Renewable Energy Powered Smart Charging System
For Electrical Vehicles

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Abstract – The main aim of this project is to design a prototype of an Electrical Vehicle that utilizes Renewable Energy Resources such as. Piezo and Solar. Additionally, this Prototype uses Wireless Power Transmission (WPT) technology which is secured through GSM. WPT enables the transmission of power from the source to the receiver without any physical connection hence it would reduce the cost and complexity. As we have also included GSM technology it enables the communication and control between sources and our vehicle and hence provides more security and reliability

*Index Terms –***Renewable Energy, Solar Energy, Piezoelectric Sensor,** *Wireless Power Transfer (WPT), GSM.*

I INTRODUCTION

Solar energy is the most abundant renewable energy resource for the generation of electricity with less pollution. The generation of electricity can be used in various fields like industries, home appliances, agriculture fields… etc, but nowadays it can also be used in electric vehicles.

Electric vehicle solves the problem of fuel and pollution. Electrical vehicles are helpful in reducing costs by replacing fuel with electricity. We can charge electric vehicles faster by using this piezoelectric sensor and Solar energy.

Security is one of the main problems nowadays. Security is the only reason for accidents and crimes. In the present technological world, proper security is important to maintain the comfort of homes, banks, and offices. The main feature of this project is to show not only advanced automatic techniques but also the security features of this prototype.

Various security services can be registered in the system, so that information can be transferred to that service's numbers in case of emergency.

Wireless power transfer is one of the emerging technologies that is used these days. Such WPT can be done in 2 ways they are near-field and far-field techniques. Here near-field technique involves Electromagnetic Induction whereas the far-field technique involves Electromagnetic Radiation. Electromagnetic induction is possible with both Electrodynamic and Electrostatic induction.

Inductive Coupling and Magnetic resonance Induction are two major techniques that are used for Electromagnetic Induction while Microwave (MW), LASER comes under Electromagnetic Radiation. Any of these techniques can be used for WPT based on user comfort. Here we have used Inductive Coupling.

Nowadays IC engine vehicles are used everywhere. But it has many drawbacks such as it runs on gasoline and diesel engines which are the conventional type of fuels and produces large amounts of carbon emission as a side product which is very harmful to the environment. Increasing demand is resulting in an increase in the price of fuels.

So to overcome this, the best option is pure electric vehicles which will run on battery and will not produce any type of emission and will be 100% eco-friendly. But the major issue to use electric vehicle is the time required for charging the EV and the lack of charging stations.
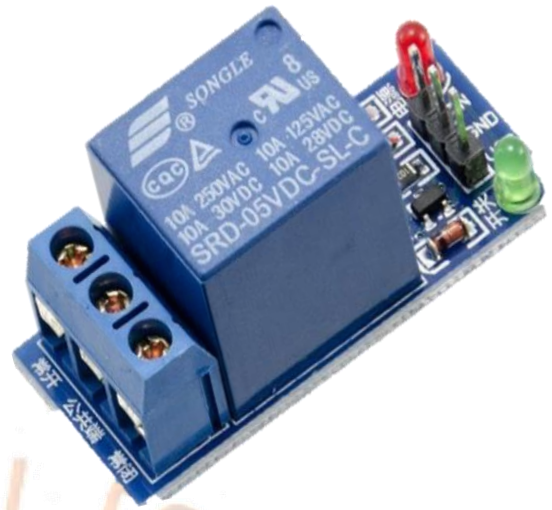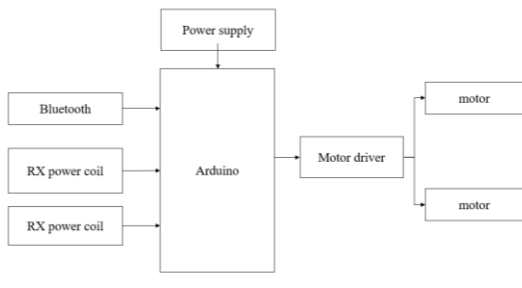
II BLOCK DIAGRAM

The block diagram shown below depicts the Transmitter and Receiver blocks of our prototype.

