

INHA UNIVERSITY TASHKENT

Database Application and Design

SOC-3060 Spring 2021

Database for Samsung Health App

Team Name: **Health App**

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1. Introduction and scope

In this Database Application and Design course, we wanted to implement a database system for an application in the category of Sport and Training for this Term Project. We named this application as **Samsung Health App**.

Samsung Health App has various features to help users manage their health. It allows users to record data related to their health (weight, sleep, food), and their activities (running, walking). It also encourages users to stay fit by offering different global challenges, fitness programs, meditation tools. Having a connection with friends seeing their activity records to motivate themselves. Here is the list of all features of the database system that we implement:

- The scope of the application is global and not a platform dependant
- Allowing users to record different kinds of health-related data, like weight, sleep, food. Showing them in a user-friendly way, so that users can clearly see the changes over time. Possibly, giving recommendations according to records.
- Recording a variety of fitness activities, like running, cycling, walking with complete details, like duration, average/max speed, distance, workout calories, steps, average/max pace
- Storing user information alongside his/her achievements, scores, and level
- Having friends and storing the list of them. Showing the leaderboard between friends
- Offering various global challenges and allowing users to participate. Rewarding users according to their activity records (ex. running, walking) in the period of a challenge
- Recording fitness programs details and allowing a user to participate
- Offering meditation tools, like music, sleep stories, different sessions

Now, there are features that we put as a secondary objective and left them off for further enhancement of the Samsung Health App. This is the list of them:

- In the future, we want users can request a challenge both within their friendship and globally.
- Maintaining this kind of challenges
- We want to record as many activity types as possible (eg. swimming, hiking, different exercises)
- We want to implement to record other types of health data (eg. stress level, blood pressure, water)
- We want to have fitness programs with some content like video tutorials.
- Enhanced meditation tools
- Storing tons of user achievement data (except the basic one)

- Multi-language support

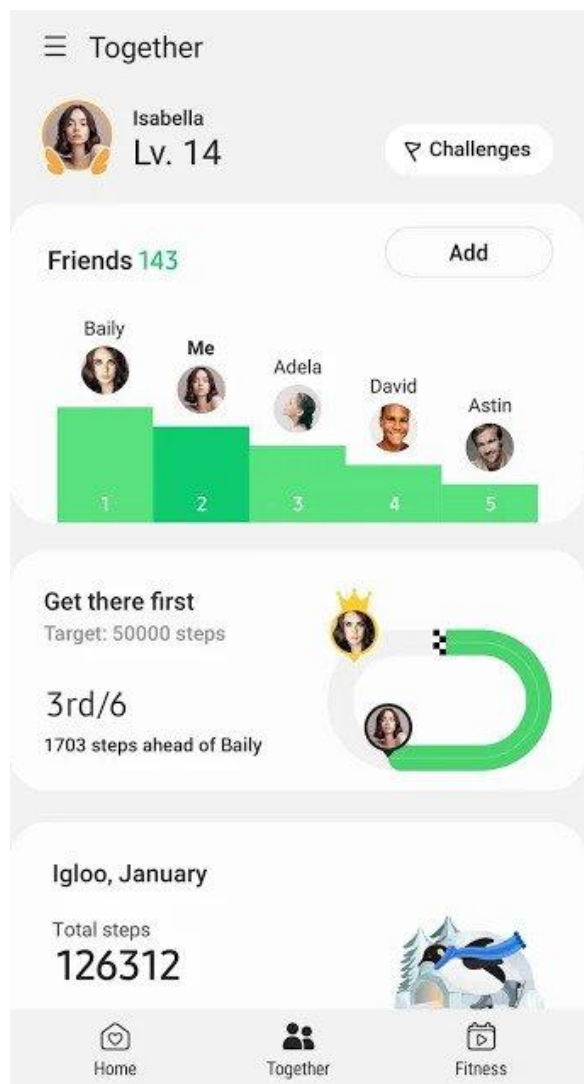
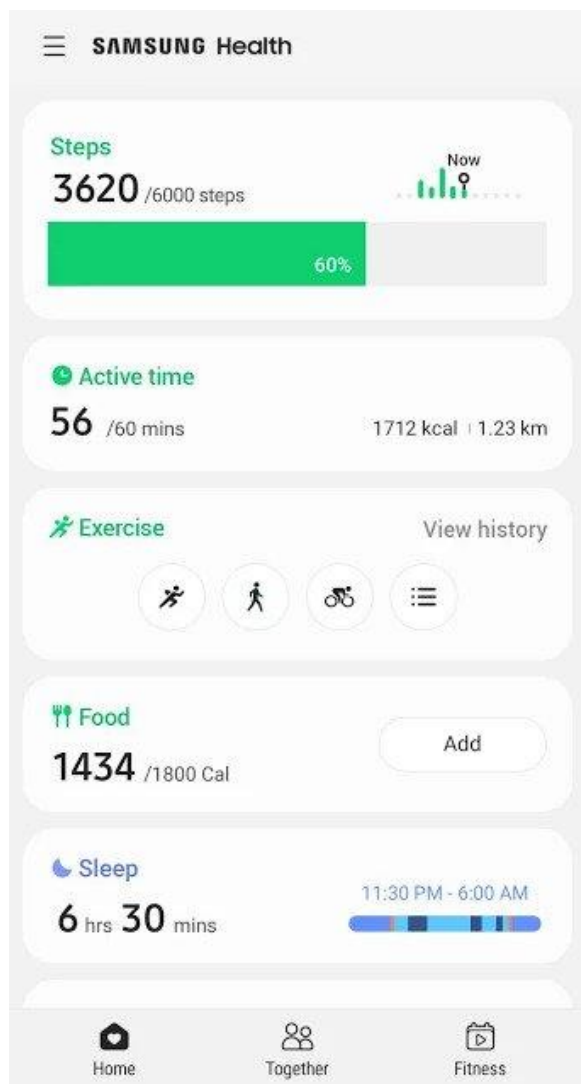
Our team is willing to help users to maintain, improve their health by every feature that is stated above. The application is global and not a platform dependant so that anyone in the world can benefit from it. Next, recording health-related data is crucial. Users may not realize a harmful change in themselves (for example, losing significant weight over a small period of time). However, with this application user data is stored and shown nicely even with the recommendations, which help them to maintain their health. The main feature of the application is recording the activities that the user had in full detail. This motivates a user to push limits on themselves by breaking their old records. Also, it offers various global challenges which anyone can compete with all over the world. In short, our team's goal is to help anyone to maintain and improve their health by recording and showing different data, motivating and encouraging users to stay fit by offering global challenges, fitness programs, meditation tools by our software system.

