PAGES: 23-29
1/15/24
JOURNAL OF SCIENTIFIC RESEARCH AND TECHNOLOGY(JSRT) VOLUME-2 ISSUE-1 JANUARY
Registered under MSME Government of India ISSN: 2583-8660

Effective Space Utilization System In Smart Cities Using IOT And Image Processing

Sumaiya Nasreen[1]

[1]*Student, Department of Computer Science and Engineering, PDA College of Engineering, Kalaburagi, Karnataka, India. sumaiyanas705@gmail.com*

ABSTRACT

In the world of Smart Cities, we're exploring new ways to improve our urban spaces using the Internet of Things (IoT). By using devices like Arduino, we're creating models for Smart City solutions, focusing on things like Smart Parking, Traffic Road Dividers, and Patrolling Vehicles.

Our main goal is to make cities safer and better by using technology like IoT and image processing. For example, we're working on special road dividers that help manage traffic by separating cars going in different directions. These "Smart Road Dividers" are designed for cities and use sensors and technologies to adapt to how busy the roads are, helping traffic flow better and easing congestion.

Cameras are being used on patrolling vehicles to spot cars parked in the wrong places. If they see something wrong, they quickly tell the right people so they can sort it out. This helps make sure that people park their cars properly and follow the rule.

Keywords: Technology, Smart Cities, Internet of Things (IoT), Smart Parking, Traffic Control, Road Dividers, Safety, Cameras, Arduino Technology.

I. INTRODUCTION

In current scenario, cities are growing fast, and technology is advancing quickly too. Smart cities are a great example of this where innovation, sustainability, and efficiency come together. New ways to use technology in cities are being explored, like using smart technology to make better use of space and improve people's lives. Two important ideas in this area are the "Smart Road Divider" and the "Wrong Way Vehicle Parking Detection System using Patrolling Vehicles."

With more people in cities, using space wisely, like roads and parking areas is important. This is where smart technology comes in. Traditional road dividers just separate traffic lanes. But in some places, like shopping areas, traffic mostly goes in one direction at certain times. This leaves the other side of the road empty. This can cause problems and waste time for drivers. "Smart Road Divider" is like special divider which could move and change lanes based on where the traffic is going. It uses sensors and special boards to know when there's more traffic in one direction. It can even add an extra lane when needed. This makes traffic flow better and helps drivers save time and fuel.

Another problem in cities is people parking their cars where they shouldn't. This makes things difficult for everyone. Usually, the police have to check and see if cars are parked illegally. But now, we have a solution using technology. The "Wrong Way Vehicle Parking Detection System using Patrolling Vehicles" uses cameras and sensors to spot cars that are parked in the wrong place. When it detects a problem, it sends a message to a special patrolling vehicle that can quickly go to the spot and take action. This could be giving a warning or sounding an alarm. This helps keep parking areas safe and fair for everyone.

The Smart Road Divider and Wrong Way Vehicle Parking Detection System both rely on cameras and sensors to capture images of their respective environments. These images undergo analysis through sophisticated algorithms. In the case of the Smart Road Divider, this analysis helps in understanding traffic flow patterns, allowing for dynamic lane adjustments for better traffic management. Similarly, the Wrong Way Vehicle Parking Detection System uses this technology to swiftly identify unauthorized parking, sending instant alerts for necessary action by authorities.

In short, the smart technologies are changing the idea of how we use space in cities. The "Smart Road Divider" and the "Wrong Way Vehicle Parking Detection System using Patrolling Vehicles" are great examples of this change. They show us how technology can make cities work better, be more eco-friendly, and create a happier life for everyone.

II. LITERATURE REVIEW

The research explored various ways to improve road safety and traffic management. They looked into using different technologies like cameras and drones to monitor cars and people. Some methods focused on faster ways to find cars, while others aimed to accurately identify individuals. Additionally, they discussed using devices connected to the internet to enhance traffic control in cities. Overall, the studies presented a range of approaches to make roads safer and traffic flow smoother.

