NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic
Engineering

AUTOMATIC IRRIGATION SYSTEM

Graduation Project
EE- 400

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TABLE OF CONTENTS

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ABSTRACT

The main objective of this thesis is to provide automatic irrigation system, and this can be done using the moisture detector so that the plant will be watered by it self when it need, also for economic in water because in some countries they have a water problems.

For this purpose we explained the moisture detector in detail, and other types of moisture detector like a plant moisture monitor, automatic surge flow.

This thesis also shows how the noise will be eliminated from the electronic circuit to get accurate output, also how to invert the output of the circuit.

INTRODUCTION

This project discusses the automatic irrigation system, and this can be done using the moisture detector circuit. The project shows how the automatic irrigation system is important in our life, because we are watering the plant and we don't know whether the plant needs watering or not. But using the automatic irrigation system the plant can water it self when it need for watering.

The first chapter explains the electronic components of the project in detail, how they work, types, applications, advantages, disadvantages and some safety guide lines for electronic projects.

The second chapter shows one type of moisture detector it is shown as a previous research.

The third chapter explains the moisture detector circuit that is used in the project in detail; we separated the circuit to two parts and explained every one when the current is flowing.

The fourth chapter shows the modifications that added to the circuit, how the noise can be eliminated from the circuit, also how to invert the output of the circuit, this chapter explains the light emitting diode because it is useful in the circuit.

CHAPTER 1
INTRODUCTION

1.1 Overview

This chapter presents the components of the project and also shows the safety guide lines for electronic projects.

1.2 Resistors

A resister is a tow –terminal electrical or electronic component that resists an electric current by producing a voltage drop between its terminals in accordance with ohm's law.

$$R = \frac{V}{I}$$

The electrical resistance is equal to the voltage drop across the resistor divided by the current that is flowing through the resister. Resistors are used as part of electrical networks and electronic circuits.

These are small cylindrical components having a lead out protruding from each end. The value is not marked in numbers and letters, but is indicated by four coloured bands around the body of the component. The value is in units called "ohms", and resistors often have values of many thousands of ohms, or even a few million ohms. In order to avoid constantly using very large numbers it is common for resistance to be specified in kilohms (k) and megohms (M). These are equal to a thousand ohms and a million ohms respectively. Thus, a resistor having a value of 33,000 ohms would normally be said to have a value of 33k, and a resistor having a value of 2,700,000 ohms would normally have its value given as 2.7M. It is common these days for the unit's symbol to be used to indicate the decimal point as well. This sometimes further shortens a value in its written form, and there is no danger of a decimal point being overlooked due to poor quality printing or something of this nature. In our two examples given above the value of 33k would not be altered since the "k" already indicates the position of the decimal point, but 2.7M would be altered to 2M7.

The resistor colour code is very straight forward, with the first two bands giving the first two digits of the value the third band giving a multiplier (i.e. the first two digits are multiplied by this third figure in order to give the value of the component in ohms), and the

Table 1.1 resistor colour code [1].

Colour	$1^{st}/2^{nd}$ band	3^{rd} band	4^{th} band
Gold	Not used	0.1	5%
Black	0	10	Not used
Brown	1	10	1%
Red	2	100	Not used
Orange	3	1000	Not used
Yellow	4	10.000	Not used
Green	5	100.000	Not used
Blue	6	1.000.000	Not used
Violet	7	Not used	Not used
Grey	8	Not used	Not used
White	9	Not used	Not used
Silver	Not used	0.01	10%

fourth band showing the tolerance of the component. The resistor colour code is detailed below.

Resistors also have a power rating, and this is not usually marked on the component (except in the case of high power types where the value and wattage may both be written on the component, no colour codes being used). For the circuits in this book ordinary miniature 1/8, 1/4, or 1/3 watt resistors are satisfactory since the power levels involved are very low higher power resistors are not really suitable, and this is due to their physical rather than electrical characteristics. Higher wattage resistors are physically quite large and would be difficult to fit into the available space, and some have very thick leadout wires, which will not fit easily into solderless breadboards.

1.2.1 Applications

In general, a resistor is used to create a known voltage-to-current ratio in an electric circuit. If the current in a circuit is known, then a resistor can be used to create a known potential difference proportional to that current. Conversely, if the potential difference between two points in a circuit is known, a resistor can be used to create a known current proportional to that difference.

Current-limiting. By placing a resistor in series with another component, such as a light-emitting diode, the current through that component is reduced to a known safe value.

An attenuator is a network of two or more resistors (a voltage divider) used to reduce the voltage of a signal.

A line terminator is a resistor at the end of a transmission line or daisy chain bus (such as in SCSI), designed to match impedance and hence minimize reflections of the signal.

All resistors dissipate heat. This is the principle behind electric heaters.

1.2.2 The Ideal Resistor

The unit of electrical resistance is the ohm. A component has a resistance of 1 ohm if a voltage of 1 volt across the component results in a current of 1 ampere, or amp, which is equivalent to a flow of one coulomb of electrical charge (approximately 6.241506×10^{18} electrons) per second. The multiples kilohm (1000 ohms) and megaohm (1 million ohms) are also commonly used.

In an ideal resistor, the resistance remains constant regardless of the applied voltage or current flowing through the device or the rate of change of the current. While real resistors cannot attain this goal, they are designed to present little variation in electrical resistance when subjected to these changes, or to changing temperature and other environmental factors.

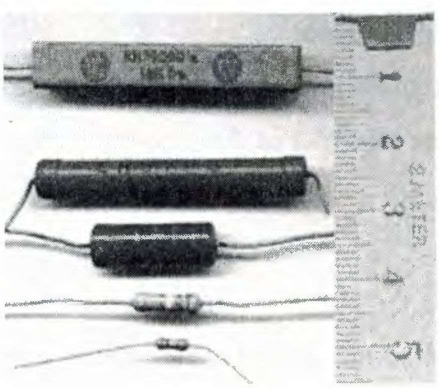

Figure 1.1 A few types of resistors [2].

1.2.3 Non-Ideal Characteristics

A resistor has a maximum working voltage and current above which the resistance may change (drastically, in some cases) or the resistor may be physically damaged (overheat or burn up, for instance). Although some resistors have specified voltage and current ratings, most are rated with a maximum power which is determined by the physical size. Common power ratings for carbon composition and metal-film resistors are 1/8 watt, 1/4 watt, and 1/2 watt. Metal-film and carbon film resistors are more stable than carbon resistors against temperature changes and age. Larger resistors are able to dissipate more heat because of their larger surface area. Wire-wound and resistors embedded in sand (ceramic) are used when a high power rating is required.

All real resistors also introduce some inductance and a small amount of capacitance, which change the dynamic behavior of the resistor from the ideal.

1.2.4 Fixed Resistor

Some resistors are cylindrical, with the actual resistive material in the centre (composition resistors, now obsolete) or on the surface of the cylinder (film) resistors, and a conducting metal lead projecting along the axis of the cylinder at each end(axial lead). There are carbon film and metal film resistors. The photo above right shows a row of common resistors. Power resistors come in larger packages designed to dissipate heat efficiently. At high power levels, resistors tend to be wire wound types. Resistors used in computers and other devices are typically much smaller, often in surface-mount packages without wire leads. Resistors are built into integrated circuits as part of the fabrication process, using the semiconductor as the resistor. Most often the IC will use a transistor-transistor configuration or resistor-transistor configuration to obtain results. Resistors made with semiconductor material are more difficult to fabricate and take up too much valuable chip area

1.2.5 Variable Resistor

The variable resistor is a resistor whose value can be adjusted by turning a shaft or sliding a control. These are also called potentiometers or rheostats and allow the resistance of the device to be altered by hand. Rheostats are for anything above 1/2 watt. Variable resistors can be inexpensive single-turn types or multi-turn types with a helical element. Some variable resistors can be fitted with a mechanical display to count the turns. Variable resistors can sometimes be unreliable, because the wire or metal can corrode or wear. Some modern variable resistors use plastic materials that do not corrode and have better wear characteristics.

1.2.6 Metal Oxide Varistor

(MOV) is a special type of resistor that changes its resistance with rise in voltage: a very high resistance at low voltage (below the trigger voltage) and very low resistance at high voltage (above the trigger voltage). It acts as a switch. It is usually used for short circuit protection in power strips or lightning bolt "arrestors" on street power poles, or as a "snubber" in inductive circuits.

1.2.7 Thermistor

A thermistor is a temperature-dependent resistor. There are two kinds, classified according to the sign of their temperature coefficients:

Positive temperature coefficient (PTC) resistor is a resistor with a positive temperature coefficient. When the temperature rises the resistance of the PTC increases. PTCs are often found in televisions in series with the demagnetizing coil where they are used to provide a short-duration current burst through the coil when the TV is turned on. One specialized version of a PTC is the polyswitch which acts as a self-repairing fuse.

Negative temperature coefficient (NTC) resistor is also a temperature-dependent resistor, but with a negative temperature coefficient. When the temperature rises the resistance of the NTC drops. NTCs are often used in simple temperature detectors and measuring instruments.

1.2.8 Sensistor

is a semiconductor-based resistor with a negative temperature coefficient, useful in compensating for temperature-induced effects in electronic circuits.

1.3 Capacitors

A capacitor is a device that stores energy in the electric field created between a pair of conductors on which equal but opposite electric charges have been placed. A capacitor is occasionally referred to using the older term condenser.

A capacitor consists of two electrodes or plates, each of which stores an opposite charge. These two plates are conductive and are separated by an insulator or dielectric. The charge is stored at the surface of the plates, at the boundary with the dielectric. Because each plate stores an equal but opposite charge, the total charge in the capacitor is always zero.

When electric charge accumulates on the plates, an electric field is created in the region between the plates that is proportional to the amount of accumulated charge. This electric field creates a potential difference $V = E \cdot d$ between the plates of this simple parallel-plate capacitor.

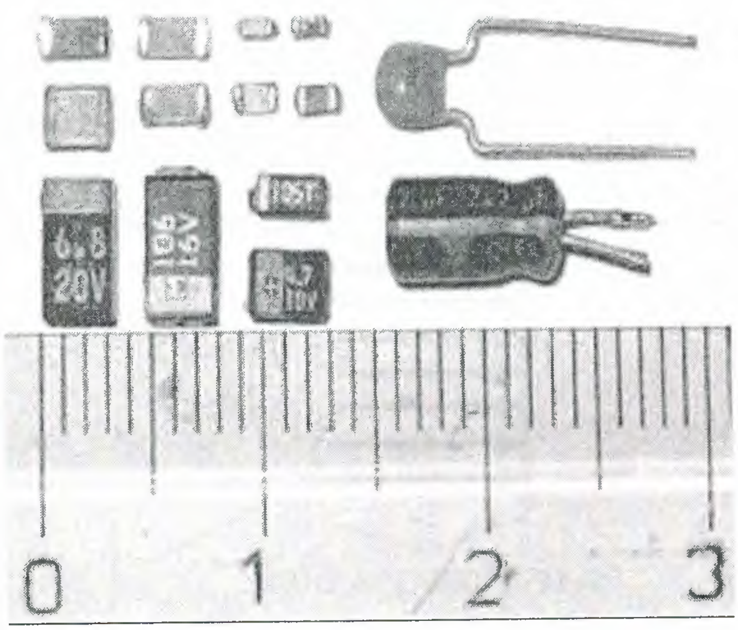

Figure 1.2 various types of capacitors [3].