2. Product perspective

Our team decided not to build or imagine an application for this project. So, we choose an *existing application* - [Samsung Health](#)^[1] in order to implement a database system.

General information about the app ^[2]: Samsung Health has various features to help you manage your health. As the app allows you to automatically record many activities, creating a healthy lifestyle is easier and simpler than ever. Samsung Health helps you record and manage your fitness activities, such as running, cycling, swimming, etc. Also, Galaxy Watch wearables users can now exercise more effectively through Life Fitness, Technogym, and Core health. Check various health records on the Samsung Health home screen. Easily add and edit the items that you want to manage such as daily steps, activity time, and body weight, simply by long-pressing the screen.

Challenge yourself against your friends and family to become healthier in a more fun and interactive way with Samsung Health Together. Samsung Health has prepared videos of expert coaches who will teach you new fitness programs including stretching, weight loss, endurance training, and more. Discover powerful meditation tools on Mindfulness that will help you relieve stress throughout your day.



Fitness

Stronger, Fitter, Faster

Day 1. Ignite with Adrienne & Gede

Programs

6-Pack Toned Abs 1 week
At-Home Bootcamp 1 week
Baby steps to 10 weeks

Mindfulness

7 Days of Calm
Day 1 - Basics of Mindfulness
Daily Calm
Jul 21 - Volume

Meditate Sleep stories Music

All the above-listed features that we want to implement in our application are inspired by Samsung Health and these features are the core features of this existing application. On the other hand, there are features that existing Samsung Health offers however, we put these features as a secondary objective and left them off. So, this is the list of differences between existing and our application:

- Users can request a challenge both within their friendship and globally.
- Maintaining this kind of challenges
- Recording tons of activity types, not including what we offer (eg. swimming, hiking, different exercises)
- Recording tons of health data, not including what we offer (eg. stress level, blood pressure, water)
- Some fitness programs have content like video tutorials. We do not want to store them (except the basic data)
- Enhanced meditation tools (sorted by type, premium packages, and so on)
- Storing tons of user achievement data (except the basic one)

3. Specific requirements

3.1 Logical database requirements

Table for Entries

No	Entity	Explanation	Identity	Attributes	Note	Sample Values	Relationship with
1	User	An application records basic user details in this entity	Strong	ID	PK (incrementing integer)	31	Activity
				Email	Simple, string	mirodilkamilov1999@gmail.com	Record
				Password	Hashed	\$2y\$10\$B0YnWOd/O7ztFkkrhogl7Oq2BxRO623HphrzU9kg0fivG9DHpdxy	Challenge
				Name: Fname, Lname	Composite, string	Mirodil Kamilov	Achievement
				Sex	Enum type	Male Female (no other type)	Fitness_program
				Date_of_birth	Simple, Date (YYYY-MM-DD)	1999-11-03	
				Activity_level	Enum type, integer (it associates with descriptive text)	Sedentary Somewhat active Active Very active (no other type)	
				Score	Simple (changed depending on challenges and activities), integer value	90	
				Level()	Derived (input: score), integer value	5	
				Height()	Derived (input: Record entity), integer value	168	

				Weight()	Derived (input: Record entity), integer value	55	
				Age()	Derived (input: Date_of_birth), integer value	22	
2	Activity	All user activities are recorded (eg. running, walking)	Strong	ID	PK (incrementing integer)	31	1
				Start_date	Simple, Datetime (YYYY-MM-DD hh:mm:ss)	2021-04-30 17:00:21	
				End_date	Simple, Datetime (YYYY-MM-DD hh:mm:ss)	2021-04-30 17:21:21	
				Num_step	Simple, integer value	3000	
				Max_speed	Simple, double value (in km)	15.4	
				{Time_distance_checkpoint}	Multi-value, representing time, distance, steps over some user activity	{"time": 2021-04-30 17:00:21, "distance": 500, "steps": 550}, ...	
				Duration()	Derived (input: Time_distance_checkpoint), integer value (in seconds)	1260	
				Distance()	Derived (input: Time_distance_checkpoint), integer value (in m)	2700	
				Avg_speed()	Derived (input: Time_distance_checkpoint), double value (in km)	10	
				Calories()	Derived (input: Time_distance_checkpoint), integer value (in kcal)	123	

