

IoT based Smart City

Aishwarya Dhote¹, Bhumika Gaikwad², Elvin Gajbhiye³, Ankit Pakhale⁴, Umesh Samarthak⁵

^{1,2,3,4} B. Tech students, Department of Information and Technology, JD College of Engineering, Nagpur-441501 Maharashtra, India

⁵ Associate Professor and project guide, Department of Information and Technology, JD College of Engineering, Nagpur-441501 Maharashtra, India

Abstract: *In today's modern world people preferred to live the sophisticated life with all facilities. The science and technological departments are rapidly growing to meet the above requirements. With advanced innovations, Internet of things plays an important role to automate different areas like street lights, homes, parking lots and door systems, etc. Currently we use manual systems to operate the above-mentioned things. In this project we studied about how IoT is used to develop the street lights, homes, parking lots and door systems in the smart way for our modern era. In addition, with the study on smart city we analysed and described different sensors and components which are used in IoT environment.*

Keywords: IoT, LDR Sensors, Relay, Wi-Fi Module ESP8266, NodeMcu, IR Sensors

1. INTRODUCTION

Smart city solutions of IoT are focused to develop cities of future that promote economic development, smart city use IoT devices to such as connected sensors, lights and meters to collect and analyze data and improve infrastructure and environment, and digitally optimize public assets. The Internet of Things can be defined as connecting various types of objects like smart phones, personal computers and tablets to internet, which brings in very new-fangled type of communication between things and people. This project consists of four major aspects of IoT: -

Smart Home: A smart home incorporates sensors, actuators, middleware and a network and has two major interacting components which is a smart network and smart load. The smart home is known as Home Automation, with the use of new technology, to make the domestic activities more convenient, comfortable, secure and economical.

Smart Street Light: IoT based smart street light system is the conversion of energy by reducing electricity wastage as well as to reduce manpower. We can use that saved energy in different purposes such as commercial, residential etc.

Smart Parking Lot: Efficient and smart way to automate the management the of the parking system that allocates the efficient parking space using IoT technology. To keep a track of the availability of the parking area, a wireless access has been provided by IoT. The user usually wastes his time and efforts in search of availability of free space in the specified parking area.

Smart Garage Door: An automatic door system which has a unique wireless id that consists of a sensing and drive unit that open and closes the door for the car which has unique id. In this process the signal is received by Arduino from the Bluetooth by using a BLYNK APP.

2. LITERATURE SURVEY

As there is a rapid advancement in technologies various works have been carried out on smart city. The smart city project can be achieved by these different technologies.

In [1] the author says that an architecture for an Internet of Things-based middleware for smart cities that will serve as a communication layer between the city's diverse systems, providing the government authority over the data and infrastructure. This architecture will encourage governments to adopt creative economic models that will result in autonomous self-driven cities while also assisting them in operating more effectively in a vendor-neutral environment. This Internet of Things middleware solution includes a messaging, queuing, and routing system that can send data to any platform for analysis. One of the biggest benefits of choosing a middleware for all IoT systems in a smart city is that the hardware usage for communication will be maximised and the capex & apex cost will be lowered, compared to using separate IoT systems for each system.

In [2] author proposed ZigBee and Arduino are used to automate the home and control the appliances. This system uses a variety of current technical sensors to manage modest household appliances. Using a web server, users may monitor the status of their household appliances.

In [3] the author said that the system is managed and controlled through a web application. Smart parking systems often gather data on available parking spots in a certain region and analyse in real-time to position cars in those spaces. It involves utilising low-cost sensors, real-time data collecting, and automated payment systems that may be accessed via mobile devices, enabling users to reserve parking in advance or to estimate parking availability extremely precisely. Thus, when implemented as a system, smart parking lowers automobile emissions in urban areas by obviating the need for individuals to pointlessly walk around city blocks looking for space. Additionally, it enables cities to precisely control their parking supply. Finding vacant parking places in metropolitan areas, one of the main issues for drivers, is made easier with smart parking. This suggests that M2M systems prioritise rightness/safety in addition to ease. Three elements make up the Parking Assistance System: a showing unit, a control module, and a monitoring module. Along with the aforementioned three modules, it will also contain an SMS gateway and a centralised supervisory system to manage a database of parking spaces. Ultrasonic sensors and ambient light sensors are part of the monitoring module, which locates available parking places and relays that information to the control unit through ZigBee. The sensor not only recognises the automobile but also offers other data like how long the car has been parked for and its condition. Information is processed by the control units, who then transfer it to a centralised supervisory system. The controller provides information about parking spaces to the centralised supervisory system.

In [4] Automatic Street Light Control System is a simple yet effective method. In this system, relay employs an automated switch. It nearly completely frees up the physical labour. This method turns on the lights automatically as soon as the sun passes directly in front of our eyes. A sensor called a Light Dependent Resistor (LDR) really performs this task and perceives light in the same way that human eyes do. When sunlight becomes visible to human eyes, the lights are immediately turned off. A similar approach is helpful for cutting down on energy usage.

