DYNAMIC WIRELESS CHARGING OF E-VEHICLE

AIM:

The aim of this project is to develop and implement a dynamic wireless charging system for electric vehicles (EVs) to address existing challenges related to charging infrastructure and range limitations, thereby promoting the widespread adoption of EVs and advancing sustainable transportation solutions.

OBJECTIVES:

- Develop a robust and efficient dynamic wireless charging infrastructure capable of wirelessly transmitting power to EVs while in motion.
- Design specialized road sections equipped with dynamic charging coils integrated seamlessly into the road surface to enable continuous charging of EVs.
- Investigate and integrate advanced power transmission technologies to optimize energy transfer efficiency and ensure reliable charging performance.
- Incorporate renewable energy sources, such as solar power, into the charging infrastructure to enhance sustainability and reduce environmental impact.
- Implement a comprehensive monitoring and control system to monitor real-time power transfer to EVs, enabling data-driven insights for system optimization and performance evaluation.

- Conduct extensive testing and validation of the dynamic wireless charging system under various operating conditions to ensure safety, reliability, and compatibility with different EV models.

ABSTRACT:

The adoption of electric vehicles (EVs) represents a crucial step towards achieving sustainable transportation and mitigating the environmental impact of conventional vehicles. However, despite the numerous benefits they offer, EVs face significant challenges related to charging infrastructure and range limitations.

The existing charging infrastructure primarily relies on stationary charging stations, which necessitate frequent stops for recharging, leading to inconvenience for EV users and limiting the practicality of long-distance travel. Additionally, the range anxiety associated with EVs remains a significant concern among potential buyers, further impeding widespread adoption.

To address these challenges, this project introduces a dynamic wireless charging system for electric vehicles, aiming to revolutionize the EV charging experience and overcome existing limitations. By implementing wireless charging technology integrated into specialized road infrastructure, EVs can receive continuous charging while in motion, eliminating the need for frequent stops and extending their effective range.

The project focuses on the development and deployment of dynamic charging coils embedded within designated road sections, coupled with advanced power transmission technology capable of wirelessly transferring energy to EVs in real-time. Furthermore, the integration of renewable energy sources, such as

solar power, into the charging infrastructure enhances sustainability and reduces reliance on grid-based electricity.

A key aspect of the project involves the implementation of a comprehensive monitoring and control system to optimize energy transfer efficiency and ensure safe operation. Real-time monitoring of power transfer to EVs enables data-driven insights for system optimization and performance evaluation.

In summary, this project aims to rectify the challenges associated with EV charging infrastructure and range limitations by introducing a dynamic wireless charging solution. By offering continuous charging while in motion, this innovative approach not only enhances the practicality and convenience of electric vehicles but also contributes to a cleaner and more sustainable transportation ecosystem.

INTRODUCTION:

In the pursuit of sustainable transportation solutions, electric vehicles (EVs) have emerged as a promising alternative to traditional internal combustion engine vehicles, offering numerous environmental and economic benefits. However, the widespread adoption of EVs is hindered by challenges associated with charging infrastructure and range limitations. Current stationary charging stations require frequent stops for recharging, leading to inconvenience for EV users and limiting the practicality of long-distance travel. Moreover, range anxiety remains a significant concern, deterring potential buyers from transitioning to EVs.

To address these challenges, this project introduces a novel approach: dynamic wireless charging of electric vehicles. Unlike conventional charging methods, dynamic wireless charging enables continuous charging of EVs while in motion, eliminating the need for frequent stops and extending the effective range of EVs. By integrating wireless charging technology into specialized road infrastructure, EVs can receive power seamlessly as they travel, offering unprecedented convenience and enhancing the viability of electric mobility.

This introduction sets the stage for the project, outlining the motivation behind the development of dynamic wireless charging technology and highlighting its potential to revolutionize the EV charging experience. As we delve deeper into the project, we will explore the technical aspects, objectives, methodologies, and expected outcomes aimed at advancing sustainable transportation solutions and accelerating the adoption of electric vehicles.

LITERATURE SURVEY:

1. **Woo-Seok Lee; Jin-Hak Kim; Shin-Young Cho; Il-Oun Lee et al proposed "Direct Wireless Battery Charging System" IEEE 2018**

   This paper presents a direct wireless battery charging system. The output current of the series-series compensated wireless power transfer (SS-WPT) system is used as a current source, and the output voltage of AC-DC converter controls the current source. Therefore, the proposed wireless battery charging system needs no battery charging circuit carrying out charging profiles, and can solve space constraints and thermal problem in many battery applications. In addition, the proposed wireless battery charging system can implement easily most other charging profiles. In this paper, the proposed wireless battery charging system is implemented and the feasibility is verified experimentally according to constant-current constant-voltage charging profile.

2. **Bong-Chul Kim; Ki-Young Kim; Sanoop Ramachandra; Ashish K et al Proposed "Wireless lithium-ion battery charging platform with adaptive multi-phase rapid-charging strategy" IEEE 2015**

the proposed wireless charging platform has been experimentally verified to show more than 70% charging time reduction compared to conventional constant-current constant-voltage (CC-CV) charging without the degradation of battery lifetime. Moreover, the proposed platform and the rapid-charging algorithm are adapted to the conventional commercial wireless robot cleaner.

3. **Yuan-Hua Zhang; Yi-Cheng Lin; Sheng-Xiu Lin; Wei-Zhe Gao; et al Proposed "An implementation of an automatic adjustment power transfer position wireless battery charging system for mobile devices" IEEE 2017**

   The proposed charging system is based on the electromagnetic inductive power transfer technique which is a short distance power transfer system. As a result, we have successfully finished the implementation of the proposed wireless battery charging system. The experimental results showed that this work can achieve the purpose of the optimal charging placement with a shortest power transfer distance.

4. **Yong Tian; Dong Li; Jindong Tian; Bizhong Xia et al Proposed "A comparative study of state-of-charge estimation algorithms for lithium-ion batteries in wireless charging electric vehicles" IEEE 2016**

   In this paper, four popular model-based SOC estimation algorithms, namely extended Kalman filter, unscented Kalman filter (UKF), sliding mode observer and nonlinear observer (NLO) are compared in terms of prediction accuracy, tracking ability to initial SOC error, and computation complexity. Since most resonant topologies for wireless charging systems are featured as constant current, a charging cycle combined with a constant current stage and several pulsed current stages is developed to evaluate the performance of these algorithms. Experimental results indicate that the UKF method performs better than the other three methods in terms of prediction accuracy, while the NLO performs best in terms of tracking ability to initial SOC error and it has the similar accuracy with the UKF method.

