IoT BASED SMART PARKING SYSTEM WITH SLOT RESERVATION

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Abstract: The ever-increasing urbanization and the proliferation of vehicles have led to a critical challenge in metropolitan areas: finding available parking spaces efficiently. This paper gives an idea about IoT-based Smart Parking System with Slot Reservation to address the above issue. The system leverages the power of the IoT to monitor and manage parking spaces in real-time, offering users the ability to reserve parking spots in advance, the suggested setup comprises of several key components, including a network of IoT sensors placed in parking lots, a centralized server, and a user-friendly website or mobile application. These IoT sensors are strategically installed in parking spaces and continuously monitor their status. They detect the presence or absence of vehicles, ensuring accurate and up-to-date information about parking availability.

The collected data from the provided sensors is transmitted to the centralized server, which processes and updates the information in real-time. The heart of the setup stays in the website, which allows users not only check the parking space's accessibility in their vicinity but also reserve a spot before arriving at the parking lot. Users can view a map displaying all available parking spaces and select the one that suits their needs. Our project also contains automated ticketing system from which user will get a booking detail along with QR code to their email id. Once a parking spot is reserved, it becomes temporarily unavailable for other users, ensuring that the user has a guaranteed space upon arrival.

Keywords: IoT, Smart Parking, Slot Reservation, Receive QR Code.

I. INTRODUCTION

In our growing cities the increase, the count of cars on the road poses a challenge; how to craft the most productive use of parking spaces within urban areas. The daily search for a parking spot has become an inefficient part of city life. To address these pressing issues this research paper presents a solution called the "IoT based smart parking system with slot reservation." This system leverages the power of the IoT to revolutionize how parking spaces are managed and accessed in environments. It not provides real time updates on parking availability. Also allows users to reserve their spots in advance bringing about a new era of convenience and efficiency in urban parking. At its core this mechanism comprises of a network of sensors installed in parking lots a central server and an easy to use mobile application. These IoT sensors are strategically placed to monitor whether parking spaces are occupied or vacant providing up, to date information. This data is then sent to a server that processes. Distributes it in real time through a website for users to access. With this knowledge, at their disposal individuals are able to make informed decisions regarding parking eradicating the necessity of driving in circles and experiencing the annoyance that comes with searching for an available parking spot. The significance of intelligent parking with regards to the IoT goes beyond convenience. By allocating parking resources it effectively addresses traffic congestion issues lessens the effects caused by vehicles hunting for parking spaces and ultimately improves the overall quality of our surroundings. Our project also contains automated ticketing system from which user will get a booking detail along with QR code to their email id.

1.1 Problematic Statement

In traditional parking facilities, the shortage of an efficient and user-friendly system often leads to parking congestion, frustration, and inefficiency. Users struggle to find available parking spots, resulting in wasted time and increased traffic within parking facilities.

Additionally, parking operators face challenges in optimizing space usage and providing a seamless parking experience. To address these issues, there is a pressing the essentiality for developing and implementing a IoT-based Smart Parking System with Space. Reservation, enabling users to reserve parking spaces in advance via a mobile app, optimizing space allocation, reducing congestion, and enhancing overall parking efficiency while ensuring data security and regulatory compliance.

II.   METHODOLOGY

In the IoT-based Smart Parking System with Slot Reservation, users access the system via web interface, selecting their desired parking space and time. Upon successful reservation, the system generates a unique QR code sent to the user, while IoT sensors detect and update the space's status as "occupied."

When arriving at the parking location, users scan the QR code using the app, allowing the system to authenticate the reservation and grant access by automatically opening the barrier to the reserved space.

After parking and leaving, the space is marked as vacant through sensor detection, updating the database accordingly. Throughout this process, the system maintains continuous monitoring, managing reservations, and providing users with feedback opportunities to enhance their parking experience.

Step 1: User Interaction and Reservation:

- User accesses the system via web interface. User views available parking spaces and selects desired location/time. User reserves a parking space, triggering a confirmation process.

Step 2: Reservation Confirmation and QR Code Generation:

- Upon successful reservation, the system generates a unique QR code for the reserved space. The QR code is sent to the user's registered email Id for easy access.

