IoT-based Smart City with Streetlight Controlling, Drainage Overflow Alert and Vehicle Parking Management

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ABSTRACT

The world's population is increasing day by day, and with it, the number of domestic problems. To address these problems and make citizens' lives easier, we are adopting the latest technology. The world is becoming increasingly smarter and looking for secure ways to optimize resources and improve the quality of life. This need has led to the development of smart and safe cities that connect the virtual world to the physical world and provide real-time services that can be adapted to real-time situations based on IoT technology. This system uses various sensors to monitor infrastructure in a city. The system sensors are connected to an ATmega16 microcontroller using the wireless communication technology IoT. We are designing a smart city for better facilities and automatic alerts in a community. In this project, we are implementing a smart parking system, a drainage leakage system, and automatic intensity control of streetlights for power savings. Everything is updated for IoT. Water level sensors are used to alert the public to leaks; parking systems will notify the public of the status; and LDRs are used to automatically save power. All components are connected to the Arduino microcontroller. The Arduino ATMEGA328 microcontroller is used to process input and produce output using the Arduino IDE with embedded C programming. It is powered by a regulated power supply that provides 5 volts of DC voltage to all hardware modules.

Keywords: Internet of Things, Smart city, Arduino UNO, water level sensors, parking system, street light system.

1. INTRODUCTION

The ongoing development of the Internet of Things (IoT)-based applications is paving the way towards the development of smart cities. Smart cities offer intelligent transportation, industry 4.0, smart healthcare, smart homes, smart banking, among others. These applications require immense security for handling data while improving the standard of citizens' life. To enable smart cities with enhanced security and privacy. The smart city comprises the ecosystem of smart environments provided in the city which can improvise its inhabitants' lifestyle. Smart cities are concerned with the adoption of information and communication technologies for enhancement in public welfare, economy, government services, environment, resource management, and urban planning. Smart cities envision the use of existing and developing digital technology to enhance every aspect of city life. One of the primary objectives of smart cities is reformed provision of fundamental services like housing, education, healthcare, transportation, energy, water, utilities, surveillance, and law enforcement. Smart cities mitigate the problems of population growth and expeditious urbanization by integrating social, business, and physical infrastructure of the city through technology. Recent advancements of technologies such as Information & Communication Technologies (ICT),

blockchain, Big Data, machine learning, automation, Artificial Intelligence (AI), and the IoT will make smart cities more interconnected, instrumented, intelligent, livable, safer, sustainable, and resilient.

As the IoT technology expands, new applications are created to make people's lives better. Cities are getting "smarter" and smart city applications are developed to take advance of the latest technological improvements. With the introduction of IoT in the field of transportation, transportation systems begin to "feel" and "think", leading to the development of Intelligent Transportation Systems (ITS). Smart transportation has attracted the attention of many researchers since there are plenty of opportunities for further enhancements. One of the most significant areas of interest in smart transportation is navigation or route optimization. The continuous growth of the urban population favored by the massive rural exodus pushed cities towards the optimization of their urban resources. In this regard, the will of cities actors and the progress in information and communication technologies (ITC) gave birth to the "smart cities". The advent of smart cities is a growing global trend. They aim to integrate ICT solutions to improve the quality of life of its citizens and their interaction with government officials. Thus, traffic and urban mobility are one of the major problems of urban development. They face many challenges of sustainable mobility in face of increasing demand of parking spaces especially those related to the limitation of capacity of the city's transport, traffic, and parking systems. One of the typical smart city illustrations is the use of public transport applications and the provision of custom information routines to users. For the design of these applications (usually with support for mobile devices), valuable information must be provided by users to optimize their movement. At the same time, transport companies are forced to improve the quality of services provided to meet the challenges of smart urban mobility.

