VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

A PROJECT REPORT ON

"*Smart Irrigation* System"

Submitted in partial fulfillment of the requirements for the award of the degree of
BACHELOR OF ENGINEERING
In
ELECTRICAL AND ELECTRONICS ENGINEERING

Submitted by

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CERTIFICATE

This is to certify that the project work entitled

"Smart Irrigation System"

is a bonafide work carried out by **SAURABH** (4AD1EE045), **SAFEENA SHAZIA** (4AD11EE012) **& SHAHANAAZ HARSHI** (4AD11EE013). In partial fulfillment for the award of degree of **Bachelor of Engineering** in **Electrical & Electronics Engineering** of the **Visvesvaraya Technological University**, Belagavi during the year 20014-2015.It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report & is deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the Bachelor of Engineering Degree.

Signature of the guide	**Signature of the H.O.D**	**Signature of the Principal**
(Mr. Sathish K.R)	(Prof. Parthasarathy L)	(Dr. L Basavaraj)

Name of the examiners: **Signature with date**

1.

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DECLARATION

We, **SAURABH** (4AD10EE045), **SAFEENA SHAZIA** (4AD11EE012) & **SHAHANAAZ HARSHI** (4AD11EE013) students of VIII semester, **Department of Electrical and Electronics Engineering, ATME College of Engineering, Mysore-570028** declare that the Project work titled "**Smart Irrigation System**" has been successfully completed. This work is submitted to **Visvesvaraya Technological University, Belagavi-590 018**, in partial fulfillment of the requirements for the award of **Degree of Bachelor of Engineering** in **Electrical and Electronics Engineering** during the academic year 2014-2015. Further the matter embodied in the Project report has not been submitted previously by anybody for the award of any degree to any university.

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ABSTRACT

Agriculture is a source of livelihood of majority Indians and has great impact on the economy of the country. In a country like India, where climatic conditions vary substantially and irrigation facilities are poor. Agriculture is timely and sufficient supply of water. Water pumps are crucial in agriculture where electricity is indeed.

The title itself indicates that the system checks the water level in the field and underground sump, based on that pumping motor will automatically pumps the water into the field. Here we are using water level sensor. By using this sensor, we can find whether the water level is of desired level. If it is not, pumping motor will pump the water. In this system, the main controlling device is microcontroller. Here water level sensor will give the status of the water level to the microcontroller, based on that microcontroller will display the status of the water pump on the LCD and switch on or off the pumping motor through relay. The pumping motor will pump the water into the field until the desired water level is reached in the field which is continuously monitored by the microcontroller.

In irrigation process, most parameter of monitoring is water level in the field, so we have to monitor the water level condition, whether the water level is of desired level. If not, then by using pumping motor, water has to be pumped automatically.

ACKNOWLEDGEMENT

The satisfaction and euphoria that accompanies successful completion of the project work would be incomplete without the people who made it possible with their guidance and blessing whose constant encouragement crowned all our efforts with success.

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1. INTRODUCTION

1.1 GENERAL INTRODUCTION

To make better use of our limited freshwater resources, growers need to have not only an efficient method of delivering the water to the plants, but also an efficient watering schedule, so that the plants are getting watered with the right amounts at the right time. And because a large percentage of the use of both surface and ground water is for agricultural irrigation, conserving water at the point-of-use, through efficiency efforts and optimal irrigation scheduling, can have a big effect on the rest of the water systems.

Our project, called Smart irrigation system may be a sign of things to come in "smart" irrigation, incorporating networked sensors that can be monitored and administered, letting water managers and farmers optimize their water use, right from click

"Smart irrigation system consists of a series of sensors that measure field's water level. The data gathered from these sensors is sent across a low cost, low power consumption microcontroller network. These sensors are effectively distributed over the cultivated area, given that different areas of the field (or fields) have different water requirements. The sensors monitor these parameters and send readings across a microcontroller to service which uses an intelligent software application to automatically analyze the data and act upon it by selectively activating irrigation nodes only in the areas required.

1.2 PROBLEM DEFINITION

PROBLEM 1:

Today most of the farmers have replaced conventional pumps with electrical pumps. But they find it very inconvenient for the condition of water pump because there is no effective water level indication system in the field. As a result, there is a plenty of water wastage as well as wastage of power consumed by the motor pump.

PROBLEM 2:

If water is not available in the sump and we operate a centrifugal pump then definitely in pump casing there are many components which would be heated up and there will be chances of wear and tear and deformation of those components due to heat. The water also acts as a coolant to cool down various components of pump. If pump is running dry then due to heat factor parts can be damaged and this will cease the pump.

PROBLEM 1 SOLUTION:

Magnetic floating sensors are used in the cultivating field which sense the water levels in the cultivating field and operate the motor pump accordingly using microcontroller through relay.

The motor is turned ON if the water level in the cultivating field falls below the desired level and the motor pump is turned OFF if the water level in the cultivating field reaches the desired level.

PROBLEM 2 SOLUTION:

The magnetic floating sensor is used to detect the water level from the pump suction port tank or sump. If this sensor does not sense water, then the water pump is not allowed to run, protecting it from burning out.

1.3 PROJECT OBJECTIVE

The main aim of our project here is to monitor the water level in cultivating field. Based on water level in the field and underground sump, pumping motor will be automatically switch ON or OFF through relay. This saves the water at the same time and on the other hand the plant can get optimum level of water, so increasing productivity of crop. It also protects the water pump from burning out.

1.4 PROJECT DEFINITION

OPEN LOOP

"It includes ON/OFF control of water pump at different time slots using keypad."

CLOSE LOOP

"It includes ON/OFF control of water pump by detecting the water level on the field and underground sump using micro controller."

IN SIMPLE WORDS: It is an water level controller in which sensors are required to sense high and low water levels. Whenever the water level falls below the desired level, the water pump starts and it stops once the water level touches the sensors. There is a third sensor which is used to detect the water level from the pump suction port tank or sump. If this sensor does not sense water, then the water pump is not allowed to run, protecting it from burning out.

1.5 BLOCK DIAGRAM

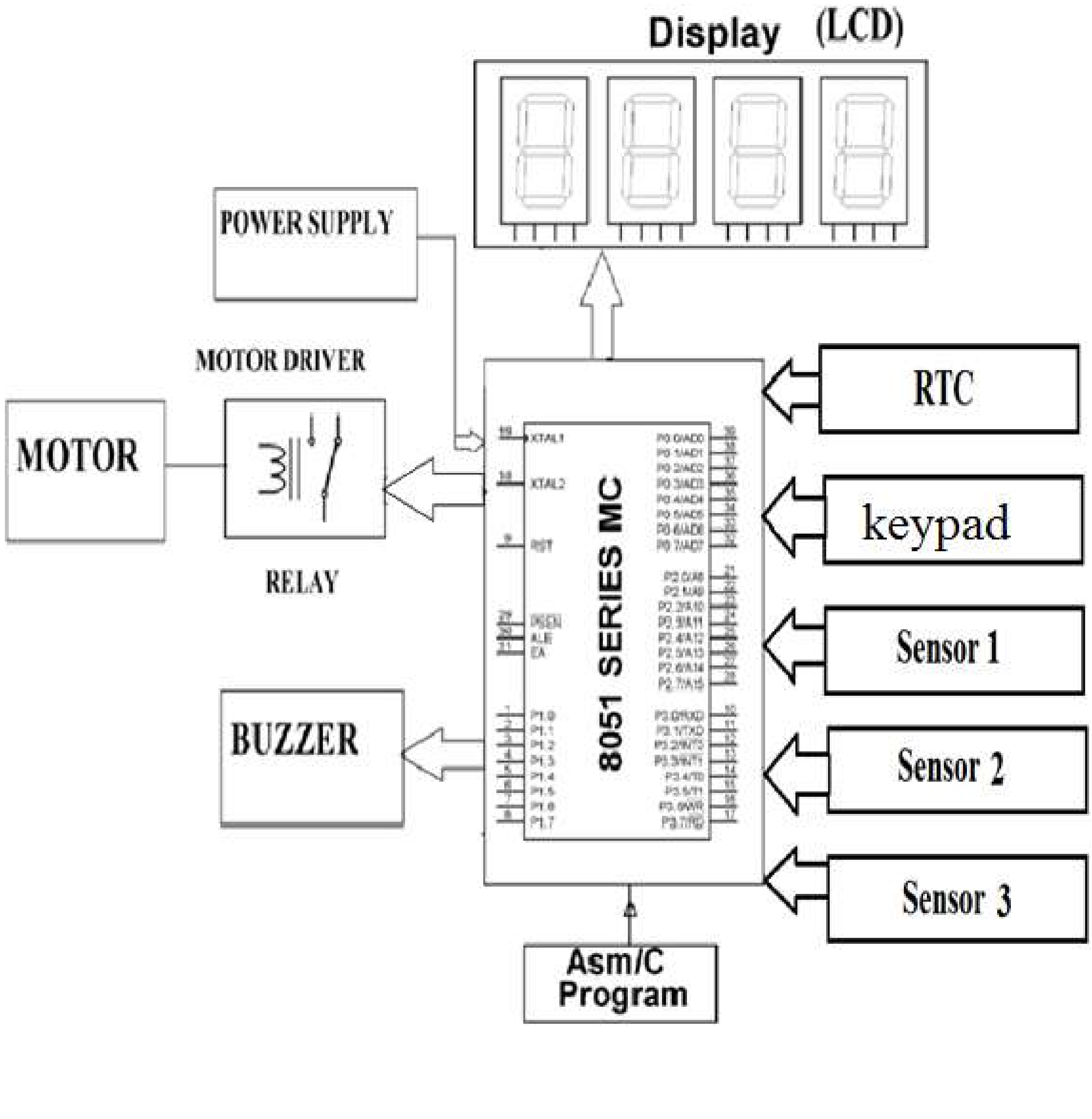


Fig 1.1: Block Diagram

1.6 CHAPTER OUTLINE

The problem definition, project (overall) objective, hardware description of the project has been compiled into several chapters as discussed here under.

- **CHAPTER 1** is an introduction chapter with general introduction, problem definition, objective of work carried out during the project, project definition and the Block Diagram.

- **CHAPTER 2** involves the Literature survey of the project for the practical implementation.

- **CHAPTER 3** involves the description of the hardware design. The chapter comprises of general operation and the use of components in the circuit.

- **CHAPTER 4** involves the circuit diagram and operation, and applications of the project.

- **CHAPTER 5** involves the Results and discussion of the project.

- **CHAPTER 6** concludes the report with suggestions for future improvements. The lists of references are provided in the report.

CHAPTER 2
LITERATURE SURVEY

2. LITERATURE SURVEY

2.1 GENERAL INTRODUCTION

The purpose of the project is to modernize the irrigation water pumping in paddy fields as well as to ensure safety of submersible pumps from burning of coils due to dryness of water mainly during the summer and draught seasons across India. Around 6% of the total agriculture motor failures in India is mainly due to human errors. The project mainly deal with ideas of automatic pumping of water to fields of required level of cultivation in paddy fields and to protect the submersible motors in the field from burning of coils due to under water level in well or sumps.

Around 43% of India's territory comes under agricultural lands. Agriculture along with forestry and logging employs to 52% of population. India accounts for 20% of all worlds rice production.
The water requirement of rice crop is comparatively higher than any other crop of the similar duration. Assured and timely supply of irrigation water has a considerable influence on the yield of the crop. During the crop growth period, the water requirement is generally high at the initial seedling establishment stage. After the transplanting, water should be allowed to stand in the field at a depth of two inches till the seedlings are well established. The second, the most important critical stage is tillering to flowering and in this period the crop should not be subjected to soil moisture stress. The water supply should be ensured in required amount during panicle initiation to flowering stage. About four inches depth of water for first two months then about six inches of water for next one month should be maintained in the field. Before harvesting, water should be drained out from the field to allow quick and uniform maturity of grain.