In a notable study [1], researchers delved into vehicle surveillance by employing morphological operations and decision trees for detection, coupled with Kalman filters for tracking. However, practical challenges surfaced, particularly in open parking lots, where relying on headlight detection posed limitations due to the erratic movement of vehicles. An alternative strategy discussed in [2] utilized Unmanned Aerial Vehicle (UAV) footage and Haar cascade features to identify individuals and vehicles. Nevertheless, the variability in thermal photography's car heat signatures led to the utilization of visual camera data for more reliable vehicle detection, prompting exploration into faster detection methods like negative imaging techniques.

The evolution of deep learning architectures, including YOLO, GoogLeNet, ResNet18, and SSMD [3], has revolutionized vehicle detection, significantly expediting the process while enhancing efficiency. The implementation of SSMD, alongside template matching, exhibited promising results in detecting illegally parked vehicles and monitoring stationary ones. However, limitations arose when attempting to apply template matching to track moving vehicles within IoT contexts.

Human detection techniques showcased the integration of linear SVMs with Histogram of Orientation (HOG) features [4] and AdaBoost classifiers [5], showcasing effective strategies to minimize false positives. These methodologies leveraged extensive training datasets, robust Graphic Processing Units (GPUs), and innovative training methodologies characteristic of deep learning networks.

The integration of IoT technologies into traffic management systems [6] facilitated data collection from various sources such as cameras, sensors, and GPS devices. This data, upon analysis, enabled real-time decision-making processes to optimize traffic flow within smart cities. Novel approaches emerged, proposing vehicle detection solely based on color, employing portable Raspberry Pi systems [7]. Additionally, proposals for mobile device tracking applications [8] underscored the utility of location-based tracking and alert functionalities.

An adaptive traffic management system driven by IoT and machine learning [9] harnessed camera sensors and controller boards to dynamically adjust traffic signals based on vehicle counts. Further studies explored intelligent traffic organization frameworks that leveraged IoT and image processing, aiming to replace conventional traffic management systems [10-12].

Several studies investigated image processing techniques [11-14] for efficient traffic light management and congestion prevention. These systems utilized cameras for image capture, cloud-based analysis, and IoT-based approaches for traffic congestion analysis.

In conclusion, our exploration of different methods for improving road safety and managing parking space has shown that there are many approaches which we found from our research. These approaches focuses on making things simpler and more affordable for people. For example, using colors to spot cars or creating mobile apps to track phones [7, 8]. These methods aim to be easy to use and not too expensive. And the approach, which we proposed, is more advanced. It uses special sensors to measure vehicles parked at wrong in real-time using patrolling vehicle and generate alarm if the vehicle is parked on the wrong place and can change road dividers accordingly. This approach is more adaptable to different traffic situations. Both approaches have their advantages, and the choice between them depends on what is needed for specific traffic scenarios and budgets. Looking forward, a combination of these methods will help us create safer and smoother-running roads, improving overall road safety and traffic flow.

III. SYSTEM ARCHITECTURE

A. SMART ROAD DIVIDER MODULE

The smart road divider project relies on IR sensors to gauge traffic density and a DC gear motor connected through a rack and pinion gear mechanism for divider adjustment. Positioned with IR sensors on either side of the road, the system is programmed to analyze traffic flow. It dynamically shifts the divider towards the side experiencing heavier traffic, creating additional space to facilitate smoother vehicular movement. Illustrated in Figure 1, the entire setup is managed by an Arduino Uno controller, receiving inputs from IR sensors and managing motor functions through the L293D motor driver IC. This configuration ensures responsive and efficient traffic management based on real-time traffic conditions.

