Heaven's Light Is Our Guide

RAJSHAHI UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING,
RAJSHAHI-6204, BANGLAGLADESH.

PROJECT REPORT
On

IoT BASED ELECTRIC VEHICLE CHARGING STATION

Course No: ETE 3200

Course Name: Project Design Based on Communication System

SUBMITTED BY:

Name: Syed Mumit Baksh
Roll: 1704046
Year: 3rd year (EVEN)
Session: 2017-18
Submission Date: 20-09-22

SUBMITTED TO:

S.P. Biswas
Assistant Professor
Dept. of ETE, RUET

CERTIFICATE

This is to certify that the project entitled "IoT BASED ELECTRIC VEHICLE CHARGING STATION" is carried out by Syed Mumit Baksh, Roll No: 1704046 under my supervision in the Department of Electronics & Telecommunication Engineering of Rajshahi University of Engineering & Technology.

Signature of the Supervisor

…….....

S.P. Biswas
Assistant Professor,
Dept. of Electronics & Telecommunication Engineering, RUET.

Countersigned Examiner

…….....

Dr. Md. Kamal Hosain
Head,
Dept. of Electronics & Telecommunication Engineering,
RUET, Rajshahi

ACKNOWLEDGEMENT

It is my privilege to express my sincerest regards to my project coordinator, S.P. Biswas, for his valuable inputs, able guidance, encouragement, whole-hearted cooperation throughout the duration of my project.

I deeply express sincere thanks to the Head of Department, Professor Dr. Md. Kamal Hosain for encouraging and allowing me to present the project on the topic “IoT Based Electric Vehicle Charging Station”.

I take this opportunity to thank all teachers who contributed their valuable advice and helped to complete this project successfully.

Finally, I would like to thank my whole class and most of all to my parents who have inspired me to face all the challenges and win all hurdles in life.

Thank you all.

1704046 Syed Mumit Baksh

Abstract

Electric vehicles are relatively a new idea that is striving for a place in the spotlight. It benefits from a number of factors, including lower nursery outflows, fuel reserve funds, and its convenience. Recently, the creation of sustainable power offices has been rapidly expanding in light of the development to suppress the arrival of greenhouse gasses responsible for global warming and to save petroleum products, which are getting increasingly important. Furthermore, the cost of photovoltaic frameworks is gradually decreasing. Along these lines, it is expected that the cost of photovoltaic power would decrease in the future. The pollutions, global warming, and petroleum product losses can be decreased by employing electric vehicles. This paper describes the design and operation of an electric vehicle charging station based on IoT.

Keywords – IoT, Electric Vehicles, EV Charging station.

INDEX

Chapter: 01- Introduction

1.1- Introduction:

Governments around the world are concerned about air pollution produced by the release of byproducts from the combustion process. Every public and commercial sector should invest in renewable energy to ensure that the air is clean and pure. It is necessary to make the changeover from ordinary homes to sensible homes and automobiles to electric vehicles (EVs). Installation of renewable energy installations has increased in recent years. As the number of electric and hybrid vehicles rises, this solution combines all of these trends to provide a practical and environmentally beneficial charging station [1]. There are two kinds of charging stations: AC charging stations and DC fast chargers. Batteries can only be charged with direct current (DC) electricity, although the majority of electricity delivered by the power grid is alternating current (AC). As a result, the majority of electric vehicles incorporate an onboard charger with an AC-to-DC converter (a rectifier). Power is delivered to the onboard charger at an AC charging station. Higher power charging using DC fast chargers need considerably larger AC-to-DC rectifiers, thus the converter is incorporated into the charging station and DC power is given straight to the vehicle, skipping the onboard converter. The majority of completely electric vehicle types can receive both AC and DC power. Charging stations have connectors that meet a number of international standards. DC charging stations are frequently outfitted with numerous connectors in order to charge a wide range of vehicles that use competing standards [2]. This paper describes the design and operation of an electric vehicle charging station based on IoT. The Internet of Things (IoT) is a network of physical items, or "things," that can connect to other systems and devices via the internet and exchange data with them. The power supply circuit in this implementation will create 12V, 5V, and -12V, which will be linked to the main charging station circuit. The controller can switch the supply automatically based on its significance. The user will be able to view the charging status and quantity on the liquid crystal display. Once charging is completed, the gadget can mechanically cease charging, ensuring that the electrical vehicle does not overcharge. EVs have been more popular in the previous decade, owing to lower greenhouse gas emissions and less reliance on oil. It's possible that by next year, there'll be over 35 million EVs on the earth [1]. However, one significant disadvantage of EVs is that their widespread adoption increases branch, high electricity demand to the power grid, and device congestion.

1.2- Applications:

Electric vehicle charging station applications are quite promising both now and in the future. We may charge electric vehicles without polluting the environment by using an EV charging station.

- It is suitable for public transit.
- Military fields appear to be ideal for this as well.
- It can be utilized for spaceflight with additional modifications.
- It can also be used for aviation.

1.3- Objectives:

- To monitor the maximum charging current set in the microcontroller.
- To monitor the charging states requested by the vehicle.
- To reduce energy consumption.
- To check the maximum charging current set according to PWM duty cycle.

Chapter: 02- Required Components & Descriptions

2.1- Apparatus:

The components we use for this project are:

- Centre tapped transformer (12V-0-12V 3A)
- Voltage regulators (7805,7812,7912)
- Capacitors (4700µF 50V, 2pcs)
- Capacitors (4.7 µF 50V, 4pcs)
- Connectors
- Diodes (1N4007, 5pcs)
- Arduino UNO
- LCD 16*2 Display
- I2C Module
- Push Button Switch
- Op-amp (LM358N)
- Resistors (1kΩ, 1pc)
- Resistors (10kΩ, 2pcs)
- Resistors (100kΩ, 2pcs)
- Resistors (470Ω, 2pcs)
- Resistors (220kΩ, 1pc)
- Resistors (47kΩ,1 pc)
- Diodes (1N4148, 2pcs)
- Ceramic Capacitors (.1 µF, 2pcs)
- Relays (30A 12V, 2pcs)
- Transistors (2N2222A, 2pcs)
- Connecting wires.

