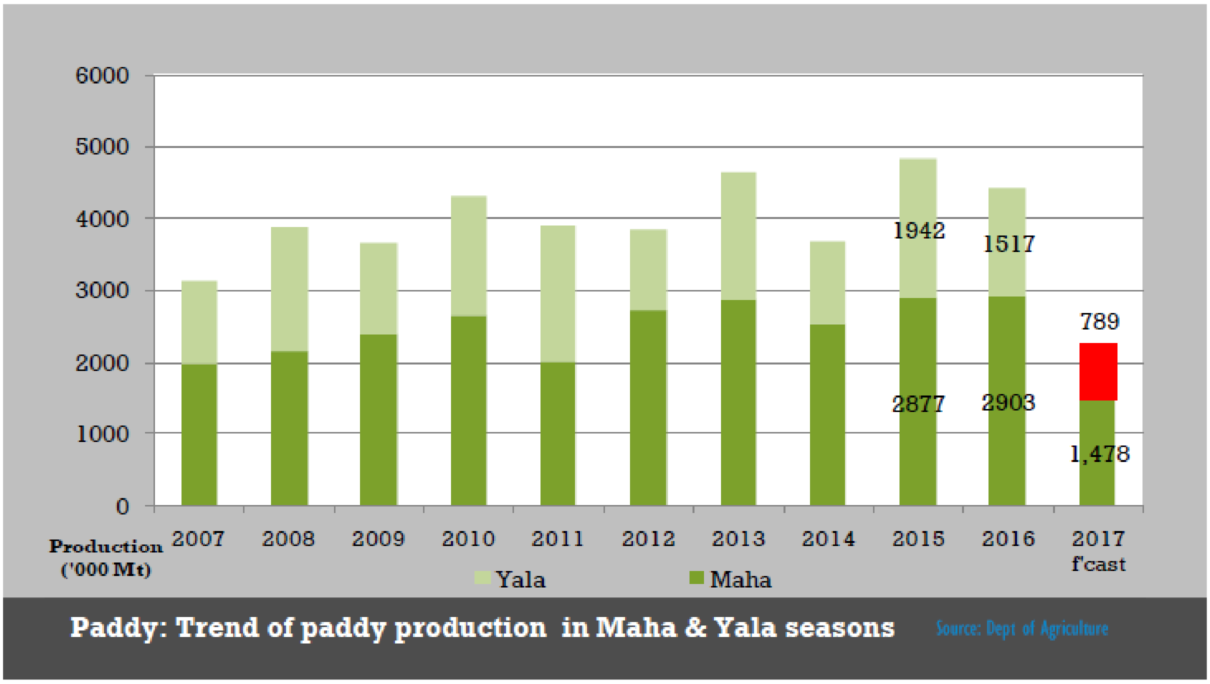

Figure 1 Trend of paddy production

Source: http://www.economynext.com/Drought,_floods_to_halve_Sri_Lanka_s_Yala_2017_rice_crop-3-8310-9.html

These two season has been created according to the above two monsoons due to the important of supplying water for the paddy crops.

Because of a wetland crop, the paddy needs much water than the other farming crops. So it's very important to keep the necessary moisture content in the soil in different kind of time periods. Because of that reason, our ancestors was very careful to keep a good irrigation system for the paddy cultivation since the ancient time.

Province/ District/ System	Type of Irrigation	Targets for Cultivation Year 2017									
		Maha 2016/17				Yala 2017				Cultivation Year	
		Sown Extent (Hectares)	Net extent to be Harvested (Hectares)	Average Yield (Kg / Ha)	Production (Mt)	Sown Extent (Hectares)	Net extent to be Harvested (Hectares)	Average Yield (Kg / Ha)	Production (Mt)	Extent (Ha.)	Production (Mt)
Colombo	Major	308	261	3,500	915	158	134	3,300	440	466	1,355
	Minor	972	825	3,500	2,885	398	335	3,200	1,070	1,370	3,955
	Rainfed	2,328	1,973	3,400	6,705	1,349	1,137	3,100	3,525	3,677	10,230
	Total	**3,608**	**3,059**	**3,435**	**10,505**	**1,905**	**1,606**	**3,136**	**5,035**	**5,513**	**15,540**
Gampaha	Major	1,855	1,560	3,700	5,770	1,332	1,101	3,500	3,855	3,187	9,625
	Minor	3,568	3,025	3,600	10,890	1,730	1,456	3,400	4,950	5,298	15,840
	Rainfed	6,077	5,150	3,400	17,510	1,938	1,641	3,300	5,415	8,015	22,925
	Total	**11,500**	**9,735**	**3,510**	**34,170**	**5,000**	**4,197**	**3,388**	**14,220**	**16,500**	**48,390**
Kalutara	Major	189	174	3,300	575	100	92	3,200	295	289	870
	Minor	1,985	1,828	3,300	6,035	1,345	1,236	3,300	4,080	3,330	10,115
	Rainfed	11,326	10,408	3,100	32,265	6,055	5,561	3,200	17,795	17,381	50,060
	Total	**13,500**	**12,410**	**3,133**	**38,875**	**7,500**	**6,889**	**3,218**	**22,170**	**21,000**	**61,045**
Galle	Major	174	136	3,800	515					174	515
	Minor	180	140	3,500	490	130	101	3,000	305	310	795
	Rainfed	15,028	11,696	3,200	37,430	8,601	6,585	3,000	19,755	23,629	57,185
	Total	**15,382**	**11,973**	**3,210**	**38,435**	**8,731**	**6,686**	**3,000**	**20,060**	**24,113**	**58,495**
Matara	Major	3,844	2,954	4,250	12,555	3,431	2,638	4,300	11,345	7,275	23,900
	Minor	3,337	2,577	3,600	9,275	3,148	2,444	3,600	8,800	6,485	18,075
	Rainfed	9,233	7,220	4,100	29,600	8,201	6,313	3,500	22,095	17,434	51,695
	Total	**16,414**	**12,750**	**4,034**	**51,430**	**14,780**	**11,396**	**3,707**	**42,240**	**31,194**	**93,670**

Figure 2 Crop production programme 2016/2017 YALA and MAHA

Source: http://www.agrimin.gov.lk/web/index.php/statistics

When we look back, King Pandukabhaya (474-367 BC) built the first water tank. It is stated that there were three tanks, called Gamini weva, Jaya weva and Abhaya weva, yet, currently, only Basawakkulama tank is exist.

1.2 Rationale of the topic

The agricultural technology has rapidly developed in last decades as well as consumer electronics. Automatic irrigations system is convenient and saves time if they can operate efficiently. This system replaces the existing traditional irrigation methods and giving farmers an opportunity to increase quality as well as productivity of the harvest.

1.3 Problem Identification

For past centuries, traditional water management system has been used in paddy cultivation in Sri Lanka. Due to shortage of water, only the some part of paddy were cultivated. Literally, in these traditional irrigation systems considerable water wastage has committed. Due to lack of useful water, the quality of the harvest is reduced and the amount of the harvest is reduced. Sometime whole harvest can be destroyed.

Figure 3 A poster showing farmers ask for payment from the government for affected areas due to drought and water shortages

In addition, this traditional irrigation system costs lot of labor as well as lots of time. There are many steps can be seen in the paddy cultivation like land preparation, seeds establishment, nutrient management and harvesting. In all these steps, the farmer has to check the soil moisture content of the paddy field and according to the condition on he has to supply the necessary amount of water for the paddy field.