2.2 History of Rice in India:

India is an important centre of rice cultivation. The rice is cultivated on the largest areas in India. Historians believe that while the *indica* variety of rice was first domesticated in the area covering the foothills of the Eastern Himalayas (i.e. north-eastern India), stretching through Burma, Thailand, Laos,Vietnam and Southern China, the *japonica* variety was domesticated from wild rice in southern China which was introduced to India. Perennial wild rice still grow in Assam and Nepal. It seems to have appeared around 1400 BC in southern India after its domestication in the northern plains. It then spread to all the fertiled alluvial plains watered by rivers. Some says that the word rice is derived from the Tamil word *arisi*.

2.3 STEP BY STEP PADDY GROWING PROCESS

STEP 1:

- Purchase rice seeds from any farmer's supply store.
- Choose your planting location.
- Gather at least 28.5g To 56.5g of rice seeds to sow

Fig 2.1: Step one of paddy growing process

STEP 2:

- Plant the rice seeds throughout the soil, during the fall or spring season.

Fig 2.2: Step two of paddy growing process

STEP 3:

- Thin or space out, the rice seeds to prevent crowding, and wait for rice grains to mature.

Fig 2.3: Step three of paddy growing process

WE CONTROL THE WATER LEVEL

- Maintain 4 inches of water level for 2 months till plant grow from 7 inches to 12 inches.
- Maintain 6 inches of water level for 1months till plant grow from 12 inches to 17 inches.

Fig 2.4: Step three of paddy growing process

STEP 4:

HARVESTING

Let the water dry out or drain any excess water before removing the rice for harvesting. Over the course of the next two weeks, they'll turn green to gold-that's when you know they're ready.

Fig 2.5: Step four of paddy growing process

2.4 OVER ALL PROCESS

Table 1: overall process

Step number	Length of the plant	Water requirement	duration	Loop used
Step 1	-	-	-	-
Step 2	Seeds	Two inches of water above the soil level	8 days	open
Step 3	7 to 12 Inches	Four inches of water above the soil level	60 days	close
	12 to 17	Six inches of water above the soil level	30 days	close
Step 4	17 inches	-	-	

CHAPTER 3
HARDWARE DEVELOPMENT

3. HARDWARE DEVELOPMENT

3.1 COMPONENTS USED

The following table below lists the components used

Table 2: purpose of components used in board

SI .NO	Components	purpose
1	Transformer(12-0-12)	Step down 230V ac to 12V ac
2	Rectifying circuit- full wave bridge rectifier	Converting AC to DC
3	Diodes IN 4007	Unidirectional current flow and current switching
4	Voltage Regulator LM7805	To obtain fixed output voltage
5	Capacitors	Stores charges and removes harmonics
6	Resistors	Biasing purpose regulate the current flow
7	Relay	On/OFF Control of motor
8	Microcontroller(at89s52/at89c51)	To interface components and to run the program
9	Lcd (44780)	To display status of motor and water level in underground sump
10	Buzzer	To indicate OFF condition of motor
11	Magnetic float Sensors	Detects water level in cultivating field and underground sump
12	Rtc	Operate motor for a particular time slot
13	Keypad	To set ON and OFF time of motor
14	Switches	To shift from open loop to close loop
15	LED	Lighting purpose

3.2 HARDWARE DETAILS

3.2.1 MICROCONTROLLER (AT89S51/52)

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non volatile memory programmer.

Features:

- Compatible with MCS®-51 Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory
- Endurance: 10,000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Power-off Flag
- Fast Programming Time
- Flexible ISP Programming (Byte and Page Mode)
- Green (Pb/Halide-free) Packaging Option

Pin Configurations of AT89S52

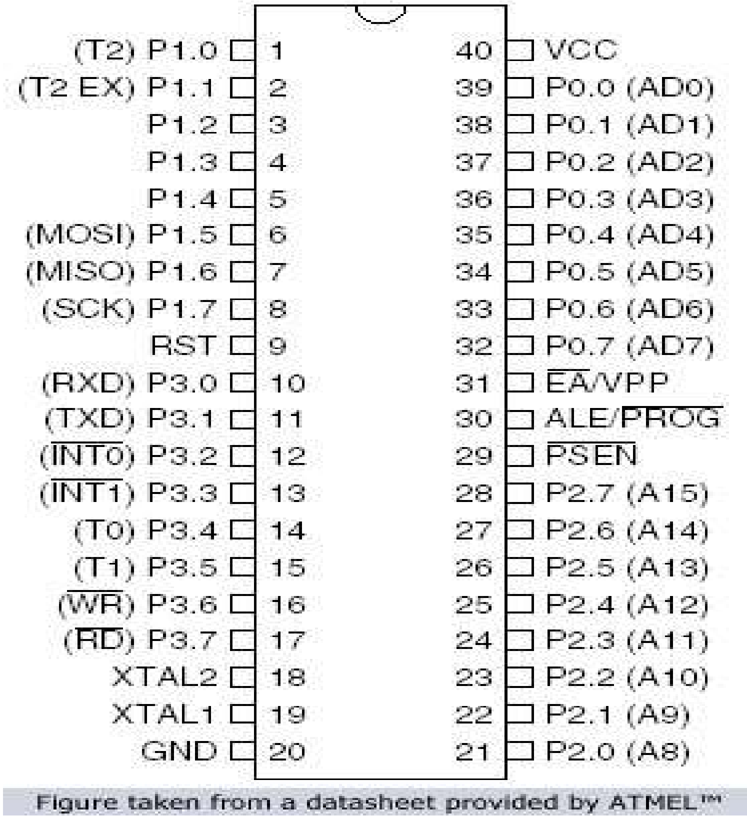


Fig 3.1: pin diagram of AT89S52

Pin Description:

VCC:

Supply voltage.

GND:

Ground.

Port 0:

Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

Port 1:

Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX).

Port 2:

Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 3:

Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups.

RST:

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives high for 98 oscillator periods after the Watchdog times out. The DISRTO bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DISRTO, the RESET HIGH out feature is enabled.

ALE/PROG:

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming.

In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory.

PSEN:

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

Output from the inverting oscillator amplifier.

Oscillator Characteristics:

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure 6.2. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

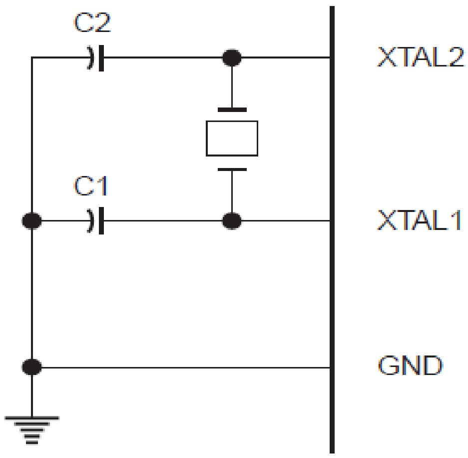


Fig 3.2: Oscillator Connections

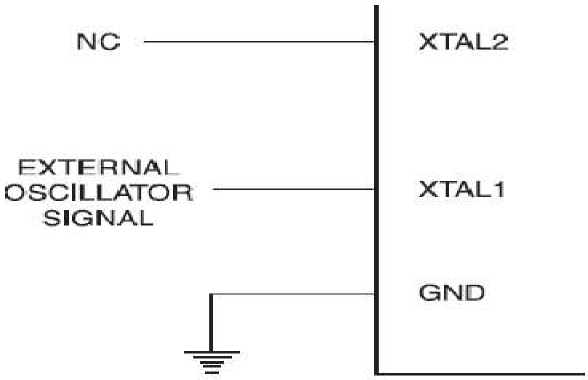


Fig 3.3: External Clock Drive Configuration

Idle Mode

In idle mode, the CPU puts itself to sleep while all the on chip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and all the special functions registers remain unchanged during this mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset.

Power down Mode

In the power down mode the oscillator is stopped, and the instruction that invokes power down is the last instruction executed. The on-chip RAM and Special Function Registers retain their values until the power down mode is terminated. The only exit from power down is a hardware reset. Reset redefines the SFRs but does not change the on-chip RAM. The reset should not be activated before VCC is restored to its normal operating level and must be held active long enough to allow the oscillator to restart and stabilize.

3.2.2 LCD

Fig 3.4: LCD

Frequently, an 8051 program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an 8051 is an LCD display. Some of the most common LCDs connected to the 8051 are 16x2 and 16x2 displays. This means 16 characters per line by 2 lines and 16 characters per line by 2 lines, respectively.

44780 LCD BACKGROUND

The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus. If a 4-bit data bus is used the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).

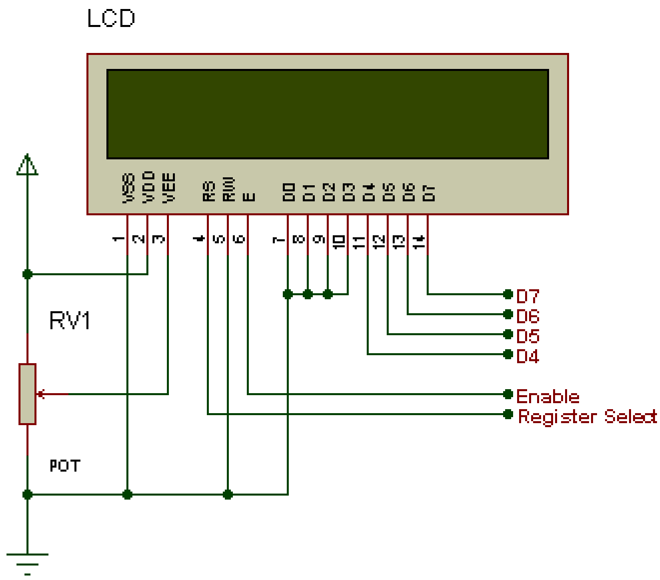


Fig 3.5: LCD background

The three control lines are referred to as EN, RS, and RW.

The EN line is called "Enable." This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus. When the other lines are completely ready, bring EN high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.
The RS line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which should be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

The RW line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get LCD status") is a read command. All others are write commands--so RW will almost always be low .Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

3.2.3 VOLTAGE REGULATOR (LM7805)

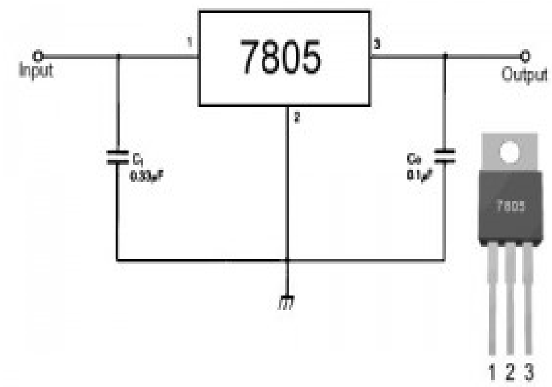


Fig 3.6: LM7805 voltage regulator

Features

- Output Current up to 1A.
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V.
- Thermal Overload Protection.
- Short Circuit Protection.
- Output Transistor Safe Operating Area Protection.

