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AUTOMATIC PLANT IRRIGATION SYSTEM

A PROJECT REPORT

Submitted *by*

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in partial fulfilment for the award of the degree of

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CERTIFICATE

This is to certify that the project entitled **"AUTOMATIC PLANT IRRIGATIONSYSTEM"** submitted by **S.THILAGAVATHI (13UEEC0138) AISHWARYA RAJENDRAN (13UEEC0605) K.PRIYADHARSHINI (13UEEC0105)** in partial fulfilment for the requirements for the award of Bachelor of Technology Degree in the department of Electronics and Communication Engineering is an authentic work carried out by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the project report has not been submitted to any other University/Institute for the award of any Degree.

Signature of Internal Guide	Signature of Head of the Department
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Submitted to Project and Viva Examination held on ________________

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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ABSTRACT

This project on "Automatic Plant Irrigation System" is intended to create an automated irrigation mechanism which turns the pumping motor ON and OFF by detecting the dampness/moisture content of the earth. In the domain of farming, utilization of appropriate means of irrigation is significant. The benefit of employing these techniques is to decrease human interference and still make certain appropriate irrigation.

The proposed model consists of three stages: Firstly, sensing the land's moisture levels. Second stage is the determination of its status: dry or wet. The last and third stage is Motor control.

This project proposes the development of Automatic Plant Irrigation System (APIS) capable of detecting loss of moisture in soil using the soil moisture sensor. Specifically, APIS utilizes the Soil Moisture Sensor to detect water content level in soil and give appropriate responses to the system based on detected condition. Using this response, APIS determines whether or not the land needs to be irrigated. In the current version, APIS is capable of detecting and irrigating a small area that can be considered to be under a single pump's coverage. Implemented using Operational Amplifier LM358, APIS uses live input data to determine the conditions. APIS represents our most basic step towards automated farming to improve turnover and reduce the impact of draught or loss due to irrigation issues.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The greatest crisis in modern day and age is a great disparity in the agricultural sector turnover. The great losses incurred in agriculture: material losses or financial losses – most of them are attributed to crop health and quality. If the crops are determined to be not up to par, this may result in a loss. In order to prevent this, we need to maintain the quality of crops and keep them at maximum health. On a practical basis, this is nearly impossible for a farmer who has large lands to observe and maintain. However, this is currently being managed manually. There is a danger in this; many of the labourers are preferring to work at white collar jobs, and as a result, there is a large deficiency in manpower. This makes automated farming a necessary part of the future. The greatest cause for the crops being not on par is improper irrigation (other than natural calamities). If the irrigation issues are resolved, most of the problem is solved. Hence this is the pinnacle point that needs to be renovated with technology. Automating this part of the process will be extremely beneficial to farmers. The automated plant irrigation system will help to reduce the work load on farmers, and help to keep the farmlands well irrigated at all times. Most of the farmers all over the world suffer to maintain their crops with proper watering methods, but find themselves helpless. This system will help farmers irrigate their lands even single-handedly, without the need of additional manpower. Its user friendly simple circuitry will make the user feel comfortable in using this system. The user only needs to install the circuit and sensors and connect the pump to the circuit and its complete. The system will start functioning upon power-up, and will need no trigger to keep it running.

1.1.1 WHAT IS DROUGHT? DANGERS OF AN ARTIFICIAL DROUGHT BROUGHT ABOUT BY MAN

A drought is a period of below-average precipitation in a given region, resulting in prolonged shortages in its water supply, whether atmospheric, surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the ecosystem and agriculture of the affected region and harm to the local economy. Annual dry seasons in the tropics significantly increase the chances of a drought developing and subsequent bush fires. Periods of heat can significantly worsen drought conditions by hastening evaporation of water vapour.

Researchers for the study, published in the journal Nature, found that drought and extreme heat reduced crop yields by as much as 10% between 1964 and 2007. Extreme cold and floods did not result in a significant reduction in crop production, according to the study.

The research provides key insight on the effects of climate on agriculture as policymakers prepare for the number of extreme weather events to spike in the coming decades due to global warming. The study, which evaluated the effect of 2,800 weather disasters on cereal crops like corn, rice and wheat, suggests that the effects of drought worsened after 1985 and are expected to continue to deteriorate in the coming decades. The study speculates that's because of more intense droughts driven by climate change, increased vulnerability to drought and changed reporting methods, but couldn't confirm any individual factor with certainty.

Developed countries experienced some of the most severe crop loss due to drought and heat, according to the research. Crop production in North America, Europe and Australia faced nearly a 20% decline thanks to drought and extreme heat, compared to less than 10% in Africa and Latin America. Researchers attributed the disparity to a difference between the agricultural methods employed in the different areas. Farmers in developed countries tend to grow crops uniformly across large areas. Water shortage affects those crops uniformly. Growing a wide variety of crops in a given region in the developing world mitigates the risk that all crops will be wiped out thanks to a given weather event.

The impact of water shortage and extreme heat on food production has been a hot button topic in development circles as the scientific understanding of climate change has grown. One recent study found that climate change could drive an 11% decrease in crop yields and a 20% increase in price by 2050 if countries do not stem their greenhouse gas emissions.

