Innovations, Challenges, and Solutions for a Sustainable Future

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Edited by

Ashok Kumar Gupta, Saurav Kumar and Tanmay Gupta

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CHAPTER 1

A RESEARCH ON IOT BASED SMART PARKING MANAGEMENT: SYSTEM FOR CENTRAL BUSINESS DEVELOPMENT AREAS (CBD)

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Abstract: The issue of limited space in urban areas and major cities is exacerbated by aimlessly parked cars on the streets, further restricting available parking spaces. To tackle parking challenges in busy locations, various global vehicle parking systems have been employed, including Volkswagen Car Parking, Multi-level Automated Parking, and the Intelligent Auto Parking System. These initiatives aim to leverage the Internet of Things (IoT) to build scaled-down car parking systems capable of accommodating four vehicles in designated parking areas. The smart parking system has been developed with real-time sensors and devices installed in parking spaces. These sensors communicate occupancy data, addressing the challenges associated with parking availability. Drivers can use an LCD display and an IoT application to search for available parking spots, making the process more efficient and contributing to reduced energy consumption and air pollution. Regarding the concept and implementation of automated vehicle parking systems, automation refers to using various methods to operate machinery or items with minimal human intervention. While labor efficiency is a key advantage of automation, it also enhances quality, accuracy, precision.

Keywords: Auto Parking, Parking Lot Management, IOT (Internet of Things), Smart Parking Management WirelessSensor.

1 Introduction

The ongoing problem of limited space in urban areas and major cities is worsened by cars being parked haphazardly on the streets, reducing the available space even further. To tackle parking issues in busy areas, several global vehicle parking systems are utilized, such as the Volkswagen Car Parking, Multi-level Automated Parking, and Intelligent Auto Parking System represent some of the employed systems [1]. The goal of this initiative is to utilize the Internet of Things to build scaled-down a car parking system that can accommodate four vehicles within a specified parking zone [3]. The upsurge in the number of automobiles proceeding the lane devices caused traffic problems, overwhelming the capability in current parking services and transportation infrastructure. To address these challenges, a smart parking system is created. It includes real-time sensors and devices installed in parking spaces that send occupancy information. Drivers can use an LCD combined with IoT technology to find available parking spaces more efficiently [2]. This approach helps them locate spots quickly, reduce energy usage, and decrease air pollution. This study details the concept and implementation of an automated vehicle parking system. Automation, or automated control, involves employing various methods to operate machinery or devices with minimal human intervention [5]. While the primary benefit of automation is improved labor efficiency, it also serves to enhance quality, accuracy, precision, and the conservation of energy and resources. Vehicle parking has increasingly become a significant issue, highlighting the inefficiencies of the manual parking systems currently used in Bangladesh [6]. This traditional method causes time and fuel wastage as drivers search for available spaces, often resulting in chaos and potential vehicle damage. Additionally, security is often lacking in these unregulated parking situations. To tackle these challenges, new car parking system is being proposed [7].

The system operates as follows: A monitor shows the available parking spaces when a driver positions their car facing the entrance of the parking garage. This project demonstrates the concept of automated vehicle parking within the Automobile Parking System [9]. In today's age of automation, this technology is designed to automatically detect as soon as a car enters or exits the parking lot through the entrance gate, displaying the current capacity of the lot. The user interface, equipped with switches, allows for setting a maximum car
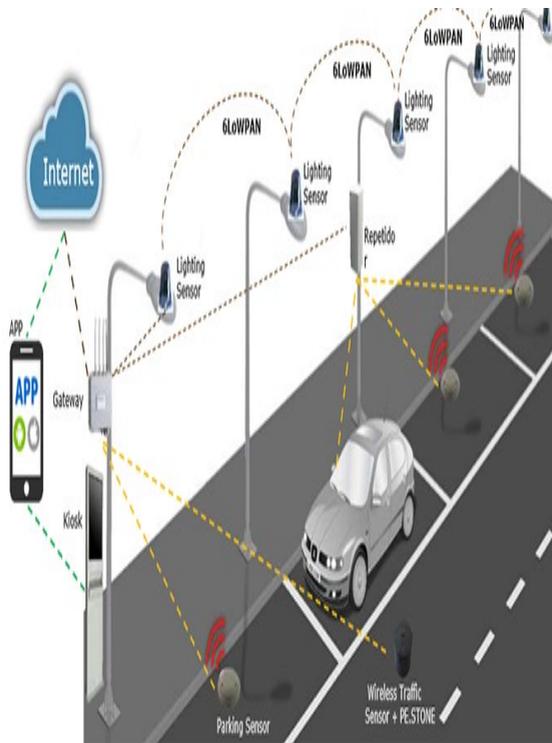
Fig. 1-1 Smart parking management system