Description

The LM78XX/LM78XXA series of three-terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a Wide range of applications. Each type employs internal current limiting, thermal shutdown and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output Current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

Absolute Maximum Ratings

Table 3: Ratings of the voltage regulator

Parameter	Symbol	Value	Unit
Input Voltage (for V_O = 5V to 18V) (for V_O = 24V)	V_I V_I	35 40	V V
Thermal Resistance Junction-Cases (TO-220)	$R_{\theta JC}$	5	°C/W
Thermal Resistance Junction-Air (TO-220)	$R_{\theta JA}$	65	°C/W
Operating Temperature Range (KA78XX/A/R)	T_{OPR}	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

PIN DIAGRAM

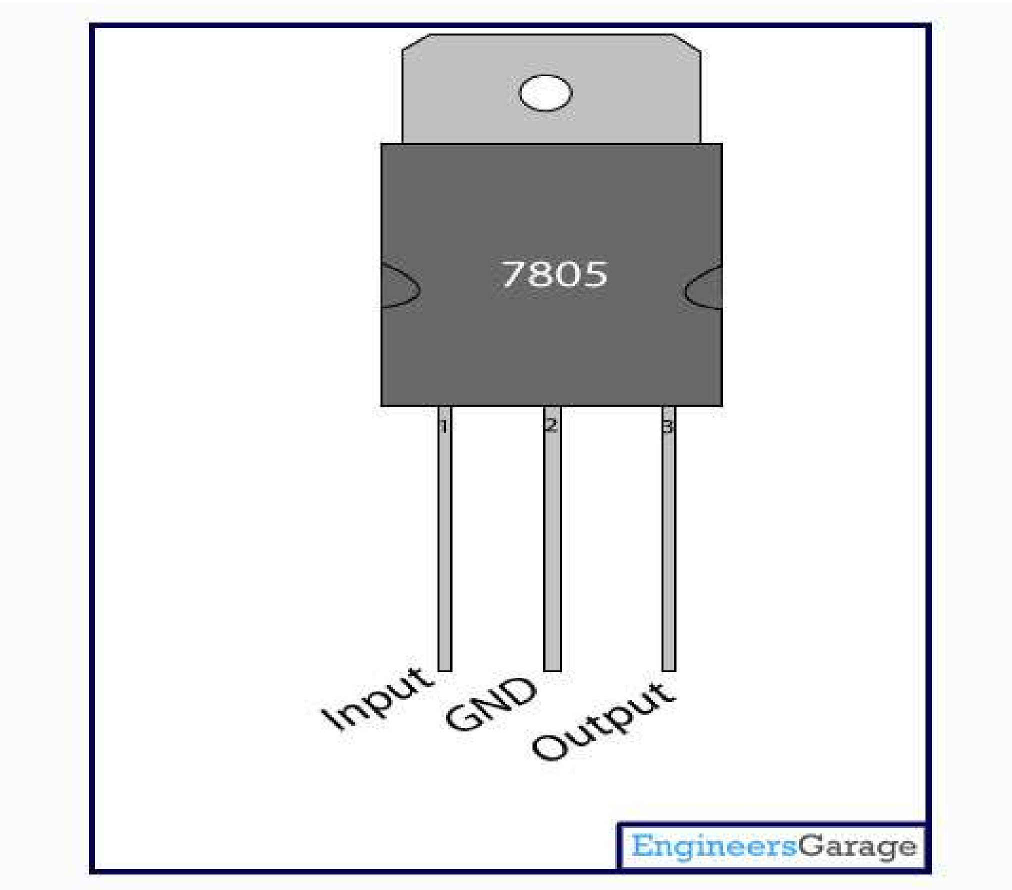


Fig3.7: Pin Diagram

Pin Description:

Table 4: Pin Description of voltage regulator

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

3.2.4 DIODE IN4007

Diodes are used to convert AC into DC these are used as half wave rectifier or full wave rectifier. Three points must he kept in mind while using any type of diode.

1. Maximum forward current capacity
2. Maximum reverse voltage capacity
3. Maximum forward voltage capacity

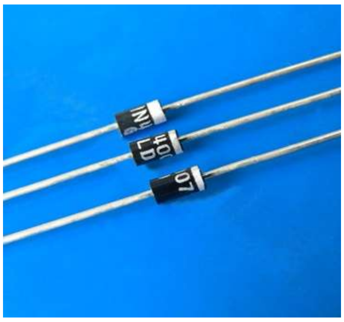


Fig 3.8: 1N4007 diodes

The number and voltage capacity of some of the important diodes available in the market are as follows:

- Diodes of number IN4001, IN4002, IN4003, IN4004, IN4005, IN4006 and IN4007 have maximum reverse bias voltage capacity of 50V and maximum forward current capacity of 1 Amp.
- Diode of same capacities can be used in place of one another. Besides this diode of more capacity can be used in place of diode of low capacity but diode of low capacity cannot be used in place of diode of high capacity. For example, in place of IN4002; IN4001 or IN4007 can be used but IN4001 or IN4002 cannot be used in place of IN4007.The diode BY125made by company BEL is equivalent of diode from IN4001 to IN4003. BY 126 is equivalent to diodes IN4004 to 4006 and BY 127 is equivalent to diode IN4007.

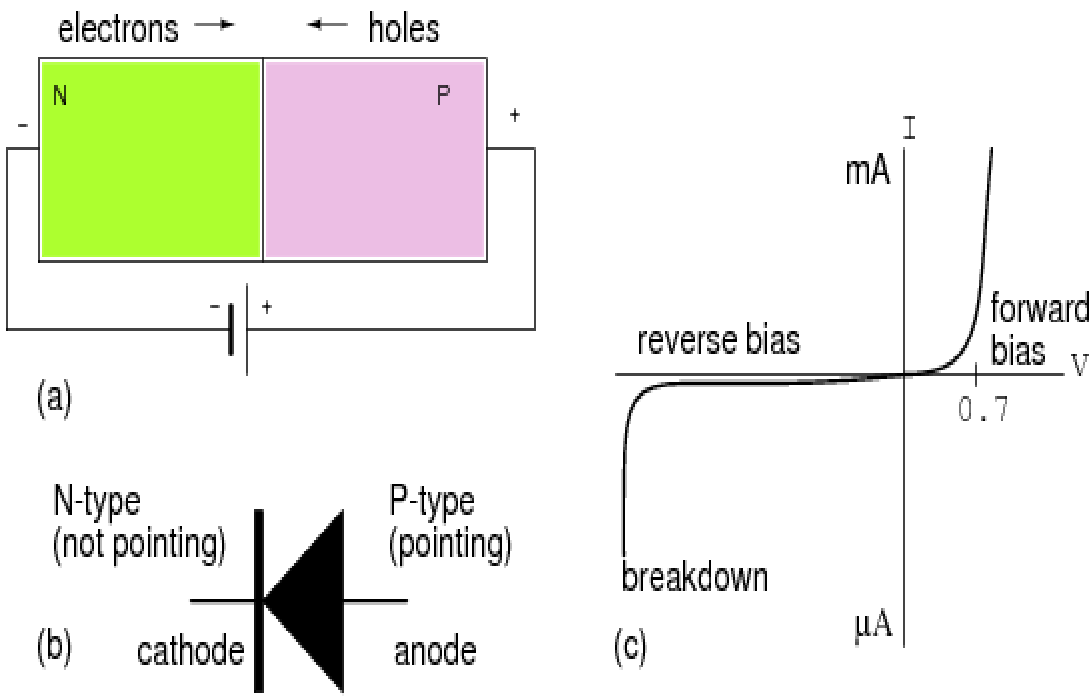


Fig 3.9: PN Junction diode

PN JUNCTION OPERATION

Now that you are familiar with P- and N-type materials, how these materials are joined together to form a diode, and the function of the diode, let us continue our discussion with the operation of the PN junction. But before we can understand how the PN junction works, we must first consider current flow in the materials that make up the junction and what happens initially within the junction when these two materials are joined together.

3.2.5 LED

Fig 3.10: LED

LEDs are semiconductor devices. Like transistors, and other diodes, LEDs are made out of silicon. What makes an LED give off light are the small amounts of chemical impurities that are added to the silicon, such as gallium, arsenide, indium, and nitride. When current passes through the LED, it emits photons as a byproduct. Normal light bulbs produce light by heating a metal filament until its white hot. Because LEDs produce photons directly and not via heat, they are far more efficient than incandescent bulbs. Not long ago LEDs were only bright enough to be used as indicators on dashboards or electronic equipment. But recent advances have made LEDs bright enough to rival traditional lighting technologies. Modern LEDs can replace incandescent bulbs in almost any application.

Colors and materials

Conventional LEDs are made from a variety of inorganic semiconductor materials. The following table shows the available colors with wavelength range, voltage drop and material.

Table 5: The available colours with wavelength range, voltage drop and material

Color	Wavelength [nm]	Voltage drop [ΔV]	Semiconductor material
Infrared	$\lambda > 760$	$\Delta V < 1.63$	Gallium arsenide (GaAs) Aluminium gallium arsenide (AlGaAs)
Red	$610 < \lambda < 760$	$1.63 < \Delta V < 2.03$	Aluminium gallium arsenide (AlGaAs) Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium(III) phosphide (GaP)
Orange	$590 < \lambda < 610$	$2.03 < \Delta V < 2.10$	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium(III) phosphide (GaP)
Yellow	$570 < \lambda < 590$	$2.10 < \Delta V < 2.18$	Gallium arsenide phosphide (GaAsP) Aluminium gallium indium phosphide (AlGaInP) Gallium(III) phosphide (GaP)
Green	$500 < \lambda < 570$	1.9[68] $< \Delta V < 4.0$	Traditional green: Gallium(III) phosphide (GaP) Aluminium gallium indium phosphide (AlGaInP) Aluminium gallium phosphide (AlGaP) Pure green: Indium gallium nitride (InGaN) / Gallium(III) nitride (GaN)
Blue	$450 < \lambda < 500$	$2.48 < \Delta V < 3.7$	Zinc selenide (ZnSe) Indium gallium nitride (InGaN) Silicon carbide (SiC) as substrate Silicon (Si) as substrate—under development
Violet	$400 < \lambda < 450$	$2.76 < \Delta V < 4.0$	Indium gallium nitride (InGaN)
Purple	Multiple types	$2.48 < \Delta V < 3.7$	Dual blue/red LEDs, blue with red phosphor, or white with purple plastic

3.2.6 BUZZER (TIP 122)

Fig 3.11: Buzzer

The quiz buzzer systems are widely used in school, colleges and TV programs. The team which presses the buzzer earliest is entitled to give the answer. At times it becomes very difficult to identify which team has pressed the button when two teams press the buzzer within a very small time gap. In such cases the decision can be biased due to human intervention. The quiz buzzer presented here takes care of the aforesaid problem. This quiz buzzer disables the other inputs as soon as the first buzzer is pressed. This quiz buzzer can be used for a maximum of eight teams. It is build around 8051 microcontroller.

3.2.7 POWER SUPPLY BLOCK

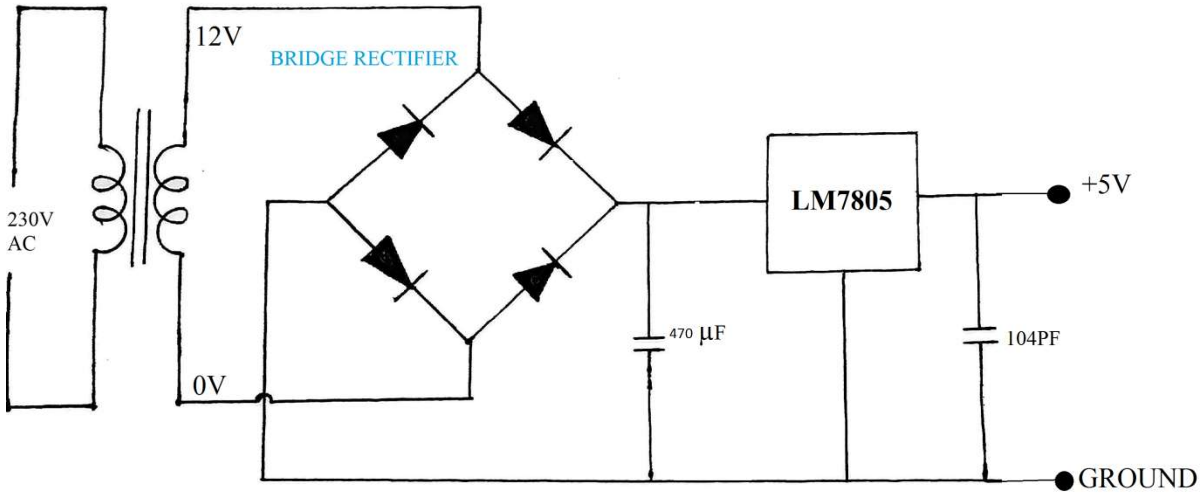
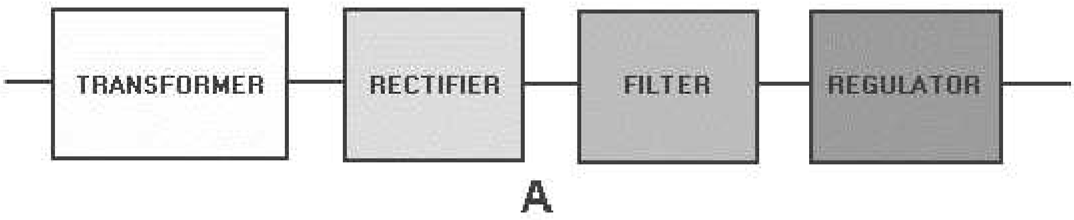