Some disadvantages of the traditional irrigation system as follows,

1. The quality of the harvest may reduce
2. The harvest can be destroyed due to lack of water or excessive of water
3. Water wastage
4. Lots of time and labor cost
5. High attention and consideration is essential

Today the farmers are not only depend on the paddy cultivation. Doing some other occupations is not a big thing and it seems some of them are doing farming as a part time job. However, the traditional water management system gives some kind of disturbance for these type of people because lots of time and work force cost for this traditional irrigation system.

1.4 Aim and Objectives

1.4.1 Aim

The automatic irrigation system will definitely give good solution for above matters and it saves lots of human effort and time.
There are many advantages can be occupied using an automatic irrigation system. Some of these advantages as follows,

1. Productivity increases

2. The quality of the harvest increases

3. Saves water

4. Reduces time and labor cost

5. No need of high attention and consideration

6. Overall efficiency increases

In my project, I have successfully implemented an automatic irrigation system for the Paddy cultivation. I mainly focus to accomplish following aims with this automatic irrigation system.

- ✓ Reduce the labor and time
- ✓ Minimize the water wastage
- ✓ Maximize the productivity

By the mean time of my project I have researched on traditional irrigation system as well as the modern irrigation systems. By combining both of traditional and modern irrigation, system I came up with a more suitable irrigation system for Sri Lanka.

1.4.2 Objectives

- To know about different type of irrigation systems from referring research papers.
- Study and develop moisture-sensing system.
- Design an automatic irrigation system.
- Implement an irrigation system on sensing soil moisture.

1.5 Project Scope

- Sense the soil moisture using a moisture detector.
- Measure/ read the soil moisture level using ATMEGA2560 micro controller.
- Check the water level of drainage canal and well.
- Operate motors either gate or ground well according to the set value.

2 Literature review

2.1 Current Irrigation Systems

2.1.1 The Tank (Water Reservoir) Irrigation System

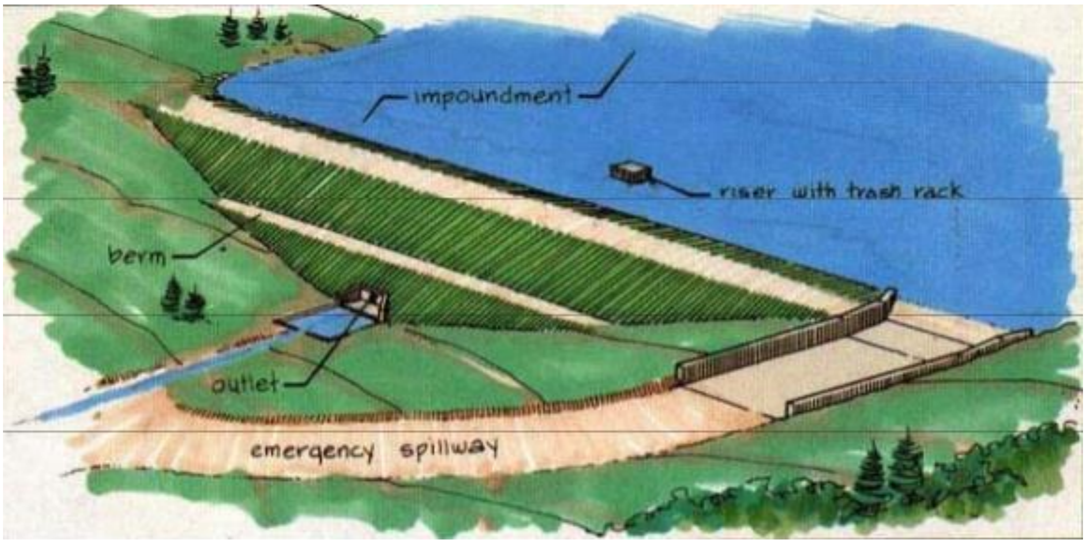

Figure 4 The tank irrigation system

Approximately 220,000 hectares in Sri Lanka are irrigated by the tank irrigation system. Government manages small village tanks that cascades irrigation in Sri Lanka.

This system is illustrated by the synergy between the tank, social capital, ecology and institutional structures. These tank systems are said to be a perfect match for the space/ field, because they have in fact been designed for the society in the country.

Figure 5 Tenurial system in Polonnaruwa – Sri lanka

Interconnections between the tanks assure that water is subject to use multiple times in each catchment. Tenurial systems facilitate the appropriate management of tanks and sharing of tank water, fishing rights etc.

2.1.2 Agro-Well Irrigation

In the 1970s and again around 2000, there was a surge in agro-wells. Vegetables and market crop cultivation on formerly rain-fed lands is now the mainstay of agrarian livelihoods. Increased profits are transforming lives in these villages. These wells have small energy footprints with most using 1 or 2 HP pumps. The high cost of kerosene leads farmers to use groundwater conservatively.

Figure 6 Agro Irrigation System

2.1.3 Pump irrigation system

Canal commands are also seeing a surge in pump irrigation. Here, lift irrigation from the feeder canal has caused a boom in vegetable cultivation.

2.1.4 Ground irrigation system

This is another important system and it argues that energy subsidies have created a groundwater based agrarian system, which place a low value on both electricity and groundwater, to the detriment of energy boards and aquifers. On the other hand, Sri Lanka and Kerala provide a model where high value crops irrigated through judicious use of groundwater, thus maximizing efficiency.

2.2 Modern irrigation methods

When latest irrigation systems come up with modern technology, popularity of such products is increased. These have several advantages over the conventional methods. Micro irrigation is one of the emerging technologies for efficient use of water.

2.2.1 Drip Irrigation

This is a micro-irrigation type irrigation method. The aim of this method is to pour water directly into the root of the plant. This minimizes evaporation. The water is buried below the surface and drips to the roots slowly.