And while developed countries have the resources to adapt, their poor counterparts are often left hard hit when they cannot produce adequate food during extreme weather events. This year's El Niño, for instance, has left millions in need of food assistance in places like Ethiopia where the majority of the population depends on agriculture to make ends meet. Funding for efforts to adapt to climate change, including by preparing farmers, has been a key focus of groups focused on the issue. [7]

Table 1: Winter Wheat Planted and Harvested in Montana's Golden Triangle, 1998-2001

	Planted Acres			Harvested Acres			Acres Harvested ÷ Acres Planted, %		
Year	Following Fallow	Recrop	Total	Following Fallow	Recrop	Total	Following Fallow	Recrop	Total
2001	554,000	72,500	626,500	363,400	32,900	396,300	65.6	45.4	63.3
2000	644,200	91,000	735,200	619,300	61,500	680,800	96.1	67.6	92.6
1999	361,400	21,000	382,400	320,200	18,400	338,600	88.6	87.6	88.5
1998	562,600	49,000	611,600	496,600	40,300	536,900	88.3	82.2	87.8

Table 2: Spring Wheat Planted and Harvested in Montana's Golden Triangle, 1998-2001

	Planted Acres			Harvested Acres			Acres Harvested ÷ Acres Planted, %		
Year	Following Fallow	Recrop	Total	Following Fallow	Recrop	Total	Following Fallow	Recrop	Total
2001	1,245,000	246,000	1,491,000	858,300	138,000	996,300	68.9	56.1	66.8
2000	1,051,700	270,000	1,321,700	1,003,600	233,000	1,236,600	95.4	86.2	93.6
1999	1,522,300	325,500	1,847,300	1,489,000	310,200	1,790,200	97.2	95.3	96.9
1998	1,398,000	270,000	1,668,000	1,335,500	245,000	1,580,500	95.5	90.7	94.7

It can be observed that the turnover is only half the amount planted. This loss was due to inefficient irrigation.[6]

1.2 AIM OF THE PROJECT

The motivation for this project came from the countries where economy is based on agriculture and the climatic conditions lead to lack of rains & scarcity of water. Our country mostly depends on agriculture. The farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of the land. Even if the farm land has a water-pump, manual intervention by farmers is required to turn the pump on/off whenever needed.

The project aim is to detect the dryness in soil using sensors and provide water to the plants appropriately. This project helps to maintain the plants quite easily. In this project we are detecting soil moisture and need for Irrigation.

The Aim of our project is to minimize this manual intervention by the farmer. Automated Irrigation system will serve the following purposes:

1) As there is no un-planned usage of water, a lot of water is saved from being wasted.

2) The irrigation is done only when there is not enough moisture in the soil and the sensors decide when the pump should be turned on/off. This saves a lot time for the farmers. This also gives much needed rest to the farmers, as they don't have to go and turn the pump on/off manually.

This Project is for the academic year 2016-2017 in partial fulfilment of the requirement for the VIIth semester mini-project in ECE.

1.3 PROBLEM STATEMENT

Nowadays, despite being an agricultural country, the number of people who die of hunger is still quite high. Access to food seems to be difficult, as price and quantity of food is still beyond the capability of the lower middle class and lower class. Irrigation induced Crop failure is a major cause of crop loss every year, and in the age of water crises, this has been elevated to great levels. In order to keep up with increasing demand, farmers are required to increase crop efficiency, by rapidly advancing technologies. In order to handle Irrigation issues, this system has been devised and implemented. Usually, farmers need large scale manpower to irrigate large lands simultaneously. However Automatic Plant Irrigation System (APIS) is an automatic system that facilitates automated irrigation of lands simultaneously, upon need.

CHAPTER 2

BACKGROUND

2.1 EXISTING SYSTEM

The continuous increasing demand of food requires the rapid improvement in food production technology. In a country like India, where the economy is mainly based on agriculture and the climatic conditions are isotropic, still we are not able to make full use of agricultural resources.

The main reason is the lack of rains & scarcity of land reservoir water. The continuous extraction of water from earth is reducing the water level due to which lot of land is coming slowly in the zones of un-irrigated land. Another very important reason of this is due to unplanned use of water due to which a significant amount of water goes to waste.

The existing system of manual irrigation is very inefficient in regard to solving these issues. In modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drip by drip due to which a large quantity of water is saved. At the present era, the farmers have been using irrigation techniques in India through manual control in which farmers irrigate the land at the regular intervals. This process sometimes consumes more water or sometimes the water reaches late due to which crops get dried. Water deficiency can be detrimental to plants before visible wilting occurs. Slowed growth rate, lighter weight fruit follows slight water deficiency. This problem can be perfectly rectified if we use automatic irrigation system in which the irrigation will take place only when there will be acute requirement of water.

2.2 PROPOSED SYSTEM

All the lands to be irrigated manually are automatically irrigated by this system. When compared to the previous system where farmers need to frequently and constantly keep monitoring the field for signs of dryness, this system will reduce the time needed to be spent on monitoring the field. It greatly diminishes the need for manpower by a great value. This system will be able to function even when the owner is unavailable for a small period of time, hence ensuring proper irrigation even in the absence of people. Also water will not be wasted during traversal.

In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump on/off when required. This process sometimes consumes more water and sometimes the water supply to the land is delayed due to which the crops dry out. Water deficiency deteriorates plants growth before visible wilting occurs. In addition to this slowed growth rate, lighter weight fruit follows water deficiency. This problem can be perfectly rectified if we use Automated Irrigation System in which the irrigation will take place only when there will be intense requirement of water, as suggested by the moisture in the soil.

