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A Review on Electrical Vehicles

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ABSTRACT: With the increase in population, the demand of luxury facilities also increases. That's why, consumption of conventional sources are also increased. So, the technology must grow towards the new sources of energy or renewable resources. Transportation is one of major field of facility. Conventionally, it uses petrol and diesel as fuel, which is a conventional source. But nowadays, electrical vehicles are more popular. It is based on renewable sources of energy. This paper deals with the basic components of electrical vehicles. It also deals with barrier and challenges related to electrical vehicles. It also gives information about charging of battery and energy management in electrical vehicle.

KEYWORDS: Electrical Vehicle, Energy Management, Battery, Challenges.

I.INTRODUCTION

With the rapid increase in the Indian Automobile market, Electric Vehicles (EVs) are turning into a promising channel towards improving air quality, energy security and economic opportunity.

The carbon dioxide emission can be reduced by taking precautionary measures to reduce the catastrophic climate change that threatens the species of this planet. Major endeavours have been taken for minimal use of fossil fuels for power generation, transport propulsion, reduction of energy consumption and protection of carbon sequestration. EVs could be the alternative to decrease the carbon dioxide gas emission.

Harmful emission from the transport sector, and investment by different OEMs, there arises a concern for growing more and low cost EVs in the forthcoming years. Several factors such as technological advancement, reduction in the cost of a vehicle, Govt policy support, vehicle purchasing incentives, parking benefit, and good public charging infrastructure facility could result in the uptake of EVs in India. As the production of EVs is very low, the overall share of EVs in the Indian market. In 2014, India's overall greenhouse gas emission amounted to 3202 million metric tonnes of carbon dioxide equivalent, which accounted for 6.55% of global greenhouse gas emissions. In India, 68% of greenhouse gas emission come from the energy sector, followed by agriculture, manufacturing processes, improvements in land use and forestry, and waste adding 19.6%, 6.0%, 3.8% and 1.9% relative to greenhouse gas emission .An electric vehicle can be used as a flexible load for standardizing the grid with a substantial share of fluctuating renewable energy generation . The owners of the Electric vehicle do not have a transaction in the electricity market due to the low power of a single transaction. Some authors considered a current practice for the estimation of current smart policies, which were established in advance for changing scenarios and are exogenous. To exploit the full potential of an EV, flexible load, and smart charging strategies should be executed. In another study by revealed that, the EV users organized them- selves to impart to the aggregator as far as timing and energy necessity. The timing requirement defines the time by which a charging operation must be completed, whereas the battery level supports the energy requirement. In a similar study conducted by indicated that a de- centralised framework and a central entity should provide the pricing signal to owners of electric vehicles expecting the centralised and de- centralised frameworks to overlap.

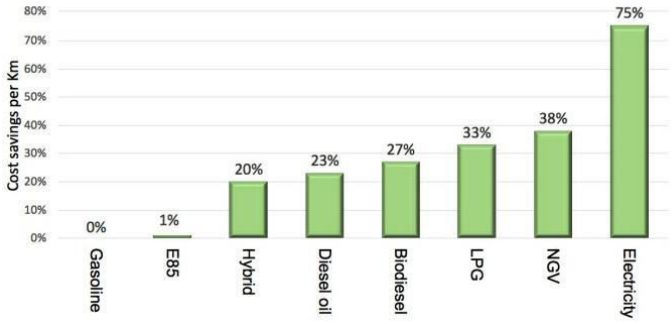

Figure 1. Comparison of savings in cost per kilometre offered by vehicles powered by Gasoline, Ethanol(E85), Hybrid, Diesel, Biodiesel, LPG, Natural Gas vehicle(NGV), and Electricity

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As the EV market expands, the focus should be on the actual adoption action of EV and not just on the intervention. Furthermore, the gap between intention and actual behaviour is important to consider. Consumer knowledge and skills for estimating and comparing the financial benefit and cost of EV are the major research gap of the current research. Future studies on how to inform customers may have implications for knowing the financial benefit and cost of EV's by policy makers and marketing specialists.

