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Smart City Management using CAN and IOT

[1]Rohit Paithane, [2]Shivani Mangalge, [3]Vinay Somwanshi, [4]Ansar Ahmed

Assistant Professor
Department of E&TC,
ICEEM, Aurangabad (MH), India

Abstract: **As cities grow larger and larger, the management of urban issues is growing. It is important to monitor and control various parameters of the city, such as pollution, traffic, street lighting, temperature, etc. Therefore, in order to monitor and control this type of parameter in the city, we can use the Internet of Things (IOT) to control and monitor these different parameters from anywhere on the planet with the help of the Internet. We can build a network of microcontrollers connected to the sensors to monitor the pollution and temperature of various parts of the city based on the darkness of the surrounding city and to control and Monitor Street lights in all areas of the city. Connecting this Microcontroller Network (ATMEGA 328p) uses the CAN (Controller Area Network) protocol. All of these microcontrollers will be interconnected via the CAN protocol, and the network will have basic nodes (microcontrollers) to collect data from every node (microcontroller) throughout the city. From the base node, the data will be transmitted over the Internet for everyone to get information about the various parameters of the city.**

***Index Terms*: IOT (Internet of Things), CAN protocol (Controller Area Network) protocol, HTTP (Hyper Text Transfer Protocol), LDR (Light Dependent Resister).**

I. INTRODUCTION (HEADING 1)

The project uses AVR ATmega328 microcontroller LDR street lamp control, the use of LM35 to monitor the city temperature, the use of MQ135 gas sensor to monitor air pollution. The project consists of two nodes connected through the MCP2515 CAN bus module. At the TX node, the sensor is connected to the measurement parameters, at the RX node, the LED is used for sensor notification. ESP8266 is used to send data over the Internet by using the HTTP protocol. Smart City is a vision of urban development that integrates information technology (ICT) and Internet of Things (IoT) technologies in a secure manner to manage urban assets. These assets include information systems, schools, libraries, transport systems, hospitals, power plants, water distribution networks, waste management, law enforcement and other community services in the local sector. Promote smart city use of city information technology to improve service efficiency. Information and communications technologies enable city officials to interact directly with communities and urban infrastructure and monitor what is happening in cities, how cities evolve, and how better quality of life can be achieved. Using sensors integrated with a real-time monitoring system, data is collected from citizens and equipment and processed and analyzed. The information and knowledge collected is the key to solving inefficiencies.