Trash defilement has a significant ecological effect. If reusing, and removal are not taken care of appropriately, the trash lying at the edges of the road could undoubtedly hold rodents and insects that bring perilous illnesses. Accumulating litter could prompt pestilences that can prompt passing's. To secure the climate, the measure of discharges should be limited to the fullest degree conceivable. To achieve this assignment, a trash checking framework is along these lines vital. Savvy urban communities are on the expansion with the most recent improvement in advancements. Keen urban communities are an essential worldview of financial arranging centered on the utilization of consolidated human and specialized assets to develop metropolitan agglomerations with the development of the Internet. With the development of Internet of Things [IoT] and the accessibility of minimal effort actuators and sensors, the upsides of innovation can be utilized to address the issue standing up to metropolitan waste administration techniques today. The Internet of Things (IoT) is a biological unit of applicable corporal issue that can be seen on the web. The 'Things' in IoT could block actual gadgets with sensor capacities that are fit for sending data naturally to the base station through IP address and the capacity to impart data. The Internet of Things (IoT) will convey over the Internet in various organizations. New bearings for the joining of IoT for the green climate were executed in this undertaking via naturally cleaning waste and offering a more viable arrangement. Smart transportation has attracted the attention of many researchers since there are plenty of opportunities for further enhancements. One of the most significant areas of interest in smart transportation is navigation or route optimization. Using data from the users' mobile devices, or with side units placed in specified locations on the road, applications try to estimate traffic congestion and propose optimal route options to minimize traveling times, and therefore reduce car emissions and energy consumption. Furthermore, to support energy consumption reduction, streetlights are proposed that can detect traffic conditions and operate accordingly, instead of being constantly on with a time schedule.

2. MOTIVATION

Technology has been growing faster and people need everything to be done in a smarter way. Instead of wasting manpower people want everything to be done automatically without their intervention. Using IoT we can implement so many services which make work simpler and smarter. To make the city smarter, we are implementing Street light controlling which saves electricity. And Vehicle parking management to reduce traffic at parking slots. And Drainage Overflow alert to keep the city hygiene. All these services are done using IoT which does not involve manpower.

Here are some of the benefits of using IoT technology in smart cities:

- Improved efficiency and productivity: IoT can help to improve the efficiency and productivity of city operations by automating tasks and providing real-time data and insights.
- Increased safety and security: IoT can help to increase safety and security in cities by providing early warning systems for potential hazards, such as flooding or fires, and by tracking the movements of people and objects.
- Improved quality of life: IoT can help to improve the quality of life in cities by providing residents with access to information and services that can make their lives easier, such as real-time traffic information and parking availability.

Overall, IoT is a promising technology that has the potential to significantly improve the lives of citizens in smart cities.

3. LITERATURE SURVEY

Aarthi et al. presented a study on an Internet of Things (IoT) based system for monitoring and alerting drainage and waste management in smart cities. The authors discuss the design and implementation of the system, which utilizes IoT technology to enhance the efficiency and effectiveness of waste management processes. Cynthia, et al. described an IoT-based smart parking management system in this research paper. The system utilizes IoT technology to provide efficient and automated parking management, improving the utilization of parking spaces and reducing congestion. The paper discusses the design and implementation of the system, highlighting its benefits and potential applications. Jabbar, et al. presented a parking management system for a smart campus using an IoT Raspberry Pi-based approach. The authors describe the design and implementation of the system, which integrates IoT devices and Raspberry Pi to enable efficient parking management and utilization. The paper discusses the features and advantages of the system in the context of a smart campus environment. Xu, et al. presented a design and implementation of a street light control system that utilizes power line carrier communication. The authors discuss the system's architecture, focusing on how power line communication enables efficient control and monitoring of streetlights. The study demonstrates the effectiveness of the system in achieving energy savings and improved street lighting management.

Parkash, and Rajendra proposed an intelligent street lighting system based on the Internet of Things (IoT) for smart cities. The paper discusses the design and implementation of the system, highlighting its ability to dynamically adjust lighting levels based on real-time conditions. The study emphasizes the energy-saving and cost-effective features of the proposed system. Kumar presented an IoT-based automatic street light control and fault detection system. The author discusses the design and implementation of the system, which utilizes IoT technology to automatically control streetlights and detect faults. The study highlights the system's ability to improve energy efficiency and reduce

maintenance costs. Singh, et al. described a smart parking system that utilizes IoT technology. The paper discusses the design and implementation of the system, highlighting its ability to provide real-time parking space availability information and optimize parking operations. The study emphasizes the potential benefits of the system in reducing traffic congestion and enhancing user convenience.