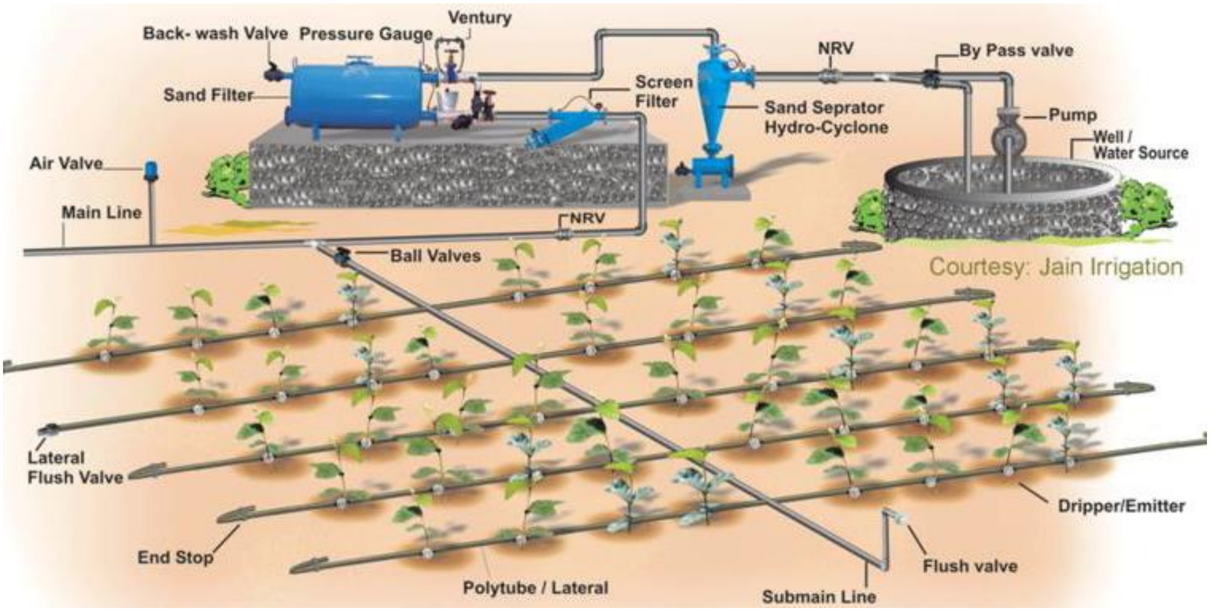

Figure 7 Drip Irrigation Syste

2.2.2 Splinker Irrigation

Figure 8 Splinker Irrigation

Sprinkler irrigation is used for irrigating agricultural crops, lawns, landscapes, golf courses, and other areas. This system is also used for cooling and for the airborne dust controlling. Allowing water to falls like natural rain and let plants to absorb slowly.

2.2.3 Center Pivot Irrigation

This is one of a modern crop irrigation method. Spinklers are used to water the plant with a aid of rotating around the pivot. This irrigates a circular area within given command. These kind of systems are operated by either a water source or an electrical supply.

Figure 9 Center Pivot Irrigation i

Figure 10 Center Pivot Irrigation ii

2.3 Importance of Soil Moisture

2.3.1 What is Soil Moisture?

This is also known as quantity of water contained in the soil. This is measured in m^3/ m^3 units.

$$Water\ content\ by\ volume = \frac{Volume\ of\ water\ \ \mathrm{m3}}{Volume\ of\ bulk\ soil\ \mathrm{m3}}$$

2.3.2 Effect on Soil Type

Moisture content of the soil may vary according to soil type. Sandy soil holds less amount of water while clay soil holds higher, as the particles are

Four standards of water content.

Name	Typical water content (vol/vol)	Conditions
Saturated water content	0.2–0.5	Fully saturated soil, equivalent to effective porosity
Field capacity	0.1–0.35	Soil moisture 2–3 days after a rain or irrigation
Permanent wilting point	0.01–0.25	Minimum soil moisture at which a plant wilts
Residual water content	0.001–0.1	Remaining water at high tension

In every stages of growing, the paddy plant needs various amount of moisture content. As well as various types of paddy seeds need various amount of moisture content. So the controlling the moisture content in the soil is more important thing in paddy cultivation. So the irrigation systems are introduced to keep the corresponding moisture content correctly.

3 Methodology

3.1 Introduction

In this project, I have to sense the soil moisture and according to that soil condition, I have to find a way of supplying the necessary amount of water for the plantation.

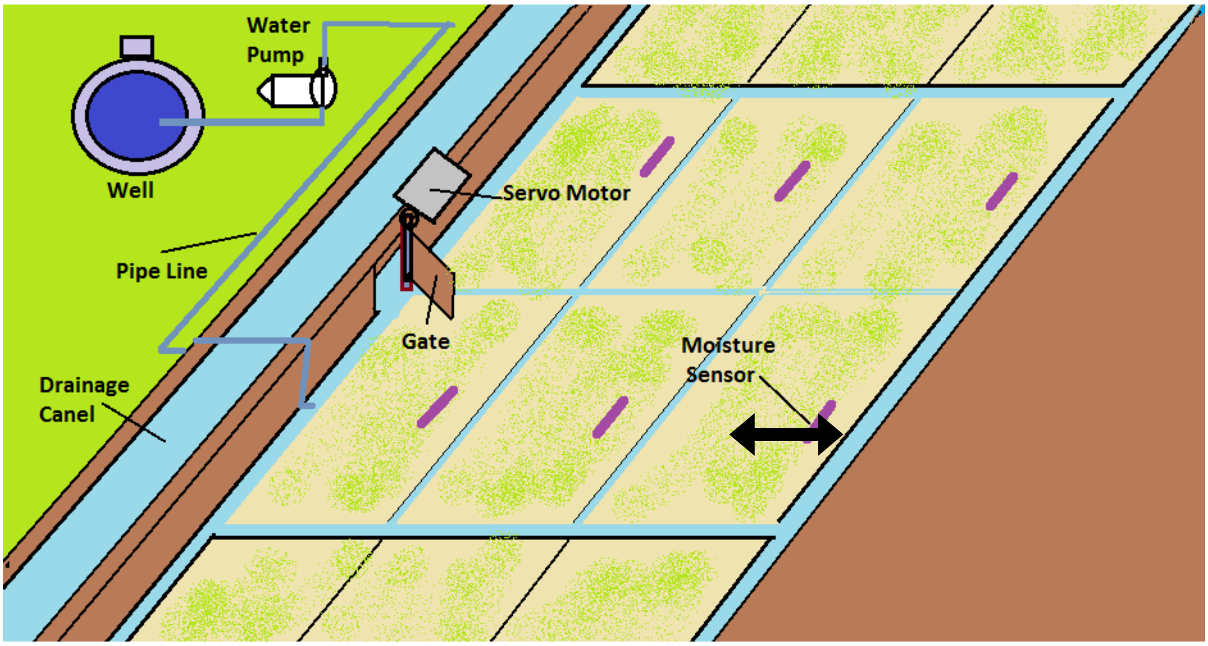

Figure 11 2D sketch of typical automatic irrigation system

Soil Moisture Sensors can be used for measuring the moisture content of the soil. As in the figure we can use one moisture sensor for one part of field. We can check the moisture details of the soil in every part of the paddy field using more soil moisture sensors. After getting the required details it can be decided to supply the water in more economical and efficient manner.

The water suppling system has been implemented for the fulfilment of the required moisture content. For the Automatic Irrigation system I implemented, two methods are proposed for water suppling to the paddy field.

3.1.1 Automatically Supply the Water from Drainage Canal (With the aid of Traditional Method)

As traditional irrigation system, we can get the water supply from drainage canal. When the soil moisture content is getting law, we can supply the water to the field from the drainage canal by opening a Gate. We can use a servomotor to open the gate because controlling the gate could be very easy. However we can adjust the flow rate of the water by controlling the amount of opening of gate which is done by the servo motor. This procedure reduces the water wastage considerably. This method is very cheaper method because we just want the power only for controlling the gate. When there is enough water in the drainage system we can use this method.

