SOLAR POWER IRRIGATION SYSTEM

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In

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CERTIFICATE

It is certified that the work contained in this Project entitled "**SOLAR POWER IRRIGATION SYSTEM**" by Vivek kumar Verma (1150433031), Abhishek Ranjan (2160433001), Bilal Ahmad (1150433013), for the award of **Bachelor of Technology** from Babu Banarasi Das University has been carried out under my supervision.

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ABSTRACT

The main aim of this project is to provide information about automatic irrigation to the plants which helps in saving money and water. The entire system is controlled using ATmega 328 microcontroller which is giving the interrupt signal to the motor. Irrigation is the methodology of misleadingly supplying water to land where harvests are developed. Generally hand pumps,channel water and precipitation were a significant wellspring of water supply for watering system. This strategy has prompted serious disadvantages like under watering system, overwatering system which thus causes filtering and loss of supplement substance of soil. Changing ecological conditions and lack of water have prompted the requirement for a framework which effectively oversees watering system of fields. Computerized watering system framework is a machine based framework, which robotizes the watering system of area by joining different programming and equipment approaches together for field watering system.

ACKNOWLEDGEMENT

Whenever a module of work is completed successfully, a source of inspiration and guidance is always there for the student. I, hereby take the opportunity to thank those entire people who helped me in many different ways.

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CHAPTER 1

INTRODUCTION

As we know that Indian economy is one of the largest developing economies of the world. The agricultural sector has its largest contribution in the Indian economy. To achieve maximum utilisation of man power and to obtain maximum profit in a given stipulated there is a need in the upgradation of various engineering techniques that are being used today. Thus maintaining proper amount of water level in the soil is one of the necessary requirements to harvest a good crop that can be a source of various types of nutrients whether micro or macro for their proper growth. If we talk about Indian farmers they are worst hit by the famines that occurs due to failure of crops depending upon various drought factors. Rain plays the key role in deciding the future of these crops as well as the farmers every year. The over utilisation of ground water has drastically reduced the ground water level in the last 15 years.So it is the need of hour to utilise each and every drop of water wisely so that it can also be used by our coming generations also. Also we should develop some new methods that use the renewable sources of energy. The development of these new techniques are going to reach our goal of sustainable development as well as to cut off the emission of greenhouse gases to a minimum level.As the name of our project that is **AUTOMATIC SOLAR POWERED IRRIGATION SYSTEM** with the help of the **Solar power** is a step to utilise some new engineering techniques. This technique will be a very good option for the small and medium farmers who suffer every year just because of failure of crops that took place every year. The implementation of this technology has a wide scope in the nearby future. The main objective of this project was to design a small scale irrigated system that would use water in more well-organized way in order to prevent excess water loss and minimize the cost of labor.

Water shortage is one of the major problem in the world. Many different methods are incorporated for conservation of water. We need water in each and every field & is needed for every human beings, animals, plants, etc. Agriculture is one such field where water is required in high quantity. Wastage of water is a major problem in agriculture. Every time excess of water is given to the fields. A number of techniques are available to save or to control wastage of water from agriculture.

In the trial of solar power based irrigation system, PV cells are used to produce electricity, that energy is stored in rechargeable batteries .The energy which is produced from the batteries is used for the system operation. Solar powered irrigation system can be appropriate alternative for farmers in present state of energy disaster automatic system using solar power. The main objective of this project is to advance an irrigation system in field of agriculture by using solar energy A water pump is used to pump the water from a boor well to a water storage tank.

Fig1.1 Shows Field Irrigation

1.1 SYSTEM DESCRIPTION

Measuring soil moisture is very significant in agriculture to help farmer for handling the irrigation system. Soil moisture sensor is one who resolves this. This sensor measures the content of water. Soil moisture sensor uses the capacitance to measure the water contented of soil. It is simple to use this sensor. Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of the soil is stated in percent

NEED FOR IRRIGATION

- In term of populations India is the second largest country
- after China. So it is necessary to increase the production of
- food to feedstuff millions of people.
- There is uneven and indeterminate distribution of rainfall
- which cause drought.
- For different water necessities of crops can only be met
- through irrigation amenities.
- Being tropical country there is quick increase in the high
- temperature and evaporation. So, for abundant cause of water artificial irrigation is essential.

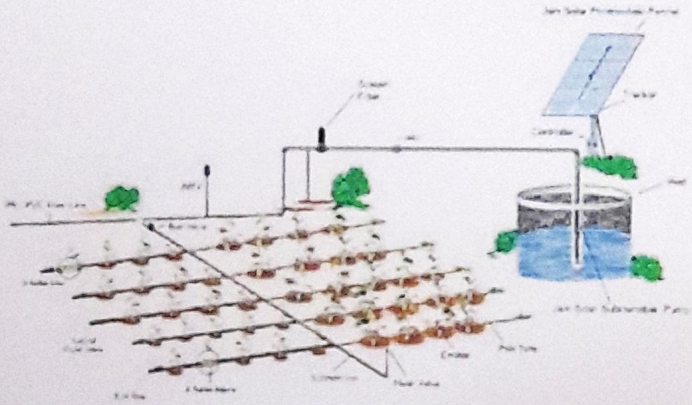

Fig1.2

1.2 WHY AUTO IRRIGATION SYSTEM

As we know that it is very difficult in agriculture field to control the water pump manually. One has to visit in fields to switch ON and OFF. In worldwide, where electricity is the main problem, villagers frequently don't have the electricity. In that situation, solar energy is used to give the power to water pumps. In this type of irrigation system, the solar charge controller is employed to store DC power of solar panels in batteries. This battery is used to give the power supply to water pumps automatically.

Automatic Solar powered irrigation system work in the sunlight. When the sun shines the water, pumping process is a sensible way of solar energy use throughout the summer, as the water need is the highest. The water pump which is used will provide a reliable water source for plantation. For any solar based water pumping system, the ability to drive water is a function of three variables like pressure, power, and velocity. These three essential components are used in this solar powered auto irrigation system. An example project of the above information is Automatic solar powered irrigation .

1.3 COMPONENTS REQUIRED

1 **Hardware requirement:**

- ATMEGA 328 Microcontroller
- Battery(Rechargable)
- Solar Panel
- Operational amplifier
- LCD display
- Relay
- Water Pump
- Voltage Regulator
- Diode
- Capacitor
- Resistor
- LED
- Crystal Oscillator
- Transistor
- LCD
- Jumper wire
- Relay
- Inductor
- Moisture sensor
- Motor
- Pump
- Potentiometer

2 **Software Requirements:**

- Embedded C

1.4 BLOCK DIAGRAM

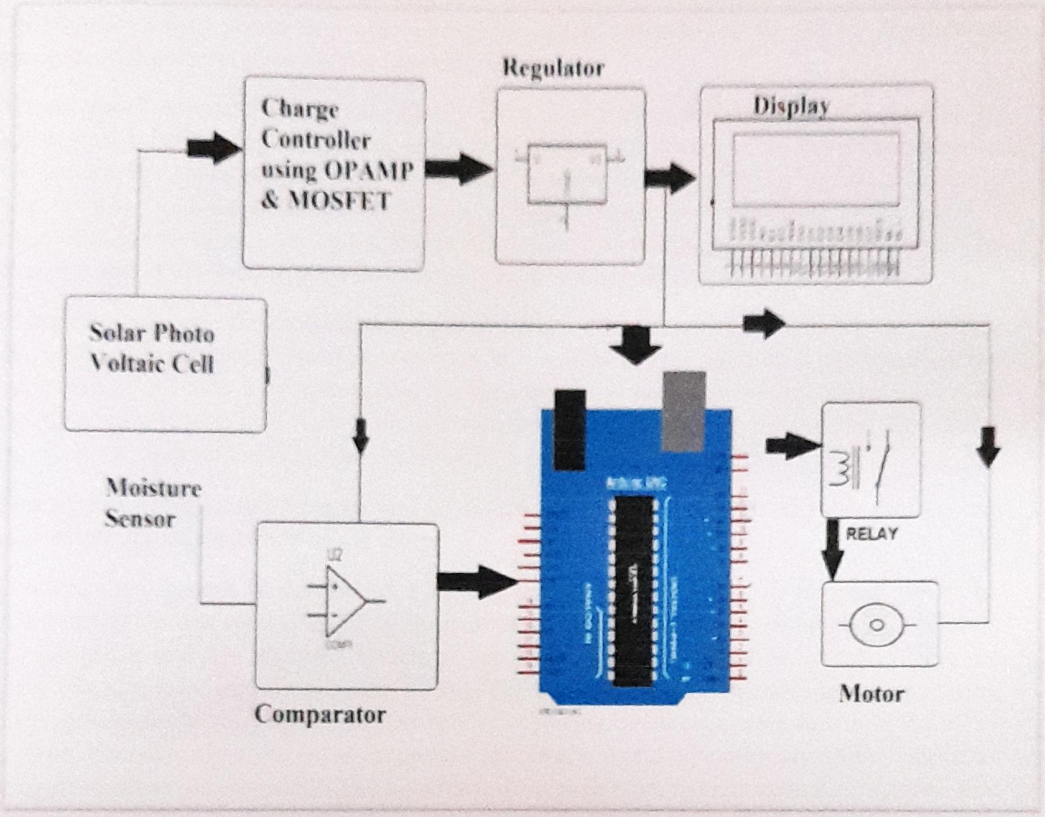

Fig1.3Block Diagram

BLOCK DIAGRAM DISCRIPTION

The main intention of this project is to develop a solar power irrigation system for agriculture to operate the irrigation pumps automatically by moisture level sensing using a solar energy. This system derives power from solar energy through photo-voltaic cells. Hence, dependency on erratic commercial power is not required.

The proposed system uses a microcontroller and a battery for power supply. In this system, the sensor part is built using an op-amp acting as a comparator connected to the microcontroller for sensing the moisture condition of the soil. A motor is controlled by the relay which is interfaced to the microcontroller through a transistor driver. In this project, a solar panel is connected to the circuit through a charge controller for monitoring the sunlight level. The charge controller is used to protect the battery by providing all protections besides charging.