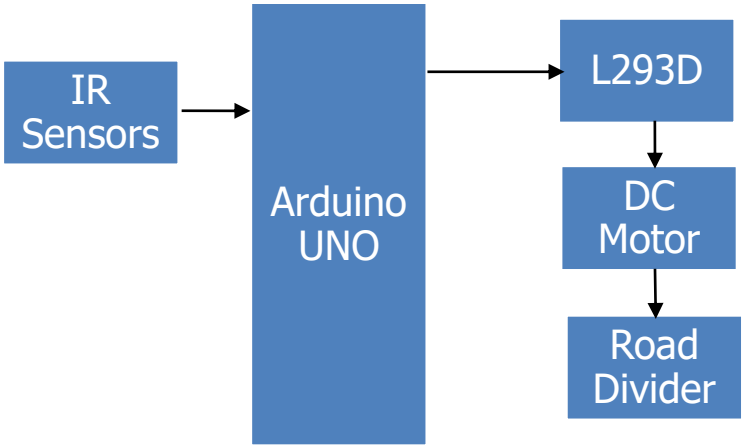

Fig1: Block Diagram For Smart Road Divider

B. WRONG-WAY VEHICLE PARKING DETECTION MODULE

The implementation of the smart parking system is executed through a NODE MCU controller interfaced with a combination of IR sensors and an RF transmitter. The system functions through IR sensors to monitor vehicle parking status, specifically catering to two distinct parking slots: restricted and allowed. Figure 2 illustrates the setup utilizing IR object sensors for sensing both parking areas. Data regarding parking availability is uploaded to the IoT Adafruit web server, enabling users to access real-time parking space availability. Additionally, if vehicles are parked in the restricted area detected by the sensors, an automatic signal is transmitted via an RF transmitter to the patrolling vehicle. Subsequently, an alarm is activated in the patrolling vehicle, ensuring immediate action upon unauthorized parking incidents.

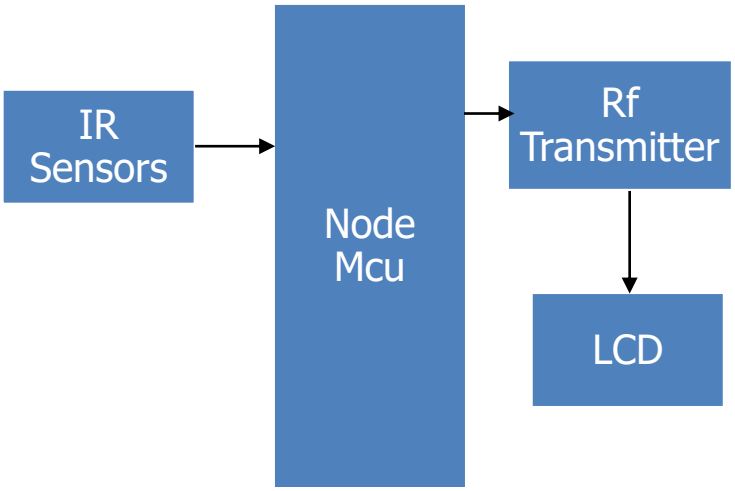

Fig 2: Block diagram for smart parking detection system

C. METHODOLOGY

The methodology employed for the development of our smart traffic road divider and parking system integrates sensor technology and sophisticated controllers.
These methodologies illustrate how these systems intelligently adapt to traffic flow and efficiently manage parking violations in urban settings.

1) Smart Road Divider:

- Sensor technology is utilized for creating a smart traffic road divider.. To do this, we place IR sensors on both sides of the road and position the divider in between them.
- These IR sensors keep a constant watch on the traffic flow. When they detect a traffic jam, we have pre-programmed software instructions stored in an Arduino controller that adjust the divider's position accordingly.
- A DC motor, controlled by an L293D motor driver, is employed to move the divider in both directions, following the commands from the Arduino controller.

2) Wrong Way Vehicle Parking Detection System:

- For our smart parking system, we rely on IR sensors again. We strategically install these sensors in parking and non-parking areas as needed.
- The NodeMCU controller comes into play here. It uploads software that sends sensor data to the Adafruit cloud. This data allows users to check in real-time if parking slots are available and helps them find a suitable spot.
- In case a vehicle is parked where it's not supposed to be, the system generates an alert. This alert is then transmitted to patrolling vehicles using an RF radio transmitter, ensuring that parking rules are enforced.
- The Espcam is a versatile camera that can be programmed for various applications.
- In our context, we've programmed it for object identification. This camera can recognize different objects on the road, especially when it's installed in patrolling vehicles. This helps improve safety by enhancing surveillance and quickly identifying incidents on the road.

IV. RESULTS

The results presents visual representations and descriptions showcasing the practical implementations and functionalities of the developed systems, namely the Parking Status Dashboard, Parking and Restricted Area Sensors, IoT-enabled Patrolling Vehicles, and the Smart Road Divider. These figures illustrate the integration of various components, wireless communication systems, and real-time monitoring capabilities embedded within the systems.