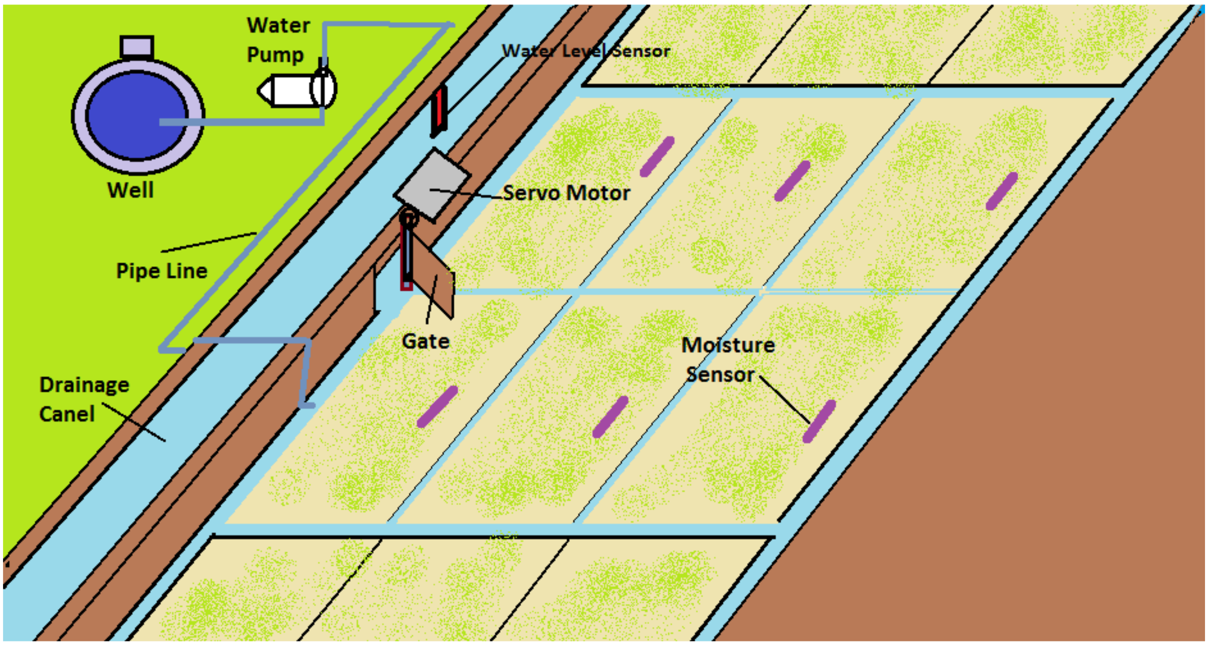

Figure 12 Supplying water through drainage canal in rainy season

3.1.2 Supply Water From A Well Using A Water Pump (With the aid of Pump Irrigation+ Agro well Irrigation)

This method costs little bit higher than the previous one because we have to power up the water pump for supplying the water to the paddy field. But we have to use this method when there isn't enough water in the drainage canal. The water pump can be set as working automatically as we desire. Additional cost is added due to the water pump and pipe lines when constructing this method.

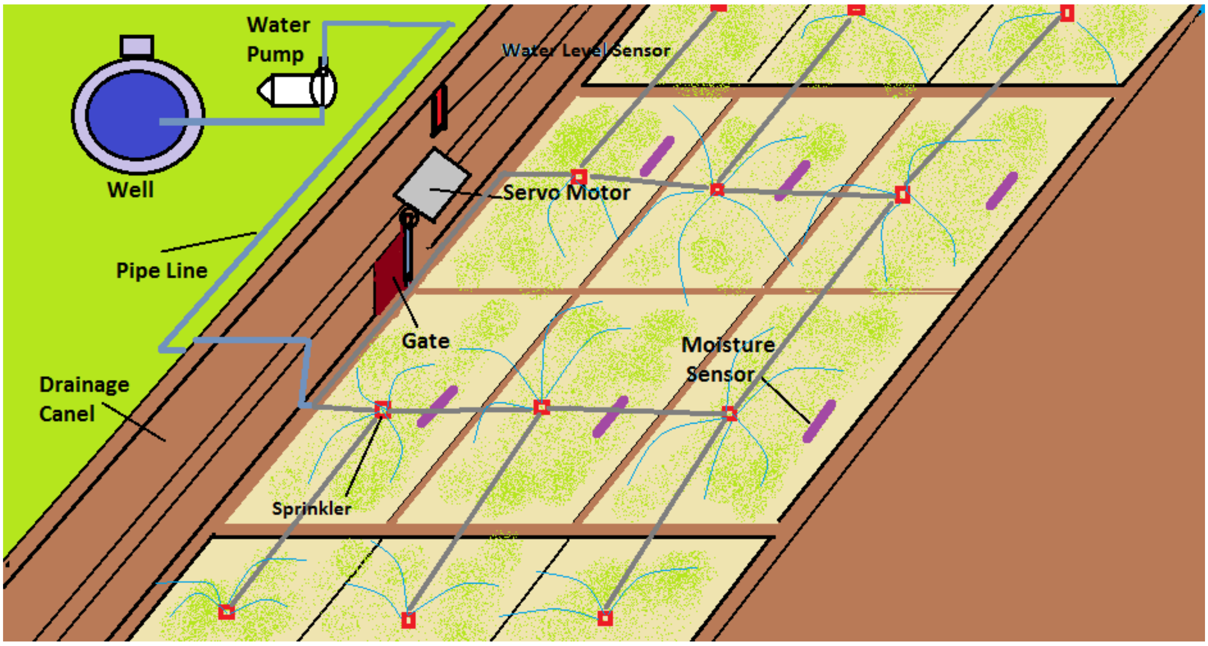

Figure 13 Supplying water using agro well connected through a water pump

We can use one of these methods individually. But if we construct the both methods we will be able to increase the reliability as well as the efficiency of the irrigation system. Not only that, but also we can save lot of amount of water by reducing the water wastage. This type of system which included both of water supplying systems is affordable for rainy seasons as well as draught seasons. So we can maximize the productivity and we can get the better harvest. Both of these systems further developed into the modern system such as sprinkle irrigation and drip irrigation system easily with the aid of the water pump and other equipment. In the above figure it is shown that how to do further develop such a system into a sprinkle system.

3.2 Required Materials and Equipment For the Irrigation System

Following equipment will be needing to implement the automatic irrigation system.
Literally, this system has 2 inputs. The 2 sensors that use for detect the moisture level of the soil and the water level of the cannel give that two inputs to the system. A keyboard is used for giving the required moisture level of the soil in the paddy field. The display is also used in this system. After processing, the data received by the sensor and given by the keyboard and the microcontroller commands the actuators. As earlier mentioned, the servo motor and water pump are those actuators and they can be identified as the two outputs in the system.

3.2.1 Microcontroller

This is the main part of the automatic irrigation system. All the signals, taken by the sensors are received by controlling unit and after processing the data it command the actuators. I have chosen the ATMEGA 2560 microprocessor for this automatic irrigation system.

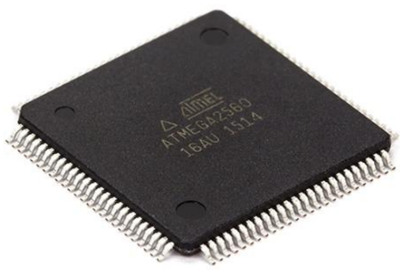

Figure 14 ATMEGA 2560

Source: https://www.rhydolabz.com/images/MIC0047.jpg

Using the compact equipment called Arduino (commercial name), it is easy to connect the other apparatus and devices and it is very easy to insert the program to the microcontroller using a PC.

3.2.2 Soil Moisture Content detector

Soil moisture sensors measure the volumetric water content in soil. Soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons. The relation between the measured property and soil moisture shall be calibrated and might vary depending on environmental factors such as soil type and temperature.