Step 3: Sensor Detection and Space Management:

- IoT sensors detect the reserved space as "occupied" in real-time. The system updates the database, marking the space as reserved and occupied.

Step 4: User Arrival and Access Process:

- User arrives at the parking location. User scans the QR code using the obtained QR code to their email at the parking entrance. The system validates the QR code's authenticity and reservation details. If validated, the barrier automatically opens, granting access to the reserved space.

Step 5: Parking Completion and Exit Process

- User parks in the reserved space and completes parking. Upon leaving, the user exits the space, marking it as vacant. IoT sensors detect the space as vacant, updating the database accordingly. User receives a confirmation of parking completion and is provided with an option to provide feedback or rate the experience.
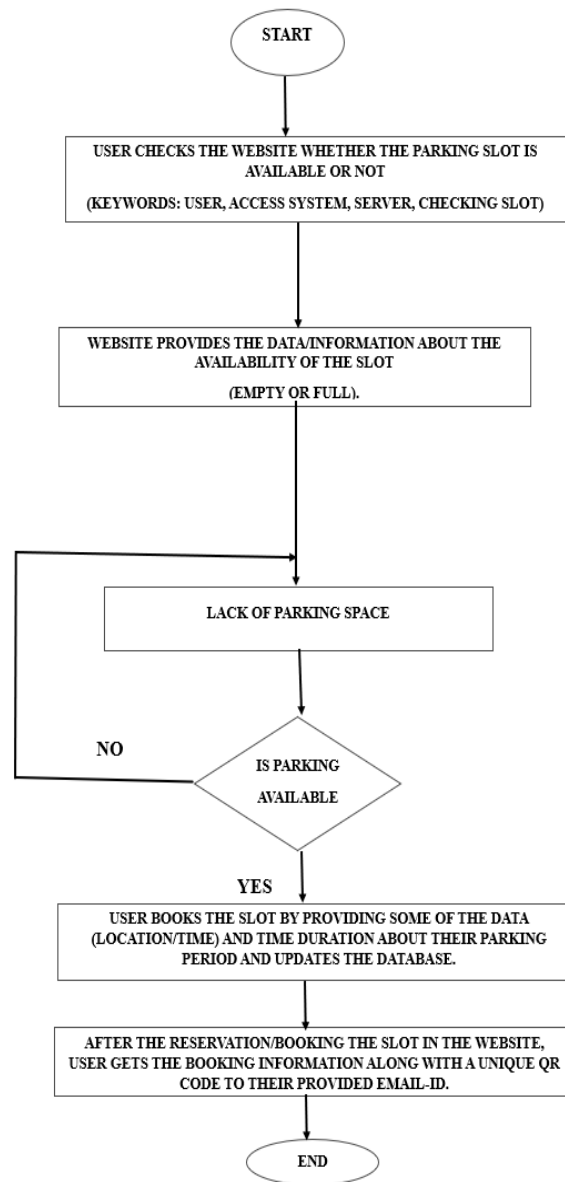
Fig. 1 Flow model of car parking system.

Fig.2 Block diagram

III. ADVANTAGES

1. Real-time Parking Data:
The system offers live, up to the minute parking information availability information, to enable informed decision-making regarding their parking requirements

2. Reduced Traffic Congestion:
   By guiding drivers to available parking spaces, your system can reduce traffic congestion and associated pollution.

3. User Convenience:
Reserving parking spaces in advance is a straightforward process for users, saving time and reducing the stress of searching for parking.

4. Environmental Benefits:
   The system contributes to environmental sustainability by decreasing efficient vehicle maintenance and greenhouse gas emissions.

5. Data Insights:
   The data collected by your system can offer valuable   perspectives for urban planners and parking facility owners to make data-driven decisions.

IV. APPLICATIONS

1. Urban Traffic Management:
   - Your automated parking solution can help optimize traffic flow and reduce congestion in cities and towns by providing real-time parking availability information to drivers.

2. Efficient Space Utilization
   - The system promotes efficient use of parking spaces, reducing the time spent by drivers looking for parking spots.

3. Environmental Impact:
   - By reducing unnecessary circling for parking, the mechanism can help decrease fuel usage and air pollution, contributing to environmental sustainability.

4. User Convenience:
   - Users can reserve parking spaces in advance, making it more convenient and reducing stress associated with finding parking.