II. METHODOLOGY

This paper contains study of electric vehicles existing at present and also the barriers of EV in Indian market. Different optimisation techniques and charging of EVs are also discussed. The paper is divided into segments such as: Section 2 describes methodology, Section 3 explains overview of electric vehicles followed by types of batteries and charging scenario in Section 4, energy management in Section 5. The optimization technique for EV and V2G is presented in Section 6 with challenges and barriers in Section 7 followed by conclusion in Section8.

III. ELECTRIC VEHICLE OVERVIEW

The grail behind the electric vehicle is to replace an internal combustion engine with an electric motor which is powered by the energy stored in the batteries through power electronic traction inverter. The Electric motor uses 90–95% of input energy to power the vehicle, which makes it a very efficient one. The key components of an Electric car are battery, charging port, charger, DC/DC converter, power electronics controller, regenerative braking, and drive system. The purpose of the electric motor is that it utilizes the electrical energy stored in batteries for powering the Electric vehicle. The EVs become environment-friendly as they are recharged with lower emission power sources.

Generally, EVs use lithium-ion batteries because they are more efficient than other cells due to their lightweight and negligible maintenance. The manufacturing of these Li-ion batteries is bit expensive as compared to the nickel-metal hydride and lead-acid batteries.

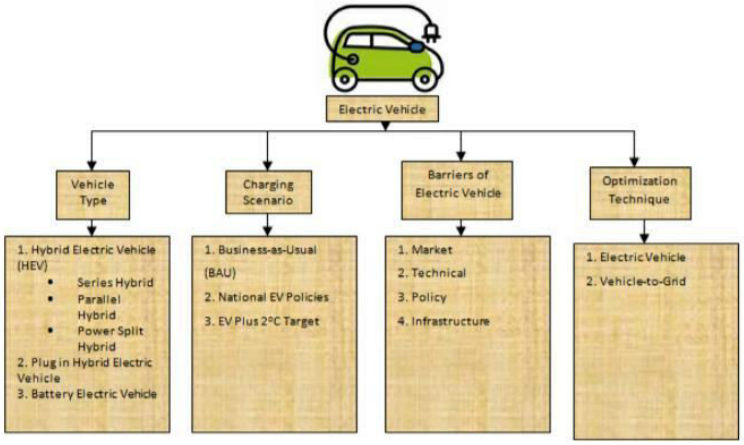

Figure 2 Overview of Electric Vehicle

3.1 Electric vehicle scenario in India

Currently, the EV market is extremely small in India. The sale of electric cars has become dormant at 2000 units per year for the last two years. But there is a vision for 100% electric vehicle sale by 2030 and since we are in 2020, the compound annual growth rate is 28.12%. India's first electric car Reva (Mahindra), was introduced in 2001, and since its launch, it could able to sell a few units. In 2010, Toyota began Prius hybrid model, followed by Camry hybrid in 2013. Electric buses and hybrid vehicles have been commenced as a pilot proposal in a few cities.

The Bangalore Municipal Transport Corporation recently introduced electric transport on a dense corridor in the city. Telangana state Government is also encouraging the use of EVs and announced that the EV owners would not pay any

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road tax. Hyderabad metro rail will be the first metro rail in the country to have EVs charging stations to be monitored and operated by power grid.

The Government of India has launched a plan on Faster Adoption and Manufacturing of Electric Vehicles (FAME II) to empower quicker adoption of an electric and hybrid vehicle. The scheme also encourages purchase of EVs by providing various incentives and setting up of charging infrastructures. The Society of Indian Automobile (SIAM) along with other automobile manufacturers aims in achieving selling of hundred percent pure EVs for intra-city public transport fleets by 2030.

IV. BATTERIES

Characteristics of Battery:

- Capacity - The storage problem and price is one amongst the most issues of electrical power. This unit are often expressed in ampere hour (Ah) or in watt hour (Wh). The capability of batteries is incessantly growing and vehicles with additional that one hundred kWh batteries are expected terribly shortly.
- Energy Density - This is getting the very best energy density potential is another vital aspect within the development of batteries, in different words, that with equal size and weight a battery is in a position to accumulate the next energy amount.
- Lifespan - Another side to contemplate is that the batteries time period, that is measured in the number of charging cycles that electric battery will hold. The goal is to get batteries that can endure a larger range of loading and unloading cycles.
- Efficacy - it is the proportion of power that's offered by the battery in reference to the energy charged.