Capacity to prevent overcrowding [10]. A microcontroller is used to detect car movements and manage entry and exit scenarios, controlling the gate is opening and closing based on the available capacity. Infrared transmitters and receivers are used to detect car movements. In many modern multiplex systems, traditional car parking setups often lack intelligent monitoring, resulting in inefficiencies and traffic jams [8]. The proposed automated parking system aims to tackle these issues by automating the parking process, reducing human intervention, and boosting efficiency. Upon entering the parking area, individuals will have their vehicles automatically parked, eliminating the need for manual searches for available spaces. By heeding the warning "Parking is full!" prompt, users can save both time and energy when the parking lot reaches full capacity. This approach optimizes the parking process, fostering discipline and organization in parking areas, ultimately leading to decreased traffic congestion and enhanced overall efficiency [10].

2 Problem Identification

The growing use of vehicles in the population is contributing to increased traffic congestion and a rise in accidents [17]. There is a significant risk to life from this, particularly if there are delays in getting crash victims from the scene to the hospital [18]. Quick action is essential, and informing the investigation unit promptly is essential to minimize the time needed for inquiries [9] [10]. While traditional or manual car parking systems are prevalent in the country, they come with various challenges including:

Traffic Jams: Many shopping malls and hospitals experience significant traffic jams at parking entrances [3] [5]. The manual process of stopping every vehicle for payment slip issuance contributes to congestion [1] [2]. Search and Navigation: Locating an available parking slot in traditional systems is often difficult and time-consuming. This leads to increased fuel consumption and wasted time for drivers [12] [3].

Security Concerns: Manual parking systems face security challenges, allowing unauthorized individuals to enter parking areas, and increasing the risk of theft and robbery. Resource Intensive: Employing guards for the entire parking operation in a manual system adds to the overall cost, making it financially burdensome [2].

3 Literature Review

In the era of automation, the technology is designed to automatically detect when a car enters or exits the parking lot through the entrance gate, indicating the current capacity of the lot [18]. The user interface, equipped with switches, allows setting a maximum capacity for cars to prevent congestion [17]. A microcontroller is deployed to sense car movement and manage entry and exit scenarios, controlling the door's opening and closing based on available capacity [19]. Infrared transmitters and receivers facilitate the sensing of car movements [10]. In many multiplex systems, conventional car parking systems lack intelligent monitoring, leading to inefficiencies and traffic congestion [11]. The proposed automated parking system aims to address these challenges by automating the parking process, reducing human efforts, and enhancing efficiency [12].The system ensures that a person entering the parking area will have their car automatically parked, eliminating the need for manual searches for available slots [13]. Users can save both energy and time by heeding the warning notice "Parking is full!" that appears if the parking lot fills up completely [14]. This approach streamlines the parking process, promoting discipline and

orderliness in parking areas, ultimately contributing to reduced traffic congestion and improved overall efficiency[15][5].

Advanced image processing algorithms are employed to analyze the captured images or video frames. The system identifies and extracts relevant information, such as the presence of vehicles, license plate numbers, and parking space occupancy of vehicles compared to traditional parking lots [15].

This is especially beneficial in densely populated areas [5]. Vehicles move between levels using ramps or elevators. Ramps are often spiralled around the exterior or located internally to connect different floors [2]. Connect parking infrastructure to the internet, enabling data exchange and advanced analytics for efficient management [3]. A Smart Parking System refers to the application of technology to manage parking spaces more efficiently and effectively [6]. IoT (Internet of Things) integration plays a crucial role in enhancing the capabilities of smart parking systems. IoT-enabled parking sensors are deployed in individual parking spaces or throughout parking lots. These sensors can detect the presence or absence of vehicles in real time [1]. Common types include ultrasonic sensors, infrared sensors, and magnetic sensors. Smart cameras can be integrated into the parking infrastructure to capture visual data [1].