1.3.1 Capacitance

The capacitor's capacitance (C) is a measure of the amount of charge (Q) stored on each plate for a given potential difference or *voltage* (*V*) which appears between the plates:

$$C = \frac{Q}{V}$$

In units, a capacitor has a capacitance of one farad when one coulomb of charge causes a potential difference of one volt across the plates. Since the farad is a very large unit, values of capacitors are usually expressed in microfarads (μF), nanofarads (nF) or picofarads (pF).

The capacitance is proportional to the surface area of the conducting plate and inversely proportional to the distance between the plates. It is also proportional to the permittivity of the dielectric (that is, non-conducting) substance that separates the plates.

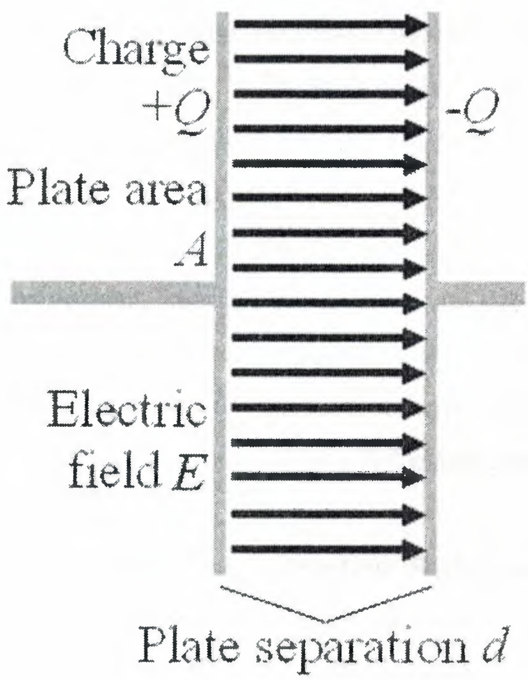

Figure 1.3 plate separations [3].

1.3.2 Applications

Energy storage a capacitor can store electric energy when disconnected from its charging circuit, so it can be used like a temporary battery. The recent commercial availability of very large value capacitors, one farad in size and larger, has enabled such components to allow batteries to be changed in electronic devices without the memory being lost, for instance, or for energy storage for delivery during extreme peak demands, as often found in the enormously powerful car audio systems now seen.

Signal processin the energy stored in a capacitor can be used to represent information, either in binary form, as in computers, or in analogue form, as in switched-capacitor circuits and bucket-brigade delay lines. Capacitors can be used in analog circuits as components of integrators or more complex filters and in negative feedback loop stabilization. Signal processing circuits also use capacitors to integrate a current signal.

Power supply applications capacitors are commonly used in power supplies where they smooth the output of a full or half wave rectifier. They can also be used in charge pump circuits as the energy storage element in the generation of higher voltages than the input voltage. Capacitors are connected in parallel with the power circuits of most electronic devices and larger systems (such as factories) to shunt away and conceal current fluctuations from the primary power source to provide a "clean" power supply for signal or control circuits. Audio equipment, for example, uses several capacitors in this way, to shunt away power line hum before it gets into the signal circuitry. The capacitors act as a local reserve for the DC power source, and bypass AC currents from the power supply. This is especially useful in car audio applications, when a stiffening capacitor compensates "power lag" from the lead-acid car battery.

Capacitors are used in power factor correction. Such capacitors often come as three capacitors connected as a three phase load. Usually, the values of these capacitors are given not in farads but rather as a reactive power in volt-amperes reactive (VAr). The purpose is to match the inductive loading of machinery which contains motors, to make the load appear to be mostly resistive.

Capacitors are also used in parallel to interrupt units of a high-voltage circuit breaker in order to distribute the voltage between these units. In this case they are called grading capacitors.

Tuned circuits capacitors and inductors are applied together in tuned circuits to select information in particular frequency bands. For example, radio receivers rely on variable capacitors to tune the station frequency. Speakers use passive analog crossovers, and analog equalizers use capacitors to select different audio bands.

Signal coupling because capacitors pass AC but block DC signals (when charged up to the applied dc voltage), they are often used to separate the AC and DC components of a signal. This method is known as AC coupling. (Sometimes transformers are used for the same effect.) Here, a large value of capacitance, whose value need not be accurately controlled, but whose reactance is small at the signal frequency, is employed. Capacitors for this purpose designed to be fitted through a metal panel are called feed-through capacitors, and have a slightly different schematic symbol.

Noise filters, motor starters, and snubbers when an inductive circuit is opened, the energy stored in the magnetic field of the inductance collapses quickly, creating a large voltage across the open circuit of the switch or relay. If the inductance is large enough, the energy will generate a spark, causing the contact points to oxidize, deteriorate, or sometimes weld together, or destroying a solid-state switch. A snubber capacitor across the newly opened circuit creates a path for this impulse to bypass the contact points, thereby preserving their life; these were commonly found in contact breaker ignition systems, for instance. Similarly, in smaller scale circuits, the spark may not be enough to damage the switch but will still radiate undesirable radio frequency interference (RFI), which a filter capacitor absorbs. Snubber capacitors are usually employed with a low-value resistor in series, to dissipate energy more slowly and minimize RFI. Such resistor-capacitor combinations are available in a single package.

In an inverse fashion, to initiate current quickly through an inductive circuit requires a greater voltage than required to maintain it; in uses such as large motors, this can cause undesirable startup characteristics, and a motor starting capacitor is used to store enough energy to give the current the initial push required to start the motor up.

Sensor applications although capacitors usually maintian a fixed physical structure and excitation varies the electrical voltage and current, the effects of varying the physical and/or electrical characteristics of the dielectric with a fixed electrical supply can also be of use. Capacitors with an exposed and porous dielectric can be used to measure humidity in air. Capacitors with a flexible plate can be used to measure strain or pressure. Capacitors are used as the sensor in condenser microphones, where one plate is moved by air pressure, relative to the fixed position for the other plate.

Accelerometers some accelerometers use MEMS capacitors etched on a chip to measure the magnitude and direction of the acceleration vector. They are used to detect changes in acceleration, eg. as tilt sensors or to detect free fall, as sensors triggering airbag deployment, and in many other applications.

weapons applications an obscure military application of the capacitor is in an EMP weapon. A plastic explosive is used for the dielectric. The capacitor is charged up and the explosive is detonated. The capacitance becomes smaller, but the charge on the plates stays the same. This creates a high-energy electromagnetic shock wave capable of destroying unprotected electronics for miles around. These devices are rumored to have been employed by the US in the 2003 invasion of Iraq, though this is highly unlikely. See Explosively pumped flux compression generator.

Large high-voltage low-inductance capacitors are used as energy sources for the exploding-bridgewire detonators or slapper detonators in nuclear weapons and other specialty weapons, and are also used as power supplies for electromagnetic guns such as railguns or coilguns.

1.3.3 Capacitor Hazards and Safety

Capacitors may retain a charge long after power is removed from a circuit; this charge can cause shocks (sometimes fatal) or damage to connected equipment. Many capacitors have low equivalent series resistance (ESR), so can deliver large currents into short circuits, and this can be dangerous. Care must be taken to ensure that any large or high-voltage capacitor is properly discharged before servicing the containing equipment. For safety purposes, all large capacitors should be discharged before handling. For board-level capacitors, this is done by placing a bleeder resistor across the terminals, whose resistance is large enough that the leakage current will not affect the circuit, but small enough to discharge the capacitor shortly after power is removed. High-voltage capacitors should be stored with the terminals shorted to dissipate any stored charge.

Large oil-filled old capacitors must be disposed of properly as some contain polychlorinated biphenyls (PCBs). It is known that waste PCBs can leak into groundwater under landfills. If consumed by drinking contaminated water, PCBs are carcinogenic, even in very tiny amounts. If the capacitor is physically large it is more likely to be dangerous and may require precautions in addition to those described above. New electrical components are no longer produced with PCBs. ("PCB" in electronics usually means printed circuit board, but the above usage is an exception.)

1.4 Transistors

The transistor is a solid state semiconductor device which can be used for amplification, switching, voltage stabilization, signal modulation and many other functions. It acts as a variable valve which, based on its input voltage, controls the current it draws from a connected voltage source. Transistors are made either as separate components or as part of an integrated circuit.

Transistors are divided into two main categories: bipolar junction transistors (BJTs) and field effect transistors (FETs). Transistors have three terminals where, in simplified terms, the application of voltage to the input terminal increases the conductivity between the other two terminals and hence controls current flow through those terminals.

1.4.1 Bipolar Junction Transistor

The bipolar junction transistor (BJT) was the first type of transistor to be commercially mass-produced. Bipolar transistors are so named because conduction channel uses both majority and minority carriers for main electric current. The terminals are named emitter, base and collector. Two p-n junctions exist inside the BJT, collector-base junction and base-emitter junction. It is commonly described as a current operated device because the collector current is controlled by the current flowing between base and emitter terminals. In contrast to the FET, the BJT is a low input-impedance device when used without voltage feedback. The BJT achieves higher transconductance compared with the FET, so it is preferred for linear amplification. Bipolar transistors can be turned on with light as well as electricity. Devices designed for this purpose are called phototransistors.

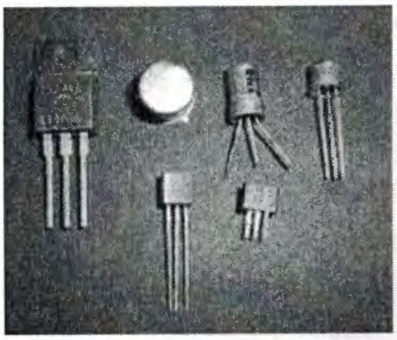

Figure 1.4 several types of transistor [4].

1.4.2 Field-effect Transistor

Field-effect transistors (occasionally called unipolar transistors) use only one of the two carrier types (either electrons or holes, depending on the subtype). The terminals of the FET are named source, gate and drain. In the FET a small amount of voltage is applied to the gate in order to control current flowing between the source and drain. In FETs the main current appears in a narrow conducting channel formed near the gate. This channel connects the source terminal to the drain terminal. The channel conductivity can be altered by varying the voltage applied to the gate terminal, enlarging or constricting the channel and thereby controlling the main current.

1.4.3 Other Transistor Types

Unijunction transistors: can be used as simple pulse generators. They comprise a main body of either P- or N-type semiconductor with ohmic contacts at each end (terminals Base1 and Base2). A junction with the opposite semiconductor type is formed at a point along the length of the body for the third terminal (Emitter).

Dual gate fet: have a single channel with two gates in cascode; a configuration that is optimized for high frequency amplifiers, mixers, and oscillators.