2.2- Descriptions:

Centre Tapped Transformer (12V-0-12V 3A): Normally, a centre-tapped transformer, also known as a two phase three wire transformer, is utilized in rectifier circuits. When working with AC power, a transformer is utilized to step-down the voltage (example, to 24V or 12V) and then convert it to DC using a rectifier circuit. Because the peak inverse voltage in a center-tapped transformer is double that of a bridge rectifier, this transformer is widely employed in full wave rectifier circuits [3].

The specifications of 12V-0-12V centre tapped transformers are:

- Step-down Centre tapped Transformer
- Input Voltage: 220V AC at 50Hz
- Output Voltage: 24V,12V or 0V
- Vertical mount type
- Low cost and small package

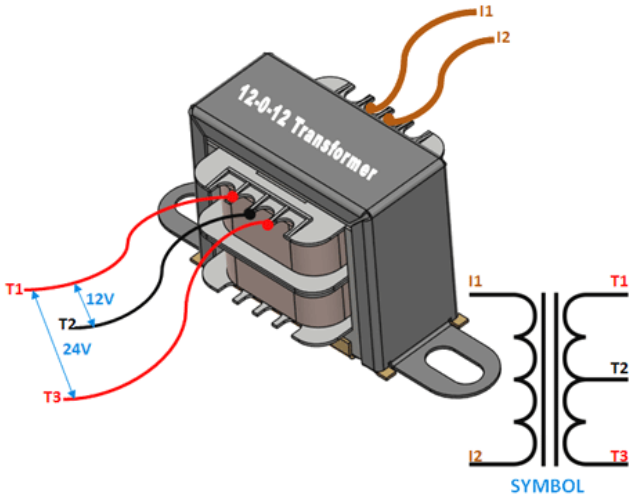
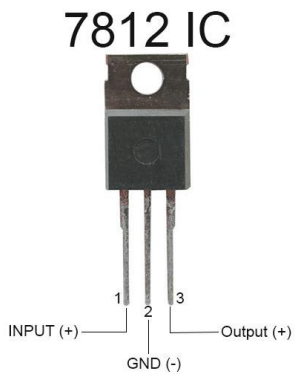


Fig 1(a): 12V-0-12V Centre tapped Transformer

Voltage Regulators (7805,7812,7912): Voltage sources in a circuit may fluctuate, resulting in variable voltage outputs. A voltage regulator integrated circuit keeps the output voltage constant. A prominent voltage regulator integrated circuit is the 7805 Voltage Regulator, which is part of the 78xx series of fixed linear voltage regulators used to maintain such variations (IC). The xx in 78xx represents the output voltage. The 7805 integrated circuit provides a +5 volts regulated power supply with the option of adding a heat sink [4]. The 7812 integrated circuit provides a +12 volts regulated power supply with the option of adding a heat sink [5]. The LM7912 is a -12V voltage regulator integrated circuit. That means, when the input voltage is between -14.5V and -27V, it will provide a constant output value of -12V [6].

Pin configuration:

Pins	7805	7812	7912
1	(V_+) Positive Input Voltage	(V_+) Positive Input Voltage	(GND) Ground
2	(GND) Ground	(GND) Ground	(V_+) Unregulated input voltage
3	(V_o) Positive Output Voltage	(V_o) Positive Output Voltage	(V_o) Outputs regulated -12V



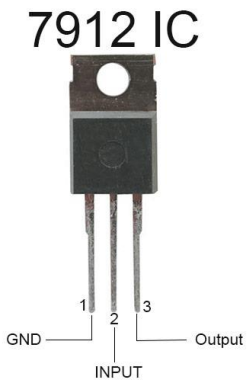


Fig (a): 7805 IC Fig (b): 7812 IC Fig (c): 7912 IC

Fig 1(b): Voltage Regulators (7805,7812,7912)

The features of 7805 IC are:

- Input Voltage range 7V-35V
- Current rating I_c = 1V
- Output Voltage range 4.8-5.2V

The features of 7812 IC are:

- Input Voltage: 14.5V to 27V DC
- Output Voltage: 11.75V to 12.25V DC
- Output Current(typical) 1A
- Peak Current: 2.2A
- Dropout voltage: 2V

The features of 7912 IC are:

- Input Voltage range is -14.5V to -27V
- Peak output current: 2.2A
- 12V negative voltage regulator

Capacitors (4700µF 50v, 4.7µF 50V): Polarity exists in electrolytic capacitors. That is, they have both a positive and a negative pin. The long pin is the positive pin, and the short pin is the negative pin. The negative strip on the capacitor label can also be used to determine polarity. The negative pin will be directly under the negative symbol [7].

The features of electrolytic capacitors are:

- Has a high range of capacitance value starting from 0.01µF to 10000µF.
- Has a high range of voltage value starting from 16V to 450V.
- Can withstand a maximum of 105°C temperature.

Fig 1(c): Electrolytic Capacitor (4700µF 50V)

Diode (1N4007): A diode is a device that only enables current to flow in one direction. In other words, current should always travel from anode to cathode [8].

The specifications of 1N4007 are:

- Average forward current is 1A.
- Reverse current is 5µA.
- Power dissipation is 3W.
- Peak repetitive reverse voltage is 1000V.
- Non-repetitive peak current is 30A.