Advanced image processing and computer vision algorithms can be applied to analyze the images and identify parking space occupancy. Some systems use ultrasound or RFID (Radio-Frequency Identification) technology to identify the presence of vehicles and transmit this information to a central management system [9]. IoT devices in smart parking systems communicate with each other and a central server using wireless communication protocols such as Wi-Fi, Bluetooth, Zigbee, or cellular networks [2]. This allows for real-time data transmission. The data collected from parking sensors and cameras is often sent to cloud-based platforms for storage, processing, and analysis. Cloud computing enables scalable and flexible storage, as well as the ability to access data from anywhere [9].

3.1 Current Parking System Scenario in India

The current parking approach has several drawbacks, particularly in the mismanagement of parking spaces [15]. Cars may collide, resulting in dents and damage during both parking and retrieval due to insufficient space and lack of organization [19]. This, in turn, leads to disputes and even fights among individuals, exacerbating the traffic situation and causing economic losses as damaged cars require repairs [7]. Additionally, the process of parking in and out consumes extra fuel, contributing to in-

creased expenses for vehicle owners [18].The traffic jams resulting from this parking chaos have a broader impact, causing a significant loss of valuable time for students, office-goers, and emergency patients [12]. The adverse effects on daily life, productivity, and the overall well-being of individuals emphasize the urgency of addressing and improving the current parking situation to ensure a more orderly and efficient urban environment [10].The current manual car parking system poses economic challenges for commercial establishments such as shopping malls and amusement parks [11]. The parking difficulties discourage people from visiting these places, resulting in economic losses for businesses [15]. Over time, the outdated manual parking system in business premises becomes a hindrance, leading to time wastage and financial setbacks [5].

To address these issues, an effective solution is Concerns about sustainability, growing motorization, and the shortage of urban space have rekindled fascination with SPS as practical substitutes for conventional multistory garages, street parking, and garages [10]. A common theme across all Smart parking Instead of relying on manual vehicle parking systems in strip malls, automated parking systems present a practical solution to these issues [11]. Through the implementation of parking fees, this automated process not only minimizes time wastage and financial losses but also provides an opportunity for revenue generation [15]. This innovative approach not only enhances efficiency but also contributes to the economic sustainability of commercial establishments, making it a valuable and progressive solution for the challenges posed by traditional parking methods systems [15]

3.2 History of Smart Parking Systems

The parking lot on Rue de Ponthieu in Paris, France is where the Smart Parking System was first used in 1905[1]. This innovative method moved automobiles to higher floors Kent Automatic Garages began using APS for more than 1,000 vehicles [10]. With the help of systems like Bowser, whom Pigeon Hole that exists and Roto Park, SPS gained popularity in the United States in the late 1940s and early 1950s [4]. Bowser Peep Hole systems were put in place in 1957, but interest in the system declined due to technical problems and long wait periods for automobile recovery [66]. But the United States saw a resurgence of curiosity in SPS in the 1990s [19]. There were 25 significant projects totaling over 6,000 parking spots [18]. Europe, Asia, especially Central America have been implementing increasingly sophisticated SPS since the 1970s, but the United States saw a resurgence of interest in SPS in the 1990s[4]. Using the paternoster SPS,

Japan alone was building up to 40,000 parking spots year by the early 1990s.japan claimed to have 1.6 million projected SPS parking spots in 2012[10]. Systems (SPS) is the goal of reducing the required number of parking spaces by eliminating the necessity for drivers and passengers to be present during the parking process [11].

Whether utilizing fully automated or semi-automated SPS, both drivers and passengers exit the vehicle at an entrance point, and the vehicle is then autonomously driven to its designated parking spot, either entirely or with partial assistance from an attendant [11]. The efficiency gained in space, when comparing SPS to traditional multi-story parking garages, is primarily attributed to a significant reduction in space unrelated to the direct parking of the vehicle [1].

The width, depth, and spacing between parking spaces are greatly diminished since there is no need to drive a car into a parking space or open car doors for drivers and passengers [15].Absence of ramps or driving lanes necessary for manoeuvring a car to and from the entry or exit of a parking space [1]. Reduced ceiling height due to the lack of foot traffic in the parking area, including drivers and passengers. No requirement for stairways, elevators, or walkways to facilitate pedestrian movement through the parking facility. In comparison SPS systems employ a steel structure (some use thin ceramic slabs), deviating from the monolithic concrete architecture of multi-story parking garages [19]. This approach contributes to an overall reduction in Volume and additional space savings [11].

3.3 Methods for Developing Smart Parking System

Evolving a Smart Parking System includes assimilating various technologies to capably manage and enhance parking spaces [15]. Here are some methods and tools commonly used in the development of smart parking systems: Evolving a Smart Parking System involves integrating various technologies to efficiently manage and optimize parking spaces [19]. Here are some methods and technologies commonly used in the development of smart parking systems [11].