Fig 3.12: power supply circuit



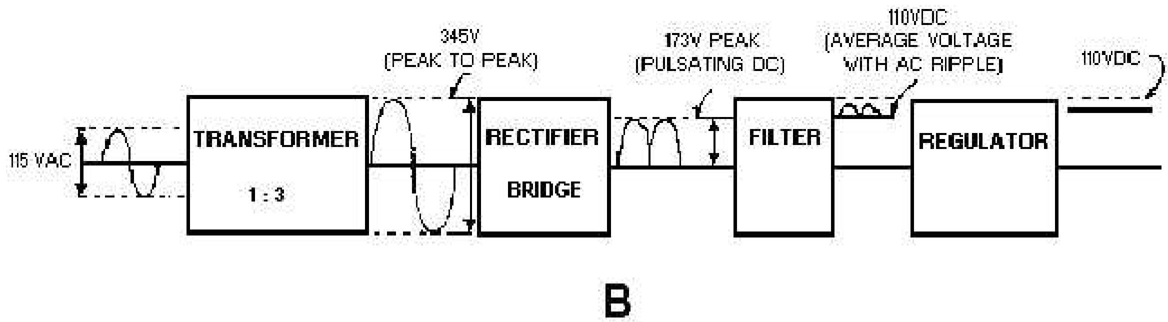


Fig 3.13: Block Diagram

Figure A—Block diagram of a basic power supply. As illustrated in view B of figure B, the first section is the TRANSFORMER. The transformer steps up or steps down the input line voltage and isolates the power supply from the power line. The RECTIFIER section converts the alternating current input signal to a pulsating direct current. However, as you proceed in this chapter you will learn that pulsating dc is not desirable. For this reason a FILTER section is used to convert pulsating dc to a purer, more desirable form of dc voltage. Figure B — Block diagram of a basic power supply. The final section, the REGULATOR, does just what the name implies. It maintains the output of the power supply at a constant level in spite of large changes in load current or input line voltages. Now that you know what each section does, let's trace an ac signal through the power supply. At this point you need to see how this signal is altered within each section of the power supply. Later on in the chapter you will see how these changes take place. In view B of figure A, an input signal of 115 volts ac is applied to the primary of the transformer. The transformer is a step-up transformer with a turns ratio of 1:3. You can calculate the output for this transformer by multiplying the input voltage by the ratio of turns in the primary to the ratio of turns in the secondary; therefore, 115 volts ac 3 = 345 volts ac (peak-to- peak) at the output. Because each diode in the rectifier section conducts for 180 degrees of the 360-degree input, the output of the rectifier will be one-half, or approximately 173 volts of pulsating dc. The filter section, a network of resistors, capacitors, or inductors, controls the rise and fall time of the varying signal; consequently, the signal remains at a more constant dc level. You will see the filter process more clearly in the discussion of the actual filter circuits. The output of the filter is a signal of 110 volts dc, with ac ripple riding on the dc. The reason for the lower voltage (average voltage) will be explained later in this chapter. The regulator maintains its output at a constant 110-volt dc level, which is used by the electronic equipment (more commonly called the load).

3.2.8 RESISTORS

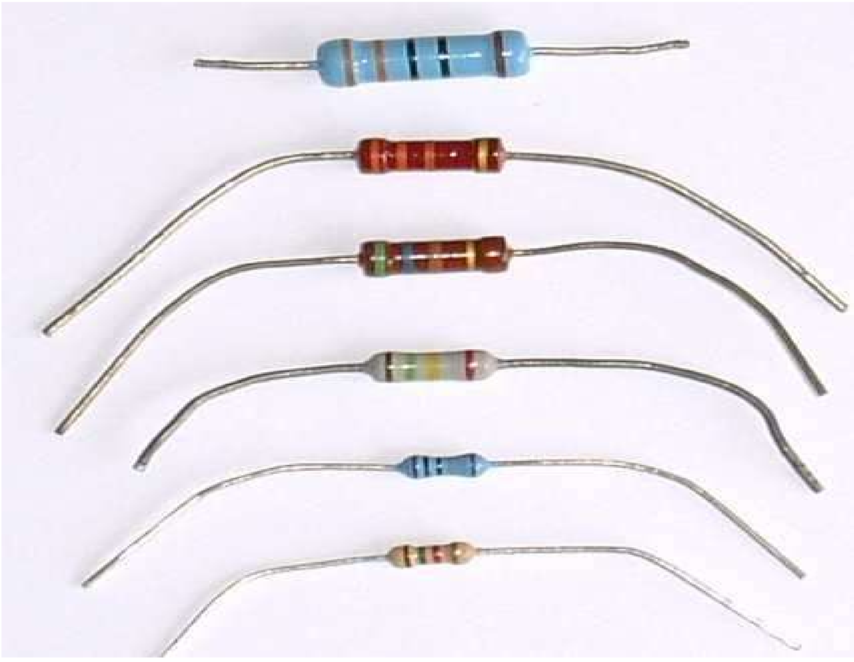


Fig 3.14: Resistors

A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law:

$$V = IR$$

Resistors are used as part of electrical networks and electronic circuits. They are extremely commonplace in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).

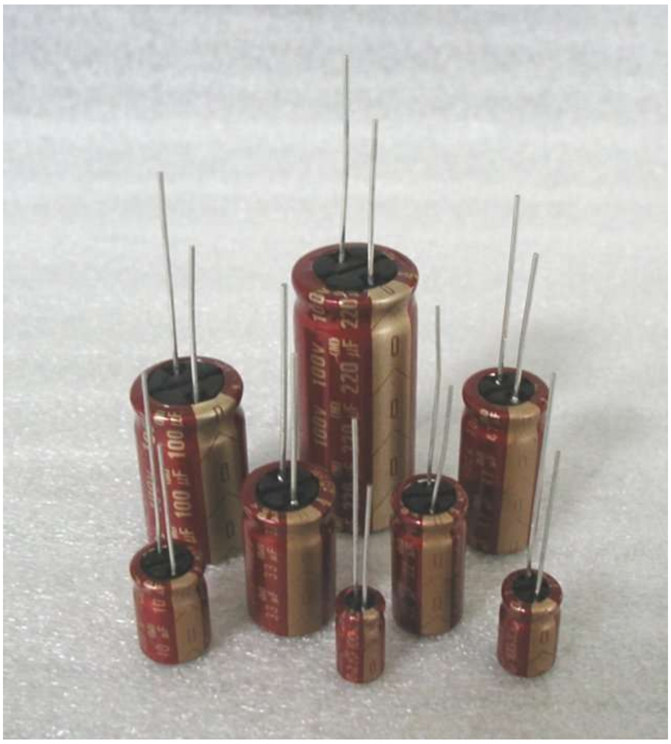
The primary characteristics of resistors are their resistance and the power they can dissipate. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage. Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design.

3.2.9 CAPACITORS

A capacitor or condenser is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

An ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

The properties of capacitors in a circuit may determine the resonant frequency and quality factor of a resonant circuit, power dissipation and operating frequency in a digital logic circuit, energy capacity in a high-power system, and many other important aspects.



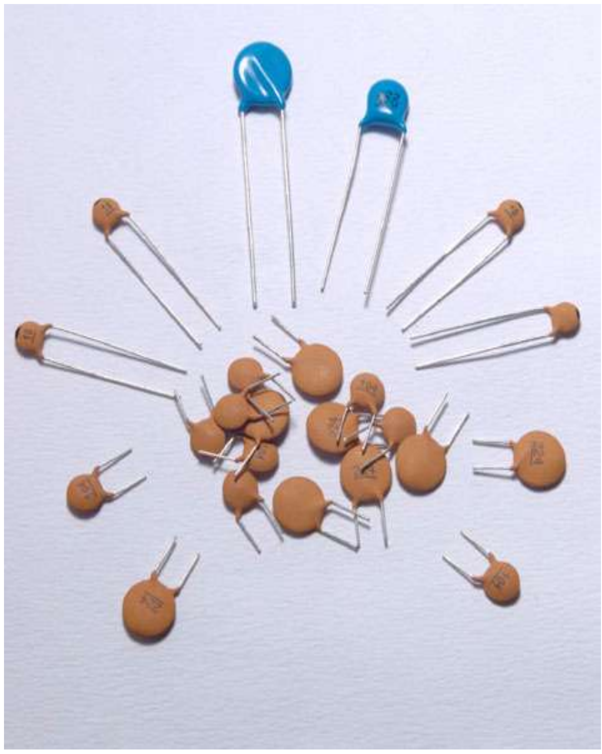


Fig 3.15: Capacitors

Theory of operation

Capacitance

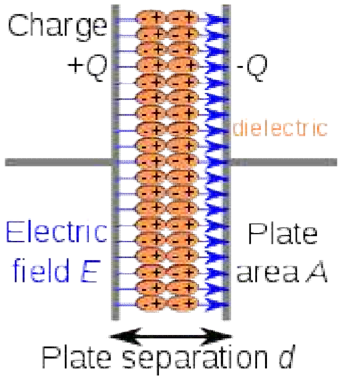


Fig 3.16: Capacitance

Charge separation in a parallel-plate capacitor causes an internal electric field. A dielectric (orange) reduces the field and increases the capacitance.

Fig 3.17: A simple demonstration of a parallel-plate capacitor

A capacitor consists of two conductors separated by a non-conductive region. The non-conductive region is called the dielectric or sometimes the dielectric medium. In simpler terms, the dielectric is just an electrical insulator. Examples of dielectric mediums are glass, air, paper, vacuum, and even a semiconductor depletion region chemically identical to the conductors. A capacitor is assumed to be self-contained and isolated, with no net electric charge and no influence from any external electric field. The conductors thus hold equal and opposite charges on their facing surfaces, and the dielectric develops an electric field. In SI units, a capacitance of one farad means that one coulomb of charge on each conductor causes a voltage of one volt across the device.

The capacitor is a reasonably general model for electric fields within electric circuits. An ideal capacitor is wholly characterized by a constant capacitance C, defined as the ratio of charge ±Q on each conductor to the voltage V between them:

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

Sometimes charge build-up affects the capacitor mechanically, causing its capacitance to vary. In this case, capacitance is defined in terms of incremental changes:

$$C = \frac{\mathrm{d}q}{\mathrm{d}v}$$

Energy storage

Work must be done by an external influence to "move" charge between the conductors in a capacitor. When the external influence is removed the charge separation persists in the electric field and energy is stored to be released when the charge is allowed to return to its equilibrium position. The work done in establishing the electric field, and hence the amount of energy stored, is given by:

$$W = \int_{q=0}^{Q} V \mathrm{d}q = \int_{q=0}^{Q} \frac{q}{C} \mathrm{d}q = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}VQ.$$

Current-voltage relation

The current i (t) through any component in an electric circuit is defined as the rate of flow of a charge q (t) passing through it, but actual charges, electrons, cannot pass through the dielectric layer of a capacitor, rather an electron accumulates on the negative plate for each one that leaves the positive plate, resulting in an electron depletion and consequent positive charge on one electrode that is equal and opposite to the accumulated negative charge on the other. Thus the charge on the electrodes is equal to the integral of the current as well as proportional to the voltage as discussed above. As with any anti derivative, a constant of integration is added to represent the initial voltage v (t_0). This is the integral form of the capacitor equation,

$$v(t) = \frac{q(t)}{C} = \frac{1}{C}\int_{t_0}^{t} i(\tau)\mathrm{d}\tau + v(t_0) .$$

Taking the derivative of this, and multiplying by C, yields the derivative form,

$$i(t) = \frac{\mathrm{d}q(t)}{\mathrm{d}t} = C\frac{\mathrm{d}v(t)}{\mathrm{d}t} .$$

The dual of the capacitor is the inductor, which stores energy in the magnetic field rather than the electric field. Its current-voltage relation is obtained by exchanging current and voltage in the capacitor equations and replacing C with the inductance L.