Different type of battery and component:

- Lead-acid batteries (Pb-PbO2) – it is terribly low specific energy and energy density ratios. The battery is created by a sulphuric acid deposit and a bunch of lead plates.
- Nickel-cadmium batteries (Ni-Cd) - These batteries have a greater energy density. It has low lifespan, and Cd (metal) could be a terribly costly and polluting element.
- Nickel-metal-hydride batteries (Ni-MH) **-** during this style of batteries, associate alloy that stores hydrogen is employed for negative electrodes rather than metallic element (Cd). Though they present the next level of self discharge than those of nickel-cadmium.
- Zinc-bromine batteries (Zn-Br2) **-** These sorts of batteries use a zinc-bromine resolution stored in 2 tanks, and within which bromide turns into Br within the positive conductor. .
- Sodium sulphur batteries (Na-S) **-** It contain sodium liquid (Na) and sulfur (S). This type of battery has a high energy density, high loading and unloading efficiency (89–92%), and a long life cycle. In addition, their advantage is that these materials have a very low cost.
- Lithium-ion batteries (Li-Ion) **-** These batteries employ, as electrolyte, a lithium salt that provides the necessary ions for the reversible electrochemical reaction that takes place between the cathode and anode. Lithium-ion batteries have the advantages of the lightness of their components, their high loading capacity, their internal resistance, as well as their high loading and unloading cycles. In addition, they present a reduced memory effect.

Charging of electric vehicle:

It will be necessary that the users will charge their vehicles in a very quick and easy manner. To do so, it'll be basic to own AN infrastructure readying that enables such quick and easy charge. Below, the various standards or rules that are created for electrical vehicles charging technology are given.

- AC Level one: Standard electric outlet that has voltage in AC of 120 V giving a maximum intensity of 16 A, that serves a most power of 1.9 kW
- AC Level a pair of normal wall socket with 240 V AC and a most intensity of 80 A, thus it offers a most power of 19.2 kW
- DC Level one. External charger that by inserting a most voltage of 500 V DC with a maximum intensity of 80 A, it provides a most power of 40 kilowatt
- DC Level a pair of. External charger that, by inserting a most voltage of 500 V DC with a most intensity of 200 A, provides a most power of 100 kilowatt.

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Connectors:

Electric vehicles have an AC/DC convertor that permits charging their batteries at home through the employment of ancient outlets. However, when it is requiring quicker charges, electrical Vehicle Charging Stations should be used, since they will directly supply DC power to the batteries. Charging Stations will supply electricity through different connectors, looking on the quality supported, and that they present the subsequent advantages:

- Sealed solutions (not affected by water or humidity)
- Carry a mechanic or electronic blockage.
- Permit communication with the vehicle.
- Electricity is not supplied till the blockage system is not activated.
- While the blockage system is activated, the vehicle can't be set in motion, so that a vehicle cannot leave whereas blocked.

Some connectors are able to charge in three-phase mode.

V. ENERGY MANAGEMENT

The energy management is critical factor for EVs. Hence, Battery Management System (BMS) is a key system, designed to manage and control battery unit in this kind of vehicle. The prime task of BMS is to manage the power delivery trying to reduce battery stress due to changes and discharges. Cell balancing is critical for EV's high powered battery packs. The BMS equalizes the changes on all the cells in chain to extend overall life of battery pack.

Auxiliary devices, such as headlamps, the dashboard and the cooling/heating unit also draw power from battery pack. A smarter managing of these energy demands would result in better power delivery without reducing power train efficiency. Therefore, a BMS should cover – i) data acquisition ii) data processing and storage iii) electrical management iv) Thermal management v) safety management vi) communication.