RFID (Radio Frequency Identification): RFID tags on vehicles can communicate with RFID readers in traditional multi-story parking garages, SPS demands significantly less structural material, as it eliminates the need for ramps, vehicle lanes, pedestrians, and certain ceiling heights[16].

Bluetooth and Wi-Fi: These technologies enable communication between sensors and mobile devices, providing real-time information on parking space availability and guiding drivers to open spots [10]. These

systems leverage technology and data to optimize parking space utilization, reduce traffic congestion, and enhance the overall urban experience [11].

Traffic Management Systems: Smart Parking Systems and Traffic Management Systems are integral components of modern urban planning and technology-driven solutions aimed at improving efficiency, reducing congestion, and enhancing overall mobility [11]. Coordinate with traffic management systems to optimize traffic flow and reduce congestion by providing real-time information about parking availability, smart parking systems help drivers find parking spaces more quickly, reducing traffic congestion caused by circling vehicles [12].

Data analytics- Integrating smart parking solutions with data analytics in a Smart City environment can significantly enhance the efficiency of parking management and contribute to a more streamlined urban mobility experience. Install smart parking sensors in designated parking spaces. These sensors can detect the presence or absence of a vehicle and transmit this data in real-time [18]. Ensure a robust communication infrastructure for seamless data transmission between the parking sensors and the central data analytics platform [11].

Machine Learning Algorithms- Integrating machine learning algorithms into smart city applications, specifically for smart parking, can significantly enhance efficiency and provide better services for both citizens and city administrators [2]. Clearly define the objectives of integrating machine learning into smart parking. Understand the specific problems you want to address, such as optimizing parking space utilization, reducing traffic congestion, or improving user experience [2]. Gather relevant data for training and testing machine learning models. This may include historical parking data, traffic patterns, weather conditions, events data, and more [2]. Clean and preprocess the data to ensure it is in a suitable format for training machine learning models [2]. Select appropriate machine learning algorithms based on your objectives. Common algorithms for smart parking systems include regression models, classification models, clustering algorithms, and neural networks. Consider factors such as the volume of data, real-time processing requirements, and interpretability of the models [15].

4 Methodology

The development of a smart parking system requires a blend of hardware and software components to effectively manage parking spaces and enhance user experience. The main objectives of the system typically include optimizing space usage, alleviating congestion, and enhancing user satis-

faction [11]. It's crucial to outline specific requirements such as how many parking spots is required, scalability options, potential integration with current infrastructure [12].Survey the parking area to grasp its layout, size, and existing infrastructure, while noting potential obstacles like physical barriers, lighting, and power sources. In line with sustainable development goals, aim to improve traffic and transportation through a holistic land use transportation design approach [13]. Traditional parking management systems pose challenges such as inefficiency and lack of real-time data. Specific objectives for an IoT-based Smart Parking Management System include enhancing efficiency, optimizing space utilization, and reducing environmental impact. Design the architectural framework for the Smart Parking Management System by defining key components such as IoT devices, sensors, communication protocols, cloud infrastructure, and mobile applications. Opt for appropriate hardware components like Arduino or similar microcontrollers, and select sensors like IR sensors for detecting parking space occupancy [15]. Determine communication protocols for seamless data exchange between IoT devices, sensors, and the central server, considering wireless technologies like Wi-Fi or Bluetooth for efficient transmission [15].

Create a mobile app that allows users to easily access parking information, make reservations, and get notifications. The app will work on iOS and Android and connect to cloud services for data storage and processing [14]. The cloud infrastructure will be designed to handle a large number of users and data points. Sensors in parking spaces will monitor occupancy, and data will be collected and processed in real-time [13]. Algorithms will optimize parking space allocation, and cloud-based tools will provide insights. The app and web interface will be intuitive, offering features like real-time availability and reservation options. Security protocols will protect user data and IoT devices, with encryption and authentication mechanisms ensuring system integrity. Thorough testing will be conducted on all components [16]. Validate the system's performance under different scenarios, including peak usage, by deploying the Smart Parking Management System in a practical setting. Monitor the system's performance, gather feedback, and implement any necessary improvements [17]. Develop a maintenance plan for ongoing system monitoring, troubleshooting, and updates. Stay updated on advancements in IoT and parking management technologies for potential system upgrades [19]. When developing an IoT-based Smart Parking Management System, ensure that key considerations such as hardware selection, communication protocols, cloud integration, and user experience are thoroughly addressed. Optimal space use with a programmable puzzle system and the opportunity for customized module

capacity [18]. Autonomous system of parking with independent charging and versatile installation for outdoor as well as indoor usage [4].