Agriculture

CHAPTER 3

PROJECT DEVELOPMENT

3.1 HARDWARE REQUIREMENTS

The hardware components required for the project are listed as follows:

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S.NO.	COMPONENT TYPE	COMPONENT	DESCRIPTION
1.	IC	LM358	Operational amplifier
2.	Sensor	Soil moisture sensor	-
3.	Switch	Relay board	12V supply
4.	Motor	DC motor pump	5V supply
5.	Potentiometer	Trim pot	Range Of MΩ

Table 3.1. list of components

3.1.1. OPERATIONAL AMPLIFIER - LM358

- It can handle a supply of 3-32VDC and source up to 20mA per channel. This Operational amplifier is great if you need to operate two individual Operational amplifiers from a single power supply. Comes in an 8-pin DIP package.
- The LM358 is a great, easy-to-use dual-channel Operational amplifier.
- LM358 applications include transducer amplifiers, DC gain blocks and all the conventional Operational amplifier circuits.

3.1.1.1. FEATURES

- Wide Supply Ranges
    - Single Supply: 3 V to 32 V
      (26 V for LM2904)

    - Dual Supplies: ±1.5 V to ±16 V
      (±13 V for LM2904)

- Low Supply-Current Drain, Independent of Supply Voltage: 0.7 mA Typical

- Wide Unity Gain Bandwidth: 0.7 MHz

- Common-Mode Input Voltage Range Includes Ground, Allowing Direct Sensing Near Ground

- Low Input Bias and Offset Parameters

    - Input Offset Voltage: 3 mV Typical
      A Versions: 2 mV Typical

    - Input Offset Current: 2 nA Typical

    - Input Bias Current: 20 nA Typical
      A Versions: 15 nA Typical

- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage: 32 V
  (26 V for LM2904)

- Open-Loop Differential Voltage Gain:
  100 dB Typical

- Internal Frequency Compensation

- On Products Compliant to MIL-PRF-38535,
  All Parameters are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters.

3.1 PIN DIAGRAM:

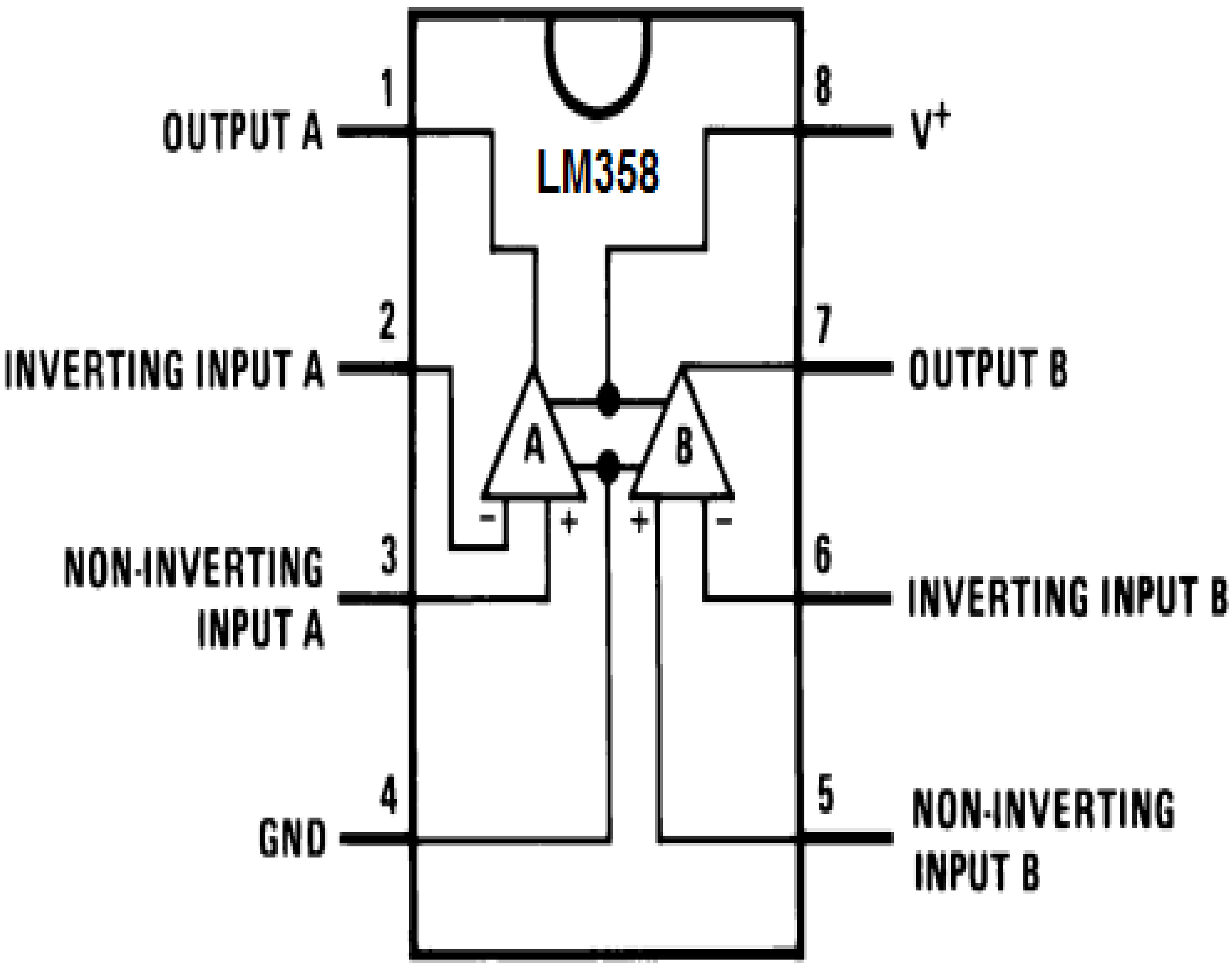

fig.3.1 pin diagram of LM358

3.1.1. CHIP DIAGRAM:

fig.3.1.1. LM358 IC

3.1.2. SOIL MOISTURE SENSOR

Soil moisture sensors measure the volumetric water content in soil.[1] Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, 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, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