3.2.10 RELAY

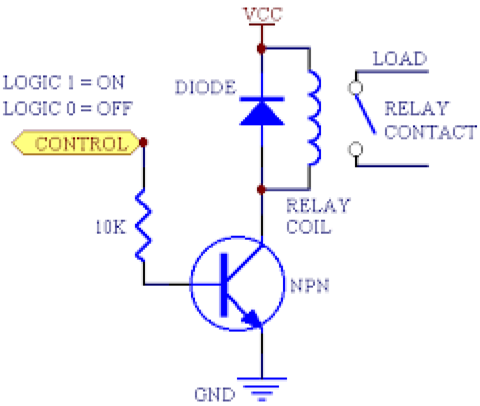


Fig 3.18: Darlington Pair

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

3.2.11 CENTRIFUGAL SUBMERSIBLE PUMP (SINGLE PHASE 35W)

Fig 3.19: centrifugal submersible pump

Features:

- Fully submersible.
- Completely noiseless.
- No rusting.
- Small size.
- Easy installation.
- Low Electricity Consumption.

Ratings:

Voltage: 165-250 V/50Hz

Power : 35W

3.2.12 REAL TIME CLOCK (RTC)

Fig 3.20: real time clock (RTC)

A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time. Although the term often refers to the devices in personal computers, servers and embedded systems, RTCs are present in almost any electronic device which needs to keep accurate time.

Terminology

The term is used to avoid confusion with ordinary hardware clocks which are only signals that govern digital electronics, and do not count time in human units. RTC should not be confused with real-time computing, which shares its three-letter acronym but does not directly relate to time of day.

Purpose

Although keeping time can be done without an RTC, using one has benefits:

- Low power consumption (important when running from alternate power)
- Frees the main system for time-critical tasks
- Sometimes more accurate than other methods

A GPS receiver can shorten its startup time by comparing the current time, according to its RTC, with the time at which it last had a valid signal. If it has been less than a few hours, then the previous ephemeris is still usable.

Power source

RTCs often have an alternate source of power, so they can continue to keep time while the primary source of power is off or unavailable. This alternate source of power is normally a lithium battery in older systems, but some newer systems use a super capacitor, because they are rechargeable and can be soldered. The alternate power source can also supply power to battery backed RAM.

Timing

Most RTCs use a crystal oscillator, but some use the power line frequency. In many cases, the oscillator's frequency is 32.768 kHz. This is the same frequency used in quartz clocks and watches, and for the same reasons, namely that the frequency is exactly 215 cycles per second, which is a convenient rate to use with simple binary counter circuits.

CHAPTER 4

CIRCUIT DIAGRAM AND OPERATION

4. CIRCUIT DIAGRAM AND OPERATION

4.1 CIRCUIT DIAGRAM

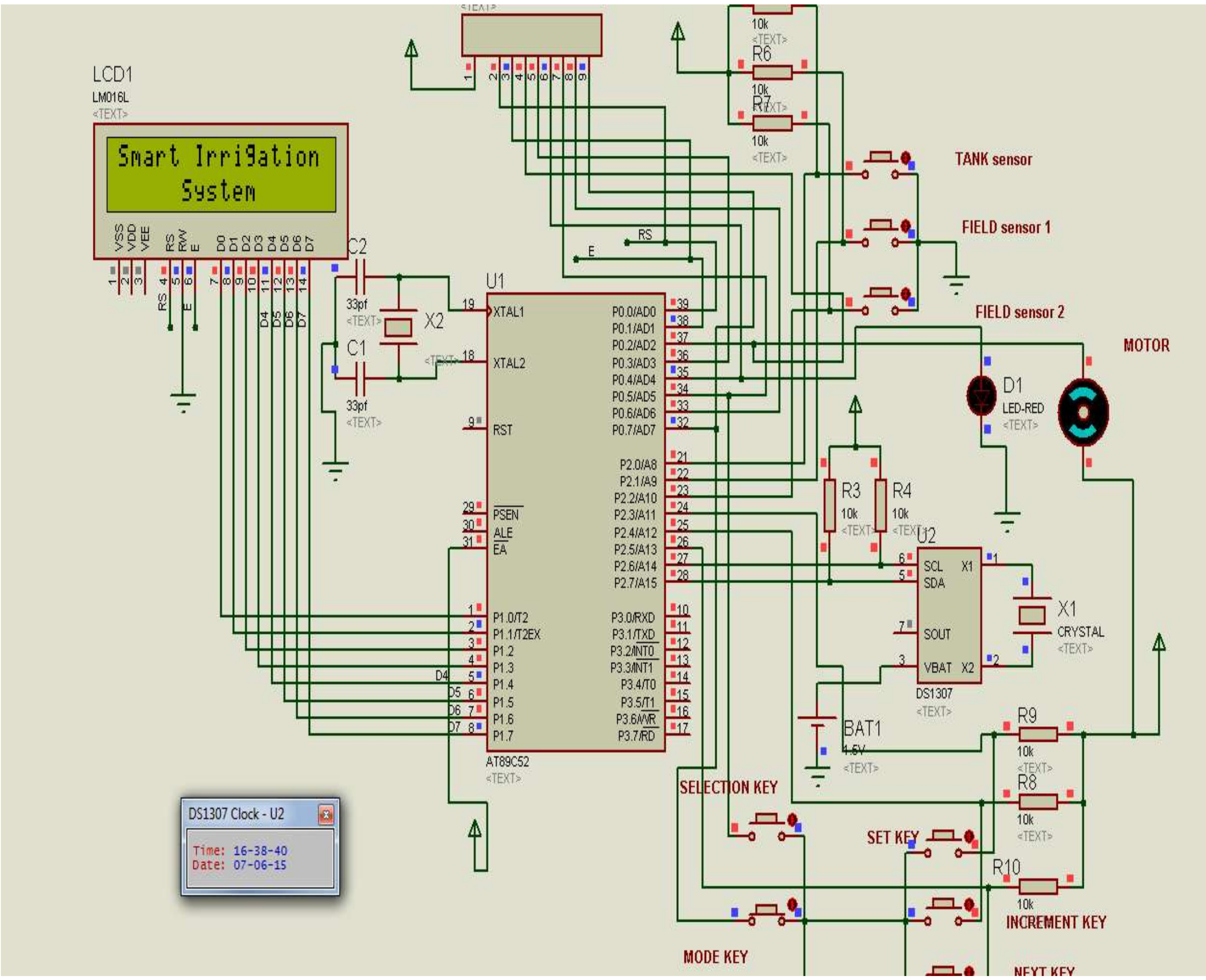


Fig 4.1: circuit diagram

Circuit diagram operation

The circuit diagram mainly comprises of Microcontroller, Power supply block, Relay, RTC, keypad, LCD, Three magnetic float sensors, Buzzer and Motor,

The project is divided into two parts they are

1. Open loop

2. Close loop

Open loop operation:

The open loop has an RTC interfaced to microcontroller. The input voltage 230 V Ac is stepped down to 5 V dc using a Bridge Rectifier which acts a source voltage to microcontroller, The ON/OFF control of motor is done by microcontroller through relay or optocoupler. An LCD and a Buzzer is also interfaced with the microcontroller to know the status of the motor.

The farmer has an option of entering the ON time and OFF time of the motor, Once the entered ON time matches with the RTC time then the motor is turned ON and the motor is turned OFF if the entered OFF time matches with the RTC time.

But before motor is turned OFF or turned ON the condition ie whether there is water availability in the underground sump is checked using an magnetic float sensor near the suction port of the pump which is interfaced with the microcontroller. If and only if there is water in the underground sump the motor is turned ON if not the motor remains in the OFF condition.

Once the motor is turned OFF due to no water available in the underground sump the buzzer generates the sound signal and LCD displays that the motor is in OFF condition.

Close loop operation:

The close loop has two magnetic float sensors placed in the cultivating field. To activate either of two sensors the switch is provided, these two sensors output is given to the microcontroller and depending on the output of these sensors the microcontroller controls the ON/OFF state of the motor.

The first sensor is placed 4 inches above the soil level and is activated for 2 months, and the other sensor is placed 6 inches above the soil level and is activated for 1 month, to select which sensor has to be in active use a switch is provided.

If the water is below the desired level the motor is turned ON and if the water level reaches the desired level the motor is turned OFF.

The another switch is provided to shift from the open loop to the close loop.

4.2 APPLICATIONS OF THE PROJECT

The applications of the project can be numerous. Some of the applications to name are:

- Agricultural fields
- Gardens
- Dry places where there is scarcity of water.

Fig 4.2: Agricultural fields

Fig 4.3: Dry places

4.3 PROS

1. It is difficult to operate water pump manually, But here Based on water level in the field and underground sump, pumping motor will be automatically switch ON or OFF through relay.

Fig 4.4: Manual operation of water pump

2. This saves the water at the same time and on the other hand the plant can get optimum level of water, so increasing productivity of crop.

Fig 4.5: Plant getting optimal level of water

3. It also protects the water pump from getting damaged which in turn will cease the water pump.

Fig 4.6: Burning out of water pump

4. Water pump controller is simple and easy to install.

5. Automatic water pump controller has low maintenance.

6. Automatic water pump controller avoids the seepage of walls.

7. Automatic water pump controller is efficient in operation and enhances the pump set life.

8. Low cost.

4.4 DRAWBACKS

1. It is a passive electrical system and hence it requires continuous power supply.

Fig 4.7: Power supply

CHAPTER 5
RESULTS AND DISCUSSION

5. RESULTS AND DISCUSSION

5.1 Project Design Development

As the project proceeded, the project went through various changes and improvements. This section discusses many of the obstacles and advancements the group faced as the project developed. The key points that will be outlined in this section are the evolution of the project design, the obstacles faced and the prototype building phase.

5.2 Initial Magnetic Float Sensor Concept & Design Consideration

Magnetic Float Sensor

Magnetic float switches / level sensor sare used to detect the senor shave seale dreed switches in a stem with a permanent magnet installed in the float. As float rises or falls, switch is activated/deactivated. Power House float sensor uses unique magnetic push at the floating magnet to respond fast to any change of liquid level.

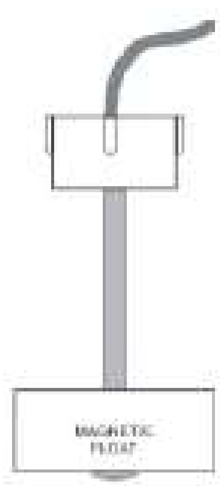


Fig 5.1 : Magnetic Float Sensor

Design 1:

In this design Power supply block is designed.

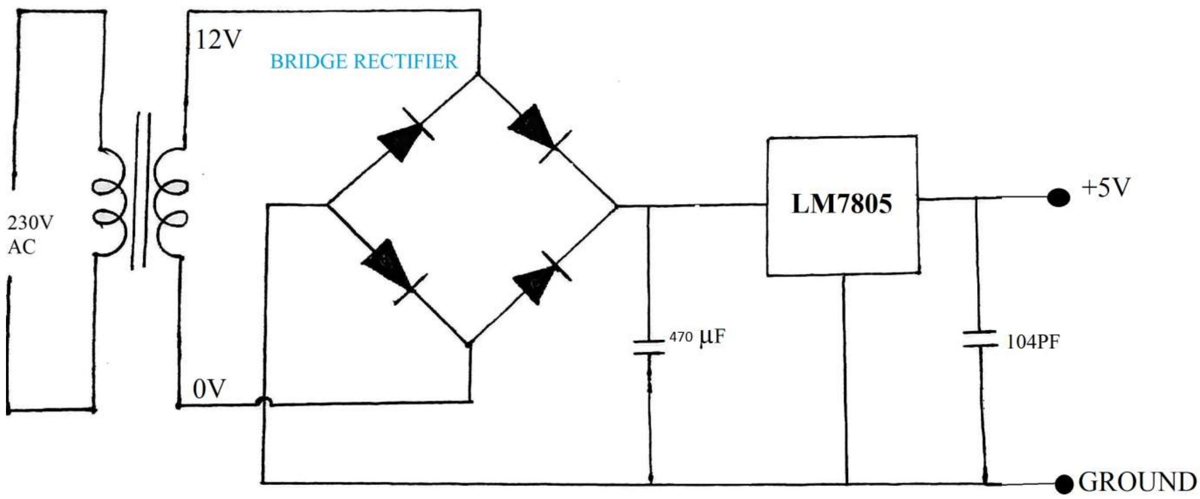


Fig 5.2: Power Supply Circuit

Here we are using transformer of rating (12 0 12) V, 1A. And a full wave bridge rectifier and capacitor of value 470 µF and 104PF to Stores charges and removes harmonics. The figure below shows the power supply block.