3	Activity_type	All activity types stored here	Strong	ID	PK (incrementing integer)	1	Activity
				Type	Simple, string	Running Walking Cycling	
4	Record	All user recorded health-related data stored here. (eg. weight, sleep, food)	Strong	ID	PK (incrementing integer)	1	1
				Value	Simple, double value	55.5	
				Date	Simple, Datetime (YYYY-MM-DD hh:mm:ss)	2021-04-30 17:21:21	
5	Record_type	The record has different types	Strong	ID	PK (incrementing integer)	1	Record
				Unit	Simple, string	kg hours kcal	
				Type	Simple, string	Weight Sleep Food	
6	Challenge	User can participate in challenges	Strong	ID	PK (incrementing integer)	1	1
				Title	Simple, string	Galaxy India Exploration	
				Description	Simple, string	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et.	
				Image	Simple, string (path of an image)	/assets/challenges/image.png	

				Start_date	Simple, Date (YYYY-MM-DD)	2021-05-03	
				End_date	Simple, Date (YYYY-MM-DD)	2021-06-03	
				{Checkpoints}	Multi-value, representing each checheckpoint with its deadline, associative score for that checkpoint	{"1": 20000, "deadline": 2021-05-10 17:21:21, "score": 50}, ...	
7	Achievement	Achievements (records) of the user is stored in this entity	Weak	Most_steps()	Derived, integer value	12200	1
				Longest_duration()	Derived, integer value (in seconds)	2160	
				Longest_distance()	Derived, integer value (in m)	5030	
				Most_calories()	Derived, integer value (in kcal)	437	
				Fastest_speed()	Derived, integer value (in km/h)	20	
				Challange_result()	Derived, string	Winner	

8	Fitness_program	User can participate in fitness program offered by application	Strong	ID	PK (incrementing integer)	12200	1
				Title	Simple, string	Weight loss	
				Description	Simple, string	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et.	
				Image	Simple, string (path of an image)	/assets/fitness-program/image.png	
				Duration	Simple, integer in weeks	1	
				Difficulty	Enum type	Low Medium High (no other type)	
				Total_workout	Simple, integer	17	
				Avg_workout_duration	Simple, integer in minutes	10	
				Schedule	Simple, string	everyday	
9	Fitness_program_type	The fitness program has its type	Strong	ID	PK (incrementing integer)	1	Fitness_program
				Type	Simple string	Build muscle	
10	Equipment	The fitness program may require many equipments	Strong	ID	PK (incrementing integer)	1	Fitness_program
				Equipment	Simple string	Exercise ball	

11	Mindfulness	User has access to mindfulness tools offered by application	Strong	ID	PK (incrementing integer)	1	
				Mind_title	Simple, string	Weight loss	
				Mind_description	Simple, string	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et.	
				Image	Simple, string (path of an image)	/assets/fitness-program/image.png	
12	Content	Mindfulness contains many contents	Strong	ID	PK (incrementing integer)	1	Mindfulness
				Author	Simple, string	Jon Doe	
				Title	Simple string	Whatever it takes	
				Path	Simple, string (path of the content)	/assets/content/content.mp3	

Table for Relationship

No	Relationship	Design Characteristics	Design Values	Note	Sample Values
1	Belong_to1	Meaning	An activity belongs to a user		
		Type	One to Many		
		Parent Entity Set and Participation	User (0, M)		
		Child Entity Set and Participation	Activity (1, 1)		
		Descriptive attributes	N/A	N/A	N/A
2	Be_in1	Meaning	An activity type can be in many activities		
		Type	One to Many		
		Parent Entity Set and Participation	Activity_type (0, M)		
		Child Entity Set and Participation	Activity (1, 1)		
		Descriptive attributes	N/A	N/A	N/A
3	Belong_to2	Meaning	A record belongs to a user		
		Type	One to Many		
		Parent Entity Set and Participation	User (0, M)		
		Child Entity Set and Participation	Record (1, 1)		
		Descriptive attributes	N/A	N/A	N/A

4	Be_in2	Meaning	A record_type can be in many records		
		Type	One to Many		
		Parent Entity Set and Participation	Record_type (0, M)		
		Child Entity Set and Participation	Record (1, 1)		
		Descriptive attributes	N/A	N/A	N/A
5	Is_participated_by	Meaning	A challenge is participate by many users		
		Type	Many to Many		
		Parent Entity Set and Participation	User (0, M)		
		Child Entity Set and Participation	Challenge (0, N)		
		Descriptive attributes	Current_steps(), Rank()	Both Current_steps and Rank are calculated with records in activity entity of particular user. Derived, integer	Current_steps: 3100 Rank: 36
6	Friendship	Meaning	User can request a friendship to many users		
		Type	Many to Many		
		Parent Entity Set and Participation	User (0, M)		
		Child Entity Set and Participation	User (0, N)		
		Descriptive attributes	Status, Created_at, Updated_at	Status: Enum type; Created_at and Updated_at is Datetime (YYYY-MM-DD hh-mm-ss)	Status: pending accepted rejected