Easy and reasonably priced installation procedure. Low running costs [3].Simple processes for driving in and out. Fast parking and retrieval: it takes less than 180 seconds to park or get a car [17]. Low noise levels and safe operation via programmed logic controller (PLC) control [6].Less confusion and waiting while parking. Helpful for new and elderly drivers who frequently have trouble parking [5]. Engine emissions are decreased as there's no need to drive around looking for a parking spot [19]. The complicated gadgets required for automation may make it expensive [18]. If the detecting devices malfunction or are out of order, it may be very difficult to remove automobiles from parking; moreover, it may result in accidents within parking [12]. Implementing a smart parking system involves significant power outages can disrupt its functionality [19].The continuous monitoring and collection of data on parking behaviours may raise privacy concerns among users [2]. The adoption of smart parking systems is increasing globally, but it may still be a minority compared to conventional systems [25]. Smart parking systems leverage tools for example sensors, cameras, and real-time statistics processing. The accuracy is generally high as these arrangements can deliver actual information on space accessibility, and occupancy status, and even guide drivers to available spaces. However, occasional technical issues or sensor malfunctions may impact accuracy [6]. Reliability is an essential aspect when evaluating different parking systems. Reliability in a smart parking system relies heavily on the sensors and technology used for vehicle detection and management [11].

The accuracy of these sensors and the robustness of the underlying technology contribute to the overall reliability. The reliability of data processing and communication between various components (sensors, servers, user interfaces) is crucial. A dependable smart parking system should efficiently process data and ensure real-time communication to avoid delays or errors [12]. Consistency in Conventional Parking management discusses to the system's capability to constantly and dependably perform its intended functions without unanticipated failures or dislocations. A dependable parking system is crucial to ensure a smooth and well-organized experience for operators. The gates, ticket dispensers, and payment machines should function without frequent breakdowns [3]. Regular maintenance and quality components contribute to hardware reliability. Vehicle detection sensors and other components that help in managing parking spaces need to be reliable to accurately determine occupancy and availability [1].

5 Survey

As part of our commitment to sustainable development, this research endeavours to enhance traffic and transportation across various modes by implementing a comprehensive land-use transportation design strategy. • Our research is specifically concentrated on Sitabuldi, the primary commercial district in Nagpur, chosen as the central hub of commercial development. This area hosts Nagpur's largest wholesale vegetable market and an array of diverse stores. The congestion on Sitabuldi Main Road, one of the main retail thoroughfares, is exacerbated by the scarcity of parking spaces, leading to extended lines. Hence to reduce the congestion and pollution causing due to this traffic we have designed a smart parking system in this area.

Longitude and Latitude of area =21.1443067   and 79.082400

6 Data collection

To ascertain the corresponding Level of Supply (LOS) for the selected route, traffic data is view

Fig 3.1 Sitabuldi Map

Analyzed. On Nagpur roads, manual counting was done to evaluate the time, fuel the environmental effect of congestion. In the Sitabuldi region, manual counts are kept for every kind of vehicle for the driving distance of around 143 meters. Two distinct times are used to drive these vehicles: during high-flow periods and free-flowing circumstances. It is computed how much money is actually lost as a result of congestion concerning the highest volume and free flow. The difference in time enacted per km between unimpeded flow and peak hours flow is used to calculate time lost. The delay, for example, is 10 km/h if the peak period acceleration is 50 km/h and the unrestrained speed is 60 km/h. For every 10 kilometres, there is a time loss of one hour due to this 10 km/h delay. The whole traffic for that one-hour time loss is used to compute the cost incurred as a result of time loss. The difference between the fuel consumption per km between normal flow and peak hour flow is used to calculate fuel loss. The extra gasoline used for peak hours is computed, and the expense loss is found by multiplying the fuel price by the additional fuel used. The extra fuel used at peak flow is converted into CO2 emissions, which are used to calculate environmental loss. The emission of CO_2 and its price, which represents the environmental damage, are multiplied to get the average price of CO_2 loss.