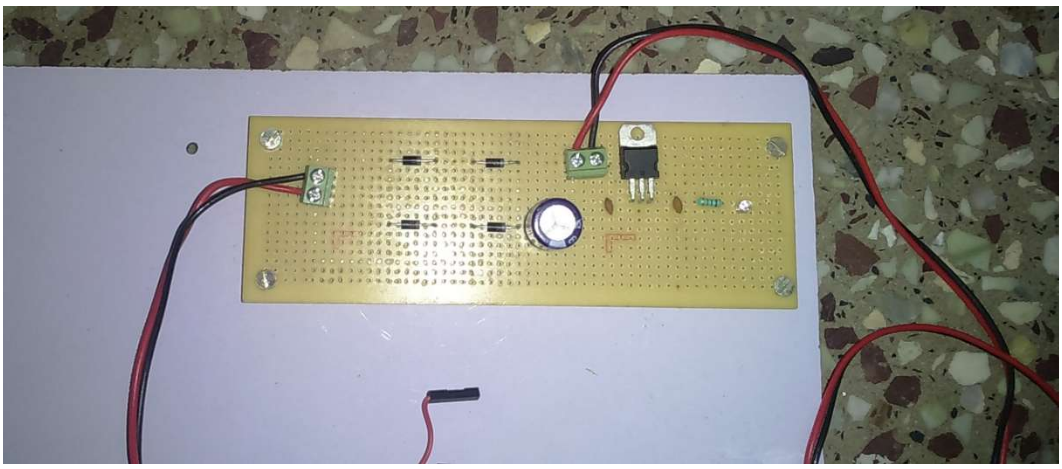


Fig 5.3: Power Supply block

Design 2:

OPEN LOOP DESIGN

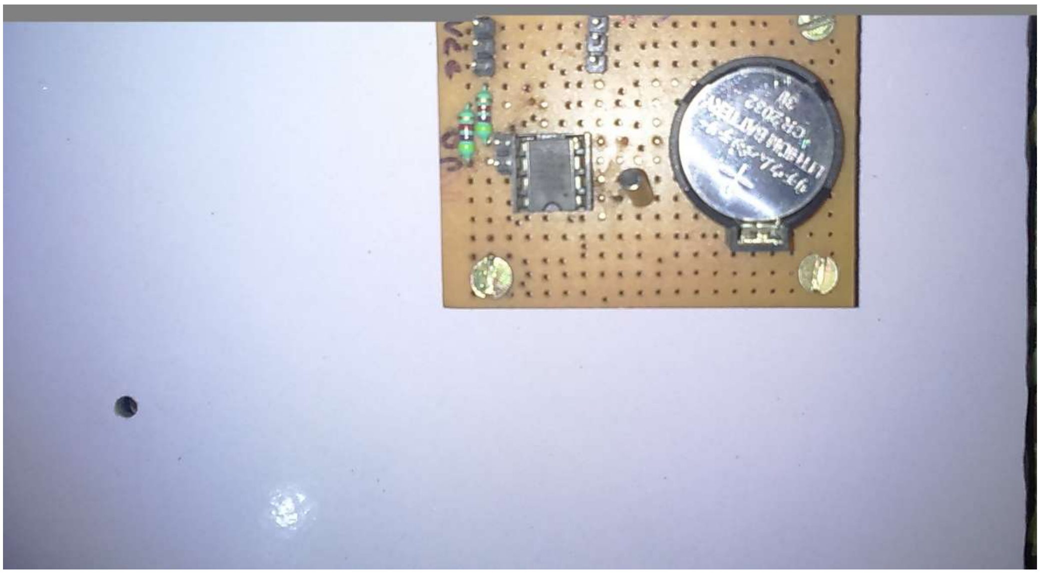
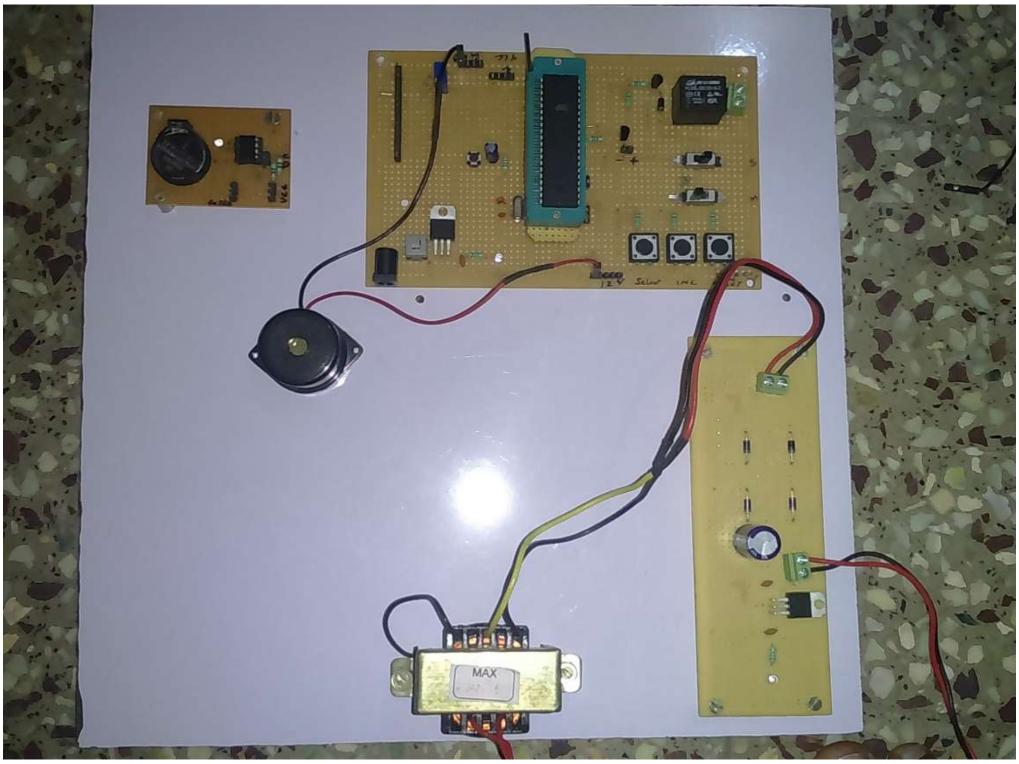


Fig 5.4: open loop



Design 3:

CLOSE LOOP DESIGN

ON/OFF of motor depending on water level by using Magnetic float sensor (simulation using keil µvision4 and isis7 professional software)

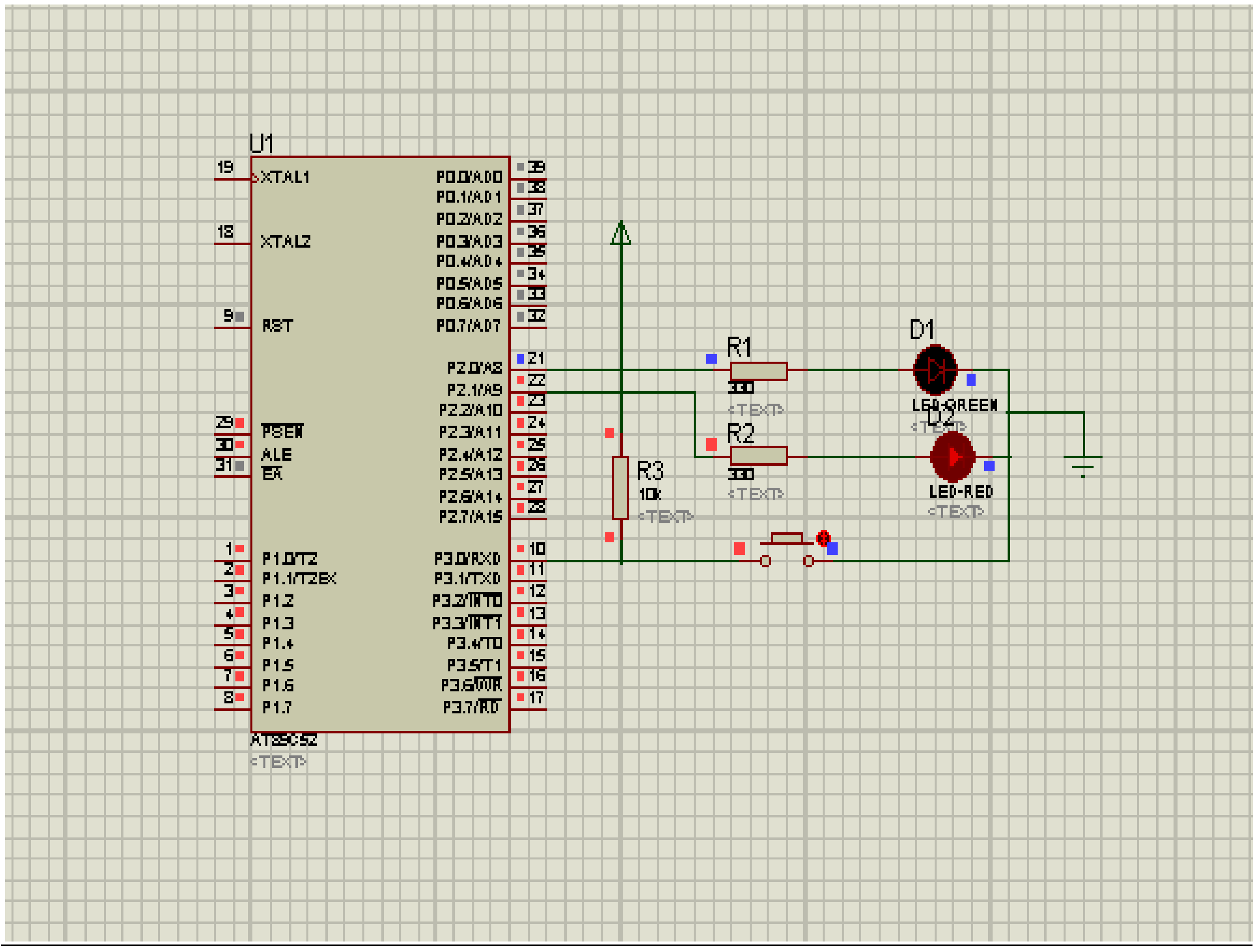


Fig 5.5 : simulation showing OFF status of motor

The above figure shows the OFF status of motor when the magnetic float sensor is in its initial position.