Transistor arrays: are used for general purpose applications, function generation and low-level, low-noise amplifiers. They include two or more transistors on a common substrate to ensure close parameter matching and thermal tracking, characteristics that are especially important for long tailed pair amplifiers.

Darlington transistors: comprise a medium power BJT connected to a power BJT. This provides a high current gain equal to the product of the current gains of the two transistors. Power diodes are often connected between certain terminals depending on specific use.

Insulated gate bipolar transistors (IGBTs) use a medium power IGFET, similarly connected to a power BJT, to give a high input impedance. Power diodes are often connected between certain terminals depending on specific use. IGBTs are particularly suitable for heavy-duty industrial applications. The Asea Brown Boveri (ABB) 5SNA2400E170100 [1] illustrates just how far power semiconductor technology has advanced. Intended for three-phase power supplies, this device houses multiple NPN IGBT chips connected in parallel in a case measuring 38 by 140 by 190 mm and massing 1.5 kg (3 lb 5 oz). The module is rated at 1,700 volts and can handle 2,400 amperes.

1.5 Integrated Circuits

The integrated circuit was made possible by experimental discoveries which showed that semiconductor devices could perform the functions of vacuum tubes and by mid-20th-century technology advancements in semiconductor device fabrication. The integration of large numbers of tiny transistors onto a small chip was an enormous improvement over the manual assembly of vacuum tubes and circuits using discrete components. The integrated circuit's mass production capability, reliability, and ease of adding complexity prompted the use of standardized ICs in place of designs using discrete transistors which quickly pushed vacuum tubes into obsolescence. There are two main advantages of ICs over discrete circuits - cost and performance. The cost is low because the chips, with all their components, are printed as a unit by photolithography and not constructed a transistor at a time. As of 2006, chip areas range from a few square mm to around 250 mm^2, with up to 1 million transistors per mm^2.

Integrated circuit is an arrangement of semiconductor components built into a monolith or chip they are classified according to the number of components in the circuit. Integrated circuits have a wide variety of packages, but here we concerned only with (LM380N) audio power amplifier, it has a 14-pin DIL plastic package. There are no common alternatives to the LM380Ndevice and that the 14-pin must be used.

1.6 Switches

A switch is a device for changing the flow of a circuit. The prototypical model is a mechanical device (for example a railroad switch) which can be disconnected from one course and connected to another. The term "switch" typically refers to electrical power or electronic telecommunication circuits. In applications where multiple switching options are required, (i.e. a telephone service) mechanical switches have long been replaced by electronic variants which can be intelligently controlled and automated.

The switch is referred to as a "gate" when abstracted to mathematical form. In the philosophy of logic, operational arguments are represented as logic gates. The use of electronic gates to function as a system of logical gates is the fundamental basis for the computer —ie. a computer is a system of electronic switches which function as logical gates.

Only two types of switches are used in the projects, and there is a little chance of confusion since one is a push-button type and the other is a miniature toggle switch (i.e. it is operated via a small lever). The push-button switch must be a push-to-make type and not a push-to-break type, and it must not be a latching type. In other words, the two tags are connected together when the switch is operated, and disconnected when the push button is released. There should be no problem in obtaining a switch of the correct type as these are the most common and cheapest type of push-button switch. Although a miniature toggle switch was used when testing the prototype projects, a standard size toggle switch is also suitable, but a much larger mounting hole will be required (usually about 13 mm or ½ in diameter). In the components list the toggle switch is specified as an SPST type, and this means a single-pole, single-throw type. In other words, it is just a simple on/off type switch, and switches of this type are sometimes advertised as on/off switches rather than SPST types. In some projects a relay is used, and this is a switch that is operated via an electromagnet, and is not operated manually. The circuit can use any relay having an operating coil with a resistance of about 185 ohms or more, and capable of operating from a 9 volt supply. A type having a fairly high coil resistance has the advantage of a comparatively low battery life.

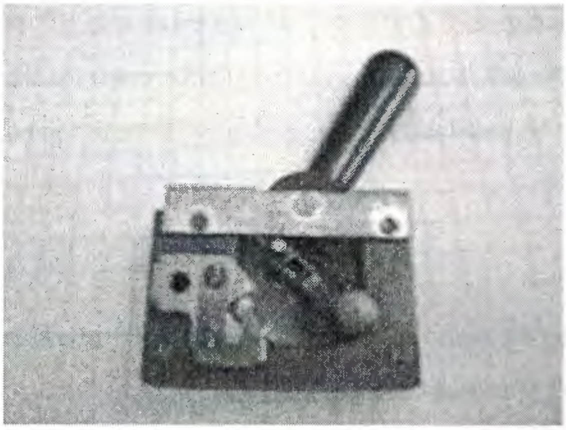

Figure 1.5 Toggle switch, depicted in circuit openposition, electrical contacts to left Background is 1/4" square graph paper [5].

Most relays operate two or four sets of switch contacts, and these are often of the changeover type rather than simple on/off contacts. A relay of this type is perfectly suitable even if you merely want the relay to switch a single piece of equipment on and off. However, make sure that the voltage and current ratings of the relay are sufficient to control the piece of equipment concerned. Relays do not normally have leadout wires, and the tags of the relay must be connected to the breadboard via suitable soldered or crocodile clip leads. A toggle switch is a generic class of electric switch that uses a mechanical lever, handle or rocking mechanism to actuate it.Toggle switches are available in many different styles and sizes, and are used in countless applications. Many are designed to provide, e.g., the simultaneous actuation of multiple sets of electrical contacts, or the control of large amounts of electric current or mains voltages.

The word "toggle" is a reference to a kind of mechanism or joint consisting of two arms, which are almost in line with each other, connected with an elbow-like pivot. In the phrase "toggle switch" it specifically refers to one kind of mechanism that can be used to implement a positive "snap-action." However, the word "toggle switch" has come to mean any kind of switch with a short handle and a positive snap-action, whether it actually contains a toggle mechanism or not.

In electronics, the word "toggle" has come to mean circuits that embody an electronic analog of a mechanical snap-action. That is, bistable switching circuits are sometimes called "toggles." In particular, the word can be used for a binary trigger, a circuit in which an impulse causes a transition from whichever state it is in to the alternate state. By further extension, in software, the act of switching from one to the other of two states can be called "toggling."

1.7 Loud Speaker

These first loudspeakers used electromagnets because large, powerful permanent magnets were not freely available at reasonable cost. The coil of the electromagnet is called a field coil and is energized by direct current through a second pair of terminals. This winding usually served a dual role, acting also as a choke coil filtering the power supply of the amplifier which the loudspeaker was connected to.

1.7.1 Phase or Polarity

All speakers have two wires, and in a multi-speaker system these must be connected from the source of the signal (the amplifier or receiver) to the speaker's input terminals with the correct polarity, or phase. If both sets of wires for left and right (in a stereo setup) are not connected in phase, the speakers will be out of phase from each other. In this case, any motion one cone makes will be opposite to the other.

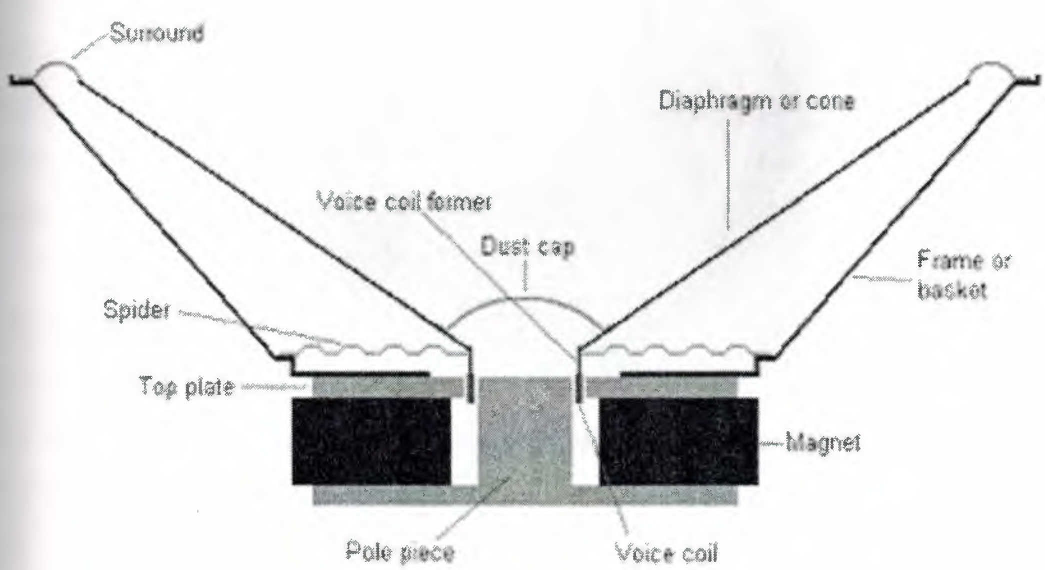

Figure 1.6 cross-section of a dynamic cone loudspeaker [6].

This type of wiring error creates inverse sound waves that partially cancel out the sound of the other speaker. This does not cause silence, because reflections from surfaces diminish the effect somewhat, but results in a major loss of sound quality. The most prominent effect to the untrained ear is a loss of bass response. The second most noticed is an unsettling feeling.

A similar effect is used in sound-cancelling headphones. The headphones produce the inverse sound waves of the external noise. The inverse sound waves and external noise cancel each other out and produce near silence.

1.7.2 Construction and Testing

Speaker design is considered both an art and science. Adjusting a design is done with instruments and with the ear. Speaker designers use an anechoic chamber (essentially a room with soundproofing that inhibits any reverberation or echo) to ensure the speaker will perform the way it is intended to. Some of the issues in speaker design are lobing, phase effects, off axis response and time coherence.

Figure 1.7 Closeup of a loudspeaker driver [6].

1.7.3 Care of Speakers

Loudspeakers are rugged devices and can take some amount of abuse. However they do have limits and exceeding them by a large factor almost always causes permanent damage. The tweeters are usually the first to go under circumstances of abuse, since they have the lightest voice coil made of thin wire which easily melts if the temperature rises excessively. Tweeters are usually designed (and rated) keeping in mind that a typical music signal doesn't contain a lot of power or energy at the higher end of the audio spectrum. Thus a tweeter rated for 50 W is meant to be used with a 50 W amplifier only if the signals below the tweeter's lower operating frequency are filtered out. Thus, feeding a low frequency (or a DC) signal to a tweeter even though electrically it may be within the tweeter's specification may cause permanent damage to the tweeter. A badly clipping amplifier may also damage the tweeter despite a crossover, since a clipped waveform generates high-frequency harmonics which can contain sufficient power to heat up the tweeter's voice coil. Most woofers (and mid-ranges) can easily take up to 1.5 times or more power than what they are rated for - however this is dependent on the particular driver and the duration of the abuse or overload. Woofers will usually take a lot of power before burning out or suffering damage to their moving systems. Physical damage occurs if the signal causes the woofer's cone displacement to exceed the safe X_{mech} limits for prolonged periods. In rare cases, a very loud signal may cause the coupling between the parts of the woofer to simply give way. A large DC fed to the woofer may cause twisting or deformation of the voice coil such that it rubs against the pole-pieces or magnet. Electrical damage occurs when the voice coil burns out. The latter two typically happen when the amplifier dumps a large DC current into the speaker - a condition typical of a failing (or failed) amplifier. In all cases, replacement or full repair of the driver are the only options.