7	Have1	Meaning	User have achievement		
		Type	One to One (Identifying)		
		Parent Entity Set and Participation	User (0, 1)		
		Child Entity Set and Participation	Achievement (1, 1)		
		Descriptive attributes	N/A	N/A	N/A
8	Participate	Meaning	User participate fitness program		
		Type	Many to Many		
		Parent Entity Set and Participation	User (0, M)		
		Child Entity Set and Participation	Fitness_program (0, N)		
		Descriptive attributes	N/A	N/A	N/A
9	Have2	Meaning	Fitness program has fitness program type		
		Type	Many to Many		
		Parent Entity Set and Participation	Fitness_program (0, M)		
		Child Entity Set and Participation	Fitness_program_type (0, N)		
		Descriptive attributes	N/A	N/A	N/A

10	Require	Meaning	Fitness program may require many Equipment		
		Type	Many to Many		
		Parent Entity Set and Participation	Fitness_program (0, M)		
		Child Entity Set and Participation	Equipment (0, N)		
		Descriptive attributes	N/A	N/A	N/A
11	Contain	Meaning	Mindfulness contains Content		
		Type	Many to Many		
		Parent Entity Set and Participation	Mindfulness (0, M)		
		Child Entity Set and Participation	Content (1, N)		
		Descriptive attributes	N/A	N/A	N/A

Table Legend:

{Some attribute} - represents multi-value attribute

Some attribute() - represents derived attribute

N/A - Not Applicable (no descriptive attributes)

Data entities and their relationships in form of English

- [Activity] must **belong to** only one [User]
 - [User] may **have** many [Activity]
- [Activity_type] can **be in** many [Activity]
 - [Activity] must **belong to** only one [Activity_type]
- [Record] must **belong to** only one [User]
 - [User] may **have** many [Record]
- [Record_type] can **be in** many [Record]
 - [Record] must **belong to** only one [Record_type]
- [Challenge] may **be participated** by many [User]
 - [User] may **participate** in many [Challenge]
- [User] can request **friendship** to many [User]
 - [User] may receive **friendship** from many [User]
- [User] may **have** [Achievement]
 - [Achievement] must **belong to** only one [User]
- [User] may **participate** in many [Fitness_program]
 - [Fitness_program] may **be participated** by many [User]
- [Fitness_program] may **have** many [Equipment]
 - [Equipment] can **be in** many [Fitness_program]
- [Fitness_program] must **have** at least one [Fitness_program_type]
 - [Fitness_program_type] can **be in** many [Fitness_program]
- [Mindfulness] may **contain** many [Content]
 - [Content] must **belong to** at least one [Mindfulness]

Legend:

- Left to right reading
- Right to left reading (opposite direction)

[Entity] - Between square brackets placed the name of Entity

Relationship - Relationship name

3.2 Functional requirements

Post procedures (after inserting data):

User entity

1. Age is calculated and stored depending on the value of Date_of_birth
2. Level is calculated and stored depending on the user Score
3. Weight is calculated and stored depending on the Records of the user have
4. Height is calculated and stored depending on the Records of the user have

Activity entity

1. Time_distance_checkpoint requires all multi-value data about the activity.
2. Duration, Distance, Avg_speed, Calories is calculated and stored depending on Time_distance_checkpoint

Achievement entity

1. Every time a new Activity is added, check if the user breaks his/her own record. If it breaks, update all corresponding attribute