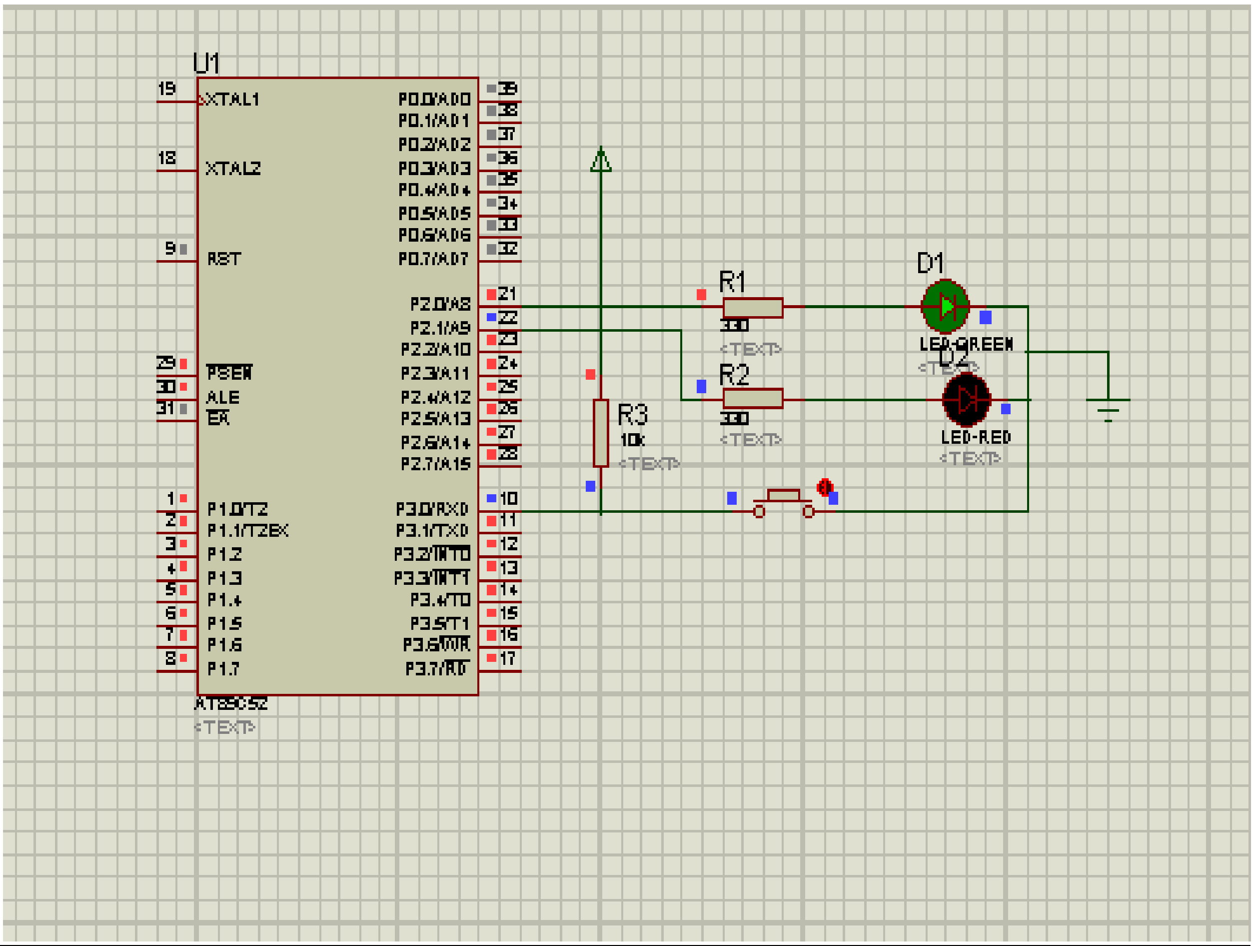


Fig 5.6: simulation showing ON status of motor

The above figure shows the OFF status of motor when the magnetic float sensor is in its initial position.

Fig 5.7: checking Magnetic float sensor

5.3 OBSTACLES AND CHANGES MADE

Sensors: Initially we wanted sensors which would detect the water level in the cultivating field as well as in the underground sump so we decided to go with water level sensor .

The working of water level sensor is as follows

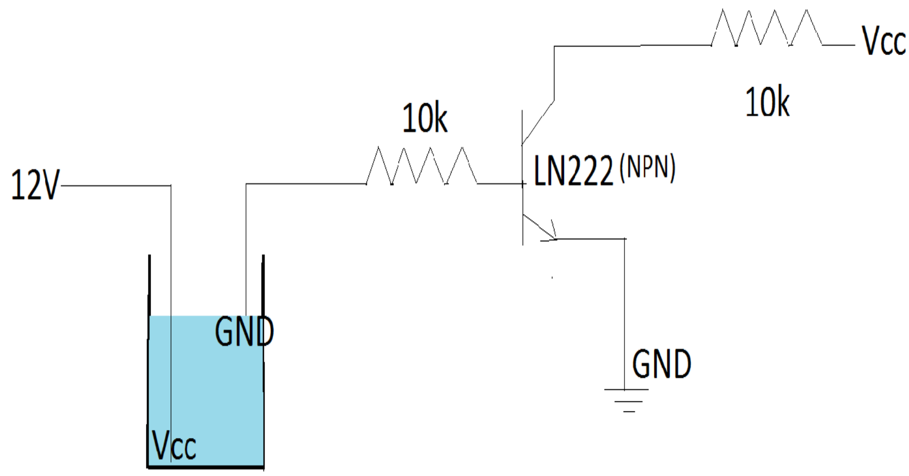


Fig 5.8: working of water level sensor

However the use of water level sensor was ruled out since it was too sensitive. So we decided to go with magnetic water level sensor.

MATHEMATICAL CALCULATIONS

CALCULATION OF ON/OFF TIME REQUIRED BY THE MOTOR TO PUMP THE WATER

As we know for the initial stages the motor should be ON for particular duration, to keep the water level of about two inches (To make sure that the soil is wet).So the calculation for the time required by the motor to pimp water is shown below

Motor rating in KW	Motor rating in HP	Discharge Q in liter/sec	Discharge Q in liter/min	Assumed water height In inches for 1 acre	Assumed water height In feet for 1 acre	Assumed water height In meter for 1 acre	Time required by motor to pump water in Minutes	Time required by motor to pump water in Hour
0.37	0.496	3.162	189.72	2 Inch	0.1666Ft	0.0508m	1083.59 min	18.05 Hr
0.75	1.005	6.406	384.36	2 Inch	0.1666Ft	0.0508m	534.86 min	08.91 Hr
1.1	1.475	9.403	564.18	2 Inch	0.1666Ft	0.0508m	364.38 min	06.73 Hr
1.5	2	12.75	765	2 Inch	0.1666Ft	0.0508m	268.72 min	04.47Hr
2.2	3	19.125	1147.5	2 Inch	0.1666Ft	0.0508m	179.14min	02.98Hr
3.7	4.9	31.23	1873	2 Inch	0.1666Ft	0.0508m	109.74min	01.82Hr
5.5	7.37	47.01	2820.6	2 Inch	0.1666Ft	0.0508m	72.88min	01.21 Hr
7.5	10	63.75	3825	2 Inch	0.1666Ft	0.0508m	53.74 min	0.89 Hr
9.3	12.47	76.5	4590	2 Inch	0.1666Ft	0.0508m	44.78 min	0.74 Hr
11	14.75	94.03	5641.8	2 Inch	0.1666Ft	0.0508m	36.42 min	0.6 Hr
15	20.11	128.20	7692	2 Inch	0.1666Ft	0.0508m	26.72min	0.44 Hr

Table 6: Calculation of ON/OFF time of motor

NOTE

1) Assumed land=1 Acre with 2 Inch water
2) Assumed water head (H) =10m
3) 1 Kw = 1.341 HP
4) 2 Inch = 0.1666Ft
5) 2 Inch = 0.0508 m
6) Q = hp*(75*e)/H

CALCULATION:

For given motor of

Power rating- 5HP

Motor efficiency- 85%

Height of the head-10m

To calculate discharge Q in liters/sec

Formula used: Q=hp*(75*e)/H

Q=hp*(75*e)/H

=5*(75*0.85)/10

Q=3.162 liters/sec

To calculate Q in liters/min multiply Q in liters/sec by 60

Q=3.162 liters/sec *60

Q=189.72 liters/min.

To calculate time t in minutes

As we know that Q= liters/time

Total quantity of water of about 2 inches above the soil level is=**205580.304 liters**

As calculated above Q=189.72 liters

Time in minutes=liters/Q (liters/min)

=205580.304/189.72

Time=1083.5 min

To calculate time t in hours

Time in hours=divide time in min by 60

Time in hours=1083.5/60

Time=18.05 hours.

CALCULATION OF ON/OFF TIME DURATION OF THE MOTOR USED IN OUR PROJECT

For given motor of

Power rating = 35watts=0.035 kw=0.0469 hp

Motor efficiency- 85%

Height of the head-10m

To calculate discharge Q in liters/sec

Formula used: Q=hp*(75*e)/H

Q=hp*(75*e)/H

=0.0469*(75*0.85)/10

Q=0.2989 liters/sec

To calculate Q in liters/min multiply Q in liters/sec by 60

Q=0.2989 liters/sec *60

Q=17.934 liters/min.

To calculate time t in minutes

As we know that Q= liters/time

Total quantity of water of about 2 inches above the soil level is=**205580.304 liters**

As calculated above Q=189.72 liters

Time in minutes=liters/Q (liters/min)

=205580.304/17.934

Time=11463.14 min

To calculate time t in hours

Time in hours=divide time in min by 60

Time in hours=11463.14/60

Time=191.05 hours.

Complete Module Picture

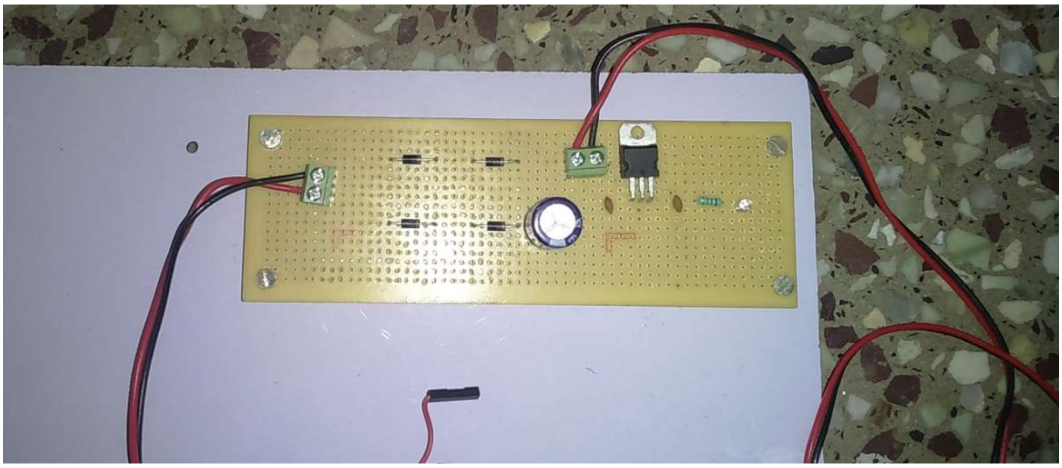


Fig 5.9: power supply block (design 1)

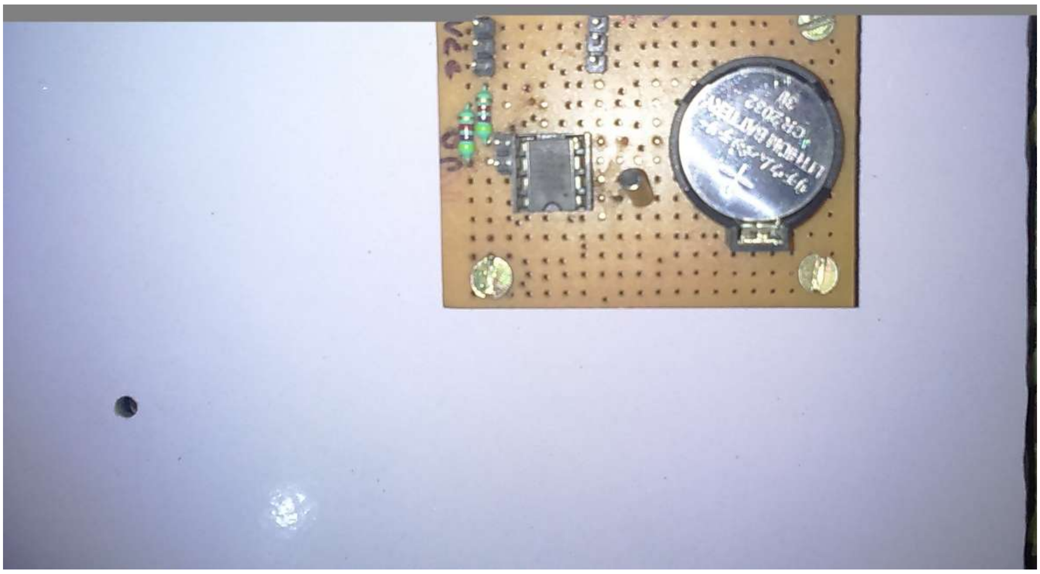


Fig 5.10: open loop(design 2)