In irrigation process, the solid monitoring is the most critical parameter, so we have to monitor the soil condition by the sensors, whether the soil is dry or wet. If it is dry, then the microcontroller sends the commands as per the program to switch the motor using a relay with the solar power, and if it is dry, then it switches off the motor automatically. The on/off condition of the pump is displayed on an LCD display.

This project in future can be enhanced by interfacing it with a GSM modem to gain control over the switching operation of the motor.

The irrigation system is defined as a system that distributes water to targeted area. The efficiency of the irrigation is based on the system used. Since antiquity, the human life is based on agriculture and the irrigation system is one of the tools that boost agriculture. There are many other types of irrigation system all over the world but these irrigations are encountering many problems. In fact, there are few modern systems but they mostly fail in one way to another. The automation plays an important role in the world economy; therefore, engineers struggle to come out with combined automatic devices in order to create complex systems that help human in its activities so that the system automatically processes itself without any human intervention. So we would like to develop an automatic irrigation system.

Basically, the project consists of electrical part and mechanical part. The electrical part consists of photovoltaic, which is meant to generate power and the power is stored in the rechargeable battery. The mechanical part consists of pump, to pump out the water from the water source. The parameters in the project are soil humidity condition, water level condition, the position of the Sun. The solar system is used to generate the power to the entire system and the solar system is much cheaper than the electrical system. It is suitable to the rural area that is why the solar system is used as a power supplier to replace DC motor electricity source. In fact the initial cost of solar installation is higher than use of DC electrical motor but the solar system has no bill compared to electrical which has bill to pay every month. It is a versatile source of renewable energy that can be used in any application. The system consists of hardware and software and, finally, the integration of the two parts to provide the results. The hardware system consists of the sensors, and drivers. In hardware design, we need all the components that are necessary to accomplish the project, and these components are solar panel, DC water pump motor, sensors and some minor components like tank and reservoir.

1.5 EXISTING SYSTEM

Most of the existing systems are manual system. The manual system needs labor for monitoring the productivity and health crop. Considering labor''s salary, the system will cost much more than the automatic system, in which there is no assistance to the system. The farmer himself has to check the moisture level of the soil and has to make a judgment whether the field requires water or not. This way of inspecting the moisture level is not accurate and this drawback can be eliminated by using soil moisture sensor which is been used in our architecture. Moreover, the temperature required for the crops to sustain, differs from crops to crops. If the temperature increases or decreases than the expected temperature, it may affect the quality of the crops. This problem can be overcome by using the shielding mechanism, thereby maintaining the desired temperature.

Fig1.4showing traditional way of checking moisture in soil

The traditional kuhl is constructed with a dug-out main diversion channel that has structures that can be temporary or permanent. Due to annual floods that might destroy the system, temporary channels, which are built using boulders, rocks, bamboo, and tree branches, are preferred. In recent years, people have also started using concrete. These kuhls flow through different distribution points creating a diversion-based system (People"s Science Institute, 2003). Moreover, this system can range from hundreds to thousands of kilometers long to allow water (primarily floodwater) to be diverted to farmlands.

hill streams or springs. Kuhls also collect rainwater and melted snow running from the slopes above them. In addition, lands that are to be irrigated are usually situated on hill-sides, and are supplied on terraces where water flows due to the gravity that "traverses the contours of a mountain slope" (People"s Science Institute, 2003, p.14). Figure 2.3 gives an illustration of kuhl design (Forestry Department, 1998).

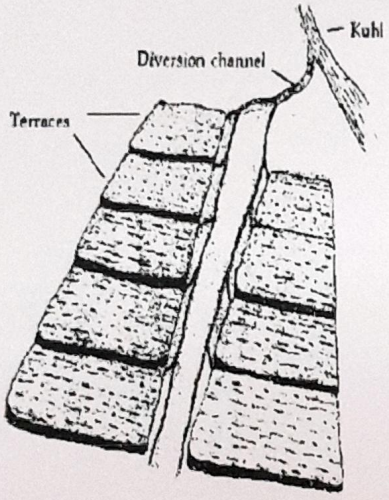

Fig. 2.3 Water Channel Flow

A group of these diversion channels often create community-based systems that are used for "sustainable, cost effective and successfully managed by local [governments]"This system, which dates back to 16th century, is used best post-monsoon when the abundant rainwater runs off through diversion channels. The construction requires a site that has a concrete foundation and has a depth of at least eight inches, where factors like the slope area of land and the available rivers are also considered (Bhaduri, 2013). In the Western Himalayan Region, for example, farmers started irrigation processes that were invented to adapt to these mountainous landscapes. In northern India from Jammu and Kashmir valleys down through Himachal Pradesh and ending in Uttaranchal, farmers have designed kuhls that are aligned with land contours to draw water from streams or springs. These canals can range in length from one

kilometer to fifteen kilometers. They generally have a trapezoidal cross section and are one to two tenths of a square meter in area .

Fig. 2.4 Tank Irrigation

Fig. 2.5 Tank Irrigation

Similar to tank irrigation systems, traditional khatris are pits, made of rocks, which mainly collect rainwater seeping through these rocks. It is generally built near the foot of the hill with a dug tunnel and steps leading inside through the basin of water. Multiple khatris may be constructed, but ideally, the water gets collected in the lower-most khatri. These structures do not provide water directly to the fields; the water needs to be carried to the locations. They are usually for drinking purposes as well as washing and taking baths. Being more expensive than kuhls (approximately INR 15000 per khatri), they are not as popular as kuhl (Center for Science and Environment, n.d.; sharma & Kanwar. 2009). One of the examples of khatri can be seen in Figure

Fig. 2.6 Khatri

Baudis and *nawns* are also tank-style surface water harvesting techniques. Deep pits are built to collect and store the water and they are generally covered with a roof. Both use same techniques, but the difference appears in the final usage of them. *Baudi* generally has a tank-like structure to store the water, in contrast to *nawn*, which is larger and used for numerous

purposes such as drinking, washing, and taking showers. One of the examples of a baudi and nawn can be seen in Figures 2.7 and 2.8 below.

Fig. 2.7 Baudi

Fig. 2.8 Nawn

Tank

Tank irrigation systems have components that include the "tank embankment, surplus of escape weir, and outlet channels" which are built across the slopes for easy collection and preservation of water. Starting from the tank bank, water flows through the sluices that connect to paddy fields. Tank irrigation is managed by local villagers and mainly used in regions that have dry seasons and irregular monsoons. However, this method has a few disadvantages. The water easily evaporates and the tank occupies a huge area of land, which leads to costly maintenance. Moreover, because the tank is used as water storage, perennial water supply is not guaranteed especially during dry, hot summers.

Wells

The implementation of the well design requires digging a hole in the ground to provide a perennial "soft water" supply. This "soft water" is more appropriate for irrigation because it sometimes has a lower salt level. Saline water is capable of destroying the quality of crops and has an adverse effect on soil. To reduce the salinity, wells, which are generally at shallow depths, are dug near the ponds where water is collected on rainy days. Well irrigation is mainly used in alluvial plains due to the softness of the soil. It is also more popular in regions where ground water is plenty and diversion channels are available. This irrigation method is preferable because of the ease of operation, and reduction of danger from water clogging compared to the canal (channel) irrigation during the water flow. Especially when the water level is high, farmers sometimes still utilize water-harvesting systems such as rahat (known as the Persian wheel), which was commonly used in India in 9th and 10th century. The rahat is typically operated either by domestic animals such as cows and ox or by people. This expense of energy to push the rod that connects through the wheel to lift the water is also one disadvantage of this An example of well irrigation using the rahat is seen on Figure 2.9 .

Fig. 2.9 Well Irrigation

Fig. 2.10 Well Irrigation: Rahat Operation

Most traditional systems, such as diversion channels and well irrigation, do not require extensive and complicated maintenance and operation. These systems rely on available natural resources, particularly the water source. Moreover, in India, engagement of the people in the community especially for a community-based system is significant. Traditional systems provide an opportunity for the people to be involved. In addition, operation and maintenance cost of a traditional system is reasonable provided that the system is shared by a number of farms and villagers that use the water .

2.2 FACTORS THAT INFLUENCE IRRIGATION DESIGN

These traditional systems are typically in small-scale (meant for a village) where maximum efficiency and sustainability is considered. Customary irrigation methods proved to be resourceful in the use of boulders and tree branches for diversion channels, the storage of rainwater in tanks and the use of wells to collect groundwater. Moreover, they have been in existence for years and able to provide the community good quality of crops (Sengupta, 1985). The implementation of traditional irrigation systems depends on factors such as the environment, economy, and technology.

Environment

Among the environmental factors, climate conditions and monsoon patterns, geographical terrain, types of natural water resources, and different types of crops and their corresponding water requirements all play a role.

Climate

There are two main seasons in Himachal Pradesh, the summer and the winter. The transition between the two seasons every year is important for the region. The main growing season for Himachal Pradesh is from June to October. This generally falls in line with the rainy/monsoon season. Traditionally, the growing season coincides with the south-western monsoon. Because it commences at the same time as the monsoon rains, there is usually plenty of water. However, apart from these two months of monsoon, the farmers have a hard time cultivating due to lack of water.

The majority of usable water at lower elevations comes directly from local rivers. These rivers are fed by glacial melt. Due to climate change, the monsoon season has been unusually dry in recent years. If the trend of global warming continues then the loss of glacial reservoirs is a potential threat. This could prove catastrophic in the event of them disappearing. If the farmers are unprepared for a prolonged drought they could lose the entire crop. A water storage system such as tank irrigation is useful in preserving water for future purposes.

Water resources

Another environmental factor that affects irrigation methods is the source of water. This includes understanding attributes of the existing seasons and yearly climate of a particular region. Developing traditional agricultural methods were primarily based on a consideration of how much water is available in a particular area. Most traditional irrigation systems used water supply from rainfall, river water, natural springs and ground water, which is accessed through wells. The amount of available rainwater and streams and rivers also help indicate if a diversion channel irrigation method is applicable. Alternative sources of water for irrigation are snow-fed perennial streams, water lifts, and the Uhl and Beas River. In and around Kamand, the main sources of water for irrigation include the river Beas, its tributary Uhl and a few natural springs.