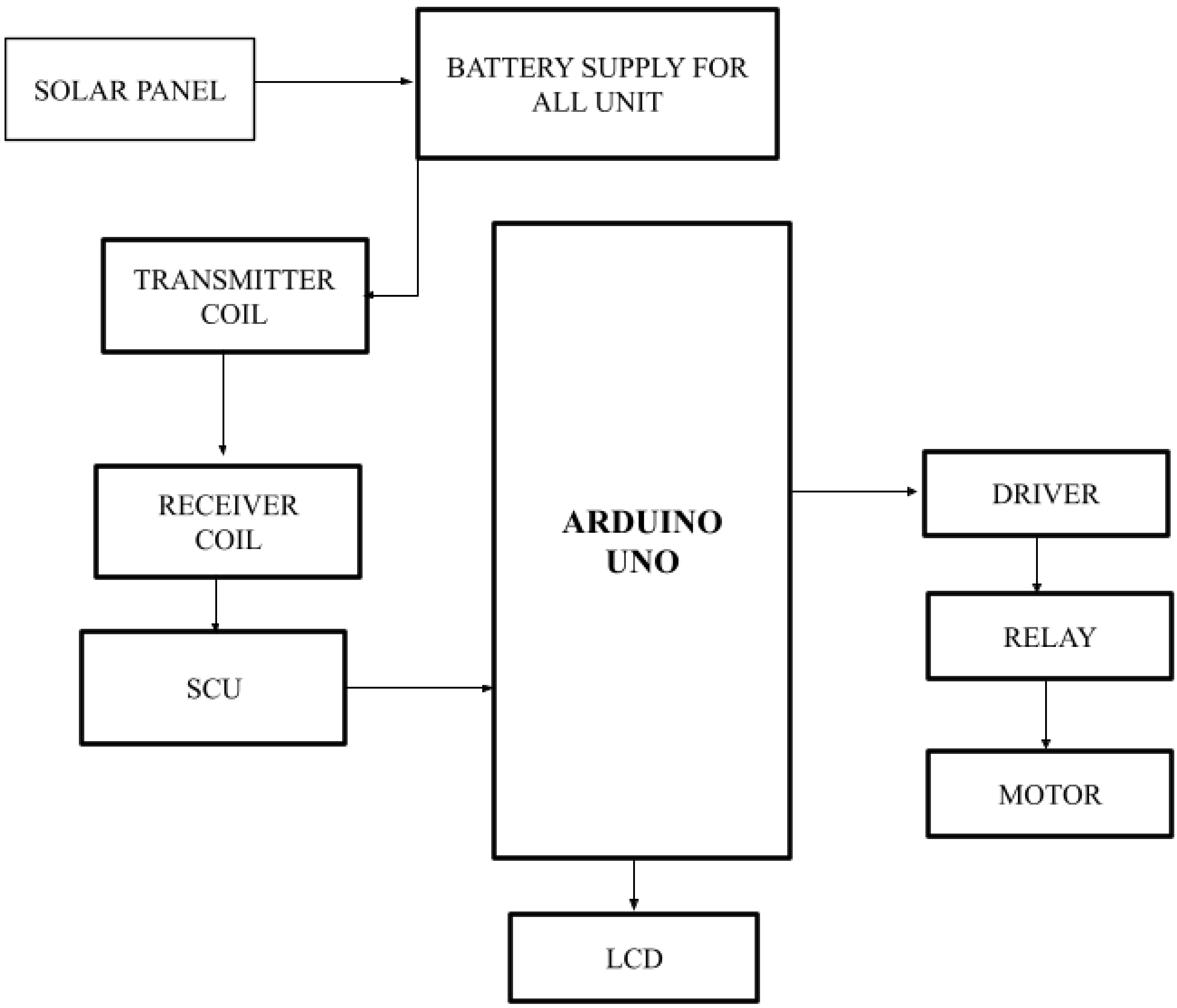
EXISTING SYSTEM:

Wireless/contactless charging of electric vehicles can improve the safety and convenience of the electric vehicle charging process. However, in order to enable wireless charging on an electric vehicle, additional components need to be added to the vehicle, which increase the cost, and weight of the vehicle. Specifically, a wireless receiver coil and power electronics are required to receive the wireless power and charge the battery. This work proposes a new integrated wireless charger, which reuses the existing drivetrain components, such as the traction inverters and the motor, to serve as the receiver-side power electronics for wireless charging. Importantly, this topology limits the high frequency currents entering the traction components, such as the motor, which are susceptible to high frequency losses. The drivetrain can serve to control the charging rate of the batteries, which eliminates the need for transmitter side battery charging control and communication. Experimental validation was done by coupling a 110 kW EV machine and dual-inverter drivetrain to a 6.6 kW wireless transmission system. A peak charging efficiency of 94.3% over a vertical coil distance of 200 mm was achieved.

PROPOSED SYSTEM:

The proposed dynamic wireless charging system for electric vehicles (EVs) integrates specialized road sections equipped with dynamic charging coils embedded beneath the surface, advanced power transmission technology for efficient energy transfer, and renewable energy sources such as solar power to enhance sustainability. This system enables continuous charging while EVs are in motion, addressing the limitations of conventional stationary charging infrastructure and extending the effective range of EVs. A comprehensive monitoring and control system ensures safe operation and optimization of power transfer, while compatibility with a wide range of EV models equipped with receiver modules facilitates widespread adoption. By offering a seamless and efficient charging experience, the proposed system contributes to advancing sustainable transportation solutions and accelerating the adoption of electric vehicles, thus fostering a cleaner and greener transportation ecosystem.

BLOCK DIAGRAM:



HARDWARE DESCRIPTION:

SOLAR PANEL

A solar panel (photovoltaic module or photovoltaic panel) is a packaged interconnected assembly of solar cells, also known as *photovoltaic cells*. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

Because a single solar panel can only produce a limited amount of power, many installations contain several panels. This is known as a photovoltaic array. A photovoltaic installation typically includes an array of solar panels, an inverter, batteries and interconnection wiring.

Photovoltaic systems are used for either on- or off-grid applications, and on spacecraft.

Theory and construction

Solar panels use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The structural (load carrying) member of a module can either be the top layer (superstrate) or the back layer (substrate). The majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon. Crystalline silicon is a commonly used semiconductor.

A solar panel, or photovoltaic module, is composed of individual PV cells. This crystalline-silicon panel has an aluminium frame and glass on the front.

In order to use the cells in practical applications, they must be:

- connected electrically to one another and to the rest of the system
- Protected from mechanical damage during manufacture, transport, installation and use (in particular against hail impact, wind and snow loads). This is especially important for wafer-based silicon cells which are brittle.

- Protected from moisture, which corrodes metal contacts and interconnections, and for thin-film cells the transparent conductive oxidelayer, thus decreasing performance and lifetime.

Most solar panels are rigid, but semi-flexible ones are available, based on thin-film cells.Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired amount of current source capability.

Separate diodes may be needed to avoid reverse currents, in case of partial or total shading, and at night. The p-n junctions of mono-crystalline silicon cells may have adequate reverse current characteristics that these are not necessary. Reverse currents are not only inefficient as they represent power losses, but they can also lead to problematic heating of shaded cells. Solar cells become less efficient at higher temperatures and so it desirable to minimize heat in the panels. Very few modules incorporate any design features to decrease temperature, but installers try to provide good ventilation behind solar panels.[1]

Some recent solar panel designs include concentrators in which light is focused by lenses or mirrors onto an array of smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

Depending on construction, photovoltaic panels can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range (specifically, ultraviolet, infrared and low or diffused light). Hence much of the incident sunlight energy is wasted by solar panels, and they can give far higher efficiencies if illuminated with monochromatic light. Therefore another design concept is to split the light into different wavelength ranges and direct the beams onto different cells tuned to those ranges.[2] This has been projected to be capable of raising efficiency by 50%. The use of infrared photovoltaic cells has also been proposed to increase efficiencies, and perhaps produce power at night.[citation needed]

Sunlight conversion rates (solar panel efficiencies) can vary from 5-18% in commercial production, typically lower than the efficiencies of their cells in isolation. Panels with conversion rates around 18% are in development incorporating innovations such as power generation on the front and back sides.

