Report on

Database for Smart Waste Management System

December 22, 2024

Prepared By:

222 1507 642, Noshin Nawar
222 1070 642, Mubashshira Kaisar

Course Instructor:

Prof. Dr. Kamruddin Nur

Contents

List of Figures

List of Tables

Project Overview

The **Smart Waste Management System** project represents an innovative approach aimed at revolutionizing urban waste collection and disposal. By leveraging the power of data-driven insights and advanced technology, this project seeks to transform how cities manage their waste, ensuring a cleaner environment and promoting sustainability. At its core, the Smart Waste Management System aspires to optimize waste collection processes, encourage recycling efforts, and provide an efficient solution for waste management authorities. The project revolves around creating a comprehensive platform that integrates various facets of waste management into a centralized database. With a focus on enhancing the convenience and efficiency of waste collection, the system tracks, monitors, and manages the entire lifecycle of waste—from collection to processing. It seeks to create a seamless and interactive experience for residents, waste collectors, and administrative authorities while promoting transparency and data accessibility. This multifaceted system is built to serve the unique needs of different stakeholders. The **Residents** interface captures user information, providing the foundation for tracking waste disposal habits and fostering engagement in recycling initiatives. Meanwhile, the **Waste Bins** interface monitors the fill levels, types, and locations of bins, enabling real-time tracking and route optimization for garbage trucks. Route planning and vehicle management are facilitated through the **Collection Routes** and **Trucks** interfaces, which work in tandem to streamline waste collection operations. These tables provide waste management authorities with the data needed to plan efficient collection schedules and allocate resources effectively. By connecting these interfaces with the **Waste Collection Record**s, the system captures detailed data on each collection instance, empowering authorities to analyze patterns and identify areas for improvement. The project also emphasizes proper waste processing so that collected waste is processed in an environmentally responsible manner. It also defines waste classifications and indicates whether they are recyclable, fostering a culture of responsible waste disposal. User interaction and system monitoring are equally prioritized in this project. It allows residents to share their experiences and suggestions, providing valuable insights for continuous improvement of the waste management system. It serves serves as a communication tool, sending reminders, recycling tips, and alerts to residents, thereby enhancing community engagement and promoting awareness. In essence, the **Smart Waste Management System** project embodies a transformative approach to urban waste management. By integrating residents, waste collection services, and administrative oversight within a unified platform, it delivers a holistic solution characterized by efficiency, environmental consciousness, and data-driven decision-making. Through its commitment to transparency, operational excellence, and community involvement, the system aims to set a new standard for sustainable waste management practices in modern cities, paving the way for a cleaner and more efficient future.

Contributions

Table 1: Team Member's Contributions

ID	Name	Tasks	Contribution
2221507642	Noshin Nawar	• Project Overview • Deliverable • Physical Database Design • Table Creation • Data Population • Query	50%
2221070642	Mubashshira Kaisar	• Project Description • Project Objective • Project Scope • Logical and Conceptual Database Design • Query • Conclusion	50%

1 Project Title

The Smart Waste Management System.

2 Project Description

The **Smart Waste Management** System is an innovative initiative designed to streamline and enhance **urban waste management** through efficient processes, data-driven decisions, and community engagement. Primarily optimized at the source, the system looks to amass the **entire life cycles of waste** from collection through processing with **sustainability** in mind. It is designed to eliminate the inefficiencies of a conventional waste management system by implementing systematically efficient work flows for the management of **timely collections**, the **categorization of waste** and **environmentally safe disposal**. This involves **waste segregation** right at the source into **organic-recyclable-general waste streams**, which lead to superior recycling and responsible organic waste processing. To further achieve the purpose of **dynamic routing of garbage collection vehicles**, the smart waste management system provides the opportunity for maximum efficiency through **previously scheduled routes** to **minimize travel time and fuel consumption**. This makes **operational costs cheaper**, **shortens collection times**, and **makes urban environments cleaner and greener**. This preventive and systematic approach makes a program more operational without affecting the environmental impact of the collection. The **categorization and processing of wastes** are essential functions of the waste management system. Waste source sorting improves the functionality of the system through facilitating its **efficient recycling**; directing **organics to composting**; and **appropriate disposal of non-recyclables or hazardous wastes**. It **lessens the reliance on landfills**, **creates a circular economy**, and **guarantees compliance with environmental regulations**. **Community involvement** is a key aspect of the system, empowering residents to actively participate in **sustainable waste management**. Through very user-friendly mobile apps and dashboards, residents **monitor waste disposal habits**, **collection schedules**, and **notifications concerning collection days or events promoting sustainability**. Such kind of engagement should create a culture of responsibility and **encourage citizens and communities towards environmentally conscious habits**. The **central data and analytics tools** provide indications of waste management operations to **administrative authorities**. With such tools, they can **track the trends in waste collection**, as well as **measure recycling rates**, and subsequently **improve efforts made towards ensuring overall efficiency**. **Future waste volumes** can easily be projected from data. Resources will, therefore, be placed more effectively, and policies that could enhance waste sustainability will be put in place. The system pursues **environmental sustainability** through promotion of recycling and composting so that it cuts down on use of landfills. It also conserves **primary raw materials** thus making the environment more sustainable and meets a lot of global environmental goals. **Smart waste management system** does not only mean waste management; it will also mean **behavioral change for a lifetime**. A vision that sees future urban structures with less waste shall now inspire people living in cities across the globe to behave sustainably, as well as link them to developing scalable solutions to address cities of different sizes. A scene of modern urban waste management would replicate efficiency with sustainability and participation by the community to answer the environmental questions posed by the present world and would, henceforth, mean a **healthier and greener future**.

3 Project Objective

The objectives of the project **Smart Waste Management** are:

- **Increasing Waste Collection Efficacy:** The system-based idea aims to achieve greater control over the waste collection process by organizing the usage information of different bins to determine the optimal routes for reaching the bins and disposing of waste. The project tends to avoid unnecessary traveling along a certain route on a given day for targeted waste collection, thereby minimizing both fuel consumption and the concomitant costs in terms of time.
- **Promoting Recycling and Sustainability:** It also provides a waste classification module to ensure that the collected waste is categorized into streams such as organic waste, recyclable waste, and others. This makes recycling easy as it directs biodegradable refuse towards the composting points and ensures proper disposal of hazardous waste materials. Additionally, the system includes educating the residents on ways to adopt sustainable practices within the community to remove irresponsible usage or disposal of the materials.
- **Unlocking Transparency and Community Participation:** The system, through simplified interfaces in form of a dashboard, enables residents, waste collectors, and administrative personnel to directly monitor waste management activities. It includes notifying applications, collection schedules, and feedback tools, which promote proper communication and increase the participation of the community towards proper disposal of wastes.
- **Ensuring Data Driven Decisions:** The incorporation of advanced analytics and reporting solutions gives the project the ability to analyze, report and track recycling rates and collection and disposal performances of such waste management authorities. This enables decision-makers to specify allocations of resources and formulate effective policies from data driven analysis, promoting sustainability of the environment.
- **Promoting the Appropriate Waste Classification and Disposal:** Waste should be sorted at the point of generation so that it can be suitable for the processing plan. The waste goes to a composting site, recyclables are sent to a recycling plant, and any such other waste that meets these criteria is taken care of. This ensures decoupling from landfills, encourages excessive circular economy usage and meets the emerging environmental standard.
- **Integrating Existing Infrastructure:** The most appropriate option is to link the system with the waste collection infrastructure already existing in cities and semi-urban areas. It would also be considered flexible for different cities if it made provisions for future, more advanced systems of larger cities while ensuring integration with the existing systems.
- **Smoothing the Management of Vehicles and Optimizing Journey:** It even incorporates highly sophisticated features for elaborate routing and scheduling of garbage truck fleets, resulting into better utilization of existing resources. Predefined routes which are also adjusted in real-time would optimize collection time, save fuel and improve collection effectiveness and reduce operation costs.
- **Facilitating Environmental Sustainability:** With regard to environmental utility, this system will help achieve global goals related to reducing the dependency on landfills, decreasing greenhouse gas emissions and conserving raw materials. Its strong focus on recycling and composting also contributes to creating a more sustainable urban ambiance, motivating organizations to adopt proper waste disposal practices.

- **Spreading Behavioral Change and Lasting Impact:** The system further focuses on learning and generating awareness among communities about the issues pertaining to sustainable waste management at the homes of the residents.
- **Providing Stakeholders with Overall Insights:** There is nothing beyond pedestrian control exercised by management on processes, so it can determine problems and plan solutions. Real-time monitoring, combined with the data collected from the past, helps optimize decisions and utilize resources while aiding for the future planning as well.
- **Creating a Template for Modern Waste Management:** Smart Waste Management System envisages a development of sustainable waste management within cities. This project is meant to take this achievement down to the middle or small cities, showing that, indeed, these three themes of efficiency, community engagement, and true sustainable consciousness can co-exist to find solutions to urban waste challenges.

Thus, in general, the project of the Smart Waste Management System, too, seeks to transform waste management in most cities, relying heavily on technology, analytics, and participation. These changes are meant to improve processes and maximize the sustainable reuse of resources while abiding by institutional conservation principles. Such arrangements in collecting waste management have reduced operational costs as well as environmental impacts associated with waste disposal through improvements in route layout and recycling promotion. The initiative strongly emphasizes transparency, which allows real-time tracking and data sharing with residents of the area, waste handlers, and administrative authorities. Thus, it will reduce pollution for the present and future urban environment.

