Design rationale and justification

Our schema centers on Transactions as the canonical records extracted from MOMO SMS messages. The Messages owner gets all his messages organized into 4 entities(The Users, Transactions, Transaction_categories and System_Logs). Users are modelled in a single Users table to avoid duplication and here the owner gets to see all persons (considered as Users) whom he sent or received money from, also considering those organisation like banks or MTN he gets transactions from and as well as the messages that follow it. Transactions_categories separates each transaction in its own related category like Money transfer, Payments, Utilities, Deposit, and others. System_logs records ETL/parsing events and links to transactions for traceability and debugging.

I intentionally used DECIMAL (10,0) for Amount and NewBalance because Rwandan francs are whole units (no cents). Numeric integrity is enforced with CHECK constraints on non-negativity. CategoryType is an ENUM that provides a controlled vocabulary for common transaction types, allowing fast filtering and reducing inconsistent free-text values. Messages in categories preserves the original text used for parsing rules and enables re-parsing when formats change.

Foreign keys enforce referential integrity: transactions must reference an existing user and category, and system logs reference transactions. Indexing choices (primary keys and the implicit index on Foreign Keys) optimize joins typical in reporting and audits. This design favors auditability, analytical queries, and iterative refinement of parsing logic while staying normalized and performant for moderate message volumes.

Data dictionary (table-by-table; column / type / description)

Users

- **Id:** INT AUTO_INCREMENT — Primary key. Unique user identifier.
- **Fullnames:** VARCHAR(255) — Full name.
- **PhoneNumber:** VARCHAR(10) UNIQUE — Phone number, national format.

Transactions_categories

- **Id:** INT AUTO_INCREMENT — Primary key.
- **UserId:** INT — FK → Users(Id). Owner of category (who created or uses it).
- **CategoryName:** VARCHAR(255) UNIQUE — Name of category (unique).

- **Messages:** VARCHAR(255) — Representative message snippet from XML used to classify transactions.

Transactions

- **Id:** INT AUTO_INCREMENT — Primary key.
- **UserId:** INT — FK → Users(Id). Owner/actor of the transaction.
- **CategoryId:** INT — FK → Transactions_categories(Id).
- **Amount:** DECIMAL(10,0) CHECK (Amount >= 0) — Transaction amount (RWF whole units).
- **Date:** DATETIME — When transaction occurred.
- **Fee:** INT CHECK (Fee >= 0) — Fee amount (RWF).
- **NewBalance:** DECIMAL(10,0) CHECK (NewBalance >= 0) — Balance after transaction.
- **Currency:** VARCHAR(10) DEFAULT 'RWF' — Currency code.
- **CategoryType:** ENUM(...) — High-level transaction type.
- **ServiceCenter:** VARCHAR(255) — Optional vendor/service center.
- **Status:** INT — Optional status code.
- **Locked:** INT — Optional boolean flag (0/1).

System_logs

- **LogId:** INT AUTO_INCREMENT — Primary key.
- **TransactionId:** INT — FK → Transactions(Id).
- **LogMessage:** VARCHAR(255) — Short message / title.
- **Issue:** ENUM('ERROR', 'WARNING', 'INFO') — Severity.
- **Description:** TEXT — Full description.
- **CreatedAt:** TIMESTAMP DEFAULT CURRENT_TIMESTAMP — When entry created.

Demonstrating Database Functionality including the enhancement security and accuracy.

