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# A Framework for Smart City Implementation using IoT-Cloud Based System Architecture

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***Abstract*—The Internet, a key participant (world wide web) in worldwide information exchange and media sharing, has experienced cumulative upgrades, developments, and given up consequent product IOT, making technology affordable and practical for all uses. Research development includes smart sensors, a communication channel and protocols for exchanging data, and peripherals like an Arduino, a Texas Instruments MSP430G2553, a Weather-proof Tx. Rx. Kit (for exchanging data), a Data Receptor and Decoder Shield for Lab View Kit (for exchanging data), an addressing and de-addressing data module, a communication shield, etc. It is now possible to communicate from a desktop computer or an Android smartphone to a portable device that has an embedded device, such as a microcontroller, a microprocessor, or a sensor. In other words, IOT combines always-on networking, always-on computation, and always-on intelligence. The Internet of Things facilitates communication between the central hub (fitted with a Lab-View interface) and the distributed modules (found in places like parks, subways, and highways) that control the lights. The Internet of Things is also useful for keeping the overall cost of setup and maintenance within reasonable economic bounds. The planned development takes into account IoT on two main scales: city-wide automation (also known as smart city) and home-level automation (also known as covering up).**

***Keywords—Internet of Things, Smart city, Power Theft, Home Automation, Lab view and Controller.***

## I. INTRODUCTION

The age of the desktop computer and the laptop computer is over. Emerging now, it includes internet-connected intelligent things including machines, infrastructures, environments, gadgets, and peripherals for consumers' everyday usage, etc. While the Internet's original purpose was to facilitate communication between individuals, its current scope will have far-reaching consequences for society [1]. The internet's ultimate purpose is to provide instantaneous, relevant data on actual uses and things. IoT was born as a direct consequence of the proliferation of internet-based applications and services thanks to a steady diet of research, analysis, and development (Internet of Things) [2]. IoT, or the Internet of Things, is a system that intends to link everyday things and technologies used by people all over the world so that they may share data and work together to provide convenience, security, and assistance to those who need it most. The acronym IoT is derived from the terms "Internet" and "Things."

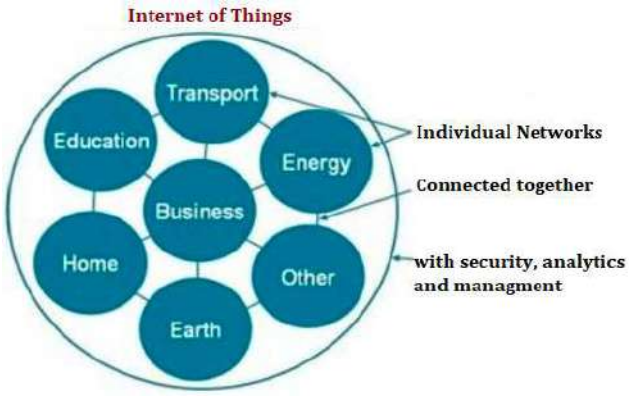


Fig. 1. Interconnected systems on a global scale

The "Internet" refers to the infrastructure that allows for flexible, customizable, and dependable connections between different "Things," or intelligent things [3]. Hence, the Internet of Things is the worldwide interconnection of several autonomous networks providing instant and trustworthy data about physical devices and services. In Figure.1 we see a representation of this worldwide link.

Systems built on the Internet of Things may be used in a wide variety of contexts [4]. As a result, it must accommodate a wide variety of hardware types. The biggest obstacle in this worldwide data network is getting the appropriate data in the right format to the right location while keeping it safe [5]. To solve this problem, we may give every smart item linked to the internet a dedicated IP address.

### A. Smart City

The following are the three main dimensions of a city: The city's technological applications, the city's technological applications, and the city's communities. Several other terms, such as "digital city," "ubiquitous city," "creative city," "smart

community city," and so on, may be used to describe a city whose degree of usefulness is along these three dimensions [6]. A smart city is one that prioritizes and functions well in all three of these areas. All governments across the globe are concerned about human population growth. Governments must overcome obstacles related to the provision of resources to citizens at affordable costs and the maintenance of supply in relation to demand [7]. In addition to this, it must be eco-conscious, minimizing waste while making efficient use of resources.