Silicon modules

Most solar modules are currently produced from siliconPV cells. These are typically categorized into either monocrystalline or multicrystalline modules.

Thin-film modules

Third generation solar cells are advanced thin-film cells. They produce high-efficiency conversion at low cost.

Rigid thin-film modules

In **rigid thin film modules**, the cell and the module are manufactured in the same production line.

The cell is created on a glass substrate or superstrate, and the electrical connections are created *in situ*, a so called "monolithic integration". The substrate or superstrate is laminated with an encapsulant to a front or back sheet, usually another sheet of glass.

The main cell technologies in this category are CdTe, or a-Si, or a-Si+uc-Si tandem, or CIGS (or variant). Amorphous silicon has a sunlight conversion rate of 6-12%.

Flexible thin-film modules

Flexible thin film cells and modules are created on the same production line by depositing the photoactive layer and other necessary layers on a flexible substrate.

If the substrate is an insulator (e.g. polyester or polyimide film) then monolithic integration can be used.

If it is a conductor then another technique for electrical connection must be used.

The cells are assembled into modules by laminating them to a transparent colourlessfluoropolymer on the front side (typically ETFE or FEP) and a polymer suitable for bonding to the final substrate on the other side. The only commercially available (in MW quantities) flexible module uses amorphous silicontriple junction (from Unisolar).

So-called inverted metamorphic (IMM) multifunction solar cells made on compound-semiconductor technology are just becoming commercialized in July 2008. The University of Michigan's solar car that won the North American Solar challenge in July 2008 used IMM thin-film flexible solar cells.

The requirements for residential and commercial are different in that the residential needs are simple and can be packaged so that as technology at the solar cell progress, the other base line equipment such as the battery, inverter and voltage sensing transfer switch still need to be compacted and unitized for residential use. Commercial use, depending on the size of the service will be limited in the photovoltaic cell arena, and more complex parabolic reflectors and solar concentrators are becoming the dominant technology.

The global flexible and thin-film photovoltaic (PV) market, despite caution in the overall PV industry, is expected to experience a CAGR of over

35% to 2019, surpassing 32GW according to a major new study by IntertechPira.

Module embedded electronics

Several companies have begun embedding electronics into PV modules. This enables performing Maximum Power Point Tracking (MPPT) for each module individually, and the measurement of performance data for monitoring and fault detection at module level. Some of these solutions make use of Power Optimizers, a DC to DC converter technology developed to maximize the power harvest from solar photovoltaic systems.

Module performance and lifetime

Module performance is generally rated under Standard Test Conditions (STC) :irradiance of 1,000 W/m², solar spectrum of AM 1.5 and module temperature at 25°C.

Electrical characteristics include nominal power (P_{MAX}, measured in W), open circuit voltage (V_{OC}), short circuit current (I_{SC}, measured in amperes), maximum power voltage (V_{MPP}), maximum power current (I_{MPP}), peak power, kW_p, and module efficiency (%).

Nominal voltage refers to the voltage of the battery that the module is best suited to charge; this is a leftover term from the days when solar panels were used only to charge batteries. The actual voltage output of the panel changes as lighting, temperature and load conditions change, so there is never one specific voltage at which the panel operates. Nominal voltage allows users, at a glance, to make sure the panel is compatible with a given system.

Open circuit voltage or V_{OC} is the maximum voltage that the panel can produce when not connected to an electrical circuit or system. V_{OC} can be measured with a meter directly on an illuminated panel's terminals or on its disconnected cable.

The peak power rating, kW_p, is the maximum output according to STC (not the maximum possible output).

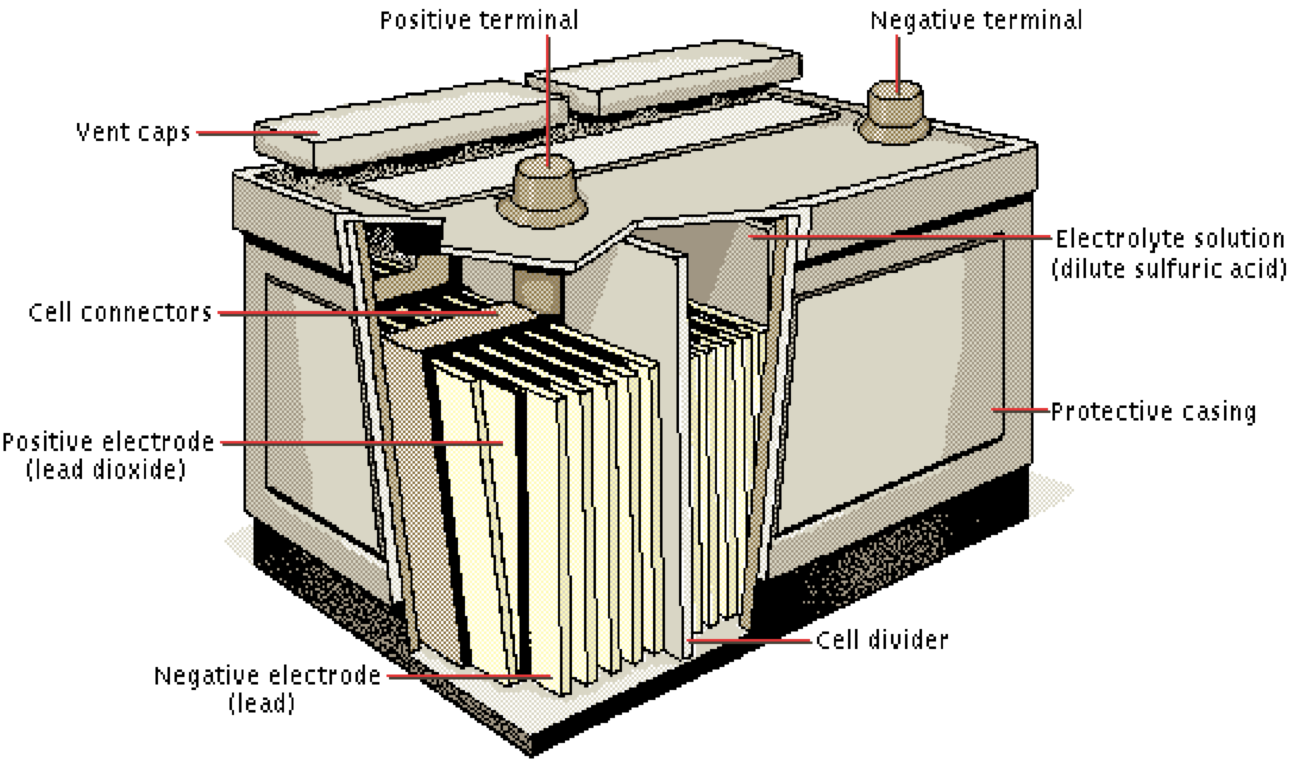
Solar panels must withstand heat, cold, rain and hail for many years. Many crystalline silicon module manufacturers offer a warranty that guarantee electrical production for 10 years at 90% of rated power output and 25 years at 80%

