# A Project Report on

# 'RTC BASED AUTOMATED FARM'

**Submitted By:** 

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#### 1. PROBLEM DEFINITION

Power failure is major problem in Indian countryside. System must be incorporated with arrangement to overcome this problem. RTC IC DS1307 also has special feature of Automatic Power-Fail Detect and Switch Circuitry, to continue its operation on backup supply without the hassle of power failures.

Different crops require different watering scheme, scheduling and different temperature conditions. To improve the productivity and also quality of agro-product because of crops need water at right time and with uniform amount. This purpose is served by RTC.

Inputs to controller from sensors are analog in nature. Including separate signal conditioning circuitry would make system bulkier and costlier. Hence, ATMEGA 32 with inbuilt ADC is used.

Water level in well cannot be predicted perfectly. So, there must be system indicating water level which is incorporated in system.

#### 2. INTRODUCTION

India is Agro based nation. Agriculture has always imparted a lion's share in the economic development of country. It is necessary to improve the productivity and quality of agro based products. Technology will boost the development in agriculture.

## Why Automate Crop Watering?

Water is the most important element in our life. Without it, we cannot survive. As we know, most of the farmers use manual system to water their crops in the farm, this system is inefficient. When we water manually, the possibility to over watering is high. Some crops can drown when we supply too much water to them. In order to overcome this problem, automatic watering system is used. Sensors such as temperature sensor and soil moisture detector are used to control the watering system. The system also has the capability to indicate the water level. There are many cases when it is inconvenient, if not impossible, to expertly irrigate without automation. For example, dedicated labor may not be available to operate drip systems frequently (multiple times per week or even per day) and for short durations of time, which in many cases is the ideal to maximize yields and avoid wasting water and fertilizer. Growers who automate find that controllers and valves are cost effective and reliable, leaving labor to perform other, more important tasks to grow a better crop.

Farm automation includes monitoring humidity, temperature, water level of wells and uniform supply of water using water sprinkler and drip water irrigation. This includes automated supply of water to the farm fields according to the temperature and humidity conditions. Farm automation will definitely prove to be a boon in the countryside where frequent power failures occur. **Real time clock (RTC)** is used in farm automation. It also includes manual setting of RTC time for change of power cut timing.

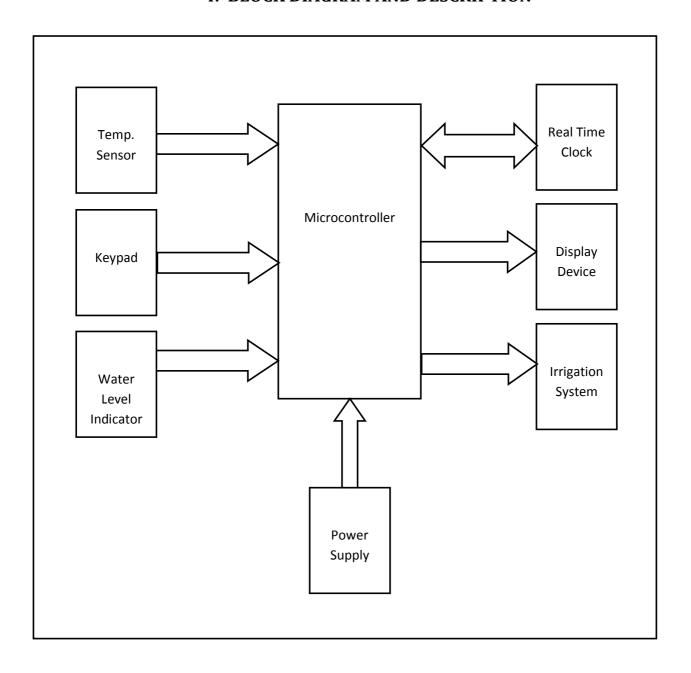
#### 3. OVERVIEW OF PROJECT

The project consists of controller **Atmega32** interfaced with Real Time Clock (RTC) **IC DS1307** through I<sup>2</sup>C Serial Interface. This RTC IC Counts Seconds, Minutes, Hours, Date of the Month, Month, Day of the week, and Year with Leap-Year Compensation Valid Up to 2100. It also has special feature of Automatic Power-Fail Detect and Switch Circuitry, to continue its operation on backup supply without the hassle of power failures.