A. After table creation here shows the described created table

```
-- Selecting the MomoApp database
mysql> use momoapp;
Database changed

                -- Describing each tables to see if it matches the script from which it was created from.
mysql> describe users;  -- Table: Users
+-------------+--------------+------+-----+---------+----------------+
| Field       | Type         | Null | Key | Default | Extra          |
+-------------+--------------+------+-----+---------+----------------+
| Id          | int          | NO   | PRI | NULL    | auto_increment |
| Fullnames   | varchar(255) | NO   |     | NULL    |                |
| PhoneNumber | varchar(10)  | NO   | UNI | NULL    |                |
+-------------+--------------+------+-----+---------+----------------+
3 rows in set (0.00 sec)

mysql> describe transactions_categories;  -- Table: Transactions_categories
+--------------+--------------+------+-----+---------+----------------+
| Field        | Type         | Null | Key | Default | Extra          |
+--------------+--------------+------+-----+---------+----------------+
| Id           | int          | NO   | PRI | NULL    | auto_increment |
| UserId       | int          | NO   | MUL | NULL    |                |
| CategoryName | varchar(255) | NO   | UNI | NULL    |                |
| Messages     | text         | YES  |     | NULL    |                |
+--------------+--------------+------+-----+---------+----------------+
4 rows in set (0.00 sec)

mysql> describe transactions;         -- Table: Transactions
+---------------+-----------------------------------------------------------------------------------------------+------+-----+---------+----------------+
| Field         | Type                                                                                          | Null | Key | Default | Extra          |
+---------------+-----------------------------------------------------------------------------------------------+------+-----+---------+----------------+
| Id            | int
           | NO   | PRI | NULL    | auto_increment |
| UserId        | int
           | NO   | MUL | NULL    |                |
| CategoryId    | int
           | NO   | MUL | NULL    |                |
| Amount        | decimal(10,0)
           | NO   |     | NULL    |                |
| Date          | datetime
           | NO   |     | NULL    |                |
| Fee           | int
           | NO   |     | NULL    |                |
| NewBalance    | decimal(10,0)
           | NO   |     | NULL    |                |
| Currency      | varchar(10)
           | NO   |     | NULL    |                |
| CategoryType  | enum('Transfer','Payments','Received','Deposit','Withdraw','Services','MTN-Messages') | NO   |     | NULL    |                |
| ServiceCenter | varchar(255)
           | YES  |     | NULL    |                |
| Status        | int
           | YES  |     | NULL    |                |
| Locked        | int
           | YES  |     | NULL    |                |
+---------------+-----------------------------------------------------------------------------------------------+------+-----+---------+----------------+
12 rows in set (0.00 sec)

mysql> describe system_logs;     -- Table: System_Logs
+---------------+-------------------------------+------+-----+-------------------+-------------------+
| Field         | Type                          | Null | Key | Default           | Extra             |
+---------------+-------------------------------+------+-----+-------------------+-------------------+
| LogId         | int                           | NO   | PRI | NULL              | auto_increment    |
| TransactionId | int                           | NO   | MUL | NULL              |
          |
| LogMessage    | varchar(255)                  | NO   |     | NULL              |
          |
| Issue         | enum('ERROR','WARNING','INFO') | NO   |     | NULL              |
          |
| Description   | text                          | YES  |     | NULL              |
          |
| CreatedAt     | timestamp                     | NO   |     | CURRENT_TIMESTAMP | DEFAULT_GENERATED |
+---------------+-------------------------------+------+-----+-------------------+-------------------+
6 rows in set (0.00 sec)


                        -- Querying each table t
```