Block Diagram of TX:
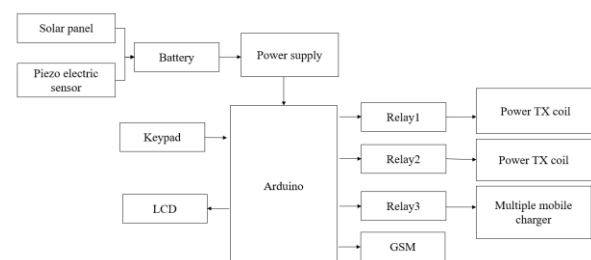
Block Diagram of RX:
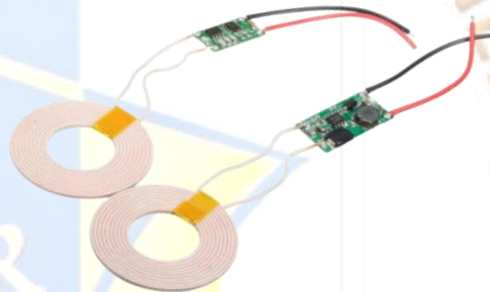

III HARDWARE REQUIREMENTS

• Arduino UNO:

The Uno with Cable is a microcontroller board base on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs); 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

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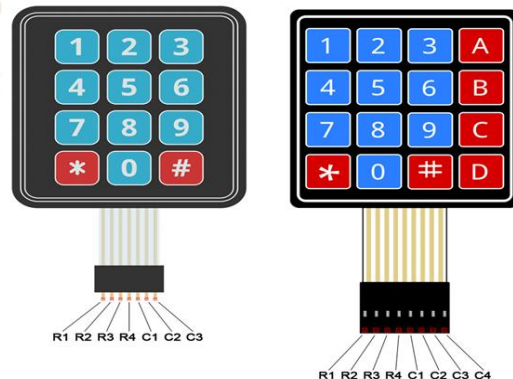

• Relay :

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low-power signal, or where several circuits must be controlled by one signal.

• WPT Coils:

The 5V 2A Large Current Wireless Charger Module Transmitter Receiver Charging Coil Module is for a variety of small electronic products, wireless charging, power supply development, and design, with a small size, easy to use, high efficiency, and low price characteristics.

• Keypad:

A Matrix keypad is the most commonly used input device in many application areas like digital circuits, telephone communications, calculators, ATMs, and so on. A matrix keypad consists of a set of push buttons or switches that are arranged in a matrix format of rows and columns.

These keypads are available in configurations like 3×4 and 4×4 based on the application it is implemented for. Internal diagram of this matrix keypad is shown in the figure above.

• Piezo Sensor :

A sensor that works on the principle of **piezoelectricity** is known as a piezoelectric sensor. Where piezoelectricity is a phenomenon where electricity is generated if mechanical stress is applied to a material. Not all materials have piezoelectric characteristics.
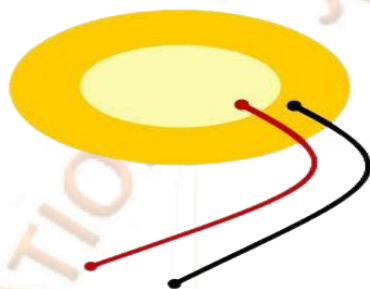

• LCD :

LCD (Liquid Crystal Display) is **a type of flat panel display that uses liquid crystals in its primary form of operation**. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors, and instrument panels.
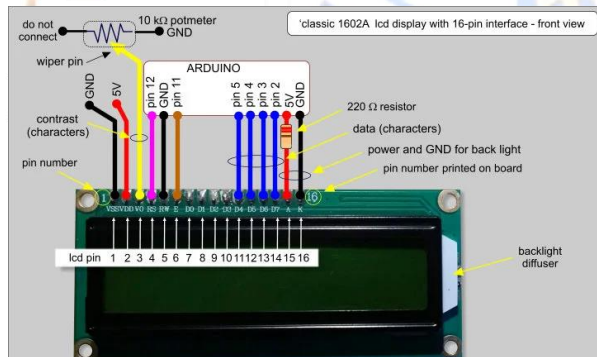
• Motor driver :

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously

in any direction
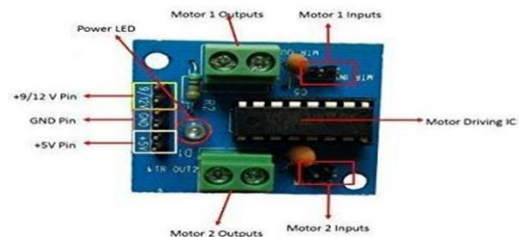
. It means that you can control two motors with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*).
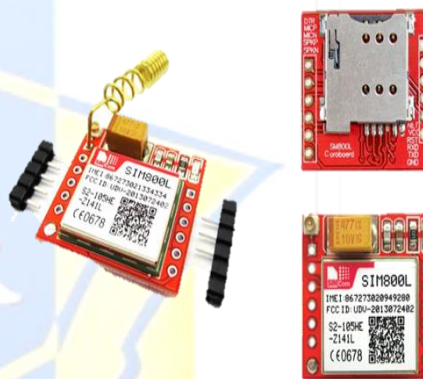
• Bluetooth :