4 Project Scope

4.1 Scope Statement:

The Smart Waste Management System is an idea that is aimed at helping waste management systems in different urban cities to reinvent themselves through the application of different technologies, in order to improve the efficiency of the waste collection process and the recycling process, and in general to enhance the efficiency of the operations they carry out.The heart of the system lies in the route planning of the garbage collection vehicles so that the complete benefit from the collection may be received within the shortest possible time and least fuel consumption. It aims to enhance waste segregation at the source, and the efficient and proper collection of recyclable, organic and non-recyclable wastes. It allows residents to choose a simple graphical interface to monitor personal garbage disposal, be aware of collection dates, and join environmental programs. To administrative authority, the system provides essential tools for real-time control of the waste management operations, evaluation of the performance indicators, and thus, the means for evidence-based management of the services. Furthermore, it promotes community involvement through incentives for sorting and properly disposing waste and within a short span, attracts a large number of individuals into sustainability programs. It is a system which can be easily adjusted and applied to the different cities, which is very suitable for the urban waste management and can contribute to reach the goal of developing the green cities and the sustainable future.

4.2 Key Milestones:

- **Development of Collection Route Optimization System:** Designing a proper algorithm for garbage truck and effective implementation of garbage truck load to reach at proper destination as soon as possible with least amount of fuel required.
- **Waste Categorization and Segregation Module:** Implementation of a waste segmentation system for classified disposal and management of recyclable, biodegradable and non-recyclable waste.
- **User Interface Development for Residents:** To enhance user convenience, a web-based interface with options enabling the residents to monitor own waste disposal behavior, check the calendar of waste collection, and receive notifications about upcoming events or changes in schedule.
- **Administrative Dashboard Implementation:** Design and implementation of management information system for administrative authorities to improve the monitoring of the full chain of handling waste and to build a track analysis tool.
- **Deployment of Community Engagement Features:** Debut of mechanisms of alerts for notifications, encouraging principles for recycling, and feedback-submission processes to refine waste management over time for the residents.
- **Scalability and System Integration:** Availability of the system that complements existing structures of waste management systems by ensuring that the system can grow and reach across different city sizes and scales.

4.3 Roles and Responsibilities:

- **Development Team:** Develops ideas for platform's architecture and translates them into creation of the necessary routes, user interfaces, and methods of waste categorization.

- **Project Manager:** Balances and monitors the duration of project milestones and operations to fit the expectations of the stakeholders.
- **Stakeholders (Residents, Collectors, Authorities):** Use the system during testing and show commitment to enhance waste management performance after the system has been deployed.

5 Deliverable

- **Smart Waste Bins Management:** Introducing bins that are programmable to determine the level of filling, type of waste found in a bin, its position in order to make work and monitoring easier.
- **Resident Portal:** A clear and easy to navigate platform through which the residents can track their waste disposal patterns, get information on recycling and learn of their contributions to the community's efforts to preserve the environment.
- **Administrative Dashboard:** An overview that allows waste management authorities to track waste collection behavior, design routes optimistically, and optimize the overall waste management system performance.
- **Dynamic Route Optimization System:** Optimisation of a sophisticated algorithm to do route planning for collection trucks in the most efficient manner possible in terms of fuel consumption time used.
- **Waste Categorization and Recycling Module:** New modules to distinguish the waste collected during operations and procedures as recyclable and non-recyclable and advise on correct disposal.
- **Community Engagement Tools:** Interpersonal communication systems to convey messages occasionally for reminder purposes and notification to the residents and service feedback systems.
- **Data Analytics and Reporting Tools:** Systems to facilitate the waste management authorities to produce reports and identify trends for increasing efficiency of the organization.