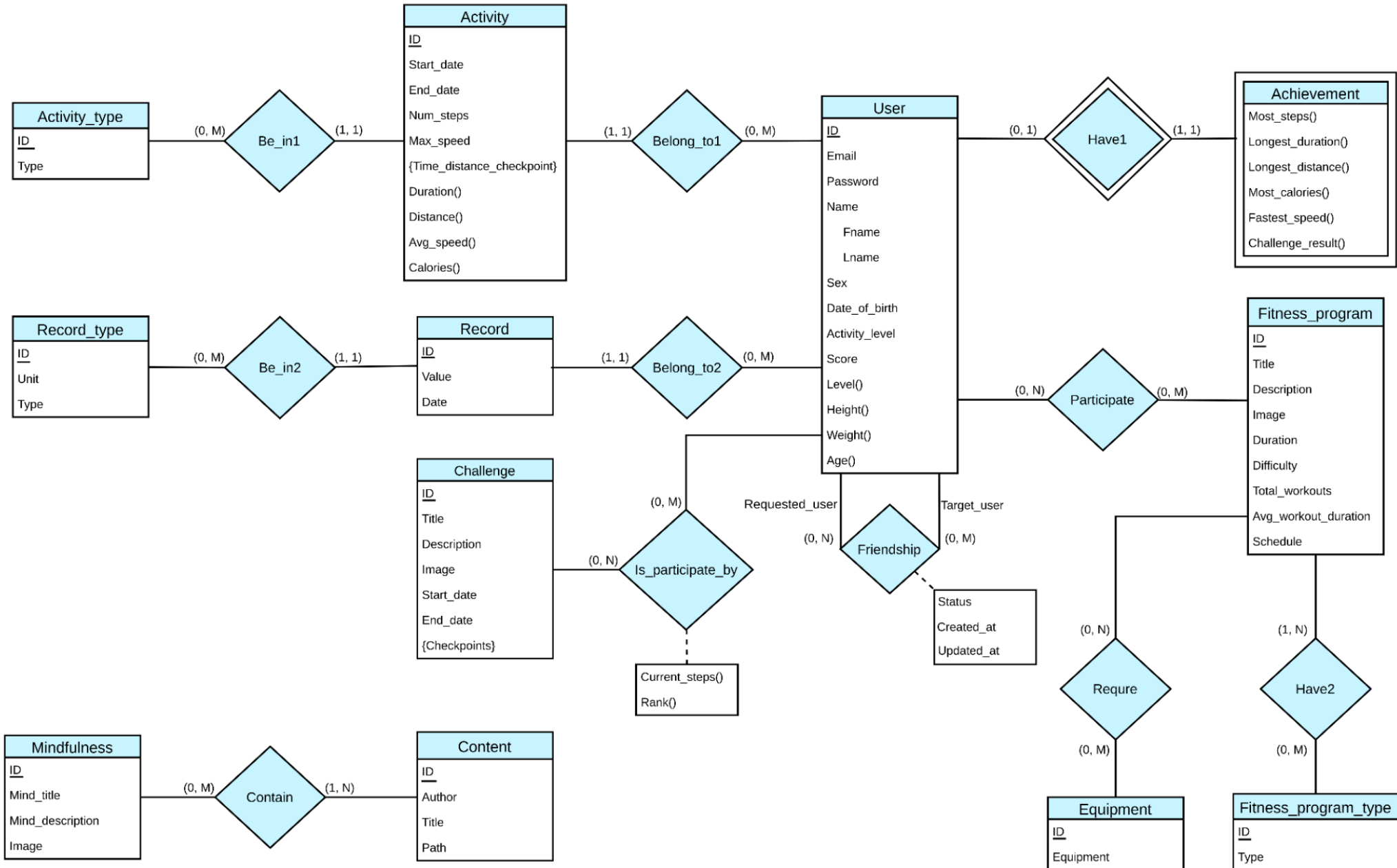
Is_participated_by relationship

1. Every time an activity is added Current_steps is calculated depending on activity
2. Every time Current_steps is changed Rank is calculated depending on it

4. Data design

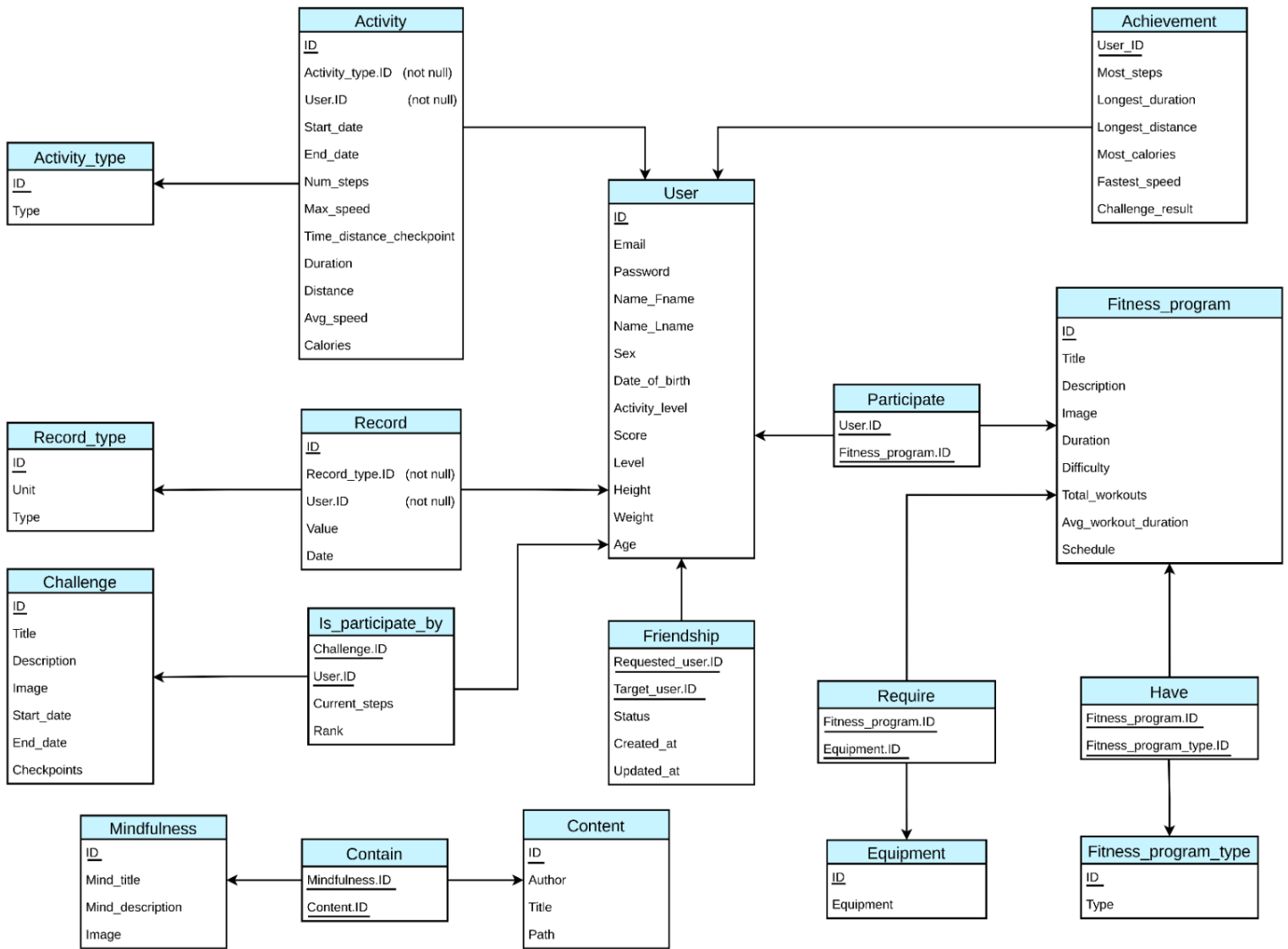
4.1 Conceptual database design

Samsung Health App: Conceptual Design



4.2 Logical database design

Samsung Health App: Logical Design



Note:

- Multi-valued attributes:

In **Activity** Entity - **Time_distance_checkpoint**. Decided to store it in the same entity and we want to store it as a JSON column like:

```
{
  {"time": "2021-04-25 22:37:33", "distance": 500, "steps": 550},
  {"time": "2021-04-25 22:40:33", "distance": 630, "steps": 700},
  ....
}
```

In **Challenge** Entity - **Checkpoints**. Decided to store it in the same entity and we want to store it as a JSON column like:

```
{
  {"1": 20000, "deadline": "2021-04-25 22:37:33", "score": 50},
  {"2": 35000, "deadline": "2021-04-31 22:40:33", "score": 80},
  ....
}
```

- Derived attributes:

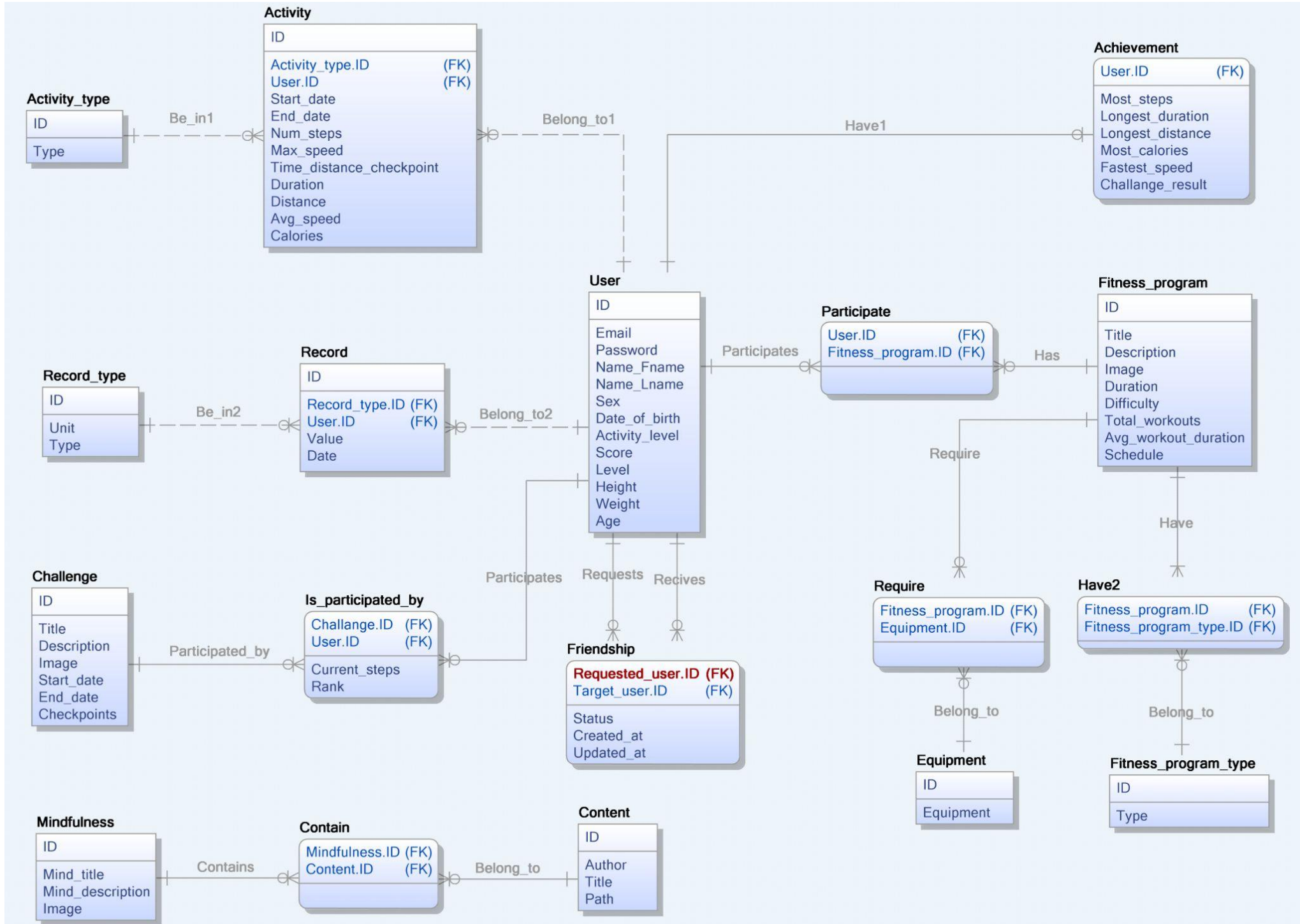
In **Activity** Entity - Duration, Distance, Avg_speed, Calories are calculated with input from Time_distance_checkpoint attribute

In **User** Entity - Height, Weight is calculated with input from Record Entity; Age is calculated with the Date_of_birth; Score is incremented depending on **Checkpoints** in Challenge Entity.