User is given a keypad and the mounted LCD display to set the time. As the circuit provides clock/calendar plus 56 bytes of NV SRAM, it can be used for wide range of applications. It is possible to program the timer as per the user's need i.e. 24x7 (seven days per week). Also the provision for back-up supply is provided to avoid the event lapse. It will help the users to automatically on/off devices (Various Machines and Motors) in many fields.

Project is designed mainly from the view of villages in India where Power failure is a major problem. As India faces shortage of electricity, in most of the villages there is no power supply for more than 10-12 hours. So they face problem in watering crops. By using Automated Farm it is possible to neglect manual controlling of pump and timing of watering to crops. So that it improves the productivity and also quality of agro-product as crops get water at right time and with uniform amount.

## 4. BLOCK DIAGRAM AND DESCRIPTION



The fig. shows the basic block schematic of Farm Automation. It consists of 8 blocks which are used as different modules in project. Now we will see each block in detail:

## 1. Power Supply:

- The System Uses +12V regulated power supply.
- Step down transformer is used to step down mains voltage to 15V.
- Transformer provides current up to 500mA.
- Bridge Rectifier is used.
- Filter capacitor is used for removing ripples present at the output of bridge rectifier.
- IC 7812 provides regulated +12V dc output voltage

#### 2. Microcontroller:

It is Central processing unit of system. It monitors all input and take corresponding action. Here we are using ATmega32 as Microcontroller. It has several features as follows:

- High-performance, Low-power AVR® 8-bit Microcontroller
- 32 Kbytes of In-System Self-programmable Flash program memory
- 1024 Bytes EEPROM
- 2 Kbytes Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- 8-channel, 10-bit ADC
- Byte-oriented Two-wire Serial Interface.

#### 3. Real Time Clock Module:

Real Time Clocks, as the name suggests are clock modules. They are available as integrated circuits (ICs) and manage timing like a clock. Some RTC ICs also manages date like a calendar. The main advantage is that they have a system of battery backup which keeps the clock/calendar running even in case of power failure. A very small current is required for keeping the RTC alive. This in most case is provided by a miniature 3v lithium coin cell. So even if the embedded system with RTC is powered off the RTC module is up and running by the backup cell. This same technique is used in PC timing also. If you have opened your computer case you will notice a small coin cell in the mother board.

These are some feature of RTC DS1307:

- 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.
- RAM for data storage
- Supports Two-wire serial interface.
- Consumes less than 500nA in battery backup mode with oscillator running.

## 4. Keypad:

- Keypad consists of 3 keys which includes keys for increment, decrement and menu select option.
- Keypad is being used to set time/date of RTC & also provides time to ON/OFF motor.
- One end of the key is connected to microcontroller's port through pull up resistor and other end is connected to ground .

#### 5. Water Level Indicator:

- It is used to monitor the level of water in the well.
- Three LED's are used to represent three different levels. The number of led's glown represent the level of water. Levels are as follows:
  - i. HIGH LEVEL: Three LED ON.
  - ii. MEDIUM LEVEL: Two LED ON.
  - iii. LOW LEVEL: One LED ON.
- Its output is being given to the microcontroller.
- Depending on water level water irrigation system is chosen.

## 6. Display Device:

Here we are using 16X2 LCD as the display device. Following are its features:

- It can show 16 characters in 1<sup>st</sup> line and 16 characters in 2<sup>nd</sup> line.
- A  $10k\Omega$  potentiometer is used for contrast control.
- It has three control lines connected to port D of micrconroller

• 8 Data lines are used for transferring data from microcontroller to LCD. These data lines are connected to port D of microcontroller.

## 7. Irrigation System:

- Irrigation System is dependent on the level of water in the well.
- High level of water indication will result in sprinkle irrigation.
- Mid level of water indication will result in drip irrigation.

## 8. Temperature Sensor:

Here we are using LM35 IC as temperature sensor. It's output is given to microcontroller's ADC which converts it into BCD format and then it is given to LCD. Depending on temp. water irrigation system is activated.

It has several features as follows:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full -55° to +150°C range
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Low self-heating, 0.08°C in stil air

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5. CIRCUIT DIAGRAM AND DESCRIPTION

The heart of circuit is controller. To fulfill different requirements we need a controller which will provide compact design and requires less hardware. ATMEGA32 provides inbuilt ADC port PAX which is used for sensors interface. A temperature sensor LM 35 is connected at PA0.