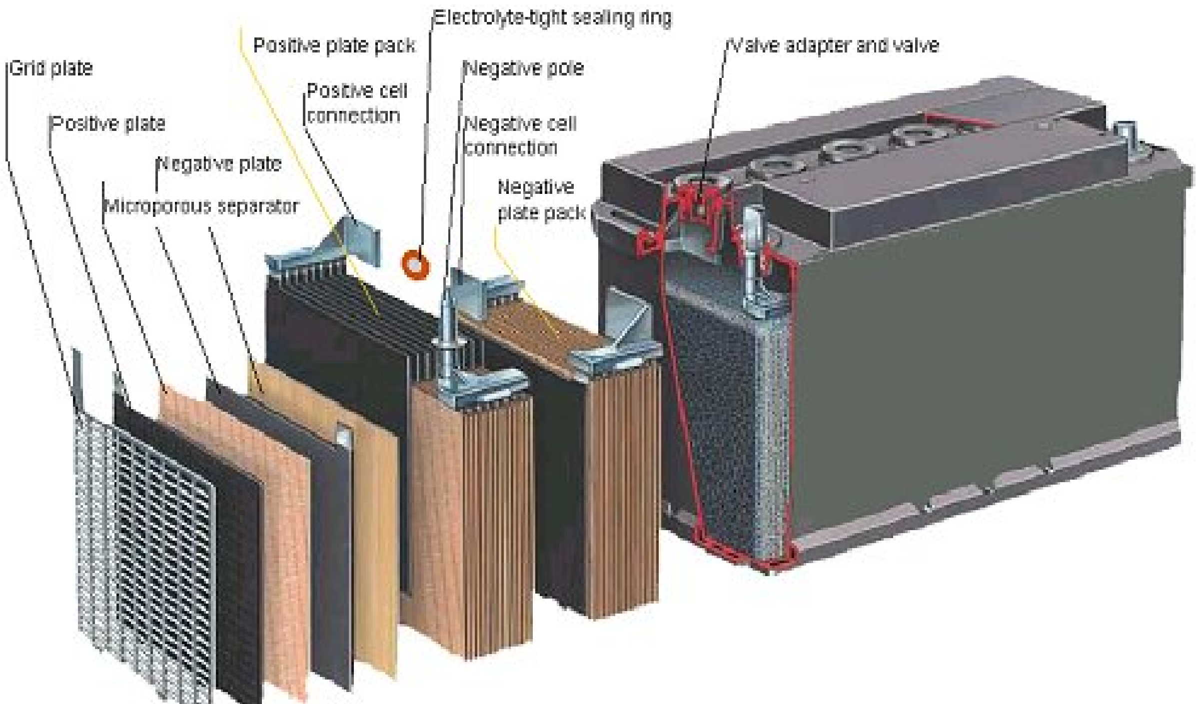
BATTERY CELLS

Battery Cells are the most basic individual component of a battery. They consist of a container in which the electrolyte and the lead plates can interact. Each lead-acid cell fluctuates in voltage from about 2.12 Volts when full to about 1.75 volts when empty. Note the small voltage difference between a full and an empty cell (another advantage of lead-acid batteries over rival chemistries).

LEAD ACID BATTERY

A lead-acid battery is an electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it.





first
the
ion)
and
oads
uffer
from a shorter cycle life and typical usable power down to only 50% Depth of

Discharge (DOD). Despite these shortcomings Lead acid batteries are still being specified for PowerNet applications (36 Volts 2 kWh capacity) because of the cost, but this is probably the limit of their applicability and NiMH and Li-Ion batteries are making inroads into this market. For higher voltages and cyclic loads other technologies are being explored.

Lead-acid batteries are composed of a Lead-dioxide cathode, a sponge metallic Lead anode and a Sulphuric acid solution electrolyte. This heavy metal element makes them toxic and improper disposal can be hazardous to the environment. The cell voltage is 2 Volts

DISCHARGE

During discharge, the lead dioxide (positive plate) and lead (negative plate) react with the electrolyte of sulfuric acid to create lead sulfate, water and energy.

CHARGE

During charging, the cycle is reversed: the lead sulfate and water are electro-chemically converted to lead, lead oxide and sulfuric acid by an external electrical charging source.

Many new competitive cell chemistries are being developed to meet the requirements of the auto industry for EV and HEV applications.

Even after 150 years since its invention, improvements are still being made to the lead acid battery and despite its shortcomings and the competition from newer cell chemistries the lead acid battery still retains the lion's share of the high power battery market.

Gassing is the production and release of bubbles of hydrogen and oxygen in the electrolyte during the charging process, particularly due to excessive charging, causing loss of electrolyte. In large battery installations this can cause an explosive atmosphere in the battery room. Sealed batteries are designed to retain and recombine these gases.

Sulphation may occur if a battery is stored for prolonged periods in a completely discharged state or very low state of charge, or if it is never fully charged, or if electrolyte has become abnormally low due to excessive water loss from overcharging and/or evaporation. Sulphation is the increase in internal resistance of the battery due to the formation of large lead sulphate crystals which are not readily reconverted back to lead, lead dioxide and sulphuric acid during re-charging. In extreme cases the large crystals may cause distortion and shorting of the plates. Sometimes sulphation can be corrected by charging very slowly (at low current) at a higher than normal voltage. Completely discharging the battery may cause irreparable damage.

Shedding or loss of material from the plates may occur due to excessive charge rates or excessive cycling. The result is chunks of lead on the bottom of the cell, and actual holes in the plates for which there is no cure. This is more likely to occur in SLI batteries whose plates are composed of a Lead "sponge", similar in appearance to a very fine foam sponge. This gives a very large surface area enabling high power handling, but if deep cycled, this sponge will quickly be consumed and fall to the bottom of the cells.

Decomposition of the Electrolyte Cells with gelled electrolyte are prone to deterioration of the electrolyte and unexpected failure. Such cells are commonly used for emergency applications such as UPS back up in case of loss of mains power. So as not to be caught unawares by an unreliable battery in an emergency situation, it is advisable to incorporate some form of regular self test into the battery.

Charging

Charge immediately after use.

Lasts longer with partial discharges.

Charging method: constant voltage followed by float charge.

ADVANTAGES

Low cost.

Reliable.

Robust.

Tolerant to abuse.

Tolerant to overcharging.

Low internal impedance.

Can deliver very high currents.

Indefinite shelf life if stored without electrolyte.

Can be left on trickle or float charge for prolonged periods.

Wide range of sizes and capacities

The world's most recycled product.

SHORTCOMINGS

Very heavy and bulky.

Typical coulombic charge efficiency only 70% but can be as high as 85% to 90% for special designs.

Danger of overheating during charging

Not suitable for fast charging

Typical cycle life 300 to 500 cycles .

Must be stored in a charged state once the electrolyte has been introduced to avoid deterioration of the active chemicals.

APPLICATIONS

Automotive and traction applications.

Standby/Back-up/Emergency power for electrical installations.

Submarines

UPS (Uninterruptible Power Supplies)

Lighting

High current drain applications.

Sealed battery types available for use in portable equipment.