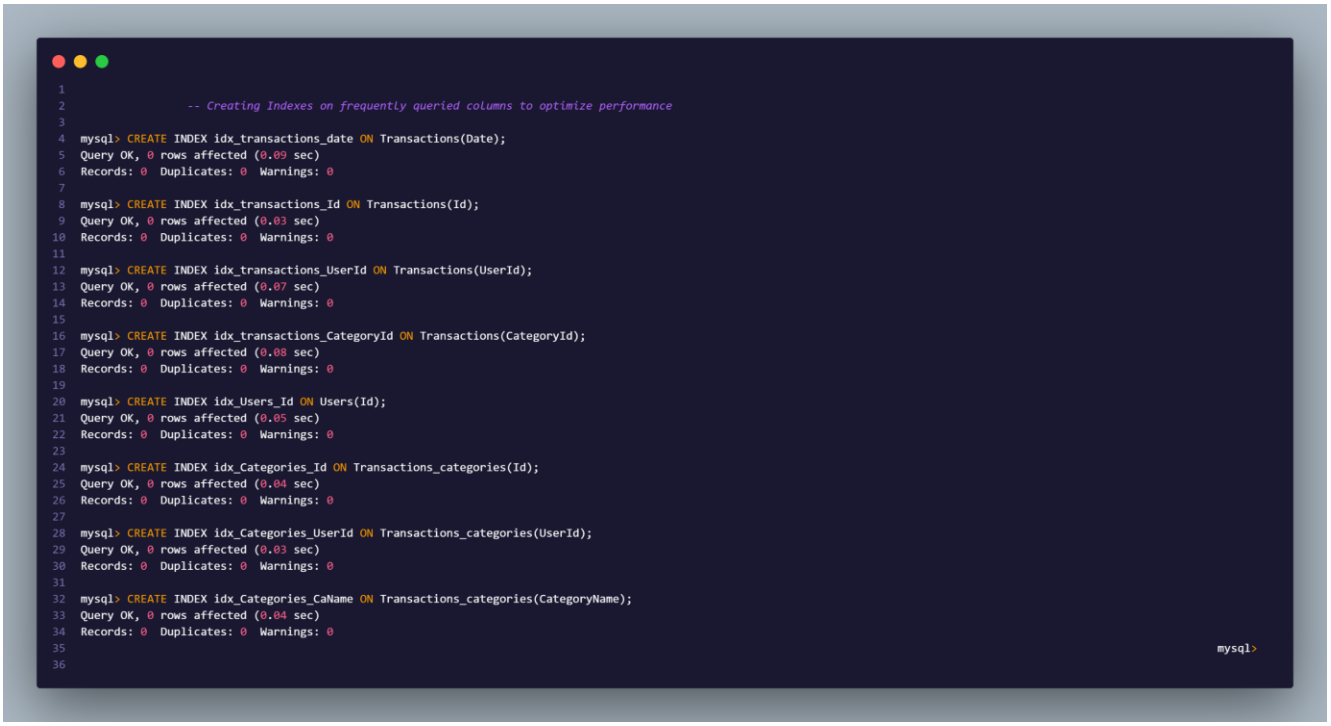
B. **Showing DML statement about inserting data into the created tables**

```sql
-- End of database_setup.sql
-- Selecting the database and describing each table to verify structure
USE MomoApp;

DESCRIBE Users;
DESCRIBE Transactions_categories;
DESCRIBE Transactions;
DESCRIBE System_logs;


-- Inserting records into every table for testing purposes

INSERT INTO Users (Fullnames, PhoneNumber) VALUES
('Samuel Carter', '95464'),
('Samuel Carter', '0790777777'),
('Bank of Kigali', '0795963036'),
('Jane Smith', '0782345683');

INSERT INTO Transactions_categories (UserId, CategoryName, Messages) VALUES
(13, 'Received', 'You have received 135983 RWF from Jane Smith (*********683) on your mobile money account at 2024-12-31 13:42:07. Message from sender: . Your new balance:164962 RWF. Financial Transaction Id: 42280278088.'),
(11, 'Transfer', '*165*S*21000 RWF transferred to Samuel Carter (250790777777) from 36521838 at 2025-01-01 13:38:05 . Fee was: 250 RWF. New balance: 45012 RWF. Kugura ama inite cg interineti kuri MoMo, Kanda *182*2*1# .*EN#'),
(12, 'Deposit', '*113*R*A bank deposit of 10000 RWF has been added to your mobile money account at 2025-01-02 23:14:15. Your NEW BALANCE :11922 RWF. Cash Deposit::CASH::::0::250795963036.Thank you for using MTN MobileMoney.*EN#'),
(10, 'Payments', 'TxId: 51732411227. Your payment of 600 RWF to Samuel Carter 95464 has been completed at 2024-05-10 21:32:32. Your new balance: 400 RWF. Fee was 0 RWF.Kanda*182*16# wiyandikishe muri poromosiyo ya BivaMoMotima, ugire amahirwe yo gutsindira ibihembo bishimishije.');

INSERT INTO Transactions (UserId, CategoryId, Amount, Date, Fee, NewBalance, Currency, CategoryType, ServiceCenter, Status, Locked) VALUES
(10, 8, 600, '2024-05-10 21:32:32', 0, 400, 'RWF', 'Payments', '+250788110383', -1, 0),
(11, 6, 21000, '2025-01-01 13:38:05', 250, 45012, 'RWF', 'Transfer', '+250788110383', -1, 0),
(12, 7, 10000, '2025-01-02 23:14:15', 0, 11922, 'RWF', 'Deposit', '+250788110383', -1, 0),
(13, 5, 135983, '2024-12-31 13:42:07', 0, 164962, 'RWF', 'Received', '+250788110383', -1, 0);

INSERT INTO System_logs (TransactionId, LogMessage, Issue, Description) VALUES
(1, 'Payment processed', 'INFO', 'The payment for the electricity bill was successfully processed.'),
(2, 'Low balance warning', 'WARNING', 'User balance is low after grocery purchase.'),
(3, 'Salary received', 'INFO', 'Monthly salary has been credited to the account.'),
(4, 'Money Transfer Failed', 'ERROR', 'The money transfer could not be processed due to insufficient funds on your account.');
```