Mathew, et al. focused on an IoT-based system for monitoring and controlling streetlights using a LoRa/LoRaWAN network. The authors discuss the implementation of the system and its benefits in terms of efficient monitoring and control of streetlights. Sultana, et al. discussed an IoT-based smart drain monitoring system that incorporates alert messages. The system aims to monitor drain conditions and provide timely alerts in case of any issues or abnormalities. The paper likely presents the design, implementation, and evaluation of the system. Sihombing, et al. presented a prototype of a drainage water level monitoring system that utilizes IoT technology and a web-based interface. The authors likely describe the design, implementation, and evaluation of the system, which aims to monitor water levels in drainage systems for effective management and maintenance. Ke, et al. discussed a smart parking surveillance system that incorporates edge artificial intelligence (AI) on IoT devices. The system is designed to enhance parking management and surveillance efficiency. The article likely presents the system architecture, AI algorithms used, and the results of its implementation and evaluation.

4. EXISTING SYSTEM

In the existing system the smart city is in manual mode of operation. In street light there is no automatic controlling, the switches will be on and off through manually if anyone forget to off these lights the power will be wasted and also it requires more power consumption. The drainage is monitoring and alerting through manual mode. In vehicle parking management, availability of parking slots for outsiders is difficult to overcome these difficulties and to improve the security we are developing the IOT based smart city. Here we are going to propose smart streetlight, drainage overflow alert and vehicle parking management, everything here is automated as well as alerting over IOT which can easily transfer the data wirelessly and can manipulate everything because of this proposed system complexity will get reduced, speed will increase, and human errors will get reduced.

5. PROPOSED METHOD

5.1 Working

In this the RPS module converts 230V AC supply into 12V DC supply. This generated 5V DC will be supplied to all the modules of the project i.e., the operating voltage of microcontroller, Wi-fi module, LCD, sensors, and other components in the system. In this project we have three applications Street Light controlling, drainage Overflow alert and Vehicle parking management. For Street light controlling, we have used one LDR sensor and one IR sensor. LDR sensor detects whether it's day or night. If it is day the LDR detects and displays "LIGHT" in the LCD. If it's night, then the LCD display "DARK". If it's dark, then LED will glow, but intensity will be low. If any object or vehicle moves, then IR sensor detects then the intensity of light will increase automatically after the vehicle passes away the intensity will become low again. In drainage Overflow alert, we have used voice module and soil moisture sensor. When the drainage is about to overflow the soil moisture sensor detects and this information of overflowing will come out as voice "DRAINAGE" from the speaker. In Vehicle parking management, we have used two IR sensors for two parking slots. The IR sensors will detect whether the car has parked or not. If IR detected the car parking, then the LCD will display as "FULL". If not, it displays as "EMPTY". And all the information about Street Light controlling, Drainage overflow and Vehicle parking management will be posted in the server through wi-fi

module. The hotspot must be connected first. We need to check the device connection. Once it is connected, we can open the website and use login credentials and the updates and status of each application can be checked easily. And it takes 15 seconds time to update the status of each operation.

In this project we are using Atmega328p Microcontroller. It has a total of 28 pins. In these 28 pins we are using only 23 pins. D0-D13 are the Digital pins (14) and A0-A5 are the Analog pins (6). Here the D0, D1 are connected to the IOT, for transmitting and receiving the data. D2-D7 pins are connected to 16*2 LCD display, D8, D9 pins are connected to IR 1 and IR 2. D10 pin is connected to water sensor. And D11, D12 pin is connected to voice. The A0 pin id is connected to IR Sensor. And A1 pin is connected to LDR sensor and A2 is connected to LED. The 230V AC is converted to 12V DC and that is given to the circuit pin&. Reset is given to pin 1 which is used to reset the circuit for connecting to the IOT module. The Oscillator is connected to pin9 and pin10.GND is connected to pin8 and pin22.