ASSESSING THE GOVERNMENT POLICIES AND PUBLIC RESPONSE

To learn about the government policies and irrigation schemes for our project, and Irrigation and Public Health (IPH) Department. Most were in agreement that the need for irrigation was high, but noted that cost and terrain as key reasons for inaccessibility. The most surprising finding was that agency officials use a cost-benefit analysis to determine action. They focus on assisting villages that could provide better income as well as helping more people. Farmers living on hilly mountains received minimal help as they are remote areas and have lesser population.

Government plans were created to improve agriculture and accelerate the process of implementing irrigation facilities. Through archival research we found that in Himachal Pradesh, government projects such as The National Watershed Development Program has created strategies to increase the productivity of agriculture. These strategies included soil and water conservation, production of high quality fruit and vegetable seeds, and better marketing facilities. The 12th draft of the five-year (2012-2017) plan of the government in Himachal Pradesh aims to improve agriculture by providing farmers access to irrigation facilities and productivity of their crops. As of March 2012, 413 schemes were completed across the state. The Accelerated Irrigation Benefit Program (AIBP), which was created in 1996-1997 aimed to complete the ongoing irrigation projects faster. Because of the program, 17374.86 hectares of land has been produced for irrigation since December 2006.

The MNREGA scheme that is being implemented in Kataula has helped farmers by constructing *kuhls* using concrete for more permanent structures. Similar schemes such as the Sigali Sadog, Kandla, Bathari, and the Arang *Kuhl* were constructed more than 15 years ago. Presently, these schemes fund the maintenance of the channels, which includes clearing of sands in the kuhls when they become blocked.

The government is unwilling to invest in these villages because the project would be costly for such a small percentage of the population.

irrigation now days. The major advantage of this water pumping system is storing water when sun is shining thus eliminating the need of batteries. It enhances the simplicity and reduce the overall cost of the system. There are two types of solar power water pumping system. They are battery coupled and direct coupled. Battery coupled water pumping system shown in fig 1(a) consists of PV panels, charge control regulator, batteries, pump controllers, pressure switch, tank and DC water pump. The PV panels charges the batteries, which provide supply to the pump whenever water is needed. In direct coupled pumping system which is shown in fig electricity from PV modules is directly sent to the pump which in turn pumps water whenever it is needed. This is designed to pump the water only during day time while battery coupled can pump the water both during day and night. Since in direct coupled water pumping system the amount of pumping is directly dependent on the sunlight hitting the PV panels and the type of the pump, thus due to change in intensity of sunlight during the day the amount of water pumped by the system also changes.

3.2 Atmega328

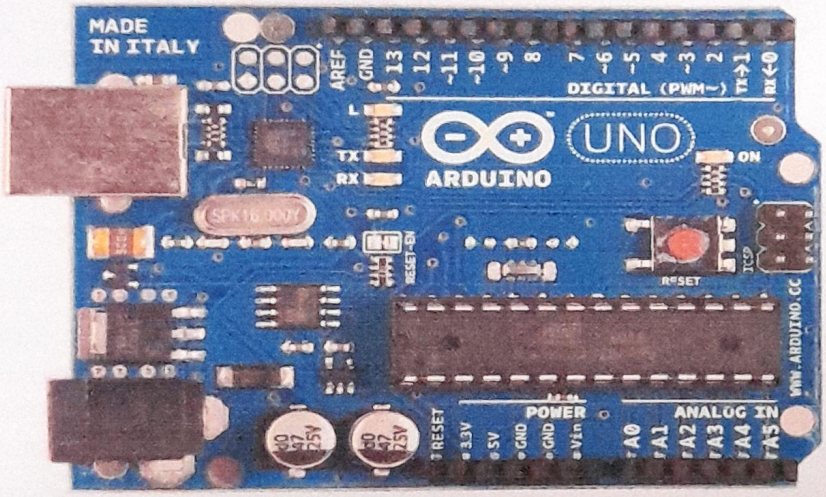

Fig 3.2ATMEL AVR328

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. It contains

everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

ARDUINO UNO SPECIFICATION

FEATURE	SPECIFICATION
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage(limits)	6-20V
Input Voltage(recommended)	7-12V
Digital I/O Pin	14(of which 6 provide PWM output)
Analog Input Pins	6
DC Current pr I/oPin	40Ma
DC Current fo 3.3V	50Ma
Flash Memory	32KB(Atmega328)of which 0.5KB used by boot loader
SRAM	2KB(Atmega328)
EEPROM	1KB(Atmega328)
Clock Speed	16MHz

Table3.2.1 showing arduino specification

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

· **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

· **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

· **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

· **GND.** Ground pins.

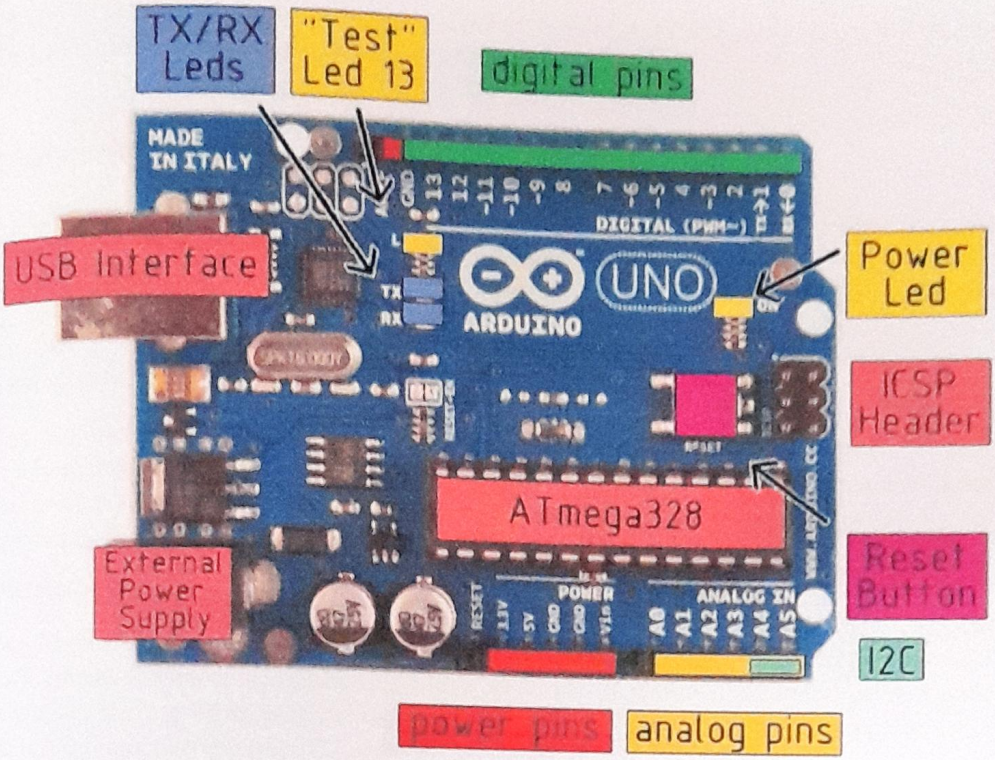

Fig3.3 showing arduino with its parts

Memory

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have

specialized functions:

· Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. TThese pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip .

· External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

· PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

· SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which,although provided by the underlying hardware, is not currently included in the Arduino language.

. LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

COMMUNICATION

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an *.inf file is required..

The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-toserial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

PROGRAMMING

The Arduino Uno can be programmed with the Arduino software (download).The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header.The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 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 '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

HOW TO USE

ARDUINO Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).

Arduino is a cross-platoform program.

Physical Characteristics

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

3.3 MOISTURE SENSOR

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. Technologies commonly used in soil moisture sensors include:

- Frequency domain sensor such as a capacitance sensor.
- Neutron moisture gauges, utilize the moderator properties of water for neutrons.
- Electrical resistance of the soil

In this particular project, we will use the moisture sensors which can be inserted in the soil , in order to measure the moisture content of the soil.

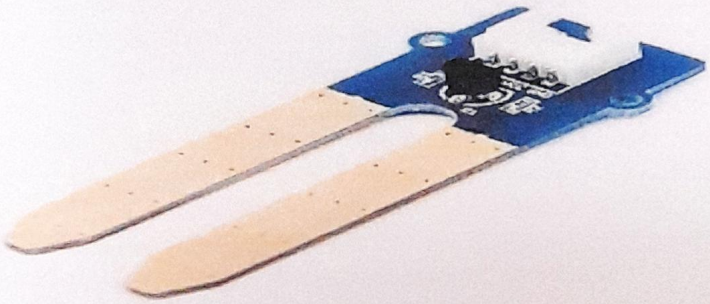

Fig3.4 moisture sensor

electrical conductivity is simply measured using two metal conductors spaced apart in the soil except that dissolved salts greatly alter the water conductivity and can confound the measurements. An inexpensive fix is to embed conductors in a porous gypsum block which releases calcium and sulphate ions to swamp the soil background level of ions. The water absorbed by the block is correlated with soil water potential over the range -60 to -600 kPa providing a tertiary indicator for use in medium to heavy soils. Non-dissolving granular matrix sensors are now available with a more exacting specification for the range 0 to -200 kPa and use internal calibration methods to offset variations due to solutes and temperature. Methods for exploiting soil dielectric properties actually measure proxy variables that more or less include a component due to the soil electrical conductivity and are thus inherently sensitive to variations in soil salinity and temperature as well as water. Measurements are also affected by soil bulk density and the proportion of bound and free water determined by the soil type.

Nevertheless, good accuracy and precision can be achieved under specific conditions and some sensor types have become widely adopted for scientific work. In general, conversions from raw sensor readings to volumetric moisture content or water potential using secondary or tertiary methods tend to be sensor or soil specific, affected or precluded at high salinity levels and dependent on temperature. Research-grade instruments typically have laboratory measured accuracy worse than +/- 4% when relying on factory settings or as good as +/- 1% when calibrated for the specific soil. Sensors based on the TDR method seem to require least calibration but may be unsuitable for soils with very high salinity or clay content. There are no comparable laboratory specifications for granular matrix sensors, possibly because they are technically more difficult to calibrate, their response times are relatively slow and the output is hysteretic for wetting and drying curves. Soil dielectric measurement is the method of choice for most research studies where expertise is available for calibration, installation and interpretation, but scope for cost reduction through sensor multiplexing is limited due to the possibility of stray capacitances. A lower manufacturing cost is possible through development of application specific integrated circuits (ASICS), though this requires a high level of investment. Multiple sensors are required to provide a depth profile and cover a representative area, but this cost can be minimized through use of a computer model to extend the measurements in a predictive way. Thus, by using the moisture sensors, the over-riding factor will be reliable, cost-effective sensors and electronic systems for accessing and interpreting the data.