3.1.2. SENSOR BOARD AND PROBE:

fig.3.1.2soil moisture sensor

3.1.2.1. COMPONENT :

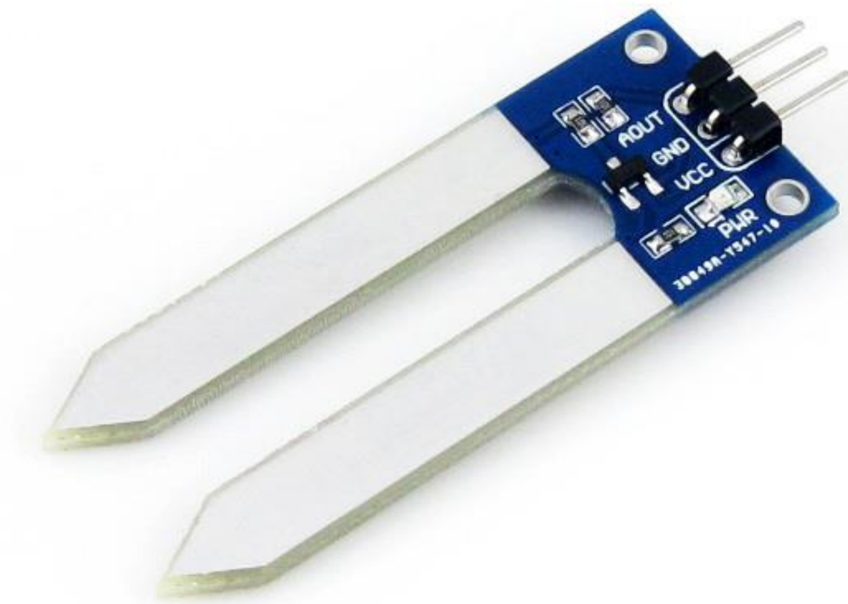

fig.3.1.2.1 sensor

3.1.3. RELAY BOARD

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

Electromagnetic relays are those relays which are operated by electromagnetic action. Modern electrical protection relays are mainly micro-processor based, but still electromagnetic relay holds its place. It will take much longer time to be replaced the all electromagnetic relays by micro-processor based static relays.