6 Diagrams

6.1 Conceptual Design Diagram

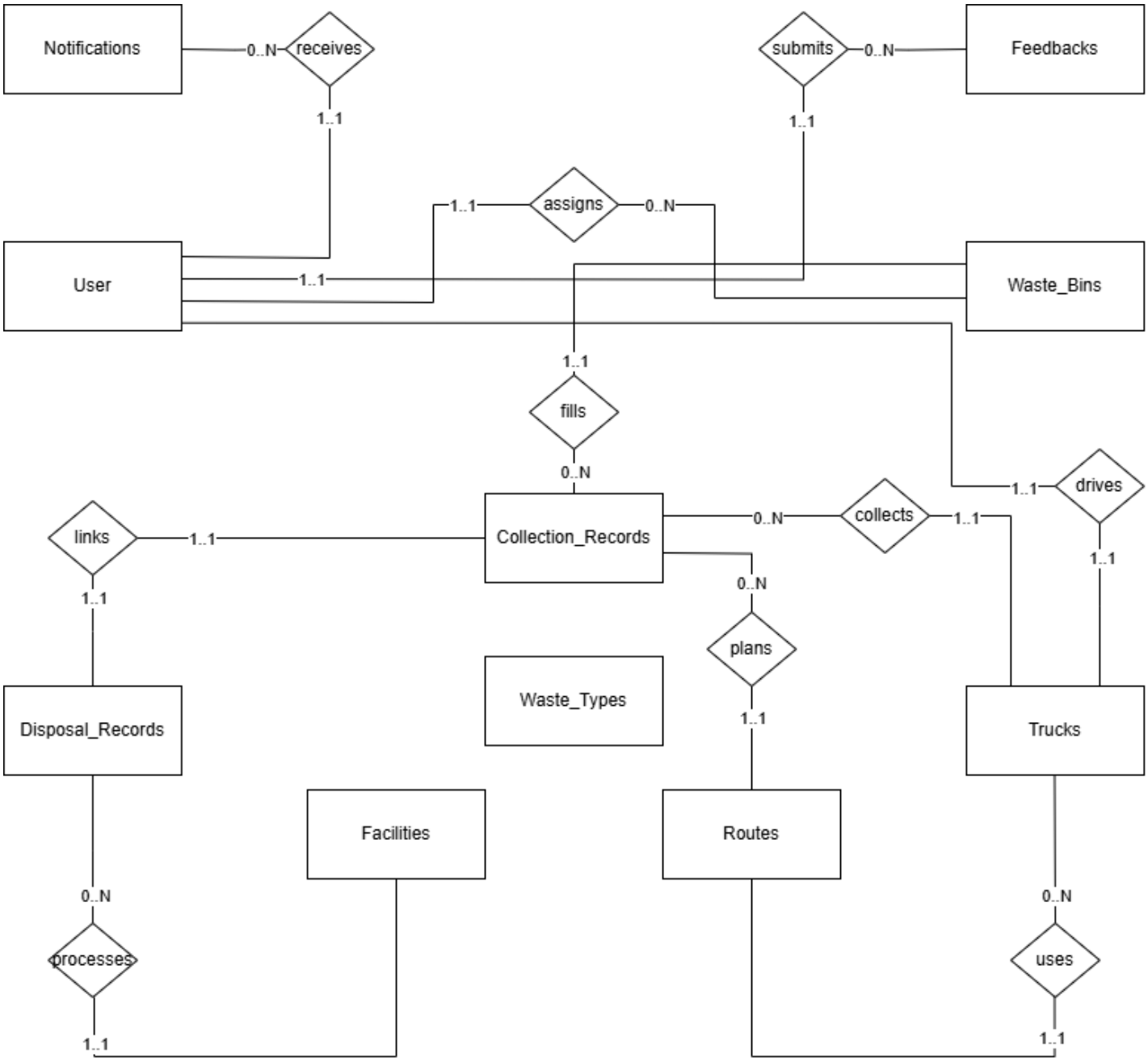


Figure 1: Conceptual Database Design

6.2 Logical Design Diagram

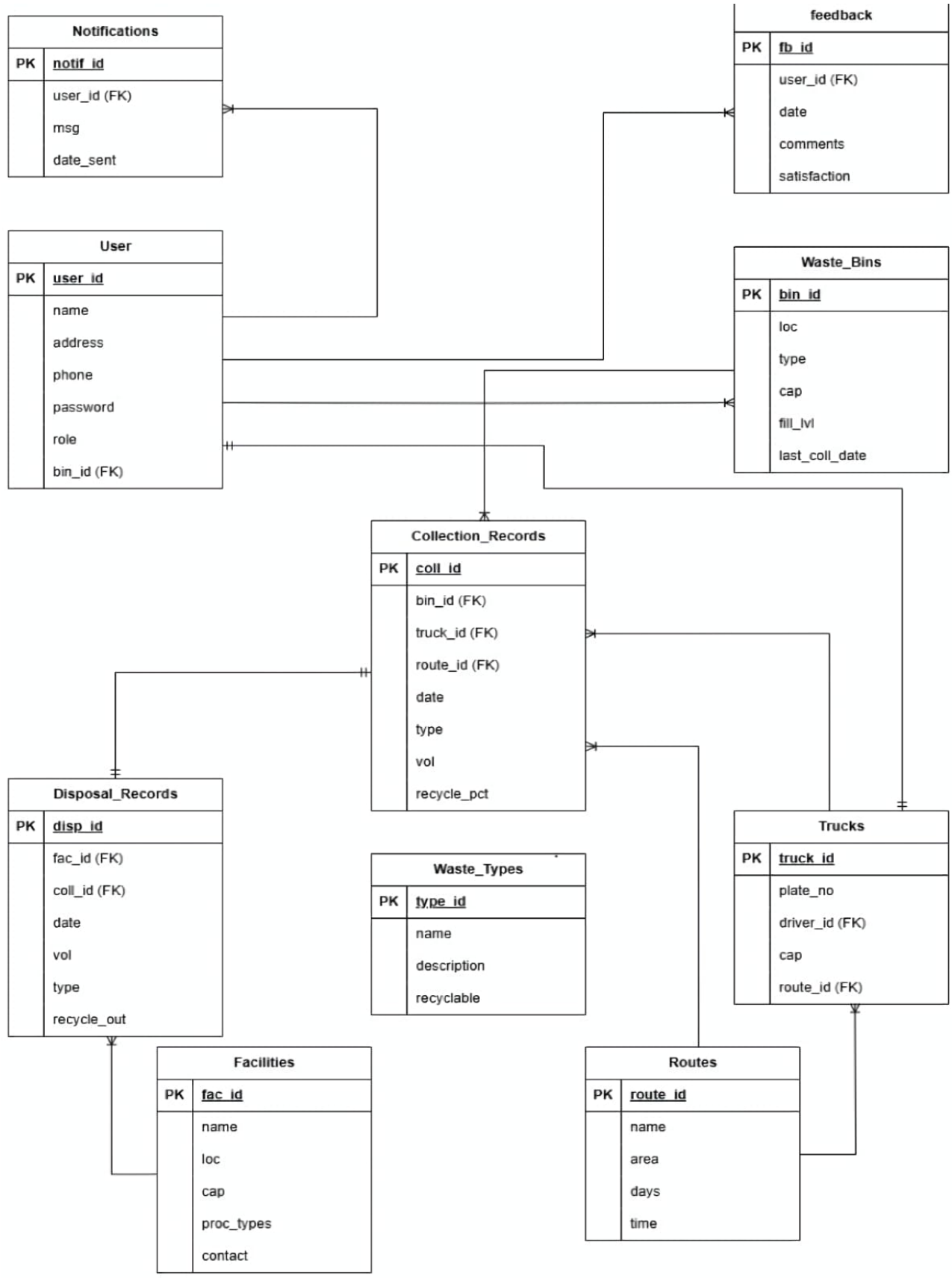


Figure 2: Logical Database Design

6.3 Physical Design Diagram

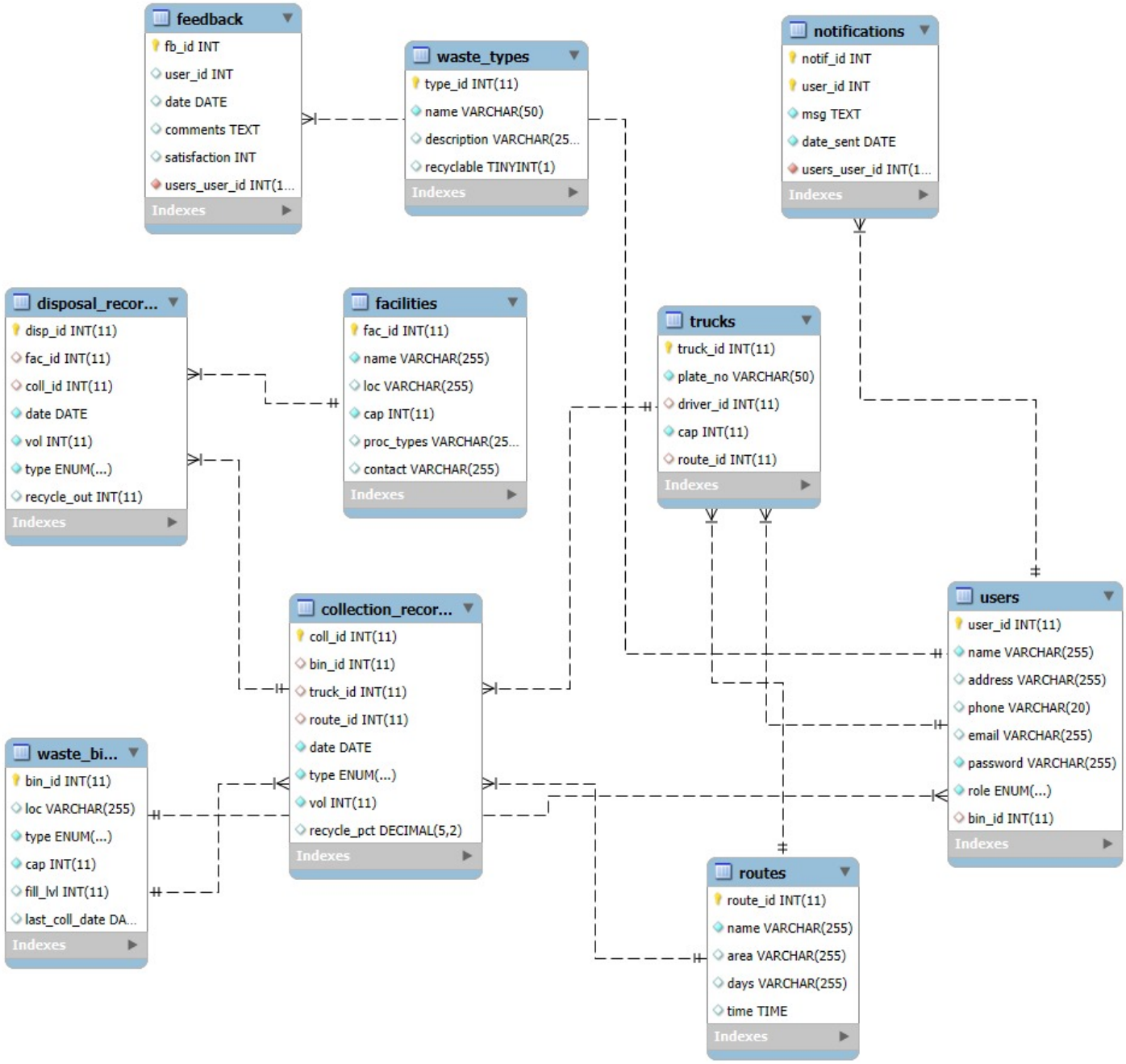


Figure 3: Physical Database Design

7 Table Creation

- **waste_bins:**

```
112 • select * from waste_bins;
113
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Co

bin_id	loc	type	cap	fill_lvl	last_coll_date
1	Dhaka, Gulshan 1	Organic	120	80	2024-12-10
2	Dhaka, Dhanmondi 27	Recyclable	150	100	2024-12-09
3	Dhaka, Uttara Sector 4	General	200	90	2024-12-08
4	Chattogram, Agrabad	Organic	100	60	2024-12-07
5	Sylhet, Zindabazar	Recyclable	130	70	2024-12-06
6	Khulna, Khalishpur	General	180	140	2024-12-05
7	Rajshahi, Shaheb Bazar	Organic	120	50	2024-12-04
8	Barishal, Sadar Road	Recyclable	140	90	2024-12-03
9	Rangpur, Terminal Area	General	160	110	2024-12-02
10	Cumilla, Kandirpar	Organic	100	40	2024-12-01
NULL	NULL	NULL	NULL	NULL	NULL

waste_bins 1

Figure 4: waste_bin Table

```sql
create table waste_bins (
    bin_id int primary key,
    loc varchar(255),
    type enum('Organic', 'Recyclable', 'General') not null,
    cap int not null,
    fill_lvl int default 0,
    last_coll_date date
);
```

- **users:**

```
136
137 •  select * from users;
138
139 •  insert into routes (route_id, name, area, days, time)
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

user_id	name	address	phone	email	role	bin_id
1	Mehedi Hasan	Gulshan 2, Dhaka	01710000001	mehedi@gulshan.com	Resident	1
2	Tahmid Rahman	Dhanmondi 32, Dhaka	01710000002	tahmid@dhanmondi.com	Resident	2
3	Rafiqul Islam	Uttara Sector 7, Dhaka	01710000003	rafiqul@uttara.com	Resident	3
4	Nusrat Jahan	Agrabad, Chattogram	01710000004	nusrat@agrabad.com	Resident	4
5	Arman Hossain	Zindabazar, Sylhet	01710000005	arman@zindabazar.com	Resident	5
6	Mim Akter	Khalishpur, Khulna	01710000006	mim@khalishpur.com	Resident	6
7	Jamil Ahmed	Shaheb Bazar, Rajshahi	01710000007	jamil@shaheb.com	Resident	7
8	Sharmin Akter	Sadar Road, Barishal	01710000008	sharmin@sadar.com	Resident	8
9	Tanim Chowdhury	Terminal Area, Rangpur	01710000009	tanim@terminal.com	Resident	9
10	Farhana Sultana	Kandirpar, Cumilla	01710000010	farhana@kandirpar.com	Resident	10
11	Officer 1	Mirpur, Dhaka	01710000011	officer1@police.com	Admin	NULL
12	Officer 2	Banani, Dhaka	01710000012	officer2@police.com	Admin	NULL
13	Driver A	Farmgate, Dhaka	01710000013	driverA@trucks.com	Driver	NULL
14	Driver B	Tejgaon, Dhaka	01710000014	driverB@trucks.com	Driver	NULL
15	Collector A	Kalabagan, Dhaka	01710000015	collectorA@collectors.com	Collector	NULL
16	Collector B	Rampura, Dhaka	01710000016	collectorB@collectors.com	Collector	NULL
17	Ashraf Uddin	Gulshan 1, Dhaka	01710000017	ashraf@gulshan.com	Resident	1
18	Salma Khatun	Dhanmondi 27, Dhaka	01710000018	salma@dhanmondi.com	Resident	2
19	Kamrul Hasan	Uttara Sector 4, Dhaka	01710000019	kamrul@uttara.com	Resident	3
20	Shakib Ali	Zindabazar, Sylhet	01710000020	shakib@zindabazar.com	Resident	5
NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 5: users Table

```sql
create table users (
    user_id int primary key,
    name varchar(255) not null,
    address varchar(255),
    phone varchar(20),
    email varchar(255),
    password varchar(255) not null,
    role enum('Admin', 'Resident', 'Collector', 'Driver') not null,
    bin_id int,
    foreign key (bin_id) references waste_bins(bin_id)
);