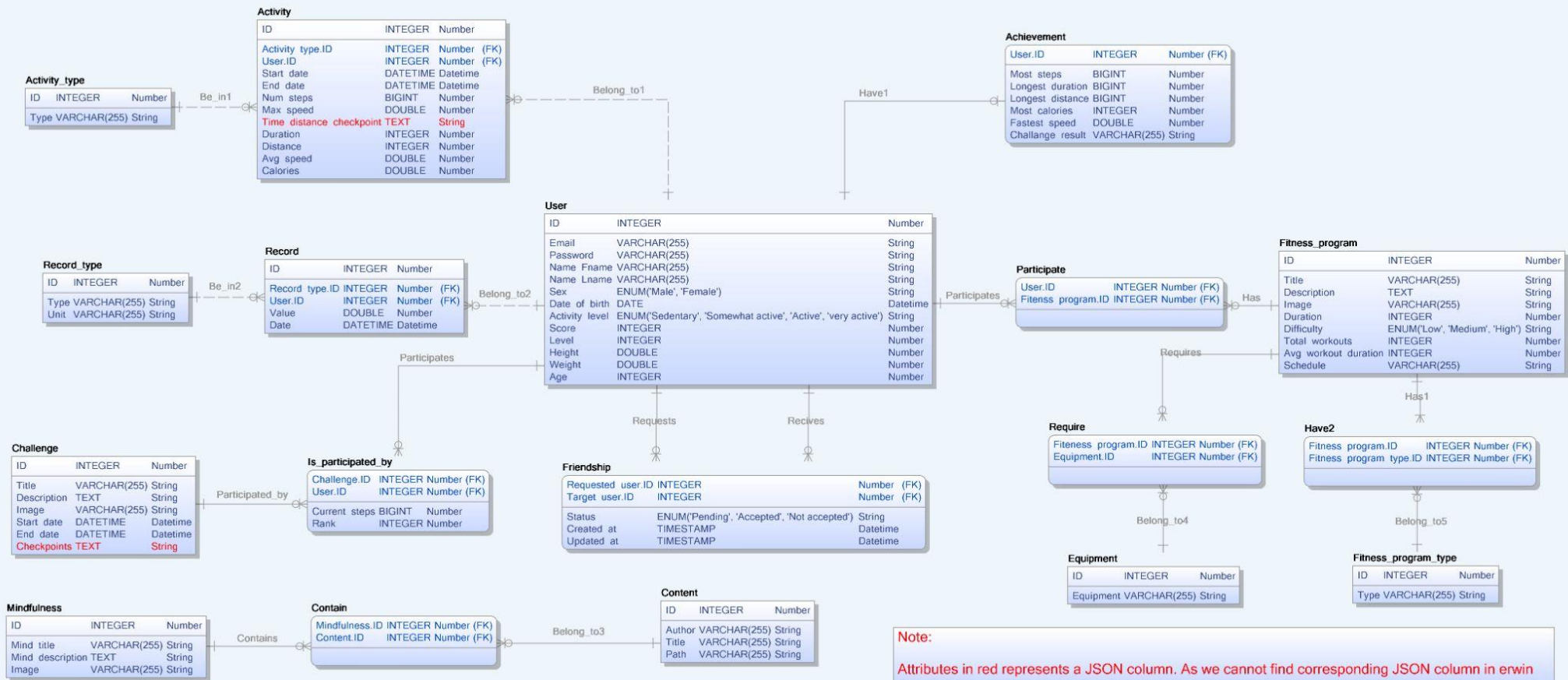
In **Achievement** Entity - All attributes are derived (except from PK) and all of them is depended on Activity entity

In **Is_participate_by** Relation - Current_steps is calculated depending on Activity Entity; Rank is calculated by Current_steps

4.3 Logical design by ERWin



4.4 Physical design by ERWin



5. Dependency design

USER

<u>ID</u>	Email	Password	Name_Fname	Name_Lname	Sex	Date_of_birth	Activity_level	Score	Level	Height	Weight	Age
	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

BCNF

ACTIVITY

<u>ID</u>	Activity_type.ID	User.ID	Start_date	End_date	Num_steps	Max_speed	Time_distance_checkpoint	Duration	Distance	Avg_speed	Calories
	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

BCNF

ACTIVITY_TYPE

<u>ID</u>	Type
	↑

BCNF

RECORD

<u>ID</u>	Record_type.ID	User.ID	Value	Date
	↑	↑	↑	↑

BCNF

RECORD_TYPE

<u>ID</u>	Type	Unit
	↑	↑

BCNF

CHALLENGE

BCNF

<u>ID</u>	Title	Description	Image	Start_date	End_date	Checkpoints
	↑	↑	↑	↑	↑	↑

IS_PARTICIPATED_BY

<u>Challenge.ID</u>	<u>User.ID</u>	Current_steps	Rank
		↑	↑

BCNF

MINDFULNESS

BCNF

<u>ID</u>	Mind_title	Mind_description	Image
	↑	↑	↑

CONTENT

BCNF

<u>ID</u>	Author	Title	Description	Path
	↑	↑	↑	↑

EQUIPMENT

<u>ID</u>	Equipment
	↑

BCNF

ACHIVEMENT

BCNF

<u>ID</u>	Most_steps	Longest_duration	Longest_distance	Most_calories	Fastest_speed
	↑	↑	↑	↑	↑