1.8 Diodes

In electronics, a diode is a component that restricts the direction of movement of charge carriers. It allows an electric current to flow in one direction, but essentially blocks it in the opposite direction. Thus the diode can be thought of as an electronic version of a check valve. Circuits that require current flowing in only one direction will typically consist of one or more diodes in the circuit design.

Early diodes included "cat's whisker" crystals and vacuum tube devices (called thermionic valves in British English). Today the most common diodes are made from ultrapure semiconductor materials such as silicon or germanium.

1.8.1 Semiconductor Diodes

Most modern diodes are based on semiconductor p-n junctions. In a p-n diode, conventional current can flow from the p-type side (the anode) to the n-type side (the cathode), but not in the opposite direction. Another type of semiconductor diode, the Schottky diode, is formed from the contact between a metal and a semiconductor rather than by a p-n junction.

A semiconductor diode's current-voltage, or I-V, characteristic curve is ascribed to the behavior of the so-called depletion layer or depletion zone which exists at the p-n junction between the differing semiconductors. When a p-n junction is first created, conduction band (mobile) electrons from the N-doped region diffuse into the P-doped region where there is a large population of holes (places for electrons in which no electron is present) with which the electrons "recombine". When a mobile electron recombines with a hole, the hole vanishes and the electron is no longer mobile. Thus, two charge carriers have vanished. The region around the p-n junction becomes depleted of charge carriers and thus behaves as an insulator. However, the depletion width cannot grow without limit. For each electron-hole pair that recombines, a positively-charged dopant ion is left behind in the N-doped region, and a negatively charged dopant ion is left behind in the P-doped region. As recombination proceeds and more ions are created, an increasing electric field develops through the depletion zone which acts to slow and then finally stop recombination. At this point, there is a 'built-in' potential across the depletion zone. If an external voltage is placed across the diode with the same polarity as the built-in potential, the depletion zone continues to act as an insulator preventing a significant electric current. However, if the polarity of the external voltage opposes the built-in potential, recombination can once again proceed resulting in substantial electric current through the p-n junction. For silicon diodes, the built-in potential is approximately 0.6 V. Thus, if an external current is passed through the diode, about 0.6 V will be developed across the diode such that the P-doped region is positive with respect to the N-doped region and the diode is said to be 'turned on'.

A diode's I-V characteristic can be approximated by two regions of operation. Below a certain difference in potential between the two leads, the depletion layer has significant width, and the diode can be thought of as an open (non-conductive) circuit. As the potential difference is increased, at some stage the diode will become conductive and allow charges to flow, at which point it can be thought of as a connection with zero (or at least very low) resistance. More precisely, the transfer function is logarithmic, but so sharp that it looks like a corner on a zoomed-out graph.

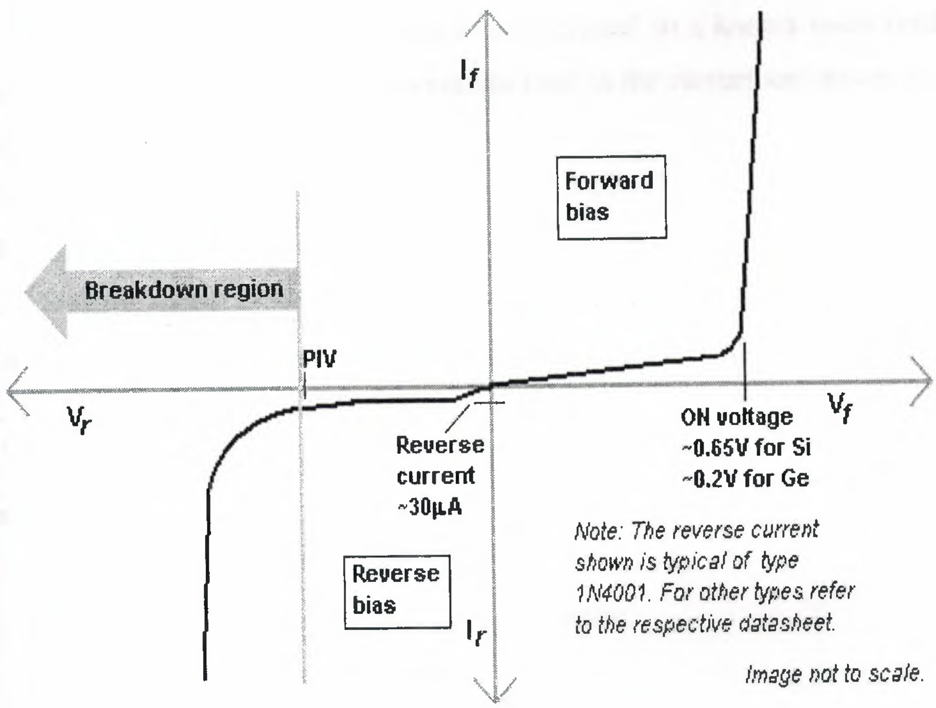

Figure 1.8 I-V characteristics of a P-N junction diode (not to scale) [11].

In a normal silicon diode at rated currents, the voltage drop across a conducting diode is approximately 0.6 to 0.7 volts. The value is different for other diode types - Schottky diodes can be as low as 0.2 V and light-emitting diodes (LEDs) can be 1.4 V or more (Blue LEDs can be up to 4.0 V).

Referring to the I-V characteristics image, in the reverse bias region for a normal P-N rectifier diode, the current through the device is very low (in the μA range) for all reverse voltages upto a point called the peak-inverse-voltage (PIV). Beyond this point a process called reverse breakdown occurs which causes the device to be damaged along with a large increase in current. For special purpose diodes like the avalanche or zener diodes, the concept of PIV is not applicable since they have a deliberate breakdown beyond a known reverse current such that the reverse voltage is "clamped" to a known value (called zener voltage). The devices however have a maximum limit to the current and power in the zener or avalanche region.

1.8.2 Shockley Diode Equation

The Shockley ideal diode equation (named after William Bradford Shockley) can be used to approximate the p-n diode's I-V characteristic in the forward-bias region.

$$I = I_S \left(e^{\frac{V_D}{n V_T}} - 1 \right)$$

where:

I is the diode current.

I_S is a scale factor called the saturation current.

V_D is the voltage across the diode.

V_T is the thermal voltage.

and n is the emission coefficient.

The emission coefficient n varies from about 1 to 2 depending on the fabrication process and semiconductor material and in many cases is assumed to be approximately equal to 1 (thus ommitted). The thermal voltage V_T is approximately 26 mV at room temperature (approximately 25°C or 298K) and is a known constant

1.8.3 Types of Semiconductor Diode

Normal (p-n) diodes, which operate as described above. Usually made of doped silicon or, more rarely, germanium. Before the development of modern silicon power rectifier diodes, cuprous oxide and later selenium was used; its low efficiency gave it a much higher forward voltage drop (typically 1.4 - 1.7 V per "cell," with multiple cells stacked to increase the peak inverse voltage rating in high voltage rectifiers), and required a large heat sink (often an extension of the diode's metal substrate), much larger than a silicon diode of the same current ratings would require.

Gold doped diodes, as a dopant, gold (or platinum) acts as recombination centers, that help a fast recombination of minority carriers. This allows the diode to operate at signal frequencies, at the expense of a higher forward voltage drop [1]. A typical example is the 1N914.

Zener diodes, that can be made to conduct backwards. This effect, called Zener breakdown, occurs at a precisely defined voltage, allowing the diode to be used as a precision voltage reference. In practical voltage reference circuits Zener and switching diodes are connected in series and opposite directions to balance the temperature coefficient to near zero. Some devices labeled as high-voltage Zener diodes are actually avalanche diodes (see below). Two (equivalent) Zeners in series and in reverse order, in the same package, constitute a transient absorber (or Transorb, a registered trademark). They are named for Dr. Clarence Melvin Zener of Southern Illinois University, inventor of the device.

Avalanche diodes, that conduct in the reverse direction when the reverse bias voltage exceeds the breakdown voltage. These are electrically very similar to Zener diodes, and are often mistakenly called Zener diodes, but break down by a different mechanism, the avalanche effect. This occurs when the reverse electric field across the p-n junction causes a wave of ionization, reminiscent of an avalanche, leading to a large current. Avalanche diodes are designed to break down at a well-defined reverse voltage without being destroyed. The difference between the avalanche diode (which has a reverse breakdown above about 6.2 V) and the Zener is that the channel length of the former exceeds the 'mean free path' of the electrons, so there are collisions between them on the way out. The only practical difference is that the two types have temperature coefficients of opposite polarities.

Transient voltage suppression (TVS) diodes, these are avalanche diodes designed specifically to protect other semiconductor devices from electrostatic discharges. Their p-n junctions have a much larger cross-sectional area than those of a normal diode, allowing them to conduct large currents to ground without sustaining damage.

Photodiodes, semiconductors are subject to optical charge carrier generation and therefore most are packaged in light blocking material. If they are packaged in materials that allow light to pass, their photosensitivity can be utilized. Photodiodes can be used as solar cells, and in photometry.

Light-emitting diodes (LEDs), in a diode formed from a direct band-gap semiconductor, such as gallium arsenide, carriers that cross the junction emit photons when they recombine with the majority carrier on the other side. Depending on the material, wavelengths (or colors) from the infrared to the near ultraviolet may be produced. The forward potential of these diodes depends on the wavelength of the emitted photons: 1.2 V corresponds to red, 2.4 to violet. The first LEDs were red and yellow, and higher-frequency diodes have been developed over time. All LEDs are monochromatic; 'white' LEDs are actually combinations of three LEDs of a different color, or a blue LED with a yellow scintillator coating. LEDs can also be used as low-efficiency photodiodes in signal applications. An LED may be paired with a photodiode or phototransistor in the same package, to form an opto-isolator.

Laser diodes, when an LED-like structure is contained in a resonant cavity formed by polishing the parallel end faces, a laser can be formed. Laser diodes are commonly used in optical storage devices and for high speed optical communication.

Schottky diodes, have a lower forward voltage drop than a normal PN junction, because they are constructed from a metal to semiconductor contact. Their forward voltage drop at forward currents of about 1 mA is in the range 0.15 V to 0.45 V, which makes them useful in voltage clamping applications and prevention of transistor saturation. They can also be used as low loss rectifiers although their reverse leakage current is generally much higher than non Schottky rectifiers. Schottky diodes are majority carrier devices and so do not suffer from minority carrier storage problems that slow down most normal diodes. They also tend to have much lower junction capacitance than PN diodes and this contributes towards their high switching speed and their suitability in high speed circuits and RF devices such as mixers and detectors.

Snap-off or 'step recovery' diodes, The term 'step recovery' relates to the form of the reverse recovery characteristic of these devices. After a forward current has been passing in an SRD and the current is interrupted or reversed, the reverse conduction will cease very abruptly (as in a step waveform). SRDs can therefore provide very fast voltage transitions by the very sudden disappearance of the charge carriers.