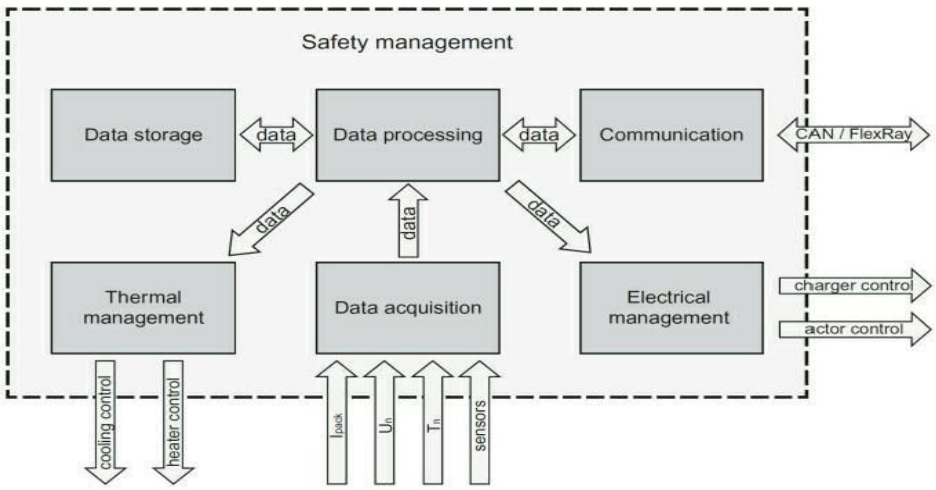

Figure 3. Figure 3 Main components of Battery Management System (BMS)

VI. OPTIMISATION TECHNIQUE

The charging demand of EV is characterised by various frameworks in different geographical locations. The scope is to investigate potential benefit of charging characteristics of all EVs. Various studies have been conducted for finding optimization technique of EVs.

Vehicle to Grid Technology

Under this concept, the parked EV can supply electrical power to the grid and have a bidirectional charger i.e. it can either deliver power to grid or can be used to charge the battery. Studies have been made on how Li-ion battery is degraded from the impact V2G operation and found the impact of bi-directional charging for maximizing the profit of

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EV users by using commercial Li-ion cells. The charging strategy and vehicle aggression could make V2G technology economically viable.
There are numerous advantages of V2G system, however if we increase no. of PEV, then it may have direct impact on dynamics of power distribution system and performance of system through overloading of transformers, cables, and feeders. This lessens the effectiveness as well as requires extra generator starts and creates voltage deviation and harmonics.

