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APPLICATIONS OF INTERNET OF THINGS IN SMART GRID INTELLIGENT SYSTEMS

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***Abstract*—** Smart meters, smart appliances, renewable energy sources, and energy-efficient resources are only some of the operational and energy-efficiency elements of a "smart grid." Smart grids rely heavily on electronic power conditioning and control of energy production and delivery. An intelligent generation, transmission, distribution, and consumption are the main components. Human-to-human contact is now the major way of communication on the Internet. The Internet of Things will replace the Internet. This technology has the potential to be used to the construction of smart grids. Smart grid research and development result in new technologies that makes life simpler for humans. This article provides an in-depth examination of the different technologies and standards for smart grids. This article explains the smart grid and innovative concepts such as electric vehicles and automated electric car charging on public roadways

Keywords— *RFID, AMI, Smart Meter, Communication Topology, IoT, EMS*

I. INTRODUCTION

The intriguing area of research and evaluation, which includes everything from academic concepts to short-term deployable functionality and associated economic models, has emerged over the last few decades. A new concept for electric power systems of the future that will be more adaptable, sensitive, and self-managing. With automated control and current communication technologies, it is possible to integrate renewable and alternative energy sources into the electric power grid via the use of the smart grid [1], [2].

Smart metres are being tested in India by the country's power providers. Numerous working groups, such as ISGF and the BIS (Bureau of Indian Standards), are cooperating and sharing protocol and technological information as part of seven current pilot projects. SMA/AMI is crucial to the smart grid's smart metering architecture (SMA) [3-5] and advanced metering infrastructure (AMI]. Customers in this system have smart metres that allow for two-way communication with the utility provider, variable pricing, outage monitoring and prepayment. They may also be disconnected remotely.

Smart metres, energy management systems, local area networks in the home, and the Internet of Things (IoT) are all discussed in detail in this article. Although radio frequency identification (RFID) has been dubbed a substitute for bar codes, RFIO systems are capable of much more. RFID has already proven useful in retail, health care, and facility management, and it offers a good foundation for the Internet of Things. [6], Smart Grids (SGs) have attracted increased interest in recent years, not only from the scientific community, but also from the general public. What distinguishes a "smart" grid from a conventional one is the additional intelligence, which includes two-way communication, sensing, and improved control and management capabilities. This enables the grid to not only detect and respond to changes in real time and autonomously, but also to maintain a high

degree of efficiency, dependability, and service quality. The **Internet of Things (IoT)** is seen as a critical technology in this regard since it enables the transition of a conventional grid into a Smart Grid. [7, 8], and [9].

II. RELATED WORKS

The IoT has the potential to significantly modify the techniques used by a variety of creative services and applications, such as watching real-time objects, acting as a search engine for objects, and facilitating their communication and interaction. The Internet of Things is a concept that encompasses a variety of technologies, including information technology, nanotechnology, biotechnology, and cognitive sciences [10-12] Rapid expansion in device storage and processing power, worldwide connection, miniaturisation, and self-determining behaviour, as well as the ability of gadgets to connect and perceive.

Smart Generation: It entails energy generation, automated voltage maintenance, and automatic power factor regulation based on input from numerous grid points. Wind turbines, concentrated solar power systems, and photovoltaic panels are all included in this category [13].

Storage Component: In light of the fact that the smart grid system contains both renewable and non-renewable energy generation, it is imperative that energy be stored for future use [14].

Transmission Subsystem Components: To build the smart transmission capability, the transmission system utilises various kinds of sensors, communication technologies, real-time monitoring, microprocessor-based relays, and automated circuit breakers.

Smart Metering Technology: The phrase "smart metre" refers to an advanced energy metre that measures the energy used by the end user and transmits data to the utility provider. Smart metering is a cost-effective way for increasing the efficiency of energy users and their energy consumption patterns, as well as for lowering the financial burden of electricity. It is created by the integration of electricity system, telecommunications, and other technologies.

Intelligent Grid Distribution Subsystem Components: The distribution system completes the process of delivering electricity to end customers. It entails automation through smart metres, customer communication linkages, utility control, and an energy management component.

Components of Demand Side Management: The DSM enables decreased emissions throughout the fuel generation process. It entails the supply of two types of data: smart energy bills and smart homes, demand side metres, and a consumer interface to improve energy efficiency. It involves the integrated communication equipment’s, intelligent electronic devices for controlling the home appliances and their control system.