Fig. 2. Intelligent appliances in a futuristic smart city

Better, more controllable methods of maintaining safety standards and accommodating the ever-increasing volume of traffic on the roadways are under consideration [8]. Plans for urban revitalization often call for the use of advanced forms of communication and information technology (ICT) in an effort to raise residents' standard of living [9]. With ICT, cities may improve the quality and efficiency of their services, cut down on wasteful resource use and the costs that come with it, and forge productive relationships with their constituents [10]. The notion of "smart cities" emerged as a result of the incorporation of ICT into the urban development plan; in these communities, everyday functions such as education, healthcare, utilities, transportation, and safety are administered using cutting-edge technical methods. Major cities would follow the same path and retain their affordable levels [11]. A smart house in a smart city is shown in Figure.2. to give you an idea of what I'm talking about. The smart meter is a prominent example of an IoT application [12]. A smart meter not only monitors energy use, but it can also talk to the power company and any attached equipment, such an air conditioner. Smart meters can monitor and manage equipment remotely, lowering power costs for customers while also helping utilities save energy and meet peak demand [13]. That's a clever move towards energy saving, transmitting and planning the supply according to demand.

## II. Literature Survey

In general, a city must deal with numerous difficulties, such as resource scarcity, poor and haphazard infrastructure, insufficient energy and water supply, price volatility, poor human health, difficulty in managing available resources and services, failure to provide timely medical facilities, preservation of resources, and so on. Each resident of a "smart city" will have access to a wide variety of relevant data on municipal services [14]. The installation of this cutting-edge technology built on the module would not only help to survive up and supply various methods of comfort to the uttermost care and availability, but it would also sort out the requirement of fighting the resource crisis [15]. The instruments necessary for urban growth are made possible by ICT. Figure.3 shows how the use of ICT in urban services has increased during the previous five years.

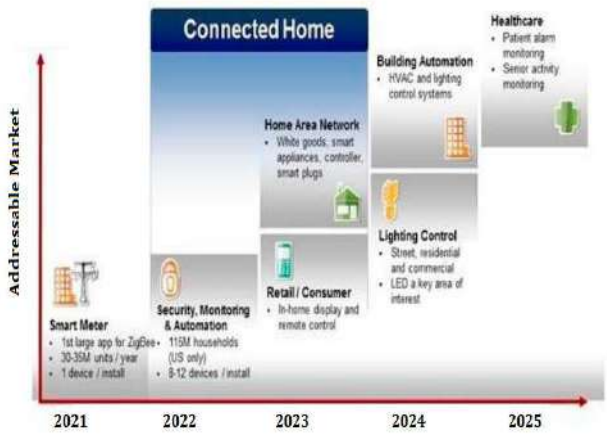


Fig. 3. ICT integration into urban services

Power is essential to the operation of these applications; IoT plays a crucial role in managing this resource by facilitating the connecting of devices and semi peripherals inside the module [16]. Wasted energy from the unneeded operation of loads and an insufficient power supply mechanism are two of the most pressing problems facing today's smart cities [17]. The current state of energy management is predicated on a "sense- analyze-respond" framework. Many sensors keep tabs on the state of the building and relay that information to a central server in near real time [18]. Data collected from the building's infrastructure and connected devices is processed and analyzed by the server. After the data has been analyzed, the servers provide directives to the automated load control devices to maximize efficiency. It is challenging and needs a large number of sensors to do neighborhood-wide sensing [19]. Data gathering, data transfer to the server, and data processing on the server are all labor-intensive and expensive processes. Extracting the needed information from large volumes of heterogeneous data in real time is a challenging undertaking in its own right. So, the following problems, some of which have only partial answers, must be fully resolved before smart energy management can be implemented [20]. In this work we go into a more in-depth study and problem formulation of the traffic management issue. The increasing volume of traffic is making it difficult to go somewhere on time, which is why Internet of Things (IoT) solutions are being proposed to oversee detours and keep things moving smoothly. Later, consideration was given to the issue of theft and mishaps and a solution to city security was presented [21]. The Internet of Things has a wide range of applications, from the home to the business, from the control of electricity to the optimization of leased spaces and buildings in times of crisis. Smart city development has similar difficulties with water supply [22]. The right kind of monitoring, which involves a lot of data on citizens' everyday activities, may help solve these issues. Because of the high population density, conventional methods of surveillance are inadequate, necessitating the use of innovative technology solutions [23]. Home appliances and other comparable things may be monitored and controlled by