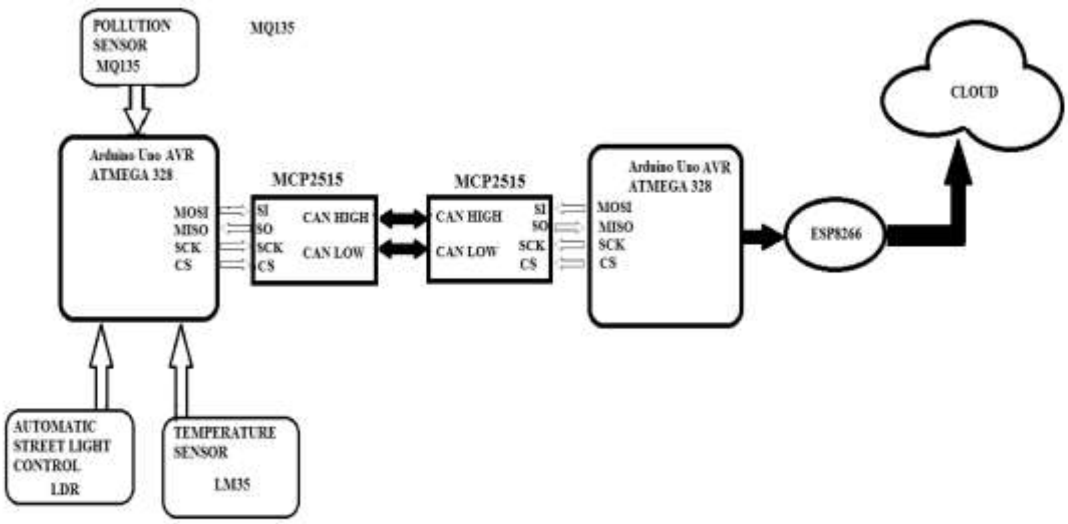

Fig-1.1: Block Diagram of Smart City Management using CAN and IOT

Information and communication technologies (ICTs) are used to improve the quality, performance and interactivity of urban services, reduce costs and resource consumption, and improve the connection between citizens and the government. Develop smart city apps to manage city traffic and deliver real-time responses. Therefore, a smart city may be better prepared to meet challenges than those who have a simple "deal" relationship with citizens. However, the term itself is still not clear, so there are many explanations.

Major technological, economic and environmental changes have generated interest in smart cities, including climate change, economic restructuring, online retail and entertainment, aging populations, urban population growth and public-financial pressures. The EU has been committed to achieving "smart" urban growth strategies for its metropolitan areas. The European Union has put together a series of plans under the European Digital Agenda. In 2010, the emphasis on strengthening innovation and investment in ICT services to improve public services and quality of life, Arup estimated that in the global smart market, by 2020, urban services will reach 400 billion US dollars. In Milton Keynes, Southampton, Barcelona, Madrid, Stockholm and China, smart city technologies and projects have been implemented. Due to the breadth of technology already implemented under smart city labels, it is hard to extract a precise definition of a smart city. Deakin and Al Wear list four factors that can help define a smarter city:

1. Apply a wide range of electronic and digital technologies to communities and cities.
2. Use of information and communication technologies to transform the living and working environment in the area.
3. Embed these information and communication technologies (ICTs) in the government system.
4. The territorialization of ICTs and people together to enhance the innovation and knowledge they provide.

1.1 Overview of Project

The Controller Area Network (CAN bus) is a robust vehicle bus standard designed to allow microcontrollers and devices to communicate with each other without a host. It is a message-based protocol originally designed for multiple wires in automobiles to save copper, but also for many other purposes. One day the CAN protocol can be used for other technologies and therefore can be used in our smart city projects. Microcontrollers can be connected to each other using the CAN bus protocol. The sensors use microcontrollers to be placed in different parts of the city with nodes all over the city. The benefit of using CAN is that data is sent as an ID, providing security and CAN reliability, so do not worry about data leakage.
The devices listed below collectively form the so-called "Internet of Things," which is crucial to shaping the smart city of the future:
* Sensors to monitor utility status, such as load on electricity, water, ground transportation and capture of real-time data;
* Gatherers that aggregate real-time data from these sensors, perform local analysis and localize measures based on results to prevent possible failures from propagating further into the network;
* Communications infrastructure that connects these gateways to the server cloud for data transfer in the local area;
* Server farm, warehouse data in a cloud-based architecture; real-time mining of these data to provide useful information to stakeholders across a variety of channels including mobile devices

These devices help to optimize the availability of local services while confirming the limits at the regional and macro levels. This provides local communities with flexibility in prioritizing the use of scarce resources.

The second important factor is the design framework for the different ICT components of the Smart City project. Although only a handful of companies dominate smart city ICT platforms, there is a need to create platforms for open gateways, APIs and open datasets so that many Indian IT companies, small and large, as well as large developer communities, can Digging for building innovative applications and services.

Sensors, communications equipment and transmission infrastructure have provided tremendous opportunities for the local electronics manufacturing industry, which has been identified by the government as a priority area. Collected data, if publicly available, provides ammunition for the country's big data and analytics start-ups.

II. Project Architecture

2.1. ARCHITECTURE OF AVR ATMEGA328

There have been many advances in our electronics industry these days, cutting-edge technologies are evolving every day, but 8-bit microcontrollers have their own place in the digital electronics market, which is dominated by 16-32 & 64-bit digital devices. While powerful and powerful microcontrollers exist on the market, 8-bit microcontrollers, due to their easy-to-understand operability, high popularity, simplified digital circuitry, low cost compared to the features offered, single Many new features in ICs and the interest of manufacturers and consumers.