3.4 PUMP

The water pump is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it to a microcontroller. It can be triggered ON/OFF by sending signals as required. The process of artificially supplying water is known as pumping.The pumping of water is a basic and practical technique, far more practical than scooping it up with one's hands or lifting it in a hand-held bucket. This is true whether the water is drawn from a fresh source, moved to a needed location, purified, or used for irrigation, washing, or sewage treatment, or for evacuating water from an undesirable location. Regardless of the outcome, the energy required to pump water is an extremely demanding component of water consumption. All other processes depend or benefit either from water descending from a higher elevation or some pressurized plumbing system

Fig3.5 Pump

3.5 MOTOR

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. 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 form of motor widely used, as 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. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Some of the most common electric motors used today include:

AC Brushless Motors

AC brushless motors are some of the most popular in motion control. They use induction of a rotating magnetic field, generated in the stator, to turn both the stator and rotor at a synchronous rate. They rely on permanent electromagnets to operate.

DC Brushed Motors

In a DC brushed motor, brush orientation on the stator determines current flow. In some models, the brush's orientation relative to the rotor bar segments is decisive instead. The commutator is especially important in any DC brushed motor design.

DC Brushless Motors

DC brushless motors were first developed to achieve higher performance in a smaller space than DC brushed motors, and they are smaller than comparable AC models. An embedded controller is used to facilitate operation in the absence of a slip ring or commutator.

Direct Drive

Direct drive is a high-efficiency, low-wear technology implementation that replaces conventional servo motors and their accompanying transmissions. In addition to being far easier to maintain over a longer period of time, these motors accelerate more quickly.

Linear Motors

These electric motors feature an unrolled stator and motor, producing linear force along the device's length. In contrast to cylindrical models, they have a flat active section featuring two ends. They are typically faster and more accurate than rotatory motors.

Servo Motors

A servo motor is any motor coupled with a feedback sensor to facilitate positioning; thus, servo motors are the backbone of robotics. Both rotary and linear actuators are used. Low-cost brushed DC motors are common, but are being superseded by brushless AC motors for high-performance applications.

Stepper Motors

Stepper motors use an internal rotor, electronically manipulated by external magnets. The rotor can be made with permanent magnets or a soft metal. As windings are energized, the rotor teeth align with the magnetic field. This allows them to move from point to point in fixed increments.

Before work begins on any new system, think carefully about the competing properties of the different motors. The selection of the right motor gets any project off to a better start.

Wound stators

A field coil may be connected in shunt, in series, or in compound with the armature of a DC machine (motor or generator)

There are three types of electrical connections between the stator and rotor possible for DC electric motors: series, shunt/parallel and compound (various blends of series and shunt/parallel) and each has unique speed/torque characteristics appropriate for different loading torque profiles/signatures.

Series connection

A series DC motor connects the armature and field windings in series with a common D.C. power source. The motor speed varies as a non-linear function of load torque and armature current; current is common to both the stator and rotor yielding current squared (I^2) behavior.A series motor has very high starting torque and is commonly used for starting high inertia loads, such as trains, elevators or hoists.[2] This speed/torque characteristic is useful in applications such as dragline excavators, where the digging tool moves rapidly when unloaded but slowly when carrying a heavy load.

A series motor should never be started at no load. With no mechanical load on the series motor, the current is low, the counter-Electro motive force produced by the field winding is weak, and so the armature must turn faster to produce sufficient counter-EMF to balance the supply voltage. The motor can be damaged by overspeed. This is called a runaway condition.

Series motors called universal motors can be used on alternating current. Since the armature voltage and the field direction reverse at the same time, torque continues to be produced in the same direction. However they run at a lower speed with lower torque on AC supply when compared to DC due to reactance voltage drop in AC which is not present in DC.Since the speed is not related to the line frequency, universal motors can develop higher-than-synchronous speeds, making them lighter than induction motors of the same rated mechanical output. This is a valuable characteristic for hand-held power tools. Universal motors for commercial utility are usually of small capacity, not more than about 1 kW output. However, much larger universal motors were used for electric locomotives, fed by special low-frequency traction power networks to avoid problems with commutation under heavy and varying loads.

Shunt connection

A shunt DC motor connects the armature and field windings in parallel or shunt with a common D.C. power source. This type of motor has good speed regulation even as the load varies, but does not have the starting torque of a series DC motor. It is typically used for industrial, adjustable speed applications, such as machine tools, winding/unwinding machines and tensioners.

Compound connection

A compound DC motor connects the armature and fields windings in a shunt and a series combination to give it characteristics of both a shunt and a series DC motor. This motor is used when both a high starting torque and good speed regulation is needed. The motor can be connected in two arrangements: cumulatively or differentially. Cumulative compound motors connect the series field to aid the shunt field, which provides higher starting torque but less speed regulation. Differential compound DC motors have good speed regulation and are typically operated at constant speed.

DISCRIPTION OF THE MOTOR USED

300 RPM Side Shaft Heavy Duty DC Gear Motor is suitable for large robots / automation systems. It has sturdy construction with gear box built to handle stall torque produced by the motor. Drive shaft is supported from both sides with metal bushes. Motor runs smoothly from 4V to 12V and gives 300 RPM at 12V. Motor has 8mm diameter, 17.5mm length drive shaft with Dshape for excellent coupling.

Specifications

RPM	300 at 12V
Voltage	4Vto12V
Stall torque	23Kg-cm at stall curent of 8.4A@12V
Shaft diameter	8mm
Gear assembly	Spur
Brush type	Carbon
Motor type	280gms
Dimension	Refer to the diagram below

Table no.3.5.1

Refer to diagram below

NOTE:THIS MOTOR IS BIT NOISY WHILE RUNNING

Dimensions

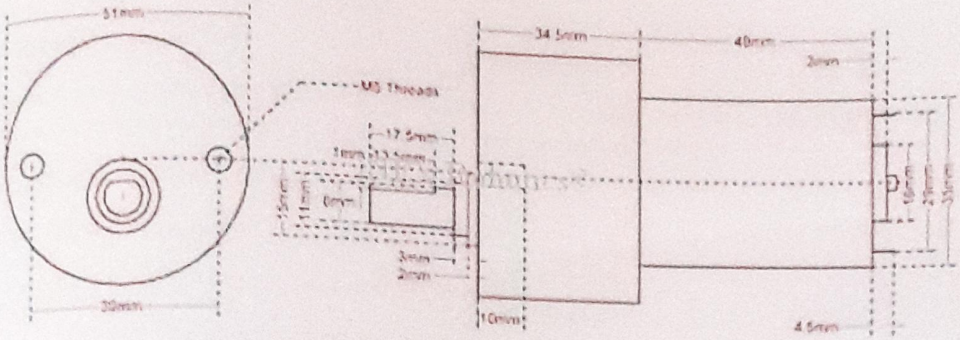

Fig3.6 Motor dimension

3.6 VOLTAGE REGULATOR

A voltage regulator is used to regulate voltage level. When a steady, reliable voltage is needed, then voltage regulator is the preferred device. It generates a fixed output voltage that remains constant for any changes in an input voltage or load conditions. It acts as a buffer for protecting components from damages. A voltage regulator is a device with a simple feed- forward design and it uses negative feedback control loops. There are mainly two types of voltage regulators: Linear voltage regulators and switching voltage regulators; these are used in wider applications. Linear voltage regulator is the easiest type of voltage regulators. It is available in two types, which are compact and used in low power, low voltage systems. Let us discuss about different types of voltage regulators.

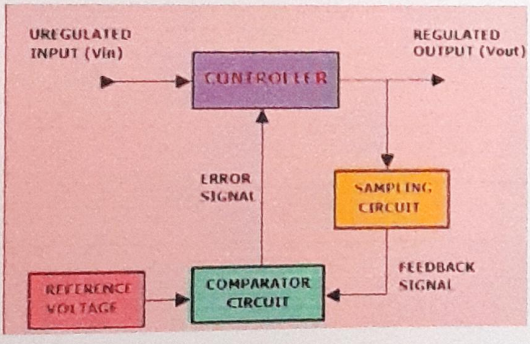

Fig3.7Voltage Regulator

Types of Voltage Regulators and Their Working Principle

Basically, there are two types of Voltage regulators: Linear voltage regulator and Switching voltage regulator.

- There are two types of Linear voltage regulators: Series and Shunt.

- There are three types of Switching voltage regulators: Step up, Step down and Inverter voltage regulator

Linear Regulator

Linear regulator acts like a voltage divider. In Ohmic region, it uses FET. The resistance of the voltage regulator varies with load resulting in constant output voltage.

Advantages of linear voltage regulator

- Gives a low output ripple voltage
- Fast response time to load or line changes
- Low electromagnetic interference and less noise

Disadvantages of linear voltage regulator

- Efficiency is very low
- Requires large space – heatsink is needed
- Voltage above the input cannot be increased

Series Voltage Regulator

A series voltage regulator uses a variable element placed in series with the load. By changing the resistance of that series element, the voltage dropped across it can be changed. And, the voltage across the load remains constant.