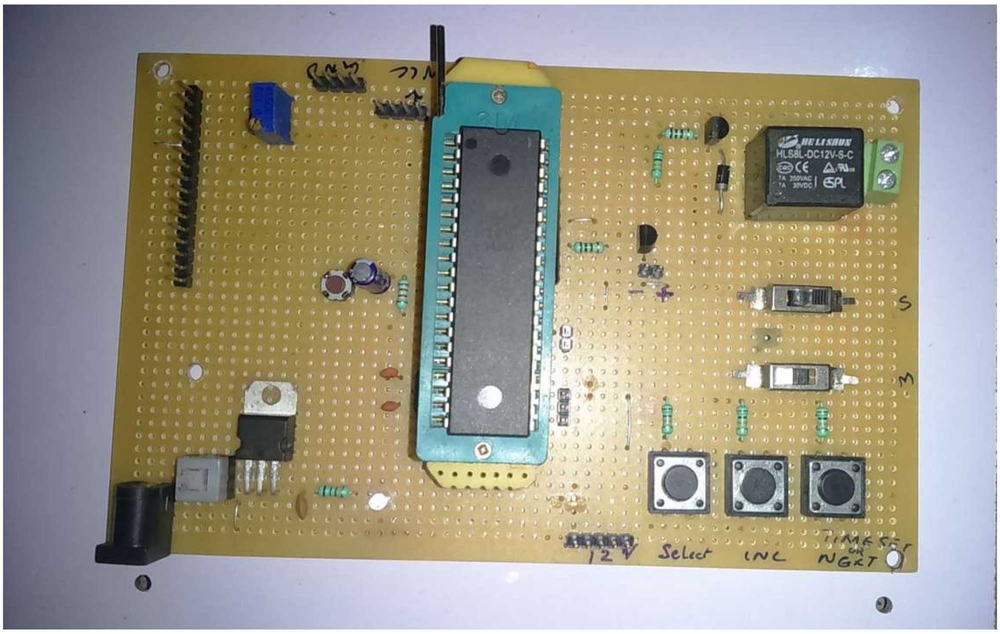


Fig 5.11: close loop(design 3)

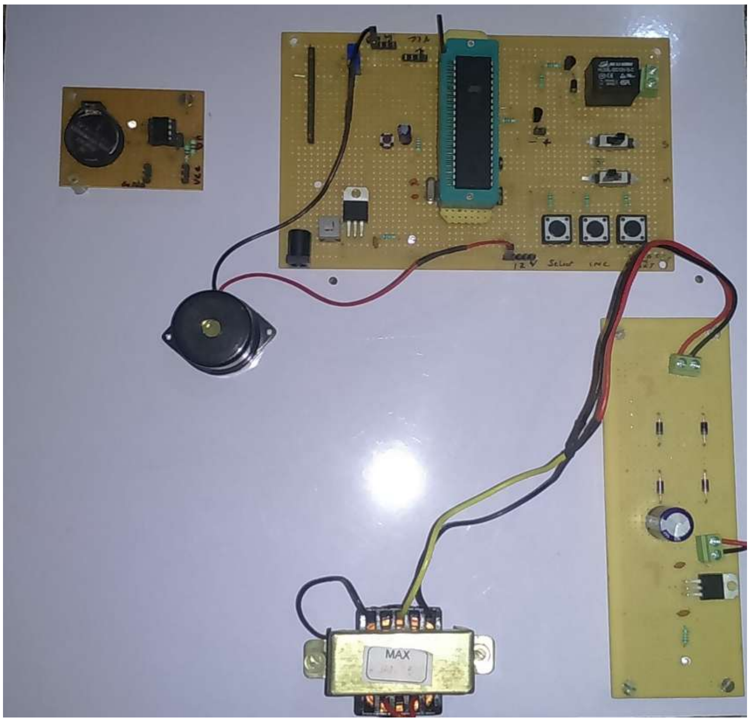


Fig 5.12: complete module

5.4 SUMMARY OF RESULTS

After analysis of all design we have come to several conclusions about designs which are listed below.

Table 7: Summary of results

Design 1	Power supply block was designed successfully by using (12 0 12)V transformer, LM7805 voltage regulator and 470 µF and 104PF Capacitors.
Design 2	Open loop was designed successfully by using RTC.
Design 3	Close loop was designed successfully by using magnetic float sensor.

CHAPTER 6

PROJECT CONCLUSION AND FUTURE SCOPE OF IMPROVEMENT

6. PROJECT CONCLUSION AND FUTURE SCOPE OF IMPROVEMENT

6.1 SUGGESTIONS FOR IMPROVEMENTS

As a whole the group felt that they achieved the objectives that they set forth for themselves at the beginning of this design process. After completing the designed prototype the group suggests the following improvements

Table 8: Problem with Suggested Solution

Problem or Flaw	Suggested Solution or Improvement
Motor selection	In our project we have assumed one acre of land so we are using 18w motor. Motor of higher rating should be used for cultivating field of larger area.
Unlevel surface of cultivating field	Solenoid valves can be used in case of unlevel surface.
Regular power cuts	The supply to agriculture is limited to few fixed hours throughout the day. In such cases Standby power systems like solar panels can be used.
The farmers have to be on their guard all the time due to the unpredictable nature of supply of electrical energy. And the farmers have to switch on their motor after electricity supply resumes.	GSM technology can be used where motor's status is sent as a message to the farmer's cell phone.

6.2 CONCLUSION

The smart irrigation system has been successfully designed and developed. The sump pump is turned off and on according to the water levels in cultivating field as well as in underground sump. Compare to other conventional methods, the smart irrigation system shows excellent performance with its reliable digital technology and it is cheaper and durable.

The smart irrigation system is a promising system in terms of system response in water level control with respect to the non linearity introduced by pumps, valves and sensors. Thus the smart irrigation system is a big boon as concerned with the agricultural sector as well as other water saving purposes including industries and house hold applications.

Based on the survey result, it is found that the smart irrigation system has a rising demand and it is a good asset from the electronics perspective.

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2. Advance Technique for Soil Moisture Content Based Automatic Motor Pumping for Agriculture Land Purpose By sanjukumar, R V Krishnaiah.
3. Ilonen J. Kamarainen J. K, Lindh T, Ahola J, Kalviainen H andPartanen, **“Diagnosis tool for motor condition monitoring.” IEEE Trans. Ind. Application**

TEXTBOOKS

1. 8051 microcontroller-Mazzidi
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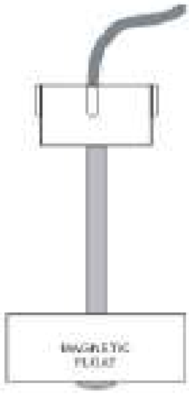
APPENDICES

APPENDIX A: SPECIFICATIONS OF MAGNETIC FLOAT SENSOR

MAGNETIC FLOAT SENSOR



Magnetic Float Sensor

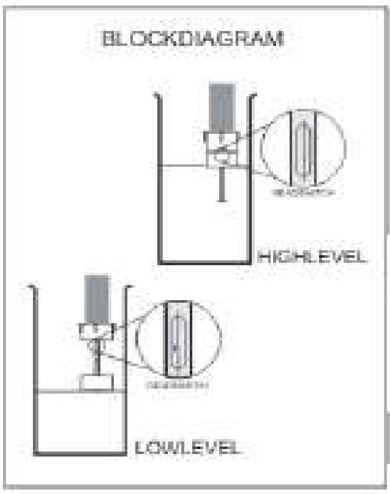
Function:
Magnetic float switches / level sensor sare used to detect the senor shave seale dreed switches in a stem with a permanent magnet installed in the float.As float rises or falls, switch is activated/deactivated.

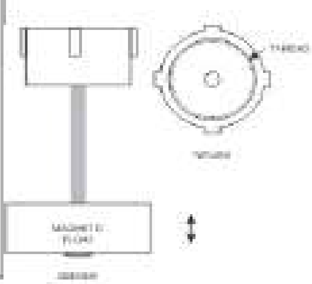
Power House float sensor uses unique magnetic push at the floating magnet to respond fast to any change of liquid level.

Features:
Unique magnetic lift
Suitable for water/oil or fuel sensing
Easy Installation
Can be installed directly on pipe

Specifications:

Level Measurement Type	:Point Level
Switching Capacity	:10 W/VA
Switching Current	:0.5 Amp.max.
Switching Voltage	:25 V DC max.
Material	:EngineeringPlastic
Cable	:2Core
Temperature	:-25 to 75°C





APPENDIX B: IN4007 DIODE CHARACTERISTICS

Maximum Ratings and Electrical Characteristics @T_A = 25°C unless otherwise specified

Single phase, half wave, 60Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

Characteristic	Symbol	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage	V_{RRM} V_{RWM} V_R	50	100	200	400	600	800	1000	V
RMS Reverse Voltage	$V_{R(RMS)}$	35	70	140	280	420	560	700	V
Average Rectified Output Current (Note 1) @ T_A = 75°C	I_O	1.0							A
Non-Repetitive Peak Forward Surge Current 8.3ms single half sine-wave superimposed on rated load	I_{FSM}	30							A
Forward Voltage @ I_F = 1.0A	V_{FM}	1.0							V
Peak Reverse Current @T_A = 25°C at Rated DC Blocking Voltage @ T_A = 100°C	I_{RM}	5.0 50							µA
Typical Junction Capacitance (Note 2)	C_j	15				8			pF
Typical Thermal Resistance Junction to Ambient	$R_{\theta JA}$	100							K/W
Maximum DC Blocking Voltage Temperature	T_A	+150							°C
Operating and Storage Temperature Range	T_J, T_{STG}	-65 to +150							°C

Notes:
1. Leads maintained at ambient temperature at a distance of 9.5mm from the case.
2. Measured at 1.0 MHz and applied reverse voltage of 4.0V DC.
3. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied, see EU Directive 2002/95/EC Annex Notes.

APPENDIX C: RTC DATASHEET

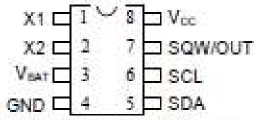
DALLAS SEMICONDUCTOR

DS1307
64 x 8 Serial Real-Time Clock

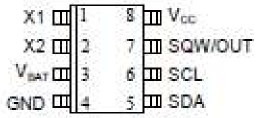
www.maxim-ic.com

FEATURES
- Real-time clock (RTC) counts seconds, minutes, hours, date of the month, month, day of the week, and year with leap-year compensation valid up to 2100
- 56-byte, battery-backed, nonvolatile (NV) RAM for data storage
- Two-wire serial interface
- Programmable squarewave output signal
- Automatic power-fail detect and switch circuitry
- Consumes less than 500nA in battery backup mode with oscillator running
- Optional industrial temperature range: -40°C to +85°C
- Available in 8-pin DIP or SOIC
- Underwriters Laboratory (UL) recognized

ORDERING INFORMATION
DS1307	8-Pin DIP (300-mil)
DS1307Z	8-Pin SOIC (150-mil)
DS1307N	8-Pin DIP (Industrial)
DS1307ZN	8-Pin SOIC (Industrial)

PIN ASSIGNMENT


DS1307 8-Pin DIP (300-mil)



DS1307 8-Pin SOIC (150-mil)

PIN DESCRIPTION
V_{CC}	- Primary Power Supply
X1, X2	- 32.768kHz Crystal Connection
V_{BAT}	- +3V Battery Input
GND	- Ground
SDA	- Serial Data
SCL	- Serial Clock
SQW/OUT	- Square Wave/Output Driver

DESCRIPTION
The DS1307 Serial Real-Time Clock is a low-power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially via a 2-wire, bi-directional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power sense circuit that detects power failures and automatically switches to the battery supply.