VARIETIES OF LEAD ACID BATTERIES

Lead Calcium Batteries

Lead acid batteries with electrodes modified by the addition of Calcium providing the following advantages:

- More resistant to corrosion, overcharging, gassing, water usage, and self-discharge, all of which shorten battery life.
- Larger electrolyte reserve area above the plates.
- Higher Cold Cranking Amp ratings.
- Little or No maintenance.

LEAD ANTIMONY BATTERIES

Lead acid batteries with electrodes modified by the addition of Antimony providing the following advantages:

- Improved mechanical strength of electrodes - important for EV and deep discharge applications
- Reduced internal heat and water loss.
- Longer service life than Calcium batteries.
- Easier to recharge when completely discharged.

- Lower cost.

Lead Antimony batteries have a higher self discharge rate of 2% to 10% per week compared with the 1% to 5% per month for Lead Calcium batteries.

VALVE REGULATED LEAD ACID (VRLA) BATTERIES

Also called Sealed Lead Acid (**SLA**) batteries.

This construction is designed to prevent electrolyte loss through evaporation, spillage and gassing and this in turn prolongs the life of the battery and eases maintenance. Instead of simple vent caps on the cells to let gas escape, VRLA have pressure valves that open only under extreme conditions. Valve-regulated batteries also need an electrolyte design that reduces gassing by impeding the release to the atmosphere of the oxygen and hydrogen generated by the galvanic action of the battery during charging. This usually involves a catalyst that causes the hydrogen and oxygen to recombine into water and is called a recombinant system. Because spillage of the acid electrolyte is eliminated the batteries are also safer.

AGM ABSORBED GLASS MAT BATTERY

Also known as Absorptive Glass Micro-Fibre

Used in VRLA batteries the Boron Silicate fibreglass mat which acts as the separator between the electrodes and absorbs the free electrolyte acting like a sponge. Its purpose is to promote recombination of the hydrogen and oxygen given off during the charging process. No silica gel is necessary. The fibreglass matt absorbs and immobilises the acid in the matt but keeps it in a liquid rather than a gel form. In this way the acid is more readily available to the plates allowing faster reactions between the acid and the plate material allowing higher charge/discharge rates as well as deep cycling.

This construction is very robust and able to withstand severe shock and vibration and the cells will not leak even if the case is cracked.

AGM batteries are also sometimes called "starved electrolyte" or "dry", because the fibre glass mat is only 95% saturated with Sulfuric acid and there is no excess liquid.
Nearly all AGM batteries are sealed valve regulated "VRLA".
AGM's have a very low self-discharge rate of from 1% to 3% per month

GEL CELL

This is an alternative recombinant technology to also used in VRLA batteries to promote recombination of the gases produced during charging. It also reduces the possibility of spillage of the electrolyte. Prone to damage if gassing is allowed to occur, hence charging rates may be limited. They must be charged at a slower rate (C/20) to prevent excess gas from damaging the cells. They cannot be fast charged on a conventional automotive charger or they may be permanently damaged.
Used for UPS applications.

SLI BATTERIES (STARTING LIGHTING AND IGNITION)

This is the typical automotive battery application. Automotive batteries are designed to be fully charged when starting the car; after starting the vehicle, the lost charge, typically 2% to 5% of the charge, is replaced by the alternator and the battery remains fully charged. These batteries are not designed to be discharged below 50% Depth of Discharge (DOD) and discharging below these levels can damage the plates and shorten battery life.

DEEP CYCLE BATTERIES

Marine applications, golf buggies, fork lift trucks and electric vehicles use deep cycle batteries which are designed to be completely discharged before recharging. Because charging causes excessive heat which can warp the plates, thicker and stronger or solid plate grids are used for deep cycling applications.

Normal automotive batteries are not designed for repeated deep cycling and use thinner plates with a greater surface area to achieve high current carrying capacity.
Automotive batteries will generally fail after 30-150 deep cycles if deep cycled, while they may last for thousands of cycles in normal starting use (2-5% discharge).
If batteries designed for deep cycling are used for automotive applications they must be "oversized" by about 20% to compensate for their lower current carrying capacity.

Early road vehicles used fuelled lamps, before the availability of electric lighting. The Ford Model T used carbide lamps for headlamps and oil lamps for tail lamps. It did not have all-electric lighting as a standard feature until several years after introduction. Dynamos for automobile headlamps were first fitted around 1908 and became commonplace in 1920s automobiles.

Silent film star Florence Lawrence is often credited with designing the first “auto signaling arm;” a predecessor to the modern turn signal, along with the first mechanical brake signal. She did not patent these inventions, however, and as a result she received no credit for–or profit from–either one.[1][2][3] Tail lamps and brake lamps were introduced around 1915, and by 1919 "dip" headlamps were available. The sealed beam headlamp was introduced in 1936 and standardised as the only acceptable type in the USA in 1940. Self-cancelling turn signals were developed in 1940. By 1945 headlamps and signal lamps were integrated into the body styling. Halogen headlamp light sources were developed in Europe in 1960. HID headlamps were produced starting in 1991. In 1993, the first LED tail lamps were installed on mass-production automobiles. LED headlamps were introduced in the first decade of the 21st century.