```

- **routes:**

```
408 •  select * from routes;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

route_id	name	area	days	time
1	Route 1	Gulshan, Banani	Monday, Wednesday, Friday	08:00:00
2	Route 2	Dhanmondi, Kalabagan	Tuesday, Thursday	09:00:00
3	Route 3	Uttara, Airport	Monday, Thursday	10:00:00
4	Route 4	Agrabad, Halishahar	Tuesday, Saturday	11:00:00
5	Route 5	Zindabazar, Amberkhana	Sunday, Thursday	12:00:00
6	Route 6	Khalishpur, Daulatpur	Wednesday, Friday	13:00:00
7	Route 7	Shaheb Bazar, Rajshahi	Monday, Saturday	14:00:00
8	Route 8	Sadar Road, Barishal	Tuesday, Sunday	15:00:00
9	Route 9	Terminal Area, Rangpur	Thursday, Friday	16:00:00
10	Route 10	Kandirpar, Cumilla	Saturday, Sunday	17:00:00
NULL	NULL	NULL	NULL	NULL

Figure 6: routes Table

```
1   create table routes (
2     route_id int primary key,
3     name varchar(255) not null,
4     area varchar(255),
5     days varchar(255),
6     time time
7 );
8
```

- **trucks:**

```
167 •  select * from trucks;
```

Result Grid | Filter Rows: | Edit: | Export/Impor

truck_id	plate_no	driver_id	cap	route_id
1	DHK-001	13	1000	1
2	DHK-002	14	1200	2
3	CTG-101	13	1500	4
4	SYL-201	14	1400	5
5	KHL-301	13	1600	6
6	RAJ-401	14	1800	7
7	BSL-501	13	1200	8
8	RNG-601	14	1300	9
9	CML-701	13	1400	10
10	DHK-003	13	1100	3
NULL	NULL	NULL	NULL	NULL

Figure 7: trucks Table

```
    create table trucks (
    truck_id int primary key,
    plate_no varchar(50) not null,
    driver_id int,
    cap int not null,
    route_id int,
    foreign key (driver_id) references users(user_id),
    foreign key (route_id) references routes(route_id)
);

```

- **collection_records:**

```
182 • select * from collection_records;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

coll_id	bin_id	truck_id	route_id	date	type	vol	recycle_pct
1	1	1	1	2024-12-01	Organic	80	60.50
2	2	2	2	2024-12-02	Recyclable	100	90.00
3	3	3	3	2024-12-03	General	120	0.00
4	4	4	4	2024-12-04	Organic	90	50.00
5	5	5	5	2024-12-05	Recyclable	110	80.00
6	6	6	6	2024-12-06	General	140	0.00
7	7	7	7	2024-12-07	Organic	60	40.00
8	8	8	8	2024-12-08	Recyclable	90	70.00
9	9	9	9	2024-12-09	General	110	0.00
10	10	10	10	2024-12-10	Organic	40	30.00
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 8: collection_records Table

```
        create table collection_records (
    coll_id int primary key,
    bin_id int,
    truck_id int,
    route_id int,
    date date not null,
    type enum('Organic', 'Recyclable', 'General') not null,
    vol int not null,
    recycle_pct decimal(5, 2),
    foreign key (bin_id) references waste_bins(bin_id),
    foreign key (truck_id) references trucks(truck_id),
    foreign key (route_id) references routes(route_id)
);

```

- **facilities:**

```
select * from facilities;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

fac_id	name	loc	cap	proc_types	contact
1	Dhaka Waste Processing Center	Gulshan, Dhaka	5000	Organic, Recyclable	01710000021
2	Chattogram Recycling Plant	Agrabad, Chattogram	4000	Recyclable	01710000022
3	Sylhet Waste Management Unit	Zindabazar, Sylhet	3000	Organic, General	01710000023
4	Khulna Eco Facility	Khalishpur, Khulna	4500	Organic	01710000024
5	Rajshahi Recycling Hub	Shaheb Bazar, Rajshahi	3500	Recyclable	01710000025
6	Barishal Green Plant	Sadar Road, Barishal	3200	General	01710000026
7	Rangpur Waste Facility	Terminal Area, Rangpur	2800	Recyclable	01710000027
8	Cumilla Processing Center	Kandirpar, Cumilla	4000	Organic, General	01710000028
9	Dhaka South Processing	Dhanmondi, Dhaka	5200	Organic	01710000029
10	Chattogram North Plant	Halishahar, Chattogram	4600	Recyclable, General	01710000030
NULL	NULL	NULL	NULL	NULL	NULL

Figure 9: facilities Table

```sql
        create table facilities (
    fac_id int primary key,
    name varchar(255) not null,
    loc varchar(255),
    cap int not null,
    proc_types varchar(255),
    contact varchar(255)
);

```

- **disposal_records:**

```
211
212 •  select * from disposal_records;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

disp_id	fac_id	coll_id	date	vol	type	recycle_out
1	1	1	2024-12-01	80	Organic	50
2	2	2	2024-12-02	100	Plastic	80
3	3	3	2024-12-03	120	General	0
4	4	4	2024-12-04	90	Organic	50
5	5	5	2024-12-05	110	Plastic	70
6	6	6	2024-12-06	140	General	0
7	7	7	2024-12-07	60	Organic	40
8	8	8	2024-12-08	90	Plastic	60
9	9	9	2024-12-09	110	General	0
10	10	10	2024-12-10	40	Organic	30
NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 10: disposal_records Table

```
1         create table disposal_records (
2     disp_id int primary key,
3     fac_id int,
4     coll_id int,
5     date date not null,
6     vol int not null,
7     type enum('Organic', 'Plastic', 'Metal', 'General') not null,
8     recycle_out int,
9     foreign key (fac_id) references facilities(fac_id),
10    foreign key (coll_id) references collection_records(coll_id)
11 );
12
```

- **waste_types:**

```
226
227 •   select * from waste_types;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

type_id	name	description	recyclable
1	Organic	Biodegradable waste, including food and plant materials.	1
2	Recyclable	Materials like plastics, metals, and paper that can be recycled.	1
3	General	Non-recyclable waste, including mixed or contaminated items.	0
4	Plastic	Includes bottles, containers, and plastic packaging.	1
5	Metal	Includes cans, scrap metal, and other metallic materials.	1
6	Glass	Glass bottles, jars, and broken glassware.	1
7	Paper	Cardboard, newspapers, and other paper products.	1
8	E-Waste	Electronics, batteries, and other electrical materials.	0
9	Hazardous	Medical or chemical waste requiring special disposal.	0
10	Compostable	Waste suitable for composting, like organic kitchen waste.	1
NULL	NULL	NULL	NULL

Figure 11: waste_types Table

```
1         create table waste_types (
2     type_id int primary key,
3     name varchar(50) not null,
4     description varchar(255),
5     recyclable boolean
6 );
7
```

- **feedback:**

```
241
242 • select * from feedback;
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

fb_id	user_id	date	comments	satisfaction
1	1	2024-12-05	Service is timely and efficient.	5
2	2	2024-12-04	Bins often overflow before collection.	3
3	3	2024-12-03	Happy with the recycling facilities.	4
4	4	2024-12-02	Collection staff is polite and professional.	5
5	5	2024-12-01	Would prefer more frequent pickups.	3
6	6	2024-12-06	Bins are always cleaned after emptying.	5
7	7	2024-12-07	Need better communication about schedules.	4
8	8	2024-12-08	Recycling guidelines are unclear.	2
9	9	2024-12-09	Satisfied with the current system.	5
10	10	2024-12-10	Some bins are damaged and need replacement.	3
NULL	NULL	NULL	NULL	NULL

Figure 12: feedback Table

```
1         create table feedback (
2     fb_id int primary key,
3     user_id int,
4     date date not null,
5     comments text,
6     satisfaction int check (satisfaction between 1 and 5),
7     foreign key (user_id) references users(user_id)
8 );
9
```

- **notifications:**

```
257 •  select * from notifications;
```

Result Grid | Filter Rows: | Edit: | Export/Import:

notif_id	user_id	msg	date_sent
1	1	Your bin will be collected on 2024-12-05 at 8:00 AM.	2024-12-01
2	2	Recycling tips: Separate plastic and paper materials.	2024-12-02
3	3	Your bin will be collected on 2024-12-06 at 9:00 AM.	2024-12-03
4	4	Reminder: Hazardous waste collection this Friday.	2024-12-04
5	5	Your bin will be collected on 2024-12-07 at 10:00 AM.	2024-12-05
6	6	Please check bin fill levels before collection.	2024-12-06
7	7	New bins are being distributed in your area.	2024-12-07
8	8	Your bin will be collected on 2024-12-08 at 11:00 AM.	2024-12-08
9	9	Schedule updated: Collection on Thursday.	2024-12-09
10	10	Your bin will be collected on 2024-12-10 at 12:00 PM.	2024-12-10
NULL	NULL	NULL	NULL