C. **After this the querying process, showing all of the inserted data**

```
                 -- Querying each table to verify inserted records
mysql> select * from users;
+----+----------------+-------------+
| Id | Fullnames      | PhoneNumber |
+----+----------------+-------------+
| 10 | Samuel Carter  | 95464       |
| 11 | Samuel Carter  | 0790777777  |
| 12 | Bank of Kigali | 0795963036  |
| 13 | Jane Smith     | 0782345683  |
+----+----------------+-------------+
4 rows in set (0.00 sec)


mysql> select * from Transactions_categories;
+----+--------+--------------+--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------+
| Id | UserId | CategoryName | Messages                                                                                                                                                                                                                       |
+----+--------+--------------+--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------+
|  5 |     13 | Received     | You have received 135983 RWF from Jane Smith (*********683) on your mobile money account at 2024-12-31 13:42:07. Message from sender: . Your new balance:164962 RWF. Financial Transaction Id: 42280278088.                    |
|  6 |     11 | Transfer     | *165*S*21000 RWF transferred to Samuel Carter (250790777777) from 36521838 at 2025-01-01 13:38:05 . Fee was: 250 RWF. New balance: 45012 RWF. Kugura ama inite cg interineti kuri MoMo, Kanda *182*2*1# .*EN#                  |
|  7 |     12 | Deposit      | *113*R*A bank deposit of 10000 RWF has been added to your mobile money account at 2025-01-02 23:14:15. Your NEW BALANCE :11922 RWF. Cash Deposit::CASH::::0::250795963036.Thank you for using MTN MobileMoney.*EN#             |
|  8 |     10 | Payments     | TxId: 51732411227. Your payment of 600 RWF to Samuel Carter 95464 has been completed at 2024-05-10 21:32:32. Your new balance: 400 RWF. Fee was 0 RWF.Kanda*182*16# wiyandikishe muri poromosiyo ya BivaMoMotima, ugire amahirwe yo gutsindira ibihembo bishimishije. |
+----+--------+--------------+--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------+
4 rows in set (0.00 sec)


mysql> select * from Transactions;
+----+--------+------------+--------+---------------------+-----+------------+----------+--------------+---------------+--------+--------+
| Id | UserId | CategoryId | Amount | Date                | Fee | NewBalance | Currency | CategoryType | ServiceCenter | Status | Locked |
+----+--------+------------+--------+---------------------+-----+------------+----------+--------------+---------------+--------+--------+
|  1 |     10 |          8 |    600 | 2024-05-10 21:32:32 |   0 |        400 | RWF      | Payments     | +250788110383 |     -1 |      0 |
|  2 |     11 |          6 |  21000 | 2025-01-01 13:38:05 | 250 |      45012 | RWF      | Transfer     | +250788110383 |     -1 |      0 |
|  3 |     12 |          7 |  10000 | 2025-01-02 23:14:15 |   0 |      11922 | RWF      | Deposit      | +250788110383 |     -1 |      0 |
|  4 |     13 |          5 | 135983 | 2024-12-31 13:42:07 |   0 |     164962 | RWF      | Received     | +250788110383 |     -1 |      0 |
+----+--------+------------+--------+---------------------+-----+------------+----------+--------------+---------------+--------+--------+
4 rows in set (0.00 sec)


mysql> select * from system_logs;
+-------+---------------+-----------------------+---------+-------------------------------------------------------------------------------------+---------------------+
| LogId | TransactionId | LogMessage            | Issue   | Description                                                                         | CreatedAt           |
+-------+---------------+-----------------------+---------+-------------------------------------------------------------------------------------+---------------------+
|     1 |             1 | Payment processed     | INFO    | The payment for the electricity bill was successfully processed.                    | 2025-09-20 21:21:26 |
|     2 |             2 | Low balance warning   | WARNING | User balance is low after grocery purchase.                                         | 2025-09-20 21:21:26 |
|     3 |             3 | Salary received       | INFO    | Monthly salary has been credited to the account.                                    | 2025-09-20 21:21:26 |
|     4 |             4 | Money Transfer Failed | ERROR   | The money transfer could not be processed due to insufficient funds on your account. | 2025-09-20 21:21:26 |
+-------+---------------+-----------------------+---------+-------------------------------------------------------------------------------------+---------------------+
4 rows in set (0.00 sec)

mysql>
```