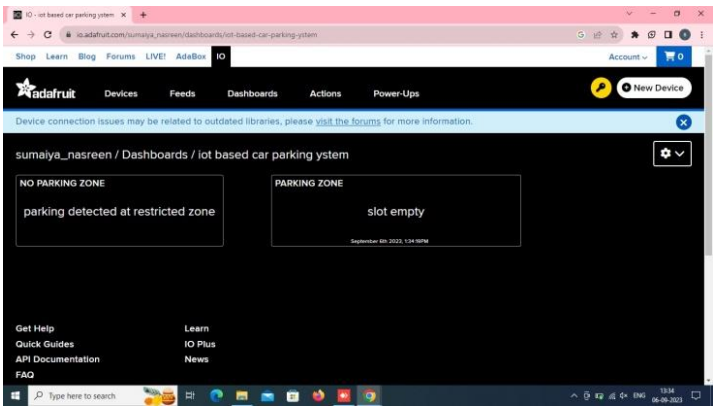

Figure 3: Adafruit IoT Parking Status Dashboard.

This web server is connected to the parking system. The wireless communication is established using the API key from a web page and programming in the nodemcu controller, once communication gets established parking system will send updates about the vehicles parked on the above page as indicated in figure3.

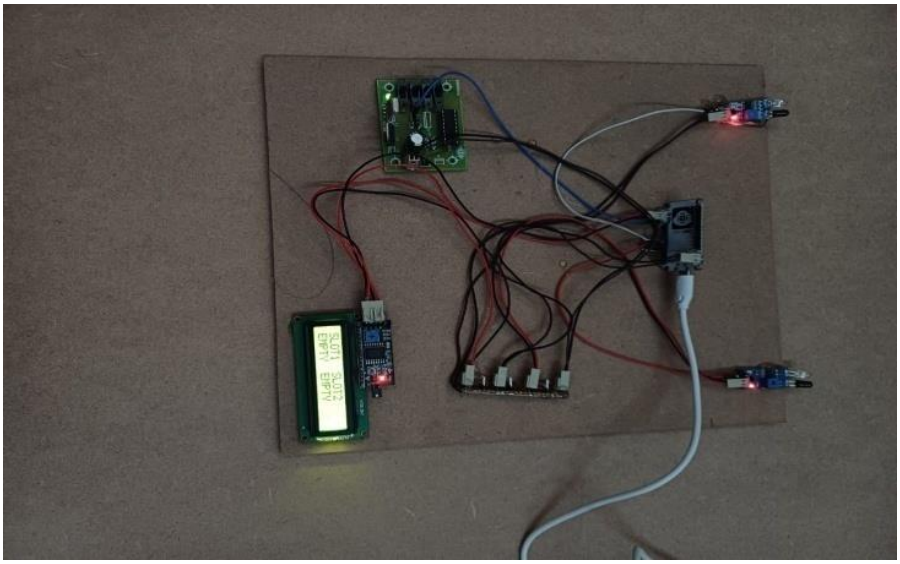

Figure 4: Sensors and LCD for Parking and Restricted Area.

The figure 4 is about the entire parking system module this module will be checking two dedicated slots using IR sensors and sending updates on the Adafruit web server also in case of a wrong parking signal will be sent to patrolling vehicles using radio communication which will generate alarm for alert purpose.