Figure 13: notifications Table

```
1         create table notifications (
2     notif_id int primary key,
3     user_id int,
4     msg text not null,
5     date_sent date not null,
6     foreign key (user_id) references users(user_id)
7 );
8
```

8 Queries

8.1 Registration

```
    insert into users (user_id, name, address, phone, email, password, role, bin_id)
    values (21, 'Hasan Kabir', 'Mirpur 10, Dhaka', '01712345678', 'hasan@gmail.com',
    '3444kabir', 'Resident', 2);


```

8.2 Login

```
    select
    case
        when u.user_id is null then 'incorrect credentials'
        else u.user_id
    end as user_id,
    case
        when u.user_id is null then null
        else u.role
    end as role,
    case
        when u.user_id is null then null
        else u.name
    end as name,
    case
        when u.role = 'resident' then u.bin_id
        else null
    end as associated_bin_id
    from
        users u
    where
        u.email = 'mehedi@gulshan.com'
        and u.password = 'password123';

-- Resident: View the resident's assigned waste bin details
select w.bin_id, w.loc, w.type, w.cap, w.fill_lvl, w.last_coll_date
from waste_bins w join users u on w.bin_id = u.bin_id
where u.user_id = 5;

```

8.3 Resident Queries

8.3.1 View the resident's assigned waste bin details

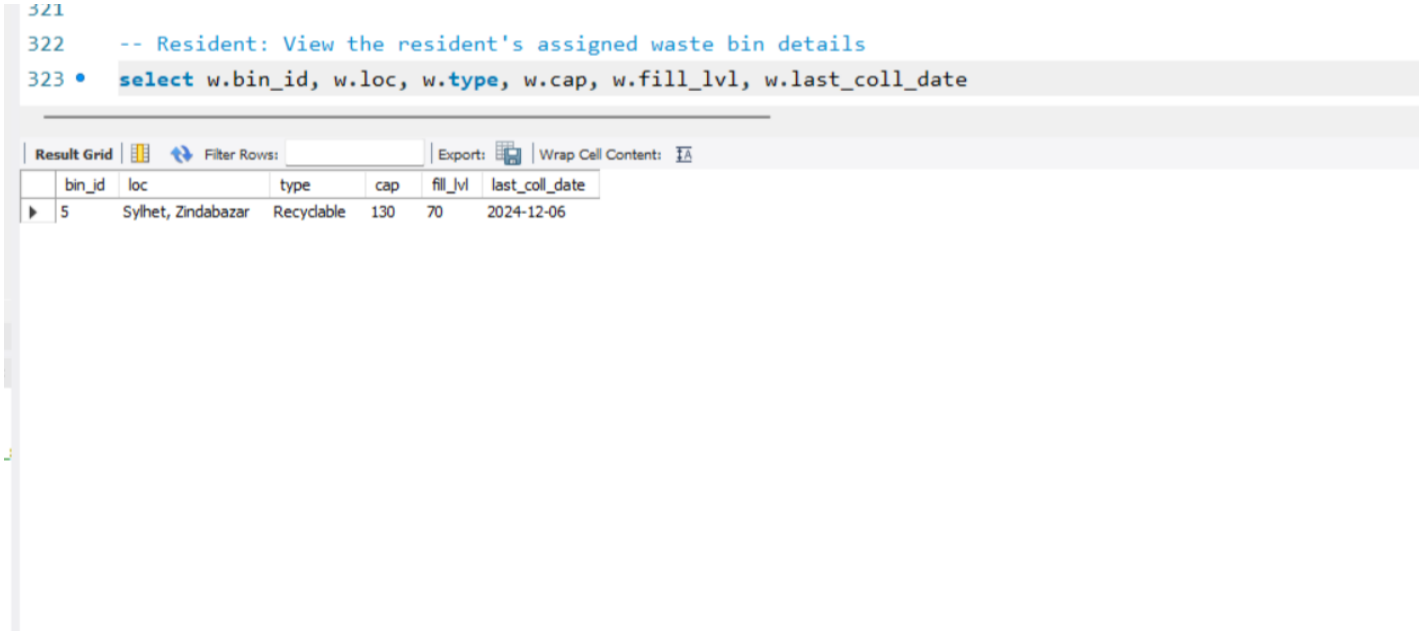


Figure 14: View the resident's assigned waste bin details

```
    select w.bin_id, w.loc, w.type, w.cap, w.fill_lvl, w.last_coll_date
from waste_bins w join users u on w.bin_id = u.bin_id
where u.user_id = 5;

```

8.3.2 Submit Feedback

```
insert into feedback (fb_id, user_id, date, comments, satisfaction)
values (11, 1, current_date(), 'Great service!', 5);
```

8.3.3 View notifications

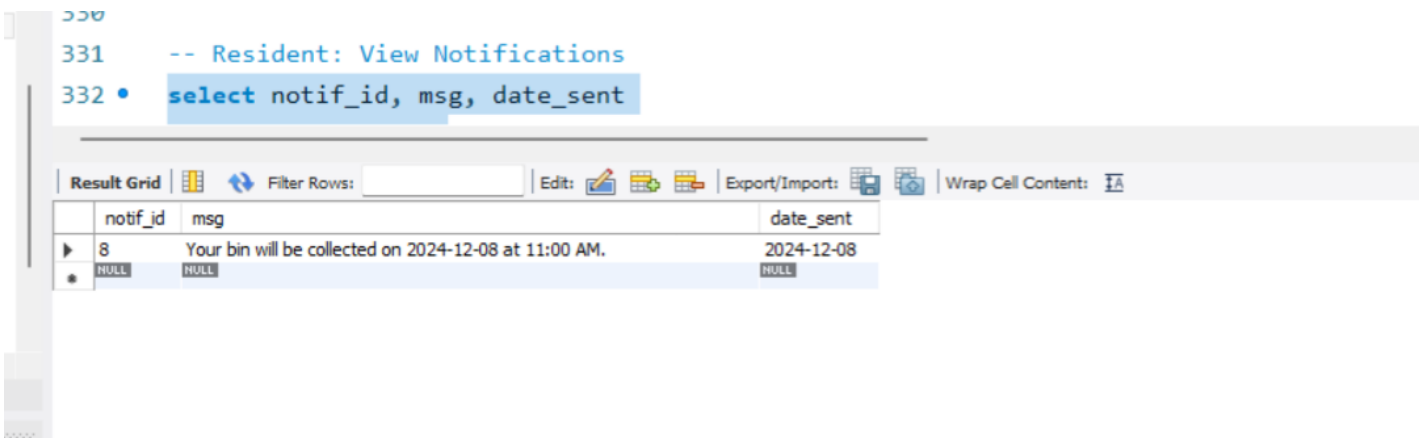


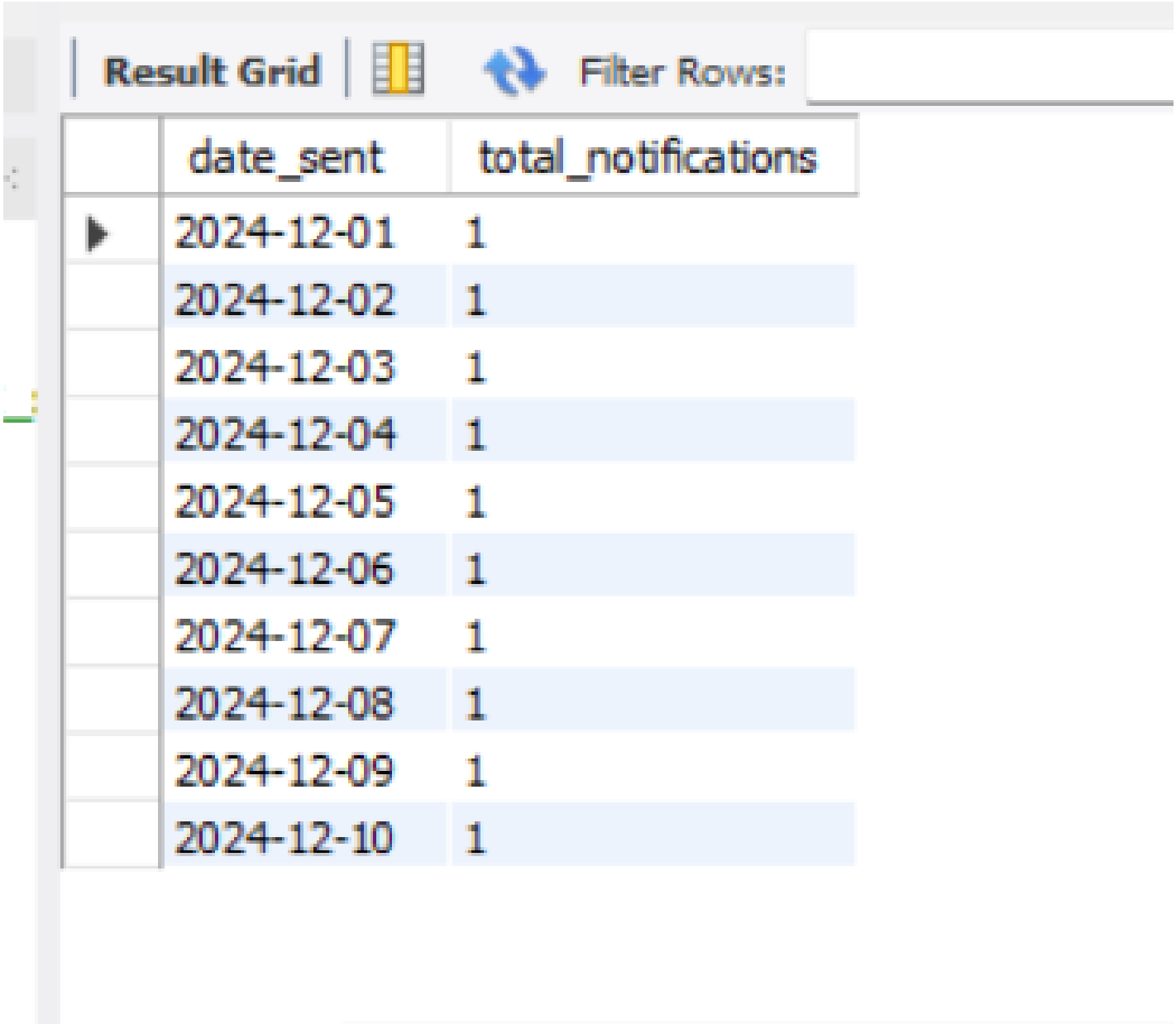
Figure 15: View notifications Table

```sql
 select notif_id, msg, date_sent
from notifications
where user_id = 8;