3.1.3 COMPONENT INTERNAL STRUCTURE:

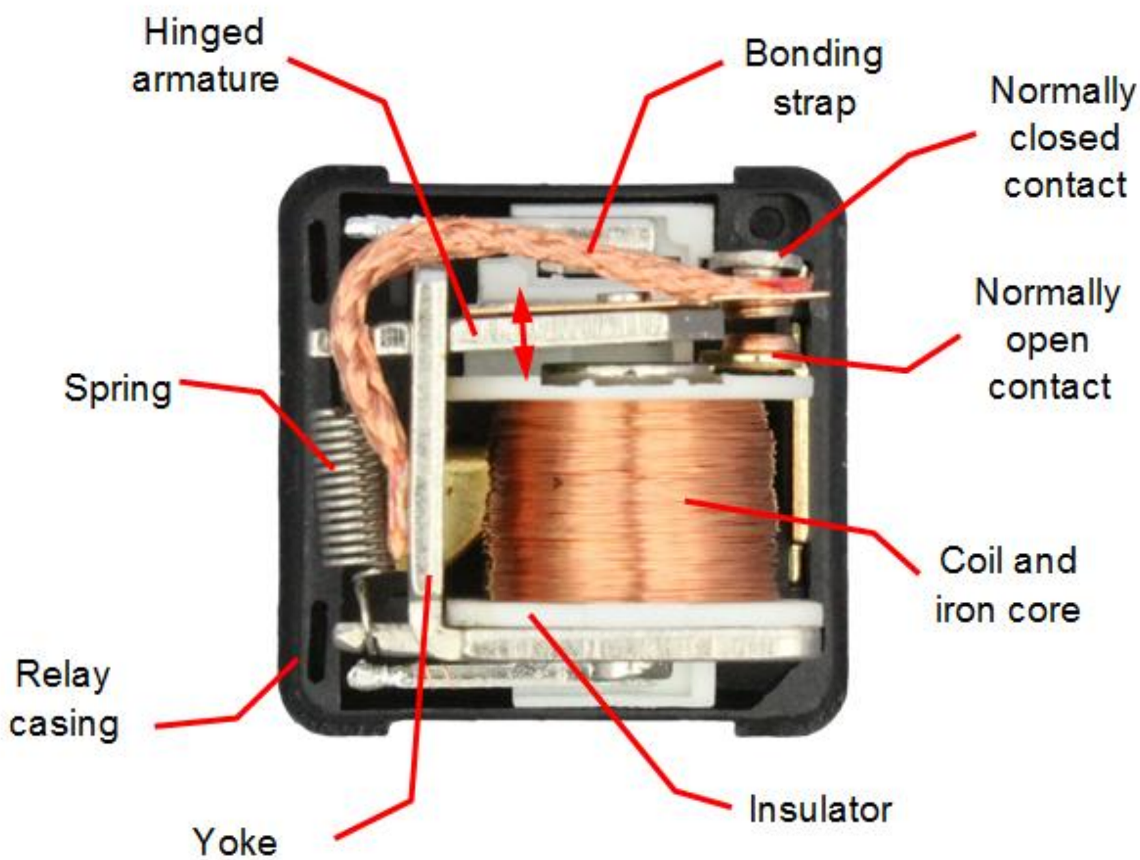

fig.3.1.3. Relay internal structure

3.1.3.1.COMPONENT EXTERNAL STRUCTURE:

3.1.3.2. OPERATIONAL DIAGRAM:

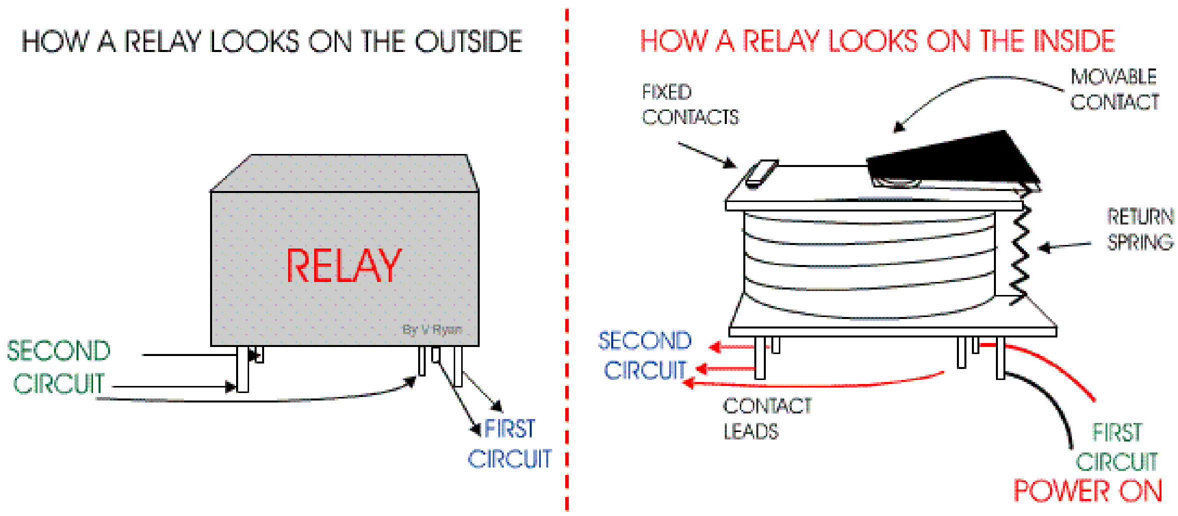

fig.3.1.4. Relay operational diagram

3.1.4. DC MOTOR PUMP

A DC motor is any of a class of rotary electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

A DC motor pump is essentially a DC Motor that is used to circulate water. The internal structure is the same. The DC motor is encased in a waterproof plastic casing and the shaft is used to drive an external arm that pumps water.

The Pump requires a 5V supply, which can be easily provided by batteries or AC supply.