ATMEGA32 has inbuilt I2C interface which can be used for interfacing RTC DS1307,which provides up to 400 KHz data transfer and Noise Suppression Circuitry Rejects Spikes on Bus Lines. SCL and SDA lines are provided at pin PCO, PC1 of port C. CMOS cell is provided for supply backup. A separate crystal of 32.768 KHz is used for RTC.

For user interaction and display of time and date, a 16X2 LCD display is used. LCD is configured in 4-bit data mode. PORT D is used for interfacing of LCD. PD0-PD3 are connected to D4-D7 of LCD data pins.

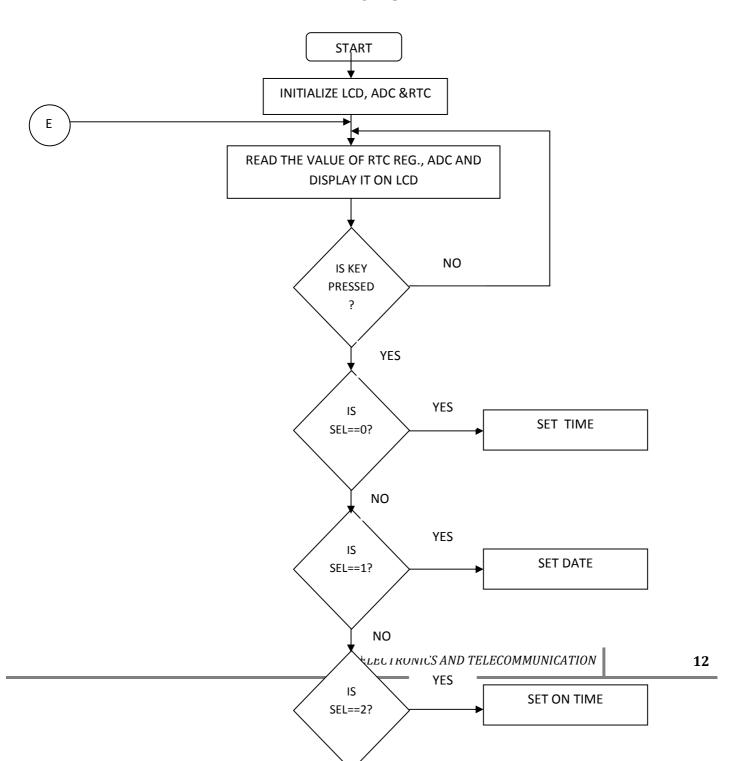
Data entry is done through three SPST switches which are connected to PORTB. Out of three switches, first is used for menu and enter operation, second for increment/left operation, third for decrement/right operation.

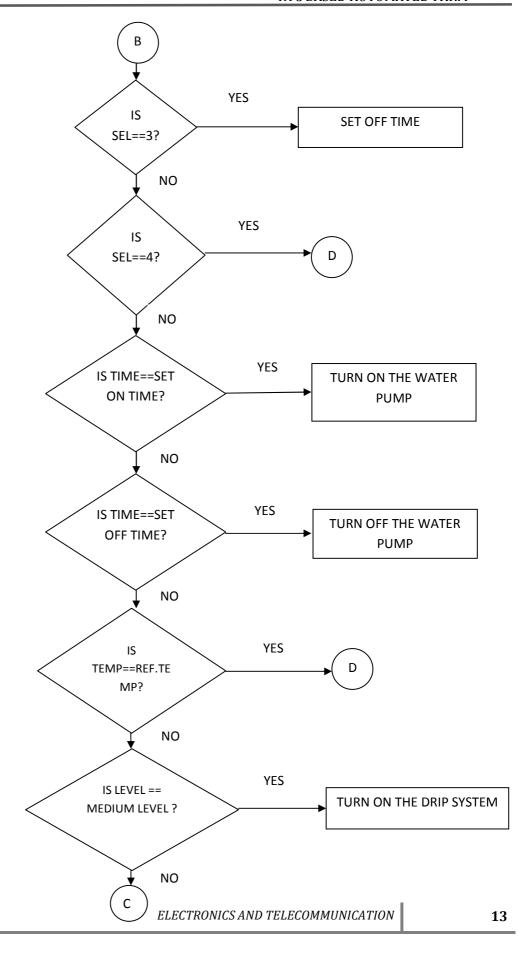
Water level detector is connected to PORTC through ULN2003. Three LEDs are used for level indication. A 230V motor is interfaced through 12V relay. Relay is operated through ULN2003. LEDs are used to indicate which irrigation system is running.