```

8.3.4 Get Notifications for a Specific Resident

```sql
   select notif_id, msg, date_sent
from notifications
where user_id = 1
order by date_sent desc;

```

8.3.5 Count the Number of Notifications Sent to Residents by Date



date_sent	total_notifications
2024-12-01	1
2024-12-02	1
2024-12-03	1
2024-12-04	1
2024-12-05	1
2024-12-06	1
2024-12-07	1
2024-12-08	1
2024-12-09	1
2024-12-10	1

Figure 16: Count the Number of Notifications Sent to Residents by Date Table

```
    select date_sent, count(*) as total_notifications
from notifications
where user_id in (select user_id from users where role = 'Resident')
group by date_sent;

```

8.4 Collector and Driver Queries

8.4.1 Calculate the Total Volume Collected by All Collectors for Each Waste Type

```
-- Collector: Calculate the Total Volume Collected by All Collectors for Each Waste Type
select type, sum(vol) as total_volume
from collection_records
group by type
order by total_volume desc;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

type	total_volume
General	370
Recyclable	300
Organic	270

Result Grid | Form Editor | Field Types

```
   select type, sum(vol) as total_volume
from collection_records
group by type
order by total_volume desc;

```

8.4.2 Get Collection history for all bins

```
    select cr.coll_id, cr.bin_id, b.loc, cr.date, cr.type, cr.vol
from collection_records cr
join waste_bins b on cr.bin_id = b.bin_id
order by cr.date desc;

```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

coll_id	bin_id	loc	date	type	vol
10	10	Cumilla, Kandirpar	2024-12-10	Organic	40
9	9	Rangpur, Terminal Area	2024-12-09	General	110
8	8	Barishal, Sadar Road	2024-12-08	Recyclable	90
7	7	Rajshahi, Shaheb Bazar	2024-12-07	Organic	60
6	6	Khulna, Khalishpur	2024-12-06	General	140
5	5	Sylhet, Zindabazar	2024-12-05	Recyclable	110
4	4	Chattogram, Agrabad	2024-12-04	Organic	90
3	3	Dhaka, Uttara Sector 4	2024-12-03	General	120
2	2	Dhaka, Dhanmondi 27	2024-12-02	Recyclable	100
1	1	Dhaka, Gulshan 1	2024-12-01	Organic	80

8.4.3 View the Assigned Routes for Each Driver

```
366  where last_coll_date < current_date() - interval 7 day;
367
368  -- Driver: View the Assigned Routes for Each Driver
369  select t.truck_id, t.plate_no, r.route_id, r.name, r.area, r.days, r.time
370  from trucks t
371  join routes r on t.route_id = r.route_id
372  where t.driver_id in (select user_id from users where role = 'Driver');
373
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

truck_id	plate_no	route_id	name	area	days	time
1	DHK-001	1	Route 1	Gulshan, Banani	Monday, Wednesday, Friday	08:00:00
2	DHK-002	2	Route 2	Dhanmondi, Kalabagan	Tuesday, Thursday	09:00:00
3	CTG-101	4	Route 4	Agrabad, Halishahar	Tuesday, Saturday	11:00:00
4	SYL-201	5	Route 5	Zindabazar, Amberkhana	Sunday, Thursday	12:00:00
5	KHL-301	6	Route 6	Khalishpur, Daulatpur	Wednesday, Friday	13:00:00
6	RAJ-401	7	Route 7	Shaheb Bazar, Rajshahi	Monday, Saturday	14:00:00
7	BSL-501	8	Route 8	Sadar Road, Barishal	Tuesday, Sunday	15:00:00
8	RNG-601	9	Route 9	Terminal Area, Rangpur	Thursday, Friday	16:00:00
9	CML-701	10	Route 10	Kandirpar, Cumilla	Saturday, Sunday	17:00:00
10	DHK-003	3	Route 3	Uttara, Airport	Monday, Thursday	10:00:00

Result Grid | Form Editor | Field Types | Query Stats | Result 8 | Read Only | Context H | Output

Figure 17: View the Assigned Routes for Each Driver

```
1     select t.truck_id, t.plate_no, r.route_id, r.name, r.area, r.days, r.time
2 from trucks t
3 join routes r on t.route_id = r.route_id
4 where t.driver_id in (select user_id from users where role = 'Driver');
5
```

8.4.4 Find the Total Capacity of Trucks for Each Route

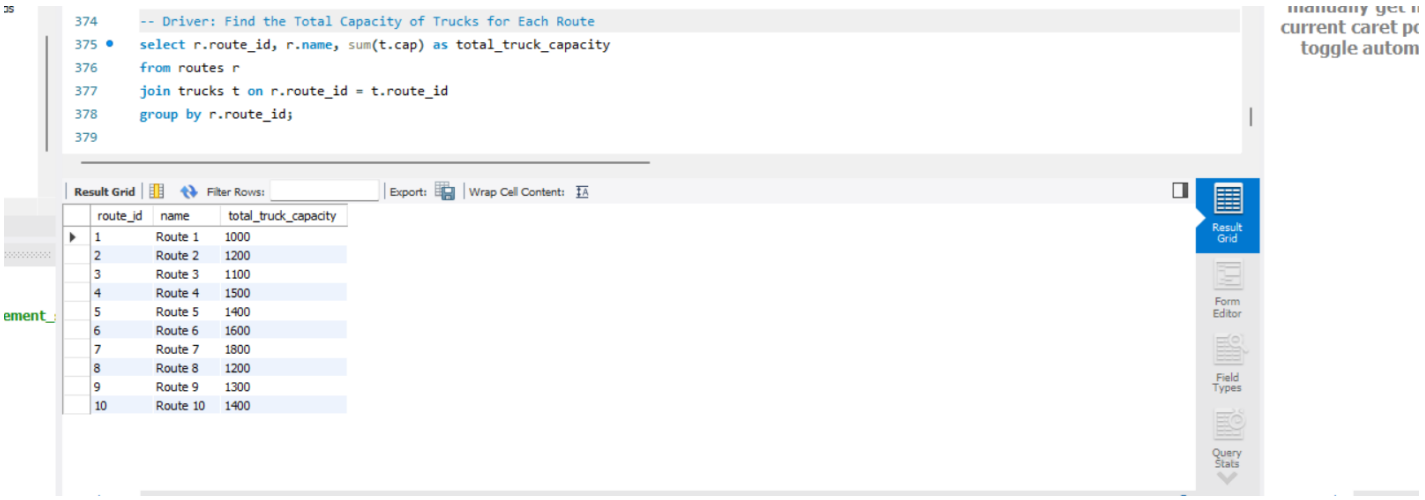


Figure 18: Find the Total Capacity of Trucks for Each Route

```sql
select r.route_id, r.name, sum(t.cap) as total_truck_capacity
from routes r
join trucks t on r.route_id = t.route_id
group by r.route_id;