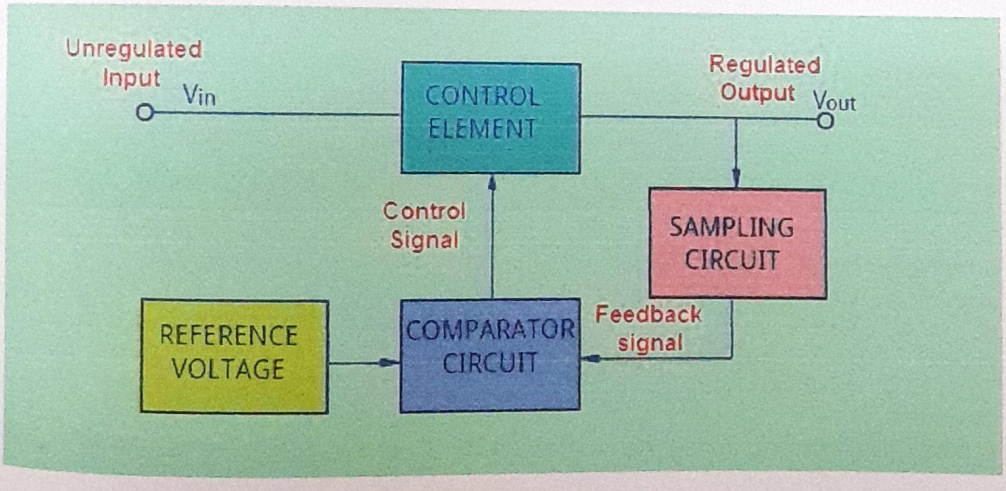

Fig3.8Series Voltage Regulator

The amount of current drawn is effectively used by the load; this is the main advantage of the series voltage regulator. Even when the load does not require any current, the series regulator does not draw full current. Therefore, a series regulator is considerably more efficient than shunt voltage regulator.

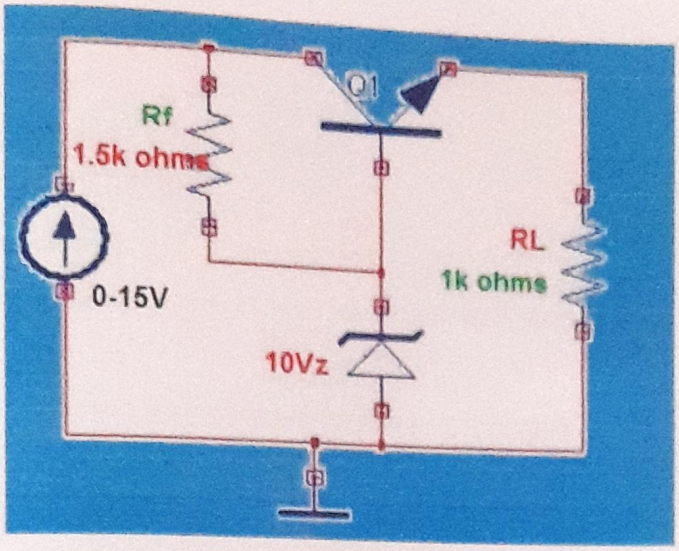

Fig3.9Series Voltage Regulator Circuit

Shunt Voltage Regulator

A shunt voltage regulator works by providing a path from the supply voltage to ground through a variable resistance. The current through the shunt regulator is diverted away from the load and flows uselessly to the ground, making this form usually less efficient than the series regulator. It is, however, simpler, sometimes consisting of just a voltage-reference diode, and is used in very low-powered circuits wherein the wasted current is too small to be of concern. This form is very common for voltage reference circuits. A shunt regulator can usually only sink (absorb) current.

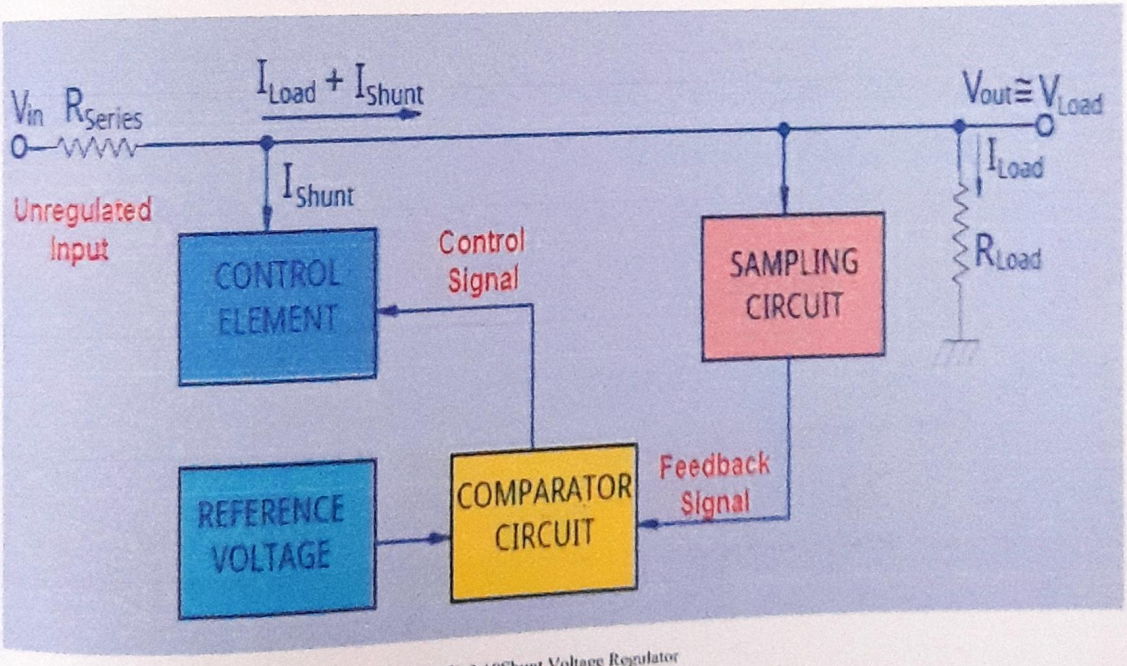

Fig3.10Shunt Voltage Regulator

Applications of Shunt Regulators

Shunt regulators are used in:

- Low Output Voltage Switching Power Supplies
- Current Source and Sink Circuits
- Error Amplifiers
- Adjustable Voltage or Current Linear and Switching Power Supplies
- Voltage Monitoring
- Analog and Digital Circuits that require precision references
- Precision current limiters

Switching Voltage Regulator

A switching regulator rapidly switches a series device on and off. The switch's duty cycle sets the amount of charge transferred to the load. This is controlled by a feedback mechanism similar to that of a linear regulator. Switching regulators are efficient because the series element is either fully conducting or switched off because it dissipates almost no power. Switching regulators are able to generate output voltages that are higher than the input voltage or of opposite polarity, unlike linear regulators.

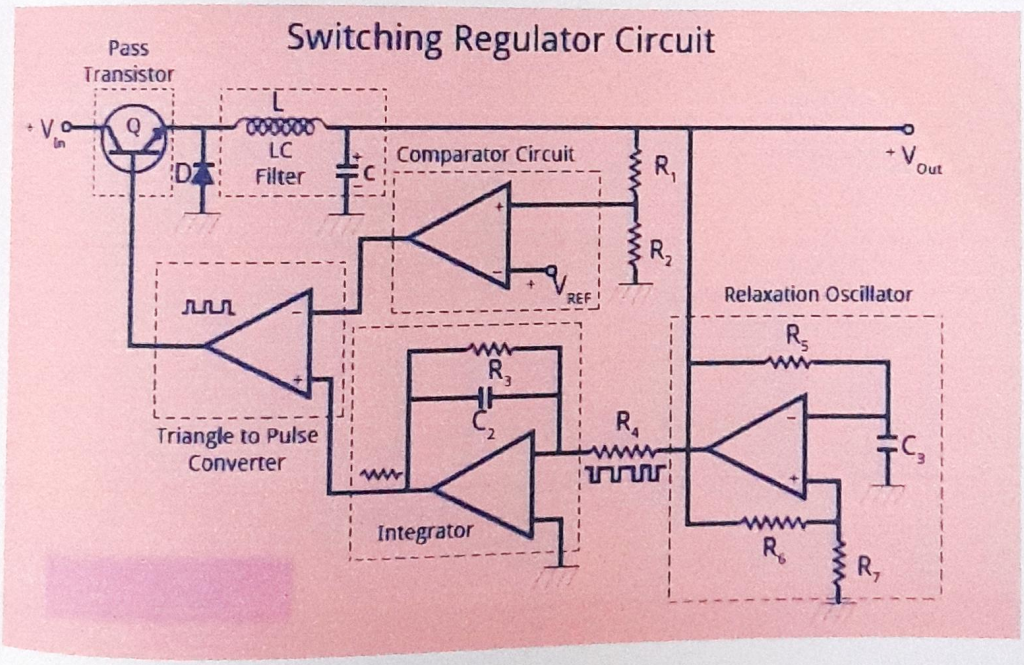

Fig3.11

Switching voltage regulator switches on and off rapidly to alter the output. It requires a control oscillator and also charges storage components.In a switching regulator with Pulse Rate Modulation varying frequency, constant duty cycle and noise spectrum imposed by PRM vary; it is more difficult to filter out that noise.A switching regulator with Pulse Width Modulation, constant frequency, varying duty cycle, is efficient and easy to filter out noise. In a switching regulator, continuous mode current through an inductor never drops to zero. It allows highest output power. It gives better performance.In a switching regulator, discontinuous mode current through the inductor drops to zero. It gives better performance when the output current is low.

DISCRIPTION OF THE VOLTAGE REGULATOR USED

An **IC7805** Voltage Regulator is a voltage controller that yields +5 volts.

A simple approach to recollect the voltage yield by a 78XX arrangement of voltage controllers is the last two digits. It yields 5 volts. The "78" section is simply the tradition that the chip creators utilization to indicate the arrangement of controllers that yield positive voltage.

Pin 1 (Input Pin): The Input pin is the pin that acknowledges the approaching DC voltage, which

the voltage controller will in the long run direct down to 5 volts.

Pin 2 (Ground): Ground pin creates the ground for the controller.

Pin 3 (Output Pin): The Output pin is the controlled 5 volts DC

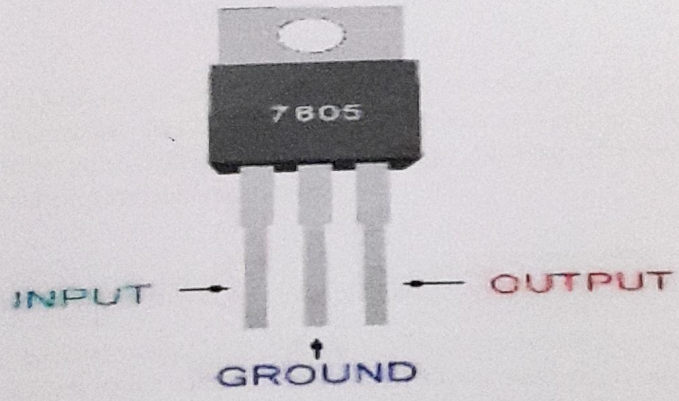

Fig3.12 Pindiagram

Pin no	Function	Name
1	Input voltage(5V-18V)	Input
2	Ground(0V)	Ground
3	Regulated output,5V(4.8V-5.2V)	Output

Table3.6.1

3.7 ELECTROLYTIC CAPACITOR

Electrolytic capacitors (e-tops) are spellbound capacitors whose anode cathode (+) are made of an uncommon metal on which a protecting oxide layer begins by anodization (framing), which goes about as the dielectric of the electrolytic capacitor. A non-strong or strong electrolyte which covers the surface of the oxide layer on a basic level serves as the second terminal (cathode) (-) of the capacitor.