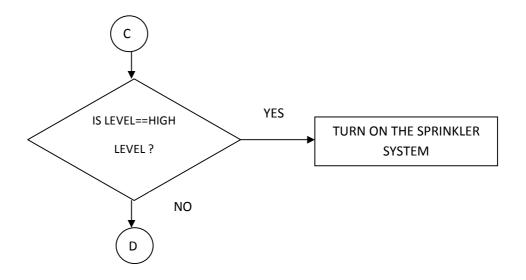
## 6. APPLICATION OF PROJECT

- 1. This system is useful for farmers who have plenty of farm area so they need automation.
- 2. This system is helpful for farmers who travels more and can't give proper attention to there farms.
- 3. This farm is useful to farmer to give water to farm in uniform amount.
- 4. This system is also used for most of the farm by interfacing different sensor to the system to observe different parameters such as humidity, moisture, temperature, air flow etc.

## 7. FLOWCHART







#### 8. ALGORITHM

#### **Main Function:**

- 1. Start
- 2. Initialize the lcd, adc and I<sup>2</sup>C.
- 3. Initialize the rtc register according to the requirement.
- 4. Configure one port as input port for keypad purpose and one port as output for LCD.
- 5. Read the values of registers from RTC through I<sup>2</sup>C and display it on LCD.
- 6. Wait for user to press menu key.
- 7. If key is pressed ,go to step 7. Otherwise go to step 4.
- 8. Display the main menu on the LCD.
- 9. Wait for user to select an option.
- 10. Read the option.
- 11. If the option read is **Set time**, then go to **Set time function**.
- 12. If the option read is **Set date**, then go to **Set Date Function**.
- 12. If the option read is **Set on time**, then go to **Set on time function**.
- 13. If the option read is **Set off time**, then go to **Set off time function**.
- 14. If the option read is **Quit**, then go to Step 4.
- 15. Check if the current time is equal to motor on time, if yes ,then turn on the motor.
- 16. Check if the motor is on and current time is equal to motor off time, if yes ,then turn off the motor.
- 17.Check the water level of the water source, if it's at medium level then turn on drip irrigation system.
- 18.Check the water level of the water source, if it's at high level then turn on sprinkler irrigation system.
- 19.End.

#### A) Set Time function:

- 1. Ask the user to enter the current time using keypad.
- 2. Read the time set by user and writes the values in the RTC registers using I<sup>2</sup>C.
- 3. Display a message indicating new time is set.
- 4. Return.

#### B) Set Date function:

- 1. Ask the user to enter the current Date using keypad.
- 2. Read the Date set by user and writes the values in the RTC registers using I<sup>2</sup>C.
- 3. Display a message indicating new date is set.
- 4. Return.

#### **C)** Set on Time Function:

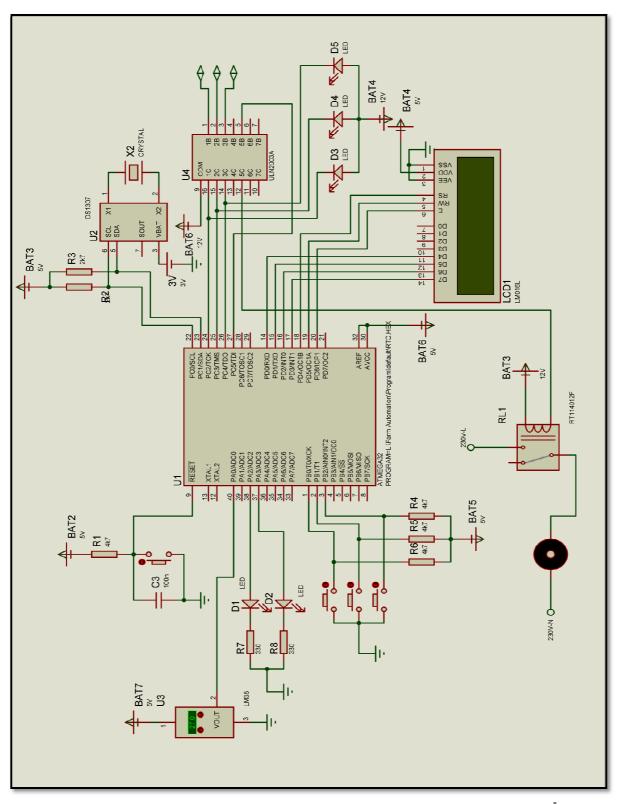
- 1. Ask the user to enter the motor on time using keypad.
- 2. Read the time set by user and store it in an array.
- 3. Display a message indicating motor on time is set.
- 4. Return.