```

8.5 Admin Queries

8.5.1 Approve feedback and display the comments which have been approved

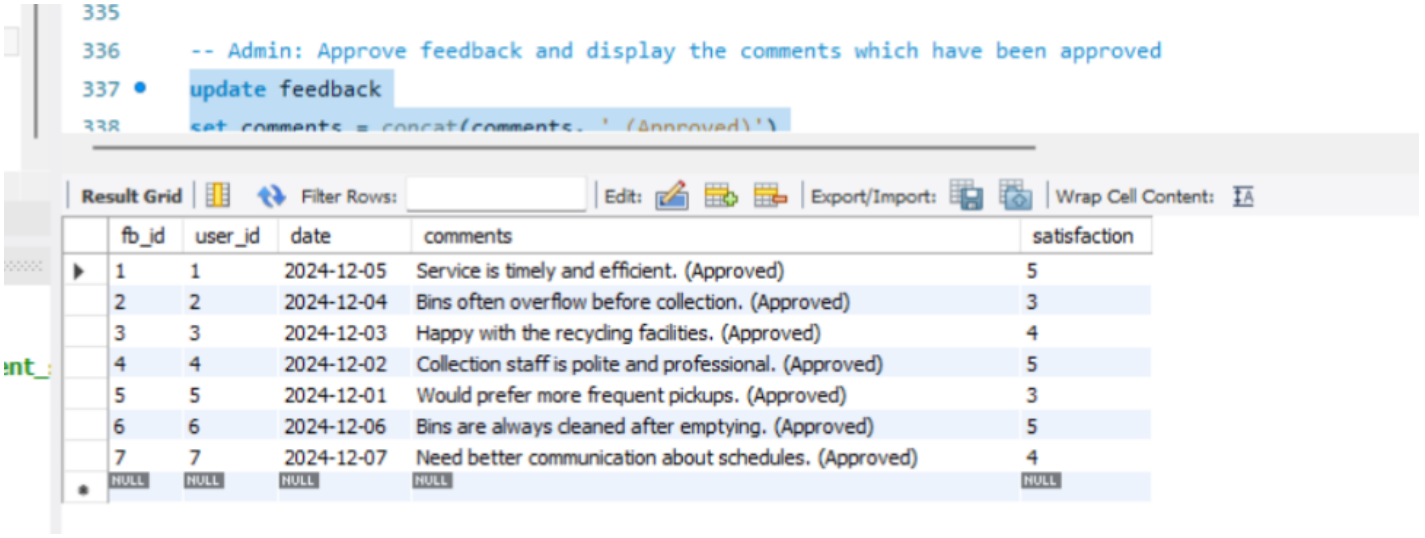


Figure 19: Approve feedback and display the comments which have been approved

```sql
update feedback
set comments = concat(comments, ' (Approved)')
where fb_id between 1 and 7;
select *
from feedback
where comments like '%(Approved)';

```

8.5.2 To view unassigned bins

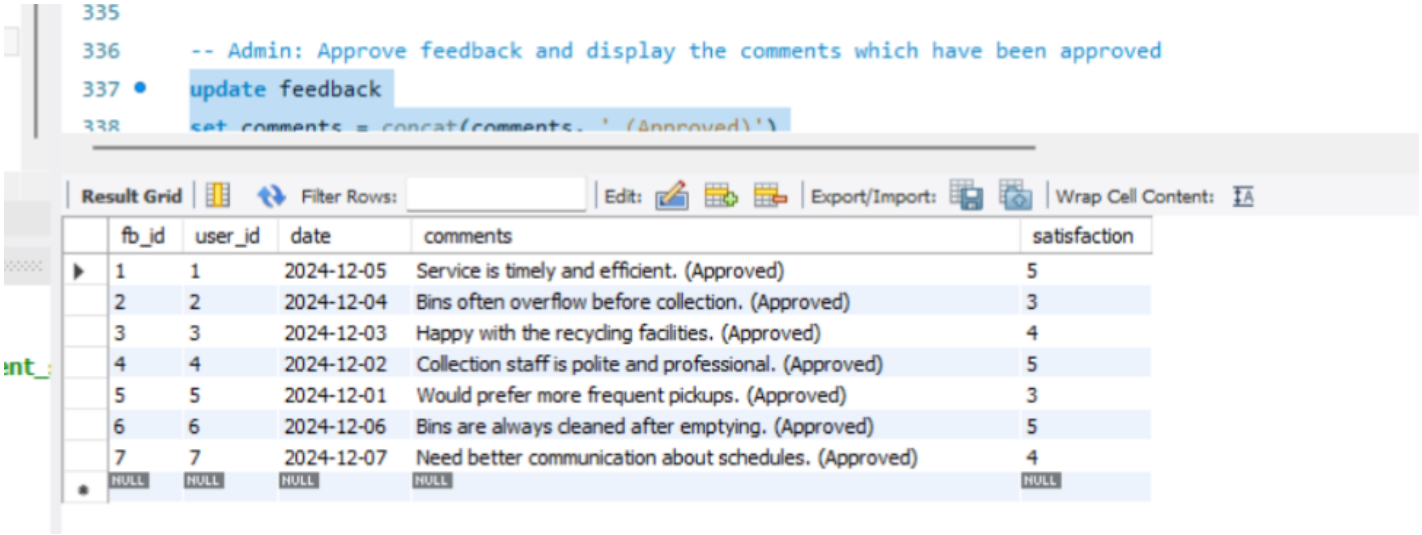


Figure 20: To view unassigned bins

```sql
select user_id, name, role, bin_id
from users
where role = 'Collector' and bin_id is null;

```

8.5.3 Assign some Bins

```sql
insert into waste_bins (bin_id, loc, type, cap, fill_lvl, last_coll_date)
 values
 (11, 'Dhaka, Mirpur 12', 'Organic', 100, 20, '2024-12-15'),
 (12, 'Chattogram, Halishahar', 'Recyclable', 120, 30, '2024-12-14'),
 (13, 'Sylhet, Ambarkhana', 'General', 150, 40, '2024-12-13'),
 (14, 'Barishal, Port Area', 'Organic', 110, 25, '2024-12-12'),
 (15, 'Rangpur, Bus Stand', 'Recyclable', 130, 50, '2024-12-11');

```

8.5.4 Assign Bins to collectors who are unassigned

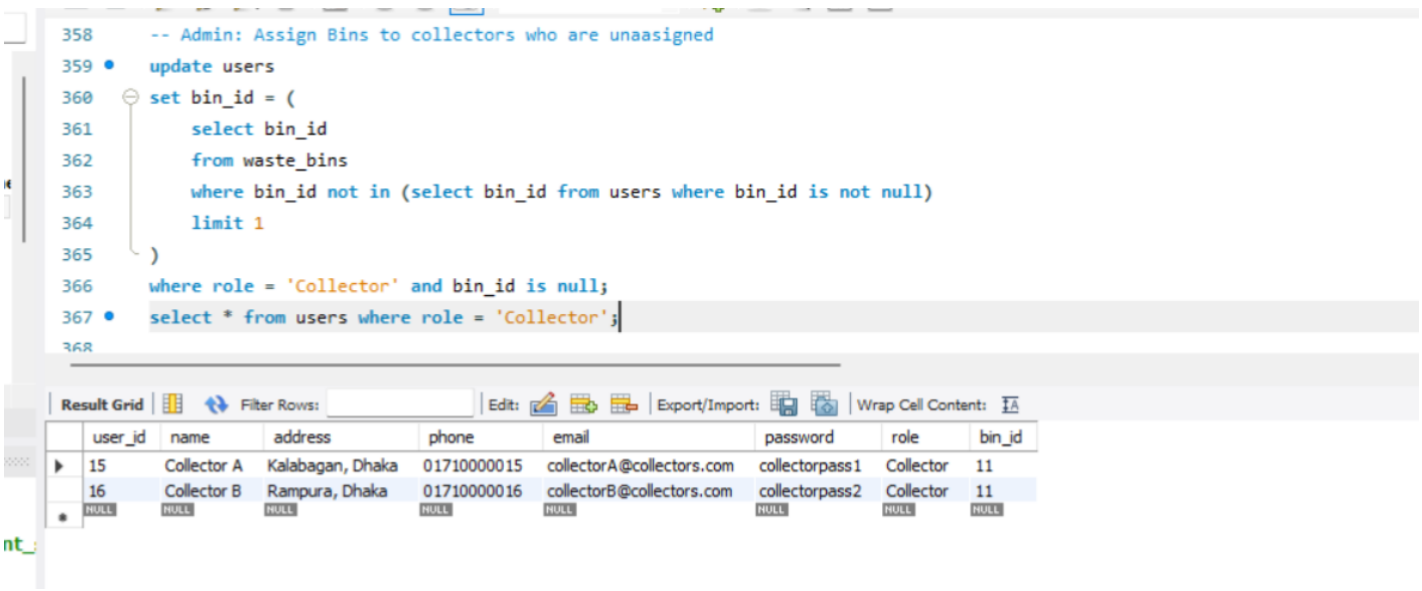


Figure 21: Assign Bins to collectors who are unassigned

```
update users
set bin_id = (
select bin_id
from waste_bins
where bin_id not in (select bin_id from users where bin_id is not null)
limit 1
)
where role = 'Collector' and bin_id is null;
select * from users where role = 'Collector';
```