Esaki or tunnel diodes, these have a region of operation showing negative resistance caused by quantum tunneling, thus allowing amplification of signals and very simple bistable circuits. These diodes are also the type most resistant to nuclear radiation.

Gunn diodes, these are similar to tunnel diodes in that they are made of materials such as GaAs or InP that exhibit a region of negative differential resistance. With appropriate biasing, dipole domains form and travel across the diode, allowing high frequency microwave oscillators to be built.

Peltier diodes, are used as sensors, heat engines for thermoelectric cooling. Charge carriers absorb and emit their band gap energies as heat. There are other types of diodes, which all share the basic function of allowing electrical current to flow in only one direction, but with different methods of construction.

Point-contact diodes, These work the same as the junction semiconductor diodes described above, but its construction is simpler. A block of n-type semiconductor is built, and a conducting sharp-point contact made with some group-3 metal is placed in contact with the semiconductor. Some metal migrates into the semiconductor to make a small region of p-type semiconductor near the contact. The long-popular 1N34 germanium version is still used in radio receivers as a detector and occasionally in specialized analog electronics.

Cat's whisker or crystal diodes, These are a type of point contact diode. The cat's whisker diode consists of a thin or sharpened metal wire pressed against a semiconducting crystal, typically galena or a lump of coal. The wire forms the anode and the crystal forms the cathode. Cat's whisker diodes were also called crystal diodes and found application in crystal radio receivers.

Varicap or varactor diodes, These are used as voltage-controlled capacitors. These were important in PLL (phase-locked loop) and FLL (frequency-locked loop) circuits, allowing tuning circuits, such as those in television receivers, to lock quickly, replacing older designs that took a long time to warm up and lock. A PLL is faster than a FLL, but prone to integer harmonic locking (if one attempts to lock to a broadband signal). They also enabled tunable oscillators in early discrete tuning of radios, where a cheap and stable, but fixed-frequency, crystal oscillator provided the reference frequency for a voltage-controlled oscillator.

PIN diodes, A PIN diode has a central un-doped, or intrinsic, layer, forming a p-type / intrinsic / n-type structure. They are used as radio frequency switches, similar to varactor diodes but with a more sudden change in capacitance. They are also used as large volume ionizing radiation detectors and as photodetectors. PIN diodes are also used in power electronics, as their central layer can withstand high voltages. Furthermore, the PIN structure can be found in many power semiconductor devices, such as IGBTs, power MOSFETs, and thyristors.

Current-limiting field-effect diodes, These are actually a JFET with the gate shorted to the source, and function like a two-terminal current-limiting analog to the Zener diode; they allow a current through them to rise to a certain value, and then level off at a specific value. Also called CLDs, constant-current diodes, or current-regulating diodes.

1.8.4 Applications

Radio demodulation, the first use for the diode was the demodulation of amplitude modulated (AM) radio broadcasts. The history of this discovery is treated in depth in the radio article. In summary, an AM signal consists of alternating positive and negative peaks of voltage, whose amplitude or 'envelope' is proportional to the original audio signal, but whose average value is zero. The diode (originally a crystal diode) rectifies the AM signal, leaving a signal whose average amplitude is the desired audio signal. The average value is extracted using a simple filter and fed into an audio transducer, which generates sound.

Power conversion, rectifiers are constructed from diodes, where they are used to convert alternating current (AC) electricity into direct current (DC). Similarly, diodes are also used in Cockcroft-Walton voltage multipliers to convert AC into very high DC voltages.

Over-voltage protection, diodes are frequently used to conduct damaging high voltages away from sensitive electronic devices. They are usually reverse-biased (non-conducting) under normal circumstances, and become forward-biased (conducting) when the voltage rises above its normal value. For example, diodes are used in stepper motor and relay circuits to de-energize coils rapidly without the damaging voltage spikes that would otherwise occur. Many integrated circuits also incorporate diodes on the connection pins to prevent external voltages from damaging their sensitive transistors. Specialized diodes are used to protect from over-voltages at higher power (see Diode types above).

Logic gates, diodes can be combined with other components to construct AND and OR logic gates. This is referred to as diode logic.

1.9 Safety Guide Lines for Electronic Projects

Make sure the equipment is disconnected form any form of power supply, this includes but not limited to power sockets from walls and batteries.

Be ware that such as television, microwaves and so forth contain components which can hold enough electrical current to stop as human heart, after it has been removed from a power supply.

Electrical current can damage the equipment when used improperly. So always make sure that the equipment is set to the correct testing mode, voltage and ampere settings.

Most important make sure that the equipment is the correct equipment for the job.

1.10 Summary

This chapter presented the components of the project with some figures, applications, and properties for each one of them also showed the safety guide lines for electronic projects.

CHAPTER 2

GARDEN MOISTURE DETECTOR

2.1 Overview

This chapter show one example of automatic irrigation systems, how it work and also indicate some figures which show the operation for the automatic irrigation process and some advantages and disadvantages.

2.2 Automatic Surge Flow and Gravitational Tank Irrigation Systems

This technology was developed and applied in Mexico during the 1970s. It is essentially an intermittent gravity-flow irrigation system. It has been used almost exclusively for small-scale agriculture and domestic gardening.

2.2.1 Technical Description

Prior to the development of this technology, electronically controlled valves were used to produce intermittent water flows for irrigation. These valves are expensive and require some technical training to operate. The diabeto (from Greek diabetes or siphon) was developed for the purpose of replacing these valves with a device that would be more cost-effective and easier to operate and maintain with a minimum consumption of energy. The system consists of a storage tank equipped with one or more siphons, as shown in Figure 2.1, the storage tank must be designed to keep a predetermined head in the system to ensure that the water discharged during the siphoning process does not exceed the water flow into the storage tank, thereby draining the tank.

Another system that produces similar results is the use of a storage tank with a bottom discharge. This system as shown in Figure 2.2 is equipped with a floater, shown in Figure 2.3, which allows the cyclical opening and closing of a gate at the bottom of the tank. In effect, the operation of the floater is similar to the mechanism in the storage tank of a toilet flushing system.

The materials normally used in the construction of the water storage tanks are gravel, cement, and reinforced concrete. The siphons are usually built of a flexible plastic material; PVC is not recommended.

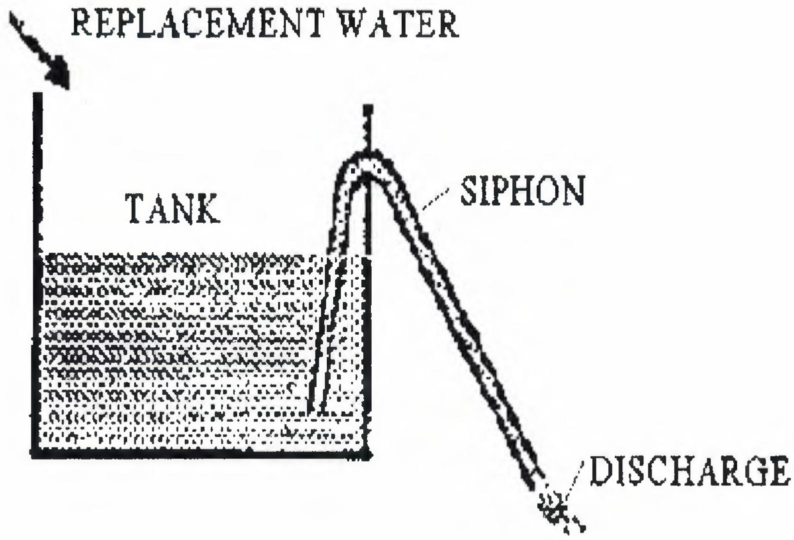

Figure 2.1 Schematic of an Automatic Surge Flow Irrigation System (Diabeto) [7].

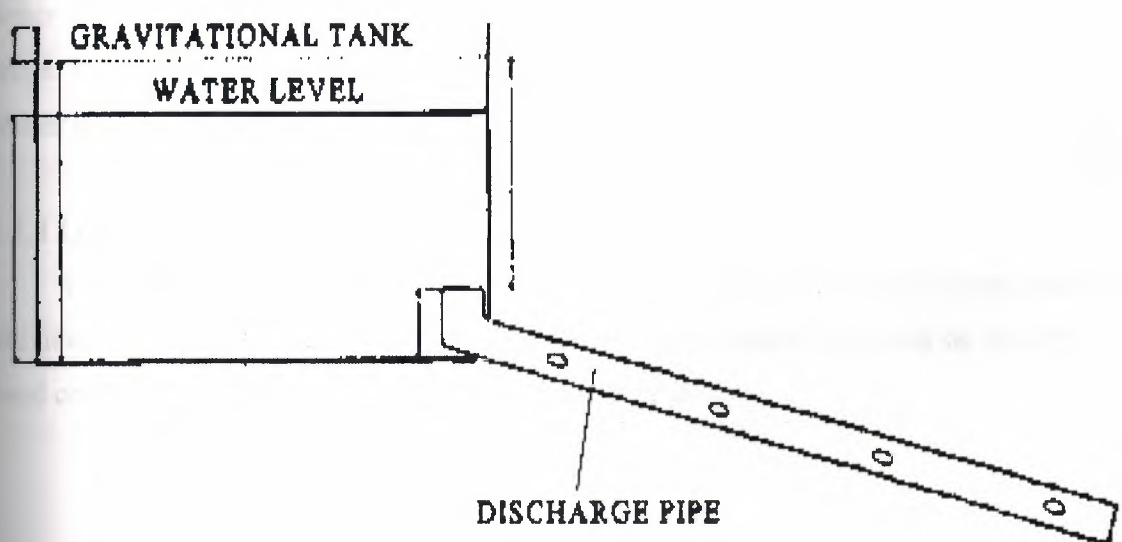

Figure 2.2 Schematic Representation of a Gravitational Tank Irrigation System [7].

The design of these systems must consider irrigation water use, available hydraulic load, topographic characteristics in the area of application, physical dimensions of the irrigated land, slope and location of furrows, and soil characteristics. Design manuals, based on laboratory and field experiments, have been developed in Mexico.

2.2.2 Extent of Use

This technology has been used primarily in the arid and semi-arid regions of Mexico. The diabeto can be used in any gravity irrigation system, but has been particularly useful in the irrigation of 100 to 300 m^2 fields, using furrow irrigation, and in domestic gardening. This technology is best suited for small-scale irrigation in rural areas. At present, it is widely used only in Mexico.

2.2.3 Operation and Maintenance

The diabeto and the gravitational tanks with bottom discharges function automatically, based on flow control devices, and do not need outside energy sources. The water is discharged into a channel that distributes it into the furrows and to the irrigated crops. Maintenance is very simple, requiring only periodic cleaning of the tanks, siphons, and/or discharge pipes.

2.2.4 Level of Involvement

Up to now, educational institutions, small private agricultural enterprises, and the Mexican Government have promoted this technology. However, it would be desirable if local communities got more involved in implementing it.