Wireless power system

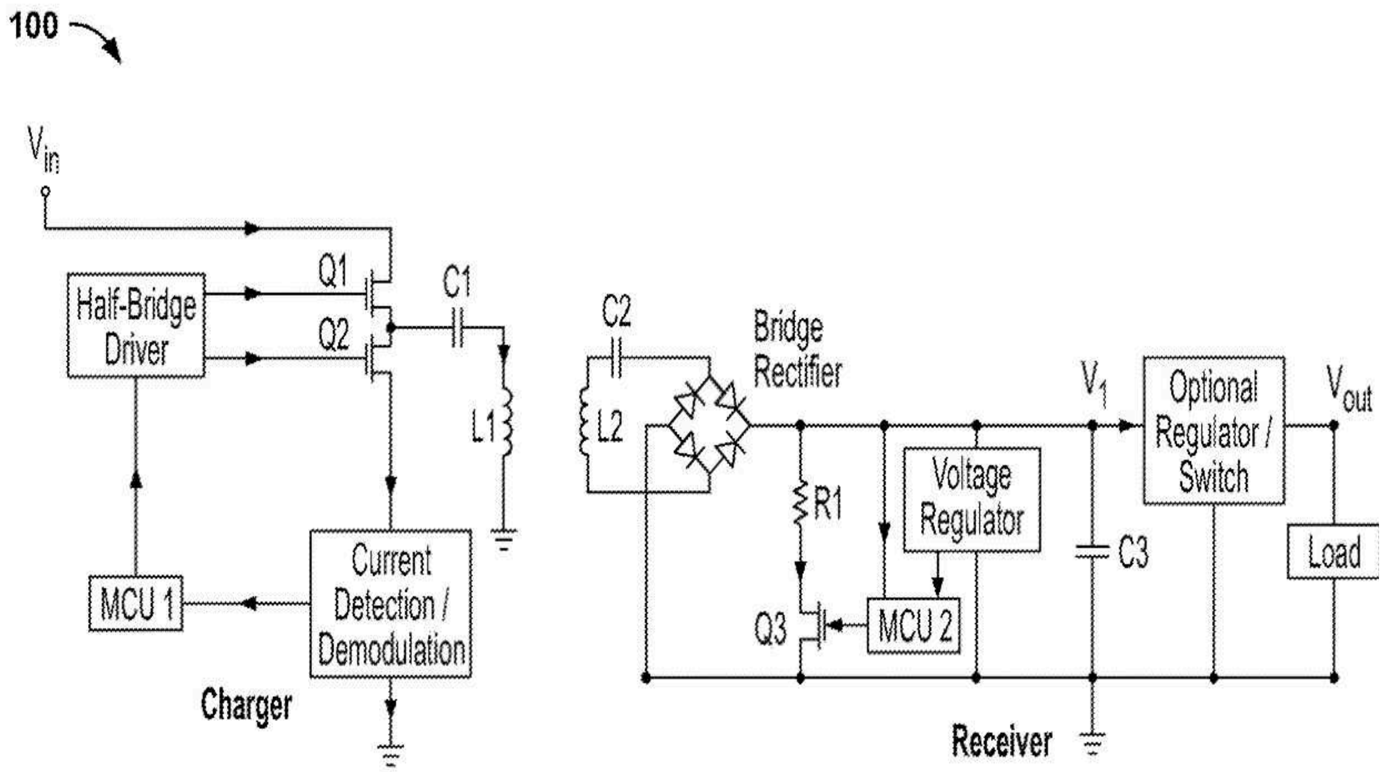


FIG. 1 shows an embodiment **100**, a wireless charger or power system comprising a charger or transmitter part, and a receiver part.

1. A wireless charger or power system comprises a charger and a receiver.
2. The charger generates a repetitive power signal using a coil drive circuit and an antenna for transmitting the power.
3. A receiver includes a coil and antenna to receive power. The receiver also performs **rectification** and **smoothing** operations.

1.

    1. Coil

A coil is an electrical device that can transfers energy between two or more circuits through electromagnetic induction. A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a

varying magnetic field impinging on the secondary winding coil. This varying magnetic field at the secondary induces a varying electromotive force (elf) or voltage in the secondary winding coil. Making use of Faraday's Law in conjunction with high magnetic core properties, transformers can thus be designed as efficiently change AC voltages from one voltage level to another within power networks.

Fig:3.3 model diagram for WPT

2. Power inverter and converter

   A power inverter is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage , frequency, output voltage and overall power handling depend on the design of the specific device. The inverter does not supply any power; the power is provided by dc source. A power inverter can be entirely electronic or may be combination of mechanical effects and electronic circuitry. And also the converter that changes alternating(AC) to direct current(DC).

3. Battery

Battery is the device which is used to store the charge. In this paper power is generated with the help of piezo electric crystal. So, the following power is stored in this battery. Hence we can consume high power with the help of battery without any loss.From the battery we will transmit power to the coil as will as to recharge the car.

2. WIRELESS ENERGY TRANSFER METHODS

Wireless power transfer methods encompass technologies such as Laser, photoelectric, radio waves (RF), microwaves, inductive coupling and magnetic resonance coupling. These technologies can be broadly categorized based on underlying mechanism, transmission range, and power rating. Based on the power transfer distance wireless energy transfer methods can be categorized into two types; near field and far field. If transfer distance is longer than the wavelength of electromagnetic wave, it is categorized in to far field technique. Laser, photoelectric, RF, microwave can be considered as far field energy transfer methods. Inductive coupling and magnetic resonance coupling based methods are regarded as near field approaches. Even though far field techniques have transmission range up to several kilometers, they suffer from the trade-off between directionality and efficiency. Frequency range of far field approaches are typically very high (GHz range) compared to near field (kHz MHz). Inductively coupled near field approaches can be used to transmit high power efficiently in very near range (up to several centimeters). Efficiency of such systems deteriorates exponentially with the distance. The non-radiative WPT system demonstrated in 2007 by MIT based on magnetic

resonance coupling can be used in mid-range application with an acceptable efficiency. This MIT experiment has gained accentuating attention from the research community because many real-world applications require longer transmission range. The main advantages of using WPT are Wireless and fast charging of electric vehicle, efficiency is greater than 95% at the same time power loss is very low.

SIGNAL CONDITIONING UNIT

In electronics, signal conditioning means manipulating an analog signal in such a way that it meets the requirements of the next stage for further processing. Most common use is in analog-to-digital converters.

In control engineering applications, it is common to have a sensing stage (which consists of a sensor), a signal conditioning stage (where usually amplification of the signal is done) and a processing stage (normally carried out by an ADC and a micro-controller). Operational amplifiers (op-amps) are commonly employed to carry out the amplification of the signal in the signal conditioning stage.

INPUTS

Signal inputs accepted by signal conditioners include DC voltage and current, AC voltage and current, frequency and electric charge. Sensor inputs can be accelerometer, thermocouple, thermistor, resistance thermometer, strain gauge or bridge, and LVDT or RVDT. Specialized inputs include encoder, counter or tachometer, timer or clock, relay or switch, and other specialized inputs. Outputs for signal conditioning equipment can be voltage, current, frequency, timer or counter, relay, resistance or potentiometer, and other specialized outputs

SIGNAL CONDITIONING PROCESSES

Signal conditioning can include amplification, filtering, converting, range matching, isolation and any other processes required to make sensor output suitable for processing after conditioning.

FILTERING

Filtering is the most common signal conditioning function, as usually not all the signal frequency spectrum contains valid data. The common example are 60Hz AC power lines, present in most environments, which will produce noise if amplified.

AMPLIFYING

Signal amplification performs two important functions: increases the resolution of the inputed signal, and increases its signal-to-noise ratio. For example, the output of an electronic temperature sensor, which is probably in the millivolts range is probably too low for an Analog-to-digital converter (ADC) to process directly. In this case it is necessary to bring the voltage level up to that required by the ADC.

Commonly used amplifiers on signal conditioning include Sample and hold amplifiers, Peak Detectors, Log amplifiers, Antilog amplifiers, Instrumentation amplifiers or programmable gain amplifiers.

ISOLATION

Signal isolation must be used in order to pass the signal from the source to the measurement device without a physical connection: it is often used to isolate possible sources of signal perturbations. Also notable is that's it is important to isolate the potentially expensive equipment used to process the signal after conditioning from the sensor.

Magnetic or optic isolation can be used. Magnetic isolation transforms the signal from voltage to a magnetic field, allowing the signal to be transmitted without a physical connection (for example, using a transformer). Optic isolation takes an electronic signal and modulates it to a signal coded by light transmission (optical encoding), which is then used for input for the next stage of processing.