Internet of Things: When we talk about the Internet of Things, we're talking about a network in which anything may be linked to the Internet through a protocol to exchange data and communicate with other intelligent gadgets in order to fulfil monitoring, tracking, management and location identification goals.

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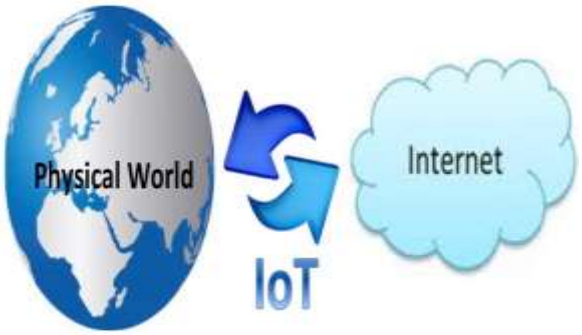

Fig. 1. IoT for power and energy systems

Economic progress is mostly driven by power and energy systems. Access to inexpensive, clean energy has become a worldwide concern, and governments all around the globe are trying to accomplish this objective. The Internet of Things Energy (IoT-E) has the potential to change present power and energy infrastructure, allowing for the global energy demand to be met. This is critical for energy conservation and cost savings. The Internet of Things enhances the security and dependability of power systems by continually transmitting their health; it also assists in preventing power outages by broadcasting any anomalies in the power systems.

Table 1: An Overview of Main Driving Factors for Smart Grids

Technology Advancement	1) The smart grid may be thought of as the fusion of the information technology, telecommunications, and energy industries. 2) New items and solutions developed as a result of technological development 3) Significant investment in Smart Grid technology and solutions by venture capital firms
Higher Efficiency with the Help of Grid Optimization	1)Numerous integration points from transmission to consumption for intelligent grid hardware and software 2) Sensors and monitoring capabilities included in the device 3) Establishment of sophisticated two-way communications networks 4) Expanding Renewable and Distributed Energy Generation and Storage Capacity 5) A network design capable of supporting a variety of distributed generating and storage modes 6) Sensible assistance is offered for a variety of renewable energy sources.
Advanced Customer Services	1) Stable, user-friendly solutions for consumer energy management 2) Devices that are networked inside the "smart home" 3) New, more efficient power pricing models
21st Century Power Quality	1) Delivering electricity that is devoid of interruptions, spikes, and fluctuations

III. CONCEPT OF ELECTRIC VEHICLE CHARGING ON ROADS

To avoid the need for direct physical contact, a Contactless Power Transfer System (CPT) transfers power electro-magnetically instead. There are two separate windings in the system, which is basically an air-core transformer. Because to the location of the pick-up coil and its alignment with a power supply, an electric vehicle may be charged using a contactless power transfer system. Electric

vehicles (EVs) may be charged via CPT systems while they are not in use, such as when they are parked or stopped at a traffic signal. It's also possible to recharge an EV wirelessly if CPT systems are put in place [30]. This article focuses primarily on the topic of charging while driving. The CPT system for on-road charging consists of two parts: long main windings placed under the road and secondary pick-up windings inserted underneath each electric vehicle's chassis. The EV receives power from the CPT system when the car is on top of it, since the secondary becomes electromagnetically coupled to the primary during driving.

While driving, a driver may recharge their vehicle's battery. For the most part, today's electric vehicles are powered by a combination of a battery pack that stores energy, a motor that transforms it into mechanical energy for the wheels, and a computer system that controls the motor's output power [8]. An electric vehicle's motor and battery may both be powered and recharged using the additional power provided by Contactless Power Transfer systems. As a result, further control over the CPT system's power flow is required. Power is also provided using the CPT system.

IV. EARTHING SYSTEMS ON ROADS WITH ELECTRIC VEHICLE

Electrical earthing is nothing but the process of transferring direct discharge of electrical energy to ground via low resistance wire the primary function of earthing in an electrical network is security. Improper earthing of the system can hazard the instrument and also it is dangerous to mankind. Monitoring soil moisture distribution is important for maintaining the minimum required resistance. The monitoring of earthing system gives correct information about instrument safety and infrastructure of earthing ground. The method is design to monitor the leakage current flowing through earthing wire. If greater amount of current flows through system the user is then immediately informed. It is also intended to keep and regulate earth resistance. The earth resistance is maintained by controlling the moisture content of the ground using a moisture sensor. The moisture sensor determines the soil's moisture content and transmits data to the Arduino. If moisture level falls, the Arduino activates the water pump through the relay and water is delivered to the soil.