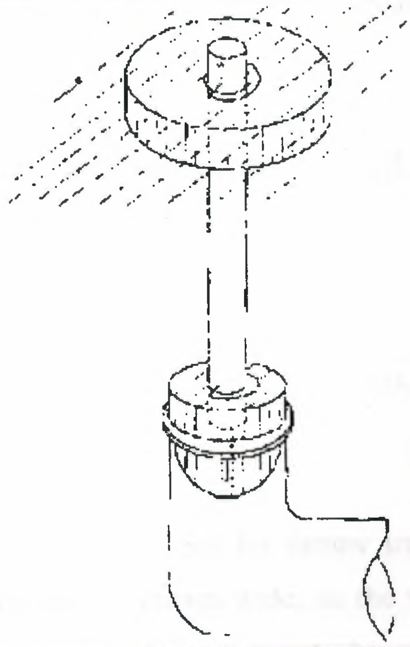

Figure 2.3 Schematic Representation of an Automatic Fluid Water Control Device used in Gravitational Tanks [7].

2.2.5 Effectiveness of the Technology

With the surge flow, automatic irrigation systems and the gravitational tank technologies, irrigation efficiencies of over 75% have been achieved in the state of Zacatecas, Mexico. This represents a significant improvement over the 25% rate reported using traditional irrigation technologies. A saving of about 25% in energy consumption costs has also been observed.

2.2.6 Suitability

The technology is recommended for arid and semi-arid areas where low precipitation and high evaporation rates prevail, and where small storage areas and depleted aquifers exist.

2.2.7 Advantages

This technology can utilize water from small wells of limited capacity, reused wastewater, and small streams.

Hydraulic energy is used as the driving force; these systems do not require external energy sources.

The systems are low-pressure.

Irrigation time and labor force requirements are small, as the systems are automatic.

The technology is low in cost.

It is easy to operate and maintain.

It is applicable to small-scale agricultural systems.

It is more efficient than traditional irrigation systems.

2.2.8 Disadvantages

The technology is not recommended for furrow irrigation in fields with dimensions greater than 200 m long and 25 meters wide, as the volume of water required in such applications will require extremely large storage tanks.

For greater efficiency, the irrigated lands should be leveled.

2.2.9 Cultural Acceptability

The technology has been tried and tested in Mexico, although it has the potential to be used in many other countries. Governments and international institutions can help disseminate information on its use.

2.2.10 Further Development of the Technology

To improve the applicability of this technology to areas using drip irrigation, a device that will automatically mix fertilizers into the water stream provided by the diabeto is under development. Also, development of modular systems is under way. Ultimately, the development of educational programs on the implementation and effective use of this technology will be necessary.

2.3 Plant Moisture Monitor

Originally intended to monitor the moisture in a potted plant, if the tree isn't kept moist, it will cease to take up water and quickly dry out. This moisture monitor uses two lamps to indicate whether the water level is O.K. or low. The circuit uses AC current to test conductivity to reduce electrically-induced corrosion.

Power is supplied by an ordinary 12 VAC molded transformer (not DC!) capable of supplying enough current to light the lamps. The SCRs should be sensitive-gate types also with a current rating higher than the lamps require. The prototype uses metal can SCRs but the ordinary 2N5064 or similar will work fine. The prototype's lamps consume 60 mA each (two per holder).

For potted plants use two stainless-steel nails as probes. Tin the heads of the nails using plumber's flux or stainless steel flux but wash the tinned nails with detergent and water before connecting the copper wires. Cover the connections with epoxy to protect the copper wires. One technique is to cover the solder connection with heat shrink with a drop or two of epoxy inside. Upon shrinking the tubing, the epoxy oozes out each end making a rugged and waterproof seal. For a plastic Christmas tree stand, connect the alligator clips to two of the screws in the stand that hold the trunk. This technique will only work if the body of the stand is plastic (non-conducting) and the ends of the screws have plastic tips to prevent penetration of the tree trunk. If your stand is metal you can use the stand as one electrode and suspend the other electrode over the water from an insulator fastened to the tree trunk or edge of the stand.

Another nice accessory is a funnel (painted green) hidden in the branches with a tube running down to the stand. Secure the end of the tube below the surface of the water to prevent splashing. No bending down is required at all.

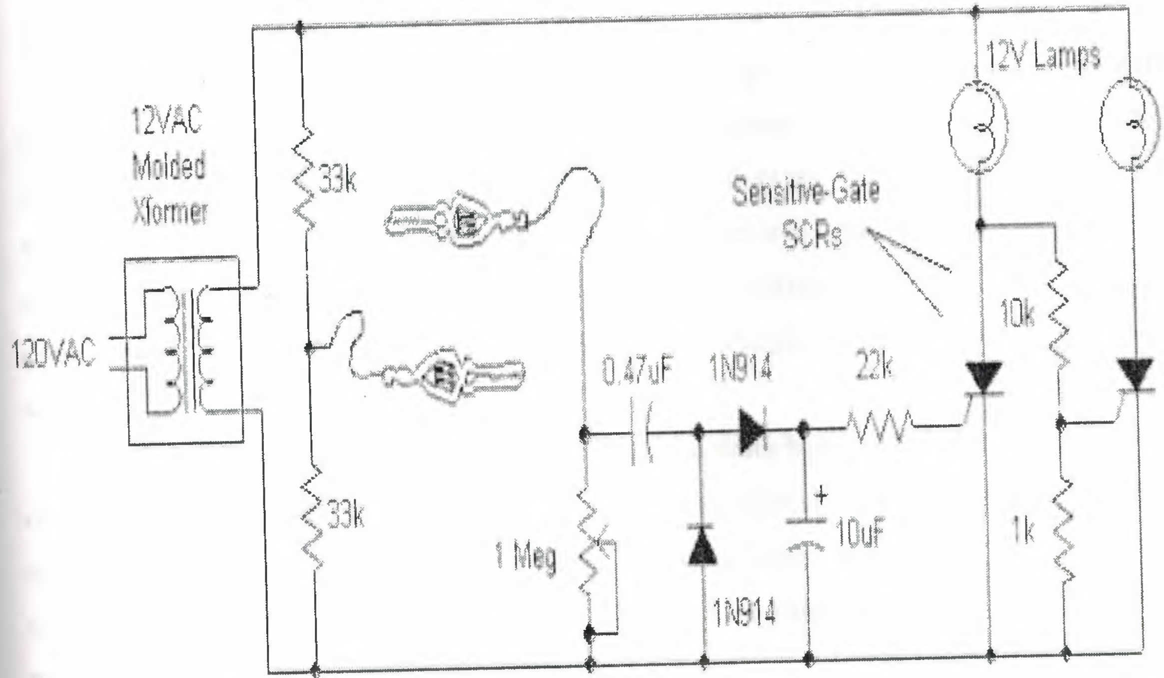

Figure 2.4 plant moisture monitor circuit [8].

2.4 Automatic Container Irrigation System

Automatic container irrigation delivers the convenience of automatic irrigation, but with the advantages of sub-irrigation. Each reservoir is controlled by its own patented float valve, which adjusts the water level to allow aeration in the soil, prevents irrigation overflow and evaporation. The reservoir is connected to a low-pressure water line or gravity-fed reservoir, and needs no timers, valves, or electricity.

2.4.1 Detail Animation of the Autofill System

Each pot or planter has its own valve, and adjusts the moisture levels independently of other pots on the same line.

No central timer or valve system required-may be used with gravity or pump-driven systems. Requires no wires or electricity.

Ultimate water efficiency-little evaporation loss, no irrigation water overflow, drainage control

Healthier plants through consistent, horticulturally sound watering practices.

2.4.2 System Design Guide

AutoFill systems are designed to run on a live, 20 psi water line. Most designs will incorporate an isolation valve, a filter, and pressure regulator at the head of the line. The AutoFill valves function even at very low pressure, so they may be used with gravity-fed water systems as well as conventional lines. Smaller pots will typically take one reservoir unit per system. Longer and larger planters will take multiple reservoirs, which can be connected off one 1/4" feeder line. The typical flow through the AutoFill valve at 20psi, when open, is 10 gal/hr.

To control drainage from the pot or planter, the drain hole needs to be elevated 3-5" off the bottom of the pot or planter. This can be accomplished by drilling drain holes in the side of the planter, or using the included overflow drainage adapter and adhesive. For critical applications, it is still recommend that a saucer be used to catch any weepage that may occur.

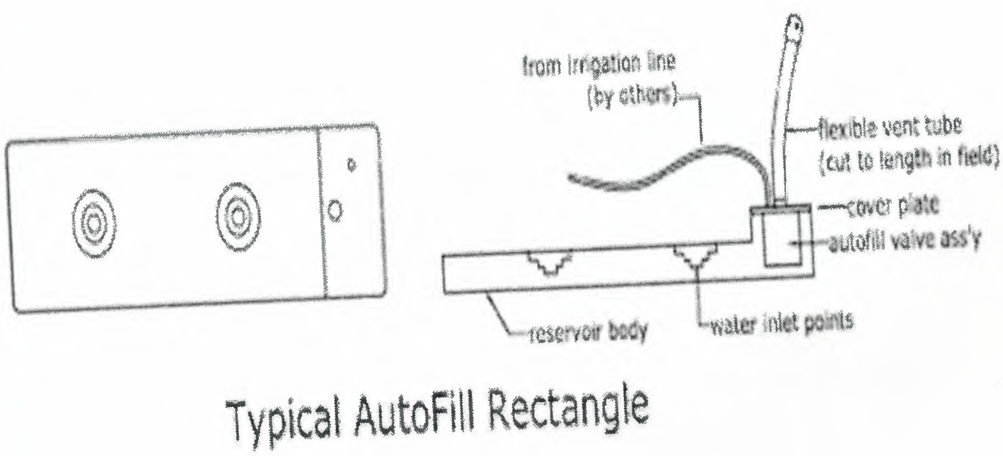

Figure 2.5 typical autofill rectangle [9].

2.5 Summary

This chapter showed one type of garden moisture detector with some figures and circuits. This devise used to check the soil moisture level, so the plants can grow healthy. If the soil moisture level is below from the expected value, then the watering valve will be active. Also, if the soil moisture level is higher than the expected value, the watering valve will be off.

CHAPTER 3

MOISTURE DETECTOR

3.1 Overview

This chapter describes the moisture detector circuit, this moisture detector verifies whether there is a moisture in the mediums or not, and this is done by having two probes immersed in the medium material. This circuit normally produces a low frequency audio output, but the operating frequency rises considerably if a couple of probes are placed in water. A more modest increase in pitch is produced if the probes are placed in some thing damp, such as moist soil.

3.2 General Description

The circuit diagram of the unit is shown in Figure 3.1 and the components are given in Table 3.1.

The circuit is little more than a low frequency oscillator based on IC1 and driving a loudspeaker LS1 via C2. The frequency at which IC1 oscillates can be considerably boosted by switching on Tr1 so the R3 is effectively connected from the input of IC1 to the negative supply rail. As the circuit stands though, Tr1 is cut off and passes no significant current.