V. RESULT

The IoT-based smart parking system with slot reservation has yielded noteworthy results that underline its efficacy in addressing urban traffic management and enhancing user experience. Real-time parking data availability was achieved, empowering drivers with timely data on space parking availability and reducing the time spent searching for parking. This, in turn, resulted in a substantial reduction in traffic congestion, contributing to lower fuel usage and decreased environmental impact, aligning with sustainability objectives.

The system's user-friendly interface and The capability to pre-book parking spaces is provided by the system in advance greatly improved user convenience and reduced the stress associated with parking. Moreover, the mechanism demonstrated its financial viability through increased revenue generation, primarily achieved through paid reservations and optimized space utilization.

The system's adaptability in managing parking for large events was a notable success, streamlining parking allocation and enhancing the overall experience for event attendees. In addition to these immediate benefits, the generated system data offered valuable insights for urban planners and parking facility owners, informing data-driven decisions and potentially contributing to the broader advancement of smart city is underway.
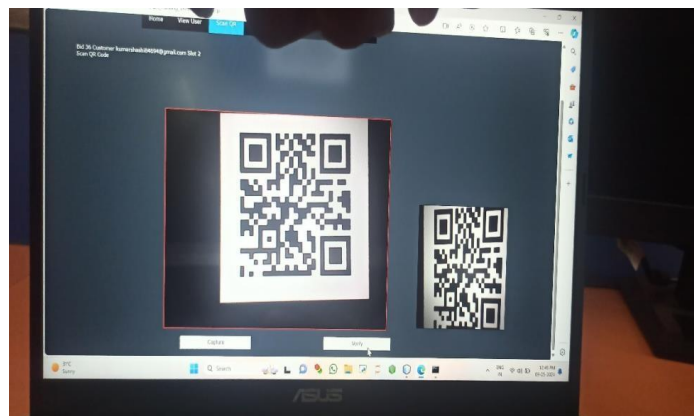
The results collectively underline the substantial impact of the IoT-based smart parking system in urban environments and offer promise for its adoption in future urban development projects.
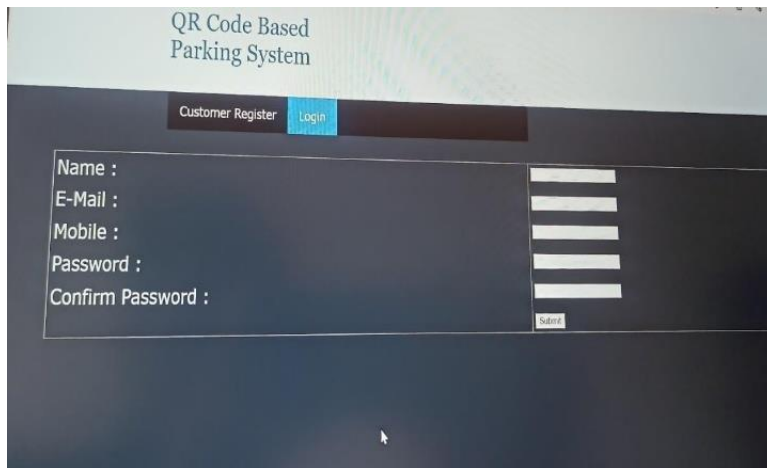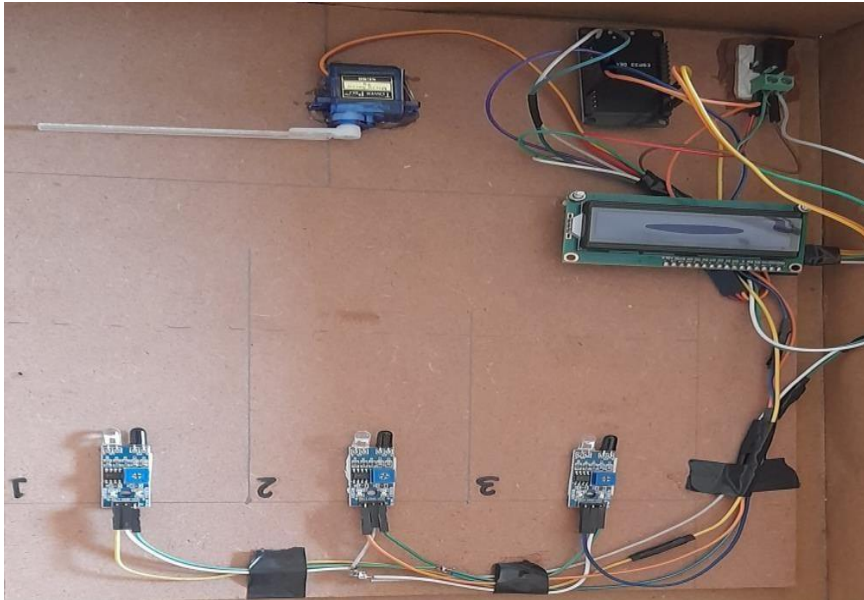
5.1- Sign in Page
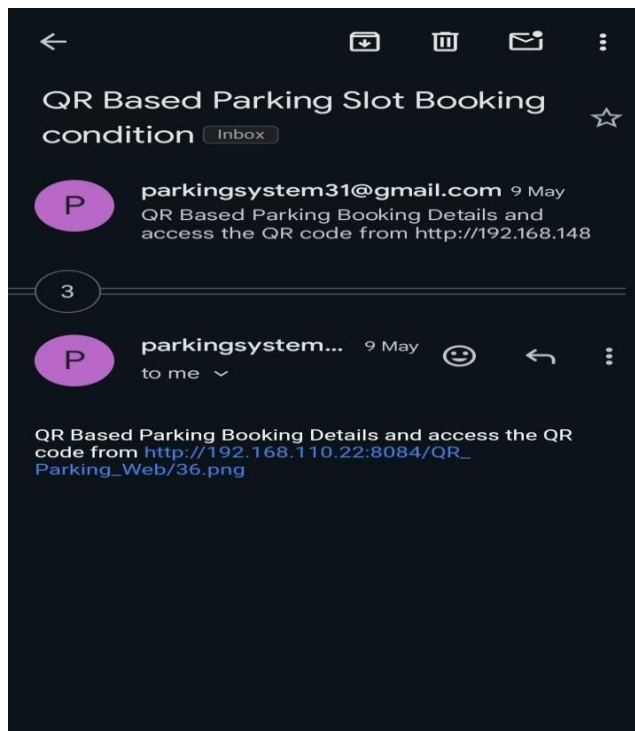
5.2- After booking QR code sended to users email id