3.1.4. COMPONENT STRUCTURE:

fig.3.1.4. DC MOTOR PUMP

CHAPTER 4

SYSTEM DESIGN

4.1 FLOW CHART

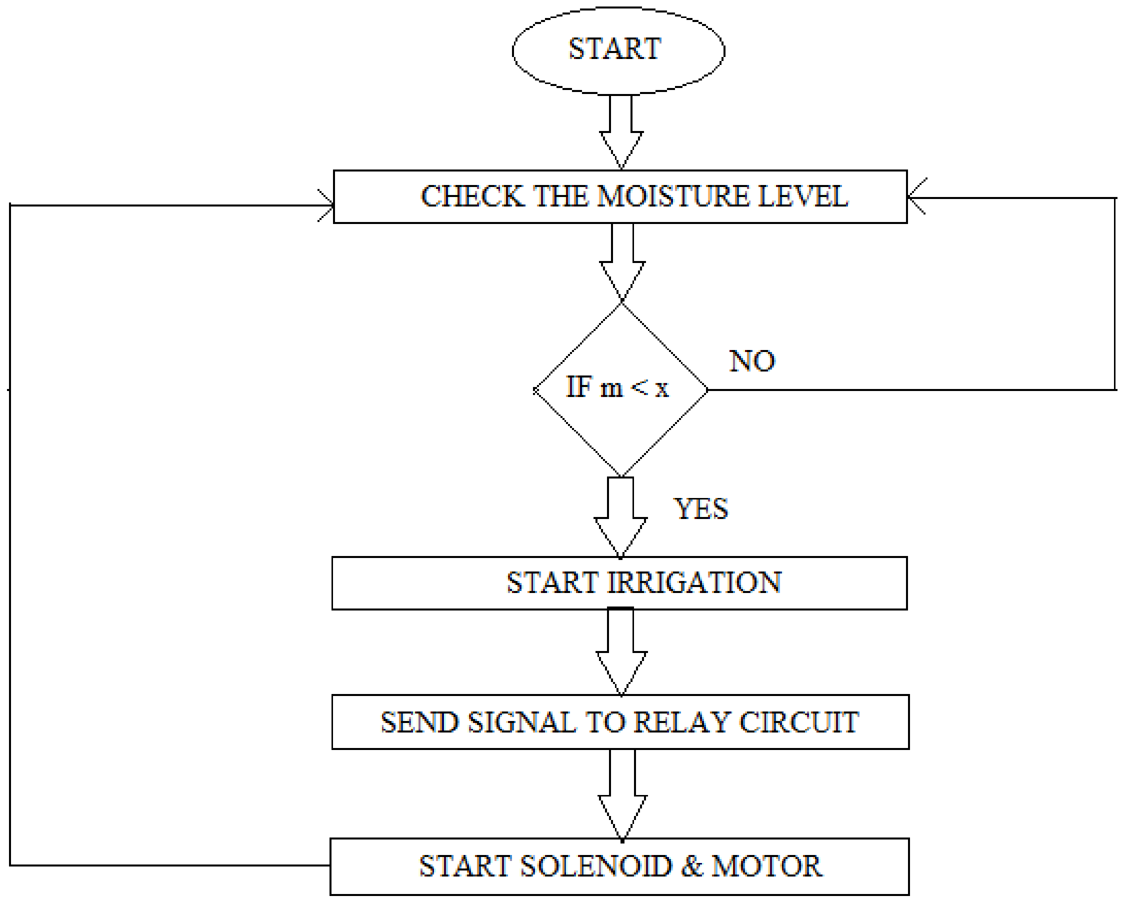

fig.4.1. flow chart of the circuit

where m – detected moisture level.

x – threshold moisture level.