#### D) Set off Time Function:

- 1. Ask the user to enter the motor off time using keypad.
- 2. Read the time set by user and store it in an array.
- 3. Display a message indicating motor off time is set.
- 4. Return.

## 9. TESTING OF HARDWARE

Circuit Diagram of project that is simulated in Protues Suit 7.6:



#### 10. DEBUGGING AND TESTING OF HARDWARE

- **Step1:** Check whether each IC and component is getting required power supply or not. This step is performed by using DMM. Vcc and common points are connected to the Vcc and Ground of components or IC's.
- **Step 2:** Check connection of Vcc and grounds. Check if there is any short between the two supplies or the two grounds.
- **Step 3:** Remove all jumpers. Check if each module is giving required output.
- **Step 4:** If not then that module is faulty.
- **Step 5:** Connect all jumpers and check the final output

#### 11. MANUFACTURING OF PCB

## Printed circuit board (PCB):

Advantage in electronics and need of industrialization and packaging have LED to development of the PCB is the name suggests, a circuit arises because of base terminal. The name is printed on board. Printed circuit construction is more compact and primitives hardening technique to make it.

## Advantages:-

- 1. Efficient routines conductor.
- 2. General flexibility in circuit packaging.
- 3. Easier component mounting.
- 4. Reduce size and weight.
- 5. Reduce wiring error.
- 6. Simple troubleshooting.

#### **Designing of PCB's:**

The designing of PCB's consist of the designing of layout followed by preparation of artwork. The layout should include all relevant aspects and detail of PCB, while the artwork preparation bring it to form required for production process.

#### **Manufacturing of PCB's:**

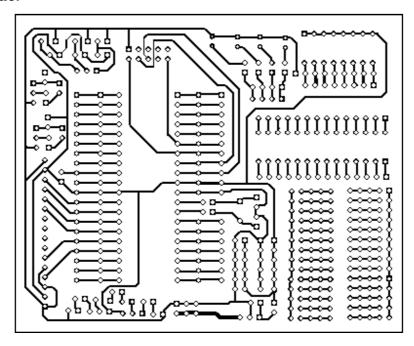
The simplest process on PCB fabrication involves following steps:

- 1. LAYOUT
- 2. ARTWORK AND RULES
- 3. IMAGE TRANSFER

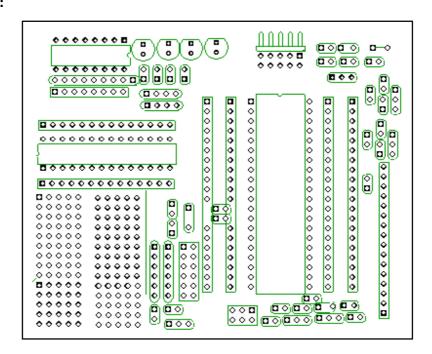
- 4. LAMINATE CLEANING
- 5. ETCHING
- 6. DRILLING
- 7. MOUNTING OF COMPONENTS
- 8. SOLDERING
- 9. LEAD CUTTING

#### PCB Layout:

#### **Bottom Side:**



#### **Top Side:**



#### 12. COMPONENT TESTING

## • Testing of resistor:

In a resistor we have two significant values which are taken as same as the color code chart.

- Third value is multiplier value, multiply with first two number values.
- This is the resistance value of the resistor.
- Forth value is of the tolerance.
- Now check the same resistor by multimeter, positive probe is connected to one end and negative to another.
- If the multimeter shows the value, resistor is in good position and vice versa.
- Confirm the value is under the tolerance value.