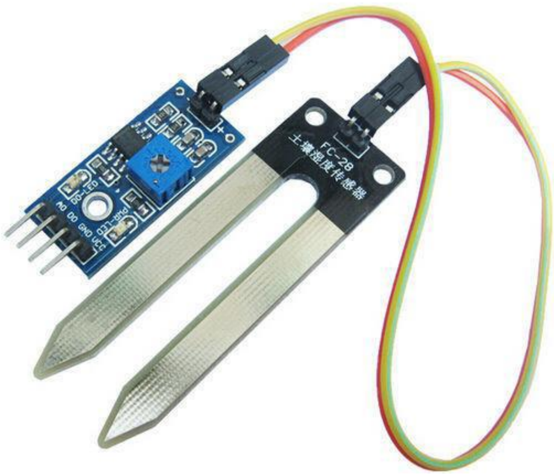

Figure 15 Arduino Moisture detecting module

Source: https://i.ebayimg.com/images/g/LCEAAOSw-7RVGnJ2/s-l300.jpg

3.2.3 Soil Moisture Content detector

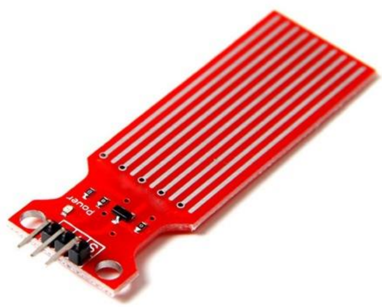

Figure 16 Arduino Water Level Indicator

Source: https://images-na.ssl-images-amazon.com/images/I/615lQaE%2BY9L._SL1170_.jpg

3.2.4 Key Pad

This type of key pad is used for giving the system required water level we want. Because of the various kinds of paddy crops need various soil moisture level, the definite moisture level should be given to the system by this key pad.

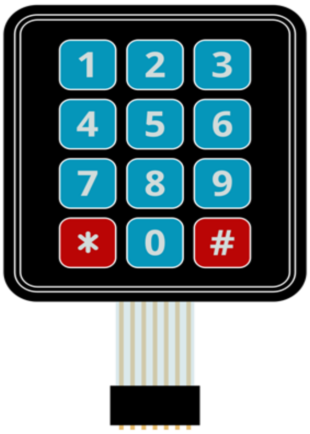

Figure 17 Arduino keypad

Source: https://www.electroschematics.com/wp-content/uploads/2015/11/AKP-1.png

3.2.5 Single Phase 220V 0.34HP Water Pump

Water pump is used to draw water from the agro well. For using this type of motor, another power circuit can be easily designed using the relays. The actuating signal can give for those relays and using an external power supply.

Figure 18 SOLEX 0.34Hp single-phase water pump

I use following little 9g servo motor and little water pump for the implementation.

Figure 19 Mini water pump

Figure 20 Mini servomotor 5V

3.2.6 16x4 LCD

LCD Display is used for showing the status of the system and the moisture content. Here I have used 16 by four LCD display and the system was programmed to show the following information on it.

1. Current soil moisture level in the paddy field
2. Required moisture level
3. The status of the servomotor (gate)
4. The status of the water pump.

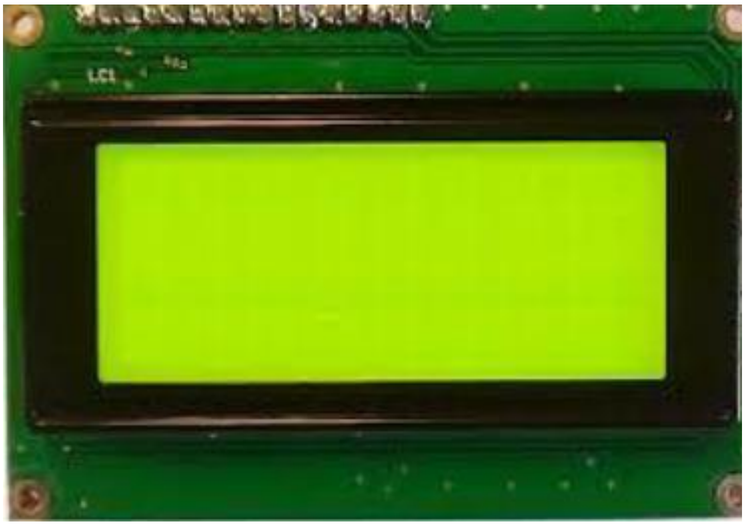

Figure 21 LCD 16x4

3.4 Design and Implementation

To control this type of irrigation system the controller must be durable as well as little bit cheaper because every farmer would be able to buy and set up the system easily. After comparing some of controllers I think ATMEGA 2560 microprocessor based controlling system would be most suitable for this type of system. Actually we can use Arduino Mega or Arduino UNO microcontrollers for the systems because they are very cheap and can be programed very easily. Durability also get considerably higher value when comparing with the other microcontrollers according to their prices. Furthermore, due to the easy programing, every person who has basic knowledge about programing will be able to construct this type of irrigation system easily.

3.4.1 Design Stage

Considering the requirement for the automatic irrigation, a system sketched as a blog diagram with above-mentioned devices.

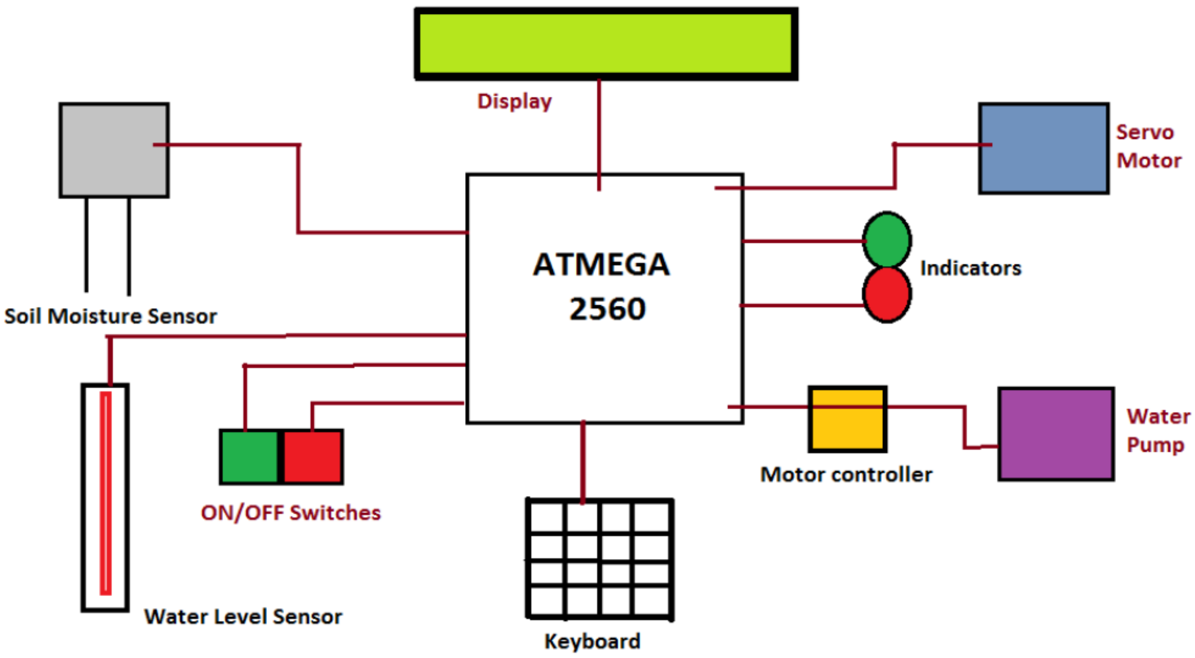

Figure 22 Block diagram - Controlling System

A flow chart will need to get a clear idea of the controlling system. It will be as follows,