With probes placed on water there will be low resistance between them and heavy base current will flow into Tr1 so that this device is biased hard into conduction and the frequency IC1 is taken to its maximum figure. It should perhaps be pointed out that pure water does in fact have a very high resistance, but most source of water (rain, tap water, etc.) contain significant amount of impurities which produces a much lower resistance.

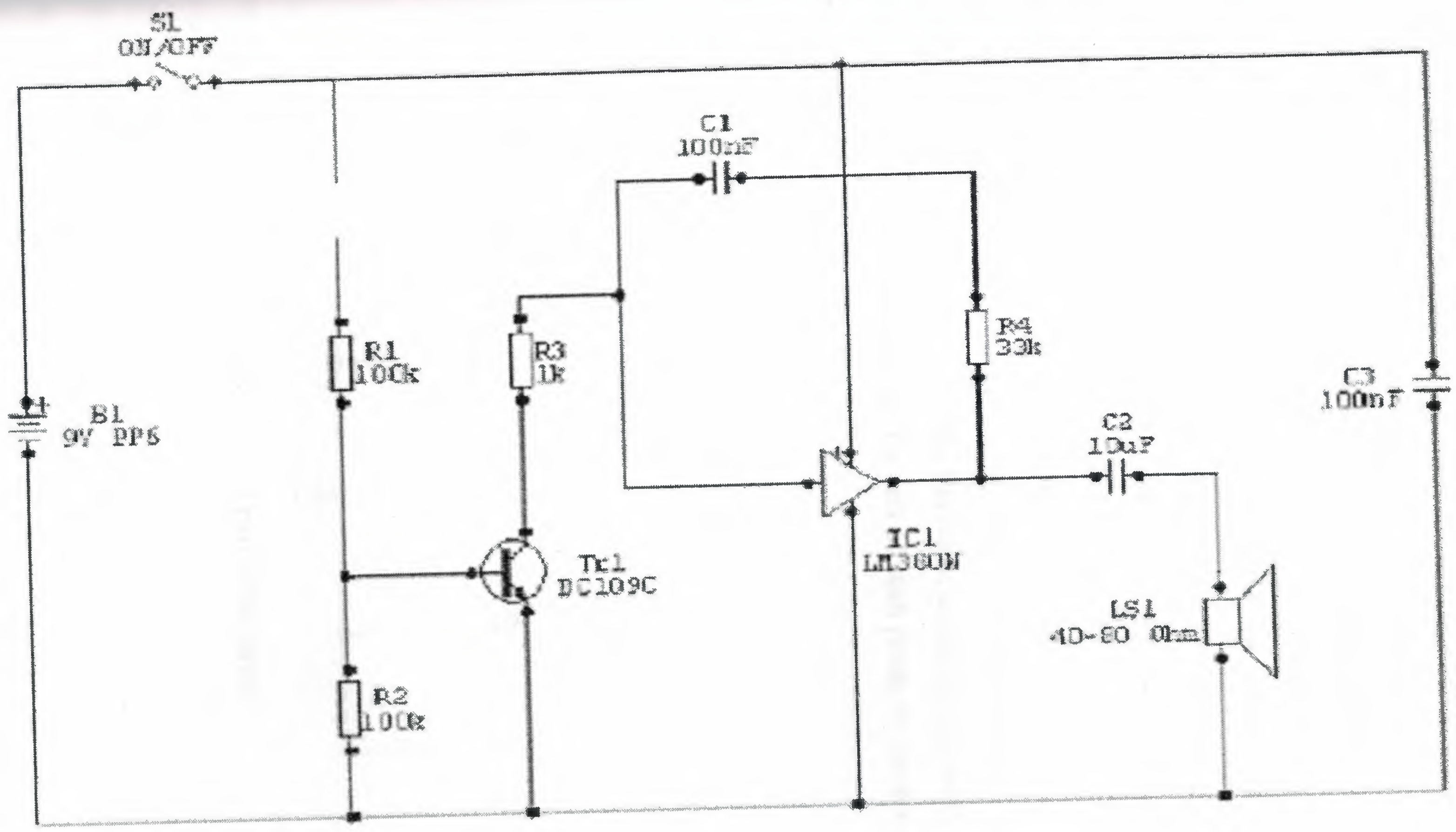

Figure 3.1 The circuit diagram of the moisture detector [10].

If the probes are placed in a medium that has only modest moisture content there, will be a much higher resistance between them, but Tr1 will still be biased into conduction to certain extent and there will be a significant increase in the operating frequency of the unit. Thus, Tr1 is not simply switched fully on or fully off, and intermediate states (and output frequencies from the unit) can be produced. The probes can simply consist of two-piece of a single strand PVC-insulated wire with a small length of insulation (say about 5 mm) removed from the ends. If the unit is to be used as a soil moisture indicator, the two probes must be mounted together so that they are a fixed distance apart. A spacing of about 200 mm is suitable. The spacing is important as it affects the sensitivity of the unit. If the unit seems to be oversensitive, incidentally, removing some of the exposed at the end of each probe is the easiest way of correcting this. Similarly, a lack of sensitivity can be corrected by removing some of the insulation at the end of each probe to leave a greater length of exposed wire.

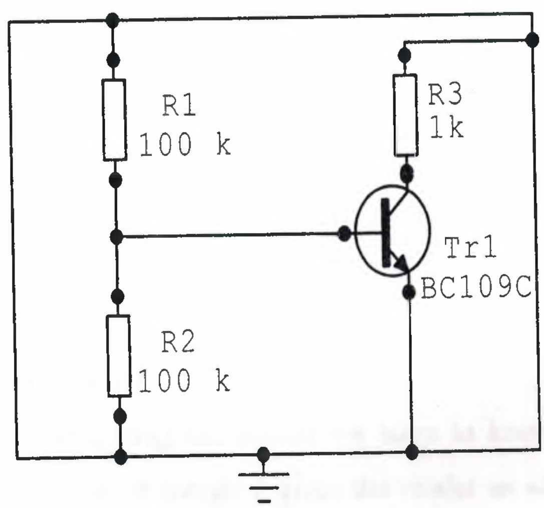

Figure 3.2 First part of the circuit

3.3 Parts List

Table 3.1 Part list of the components [10].

Part Label	Part Description
R1	100 K (Brown, Black, Yellow, Gold)
R2	100 K (Brown, Black, Yellow, Gold)
R3	1 K (Brown, Black, Red, Gold)
R4	33 K (Orange, Orenge, Orenge, Gold)
C1	100 nF Polyester (Brown, Black, Yellow, Black, red)
C2	10 μF 25V electrolytic
C3	100 nF Polyester (Brown, Black, Yellow, Black, red)
IC1	LM380N
Tr1	BC109C
S1	SPST Miniature Toggle Type
B1	PP6 Sise 9 Volt and Connector to Suit
LS1	Miniature Type Having an Impedance in the Range 40 to 80 ohms

3.4 Operation of the Circuit

At the beginning of analyzing the circuit we have to know that this circuit has a source of (9 DC Vs Battery) which means it gives the reader an idea of a simple moisture detector that has the same operation of the ones used at the watering plant system, it might be sourced by more than (9 DC Vs Battery).

Starting with the (9 DC Vs Battery) when the toggle switch is in short circuit position (ON) the current go from the positive pole to the negative pole, at the probes the current can conduct through the medium if there is a moist, here we will assume that there is a moist to analyze the circuit. We know that moist is a water and water has a chemical property that let the electrical current pass through it, now the current passed through the probes to R1 (100KΩ)which connected in parallel with R2(100KΩ), according to the relation of ohm's low the current will be reduced in the resistor. A transistor is connected a cross the connection point of R1 and R2. The current now at the base side of the transistor, we know that the purpose of the transistor is to control the current that entering to the forward device.

Then the current passed through R3 also here the current will be reduced as it is shown in the first part of the current traveling circuit figure 3.2.

Now the current passed through R3, here the current has two direction to go the first branch through the capacitor C1 (100F) which will charge with the voltage since it is a storage device, a series resistor R4 (33KΩ) is connected with the capacitor of (100nF). And the second branch is entering the integrated circuit IC1 (LM380) through its second pin this IC has a 14 pins, pin number 14 is the VCC (the voltage that is given to the IC to operate), the third, fourth, fifth, seventh, tenth, eleventh and twelfth are grounded, and the others left disconnected except pin number 8 which is the out put of the integrated circuit. Those two branches are connected in series with the capacitor C2 (10μF) that reduce the out put, at the end this current enter the loud speaker LS1 that has a resistor range of (40-80) ohm's. the whole circuit is connected in parallel with the C3 (100nF) which connected from the switch to ground.

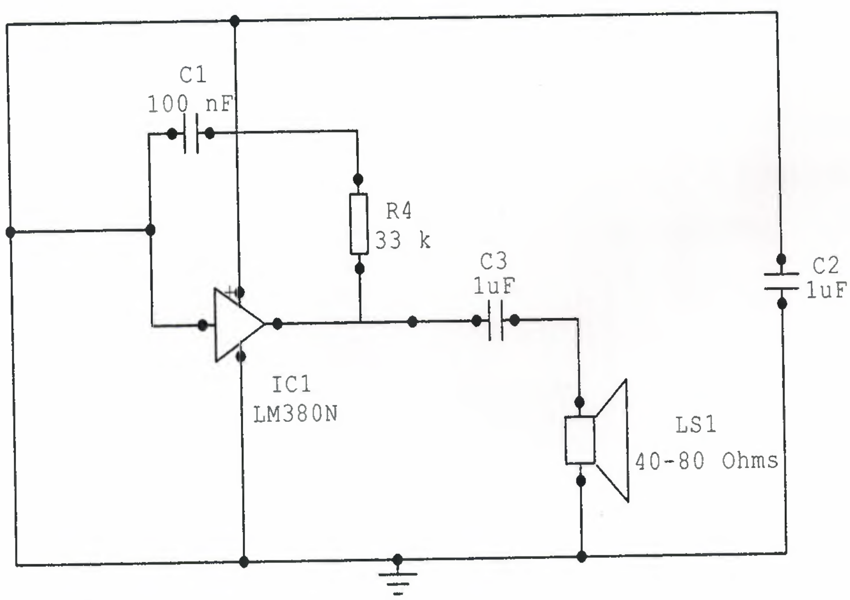

Figure 3.2 Second part of the circuit

3.5 Summary

This chapter described the operation of the soil moisture detector we separated the circuit in to two parts and we explained every one in detail how its work and how the current flowing we followed the current from the battery to the switch when it is ON passing through the probes until reaching the out put which is the loud speaker. In the next chapter we will cover the noise problem in detail and the modifications part of the project to reduce the noise.

CHAPTER 4
MODIFICATIONS OF MOISTURE DETECTOR

4.1 Overview

This chapter shows the results and the modifications that added to the circuit such as reducing the noise, inverting the operation of the circuit in this chapter also the LED (light emitting diode) will be described in detail because we will connect some of them in the circuit to show the device state (ON or OFF).