Microcontrollers today are very different from those in the initial stages of microcontrollers, with the number of manufacturers far surpassing that of a decade ago. Some of the current major manufacturers are Microchip (publication: PIC Microcontroller), Atmel (publication: AVR Microcontroller), Hitachi, Phillips, Maxim, NXP, Intel and others. Our interest is ATmega32. It belongs to Atmel's AVR family of microcontrollers.

2.2 Controller Area Network

Controller Area Network The bus is a serial communications bus originally defined by the International Organization for Standardization (ISO) developed for the automotive industry, using a two-wire bus instead of a complex wire harness. Controller Area Network bus or CAN bus is a vehicle bus standard that is designed to allow devices and microcontrollers to communicate with each other in a vehicle without the need for a host.CAN is a reliable real-time protocol that implements multicast, data push, publisher / subscriber models. CAN message is very short (data payload up to 8 bytes, the title of 11 or 29). It is distributed so there is no centralized master or hub to become a single point of failure; it's flexible in size. Its real-time capabilities include deterministic messaging times and global priorities by using priority message IDs. Now one day is also used for other purposes than cars.

The CAN network consists of several CAN nodes connected via a physical transmission medium (CAN bus). In fact, the CAN network is usually based on a line topology with a linear bus, to which a number of electronic control units are respectively connected to the linear bus. A passive star topology can be used as an alternative. Unshielded twisted pair is the most commonly used physical transmission medium (unshielded twisted pair - UTP) applications, through this transmission medium can achieve symmetrical signal transmission. The maximum data rate is 1 Mbit / s. Allow maximum network extension of about 40 meters. At the end of the CAN network, the bus terminating resistors help to prevent transients (reflections). ISO 11898 states that the maximum number of CAN nodes is 32.

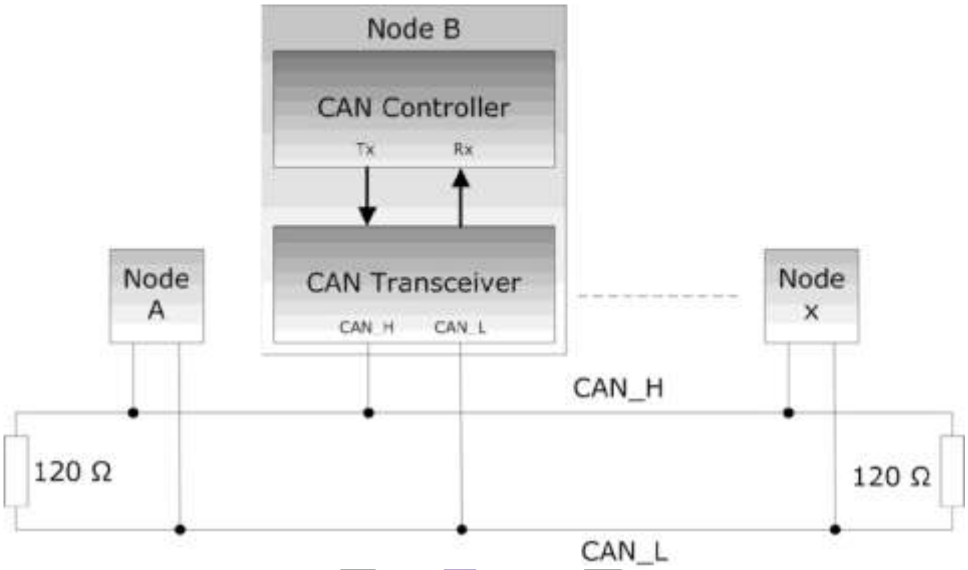

Fig - 2.2.1 : CAN NETWORK

2.3 IOT Architecture

The Internet of Things system consists of three major components, sensors, network connectivity and data storage applications. The same situation is described in Figure 1. As shown, sensors in IoT devices can communicate directly with a central server for data storage or communication through a gateway device.