an autonomous energy and water monitoring system. Moreover, these methods may lessen the waste of the smart city's precious resource [24]. And at last, an important factor was considered, the waste of a precious resource in the little act of irrigation. In this work, we learn about the third module, which focuses on minimizing wastage by finding uses for the water that would otherwise be lost during the irrigation process. This paper also contrasts the issue of excessive power use by operating Highway and High Mast lighting outside of their intended areas of use. As we are slowly but steadily heading toward a situation in which all natural resources are depleted, self-sufficiency is really the primary objective of future smart cities, and it is crucial to embrace new strategies and approaches to address this challenge as soon as possible. Public Wi-Fi access has endowed cities with sensor capacities that may reflect user movement patterns and group traits, making them an integral element of the information infrastructure for smart cities. For instance, a weather management system may be used for the management of natural resources [25]. The weather station in our smart house is only one example of the advanced building system technologies available today. The roof also has sensors that record the time, date, and twilight/brightness values through radio signal in addition to the wind and rain. The blinds will automatically rise to shield you from the sun. Wind warnings are canceled when it starts to rain heavily. If necessary, the weather station may also adjust the temperature in your conservatory or turn on the outside lights. Long-term recording of weather conditions allows you to better tailor your system's future operations. Radio-based recognition offers ubiquitous reach and does not need any on-body worn equipment or any type of active engagement from the monitored people, making it a smooth, non-intrusive way of environmental awareness.

## III. PROPOSED MODULE

LabVIEW can recognize and manage your household appliances with its built-in features. It keeps tabs on your home's electronics and turns off energy draining gadgets like fans, lights, and air conditioners while you're not there to save money. Figure depicts a block schematic of the LabVIEW-enabled energy saving system. Due to the limited power supplies, maintaining a constant power supply becomes a significant difficulty. As a result, reducing waste is another strategy for keeping up with the rising power supply demand. As a graphical user interface (GUI) for desktop control and sensor response signal acquisition, LabVIEW plays a crucial role. It keeps tabs on your home's electronics and turns off energy draining gadgets like fans, lights, and air conditioners while you're not there to save money. Figure depicts a block schematic of the LabVIEW-enabled energy saving system. Because of the scarcity of available electricity, ensuring a steady supply is a huge concern. As a result, reducing waste is another strategy for keeping up with the rising power supply demand. The Extremely low power MSP43Dt7FDRR is controlled and programmed using the TI DSP development tool, which allows for efficient operation and management of sensor readings. The TI kit is being used because it can handle running on a single channel bus and can tell the difference between the relative frequencies produced by the individual sensors. The analog and digital sensor signals are sampled and managed with the help of an Arduino program. Trio Lab-View, TI development, and Arduino sketch-enabled platforms have all been used to carry out the intended research.