APPLICATIONS

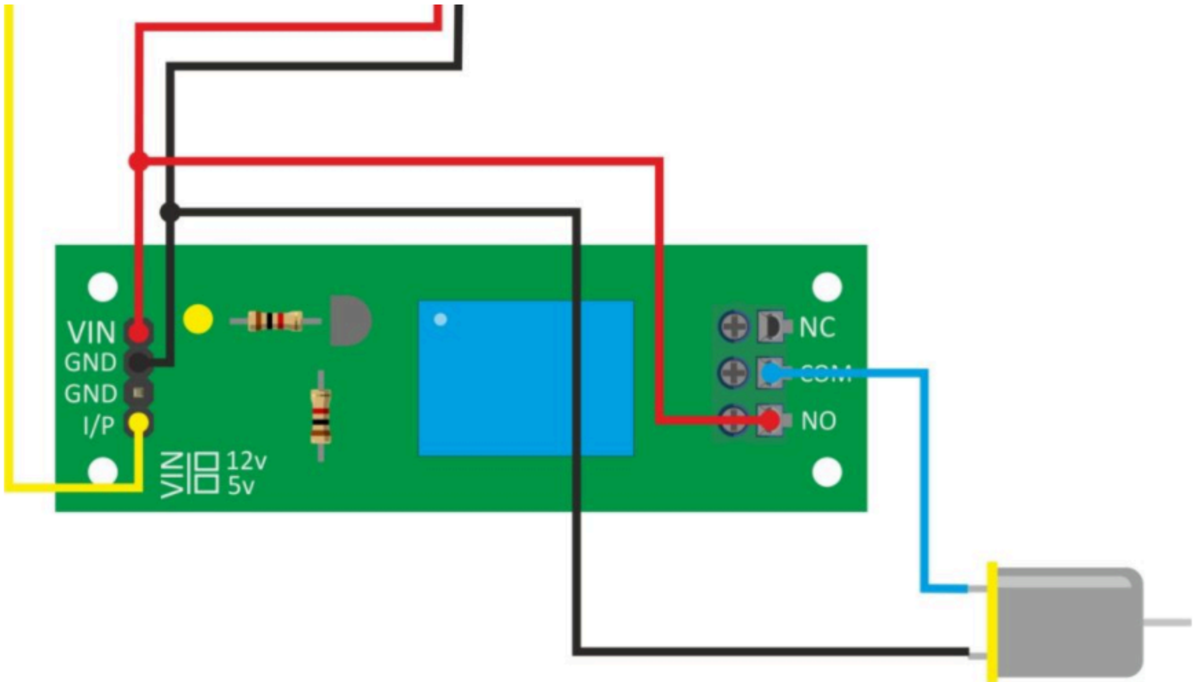
It is primarily utilized for data acquisition, in which sensor signals must be normalized and filtered to levels suitable for analog-to-digital conversion so they can be read by computerized devices. Other uses include preprocessing signals in order to reduce computing time, converting ranged data to boolean values, for example when knowing when a sensor has reached certain value.

Types of devices that use signal conditioning include signal filters, instrument amplifiers, sample-and-hold amplifiers, isolation amplifiers, signal isolators, multiplexers, bridge conditioners, analog-to-digital converters, digital-to-analog converters, frequency converters or translators, voltage converters or inverters, frequency-to-voltage converters, voltage-to-frequency converters, current-to-voltage converters, current loop converters, and charge converters.

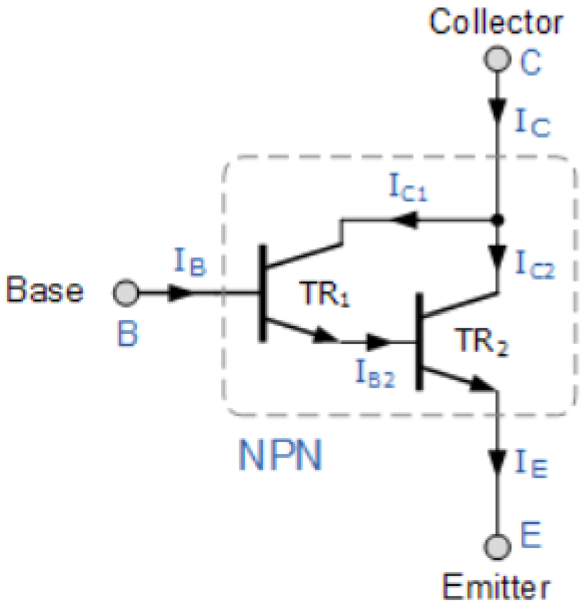
DRIVER / RELAY MODULE

- The driver relay circuit is connected with the digital pins of the micro controller & dc motors will be directly interfaced with the relay module
- According to the pre-loaded code, the controller will send a signal to driver/ relay circuit (ON / OFF). When the driver/ relay circuit gets ON condition the motor will be turned on using 12 volt dc supply
- The connection made with the motor and relay module is shown as below
- The red colour wire denotes the + ve supply, black colour wire denotes the – ve supply and the yellow colour wire mentioned in the diagram will get the output signal sent from the controller to turn on and of the relay

- In relay module there is 3 pins such as normally open/ normally closed and COM
- COM is directly supplied with 12 volt supply
- One terminal of the motor will be connected with the COM pin and the other terminal will be connected with ground
- Initially NC and COM will be connected together in the relay module
- When the relay module get a signal from the controller the connection will set to NO and COM and then the motor can be turned ON
- unless the motor will be in OFF condition
- Once the relay get OFF condition from the controller the connection between the NO and COM will be triggered OFF and the motor will be turned OFF



Relay operation using Darlington Pair



When the base terminal of the NPN transistor is grounded (0 volts), zero current flows into the base therefore Ib = 0.

As the base terminal is grounded, no current flows from the collector to the emitter terminals therefore the non-conducting NPN transistor is switched “OFF” (cut-off).

If we now forward biased the base terminal with respect to the emitter by using a voltage source greater than 0.7 volts, transistor action occurs causing in a much larger current to flow through the transistor between its collector and emitter terminals.

The transistor is now said to be switched “ON” (conducting).

If we operate the transistor between these two modes of cut-off and conduction, the transistor can be made to operate as an electronic switch.

Thus, by this operation we can operate the transistor as a switch to ON and OFF the motor

DC MOTOR

- In this project the motor is used to drive the vehicle which is connected with the driver relay circuit

- The 2 terminals of the motor is connected with the relay and the relay is operated according to the instructions mentioned in the program.
- The dc motor is operating voltage 12 dc voltage and ground
- The motor ON/OFF status will be controlled by micro controller which is programmed in prior programming manner.
- 2 DC motors connected here will built a vehicle set up in our prototype design

Geared dc motors can be defined as an extension of dc motors. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction.

DC MOTOR:

GENERAL DESCRIPTION

The relationship between torque vs speed and current is linear as shown left; as the load on a motor increases, Speed will decrease. The graph pictured here represents the characteristics of a typical motor. As long as the motor is used in the area of high efficiency (as represented by the shaded area) long life and good performance can be expected. However, using the motor outside this range will result in high temperature rises and deterioration of motor parts. A motor's basic rating point is slightly lower than its maximum efficiency point. Load torque can be determined by measuring the current drawn when the motor is attached to a machine whose actual load value is known.

PRODUCT DESCRIPTION

Geared dc motors can be defined as an extension of dc motors. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. A DC motor can be used at a voltage lower than the rated voltage. But, below 1000 rpm, the speed becomes unstable, and the motor will not run smoothly.

FEATURES

- Supply voltage: 12VDC
- Speed: 60rpm
- Long Lifetime, Low Noise, Smooth Motion
- Equipped with high efficiency

APPLICATIONS

- Coin Changing equipment
- Peristaltic Pumps
- Damper Actuators

- Fan Oscillators
- Photo copier
- Ticket printer

16×2 LCD

GENERAL DESCRIPTION

- LCD stands for liquid crystal display. They come in many sizes 8x1 , 8x2 , 10x2 , 16x1 , 16x2 , 16x4 , 20x2 , 20x4 ,24x2 , 30x2 , 32x2 , 40x2 etc . Many multinational companies like Philips Hitachi Panasonic make their own special kind of LCD'S to be used in their products. All the LCD'S performs the same functions (display characters numbers special characters ASCII characters etc).Their programming is also same and they all have same 14 pins (0-13) or 16 pins (0 to 15). Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc.