FITNESS_PROGRAM_TYPE

<u>ID</u>	Type
	↑

BCNF

FITNESS_PROGRAM

BCNF

<u>ID</u>	Title	Description	Image	Difficulty	Total_workouts	Avg_workout_duration	Schedule
	↑	↑	↑	↑	↑	↑	↑

6. Application/Interface

7. Testing (of database)

1. Show current user's achievements

```
SELECT a.Most_steps, Longest_duration, Longest_distance,  
Most_calories, Fastest_speed, Challenge_result FROM Achievement a  
WHERE `User.ID` = 2;
```

+ Options							
← T →							
		Most_steps	Longest_duration	Longest_distance	Most_calories	Fastest_speed	Challenge_result
<input type="checkbox"/>	Edit	Copy	Delete	14552	2955	9523	436 16840.815009325 NULL
↑							
<input type="checkbox"/> Check all		With selected: Edit Copy Delete Export					
Console							
Press Ctrl+Enter to execute query							
> SELECT a.Most_steps, Longest_duration, Longest_distance, Most_calories, Fastest_speed, Challenge_result FROM Achievement a WHERE `User.ID` = 2;							

2. Show current user's friends

```
SELECT u.Name_Fname, u.Name_Lname, u.Email, f.Status, f.Created_at  
FROM User u JOIN Friendship f ON f.`Target_user.ID` = u.ID WHERE  
f.`Requested_user.ID` = 2;
```

+ Options				
Name_Fname	Name_Lname	Email	Status	Created_at
Johnathan	Metz	sydnie.thompson@example.org	Pending	2021-05-01 16:14:30
Maxime	Zulauf	layla61@example.net	Accepted	2021-05-03 16:13:00
Console				
Press Ctrl+Enter to execute query				
> SELECT u.Name_Fname, u.Name_Lname, u.Email, f.Status, f.Created_at FROM User u JOIN Friendship f ON f.`Target_user.ID` = u.ID WHERE f.`Requested_user.ID` = 2				

3. Show current user's all activity details (including Activity type)

```
SELECT at.Type, a.Start_date, a.End_date, a.Num_steps, a.Max_speed,  
a.Duration, a.Distance, a.Avg_speed, a.Calories
```

```
FROM ((Activity a
```

```
JOIN User u ON u.ID = a.`User.ID`)
```

```
JOIN Activity_type at ON at.ID = a.ID) WHERE u.ID = 6;
```

+ Options								
Type	Start_date	End_date	Num_steps	Max_speed	Duration	Distance	Avg_speed	Calories
Walking	2021-06-05 12:00:00	2021-06-05 12:12:00	1704	7.86	720	1388	6.94	256
Running	2021-05-05 11:00:00	2021-05-05 11:12:00	2100	8.2	720	1943	9.715	300
Cycling	2021-05-06 11:00:00	2021-05-06 11:13:00	2190	8.4	780	2000	10	310
Console								
Press Ctrl+Enter to execute query								
> SELECT at.Type, a.Start_date, a.End_date, a.Num_steps, a.Max_speed, a.Duration, a.Distance, a.Avg_speed, a.Calories FROM ((Activity a JOIN User u ON u.ID = a.`User.ID`) JOIN Activity_type at ON at.ID = a.ID) WHERE u.ID = 6;								

4. Show current user's all record details (including Record type and unit)

```
SELECT rt.Type, r.Value, rt.Unit, r.Date
FROM ((Record r
JOIN User u ON u.ID = r.`User.ID`)
JOIN Record_type rt ON rt.ID = r.ID) WHERE u.ID = 6;
```

+ Options

Type	Value	Unit	Date
Weight	55	kg	2021-05-05 16:31:22
Sleep	59	hours	2021-04-05 16:31:22
Food	7	kcal	2021-05-05 16:32:15

☐ Show all | Number of rows: 05 | Filter rows | Search this table

☒ Console

Press Ctrl+Enter to execute query

```
> SELECT rt.Type, r.Value, rt.Unit, r.Date
FROM ((Record r
JOIN User u ON u.ID = r.`User.ID`)
JOIN Record_type rt ON rt.ID = r.ID) WHERE u.ID = 6;
```

5. Show current user's all challenge details (including user's current steps and rank)

```
SELECT Title, Description, Image, Start_date, End_date, Checkpoints,
p.Current_steps, p.`Rank`
FROM ((Challenge ch
JOIN `Is_participated_by` p ON ch.ID = p.`Challenge.ID`)
JOIN `User` u ON p.`User.ID` = u.ID) WHERE u.ID = 6;
```

+ Options

Title	Description	Image	Start_date	End_date	Checkpoints	Current_steps	Rank
Galaxy India Exploration	The Galaxy India Explorathon is set to kick off on...	/assets/challenge/image1.jpg	2021-05-05 00:00:00	2021-06-05 00:00:00	[{"1": "20000", "score": 50, "deadline": "2021-05-...	8004	1

☒ Console

Bookmarks Op

Press Ctrl+Enter to execute query

```
> SELECT Title, Description, Image, Start_date, End_date, Checkpoints, p.Current_steps, p.`Rank`
FROM ((Challenge ch
JOIN `Is_participated_by` p ON ch.ID = p.`Challenge.ID`)
JOIN `User` u ON p.`User.ID` = u.ID) WHERE u.ID = 6;
```

8. References

1. Official Samsung Health App [website](#)
2. [Google Play page](#) of the Samsung Health App