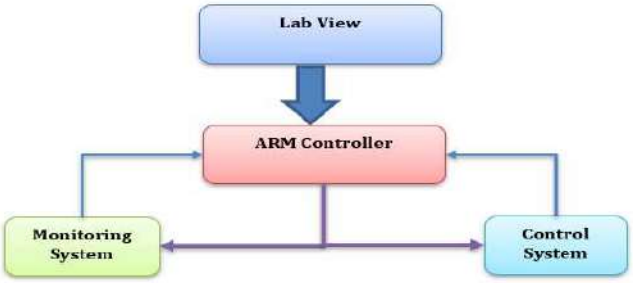


Fig. 4. Block diagram

Figure 5 provides a visual summary of the intended research. LabVIEW, on the other hand, performs the most crucial function in managing a relation and establishing a GUI interface between a user and digital system, while the other two serve primarily as interlinking to device. It has a traffic control module, an irrigation system module, and a highway lighting control module, among other systems of importance. Systems with LabVIEW support have been utilized for further research. A local area network (LAN) is a group of connected computers, phones, or other electronic devices that share a single physical location and may exchange data wirelessly. A local area network (LAN) is a network that is utilized inside a specific geographical region, such as a single building. Within the bounds of the network's local coverage region, it allows users to maintain an active connection and establish a working communication link to the global Internet. The acronym "WLAN" refers to this wireless tethering system. Wi-Fi is the brand name for the currently existing networks, which are based on the IEEE 802.11 standard protocols.

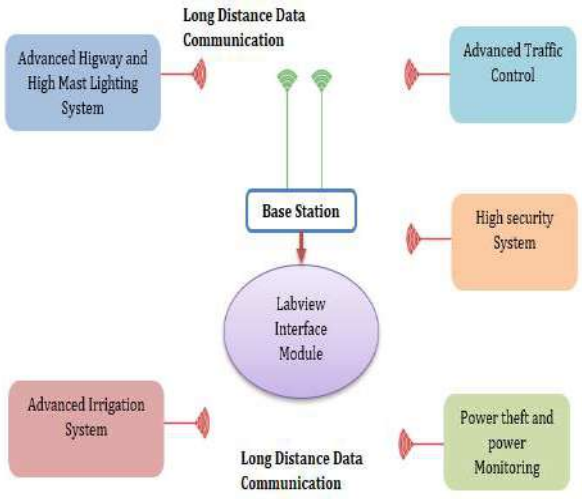


Fig. 5. Architecture of Proposed Module

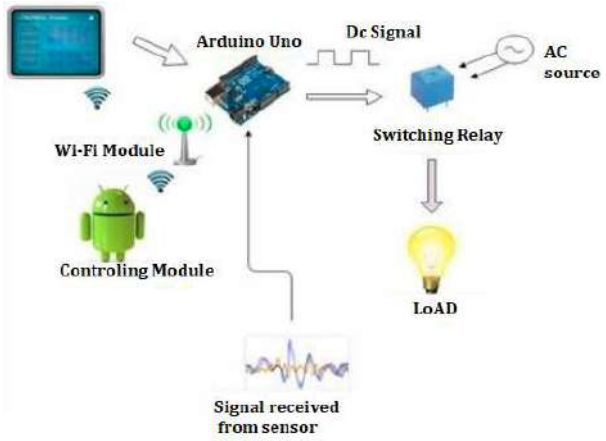


Fig. 6. Overall Flow from signal generation

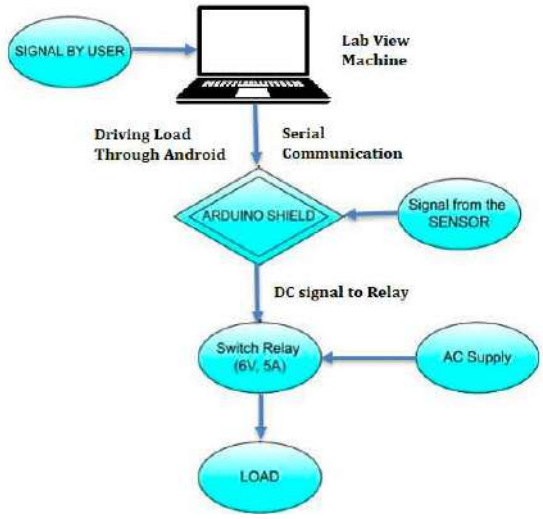


Fig. 7. Signal flow from user up to the load

In our project, we used this technology to allow for wirelessly linked Android smartphones to act as remote controls for the main machine. Wireless connection also offers reliability for connecting several devices to a wireless network, allowing each user in the region to exercise independent control over appliances connected to the network. The connected device must be running Android and have the appropriate application installed to complete the task. Our suggested approach for a module to get started on user-initiated signal routing through Arduino and relay is shown in detail in Figures.6 and 7.