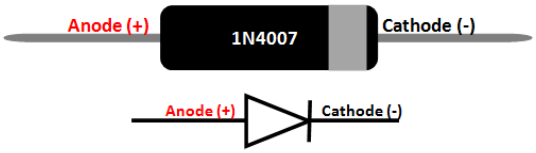


Fig 1(d): Diode (1N4007)

Arduino UNO: Arduino is an open source device that designs and single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various

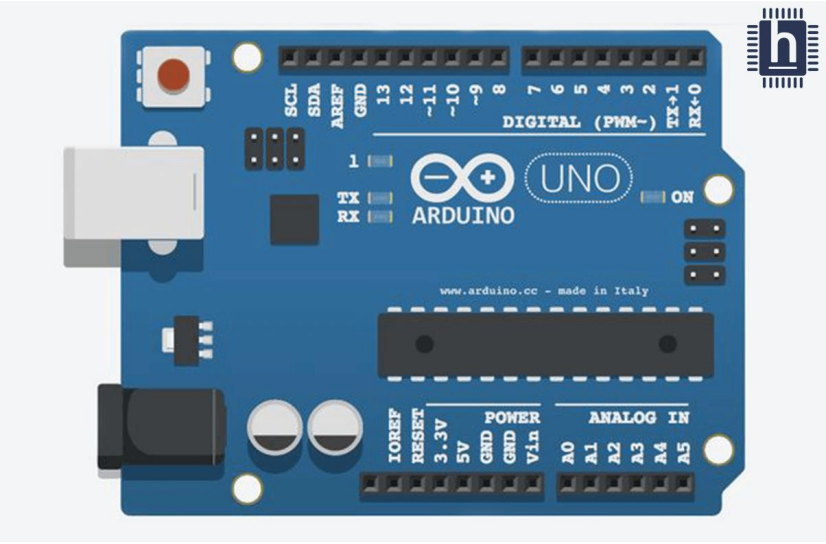


Fig 1(e): Arduino UNO

expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers [9].

Product Specification	
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm

LCD Display: LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. It has 16 columns and 2 rows and that's why it is called 16*2 LCD display. There are also 8*1,16*1 LCD displays but most of us use 16*2 LCD display. A 16*2 LCD display will have (16*2)=32 characters and each character will have (5*8)=40 pixels. This LCD has two registers, namely, comm and Data. Here we use 16*2 LCD display to make it act as a counter and to display the number of visitors [10].

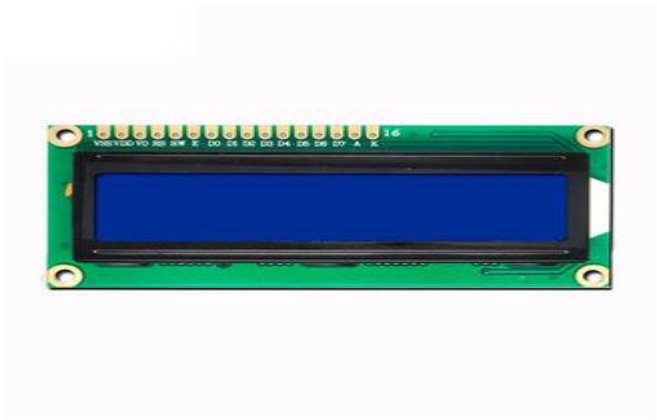


Fig 1(f): 16*2 LCD Display

The features of 16*2 LCD display are:

i. Operating Voltage is 4.7V to 5.3V.
ii. Current consumption is 1mA without backlight.
iii. Alphanumeric LCD display module, meaning can display alphabets and numbers.
iv. Consists of two rows and each row can print 16 characters.
v. Each character is built by a 5×8 pixel box.
vi. Can work on both 8-bit and 4-bit mode.
vii. It can also display any custom generated characters.
viii. Available in Green and Blue Backlight.

Pinout:

Pin No:	Pin Name:	Description
1	Vss (Ground)	Ground pin connected to system ground
2	Vdd (+5 Volt)	Powers the LCD with +5V (4.7V – 5.3V)
3	VE (Contrast V)	Decides the contrast level of display. Grounded to get maximum contrast.
4	Register Select	Connected to Microcontroller to shift between command/data register
5	Read/Write	Used to read or write data. Normally grounded to write data to LCD
6	Enable	Connected to Microcontroller. Pin and toggled between 1 and 0 for data acknowledgement
7	D0	Data pins 0 to 7 forms a 8-bit data line. They can be connected to Microcontroller to send 8-bit data.These LCD's can also operate on 4-bit mode in such case Data pin 4,5,6 and 7 will be left free.
8	D1	Data Pin 1
9	D2	Data Pin 2
10	D3	Data Pin 3
11	D4	Data Pin 4
12	D5	Data Pin 5
13	D6	Data Pin 6

Pin No:	Pin Name:	Description
14	D7	Data Pin 7
15	A	Backlight LED pin positive terminal
16	K	Backlight LED pin negative terminal

I2C Module: Controlling an LCD panel might be difficult due to the restricted pin resources in a microcontroller/microprocessor. With only two pins, serial to parallel adapters such as the I2C serial interface adapter module with PCF8574 chip make the job simple. The serial interface adapter connects to a 16x2 LCD and has two signal output pins (SDA and SCL) for communicating with an MCU/MPU [11].

The features of I2C module are:

- Operating Voltage: 5V DC
- I2C control using PCF8574
- Can have 8 modules on a single I2C bus

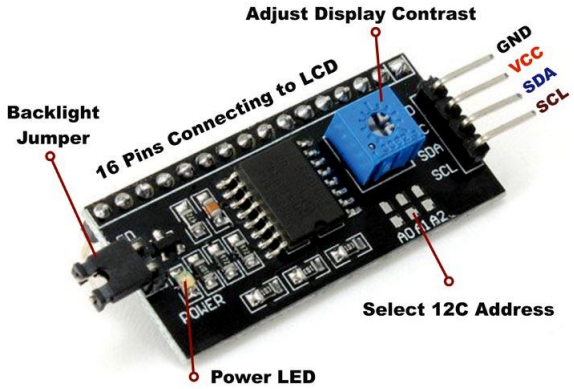


Fig 1(g): I2C Module

Pin Configuration:

Pin Name	Pin Type	Pin Description
GND	Power	Ground
V_{cc}	Power	Voltage Input
SDA	I2C Data	Serial Data
SCL	I2C Clock	Serial Clock
A0	Jumper	I2C Address Selection 1
A1	Jumper	I2C Address Selection 2
A2	Jumper	I2C Address Selection 3
Backlight	Jumper	Control Backlight of panel

Ceramic Capacitors: A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. Ceramic Capacitors have no polarity. So, they can be connected in any direction. They are breadboard friendly. They are used in filter circuits, resonant circuits. They are also used for removing noise from a circuit [12].