3.3.2 Flow Chart of the Automatic Irrigation System

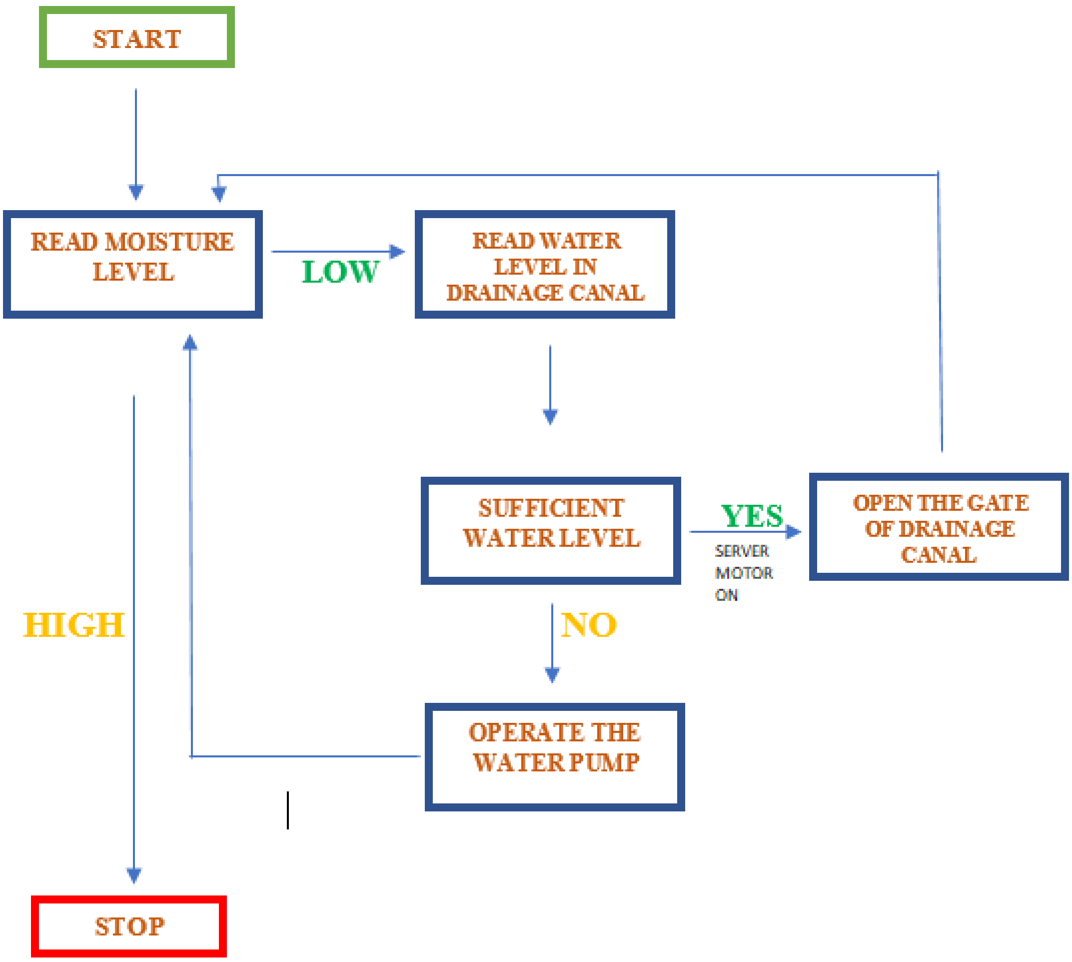

Figure 23 Flow chart of the controlling system

Using above blog diagram and the flow chart I was able to designed an electrical circuit using *proteous* software for the automatic irrigation system. After getting the all the devices connected, it could be easily check whether the system can accomplish our targets.

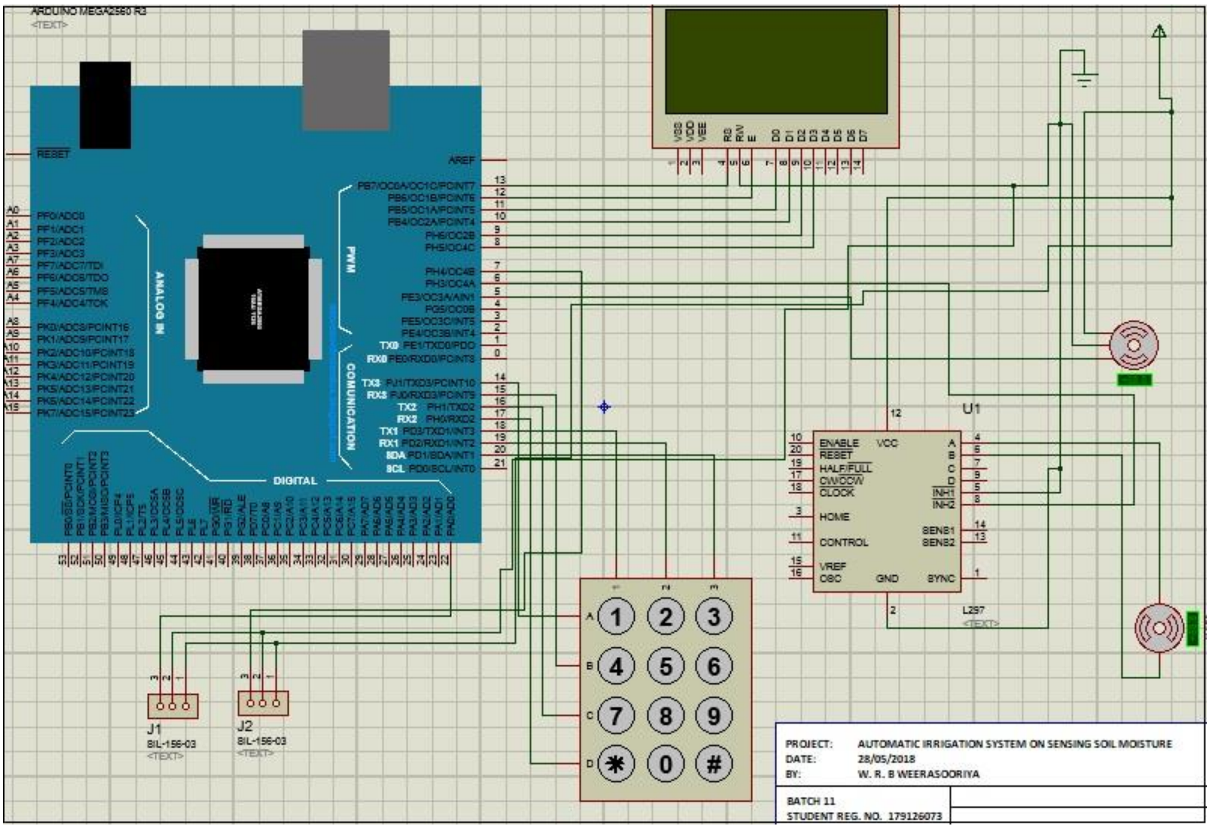

Figure 24 Circuit diagram

Using above circuit diagram, function of the system can be successfully tested.