## IV. Technological Overview

### A. Power theft scenario

The traffic control system offers the simulation and image to regulate traffic at desired areas, the camera-based surveillance system protects the protection of people in public places, and the power anti-theft module is basically a real-time power monitoring sub-system. In order to guarantee that smart city automation, offering comfort to end users in their desired methods, the framework lays out the necessary equipment along with its function. The importance of having reliable access to power has risen across all demographics and economic strata in recent years. Generation, transmission, and distribution to final users make form the bare bones of the power supply process. Power dissipation losses are inevitable due to a small number of technological flaws in various devices. These losses can be mitigated by taking use of the rapidly advancing technological capabilities, but what about the other types of losses? Power theft encompasses monetary and non-monetary damages that are intentionally inflicted by humans for the purpose of gaining unauthorized access to electricity. The electricity is transmitted and distributed to customers in India through an elaborate infrastructure. By doing so, the human being utilizes the authority for his own purposes in violation of the law. This created module has therefore included new technologies that might aid in keeping track of each consumer's use history through dual metering in order to combat this kind of power theft.

### B. Camera Based Security

Places like airports, subways, and shopping centers all have tight camera-based security that allows passengers and shoppers to come and go freely at all hours of the day and night. The smart city security system develops an improved and swift communication of Real time video transmission with public safety in mind (using 300 ft. 5.8 Hz weather proof video link). CCTV cameras play an important part in the resolution of many cases and provide enough evidence for the prosecution of those responsible for crimes.

### C. Traffic Control System

The current norm of timing traffic signals according to a predetermined schedule is inefficient and causes delays due to imbalances in the flow of traffic. As this is an issue, the smart city and security module provides a way for remote users to manually regulate traffic lights. With a human controller, traffic may be redirected and rechanneled in the event of congestion in a single lane. Traffic maintenance in the past and in the present often included an on-site traffic controller or on-site traffic lights, which was not enough to achieve the intended goal in managing it properly, leading to traffic congestion. If this module were put into use, it could automatically control and maintain a record of the city's traffic, allowing it to solve the issue of high traffic rush by sending out alerts before the rush point. It would either cause traffic to back up at the major rush point for longer than necessary or cause motorists to use other routes. This resulted in the city's traffic functioning more efficiently. An everyday example has been used to help readers fully grasp the problem.

## V. Results And Discussion

### A. Power theft module

After the system module is set up, it can monitor the power use of individual consumers in real time. If power theft is detected (say, by noticing a discrepancy in your Power Unit measurements), you may quickly identify the offender. Three examples broken down into their respective categories for example, (House 1) was found to have committed power theft after a discrepancy was found between the readings taken from the home's meter and those taken from the Pole Mounted Unit during a simulation run using the Lab View Module.