4.2. FLOW DIAGRAM

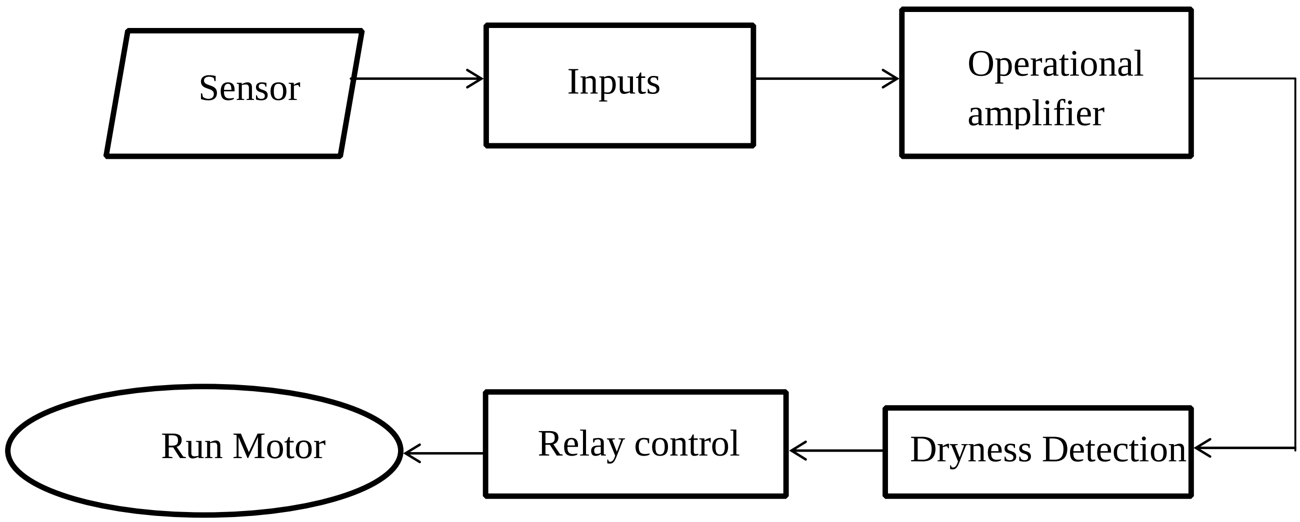

fig.4.2. Flow diagram of the circuit

4.3 CIRCUIT DIAGRAM

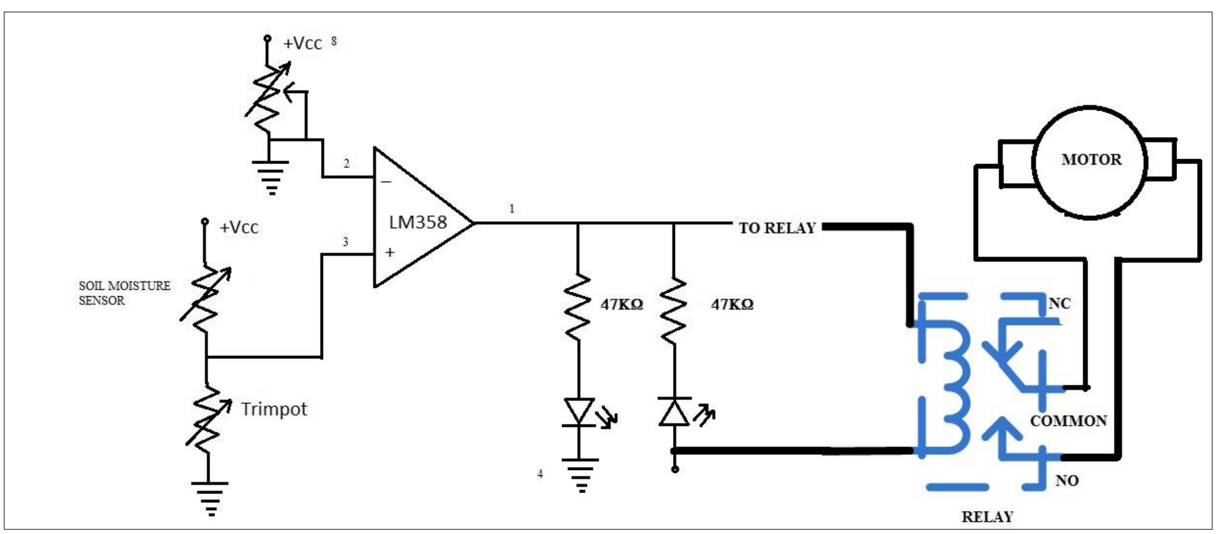

fig.4.3. circuit diagram

4.4 ADVANTAGES

- The main advantage of this project is that it has faster execution when compared to manual execution of the process.

- It is simple, portable and provides high performance.

- It consumes less power

- Dryness can be easily detected in soil.

- Permits a non- expert to do the work of an expert.

- Improves productivity by increasing work output and improving efficiency.

- Saves time in accomplishing specific objective.

- This system ensures that the plants do not endure from the strain or stress of less and over watering.

- This system saves labour cost and water up to 70%. The working of this irrigation system covers over 40 crops spanning across 500 acres.

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4.5 APPLICATIONS OF PROJECT

We propose an application to detect water deficiency state in soil based exclusively on sensor-provided data.

In an Automated Irrigation System, the most significant advantage is that water is supplied only when the moisture in soil goes below a pre-set threshold value.

- This system can be used in roof gardens in highly populated areas where land is expensive and gardening on rooftops seems like the only viable option left.
- The lawns of houses and public buildings can be maintained by these systems, thereby reducing the need for human monitoring.

- The greatest application is in agricultural lands, where farmers are assisted greatly by this. There is no need for the farmer to actually be present during operation.
- Gardens that need to be monitored in the absence of home owners require systems like APIS. Home gardens that are maintained with large effort by home owners require proper observation and maintenance. It can be provided by APIS.
- This system can be used in the field of pisciculture. Fish farming or pisciculture involves raising fish commercially in tanks or enclosures, usually for food. It is the principal form of aquaculture, while other methods may fall under mariculture. The fishes need to be in a depth of 1m in the aquarium and this depth is maintained with the help of APIS. The appropriate threshold value is assigned and the circuit is operated.
- Irrigation in parks needs to be done even when people are not there to maintain the grass or trees.
- Detection in this manner is cheap, non-invasive and can be applied on a population-wide scale.
- The presence of technology in all aspects of life has enabled solutions to real life problem that were either difficult or unfeasible.

4.6 FUTURE ENHANCEMENT

The application certainly is much more advantageous than the manual system. There will be no bias in the regions being covered and the delay is kept as minimal as it can be.

- The operator does not require any previous training because of its user friendliness.
- The operator is free from any technical issues. Extremely simple design makes the circuit easy to implement and maintain.
- Alterations in the system can be done easily if the process of the working changes in future.
- In future according to the user's requirement it can be updated to meet the user requirements.
- Smart Wifi Irrigation Controllers are next generation controllers that adjust your irrigation system automatically using real-time weather information. Moreover, you can control it from anywhere, anytime.

4.7 LIMITATIONS

- The system requires two different power supplies. While implementing in large fields, industrial supply can be used to run the motor. In small gardens this may seem like a large wastage.
- Needs a large amount of sensing equipment for very large irrigation areas.
- The system is not 100% reliable. Unexpected factors can cause errors, and it may in some cases cause loss. Despite being good, it needs to be manually checked and maintained once every few weeks..

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 METHODOLOGY

Implementation of the project required the design of the system developed in the design phase of the project to be carefully implemented.

The extensive implementation of automated systems in agriculture has proven to successfully reduce cost. The operation of automated agricultural system could potentially revolutionize the irrigation process and the way it has impacted the commercial & industrial sectors. Thus, this project has been an expert or non-expert-system-based method of field monitoring for detecting dryness & treatment of the field. The prototype system food and beverage industry has the potential to be useful for the industry, seeking ways to make agriculture cost effective. Furthermore, the ultimate beneficiaries of the project are the farmers who are the backbone of an agricultural economy.

5.2 PROJECT PLAN

The Objective of the project planning is to provide a framework that enables an owner to make reasonable estimate of the resources, cost and schedule. The project leader is responsible for designing the system precisely according to the requirement specified by the owner/ customer. He is also responsible for maintenance of the system for certain period of time, since in most cases, cost of maintenance is much higher than cost of developing the system. Thus to reduce development and maintenance cost and to provide the system within planned time, proper planning of system is necessary.

5.2.1. Initial Investigation of design:

The most crucial phase of managing system projects is planning to launch a system investigation, we need a master plan detailing the steps to be taken, the people to be questioned, and outcome expected. The initial investigation has the objective of determining whether the user's request has potential merits the major steps are defining user requirements, studying the present system and defining the performance expected by candidate system to meet user requirements. The first step in the system development life cycle is the identification of need. There may be a user request to change, improve or enhance an existing system. The initial investigation is one way of handling these needs. The objective is to determine whether the request is valid and feasible before a recommendation is reached to do nothing, improve or modify the existing system, are to build a new one.