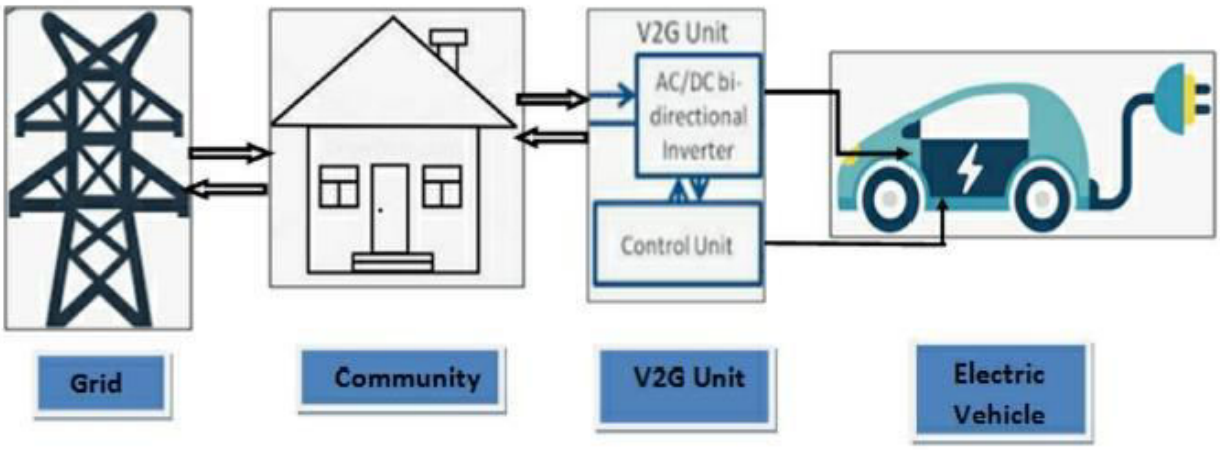

Figure 4 Vehicles to Grid Charging

Application of optimization technique for V2G

The energy transfer of V2G has already been carried out in different countries to regulate varying, unpredicted energy demand or variation in supply availability. Several element must be met to enable V2G, these are i) the vehicle must have connection with grid for transfer of electrical power ii) communication either control or logical connection concerning grid operation iii) onboard metering device of the vehicle.
Previously, vehicles were only able to charge and were not able to discharge so supporting the grid was not possible at that time.V2G capable vehicle provide possible back-up for renewable power sources such as, wind and solar power, supporting efficient integration of intermittent power production. The electric vehicle enables G2V and V2G to maximize profit in smart distribution system. The multi-objective multi-verse optimization algorithm is used for minimizing the impact of charging and discharging of EVs on grid.

VII.BARRIERS AND CHALLENGES OF ELECTRIC VEHICLES IN INDIA

- Consumer Appreciation - Consumer appreciation plays a vital role in attracting new customer and retains an existing customer. Despite the growing range in the auto market with a broader range of electric vehicles, the choice of buying an electric car is limited and is expected to continue over time
- Raw materials - The raw materials for EVs batteries include lithium, nickel, phosphate and manganese, graphite, and cobalt, which are rare earth material production. The lithium-ion batteries alone consume 5mil- lion tons/year of nickel, which could lead to 10–20 times more consumption of lithium and cobalt in future.
- High capital Cost - The batteries and parts of an electric vehicle are costly as compared to normal gas vehicle and the parts also need replacement more than once in a lifetime.
- Battery efficiency - As the EVs batteries are designed for a long life, it wears out in due course of time. Currently, most manufacturers are offering eight years/100,000 mile warranty for their batteries
- Driving range - A driving range is recognized as the main barrier of Electric vehicle typically because EVs has a smaller range as compared with the equivalent ICE vehicle. The distance an electric vehicle can travel on a full charge or full tank is considered as a significant drawback to uptake the EV in the global market. Most of the BEV provides a driving range of less than 250 km per recharge.
- Charging time - Charging time is closely related to the issue of driving range. With a slow charger, the EV can take up to 8 h for a full charge from the empty state using a 7 kW charging point. The charging time mainly depends

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upon the size of the battery. Bigger the size of car batteries, longer the time it takes to recharge the battery from empty to full state. The EV chargers are categorized in accordance with their charging speed at which their battery gets recharged.

- Charging Infrastructure - The chargeable batteries ought to be appreciated by EV manufacturers from a design point of view so that discharge batteries might be replaced by completely energized batteries. There should also be an option for setting up a charging point such as location, like home and workplace, is ideal for slow charging and places like highways and commercial complexes where vehicle halt for a shorter duration, fast charging would be the best option.
- Battery recycling - The batteries used in Electric vehicles are generally planned to last for a limited lifetime of the vehicle but will wear out eventually. The pricing for battery replacement is not properly informed by the manufacturers, but if there is a need for battery replacement outside its warranty period, then it adds the expenses by dumping the old battery with a new one. The chemical elements of the batteries like Lithium, Nickel, Cobalt, Manganese, Titanium not only increases the cost-effectiveness of the supply chain but also have environment concern during scraping of the battery elements.

VIII. CONCLUSION

Electric vehicles are definitely more environmentally friendly than internal-combustion vehicles. Batteries are being engineered to have a long life. When these become more widespread, battery recycling will become economically possible. This paper provides a detailed overview of Electric Vehicles, their components like batteries and their charging types. The paper also provides the challenges and barriers faced by the EV's. The development of a new concept of Vehicle-to-Grid can either deliver power to the grid or can be used to charge the battery when non-conventional energy sources are not available. The paper also provides the study about energy management and this technology is an important aspect of energy security, renewable energy, and giving a great scope to deal with global warming issues. Pollution level is increasing day by day and in future and these electric vehicles will help in in reducing the pollution and are a future in automobile industry.