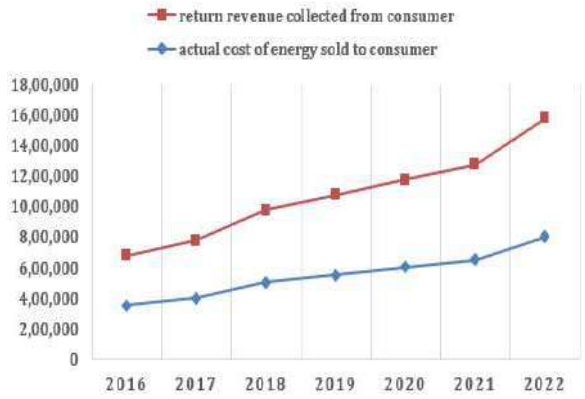


Fig. 8. Highlights of the local region sub-trends station's

(House 2) When both the home meter and the pole mounted unit show the same readings, indicating that there is no instance of power theft. Module (House 3) displays a situation in which neither the customer nor the pole-mounted equipment detects any power use. It follows that this strategy, if put into practice, would unquestionably provide the intended outcome and function effectively. As a result, these aids government agencies in keeping tabs on power use and uncovering illegal activities like power theft. Indirectly, this would boost the economy, cut down on harmful behaviors, and provide them a better return on the energy they sell to the public. Revenue collected as a percentage of total power sales is shown in Figure.8. The divergence in the trend lines indicates a loss for the Indian government. This raises the need of setting up a system to detect and prevent power theft.

### *B. Air Conditioning System*

In order to provide the highest possible standard of life sensor LM-35 and Humidity detector, both of which are permanently set to their maximum readings, are part of the automated control system and are constantly tracking the changing temperatures and humidity levels.


Fig. 9. Air conditioner controller

When an analog signal from a humidity sensor indicates that relative humidity is above 75 percent, an Arduino board will send a signal to a relay, switching the central air conditioner to dry mode. When humidity levels return to normal, the relay will switch back to normal operation, and National Instruments will reset the board. On the other hand, a thermistor maintains a high state permanently and detects changes in ambient temperature. Its output voltage varies with the temperature in degrees Celsius; the status of this and other parameters is shown in real time on the desktop. The Arduino board provides the necessary 5 V power, and the device's analog readings may be read off at the board's analog input ports. With an Android smartphone or a PC with the appropriate program loaded, you may remotely regulate the temperature of this automated system.

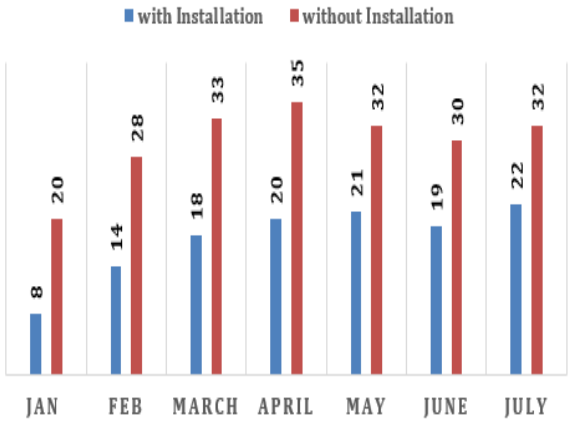


Fig. 10. Water savings benefits from module placement

After installation, this system is helpful for businesses, residences, and hotels in terms of accurately calculating and recording energy use (Figure.10.). If rewiring and installing a new energy meter were a huge obstacle, this energy usage calculator might be useful for rental flats, floors, and rooms of apartments and cottages. This module seems to be useful for managing and monitoring the energy flow, as well as recording this data for later use. In this study, we introduce the idea, characteristics, and significance of home automation as a module that serves as a need and a convenience for the customer.

## VI. CONCLUSION

The Internet of Things is a paradigm shift that treats everything as if it were smart. All it takes for an item to be considered "intelligent" is for it to have identification, sensing, communication, and processing capabilities that allow it to interact with other internet-connected things, programs, and services. The Internet of Things relies on intelligent items, which in turn improves the quality of life in urban areas. In a smart city, several Internet of Things–based apps are active in various neighborhoods. In order to turn a city into a "smart city," we have used the Internet of Things to analyze its electricity use, irrigation system, traffic flow, and security system. The Internet of Things is a crucial component of every module, and it will continue to play an increasingly important role in the years to ahead. This phenomenon will define our generation and the ones to follow. Current trends suggest that the Internet will become more important in the future, serving as a driving force for mankind by providing the necessities of life in the most convenient and cost-effective ways possible.

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