The required apparatus and material also were made myself instead small water pump and the servo motor.

3.4 Implementation

The following figure shows simulation apparatus of the automatic irrigation system.

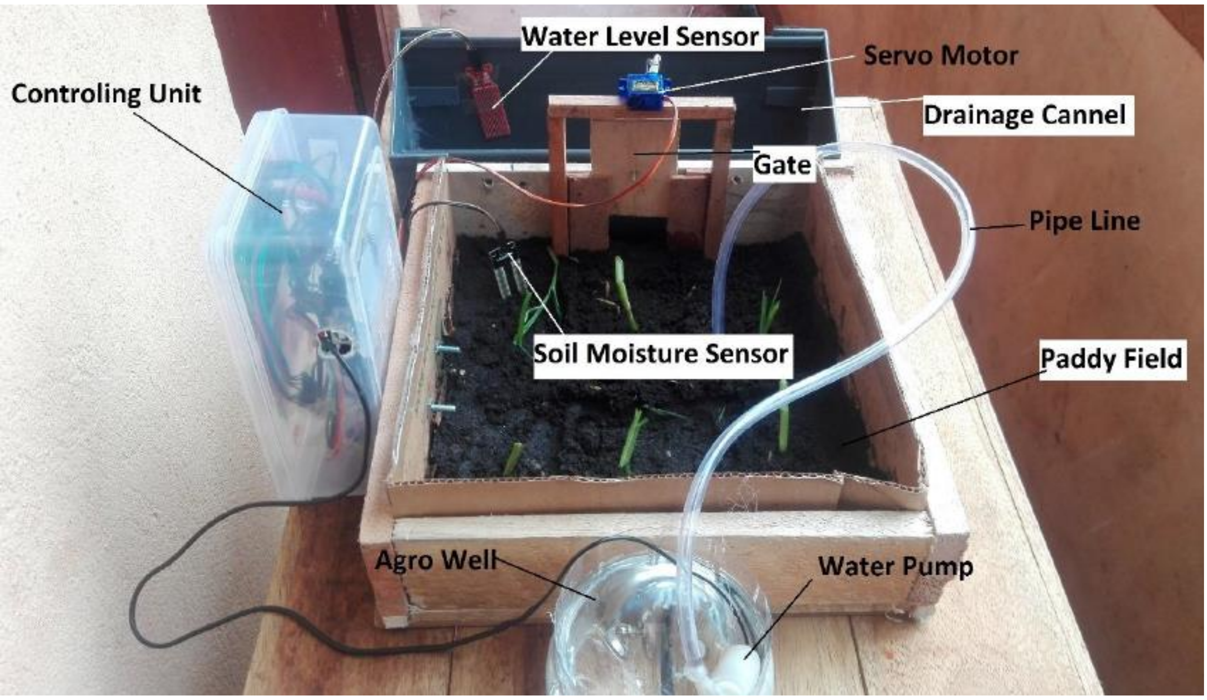

Figure 25 Main components of the system

Above simulator can perform all the real system working and can be tested. The controlling box consists with the ATMEGA 2560 microprocessor. All the sensors, which give input signal as well as the actuators, are connected to this main box.

The key board and the display are also fixed outside of the main controlling box.

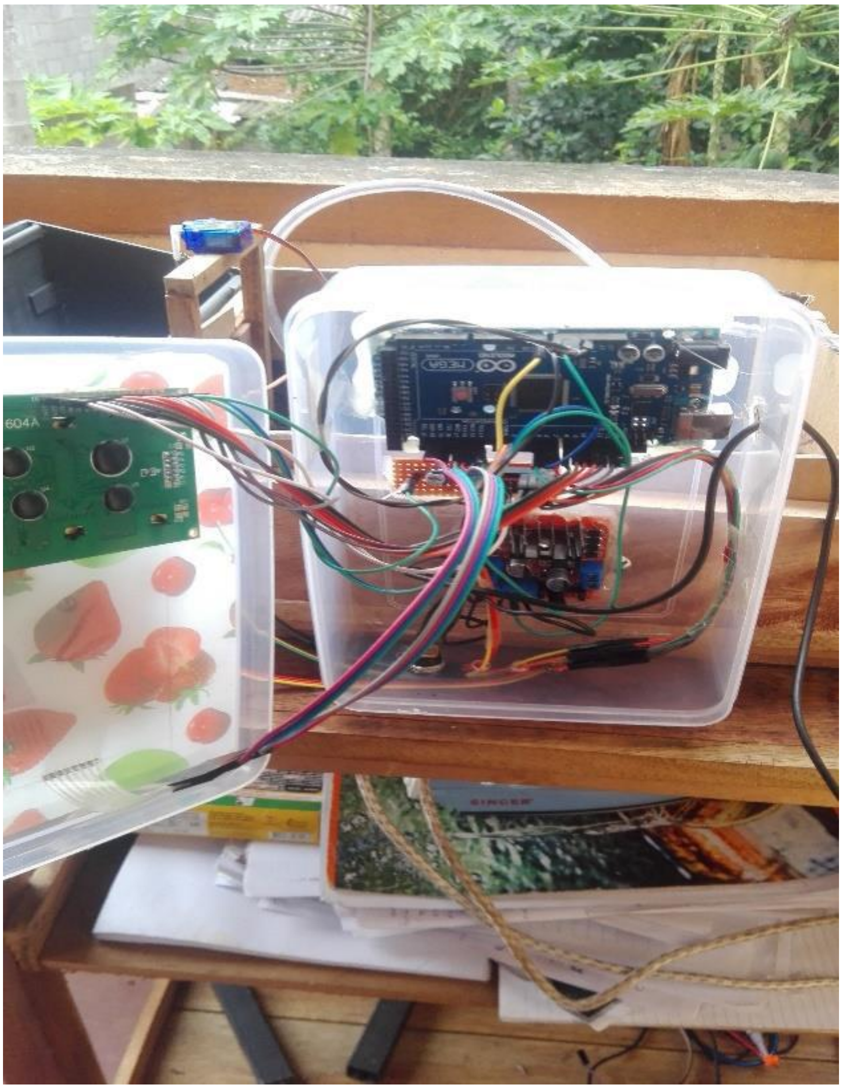

Figure 26 Inner view of the controller

3.4.1 Working Principle

Initially, when program starts, soil moisture is measured by the detector, according to the moisture content of the soil, the LED display will show upon the how much moisture content is there.

If the moisture content does not show the required value that must need for the paddy crops, we can enter the required moisture content that should be in the soil using the keyboard. Here we use "#" button in the keypad for entering the relevant value. As an example if we need 52% of the soil moisture content in the soil, we have to enter number 5, number 2 and the # key by pressing the keyboard buttons.

Figure 27 Moisture detector in soil

Figure 28 LCD showing initial start up

Figure 29 Setting up target value using keypad

After giving the required moisture content, the system automatically supply the necessary amount of water until the soil acquired its required moisture content. After the fulfilment the system, automatically stops the water supply by stopping the water pump or by closing the gate.

We can change this required moisture content in anytime. Until we change this value, the system automatically keep the given moisture content in the soil by actuating the water pump and the gate. When considering the water supply system, there are two methods for supplying the water for the paddy field. However, both of methods never supply the water supply at the same time.