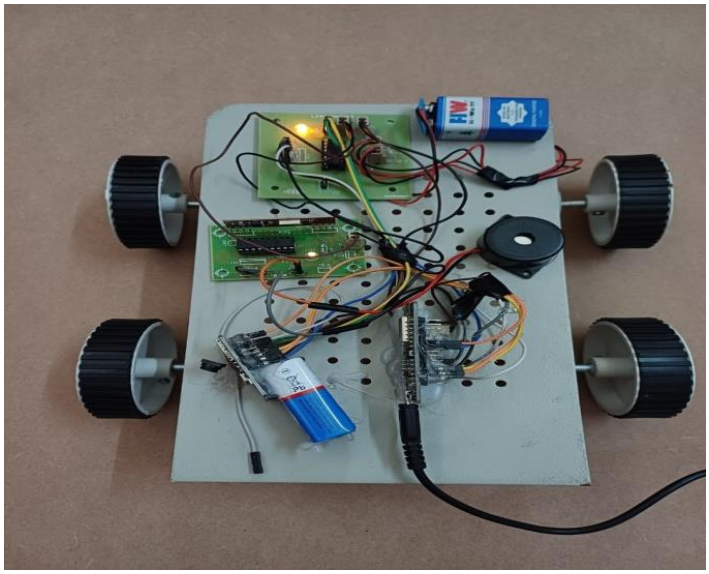

Figure 5: Live Video IoT Vehicle for Parking Control

The figure 5 representation patrolling vehicle that is fitted with an esp32cam and radio receiver that communicates with the parking system and generates an alarm when any wrong parking is detected using a buzzer. This vehicle is controlled using a web server using an IOT web page and it can be moved in different directions to check the movement of persons on the road remotely on the web page.

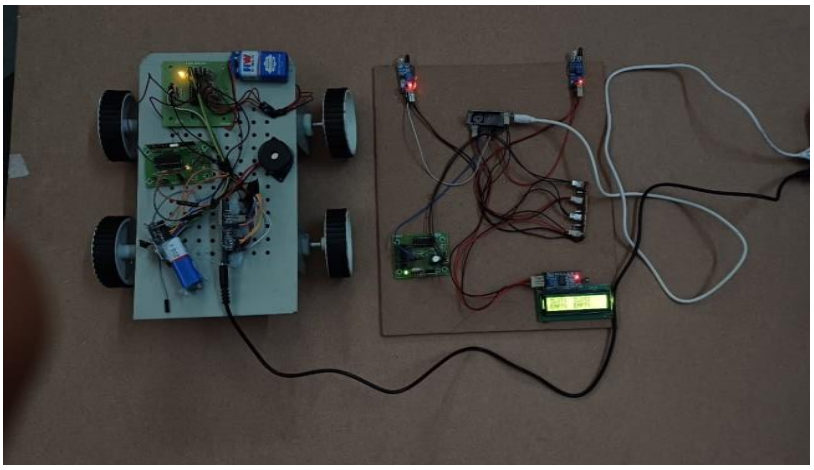

Figure 6: Parking indicator and patrolling placed in a single frame while testing modules

The figure 6 is a collection of two modules in one frame i.e. parking indicator and patrolling vehicle they have wireless communication using RF They communicate continuously for parking updates.

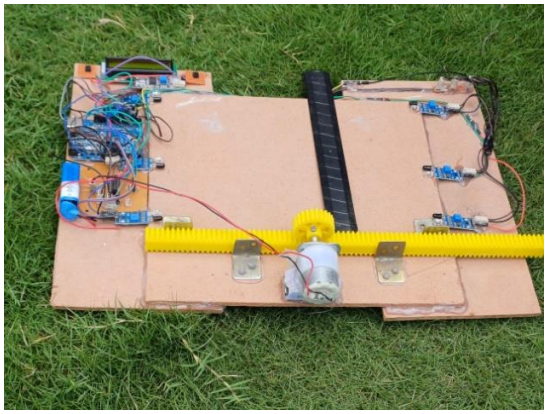

Figure 7: Smart road divider

The figure 7 shows a smart road divide project with sensors connected on both sides of the road and a movable road divider attached to a gear DC motor with a gear roller for smooth movement between roads as per the sensor signal for road widening. on each side I.e. it detects three mediums of traffic ranging from a low, medium, and high range of traffic. It also has two switches attached on either side for manual adjustment of the road divider if any in case it needs to be controlled manually.

Figure 8: Road divider attached with a gear rack

Road divider attached with a gear rack and pinion for moving left and right on the roadside. This alignment only moves smoothly between the roads on either side dc gear motor used is 60 RPM it works on 9-12 DC voltage.

