ISTANBUL KÜLTÜR UNIVERSITY

Department of Computer Engineering

CSE5041 Database Design & Development
Project Report

CLIMATE TRACKER APP

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1 INTRODUCTION

1.1 PROJECT DESCRIPTION

The **Climate Tracker Application Database** stores information about locations, air quality, weather conditions, humidity, temperature, wind and changes made to the database. The following data have been identified in the requirements collection and analysis phase and are to be represented in the enterprise:

• The application tracks various locations. Each location has a unique LocationID, a city name, a country name, and geographic coordinates (latitude and longitude).

• A location records various weather data attributes. These include air quality measurements such as AQI (Air Quality Index), PM2.5, PM10, and Ozone levels, as well as weather conditions like rainfall, snowfall, temperature, humidity, and wind speed and direction. Each record is associated with a specific timestamp.

• The database stores a log of all changes made to critical tables, such as Locations, AirQuality, Precipitation, and Temperature. The log tracks the table name, operation type (INSERT, UPDATE, DELETE), the timestamp of the operation, and details about the change.

• For analysis purposes, the database supports aggregations and trends such as average air quality by city and precipitation trends for each location. These aggregations allow users to monitor and evaluate environmental conditions over time.

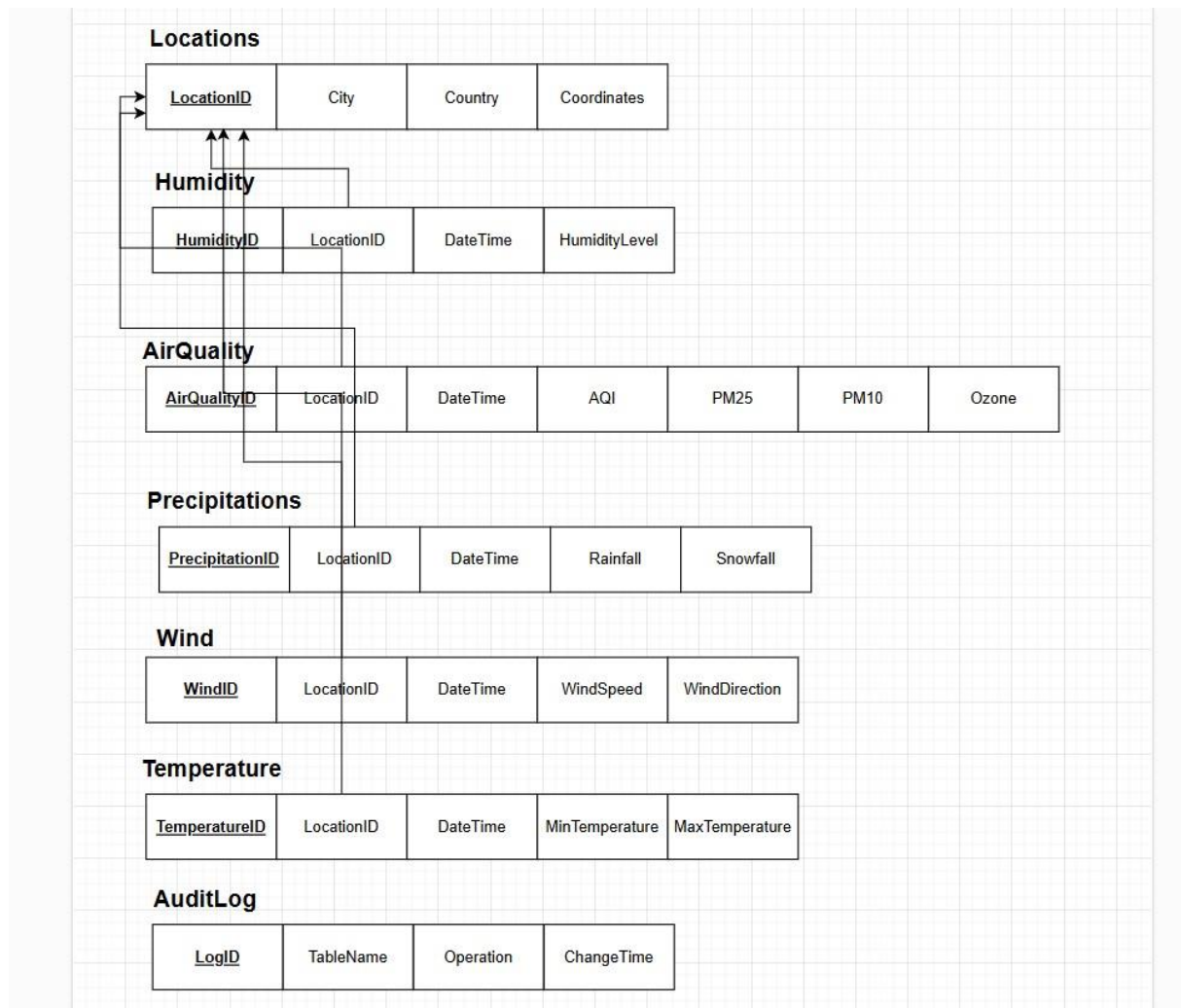# 2 ENTITY RELATIONAL MODEL

2.1 ENHANCED ER DIAGRAM
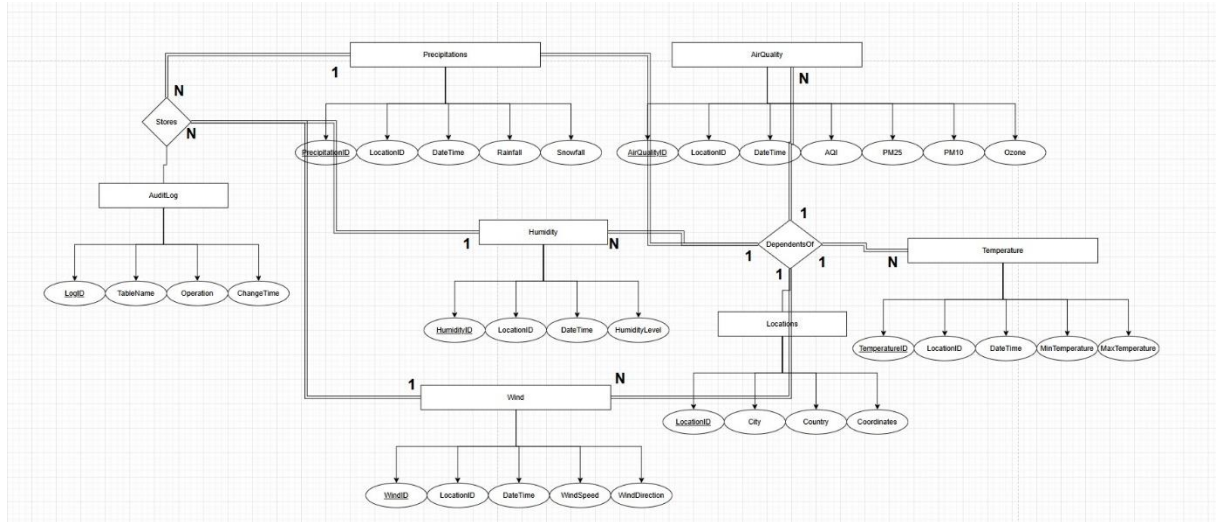
Figure 1: *EER diagram of the Climate Tracker App Database*
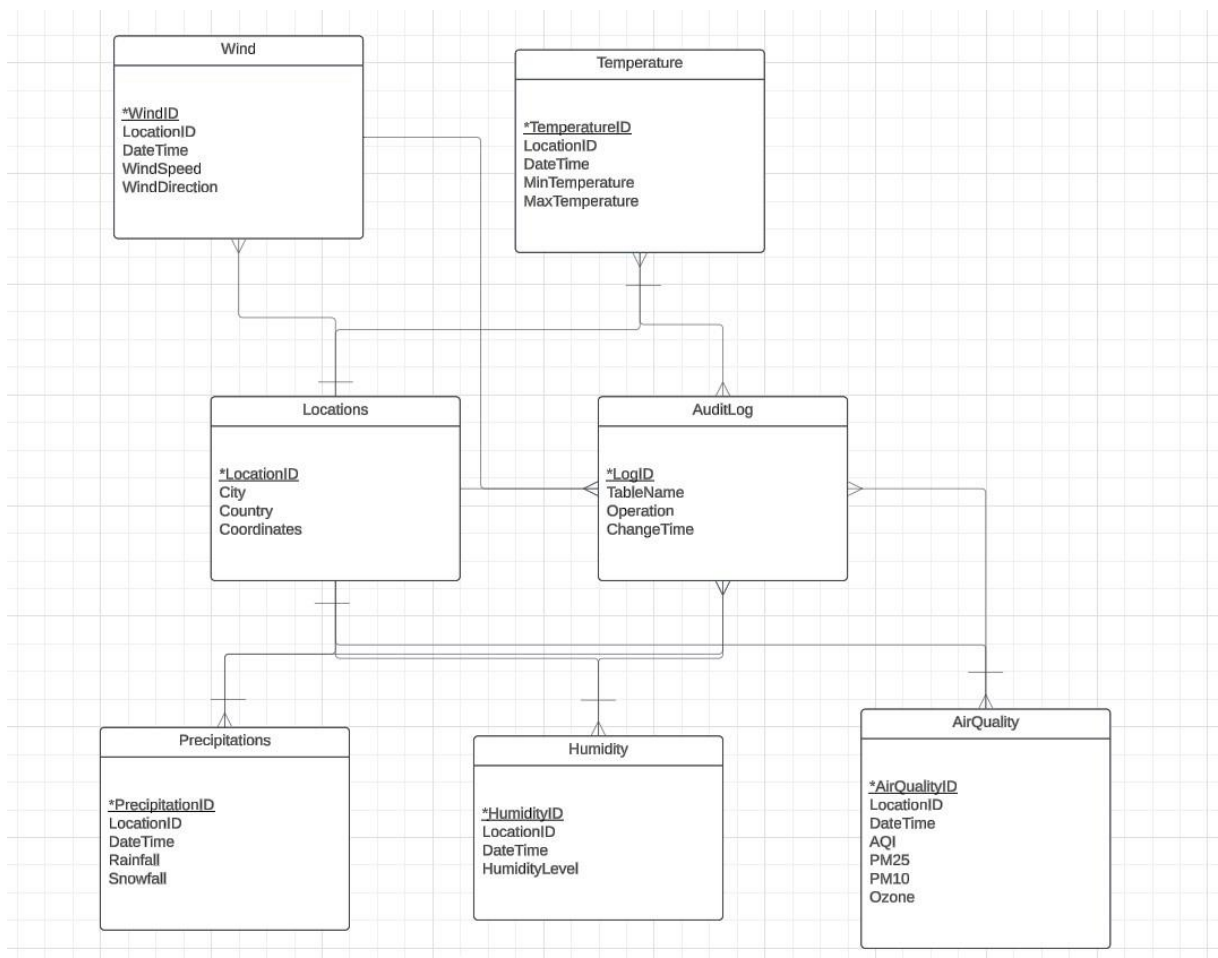
Figure 2: *Database diagram of the Climate Tracker App Database*