Fig 1(g): Ceramic Capacitor (0.1µF)

The features of ceramic capacitors are:

- Capacitor Type – Ceramic.
- Has a high range of capacitance value starting from 10pF to 3.3uF.
- Has a high range of voltage value starting from 16V to 450V.
- Can withstand a maximum of 105°C temperature.

Diode (1N4148): A diode is a device that only enables current to flow in one direction. In other words, current should always travel from anode to cathode. The maximum current carrying capability of the IN4148 Diode is 300mA, and it can sustain peaks of up to 2A. Because of its quick recovery time of 8ns at a forward current of 10mA, this diode is employed in applications requiring fast switching [13].

The features of 1N4148 are:

- Fast switching diode
- Peak repetitive Reverse voltage is 100V
- RMS reverse voltage is 75V
- Peak forward surge current is 2A
- Forward continuous current is 300mA
- Reverse recovery time 8ns.

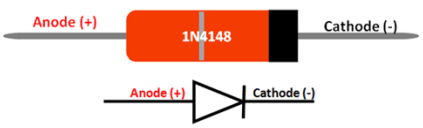


Fig 1(h): Diode (1N4148)

Push Button Switch: Push Buttons are tactile switches that are generally open. Only by pressing the button we have the ability to energize the circuit or make a specific connection. Simply put, it connects the circuit when squeezed and breaks it when released. A push button is also utilized to activate the SCR via the gate terminal. These are the most common buttons seen on electronic gadgets in our daily lives. It is used in calculators, push-button telephones, magnetic locks etc.

The features of push button switch are:

- Prevent flux rise by the insert-molded terminal
- Snap-in mount terminal
- Contact bounce: MAX 5mS
- Crisp clicking by tactile feedback

Fig 1(i): Push Button Switch

Op-amp (LM358N): The LM358N is a dual op-amp integrated circuit having two op-amps supplied by a single power source. It is one half of the LM324 Quad op-amp, which has four op-amps with a shared power supply.
The differential input voltage range can be the same as the power supply voltage range. The default input

offset voltage is incredibly low, measuring only 2mV. The normal supply current is 500uA and hasa maxi mum current of 700uA regardless of the supply voltage range. The operational temperature ranges from 0˚ C to 70˚C at ambient, with a maximum junction temperature of 150 ° C.

It is used in integrators, differentiators, voltage follower, digital multimeter etc. [14].

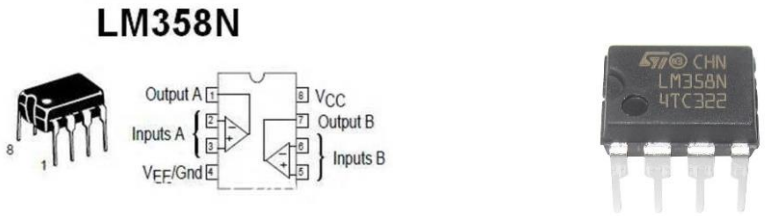


Fig 1(j): Op-amp (LM358N)

The specification of LM358N are:

- Low Supply current – 700uA
- Single supply for two op-amps enables reliable operation
- Integrated with two Op-Amps in a single package
- Short circuit protected outputs
- Operating ambient temperature – 0˚C to 70˚C

Relay (30A 12V): In electronics, relays are the most used switching device. The first significant relay parameter is the Trigger Voltage, which is the voltage required to turn on the relay and shift the contact from Common NC to Common NO. The other parameter is your load voltage and current, which is the amount of voltage or current that the relay's NC, NO, or Common terminal can withstand. It is commonly used in switching circuits, for home automation projects to switch AC loads, used in safety circuits to disconnect the load from supply in event of failure [15].

Pin Number	Pin Name	Description
1	Coil End 1	Used to trigger (On/Off) the Relay, Normally one end is connected to 12V and the other end to ground.
2	Coil End 2	Used to trigger (On/Off) the Relay, Normally one end is connected to 12V and the other end to ground.
3	Common (COM)	Common is connected to one End of the Load that is to be controlled.
4	Common (COM)	Common is connected to one End of the Load that is to be controlled.
5	Normally Close (NC)	The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger.
6	Normally Open (NO)	The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger.

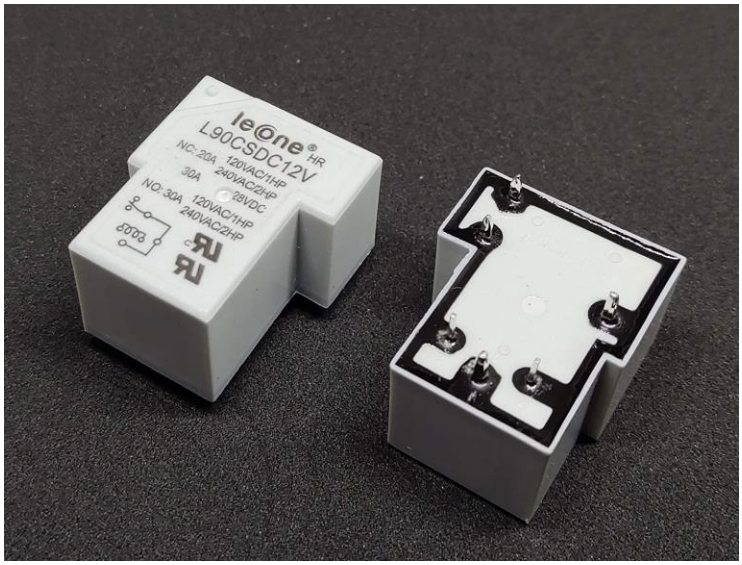


Fig 1(k): Relay (30A 12V)