Fig3.13 Electrolytic Capacitor

The expansive capacitance of electrolytic capacitors makes them especially suitable for passing or bypassing low-recurrence flags up to some super hertz and putting away a lot of vitality. They are broadly utilized for decoupling or clamor filtereng in force supplies and DC connection circuits for variable-recurrence drives.

3.8 DIODE

A diode is a device which only allows unidirectional flow of current if operated

within a rated specified voltage level.A diode only blocks current in the reverse direction while the reverse voltage is within a limited range otherwise reverse barrier breaks and the voltage at which this breakdown occurs is called reverse breakdown voltage. The diode acts as a valve in the electronic and electrical circuit. A P-N junction is the simplest form of the diode which behaves as ideally short circuit when it is in forward biased and behaves as ideally open circuit when it is in the reverse biased. Beside simple PN junction diodes, there are different

types of diodes although the fundamental principles are more or less same. So a particular arrangement of diodes can convert AC to pulsating DC, and hence, it is sometimes also called

as a rectifier.The name diode is derived from "di-ode" which means a device having two electrodes.

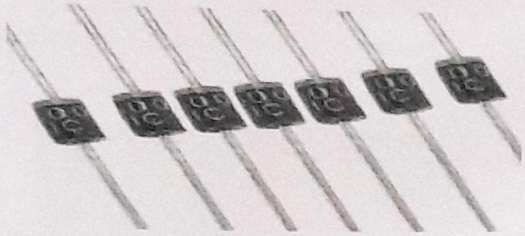

Fig3.14 Diode

3.9 LCD Display

LCD is an electronic visual showcase, or feature show that uses the light balancing properties of fluid gems. Fluid gems don't discharge light directly.

LCDs are accessible to show discretionary pictures (as in a broadly useful PC show) or altered pictures which can be shown or covered up, for example, preset words, digits, and 7-section shows as in a computerized clock. They utilize the same fundamental innovation, with the exception of that discretionary pictures are comprised of an extensive number of little pixels, while different showcases have bigger components. LCDs are utilized as a part of an extensive variety of utilizations including PC screens, TVs, instrument boards, airplane cockpit presentations, and signage. They are basic in shopper gadgets, for example, DVD players, gaming gadgets, timekeepers, watches, number crunchers, and phones, and have supplanted cathode beam tube (CRT) shows in many applications. They are accessible in a more extensive scope of screen sizes than CRT and plasma shows, and since they don't utilize phosphors, they don't endure picture blaze in. LCDs are, nonetheless, powerless to picture ingenuity.

Fig3.15 LCD

3.10 LED

Light radiating diodes, regularly called LEDs, are genuine unsung saints in the hardware world. They do many diverse occupations and are found in a wide range of gadgets. In addition to other things, they frame numbers on computerized tickers, transmit data fromremote controls, light up watches and let you know when your apparatuses are turned on. Gathered together, they can shape pictures on a large TV screen or enlighten an activity light. Fundamentally, LEDs are simply minor lights that fit effectively into an electrical circuit. Be that as it may,not

at all like common brilliant globules, they don't have a fiber that will wear out, and they don't get particularly hot. They are enlightened exclusively by the development of electrons in a semiconductor material, and they keep going generally the length of a standard transistor. The lifespan of a LED surpasses the short existence of a brilliant knob by a great many hours. Minor LEDs are as of now supplanting the tubes that light up LCD HDTVs to make drastically more slender TVs. In this article, we'll inspect the innovation behind these pervasive signals, enlightening some cool standards of power and light simultaneously.

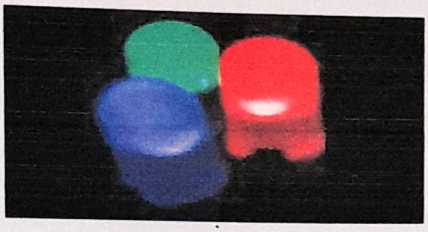

Fig3.16 LED

3.11 OPERATIONAL AMPLIFIER

An operational intensifier ("operation amp") is a DC-coupled high-increase electronic voltage speaker with a differential data and, normally, a solitary finished output.In this arrangement, an operation amp creates a yield potential (in respect to circuit ground) that is ordinarily a huge number of times bigger than the potential distinction between its info terminals.Operational enhancers had their causes in simple PCs, where they were utilized to do scientific operations in numerous direct, non-straight and recurrence ward circuits.

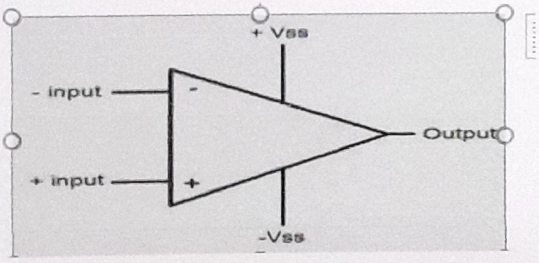

Fig3.17 Pin diagram of op-amp

3.12 PVC WIRES

Applications:

Open and covered wiring in businesses/private and business structures.

House meter and water pump associations.

Road light and movement signal associations.

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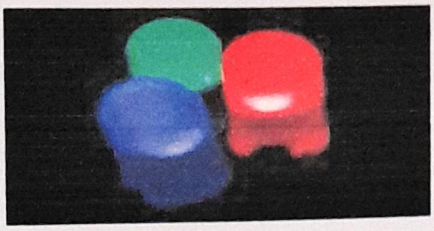

Fig3.16 LED

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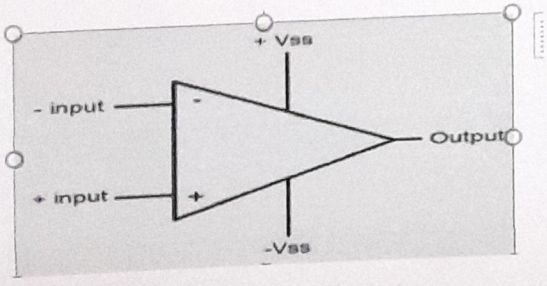


Fig3.17 Pin diagram of op-amp

3.12 PVC WIRES

Applications:

Open and covered wiring in businesses/private and business structures.

House meter and water pump associations.

Road light and movement signal associations.

3.15 POTENTIOMETER

The soil moisture sensor or the hygrometer is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of your plants. The sensor is set up by two pieces: the electronic board (at the right), and the probe with two pads, that detects the water content (at the left).

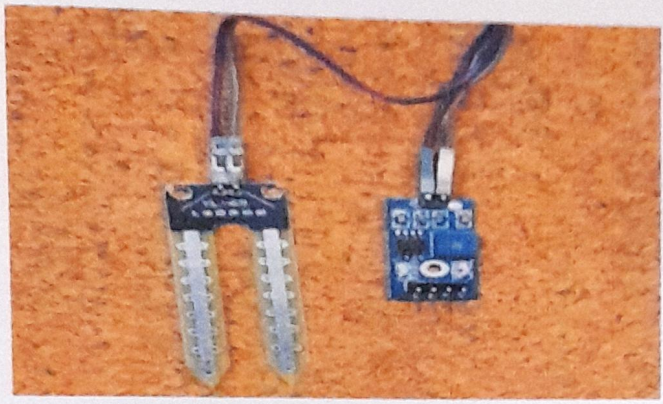


Fig 3.20 Shows moisture sensor with potentiometer

The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED, as you can see in the following figure.

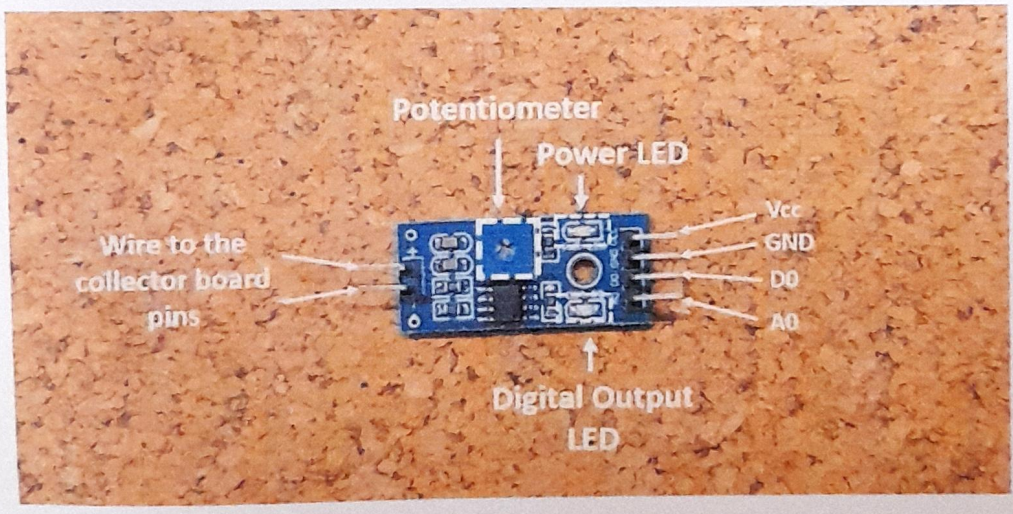


Fig3.21 Shows Potentiometer's Parts

How does it work?

The voltage that the sensor outputs changes accordingly to the water content in the soil.