## Testing of capacitor:-

- Take the capacitor which is to be tested.
- The facility for testing the capacitor is provided on the DMM.
- Move the positive lead of the capacitor and connect to the positive probe of the DMM.
- Due to this capacitor goes to charge.
- Now move the negative lead of the capacitor and connect to the negative probe of the DMM.
- After this we can see that reading on DMM goes on decreasing, this means that the capacitor is in good condition & vice versa.

# • Testing of IC's:-

- Take the digital IC tester.
- Put the IC in socket of the IC tester.
- Input the IC no. from the keypad available on IC tester.
- If the IC is in good condition, it can display OK sign. Thus the IC is in good condition otherwise it is faulty.

#### 13. ADVANTAGES

- Frees the farmer for other tasks
- Automatic irrigation systems are convenient, especially for those who travel. If installed and programmed properly, automatic irrigation systems can even save you money and help in water conservation. Dead lawn grass and plants need to be replaced, and that can be expensive. But the savings from automatic irrigation systems can go beyond that.
- Watering with a hose or with an oscillator wastes water. Neither method targets plant roots with any significant degree of precision. Automatic irrigation systems can be programmed to discharge more precise amounts of water in a targeted area, which promotes water conservation.
- Performs the best possible job by continually operating the automated systems within ideal parameters
- Alert mechanisms advise the farmer of any problems detected by the farm monitoring equipment
- Helps the farmer optimize resources and achieve the best possible outcomes for their nutrient solution, water supply and the growing systems themselves
- Helps to grow and deliver the best quality product
- Logs key variables which can assist the farmer to meet certification and regulatory requirements.

#### **14. FUTURE SCOPE**

Available services for commercial hydroponics farms include:

- Continual nutrient monitoring to set parameters, including water top up, nutrient top up and water usage.
- Various feeding/watering/misting schedules, integrating real-time parameters such as air temperature and humidity.
- SMS and email alerts for deviations from parameters that may indicate a problem, for example burst pipe.
- Logging of key environmental variables including temperature, wind speed and direction, humidity and rainfall, for automated and management decision making
- Secure off-site monitoring via the internet.
- Battery backup can be given to whole system through solar charging and tracking.

# **15. ESTIMATION OF PROJECT**

| Sr.No | Component            | Quantity | Rate(Rs) | Amount(Rs) |
|-------|----------------------|----------|----------|------------|
| 1.    | 16 x 2 LCD           | 1        | 130/-    | 130/-      |
| 2.    | Atmega32             | 1        | 200/-    | 200/-      |
| 3.    | LM 7805              | 1        | 9/-      | 9/-        |
| 4.    | Capacitor (1000uF-   | 1        | 4/-      | 4/-        |
|       | 25V)                 |          |          |            |
| 5.    | Battery Holder       | 1        | 6/-      | 6/-        |
| 6.    | Crystal (32.768 KHz) | 1        | 4/-      | 4/-        |
| 7.    | LED's                | 7        | 1/-      | 7/-        |
| 8.    | Crystal (16 KHz)     | 1        | 8/-      | 8/-        |
| 9.    | IC DS1307            | 1        | 20/-     | 20/-       |
| 10.   | Bridge               | 1        | 6/-      | 6/-        |
| 11.   | 2 Pin Reset          | 2        | 4/-      | 8/-        |
| 12.   | IC LM35              | 1        | 35/-     | 35/-       |
| 13.   | 40 Pin IC Base       | 1        | 4/-      | 4/-        |
| 14.   | 8 Pin IC Base        | 1        | 2/-      | 2/-        |
| 15.   | Relay                | 1        | 10/-     | 10/-       |
| 16.   | ULN2003              | 1        | 10/-     | 10/-       |
| 17.   | Motor                | 1        | 150/-    | 150/-      |
| 18.   | Relimate connector   | 5        | 10/-     | 50/-       |
| 19.   | Transformer          | 1        | 70/-     | 70/-       |
| 20.   | CMOS CELL            | 1        | 15/-     | 15/-       |
| 21.   | Switches             | 4        | 4/-      | 16/-       |
| 22.   | LM 7812              | 1        | 10/-     | 10/-       |
| 23.   | Miscellaneous        |          |          | 50/-       |
|       |                      | TOTAL    |          | 899/-      |

#### 16. REFERENCES

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# **APPENDIX**