7 Traffic Volume Count

Table 1-1 Traffic volume count of 9-10-2023 (Monday) 10:00 AM to 2:00 PM

TRAFFIC VOLUME COUNT

Time-Morning&Noon	0.5	1.5	1	1.5	3.5	
	Two Wheeler	Three Wheeler	Car	Cart	Truck	PCU
10:00 - 10:15	156	48	13	15	2	192.5
10:15 - 10:30	167	53	11	22	1	210.5
10:30 - 10:45	187	54	13	13	0	207
10:45 - 11:00	145	59	16	19	4	219.5
TOTAL	655	214	53	69	7	829.5
11:00 - 11:15	187	51	11	2	1	187.5
11:15 - 11:30	180	43	18	4	3	189
11:30 - 11:45	197	76	16	9	0	242
11:45 - 12:00	190	45	9	13	3	201.5
TOTAL	754	215	54	28	7	820
12:00 - 12:15	226	32	19	1	2	188.5
12:15 - 12:30	233	34	21	5	0	196
12:30 - 12:45	238	45	22	9	0	222
12:45 - 1:00	217	87	14	2	1	259.5
TOTAL	914	198	76	17	3	866
1:00 - 1:15	143	32	13	1	2	141
1:15 - 1:30	145	28	21	2	0	138.5
1:30 - 1:45	167	45	16	0	0	167
1:45 - 2:00	203	32	14	2	1	170
TOTAL	658	137	64	5	3	616.5

Table 1-2 Traffic volume count of 9-10-2023 (Monday) 4:00 PM to 8:00 PM

Time- Evening	Two Wheeler	Three Wheeler	Car	Cart	Truck	PCU
4:00 - 4:15	204	43	43	1	2	218
4:15 - 4:30	165	25	21	0	1	144.5
4:30 - 4:45	177	39	36	2	1	189.5
4:45 - 5:00	198	21	54	4	0	190.5
TOTAL	744	128	154	7	4	742.5
5:00 - 5:15	203	41	67	1	1	235
5:15 - 5:30	213	45	74	3	0	252.5
5:30 - 5:45	243	39	87	0	0	267
5:45 - 6:00	276	38	41	2	1	242.5
TOTAL	935	163	269	6	2	997
6:00 - 6:15	256	41	81	0	0	270.5
6:15 - 6:30	298	51	68	1	1	298.5
6:30 - 6:45	265	38	78	1	2	276
6:45 - 7:00	232	33	72	0	0	237.5
TOTAL	1051	163	299	2	3	1083
7:00 - 7:15	278	43	76	1	1	284.5
7:15 - 7:30	298	36	72	2	1	281.5
7:30 -7:45	303	45	69	0	0	288
7:45 - 8:00	213	19	63	0	0	198
TOTAL	1092	143	280	3	2	1052

Table 1-3 Traffic volume count of 10-10-2023 (TUESDAY) 10:00AM to 8:00PM

TRAFFIC VOLUME COUNT						
	0.5	1.5	1	1.5	3.5	PCU
Time-Morning&Noon	Two Wheeler	Three Wheeler	Car	Cart	Truck	PCU
10:00 - 10:15	176	43	14	23	1	204.5
10:15 - 10:30	167	54	12	25	0	214
10:30 - 10:45	201	67	19	26	3	269.5
10:45 - 11:00	205	56	16	18	2	236.5
TOTAL	749	220	61	92	6	924.5
11:00 - 11:15	231	61	11	16	1	245.5
11:15 - 11:30	193	59	10	5	5	220
11:30 - 11:45	178	76	9	9	2	232.5
11:45 - 12:00	214	67	14	16	1	249
TOTAL	816	263	44	46	9	947
12:00 - 12:15	213	27	14	1	0	162.5
12:15 - 12:30	209	31	23	2	1	180.5
12:30 - 12:45	234	46	20	5	3	224
12:45 - 1:00	245	86	18	3	0	274
TOTAL	901	190	75	11	4	841
1:00 - 1:15	143	31	17	1	2	143.5
1:15 - 1:30	150	29	21	0	1	143
1:30 - 1:45	234	43	19	2	4	217.5
1:45 - 2:00	213	39	14	0	0	179
TOTAL	740	142	71	3	7	683