Figure 30 Gate is at CLOSED Position

The system was programmed to check whether there is enough water in the canal. The water level sensor was fixed in the cannel and it observes the water level of the cannel. If there is enough water is in the cannel, the system never uses the pumping system to supply water to the paddy field. When there is enough water in the canal, the system operates the servomotor and open the gate. The water flows through the gate from canal to the paddy field. The opening space of the gate is also change according to the required moisture content. If we need 100% of moisture content in the soil, the servo motor turns 180 degrees and the gate is fully open for full fill the requirement immediately. But if the less value of moisture content needed, system automatically reduces the opening space and slows down the water flow.

Figure 31 Showing Insufficient Water level in the Canal

Nevertheless, in the dry season drainage canal doesn’t have enough water level to feed paddy. In such situations, the signal coming from the water level sensor, the irrigation system automatically turns into a pump irrigation system. Here the water pump is actuated and the required water is carried through the pipes from the agro well to the paddy field.

Although this procedure cost little more amount, the crops will definitely protected by occupying the required moisture content through this pump system.

This pump system can be developed into the dip irrigation system and sprinkler irrigation system by adding some more equipment for the current system.

4 Conclusion

Sri Lanka is an agricultural country. Therefore, the Paddy cultivation is the major cultivation system in Sri Lanka. Ancient Sri Lanka has and marvelous irrigation systems that is used for the paddy cultivation. This traditional irrigation system has been developed over the thousands of years. In the present Sri Lanka people do the paddy cultivation using the irrigation systems like water reservoir irrigation, pump irrigation and etc. Some modern techniques like sprinkles and drip irrigation has been got some trend in the cultivation Nowadays people used to find better and feasible irrigation systems for the cultivation.

This is a small effort I have taken to find out a better solution to give farmers in Sri Lanka as they are being faced with water requirement for cultivation purposes since many years. Using soil moisture sensor and some other apparatus, I have implemented an automatic irrigation system. I have main three aims and objectives by doing this project. Reducing the labor and time in irrigation system, minimizing the water wastage and maximizing the productivity.

By doing this project, I was able to study the traditional irrigation systems as well as the modern irrigation systems. I tried many ways to develop current existing irrigations systems and finally with aid of researches, I am able to find a convenient and a useful method using microcontroller based control system, implementing an successful automatic irrigation system.

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Appendix

Coding of the project Automatic Irrigation System on Sensing Soil Moisture Content for Paddy Fields in Sri Lanka

```
#include<LiquidCrystal.h> //including the LiquidCrystal Library

#include <Keypad.h> //including the Keypad Library

#include<Servo.h> //including the Servo Library

LiquidCrystal lcd (13, 12, 11, 10, 9, 8);

Servo Servo_motor;

byte value1;

byte value2;

byte positions = 1;

const byte ROWS = 4; //four rows

const byte COLS = 3; //three columns

char keys[ROWS][COLS] = {

{'1', '2', '3'},

{'4', '5', '6'},

{'7', '8', '9'},

{'*', '0', '#'}

};

byte rowPins[ROWS] = {14, 15, 16, 17}; //connect to the row pinouts of the keypad

byte colPins[COLS] = {18, 19, 20}; //connect to the column pinouts of the keypad

Keypad MyKeyPad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
```

```
int Moisture_content;
int Target_level;
boolean cannel_water;
boolean water_pump;
int Servo_angle;
void setup() {
Servo_motor.attach(5);
pinMode(7, INPUT);
pinMode(6, OUTPUT);
lcd.begin(16, 4);
Serial.begin(9600);
MyKeyPad.addEventListener(keypadEvent); // Add an event listener for this keypad
lcd.setCursor(0, 0);
lcd.print("AUTOMATIC");
lcd.setCursor(3, 1);
lcd.print("IRRIGATION");
lcd.setCursor(10, 2);
lcd.print("SYSTEM");
for (int i = 12; i >= 0; i--) {
lcd.setCursor(i, 3);
lcd.print("By Samitha ");
delay(1dre`000);
}
delay(30);
```

```
lcd.clear();

lcd.setCursor(0, 0);

lcd.print("Moist.level= ");

Servo_motor.write(0);

}

void loop() {

char key = MyKeyPad.getKey();

int Moisture_content_Direct = analogRead(A0);

Moisture_content = map(Moisture_content_Direct, 1024, 0, 0, 100);

Servo_angle = map(Target_level, 0, 100, 0, 90);

cannel_water = digitalRead(7);

displays();

motor_controlling();

delay(100);

}

void keypadEvent(KeypadEvent key) {

switch (MyKeyPad.getState()) {

case PRESSED:

switch (positions) {

case 1:

if (key == '1') {

value1 = 1;

positions = 2;

}
```

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```
if (key == '2') {
value1 = 2;
positions = 2;
}
if (key == '3') {
value1 = 3;
positions = 2;
}
if (key == '4') {
value1 = 4;
positions = 2;
}
if (key == '5') {
value1 = 5;
positions = 2;
}
if (key == '6') {
value1 = 6;
positions = 2;

}
if (key == '7') {
value1 = 7;
positions = 2;
}
if (key == '8') {
```

```
value1 = 8;
positions = 2;
}
if (key == '9') {
value1 = 9;
positions = 2;
}
if (key == '0') {
value1 = 0;
positions = 2;
}
if (key == '#') {
Target_level = (value1*10)+value2;
positions = 1;
value1=0;
value2=0;
}
break;
case 2:
if (key == '1') {
value2 = 1;
```

positions = 1;

```
}
```

```
if (key == '2') {
value2 = 2;
positions = 1;
}
if (key == '3') {
value2 = 3;
positions = 1;
}
if (key == '4') {
value2 = 4;
positions = 1;
}
if (key == '5') {
value2 = 5;
positions = 1;
}
if (key == '6') {
value2 = 6;
positions = 1;
}
if (key == '7') {
value2 = 7;
positions = 1;
}
if (key == '8') {
```

```
value2 = 8;
positions = 1;
}
if (key == '9') {
value2 = 9;
positions = 1;
}
if (key == '0') {
value2 = 0;
positions = 1;
}
if (key == '#') {
Target_level = value1;
positions = 1;
value1=0;
value2=0;
}
break;
}
}
}
void displays() {
lcd.setCursor(0, 1);
lcd.print("Moist.level=");
lcd.print(Moisture_content);
```

```
lcd.print("% ");
lcd.setCursor(0, 0);
lcd.print("TargetValue=");
lcd.print(Target_level);
lcd.print("% ");
}
void motor_controlling() {
if (Moisture_content < Target_level) {
if (cannel_water == 1) {
Servo_motor.write(Servo_angle);
digitalWrite(6, LOW);
lcd.setCursor(0, 2);
lcd.print("WaterPump: OFF");
lcd.setCursor(0, 3);
lcd.print("Gate :OPEN ");
} else {
Servo_motor.write(0);
digitalWrite(6, HIGH);
lcd.setCursor(0, 2);
lcd.print("WaterPump: ON ");
lcd.setCursor(0, 3);
lcd.print("Gate :CLOSE");
}
} else {
Servo_motor.write(0);
```

```
digitalWrite(water_pump, LOW);

lcd.setCursor(0, 2);

lcd.print("WaterPump: OFF");

lcd.setCursor(0, 3);

lcd.print("Gate :CLOSE");

}

}
```

Appendix: Time Frame