PRODUCT DESCRIPTION

- This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply. Please take care not to exceed 5V, as this will cause damage to the device. The 5V is best generated from the E-blocks Multi programmer or a 5V fixed regulated power supply. The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

FEATURES

- Input voltage: 5v
- E-blocks compatible
- Low cost
- Compatible with most I/O ports in the E-Block range
- Ease to develop programming code using Flow code icons

APPLICATIONS

- Monitoring

MICROCONTROLLER

ARDUINO UNO

GENERAL DESCRIPTION

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.

PRODUCT DESCRIPTION

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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 a AC-to-DC adapter. Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers.

Arduino UNO

FEATURES

- Microcontroller: ATmega328P
- Operating voltage: 5V
- Input voltage: 7-12V

- Flash memory: 32KB
- SRAM: 2KB
- EEPROM: 1KB

APPLICATIONS

- Real time biometrics
- Robotic applications
- Academic applications

SOFTWARE DESCRIPTION:

SKETCH

In the getting started guide (Windows, Mac OS X, Linux), you uploaded a sketch that blinks an LED. In this tutorial, you'll learn how each part of that sketch works.

A *sketch* is the name that Arduino uses for a program. It's the unit of code that is uploaded to and run on an Arduino board.

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

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 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. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy,[2] aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50
- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.
- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.
- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

Variables

A *variable* is a place for storing a piece of data. It has a name, a type, and a value. For example, the line from the Blink sketch above declares a variable with the name `ledPin`, the type `int`, and an initial value of 13. It's being used to indicate which Arduino pin the LED is connected to. Every time the name `ledPin` appears in the code, its value will be retrieved. In this case, the person writing the program could have chosen not to bother creating the `ledPin` variable and instead have simply written 13 everywhere they needed to specify a pin number. The advantage of using a variable is that it's easier to move the LED to a different pin: you only need to edit the one line that assigns the initial value to the variable.

Functions

A *function* (otherwise known as a *procedure* or *sub-routine*) is a named piece of code that can be used from elsewhere in a sketch. For example, here's the definition of the `setup()` function from the Blink example:

```
void setup()
{
    pinMode(ledPin, OUTPUT);
}
```

The first line provides information about the function, like its name, "setup". The text before and after the name specify its return type and parameters: these will be explained later. The code between the `{` and `}` is called the *body* of the function: what the function does.

pinMode(), digitalWrite(), and delay()

The `pinMode()` function configures a pin as either an input or an output. To use it, you pass it the number of the pin to configure and the constant INPUT or OUTPUT. When configured as an input, a pin can detect the state of a sensor like a pushbutton; As an output, it can drive an actuator like an LED.

The `digitalWrite()` functions outputs a value on a pin.

For example, the line:

```
digitalWrite(ledPin, HIGH);
```

The `delay()` causes the Arduino to wait for the specified number of milliseconds before continuing on to the next line. There are 1000 milliseconds in a second, so the line:

delay(1000);

setup() and loop()

There are two special functions that are a part of every Arduino sketch: `setup()` and `loop()`. The `setup()` is called once, when the sketch starts. It's a good place to do setup tasks like setting pin modes or initializing libraries. The `loop()` function is called over and over and is heart of most sketches. You need to include both functions in your sketch, even if you don't need them for anything.

Everything between the `/*` and `*/` is ignored by the Arduino when it runs the sketch (the `*` at the start of each line is only there to make the comment look pretty, and isn't required). It's there for people reading the code: to explain what the program does, how it works, or why it's written the way it is. It's a good practice to comment your sketches, and to keep the comments up-to-date when you modify the code. This helps other people to learn from or modify your code.

APPLICATION:

- **Transportation:** Implementation of dynamic wireless charging infrastructure on highways, urban roads, and public transportation routes, enabling continuous charging of EVs while in motion, thereby promoting the adoption of electric mobility and reducing reliance on fossil fuels.
- **Fleet Management:** Integration of dynamic wireless charging technology into commercial fleets, such as delivery vehicles and buses, to optimize

operational efficiency, reduce downtime for recharging, and minimize environmental impact.

- **Urban Planning**: Incorporation of dynamic wireless charging infrastructure into urban planning initiatives, facilitating the development of smart cities with sustainable transportation solutions and reducing air pollution and greenhouse gas emissions.
- **Emergency Services:** Deployment of dynamic wireless charging systems for emergency response vehicles, ensuring rapid response times and uninterrupted operation during critical situations.
- **Public Infrastructure:** Integration of dynamic wireless charging technology into public infrastructure projects, including parking lots, airports, and tourist destinations, to provide convenient charging options for EV owners and promote sustainable tourism.

ADVANTAGES:

- **Continuous Charging**: Enables continuous charging of EVs while in motion, eliminating the need for frequent stops and extending the effective range of electric vehicles, thereby enhancing convenience and usability.
- **Increased Adoption of EVs:** Overcomes barriers to EV adoption, such as range anxiety and limited charging infrastructure, by providing a practical and scalable charging solution that enhances the viability of electric mobility.

- **Environmental Benefits:** Reduces reliance on fossil fuels and minimizes greenhouse gas emissions associated with transportation, contributing to efforts to combat climate change and improve air quality in urban areas.
- **Optimized Efficiency:** Utilizes advanced power transmission technology to optimize energy transfer efficiency, reducing power losses and enhancing the overall efficiency of the charging system.
- **Versatility:** Offers versatile applications across various sectors, including transportation, fleet management, urban planning, emergency services, and public infrastructure, catering to diverse needs and requirements.

RESULT AND DISCUSION:

The dynamic wireless charging system demonstrated its potential to revolutionize electric vehicle (EV) charging, offering continuous charging while in motion and addressing key challenges of traditional infrastructure. Real-time monitoring confirmed high efficiency and reliability, validating the integrated power transmission technology. Integration of renewable energy, particularly solar power, reduced environmental impact and enhanced sustainability. Safety measures ensured secure operation. Versatility in applications highlighted scalability across various sectors. The system's transformative impact on EV adoption underscores its significance in advancing sustainable transportation. Further research will optimize the system and facilitate widespread integration, fostering a cleaner and greener transportation ecosystem.

CONCLUSION:

In conclusion, the dynamic wireless charging system for electric vehicles (EVs) represents a significant advancement in sustainable transportation technology. Through continuous charging while in motion and integration of renewable energy sources, particularly solar power, the system addresses critical challenges associated with traditional EV charging infrastructure. Real-time monitoring confirms its efficiency, reliability, and safety, while its versatility enables applications across multiple sectors. The system's transformative potential in accelerating EV adoption and reducing environmental impact underscores its importance in shaping a cleaner and greener transportation future. Moving forward, further research and collaboration among policymakers, industry stakeholders, and researchers will be essential to optimize the system and facilitate its widespread deployment. By harnessing the insights gained from this project, we can pave the way for a more sustainable and accessible electric mobility ecosystem.