Resistors: Resistors have two leads and no polarity, so they can be connected in any way. The resistance or value determines how much opposition it causes to the flow of current. The electricity will flow more slowly as the resistance value increases. Resistors are not available in all values; there are only a few commonly used standard values, which are described below. Standard Resistor Values: 0Ω, 1Ω, 10Ω, 22Ω, 47Ω, 100Ω, 150Ω, 200Ω, 220Ω, 270Ω, 330Ω, 470Ω, 510Ω, 680Ω, 1KΩ, 2KΩ, 2.2KΩ, 3.3KΩ, 4.7KΩ, 5.1KΩ, 6.8KΩ, 8.2KΩ, 10KΩ, 20KΩ, 33KΩ, 39KΩ, 47KΩ, 51KΩ, 68KΩ, 100KΩ, 220KΩ, 300KΩ, 470KΩ, 680KΩ, 1MΩ. Resistors are also rated according to how much current they can withstand; this is known as power (wattage) rating. The higher the power rating, the larger the resistor and the more current it can handle. For all electronics projects, a quarter watt (1/8) resistor is utilized by default [17].

Applications of resistors are:

- Current limiter
- It is used to create voltage drop
- It is used to measure current as shunt resistor
- It is used in heater, microwave, toaster etc.
- It is further used in light-bulb.

The features of resistors are:

- Carbon Film Resistor
- 4-band Resistor
- Resistor value varies based on selected parameter
- Power rating varies based on selected parameter

Fig (a): 1kΩ

Fig (b): 10 kΩ

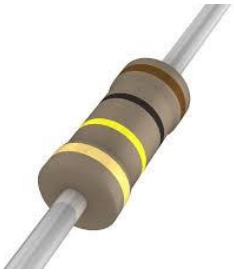


Fig (c): 100kΩ

Fig (d): 470 Ω

Fig (e): 220 kΩ

Fig (f): 47kΩ

Fig 1(l): Resistors

Transistors (2N2222A): Because the 2N2222A is an NPN transistor, the collector and emitter are open (reverse biased) when the base pin is held at ground and closed (forward biased) when a signal is applied to the base pin. The gain value of 2N2222A ranges from 110 to 800, and this number defines the transistor's amplification capacity. Because the maximum current that can flow through the Collector pin is 800mA, we cannot connect loads that use more than 800mA to this transistor. To bias a transistor, we must feed current to the base pin; this current (IB) should be kept to a maximum of 5mA. When fully biased, this transistor can enable up to 800mA to pass across the collector and emitter. This stage is known as the Saturation Region, and the typical voltage allowed across the Collector-Emitter or Base-Emitter could be 200 or 900 mV. When the base current is eliminated, the transistor turns completely off; this stage is known as the Cut-off Region, and the Base Emitter voltage can be as high as 660 mV. It Can be used to switch high current (upto 800mA) loads. It is used in inverter and rectifier circuits. It is also used in speed control of motors [16].

Fig 1(m): 2N2222A Transistor

2.3- Details about Software (For Designing PCB):

EasyEDA is a web-based EDA tool package that allows hardware engineers to design, model, exchange, and debate schematics, simulations, and printed circuit boards openly and privately. Other capabilities include the ability to create a bill of materials, Gerber and pick and place files, as well as documentary outputs in PDF, PNG, and SVG formats. EasyEDA supports the generation and editing of schematic diagrams, the SPICE simulation of mixed analogue and digital circuits, the development and modification of printed circuit board layouts, and the optional fabrication of printed circuit boards. That's why it was chosen.

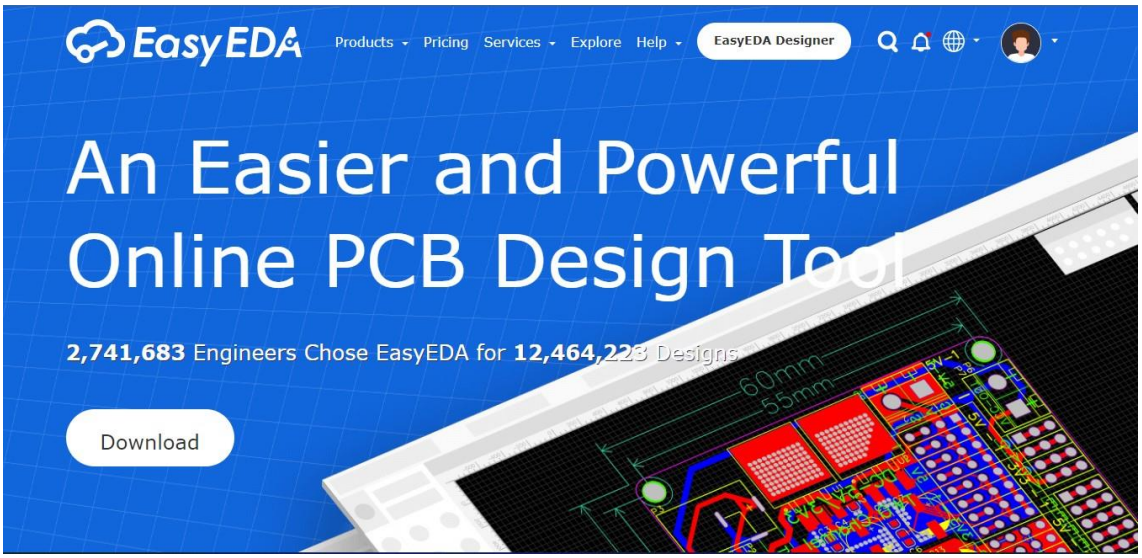


Fig 2: EasyEDA start page

Chapter: 03 – Designing & Implementation

3.1- Circuit Diagram:

The circuit diagram of the IoT based EV charging station is given below:

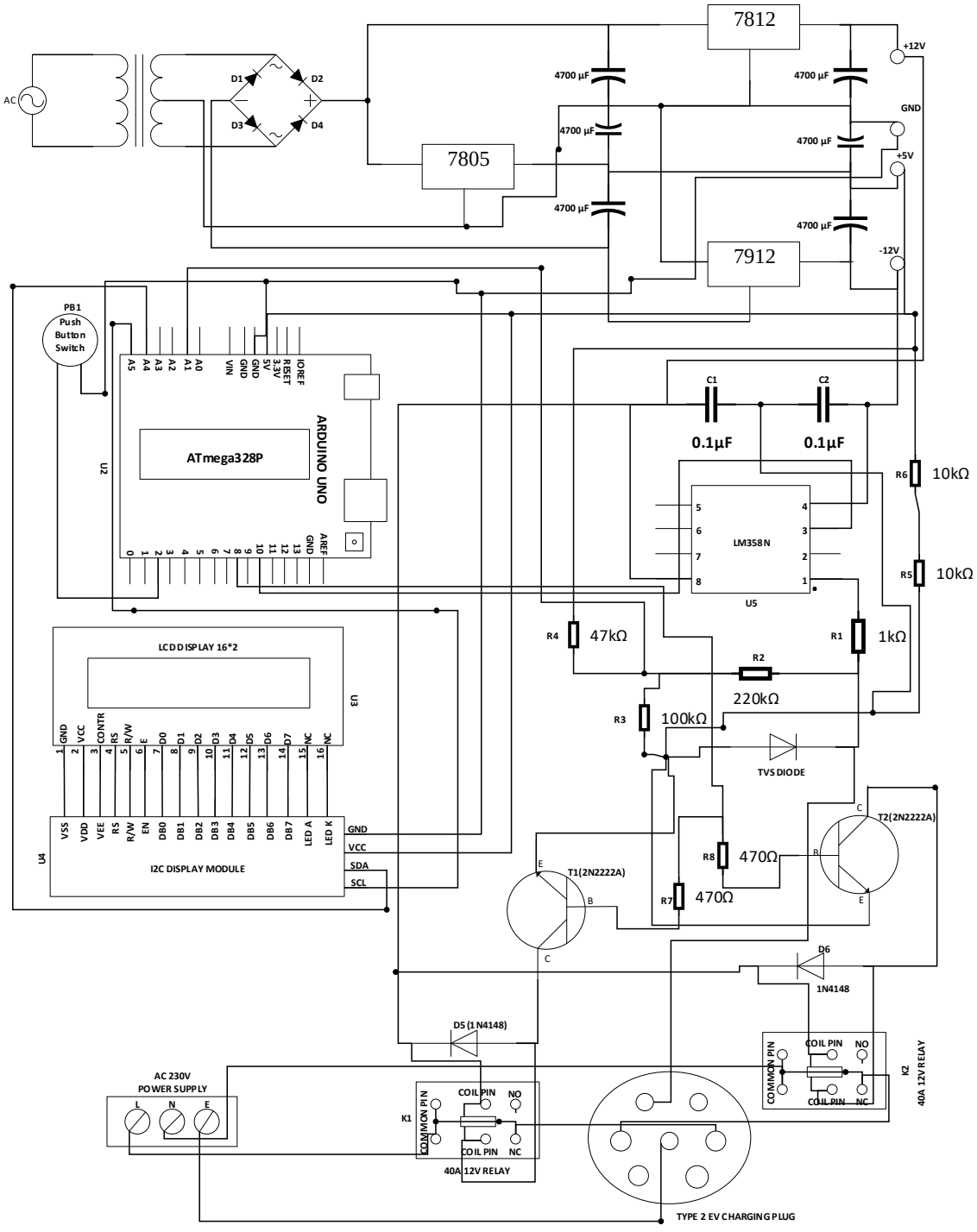
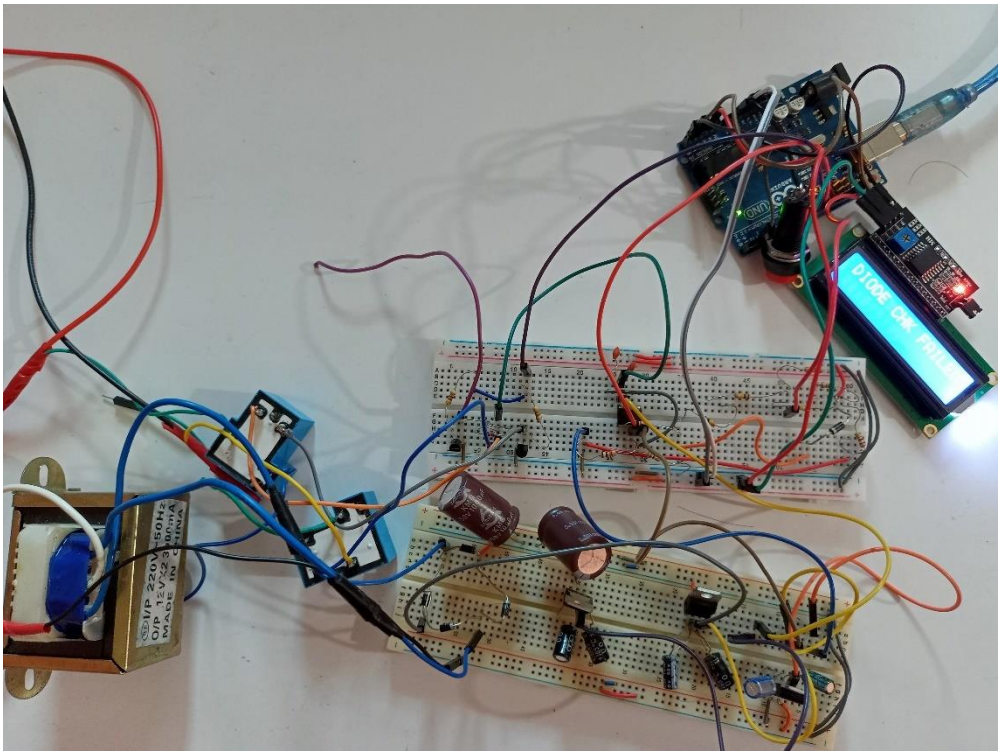