3. SYSTEM DESIGN

Block Diagram: -

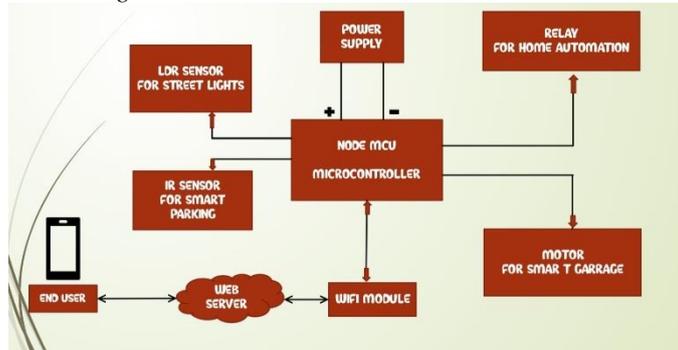


Fig. 1. Block Diagram

The system has low cost and efficient monitoring in the utilization of IoT based devices. Different modules are used with NodeMCU ESP8266

Hardware Used

The hardware used to build the system are as follows: -

- A. Power Supply Unit
- B. LDR Sensors
- C. Motors
- D. IR Sensors
- E. Relay Module
- F. Node MCU ESP8266

A. Power Supply Unit

It is the main circuit to provide energy to all components it is an electronic circuit which takes 230V single phase AC supply and converts it into 5V DC to all particulars of the project

B. LDR Sensors

Light Dependent Resistors are the sensors which are used to detect the intensity of light. It is also known as photoresistors. When the light falls on the sensor the value of the resistance changes.

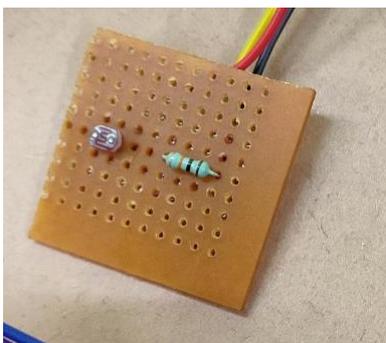


Fig. 2. LDR Sensor

C. Motor

To open and close the garage doors automatically. The motor is driven by motor driver circuit which controls the direction of motor by reading or receiving the signals from microcontroller.



Fig. 3. Motor

D. IR Sensor

An infrared sensor is an electronic device which detects the presence of objects. It emits the infrared light if that IR light does not reflect back which means there is not object present Infront of the sensor. It will be used in the project to detect car in car parking lot.

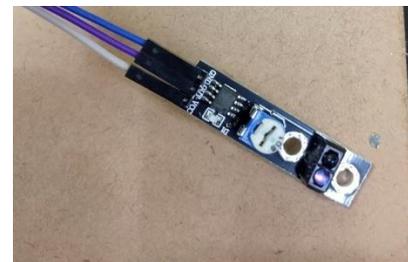


Fig. 4. IR Sensor

E. Relay Module

It is an electromagnetic switch which controls AC load when the signal packet received from main microcontroller unit. The electromagnet will pull to open or close the circuit when activated. It is used in home automation to turn on and off the appliances.



Fig. 5. Relay Modules

F. Node MCU ESP8266

NodeMCU is an open- source Internet resource (IoT) platform The ESP8266 NodeMCU CP2102 board has ESP8266 which is a largely intertwined chip designed for the requirements of the new IoT- connected world. Provides a complete result and contains a Wi- Fi network, allowing it to host an operation or download all Wi- Fi communication conditioning from another app processor. The ESP8266 has the capability to reuse and store capabilities allowing it to be integrated with detectors and other device-specific bias through its GPIOs with a many earlier advancements and smaller lading during operation. Its high position of chip integration allows for minimum external gyration, and the entire result, including the frontal module, is designed to accommodate a small PCB area [5].

4. WORKING

NodeMCU ESP8266 Specifications & Features [6].

- Microcontroller Tensilica 32-bit RISC CPU Xtensa LX106 Operating Voltage - 3.3V
- Operating Voltage - 3.3 V
- Input Voltage 7-12V
- Digital I/ O Legs -16
- Analog Input Legs -1
- UARTs -1
- SPIs -1
- I2Cs -1
- Flash Memory - 4 MB
- SRAM - 64 KB
- Clock Speed - 80 MHz
- USB- TTL is included onboard, Enabling Plug n Play
- PCB Antenna

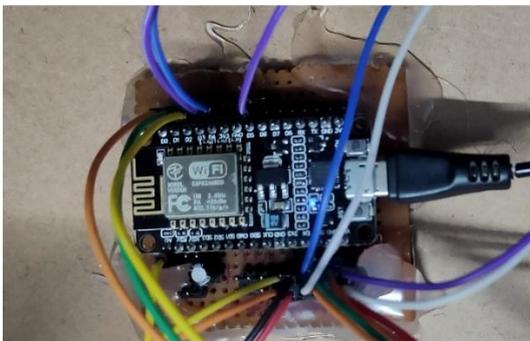


Fig. 6. NODE MCU ESP8266

Software used

A) **Arduino IDE (Integrated Development Environment)** – It is used to program the microcontroller

B) **Blynk Android Application** – It is a platform that allows us to quickly build interfaces for controlling and monitoring the hardware project from our android device.