4.2 Light Emitting Diode

LED's are special diodes that emit light when connected in a circuit. They are frequently used as "pilot" lights in electronic applications to indicate whether the circuit is closed or not.

4.2.1 Connecting and Soldering

LEDs must be connected the correct way round, the diagram may be labelled a or + for anode and k or - for cathode (yes, it really is k, not c, for cathode!). The cathode is the short lead and there may be a slight flat on the body of round LEDs. If you can see inside the LED the cathode is the larger electrode (but this is not an official identification method).

LEDs can be damaged by heat when soldering, but the risk is small unless you are very slow. No special precautions are needed for soldering most LEDs.

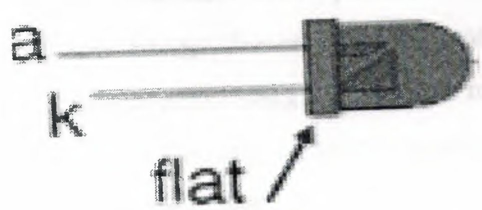

Figure 4.1 light emitting diode diagram [12].

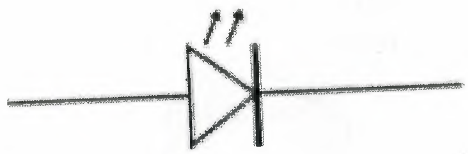

Figure 4.2 A symbol circuit of a light emitting diode [12].

4.2.2 Testing an LED

Never connect an LED directly to a battery or power supply It will be destroyed almost instantly because too much current will pass through and burn it out.

LEDs must have a resistor in series to limit the current to a safe value, for quick testing purposes a 1kΩ resistor is suitable for most LEDs if your supply voltage is 12V or less. Remember to connect the LED the correct way round.

4.2.3 What Causes the LED to Emit Light and What Determines the Color of the Light?

When sufficient voltage is applied to the chip across the leads of the LED, electrons can move easily in only one direction across the junction between the p and n regions. In the p region there are many more positive than negative charges. In the n region the electrons are more numerous than the positive electric charges. When a voltage is applied and the current starts to flow, electrons in the n region have sufficient energy to move across the junction into the p region. Once in the p region the electrons are immediately attracted to the positive charges due to the mutual Coulomb forces of attraction between opposite electric charges. When an electron moves sufficiently close to a positive charge in the p region, the two charges "re-combine".

Each time an electron recombines with a positive charge, electric potential energy is converted into electromagnetic energy. For each recombination of a negative and a positive charge, a quantum of electromagnetic energy is emitted in the form of a photon of light with a frequency characteristic of the semi-conductor material (usually a combination of the chemical elements gallium, arsenic and phosphorus). Only photons in a very narrow frequency range can be emitted by any material. LED's that emit different colors are made of different semi-conductor materials, and require different energies to light them.

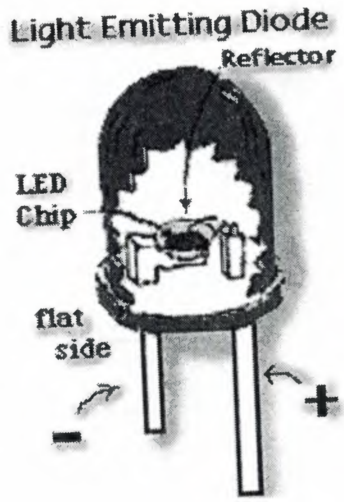

Figure 4.3 Internal structure of a light emitting diode [12].

4.2.4 How Much Energy Does an LED Emit?

The electric energy is proportional to the voltage needed to cause electrons to flow across the p-n junction. The different colored LED's emit predominantly light of a single color. The energy (E) of the light emitted by an LED is related to the electric charge (q) of an electron and the voltage (V) required to light the LED by the expression: $E = qV$ Joules. This expression simply says that the voltage is proportional to the electric energy, and is a general statement which applies to any circuit, as well as to LED's. The constant q is the electric charge of a single electron, (-1.6×10^{-19} Coulomb).

4.2.5 Colors of Led

LEDs are available in red, orange, amber, yellow, green, blue and white. Blue and white LEDs are much more expensive than the other colours.The color of an LED is determined by the semiconductor material, not by the coloring of the 'package' (the plastic body). LEDs of all colors are available in uncolored packages which may be diffused (milky) or clear (often described as 'water clear'). The colored packages are also available as diffused (the standard type) or transparent.

4.2.6 Connecting LEDs in Series

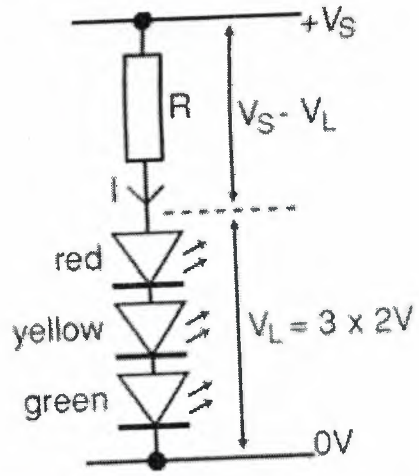

Figure 4.4 Series connection of light emitting diode [12].

If you wish to have several LEDs on at the same time it may be possible to connect them in series. This prolongs battery life by lighting several LEDs with the same current as just one LED.

All the LEDs connected in series pass the same current so it is best if they are all the same type. The power supply must have sufficient voltage to provide about 2V for each LED (4V for blue and white) plus at least another 2V for the resistor. To work out a value for the resistor you must add up all the LED voltages and use this for V_L.

4.2.7 Connecting LEDs in Parallel

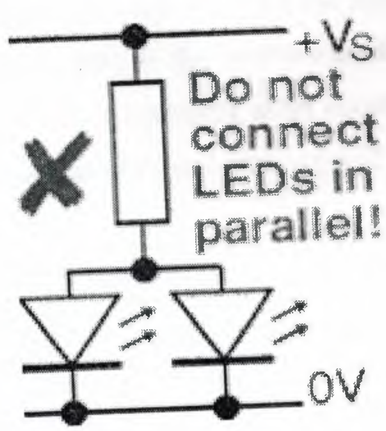

Figure 4.5 parallel connection of light emitting diode [12].

Connecting several LEDs in parallel with just one resistor shared between them is generally not a good idea. If the LEDs require slightly different voltages only the lowest voltage LED will light and it may be destroyed by the larger current flowing through it. Although identical LEDs can be successfully connected in parallel with one resistor this rarely offers any useful benefit because resistors are very cheap and the current used is the same as connecting the LEDs individually. If LEDs are connected in parallel each one should have its own resistor.

4.3 Eliminating the Noise

This section explains how noise could be decreased in the electronic circuit, so for this purpose capacitors are used, where that can be connected in parallel with some other capacitors, in this project we found that the best way to eliminate the noise is to connect a capacitor between the input of the integrated circuit which is pin number two and the output which is the loud speaker.

That value of the capacitor was reached using a variable capacitor and adjusting it to the best value, which is 10μf because this value gives us the best output.

4.4 Connecting Leds within the Circuit

In the circuit we have to show that the current is passing through it so that a light emitting diode is required. We have placed a diode in the circuit so that when the speaker is giving sound that means the plant needs watering at the same time the light emitting diode is "ON", and vice versa when the speaker is OFF the light emitting diode will turn off.

In order to connect the leds in the way we need it we should construct the circuit shown in figure 4.7. This circuit is operating as an inverter, if we apply a positive volt as an input we will have at the output (0V) and vice versa if the input is (0V) the output will be positive volt.

This is what we need it when the current is flowing in the circuit that mean the plant watered we have to invert it so that when the plant need watering the current should flow so the light emitting diode will turn ON. This circuit is doing the job in the way that we need it.

Figure 4.7 picture for the circuit from outside the house packet.

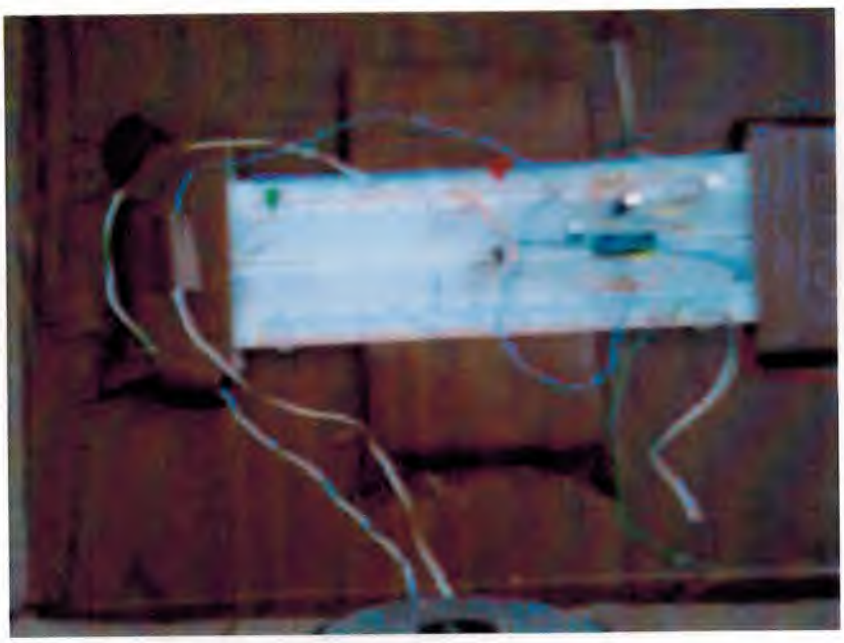

Figure 4.8 figure for the circuit in side the house packet.

4.6 Summary

This chapter covered the modifications of the moisture detector; the results reached, and explained the light emitting diode because we used it with in the circuit to show the current is passing. Also this chapter showed how the output will be inverted in order to get an automatic irrigation system.

CONCLUSION

The project explained the automatic irrigation system by using the moisture detector circuit and also showed how the project is important in our life. The plant can water it self automatically and when it need water, also for more economic in water by using the automatic irrigation system the water problem can be solved because in some countries they are suffering from water.

The first chapter of this project explained the electronic devices especially the devices used in the project resistors, capacitors, diodes, transistors, switches, integrated circuits, loud speaker and the safety guide lines for electronic projects. Every one of these devices is explained in detail with some applications, advantages and disadvantages for each one of them.

The second chapter showed an example of automatic surge flow and gravitational tank irrigation system with detail explanation in addition to some figures for top discharge and bottom discharge. Also the second chapter showed an example of plant moisture monitor with the circuit explanation.

The third chapter explained the moisture detector circuit which is the circuit used in the project, all the parts used in the circuit and the operation of the circuit, we followed the current from the battery passing through the switch when the switch is on until reaching to the speaker.

The fourth chapter which is the last chapter showed the modification and the additions that added to the circuit also the results. After we finished from building the circuit, the circuit was working but we had a noise and also we have to invert the operation of the circuit. The noise is eliminated by adding one capacitor, the operation of the circuit is inverted in order to get the automatic irrigation system because the circuit is a moisture detector circuit so it is detecting water or moist that's why we inverted it. The chapter also showed the inverter circuit which we used it for inverting the circuit operation.

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