D. **This last part shows more about altering the entities to improve the tables accuracy and security**



```
-- Creating Indexes on frequently queried columns to optimize performance

mysql> CREATE INDEX idx_transactions_date ON Transactions(Date);
Query OK, 0 rows affected (0.09 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_transactions_Id ON Transactions(Id);
Query OK, 0 rows affected (0.03 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_transactions_UserId ON Transactions(UserId);
Query OK, 0 rows affected (0.07 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_transactions_CategoryId ON Transactions(CategoryId);
Query OK, 0 rows affected (0.08 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_Users_Id ON Users(Id);
Query OK, 0 rows affected (0.05 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_Categories_Id ON Transactions_categories(Id);
Query OK, 0 rows affected (0.04 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_Categories_UserId ON Transactions_categories(UserId);
Query OK, 0 rows affected (0.03 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> CREATE INDEX idx_Categories_CaName ON Transactions_categories(CategoryName);
Query OK, 0 rows affected (0.04 sec)
Records: 0  Duplicates: 0  Warnings: 0

                                                                                mysql>
```

On this Last picture, we used on delete and on update constraints especially cascade to permit the change of data when a record is changed or deleted.

```
-- Insuring security and data integrity by modifying foreign key constraints and also include cascading actions

mysql> alter table system_logs drop foreign key system_logs_ibfk_1, add constraint system_logs_TransactionId foreign key(TransactionId) references transactions(Id);
Query OK, 5 rows affected (0.08 sec)
Records: 5  Duplicates: 0  Warnings: 0

mysql> alter table transactions_categories drop foreign key transactions_categories_ibfk_1, add constraint transactions_categories_UId foreign key(UserId) references users
(Id) on delete cascade on update cascade;
Query OK, 5 rows affected (0.08 sec)
Records: 5  Duplicates: 0  Warnings: 0

mysql> alter table transactions drop foreign key transactions_ibfk_1, drop foreign key transactions_ibfk_2, add constraint transactions_UId foreign key(UserId) references users(Id) on delete cascade on update cascade, add constraint transactions_CId foreign key(CategoryId) references transactions_categories(Id) on delete cascade on update cascade;
Query OK, 5 rows affected (0.09 sec)
Records: 5  Duplicates: 0  Warnings: 0

mysql> alter table system_logs drop foreign key system_logs_TransactionId, add constraint system_logs_TransactionId foreign key(TransactionId) references transactions(Id) on delete set null on update set null;
Query OK, 4 rows affected (0.07 sec)
Records: 4  Duplicates: 0  Warnings: 0
```