Language Used

A) **C language**

Framework used – Embedded C: - It is a set of language extensions for the C programming language by the C standards committee to address commonality issues that exist between C extensions for different embedded systems

The system is divided in four parts home automation, Street lights, Smart parking and Garage door. In the system, every device is required to work on the basis of IoT, are connected to the same network. Microcontroller works as the brain of the whole system.

It is the adaptive system consists of NodeMCU ESP8266, LDR Sensor, relay, IR sensor, motor.

In home automation, the relays are connected to the node mcu and the results can be seen in smart phone. All the electrical appliances can be controlled through the smart phone from long distance. In this project only lights are controlling through internet.

In street light system, LDR sensor is connected to the microcontroller, In the daytime when the sunlight falls on the sensor, its resistance decreases and makes the lights turned off. When in the night time the light does not fall on the sensor its resistance increases and switches the light on.

In parking lot, the IR sensor is connected to the microcontroller. The sensor detects the car and gives signal to the microcontroller that sends notification in the user's mobile phone as the parking space is full or vacant.

In garage door, the motor is connected to the microcontroller and the door of the garage. The motor is operated on/off through the smartphone. User can simply open and close the door of the garage through his smartphone. The user also can know by his smartphone that whether his garage door is opened or closed.

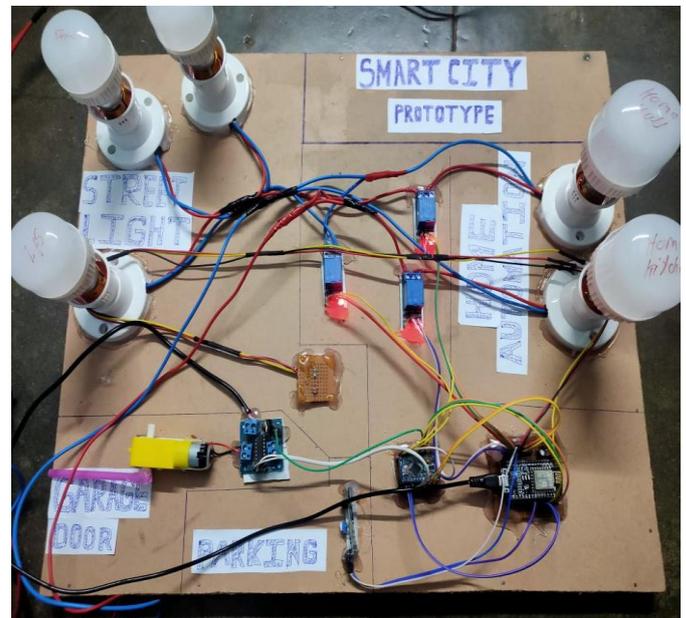


Fig. 7. Smart City Prototype

5. CONCLUSION

In home automation, the cost of wiring and switching is reduced by utilizing wireless network and home appliances can be easily controlled via mobile application and the system provides the real time statistics of home environment.

In smart street light system, the manual visit to the location and human intervention can only be required in the case of malfunction the efficiency is also more than the manual systems the reprogram can also be done on device with respect to our needs.

In smart parking, due to the real time information of availability in parking slots in a parking area, the users can book a parking slot from remote locations by the use of mobile application.

In smart garage door, the user can remotely open and close the door through the mobile phone. It is useful for the people especially have difficulty opening the door. Further the fingerprint system can also be used to prevent unauthorized use and entry.

6. REFERENCES

- [1] R. Ranjan and R. Kumar, "Smart City- an IoT based Approach," *International Journal of Engineering Research & Technology (IJERT)*, pp. 1-3, 2018.
- [2] a. Bangali, "Design and Implementation of Security Systems for Smart Home based on GSM technology," *International Journal of Smart Home*, vol. 7, no. 6, pp. 201-208, 2013.
- [3] H. Tanti and P. Kasodariya, "Smart Parking System based on IOT," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, no. 5, 2020.
- [4] M. Boda and S. Chettukindi, "IOT based Smart Street Light System," *International Journal of Scientific Engineering and Research (IJSER)*, vol. 9, no. 6, 2021.
- [5] "ESP8266 Node MCU board specifications and pins descriptions," <https://www.electronicshobbies.com/>. [Online].
- [6] "NodeMCU ESP8266 Specifications & Features," <https://components101.com/>. [Online].