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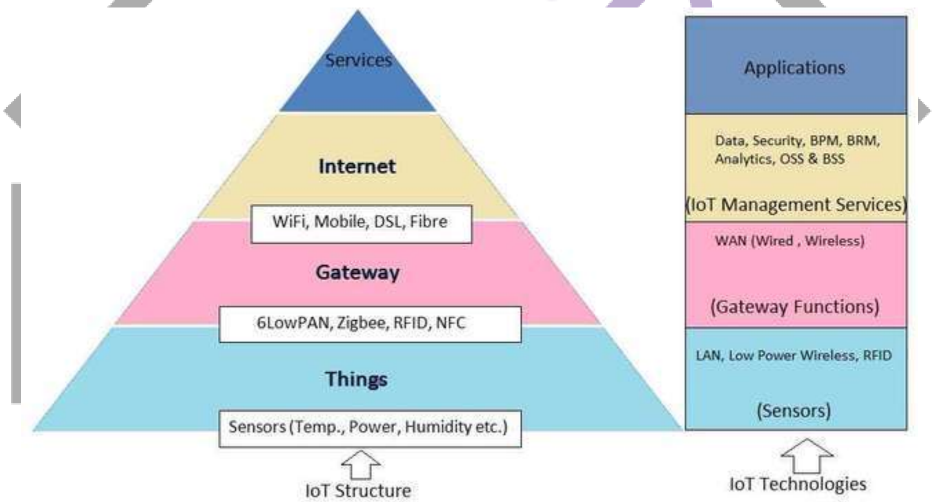

Fig - 2.3: IOT Architecture

Depending on the application, such as temperature, power, humidity, proximity, strength, etc., sensors for a variety of applications can be used for different IoT devices. Gateways are responsible for a variety of wireless standard interfaces, so a gateway can handle multiple technologies and multiple sensors. The typical wireless technologies widely used today are 6LoWPAN, Zigbee, Zwave, RFID, NFC and the like. The gateway uses backbone wireless or wireline technologies such as WiFi, Mobile, DSL, or Fiber to interface with the cloud. As shown, the Internet of Things supports IPv4 and IPv6 protocols. With support for IPv6, which is about 128 bits in IPv6 address length, there are enough addresses available to meet the growing demand for IoT devices. DTN (Delay-tolerant Networks) is a unique feature of the Internet of Things that takes into account the large variable delay requirements of IoT-based networks over traditional computer networks.

III. Future Scope

Over the years, CANopen, a CAN-based CAN-based higher-level protocol, represents the best choice for low-cost industrial embedded networks. However, since the formal introduction of CAN in 1986, efforts have been made to replace CAN and CANopen in order to overcome the most obvious drawbacks such as limited baud rates and limited network length. Industrial Ethernet technology is currently CANopen as the preferred low-cost industrial network technology, the biggest problem. Ethernet technology will eventually replace most CANopen applications, at least in new developments, starting in areas such as industrial control including motion control, especially in the robotics arena. Ironically, CAN (CANopen's underlying hardware layer) has a much longer life