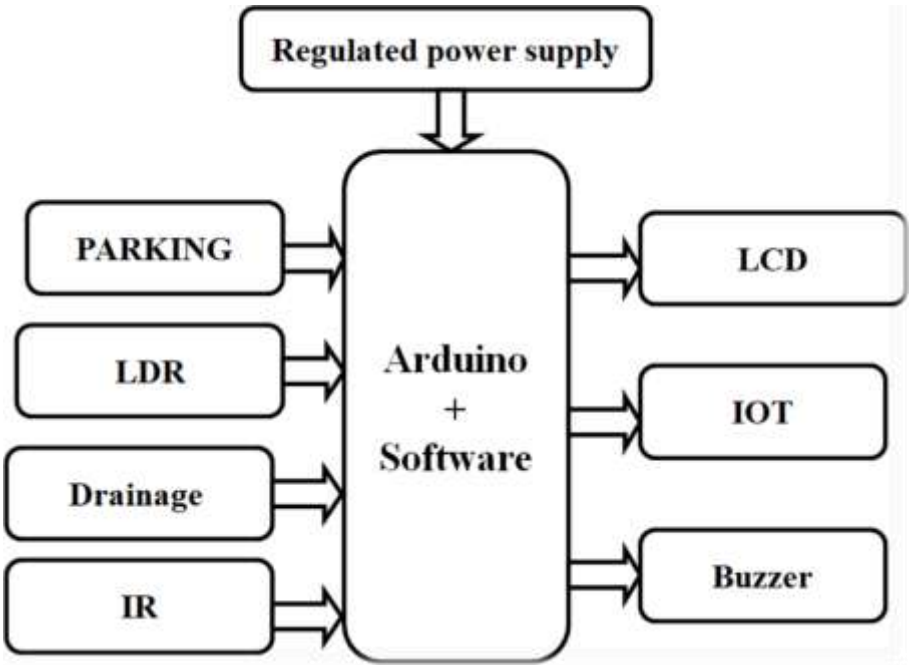
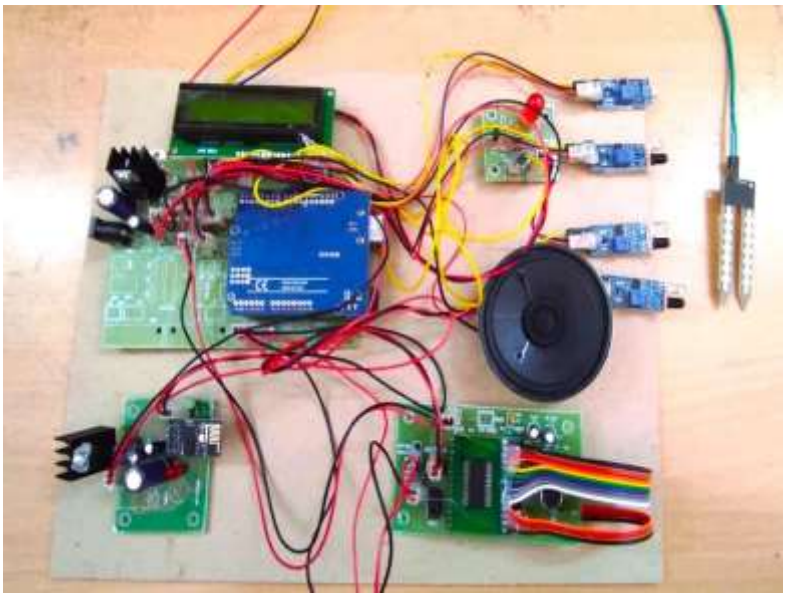


Figure 1: Proposed block diagram of smart city using IoT.

6. RESULTS

Here the circuit is turned ON by using the regulated power supply of 12v which is then converted to 5V DC current. The LED is the indication for 5V current so, if there is 5V current then automatically the LED glows. The generated 5V DC current passes to every hardware component in the circuit. Since there are three applications, the output of Drainage overflow will come as voice "DRINAGE" from the speaker and for vehicle parking, when slots are filled the voice will come as "SLOTS FILLED". The remaining two applications output will be shown in LCD.



When we hit the reset button after providing the regulated power supply, the LCD displays the "IOT Smart City". The output may be seen in the following image after we have connected the IoT module via a WIFI connection. Here the Wi-Fi is connected to the IOT server. After the Wi-Fi is connected the following output can be seen.

This image shows the output of streetlight and vehicle parking in the LCD. If it is night and vehicle pass then IR will be ON and S1, S2 displays vacancies of parking If there is any vacancy it will show empty and if there are not any vacancies then it shows Full. This image displays the database and project's finished product. By using username and password anyone can login onto this server and can monitor these three applications.

7. CONCLUSION

Overview of the project is "IOT Based Smart City with Street Light Controlling, Drainage Overflow Alert and Vehicle parking Management" the main aim of this project make works simpler and smarter by automating the things without involving of human intervention. In this we have used IoT module for transmitting the data. And the data can be controlled by Microcontroller. And the voice of the Drainage overflow can be produced by APR voice module. By using the Wi-Fi, connect to the IoT server. The status of each operation will be displayed on LCD besides IOT Server.

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