Thus for an effective test and written paper follow-up data resulting from different circumstances, it is vital to design the APIS.

5.3 WORKING

This project consists of two sections: the external sensor unit, and the inbuilt processing unit. In the external sensor unit, the basic requirement of sensing the moistness of the sand or soil through capacitive reactance is performed, the arms of the sensor are able to detect resistance and provide input to the IC.

When the soil becomes dry, it produces large voltage drop due to high resistance, and this is sensed by the soil moisture sensor, and this resistance causes the operational amplifier to produce an output that is above the threshold value required. This causes the relay to change from normally open to closed condition – The relay becomes on.

When the relay is turned on, the valve opens and water through the pipes rushes to the crops. When the water content in the soil increases, the soil resistance gets decreases and the transmission of the probes gets starts to make the operational amplifier stop the triggering of the relay. Finally the valve which is connected to the relay is stopped.

Op-amp is configured here as a comparator. The comparator monitors the sensors and when sensors sense the dry condition then the project will switch on the motor and it will switch off the motor when the sensors are in wet. The comparator does the above job it receives the signals from the sensors.

A transistor is used to drive the relay during the soil wet condition. 5V double pole – double through relay is used to control the water pump. LED indication is provided for visual identification of the relay / load status. A switching diode is connected across the relay to neutralize the reverse EMF.

This project works with 5V regulated power supply for the internal blocks and uses regulated 12V power supply for the relay board. Power on LED is connected for visual identification of power status.

First, the sensor probes are inserted in the soil at specific locations in the field, at a depth of 5cm from the soil surface at regular intervals in the field. The wiring is made with protective covering so that it is not harmed by any unexpected factors like rocks in the field.

Since wet soil is more conductive than dry soil, the soil moisture sensor module has a comparator in it. The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry.

When the moisture in the soil is above the threshold, the relay will be turned on. The relay coil gets energized and turns on the motor. The LED is also turned on as an indicator. The soil begins to get supplied with water, and the water content of the soil increases.

When the moisture content of the soil increases and reaches the threshold value, the output of the soil moisture sensor is low and the motor is turned off. This prevents a case of over-watering.

5.3.1. WORKING MODEL STRUCTURE

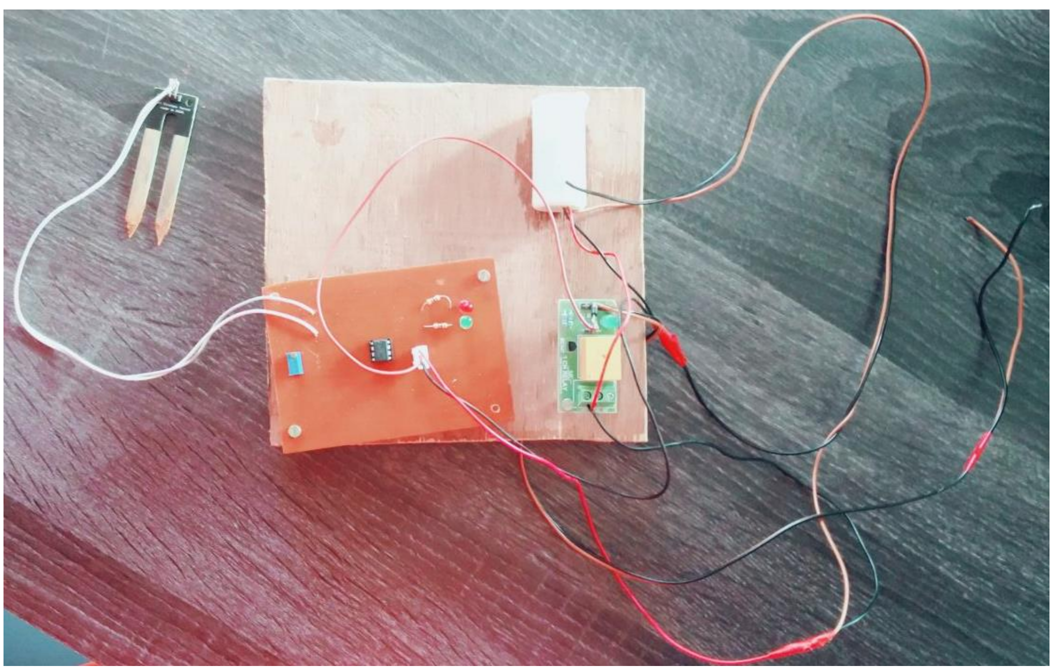

fig.5.3.1. Working model

CHAPTER 6

CONCLUSION

Irrigation becomes easy, accurate and practical with the idea above shared and can be implemented in agricultural fields in future to promote agriculture to next level. The output from moisture sensor and level system plays major role in producing the output.

Thus the “AUTOMATIC PLANT IRRIGATION SYSTEM” (APIS) has been designed and tested successfully. It has been developed by integrating all the features of all the hardware components used. Presence of every module has been reasoned above and placed carefully in order to contribute to the best working of the unit. The system has been tested to function automatically, and to the best of its ability. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the operational amplifier which triggers the DC Motor pump to turn ON and supply the water to respective field area. When the desired moisture level is reached, the system halts on its own and the DC Motor pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully.

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