expectancy in North America than CANopen is a high-level protocol. However, there may be too many good things, which is definitely the case for Ethernet-based fieldbus technology.
There are currently over 20 different Industrial Ethernet solutions that have unique strengths and weaknesses that make pro / duel decisions difficult. In addition to the technical aspects, the main issue is which one of these technologies can survive in the market and how they support the current need for control components. In short, fighting between these technologies is just a marketing battle. It will also address the need for faster fieldbus systems and narrow down the potential winners in the Ethernet race.
The Future of the Internet of Things As technology is increasingly advanced, access to the Internet in every corner of the world will be readily available, so the future of the Internet of Things is undoubtedly bright. Achieving greater connectivity is a requirement in today's world of progress; therefore, the Internet of Things (IoT) has become an important tool for interconnecting devices. The Internet of Things will change our lives beyond imagination. This will make our life faster, easier and more productive. Now, people want to have full access to all their products at home while away or in the office. For example, one could turn off the electric motor, the alternating current, or the lights in the house while sitting in the office. IoT technology is this kind of intelligence to bring people's way of life. According to Xing Zhihao and Zhong Yongfeng, the Internet of Things may have a tremendous impact on our daily life and become a major force in power, transportation, industrial control, retail, utility management, healthcare, water resources management, and petroleum.It can greatly improve productivity and our lives. Not surprisingly, its huge market potential is attracting investment from government, telecom carriers, manufacturers and industry users. M2M is also known as machine-to-machine, machine-to-machine, machine-to-machine or machine-to-machine, and the Internet of Things intelligently connects people, devices and systems. Is considered another IT wave after computers, the Internet and mobile communications and represents the pinnacle of our current ICT (Information and Communication Technology) ambitions.
Human beings are constantly developing and looking for new technologies and things, so the Internet of Things will have a great impact on our daily life. Internet-enabled products will certainly make our life easier than it is today. We will be able to operate multiple devices simultaneously. The Internet of Things is certainly able to connect to different types of devices and it will go a long way since it provides the ease of operation for those who use it. We can pay close attention to what we are doing at the office, at home and at the kids, something we can not do, and although we have these facilities now, we are connected to different devices. I think in the future almost all devices in daily life will have a connected application. There will be machine to machine interfaces where the devices talk to each other. As more people surf the Internet, the Internet of Things will lead to greater awareness of environmental and social issues and greater access to new technologies and solutions in education, human rights, environmental hazards and education. From climate change to disease prevention, from smart parking to traffic management, from water conservation to waste management, all the answers lie in the Internet of Things and we will find a better way to deal with it. The Internet of Things (IoT) will bring about the following changes in people's life style in the near future:
a) Monitoring and reporting: Ten million devices, devices will be interconnected through the concept of Internet of Things. The data currently entered is not fully automated on the Internet, but it will also be achieved through Self-Monitoring Analysis and Reporting Technology (SMART). Use IOT to monitor every action in our home and connect to the internet. By reporting and monitoring, we mean to say that if there is a gas leak, the sensor can find it and communicate it to us. Smart cities will ensure that they live in a clean and safe environment, with smart transportation systems ensuring fewer accidents.
b) Plants and Animals: The Internet of Things will drive a huge innovation in the way we grow, process, distribute, store and consume food. Based on the data we can tell people, computers, and machines, we know the needs of plants and animals, such as when they need water, treatment, medical support, need more sunlight or personal attention.
c) Utility: The Internet of Things will revolutionize the digital revolution in all fields. This will make everyday life easier with the available technology, which will be user-friendly. According to Xing Zhihao, Zhong Yongfeng introduction, power companies will read the meter through the telemetry system, rather than access to housing; doctors by allowing patients to use the device at home instead of requiring patients to stay in the hospital to remotely monitor the patient's condition around the clock; car terminal Automatically display the nearest parking space; sensors in Smart Home turn off utilities, shut down windows, monitor security, and report to homeowners in real time. These are scenarios that previously existed only in science fiction. But as the Internet of Things era, they will become a reality.
d) Information: In the future, the use of the Internet will be much faster than we think; we can get the answer with just one thought. People can access the Internet anytime, anywhere without any expensive gadgets.

IV. CONCLUSIONS

In our project, we transmit the input to the temperature (LM 35), photosensitivity (LDR) and pollution sensor (MQ135) using the CAN protocol to the Arduino UNO board for a robust CAN network. Arduino IDE software is used for programming. The CAN transceiver MCP2515 is used for communication between two Arduino UNO boards. Data from the second Arduino UNO board is sent to the ESP8266 wifi module via UART. Programming with the HTTP protocol The ESP8266-12 WiFi module is implemented using the Arduino IDE software. Data from the ESP8266 wifi module is sent to the thing Speak and can be monitored remotely.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar.

V. ACKNOWLEDGMENT

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