To communicate smartphone with the HC-05 Bluetooth module, the smartphone requires Bluetooth terminal application for transmitting and receiving data. You can find Bluetooth terminal applications for Android and Windows in the respective app. stores.
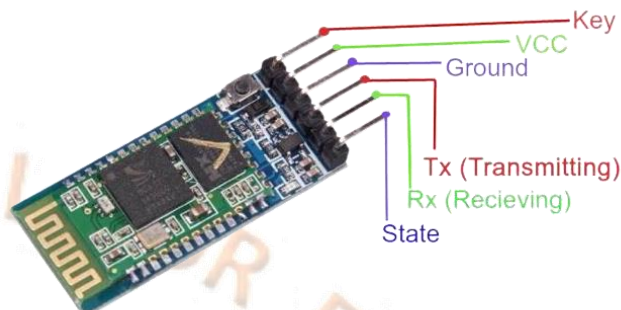
• GSM Module:

A GSM modem is a device which can be either a mobile phone or a modem device which can be used to make a computer or any

other processor communicate over a network.

A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It can be connected to a computer through serial, USB or Bluetooth connection.

IV How solar panels work:

The solar panels are consisting of smaller units called solar cells. These solar cells are mostly made from silicon.Silicon is a semiconductor that is the second most abundant material on the earth. In a solar cell crystalline silicon is sandwiched between conductive material. Each silicon atom is connected to its four neighboring atoms which keeps the electrons in place so no current flow through it.

In solar cell it consists of two different layers of silicon, one is n-type silicon and the other is p-type silicon. Whenever these two types of silicon materials are together then the p-n junction is formed. In the p-n junction, it creates a positive charge on one side and creating a negative charge on the other side.
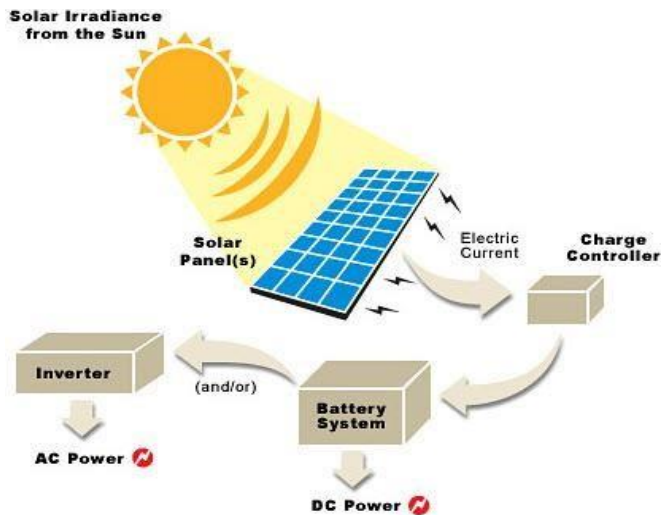
Figure: Foot step energy harvesting.

As we know that the tiny particles in a light is called photons and these are to be shooting out from the sun. When these photons are to be strikes to the surface of the silicon cell with enough energy then it knocks an electron from its bond and leaving a hole. The negatively charged electron and location of the positively charged hole are now free to move around but due to the electric field present at the p-n junction, they will go in one way. The electron from the n side and the hole drawn from the p side, these mobile electrons are collected by the thin metal fingers at the top of the cell.

From there it can pass to the external circuit connected to it, then it powers a light bulb. Each silicon cell only puts out half a volt, but you can string them together which causes you to get more power. For example, if we want to charge a cell phone through solar and twelve photovoltaic cells are enough for it.

HOW PIEZO WORKS

Piezoelectric sensors are electronic components that are able to convert a mechanical or thermal input source into an electrical signal. It works by the principle of electromechanical coupling. Piezoelectricity is the phenomenon that some materials will produce an electrical voltage when subjected to mechanical stress. piezoelectric effect used to measure the electrical potential caused by applying mechanical force to a piezoelectric material. piezoelectric materials are based on the principle of electromechanical energy conversion and primarily measure force, as well as other quantities such as pressure, acceleration, temperature, and strain by converting the acquired data to an electrical charge.