2.2 RELATIONAL SCHEMA & MAPPING

Figure 3: Relational schema of the Climate Tracker App Database with arrows indicating referential integrity

3 NORMALIZATION

3.1 FUNCTIONAL DEPENDENCIES

F = { FD1: LocationID → City, Country, Coordinates

FD2: AirQualityID → LocationID, DateTime, AQI, PM25, PM10, Ozone

FD3: PrecipitationID → LocationID, DateTime, Rainfall, Snowfall

FD4: TemperatureID → LocationID, DateTime, MinTemperature, MaxTemperature

FD5: HumidityID → LocationID, DateTime, HumidityLevel

FD6: WindID → LocationID, DateTime, WindSpeed, WindDirection

FD7: AuditLogID → TableName, Operation, ChangeTime

FD8: LocationID, DateTime → AirQualityID

FD9: LocationID, DateTime → PrecipitationID

FD10: LocationID, DateTime → TemperatureID

FD11: LocationID, DateTime → HumidityID

FD12: LocationID, DateTime → WindID

UNNORMALISED FORM

LocationID	City	Country	Coordinates	AQI	Rainfall
1	İstanbul	Turkey	41.0082,28.9784	120	10
1	İstanbul	Turkey	41.0082,28.9784	110	5
2	Ankara	Turkey	39.9208,32.8541	90	0

In the Unnormalised Form (UNF), all the data is stored in a single table without any normalization. It may contain repeating groups, redundant data, and inconsistent structure.

Repeated City, Country, and Coordinates for the same LocationID.

Repeating data for different measurements (AQI, Rainfall)

FIRST NORMAL FORM

We arranged all our tables according to first normal form. Here is an example:

AirQualityID	LocationID	DateTime	AQI	PM25	PM10	Ozone
1	1	2024-12-18 10:0...	65	12,5	25,4	0,03
2	2	2024-12-18 11:0...	40	8,1	15,2	0,02
3	3	2024-12-18 12:0...	90	20,3	45,1	0,05
4	4	2024-12-18 13:0...	55	10	18,5	0,02
5	5	2024-12-18 14:0...	70	15,2	28	0,04
6	6	2024-12-18 15:0...	35	5,7	12,8	0,01
7	7	2024-12-18 16:0...	85	19	40	0,04
8	8	2024-12-18 17:0...	75	14,5	30	0,03
9	9	2024-12-18 18:0...	50	9,5	20,5	0,02
10	10	2024-12-18 19:0...	80	17	38	0,05
NULL	NULL	NULL	NULL	NULL	NULL	NULL

SECOND NORMAL FORM

For each table, we have assigned only one primary key. Thus, all the attributes are dependent on just one key. All our tables are in the second normal form.

THIRD NORMAL FORM

For each table, we have assigned only one primary key, There are no transitive dependencies. All our tables are in the third normal form.