V. CONCLUSION

In conclusion, the implementation of the automated road divider system and the wrong-way vehicle parking detection and alarm generation system using patrolling vehicles offer significant solutions to urban traffic and parking issues in smart cities. The automated road divider, with its smart technology and sensors, has the potential to adapt to traffic conditions, reducing congestion and improving traffic flow. Similarly, the parking detection system, equipped with sensors and cameras, can quickly spot unauthorized parking. When paired with patrolling vehicles, this system ensures timely responses to violations, enhancing parking regulation enforcement and contributing to safer and more efficient city living. These advancements highlight how technology can improve urban life, making cities more manageable and pleasant places to live.

REFERENCES

1. N. Dalal and B. Triggs, ―Histograms of oriented gradients for human detection,‖ in 2005 IEEE Computer Society Conference on computer vision and Pattern Recognition, vol. 1. IEEE, 2005, pp. 886–893.
2. Dr. Sharanabasappa Gandage, Poornachandra Swami, Rohit, & Shankar Reddy Bengire. (2023). Virtual Paint. Journal of Scientific Research and Technology, 1(2), 25–38.
3. Dr. Rekha J Patil, Indira Mulage, & Nishant Patil. (2023). Smart Agriculture Using IoT and Machine Learning. Journal of Scientific Research and Technology, 1(3), 47–59.
4. M. Anandhalli and V. P. Baligar, ―A novel approach in real-time vehicle detection and tracking using Raspberry Pi,‖ Alexandria Eng. J., 2017.
5. Shubam Sharma, & Prof. Vinod Sharma. (2023). Comparison of machine learning techniques in the diagnosis of erythematous squamous disease. Journal of Scientific Research and Technology, 1(4), 1–9.
6. Deeksha Nargotra, & Prof. Vinod Sharma. (2023). Grape Leaf Disease Detection Using Deep Learning. Journal of Scientific Research and Technology, 1(5), 128–139.
7. Hassina Kouser, & Prof. Vibhakar Mansotra. (2023). Deep Learning-Based Segmentation Of Brain Tumor. Journal of Scientific Research and Technology, 1(5), 78–91.
8. Sabina Anjum, & Asra Fatima. (2023). Predictive Analytics For FIFA Player Prices: An ML Approach. Journal of Scientific Research and Technology, 1(6), 204–212.
9. Antariksh Sharma, Prof. Vibhakar Mansotra, & Kuljeet Singh. (2023). Detection of Mirai Botnet Attacks on IoT devices Using Deep Learning. Journal of Scientific Research and Technology, 1(6), 174–187.
10. Dr. Megha Rani Raigonda, & Rajeshwari Hatti. (2024). Haze Removal Of Underwater Images Using Fusion Technique. Journal of Scientific Research and Technology, 2(1), 12–16. https://doi.org/10.61808/jsrt80
11. Dr. Megha Rani Raigonda, & Shweta. (2024). Signature Verification System Using SSIM In Image Processing. Journal of Scientific Research and Technology, 2(1), 5–11. https://doi.org/10.61808/jsrt79
12. Shri Udayshankar B, Veeraj R Singh, Sampras P, & Aryan Dhage. (2023). Fake Job Post Prediction Using Data Mining. Journal of Scientific Research and Technology, 1(2), 39–47.
13. Gaurav Prajapati, Avinash, Lav Kumar, & Smt. Rekha S Patil. (2023). Road Accident Prediction Using Machine Learning. Journal of Scientific Research and Technology, 1(2), 48–59.
14. Dr. Rekha Patil, Vidya Kumar Katrabad, Mahantappa, & Sunil Kumar. (2023). Image Classification Using CNN Model Based on Deep Learning. Journal of Scientific Research and Technology, 1(2), 60–71.
15. Ambresh Bhadrashetty, & Surekha Patil. (2024). Movie Success and Rating Prediction Using Data Mining. Journal of Scientific Research and Technology, 2(1), 1–4. https://doi.org/10.61808/jsrt78
16. Dr. Megha Rani Raigonda, & Shweta. (2024). Signature Verification System Using SSIM In Image Processing. Journal of Scientific Research and Technology, 2(1), 5–11. https://doi.org/10.61808/jsrt79
17. Priyanka Kulkarni, & Dr. Swaroopa Shastri. (2024). Rice Leaf Diseases Detection Using Machine Learning. Journal of Scientific Research and Technology, 2(1), 17–22. https://doi.org/10.61808/jsrt81