Piezoelectric sensors are used to measure all kind of measurements like Flex motions, touch, vibrations, and shock measurements. They are used in sectors such as healthcare, aerospace, consumer electronics, and nuclear instrumentation. They are important as vibration and shock shorten the life of electronic and electromechanical systems so delicate leads and bond wires tend to be stressed. Due to impact and impulse shock, an intermittent failure may occur as a result of system failure.
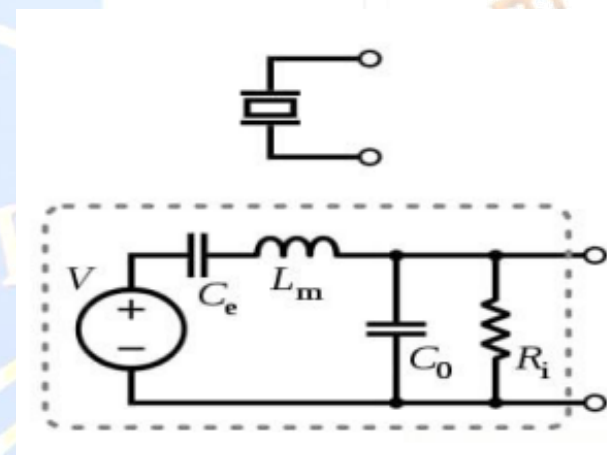

Figure: Circuit diagram of piezoelectric sensor

We can define bridge rectifiers as a type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (AC) current generated by piezoelectric sensors to direct (DC) current. The voltage should be rectified so that the series of LEDs placed in parallel will be lighted up.

This project gives best economical way of generating power which is very useful for common people. This model is useful for applications which require more power. India is a developing country, hence it requires better energy management. Although this model is eco-friendly, there are obviously some limitations to the systems presented. The final prototype design fulfils the objective of generating electricity from piezo electric sensors.

Advantages:

→No more changing batteries

→No messy cords

→Reduces the use of disposable batteries

→Reduces energy loss

→Never run out of battery power in wireless zones

→Power transfers more efficiently than through wires

Applications:

• In industries

• Subsea applications

• Charging mobile devices, unmanned aircraft, home appliances and electric vehicles

V Result

On satisfying our requirements we have designed a prototype as shown below,

VI Conclusion

In conclusion, the implementation of renewable energy-powered smart charging stations for electric vehicles (EVs) is a promising solution to reduce carbon emissions, increase energy efficiency, and promote sustainable transportation. By utilizing renewable sources of energy such as solar, and piezo, these charging stations can provide reliable and clean energy to power EVs. Overall, renewable energy-powered smart charging stations for EVs hold great potential to accelerate the transition toward a more sustainable and carbon-free future.

References:

[1] Liguang Xie; Yi Shi; Hou, Y.T.; Lou, A., "Wireless power transfer and applications to sensor networks," Wireless Communications, IEEE, vol.20, no.4, pp.140,145, August 2013.

[2] Pawade, Sourabh, Tushar Nimje, and Dipti Diwase. "goodbye wires: an approach to wireless power Transmission." Int. journal of emerging technology and advanced engineering. ISSN: 2250- 2459.

[3] Schneider, D., "Wireless power at a distance is still far away [Electrons Unplugged]," Spectrum, IEEE, vol.47, no.5, pp.34,39, May 2010.

[4] Gozalvez, J., "WiTricity-The Wireless Power Transfer [Mobile Radio]," Vehicular Technology Magazine, IEEE, vol.2, no.2, pp.38,44, June 2007.
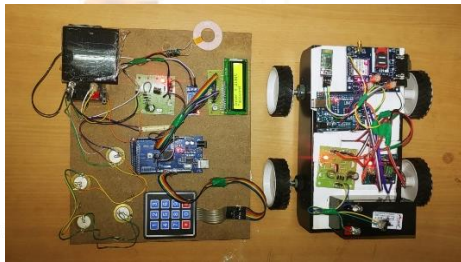
[5] Teck Chuan Beh; Kato, M.; Imura, T.; Sehoon Oh; Hori, Y., "Automated Impedance Matching System for Robust Wireless Power Transfer via Magnetic Resonance Coupling," Industrial Electronics, IEEE Transactions on, vol.60, no.9, pp.3689,3698, Sept. 2013.

[6] Kurs, Andre; Moffatt, Robert; Soljacic, Marin, "Simultaneous midrange power transfer to multiple devices," Applied Physics Letters, vol.96, no.4, pp.044102, 044102-3, Jan 2010.

[7] Kurs, Andre, et al. "Wireless power transfer via strongly coupled magnetic resonances." science 317.5834 (2007): 83-86.

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