8.5.5 List All Bins with Their Collection History

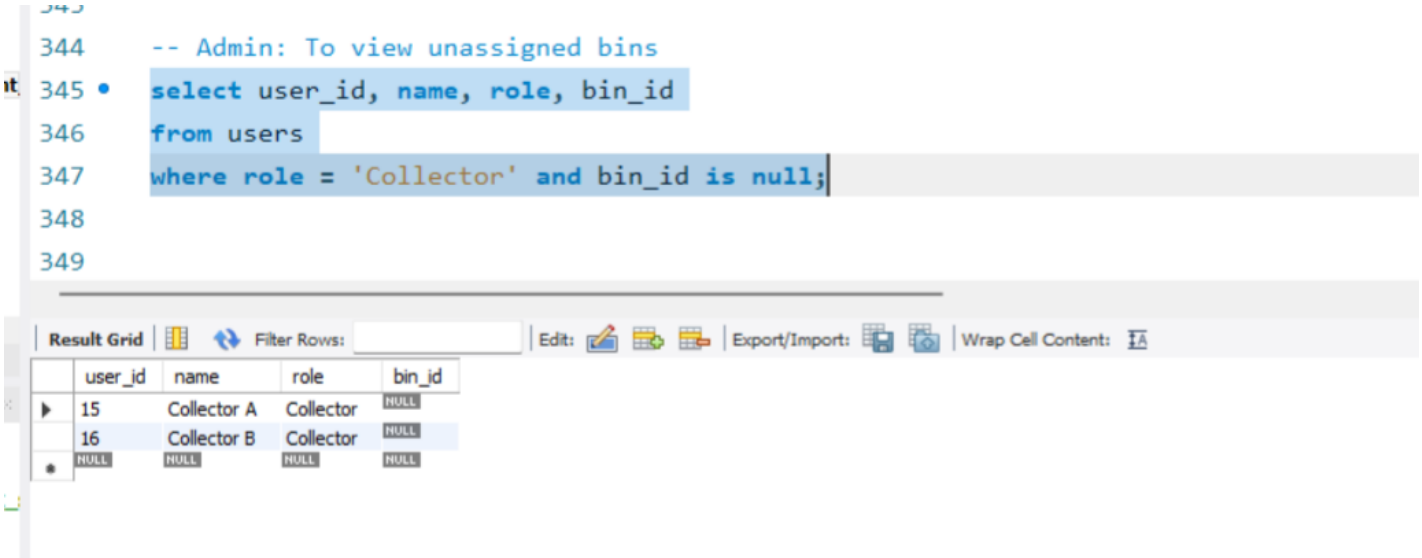


Figure 22: List All Bins with Their Collection History

```
    select b.bin_id, b.loc, cr.coll_id, cr.date, cr.type, cr.vol
from waste_bins b
join collection_records cr on b.bin_id = cr.bin_id
order by b.bin_id, cr.date desc;

```

8.5.6 Identify Users with No Feedback Submitted

```
    select u.user_id, u.name, u.role
from users u
left join feedback f on u.user_id = f.user_id
where f.fb_id is null
order by u.role, u.name;

```

```
370 •  select u.user_id, u.name, u.role
371    from users u
372    left join feedback f on u.user_id = f.user_id
373    where f.fb_id is null
374    order by u.role, u.name;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

user_id	name	role
11	Officer 1	Admin
12	Officer 2	Admin
17	Ashraf Uddin	Resident
21	Hasan Kabir	Resident
19	Kamrul Hasan	Resident
18	Salma Khatun	Resident
20	Shakib Ali	Resident
15	Collector A	Collector
16	Collector B	Collector
13	Driver A	Driver
14	Driver B	Driver

Figure 23: Identify Users with No Feedback Submitted

8.5.7 View Collection Records Along with Truck and Driver Information

```
    select cr.coll_id, cr.date, cr.type, cr.vol, t.plate_no, u.name as driver_name
from collection_records cr
join trucks t on cr.truck_id = t.truck_id
join users u on t.driver_id = u.user_id
order by cr.date desc, t.plate_no;
```

```
6
```

```
377 •  select cr.coll_id, cr.date, cr.type, cr.vol, t.plate_no, u.name as driver_name
378    from collection_records cr
379    join trucks t on cr.truck_id = t.truck_id
380    join users u on t.driver_id = u.user_id
381    order by cr.date desc, t.plate_no;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

coll_id	date	type	vol	plate_no	driver_name
10	2024-12-10	Organic	40	DHK-003	Driver A
9	2024-12-09	General	110	CML-701	Driver A
8	2024-12-08	Recyclable	90	RNG-601	Driver B
7	2024-12-07	Organic	60	BSL-501	Driver A
6	2024-12-06	General	140	RAJ-401	Driver B
5	2024-12-05	Recyclable	110	KHL-301	Driver A
4	2024-12-04	Organic	90	SYL-201	Driver B
3	2024-12-03	General	120	CTG-101	Driver A
2	2024-12-02	Recyclable	100	DHK-002	Driver B
1	2024-12-01	Organic	80	DHK-001	Driver A

Figure 24: View Collection Records Along with Truck and Driver Information

8.5.8 View all bins that Have Not Been Collected in the Last 7 Days

```
363    -- Admin: View all bins that Have Not Been Collected in the Last 7 Days
364 •  select bin_id, loc, type, last_coll_date
365    from waste_bins
366    where last_coll_date < current_date() - interval 7 day;
367
```

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

bin_id	loc	type	last_coll_date
1	Dhaka, Gulshan 1	Organic	2024-12-10
2	Dhaka, Dhanmondi 27	Recyclable	2024-12-09
3	Dhaka, Uttara Sector 4	General	2024-12-08
4	Chattogram, Agrabad	Organic	2024-12-07
5	Sylhet, Zindabazar	Recyclable	2024-12-06
6	Khulna, Khalishpur	General	2024-12-05
7	Rajshahi, Shaheb Bazar	Organic	2024-12-04
8	Barishal, Sadar Road	Recyclable	2024-12-03
9	Rangpur, Terminal Area	General	2024-12-02
10	Cumilla, Kandirpar	Organic	2024-12-01
12	Chattogram, Halishahar	Recyclable	2024-12-14
13	Sylhet, Ambarkhana	General	2024-12-13
14	Barishal, Port Area	Organic	2024-12-12
15	Rangpur, Bus Stand	Recyclable	2024-12-11
NULL	NULL	NULL	NULL

Result Grid | Form Editor | Field Types | Query Stats | Execution Plan

waste_bins 7 | Apply | Revert | Context

Figure 25: View all bins that Have Not Been Collected in the Last 7 Days

```
1      select bin_id, loc, type, last_coll_date
2  from waste_bins
3  where last_coll_date < current_date() - interval 7 day;
4
```

8.5.9 View Feedback from All Users Sorted by Satisfaction

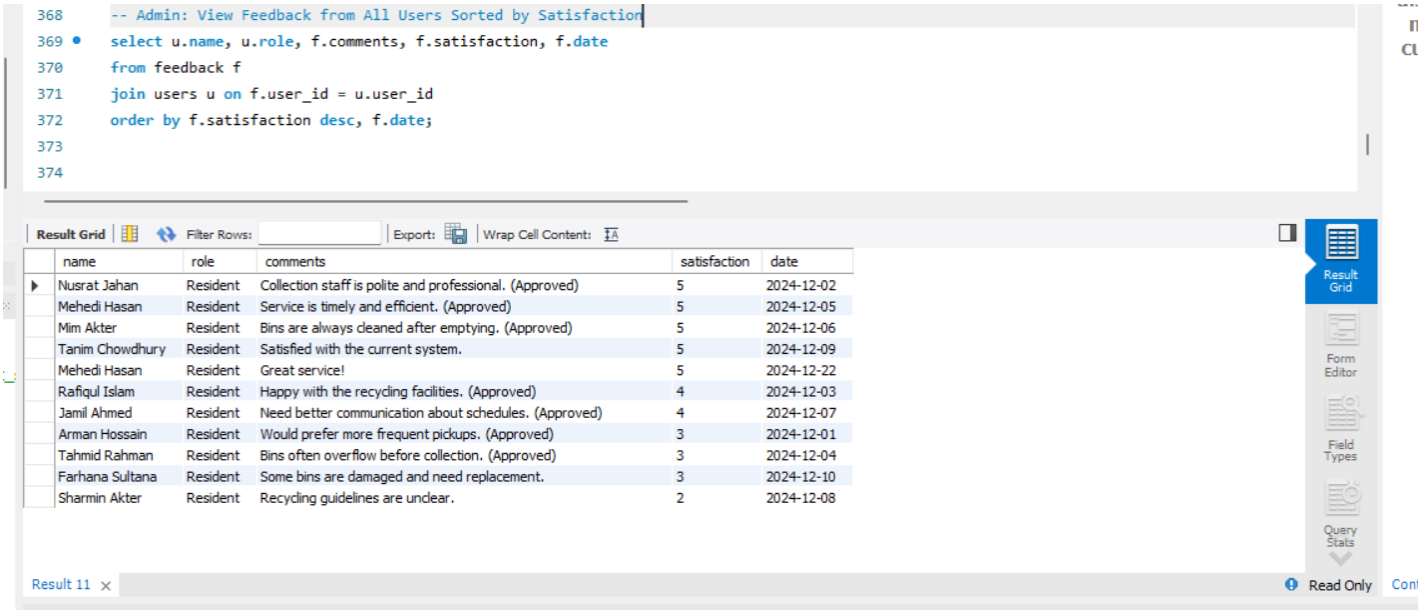


Figure 26: View Feedback from All Users Sorted by Satisfaction

```
    select u.name, u.role, f.comments, f.satisfaction, f.date
from feedback f
join users u on f.user_id = u.user_id
order by f.satisfaction desc, f.date;

```

9 Conclusions

The concept of **Smart Waste Management System** is arguably one of the innovative solutions to modern waste management problems. Using the technology and data mechanics, the system represents a safe and environmentally sustainable way of waste collection, sorting, and disposal. Its incorporation of functions like dynamic route optimization, waste classification, extensive and detailed residents' and administrative authorities' options guarantees efficient functioning, low environmental pressure, and engaged residents. This project is also focused not only on the optimization of work processes within the field of waste management but also on the promotion of environmental literacy among residents and increasing their awareness of the problem. By prioritizing sustainability, transparency, and operational excellence, the **Smart Waste Management System** sets a benchmark for modern urban waste management, paving the way for cleaner cities and a greener future.