Time- Evening							
4:00 - 4:15	198		37	56	1	3	222.5
4:15 - 4:30	183		56	14	2	0	192.5
4:30 - 4:45	187		31	36	0	1	179.5
4:45 - 5:00	203		29	48	3	0	197.5
TOTAL	771		153	154	6	4	792
5:00 - 5:15	245		44	67	0	0	255.5
5:15 - 5:30	287		46	83	1	0	297
5:30 - 5:45	198		38	67	2	0	226
5:45 - 6:00	249		42	41	0	1	232
TOTAL	979		170	258	3	1	1011
6:00 - 6:15	254		45	87	1	0	283
6:15 - 6:30	266		35	76	2	1	268
6:30 - 6:45	309		51	65	3	1	304
6:45 - 7:00	276		43	78	1	3	292.5
TOTAL	1105		174	306	7	5	1148
7:00 - 7:15	306		54	81	0	2	322
7:15 - 7:30	287		56	67	1	0	296
7:30 -7:45	345		32	73	3	1	301.5
7:45 - 8:00	231		19	76	2	0	223
TOTAL	1169		161	297	6	3	1143

Table 1-4 Traffic volume count of 11-10-2023 (WEDNESDAY) 10:00AM to 2:00PM

TRAFFIC VOLUME COUNT						
	0.5	1.5	1	1.5	3.5	PCU
Time-Morning&Noon	Two Wheeler	Three Wheeler	Car	Cart	Truck	
10:00 - 10:15	176	43	14	18	1	197
10:15 - 10:30	166	54	9	15	0	195.5
10:30 - 10:45	201	67	24	22	2	265
10:45 - 11:00	213	58	16	23	1	247.5
TOTAL	756	222	63	78	4	905
11:00 - 11:15	231	49	11	15	1	226
11:15 - 11:30	167	51	11	3	2	182.5
11:30 - 11:45	223	87	13	9	6	289.5
11:45 - 12:00	218	83	12	16	0	269.5
TOTAL	839	270	47	43	9	967.5
12:00 - 12:15	227	31	15	13	2	201.5
12:15 - 12:30	207	37	23	3	0	186.5
12:30 - 12:45	198	46	28	3	0	200.5
12:45 - 1:00	189	78	14	6	1	238
TOTAL	821	192	80	25	3	826.5
1:00 - 1:15	145	34	13	1	2	145
1:15 - 1:30	132	21	12	2	1	116
1:30 - 1:45	133	43	18	1	0	150.5
1:45 - 2:00	209	31	9	0	1	163.5
TOTAL	619	129	52	4	4	575

Time- Evening						
4:00 - 4:15	208	43	46	0	2	221.5
4:15 - 4:30	188	52	11	1	1	188
4:30 - 4:45	176	39	32	2	0	181.5
4:45 - 5:00	201	29	46	6	0	199
TOTAL	773	163	135	9	3	790
5:00 - 5:15	199	42	87	3	0	254
5:15 - 5:30	278	36	67	2	1	266.5
5:30 - 5:45	298	52	79	0	2	313
5:45 - 6:00	321	43	89	1	0	315.5
TOTAL	1096	173	322	6	3	1149
6:00 - 6:15	247	41	67	1	1	257
6:15 - 6:30	254	54	76	2	2	294
6:30 - 6:45	220	32	56	1	0	215.5
6:45 - 7:00	219	36	43	3	0	211
TOTAL	940	163	242	7	3	977.5
7:00 - 7:15	277	46	81	1	2	297
7:15 - 7:30	203	56	78	2	0	266.5
7:30 -7:45	301	32	69	0	0	267.5
7:45 - 8:00	218	17	61	0	0	195.5
TOTAL	999	151	289	3	2	1027

Table 1-5 Traffic volume count of 12-10-2023 (THURSDAY) 10:00AM to 8:00PM)

TRAFFIC VOLUME COUNT						
	0.5	1.5	1	1.5	3.5	PCU
Time-Morning&Noon	Two wheeler	Three wheeler	Car	Cart	Truck	
10:00 - 10:15	230	52	13	18	1	236.5
10:15 - 10:30	190	55	11	4	9	226
10:30 - 10:45	220	90	14	8	0	271
10:45 - 11:00	224	85	14	16	0	277.5
TOTAL	864	282	52	46	10	1011
11:00 - 11:15	183	45	16	22	2	214
11:15 - 11:30	169	58	10	28	0	223.5
11:30 - 11:45	207	69	20	17	5	270
11:45 - 12:00	211	62	18	20	0	246.5
TOTAL	770	234	64	87	7	954
12:00 - 12:15	245	33	19	2	1	197.5
12:15 - 12:30	210	38	24	4	0	192
12:30 - 12:45	258	50	21	4	0	237
12:45 - 1:00	233	88	17	5	0	273
TOTAL	946	209	81	15	1	899.5
1:00 - 1:15	150	34	17	2	1	149.5
1:15 - 1:30	143	28	22	0	1	139
1:30 - 1:45	242	46	18	3	2	219.5