When the soil is:

Wet: the output voltage decreases

Dry: the output voltage increases

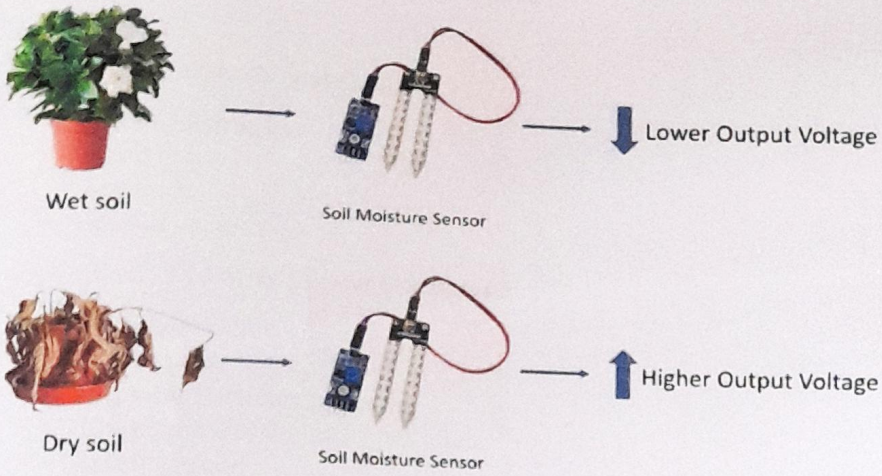


Fig.3.22 Moisture Sensor Working

The output can be a digital signal (D0) LOW or HIGH, depending on the water content. If the soil humidity exceeds a certain predefined threshold value, the modules outputs LOW, otherwise it outputs HIGH. The threshold value for the digital signal can be adjusted using the potentiometer. The output can be a analog signal and so you'll get a value between 0 and 1023.

PIN Wiring

Pin	Writing to Arduino Uno
A	Analog Pins
D	Digital Pins
GND	GND
VCC	5V

Table no.3.6.1

3.16 16MHZ CRYSTAL OSCILLATORS

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency.

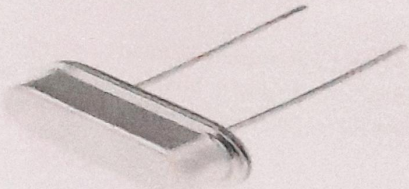


Fig3.23 Crystal Oscillator

Features of 16 MHz Crystal Oscillators:

- Stability in frequency.
- Small in size.
- Low cost.
- Easy of interfacing.

Applications of 16 MHz Crystal Oscillators:

- Resonance circuit.
- DIY projects.
- Electrical/electronic projects.
- Clock generator for microcontroller.
- DTMF decoder.

3.17 JUMPER WIRES

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

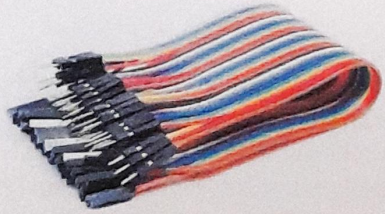


Fig 3.24 Jumper Wire

3.18 INDUCTOR

An inductor, also called a coil, choke, or reactor, is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it.An inductor typically consists of an insulated wire wound into a coil around a core.

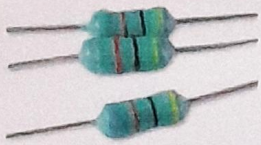


Fig3.25 Inductor

3.19 BATTERY

A battery is a collection of one or more cells that go under chemical reactions to create the flow of electrons within a circuit. There is lot of research and advancement going on in battery technology, and as a result, breakthrough technologies are being experienced and used around the world currently. Batteries came into play due to the need to store generated electrical energy. As much as a good amount of energy was being generated, it was important to store the energy so it can be used when generation is down or when there is a need to power standalone devices which cannot be kept tethered to the supply from the mains. Here it should be noted that only DC can be stored in the batteries, AC current can't be stored.

Battery cells are usually made up of three main components;

1. The Anode (Negative Electrode)
2. The Cathode (Positive Electrode)
3. The electrolytes

The anode is a negative electrode that produces electrons to the external circuit to which the battery is connected. When batteries are connected, an electron build up is initiated at the anode which causes a potential difference between the two electrodes. The electrons naturally then try to redistribute themselves, this is prevented by the electrolyte, so when an electrical circuit is connected, it provides a clear path for the electrons to move from the anode to the cathode thereby powering the circuit to which it is connected.

Types of Batteries

Batteries generally can be classified into different categories and types, ranging from chemical composition, size, form factor and use cases, but under all of these are two major battery types;

1. Primary Batteries

2. Secondary Batteries

1. Primary Batteries

Primary batteries are batteries that **cannot be recharged** once depleted. Primary batteries are made of electrochemical cells whose electrochemical reaction cannot be reversed. Primary batteries exist in different forms **ranging from coin cells to AA batteries**. They are commonly used in standalone applications where charging is impractical or impossible. A good example of which is in military grade devices and battery powered equipment. It will be impractical to use rechargeable batteries as recharging a battery will be the last thing in the mind of the soldiers. Primary batteries always have high specific energy and the systems in which they are used are always designed to consume low amount of power to enable the battery last as long as possible.

Fig3.26 Primary Battery

Some other examples of devices using primary batteries include; Pace makers, Animal trackers, Wrist watches, remote controls and children toys to mention a few.The most popular type of primary batteries are alkaline batteries. They have a high specific energy and are environmentally friendly, cost-effective and do not leak even when fully discharged. They can be stored for several years, have a good safety record and can be carried on an aircraft without being subject to UN Transport and other regulations. The only downside to alkaline batteries is the low load current, which limits its use to devices with low current requirements like remote controls, flashlights and portable entertainment devices.

2. Secondary Batteries

Secondary batteries are batteries with electrochemical cells whose chemical reactions can be reversed by applying a certain voltage to the battery in the reversed direction. Also referred to as **rechargeable batteries**, secondary cells unlike primary cells can be recharged after the energy on the battery has been used up.They are typically used in high drain applications and

other scenarios where it will be either too expensive or impracticable to use single charge batteries. Small capacity secondary batteries are used to power portable electronic devices like **mobile phones**, and other gadgets and appliances while heavy-duty batteries are used in powering diverse **electric vehicles** and other high drain applications like load levelling in electricity generation. They are also used as standalone power sources alongside **Inverters to supply electricity**. Although the initial cost of acquiring rechargeable batteries is always a whole lot higher than that of primary batteries but they are the most cost-effective over the longterm.

Secondary batteries can be further classified into several other types based on their chemistry. This is very important because the chemistry determines some of the attributes of the battery including its specific energy, cycle life, shelf life, and price to mention a few.

There are basically four major chemistries for rechargeable batteries

1. Lithium-ion(Li-ion)
2. Nickel Cadmium(Ni-Cd)
3. Nickel-Metal Hydride(Ni-MH)
4. Lead-Acid

Nickel-Cadmium Batteries

The nickel–cadmium battery (NiCd battery or NiCad battery) is a type of rechargeable battery which is developed using nickel oxide hydroxide and metallic cadmium as electrodes. Ni-Cd batteries excel at maintaining voltage and holding charge when not in use. However, NI-Cd batteries easily fall a victim of the dreaded "memory" effect when a partially charged battery is recharged, lowering the future capacity of the battery.

Fig3.27

In comparison with other types of rechargeable cells, Ni-Cd batteries offer good life cycle and performance at low temperatures with a fair capacity but their most significant advantage will be their ability to deliver their full rated capacity at high discharge rates. They are available in different sizes including the sizes used for alkaline batteries, AAA to D. Ni-Cd cells are used individual or assembled in packs of two or more cells. The small packs are used in portable devices, electronics and toys while the bigger ones find application in aircraft starting batteries, Electric vehicles and standby power supply.

Some of the properties of Nickel-Cadmium batteries are listed below.

- Specific Energy: 40-60W-h/kg
- Energy Density: 50-150 W-h/L
- Specific Power: 150W/kg
- Charge/discharge efficiency: 70-90%
- Self-discharge rate: 10%/month
- Cycle durability/life: 2000cycles

Fig3.28

NiMH batteries find application in high drain devices because of their high capacity and energy density. A NiMH battery can possess two to three times the capacity of a NiCd battery of the same size, and its energy density can approach that of a lithium-ion battery.

Unlike the NiCd chemistry, batteries based on the **NiMH chemistry are not susceptible to the "memory"** effect that NiCads experience.

Below are some of the properties of batteries based on the Nickel-metal hydride chemistry;

- Specific Energy: 60-120h/kg
- Energy Density: 140-300 Wh/L
- Specific Power: 250-1000 W/kg
- Charge/discharge efficiency: 66% - 92%
- Self-discharge rate: 1.3-2.9%/month at 20°C
- Cycle Durability/life: 180 -2000

Lithium-ion Batteries

Lithium ion batteries are one of the most popular types of rechargeable batteries. They are found in different portable appliances including mobile phones, smart devices and several other battery appliances used at home. They also find applications in aerospace and military applications due to their lightweight nature.

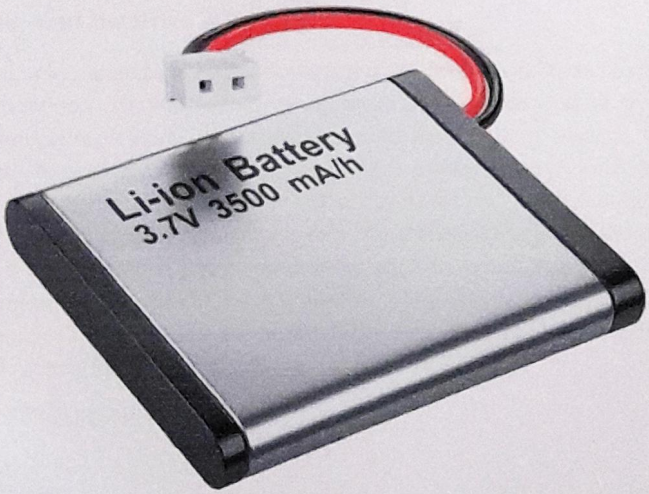


Fig3.29

Lithium-ion batteries are a type of rechargeable battery in which lithium ions from the negative electrode migrate to the positive electrode during discharge and migrate back to the negative electrode when the battery is being charged. Li-ion batteries use an intercalated

lithium compound as one electrode material, compared to the metallic lithium used in non-rechargeable lithium batteries.