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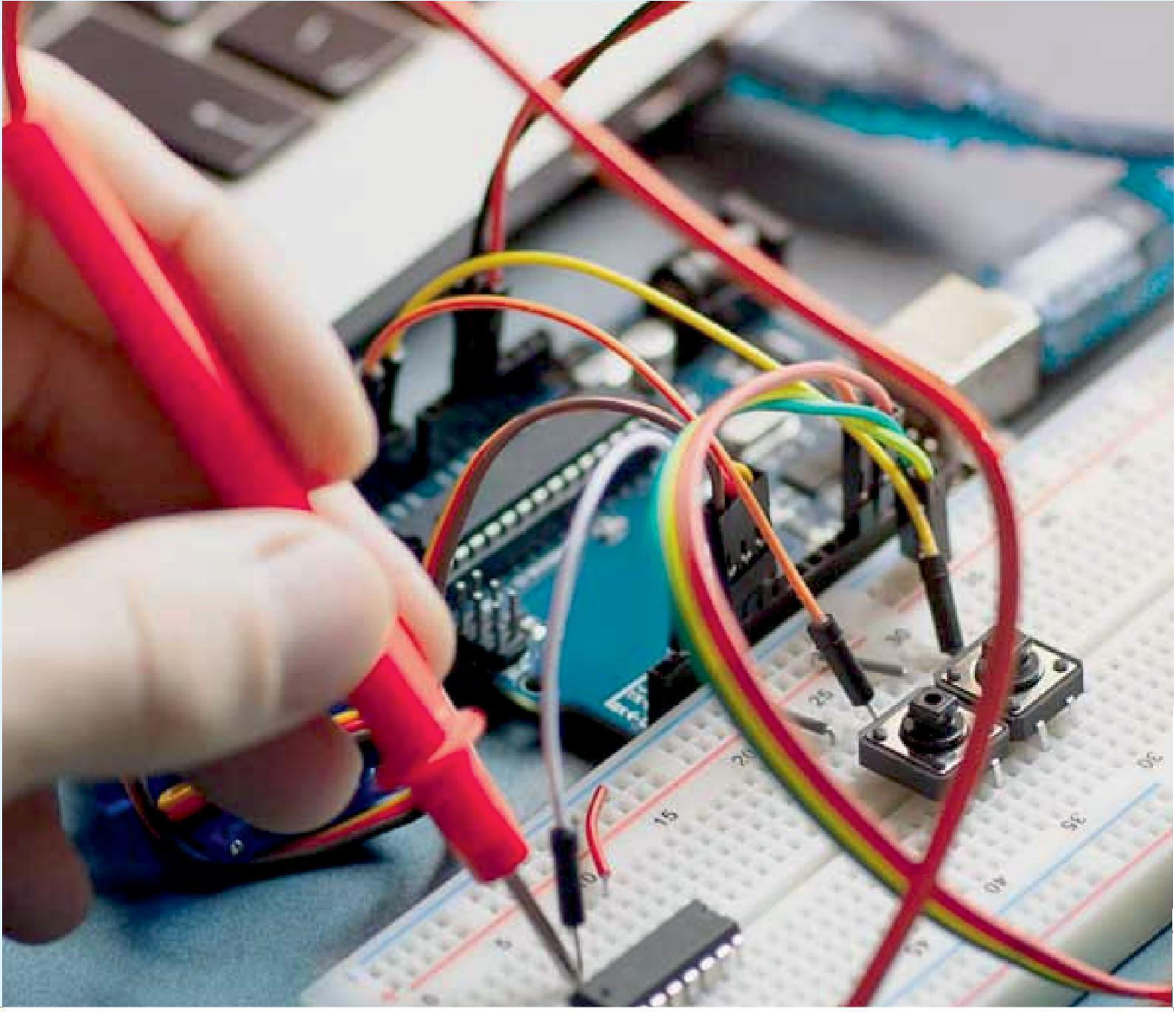

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