Fig 3(a): Circuit Diagram of IoT Based EV Charging Station

3.2- Hardware Setup:

Bread Board Setup:



(I)

(II)

Fig 3(b): Bread board setup when “diode check failed”

(I) (II)

Fig 3(c): Bread board setup when current is present

PCB Layout:

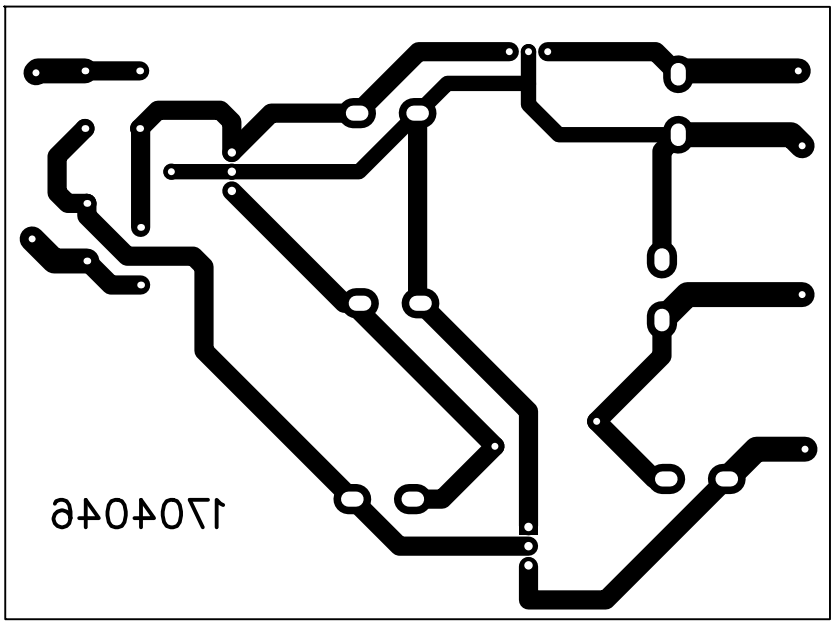


Fig 3(d): PCB layout for Power Supply

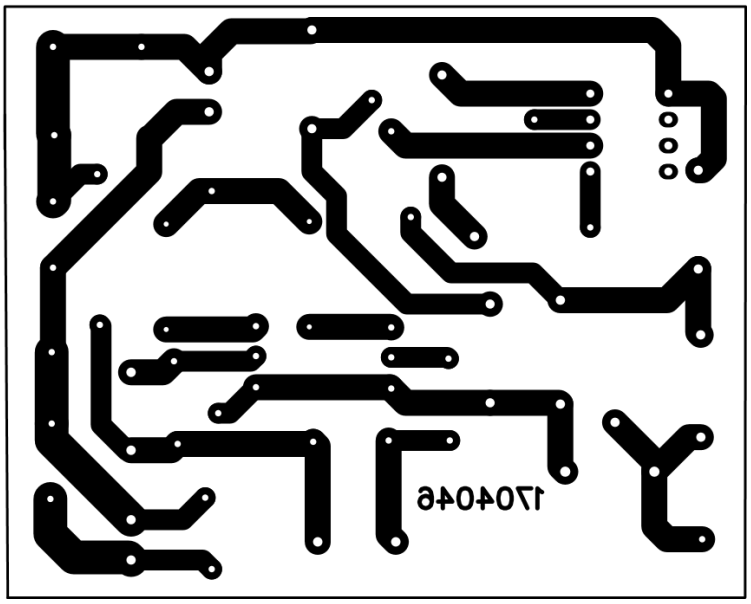


Fig 3(e): PCB layout for main circuit of EV Charging Station

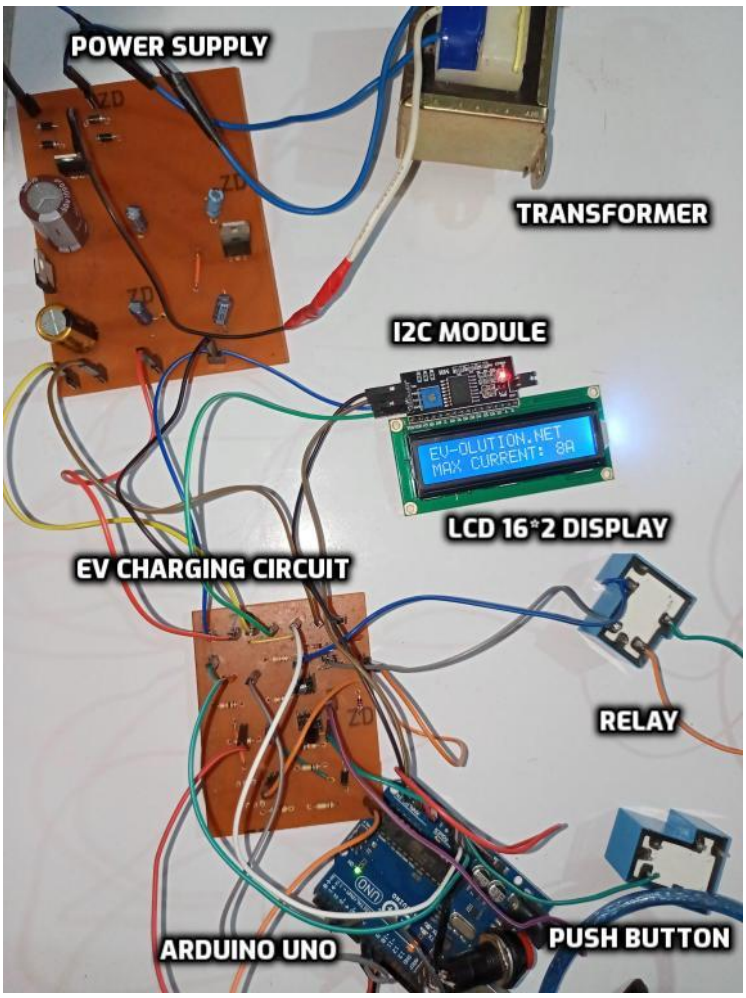


Fig 3(f): PCB Setup for IoT Based EV charging station

3.3- Operating Principle:

In this project, there are two circuits. One for power supply and the other for the EV charging. There is also an Arduino UNO, a push button switch, a LCD display and I2C module connected. When not linked to the vehicle, it will display the maximum current specified in the microcontroller. To modify the maximum current, push and hold the button until the required current appears on the display. The frequency of the control pilot signal must be 1kHz in this case. The display status changes and charging point relays are triggered when the car submits a charging request. The display shows the active charging time as well as the theoretical energy consumption. It also displays the microcontroller's maximum current value. Charging point on control pilot line generates +12V to -12V square wave. The charging condition sought by the car is defined by a voltage drop on the positive side. A negative side is generated for safety purposes to detect the presence of a diode. If the diode is present, the negative side will remain unchanged. If there is a change on the negative signal side, the relays are deactivated for safety. The display will read "DIODE CHECK FAILED." Charging resumes after the issue is repaired. If ventilation is requested, charging is turned off and no PWM signal is produced. If the vehicle requests that charging be stopped, the charging station relays are disconnected and the display reads "CHARGED." It will also display the entire amount of active charging time as well as the overall theoretical energy usage till the vehicle is disconnected. The maximum possible current set on the charging station should be 6A for a 10% PWM duty cycle. Similarly, for PWM duty cycles of 16%, 25%, 40%, and 50%, the maximum available current should be 9.6A, 15A, 24A, and 30A, respectively. Thus, the operation occurs.

Chapter: 04 – Result & Discussion

4.1- Result & Discussion:

The main purpose of this project is to design EV charging station for electric vehicles to reduce pollution, global warming and to save petroleum products. EVs are exceptional when compared to other prospective advancements for healthy and practical transportation frameworks. Though it requires no gas, no emission, low maintenance, there are also some limitations. The biggest reason why people do not favor electric automobiles is the scarcity of charging facilities. Charging stations, unlike petrol stations, are not widespread. There is always the concern of what will happen if the vehicle's battery dies. People in our country are more concerned with more convenient and faster commuting methods than with protecting the environment from the negative consequences of pollution. It is possible to overcome this problem by utilizing public electricity and solar panels. Moreover, though at present EV is costly, year after year, it is upgraded with more innovative technology and solutions to cut costs. Thus, we can say this project fulfills its objectives and can be implemented practically.

4.2- Advantages:

The advantages of EV charging stations are:

- No gas is required.
- More convenient.
- Low maintenance.
- Reduced Noise pollution.
- It makes it easier for EVs to drive.

4.3- Disadvantages:

The disadvantages of EV charging stations are:

- Recharge points.
- Initial investment is steep.
- Electricity isn’t free.
- Short driving range and speed of EV.
- Longer recharge time.
- accountable for urban electricity shortages.

4.4- Future Plan:

- EV drivers are happy if their chargers can tell them when the electricity is the cheapest. This is why smart EV chargers require a scheduling capability to allow charging activities only at specific times. Without the need for any additional assistance from an EV driver. This fantastic feature saves both time and money.

- The majority of EV chargers currently offer static load balancing, which implies manual load control. Another aspect closely related to smart charging is dynamic load balancing, which basically provides safe charging and effective energy distribution. As a result, it can be enhanced by making load balancing dynamic.
- Enabling V2G or bidirectional charging.
- Making EV charging wireless.

4.5- Conclusion:

The main purpose of this project is to lessen human efforts, reduce pollution & global warming, save petroleum products. As EVs become more popular, the number of electric charging stations is growing. If we can put up more charging points per km or mile while lowering costs and improving technology, it would assist the city retain cleanliness, rural areas benefit, and economic growth. If this occurs, the day will come when there will be no polluting vehicles.

4.6- References:

[1] V. K. V. A. L. D. V. D. R. K. P. R. Vinoth Kumar K, ”Implementation of Smart Electric Vehicle Charging Station Driven Using Experimental Investigation,” 2021 2nd Global Conference for Advancement in Technology (GCAT), Oct 1-3, 2021

[2] https://en.wikipedia.org/wiki/Charging_station#Safety

[3] https://components101.com/transformers/12-0-12-center-tapped-transformer

[4] https://www.electronicsforu.com/technology-trends/learn-electronics/7805-ic-voltage-regulator

[5] https://components101.com/ics/lm7812-voltage-regulator-ic-pinout-datasheet-circuit-specifications

[6] https://components101.com/regulators/lm7912-negative-voltage-regulator

[7] https://components101.com/capacitors/electrolytic-capacitor-pinout-datasheet

[8] https://components101.com/diodes/1n4007-diode

[9] https://store.arduino.cc/usa/arduino-uno-rev3

[10] https://components101.com/displays/16x2-lcd-pinout-datasheet

[11] https://components101.com/modules/i2c-serial-interface-adapter-module

[12] https://components101.com/ceramic-capacitor-pinout-parameters-datasheet

[13] https://components101.com/diodes/1n4148-diode-pinout-equivalent-datasheet

[14] https://components101.com/ics/ic-lm358-pinout-details-datasheet

[15] https://components101.com/switches/12v-relay

[16] https://components101.com/transistors/2n2222a-pinout-equivalent-datasheet

[17] https://components101.com/resistors/resistor