Lithium ion batteries generally possess high energy density, little or no memory effect and low self-discharge compared to other battery types. Their chemistry alongside performance and cost vary across different use cases for example, Li-ion batteries used in handheld electronic devices are usually based on lithium cobalt oxide ($LiCoO_2$) which provides high energy density and low safety risks when damaged while Li-ion batteries based on Lithium iron phosphate which offer a lower energy density are safer due to a reduced likelihood of unfortunate events happening are widely used in powering electric tools and medical equipment. Lithium ion batteries offer the best performance to weight ratio with the lithium sulphur battery offering the highest ratio.

Some of the attributes of lithium ion batteries are listed below;

- Specific Energy: 100: 265W-h/kg
- Energy Density: 250: 693 W-h/L
- Specific Power: 250: 340 W/kg
- Charge/discharge percentage: 80-90%
- Cycle Durability: 400: 1200 cycles
- Nominal cell voltage: NMC 3.6/3.85V

DESCRIPTION OF THE BATTERY USED

Lead-Acid Batteries

Lead acid batteries are a low-cost reliable power workhorse used in heavy duty applications. They are usually very large and because of their weight, they're always used in non-portable applications such as solar-panel energy storage, vehicle ignition and lights, backup power and load levelling in power generation/distribution. The lead-acid is the oldest type of rechargeable battery and still very relevant and important into today's world. Lead acid batteries have very low energy to volume and energy to weight ratios but it has a relatively large power to weight ratio and as a result can supply huge surge currents when needed. These attributes alongside its low cost makes these batteries attractive for use in several high current applications like powering automobile starter motors and for storage in backup power supplies.

POWER-4V 1Ah

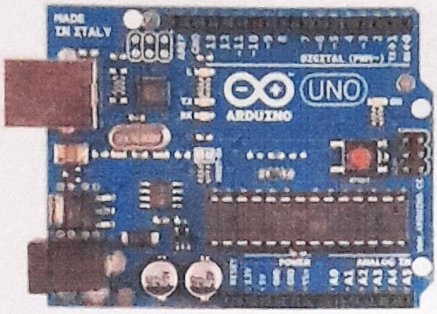
Fig3.29

ARDUINO IDE TOOL

The open-source Arduino environment makes it easy to write code and upload it to the i/o board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, avr-gcc, and other open source software. Steps for using Arduino IDE

Step 1: Get an Arduino board and USB cable

In this tutorial, we assume you're using an Arduino Uno You also need a standard USB cable (A plug to B plug): the kind you would connect to a USB printer, for example.



Step 2 : Download the Arduino environment

Get the latest version from the download page. When the download finishes, unzip the downloaded file. Make sure to preserve the folder structure. Double-click the folder to open it. There should be a few files and sub-folders inside.

Step 3 : Connect the board The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply. If you're using an Arduino Diecimila, you'll need to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it's on the two pins closest to the USB port.

Connect the Arduino board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

Step 4 : Install the drivers

Installing drivers for the Arduino Uno or Arduino Mega 2560 with Windows7, Vista, or XP

Step 5: Launch the Arduino application

Double-click the Arduino application. (Note: if the Arduino software loads in the wrong language, you can change it in the preferences dialog. See the environment page for details.)

Step 6: Open the blink example

Open the LED blink example sketch: File > Examples > 1.Basics > Blink. Step 7: Select your board You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino. Step 8: Select your serial port Select the serial device of the Arduino board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu; the entry that disappears should be the Arduino board. Reconnect the board and select that serial port. Step 9 : Upload the program Now, simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX leds on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.

CHAPTER 5

5.1 CIRCUIT DIAGRAM

The given circuit diagram shows the connection of Arduino with the LCD and the soil moisture sensor.

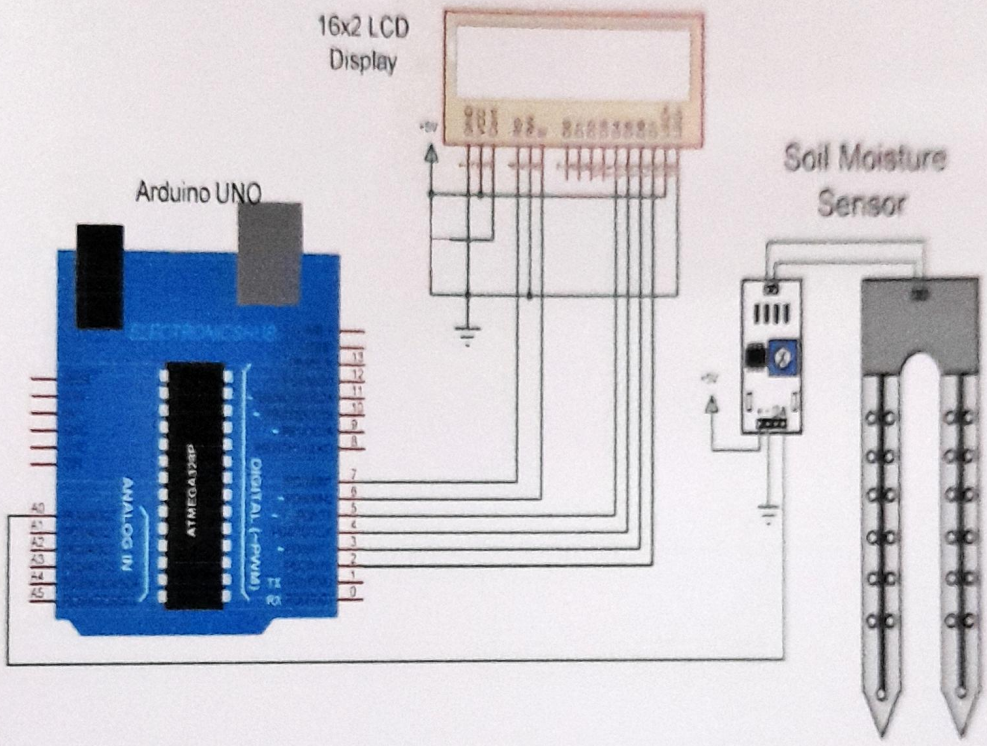


Fig4.1 CONNECTION OF LCD AND MOISTURE SENSOR WITH ATmega 328

5.2 The given circuit diagram below shows the connection of Arduino with the LCD,moisture sensor and motor.

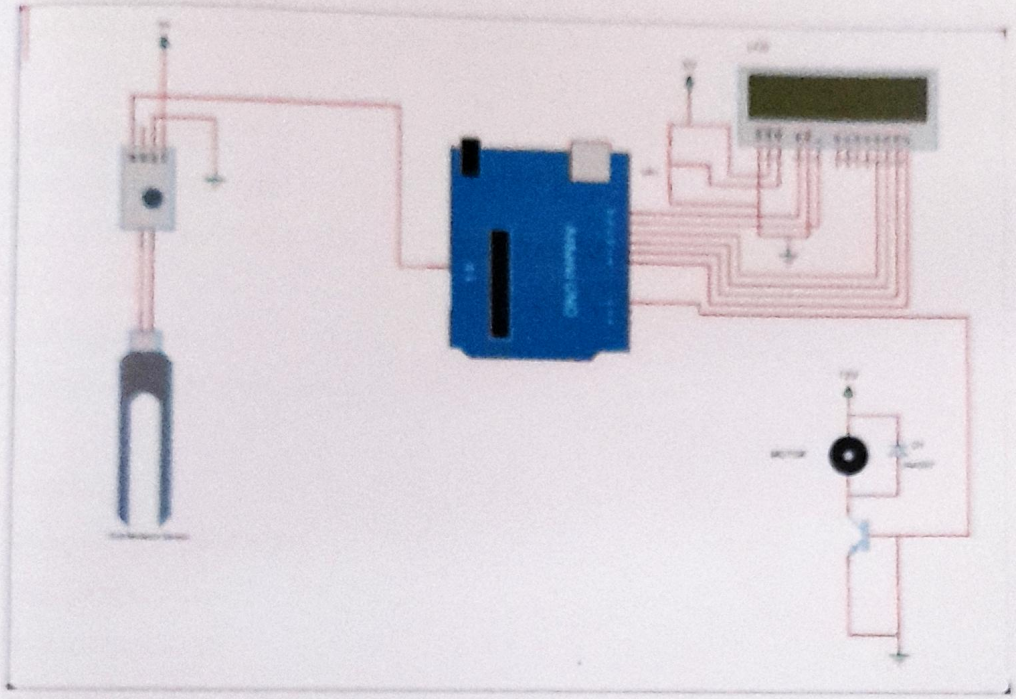


Fig6.2 CONNECTION OF ARDUINO WITH MOTOR AND LCD,MOISTURE SENSOR

CHAPTER 6

Here the programming is done for the LCD to display the pump status and also to control the motor when it has to be ON and when it has to be OFF.

PROGRAMMING

```
#include <LiquidCrsystal.h>
LiquidCrsystal lcd(7,6,5,4,3,2);
Void setup(){
Lcd.begin(16,2);
pinMode(12,INPUT);//
}
Void loop(){
If(digitaRead(12)==HIGH)
{lcd.clear();
{lcd.setCursor(1,0);
lcd.print("PUMP INDICATOR");
lcd.setCursor(0,1);
lcd.print("PUMP ON");}
else
{lcd.clear();
lcd.setCursor(0,0);
lcd.print("PUMP INDICATOR");
lcd.setCursor(0,1);
lcd.print("PUMP OFF");}
delay(2000);
}
```

RESULT

Irrigation becomes easy, accurate and practical with the impression above shared and can be executed in agricultural fields in future to endorse agriculture to next level. The output from moisture sensor and level system plays vide role in producing the output.

CONCLUSION

The purpose of designing of Automatic Solar Powered Irrigation System is successfully achieved and fulfills the desired objectives. The hardware and software used performed their function properly to produce desired result which is the required for the farmers in the irrigation field. Using this system, farmers will get the protection while doing the irrigation work in extremely odd weather conditions, hard work of repeated assembly and will get rid of poisonous reptiles. The system, which is designed, will help the farmers to do the irrigation process in night also. The system designed do not requires the physical presence of the farmers during irrigation in the fields. The system is automatically monitored and controls the pump on and off.

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