This design is about a system for monitoring and controlling earth resistance The earth resistance is maintained by controlling the humidity content of the earth with a humidity detector. The proposed earthing system's main component is current monitoring set. which monitors the leakage current. As shown in figure 1, the number of apparatuses shown is connected to common earthing point. The current detector is used to intellect the current flowing through earthing line and also it supplied to I to V converter. The outcome of I to V fed to Arduino and the Arduino take a decision and it displays current position over the display. Soil humidity detectors senses the humidity of the soil and gives data to the Arduino. If moisture decreases Arduino operates water pump through relay and water supplied to soil. In this design by using soil humidity detectors the humidity content of the soil is measured and by using electronic circuit it maintains humidity position. The Arduino circuit continuously observing humidity positions if humidity position goes down the regulator circuit automatically starts the water pump and water is supplied to earth. In this project the earthing current is continuously monitored and the moisture level kept continuously high to ensure smooth working of earthing system. This system can also be used for higher industrial application as it has the capability to sense the minor changes in leakage current. Dimensional and grid electrodes are used to verify ground resistance near residential area. It is found that there is no uniqueness in soil property. Below the data is given for resistance at different level of moisture in soils

Using a soil moisture sensor, one can tell how much moisture is in the soil. It passes input to Arduino in the form of high or low. Depend on these signals the relay system, which is connected to water

pump circuit works. (i.e. If moisture content is low then moisture sensor will send low signal to Arduino and relay circuit will close and water pump will start and Vice versa.)

Applications of the system:
1.Medical equipment.
2. Projects based on GSM.
3. Embedded Systems
4. Metal Detector Arduino
5. Automation in Industry.

V. WORKING MECHANISM

Here, the relay uses the current force for starting or concluding switch connections. Generally, this can be done through a coil to attract the switch connections & drags them together when triggered. A spring drives them independently when the coil isn't strengthened.

By using this system, there are generally two benefits, the primary one is, the essential current for triggering the relay is lower amount compared to the current employed by relay connections for switching. The additional advantage is, both the contacts & the coil are insulated galvanically, which suggests that there is no electrical connection among them.

Soil Moisture Sensor: A soil humidity detector is a kind of detector that measures the quantity of water in the soil. It is necessary to remove the direct gravimetric dimension of soil humidity from the sample before it can be weighed. These detectors use other soil parameters such the dielectric constant, electrical resistance, or interaction with neutrons and replacement of the moisture content to calculate the volumetric water content indirectly.

Working: This sensor primarily uses capacitance to determine the soil's moisture content (dielectric permittivity). Because this sensor is often used by putting it into the ground, the status of the water content inside the soil is frequently expressed as a percentage. This sensor is ideal for conducting experiments in scientific courses such as ecology, agriculture, biology, soil science, botany, and horticulture.

LCD 16x2 Display: Liquid crystal display is referred to as LCD. Devices such as mobile phones, calculators, computers and television sets all employ electronic display modules (EDMs). Multi-segment LEDs and 7-segment LEDs are the most often utilised in these displays. As a result of its affordability, ease-of-use, and lack of constraints, this module is a good fit for a wide range of applications, including games.

VI. CONCLUSION

The purpose of this article is to provide an overview of IoT technology and its numerous applications in smart grid technologies. The 21st century has brought the great discoveries and advancement in the field of electrical engineering technology. This advancement also brought many challenges and required approaches to handle the challenges. The smart grid system based on IoT is one such approach. In this paper, we explain the concept and basic architecture of the smart metering system. It is also useful in the smart city technology which is going to be developed in India in future.

The leakage current is monitored in the system so that any chance to damage the earthing system is less. Same system is often used for higher leakage current as protection provided by Arduino controller circuit. If any change occurs in system, then immediately informed to user. Continues

change in current is monitored and displayed by the system. Same system can be used for automatic plant watering, Automatic irrigation system. Monitoring and protection of earthing system reduces the harm to the apparatus because of earth leakage current. It also helps to preserve and supervise earth resistance. And the moisture level in soil continuously kept high.

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