5.3- QR code validation process at Admin page

5.4- Hardware part (parking slots)

VI.   CONCLUSIONS

The IoT-based smart parking system with slot reservation represents a significant advancement in urban traffic management and user convenience. The results of this research clearly demonstrate the system's positive impact on traffic flow, environmental sustainability, user satisfaction, revenue generation, and event parking management. In conclusion, this research has demonstrated the system's real-time parking data availability reduces traffic congestion by guiding drivers to available spaces. The system effectively contributes to environmental sustainability by decreasing fuel consumption and air pollution, aligning with global efforts to combat climate change. Moreover, the system's user-friendly interface and reservation capabilities have greatly improved user convenience, reducing stress and enhancing the overall experience for drivers.

Financially, the system's ability to generate revenue through paid reservations and optimized space utilization has already been a notable success, ensuring its viability for implementation in various urban settings. Event parking management has also benefited from the system, streamlining the allocation of parking spaces during large gatherings, thus improving the overall experience for event attendees. Furthermore, the collected data has provided invaluable insights for urban planners and parking facility owners, allowing for data-driven decision-making and informed urban development strategies.

In summary, the IoT-based smart parking system has demonstrated its ability to positively impact urban environments by reducing traffic congestion, contributing to environmental sustainability, enhancing user convenience, and providing financial benefits. The successful integration of this system represents a significant step towards smarter, more efficient urban spaces. As smart city initiatives continue to evolve, this research highlights the import of technology-driven solutions in creating more sustainable and user-friendly urban environments. The findings presented in this paper open doors to further exploration and implementation of IoT solutions in the context of smart cities.

The system's contributions extend beyond the confines of this research and into the realms of urban planning, environmental sustainability, and enhanced user experiences, making it a valuable asset for the future of modern cities.

DATA AVAILABILITY
All data supporting the findings of this study are available within the paper.

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