1:45 - 2:00	210	33	17	2	0	174.5
TOTAL	**745**	**141**	**74**	**7**	**4**	**682.5**
Time- Evening						
4:00 - 4:15	204	41	55	0	1	222
4:15 - 4:30	183	52	20	1	1	194.5
4:30 - 4:45	197	32	37	5	0	191
4:45 - 5:00	205	30	51	4	1	208
TOTAL	**789**	**155**	**163**	**10**	**3**	**815.5**
5:00 - 5:15	293	46	91	0	0	306.5
5:15 - 5:30	265	36	78	0	1	268
5:30 - 5:45	301	51	71	1	0	299.5
5:45 - 6:00	288	48	82	0	2	305
TOTAL	**1147**	**181**	**322**	**1**	**3**	**1179**
6:00 - 6:15	250	44	70	0	0	261
6:15 - 6:30	263	48	86	2	0	292.5
6:30 - 6:45	280	35	70	0	0	262.5
6:45 - 7:00	273	40	48	1	0	246
TOTAL	**1066**	**167**	**274**	**3**	**0**	**1062**
7:00 - 7:15	300	50	83	2	1	314.5
7:15 - 7:30	309	59	78	0	0	321
7:30 -7:45	335	35	71	2	0	294
7:45 - 8:00	225	20	67	3	1	217.5
TOTAL	**1169**	**164**	**299**	**7**	**2**	**1147**

Table 1-6 Traffic volume count of 13-10-2023 (FRIDAY) 10:00AM to 8:00PM

TRAFFIC VOLUME COUNT						
	0.5	1.5	1	1.5	3.5	
Time-Morning&Noon	Two wheeler	Three wheeler	Car	Cart	Truck	PCU
10:00 - 10:15	134	41	12	23	1	178.5
10:15 - 10:30	125	54	9	16	1	180
10:30 - 10:45	187	67	9	19	3	242
10:45 - 11:00	167	62	16	20	0	222.5
TOTAL	613	224	46	78	5	823
11:00 - 11:15	194	56	12	3	2	204.5
11:15 - 11:30	190	47	9	416	4	212.5
1:30 - 11:45	213	87	2	4	1	248.5
11:45 - 12:00	228	76	13	19	1	273
TOTAL	825	266	36	42	8	938.5
12:00 - 12:15	199	31	19	1	2	173.5
12:15 - 12:30	241	34	21	4	1	202
12:30 - 12:45	245	46	22	7	1	227.5
12:45 - 1:00	213	84	17	2	4	266.5
TOTAL	898	195	79	14	8	869.5
1:00 - 1:15	134	32	17	14	0	153
1:15 - 1:30	111	22	12	2	0	103.5
1:30 - 1:45	238	43	18	0	0	201.5

1:45 - 2:00	211	39	16	1	1	185
TOTAL	**694**	**136**	**63**	**17**	**1**	**643**
Time- Evening						
4:00 - 4:15	209	39	43	0	1	209.5
4:15 - 4:30	176	54	21	2	3	203.5
4:30 - 4:45	167	31	32	4	2	175
4:45 - 5:00	201	28	46	7	0	199
TOTAL	**753**	**152**	**142**	**13**	**6**	**787**
5:00 - 5:15	265	43	78	1	0	276.5
5:15 - 5:30	297	39	77	5	1	295
5:30 - 5:45	301	43	56	0	2	278
5:45 - 6:00	234	49	86	2	2	286
TOTAL	**1097**	**174**	**297**	**8**	**5**	**1136**
6:00 - 6:15	235	42	32	1	1	217.5
6:15 - 6:30	265	43	76	4	2	286
6:30 - 6:45	234	32	67	3	0	236.5
6:45 - 7:00	276	38	45	0	0	240
TOTAL	**1010**	**155**	**220**	**8**	**3**	**980**
7:00 - 7:15	300	45	87	3	2	316
7:15 - 7:30	278	48	76	0	0	287
7:30 -7:45	277	23	65	0	0	238
7:45 - 8:00	312	19	61	1	2	254
TOTAL	**1167**	**135**	**289**	**4**	**4**	**1095**