Ontology Development for User Data and Motivation Goal-Setting in Running Apps

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In the domain of mobile health technologies, running applications are widely used to promote physical activity and support goals in different ways. However, applications differ in their data representation and use of motivational strategies to support goal achievement. This paper presents an ontology that formally represents key concepts such as user, goals, session, and feedback within running tracking applications. The ontology is based on an analysis of 10 popular Android running applications and is designed to address gaps in how applications use personalization and motivation to support user engagement. A literature review revealed that no existing ontologies specifically target running applications, leaving a gap in formally capturing concepts related to them. To address this gap, the developed ontology offers a structured and extensible model that supports the representation of user behaviour and goal setting. It analyses how running applications implement goal-setting strategies and different personalization techniques to support user engagement and behavioural change.

Additional Key Words and Phrases: Ontology, Running Applications, Goal-Setting Theory, Self-Determination Theory, Fitness Tracking, Motivation

1 INTRODUCTION

In recent years, mobile health applications is one of the fastest growing categories among mobile applications and the digital health domain, with more than half of all people using mobile phones having an app for health on their phones [1]. The increasing demand for this kind of application has led major sport brands, such as Adidas or Nike, to build their own applications tailored to consumer needs [1]. These applications provide users with real-time feedback on training sessions, including GPS route, distance, duration, average speed, pace, and calories burned. When combined with personalized goal setting and motivational strategies, these features have been shown to increase user engagement and support a better physical activity over time [2, 3].

Past research has explored how motivational and behavioural theories, such as Goal-Setting Theory(GST) and Self-Determination Theory(SDT), contribute to the design of fitness applications and their goal setting techniques [1, 4]. While these theories help explain user interaction with the applications, the conceptual principle of these theories is not reflected in the structure of the application's features. This highlights the need for a more standardized and reusable way to represent user goals and motivational strategies.

Interoperability is important in the domain of running tracking apps because often users use different fitness applications and devices to track their fitness activity. Without a shared structure for how goals are represented, it becomes difficult for these systems to work together and provide relevant feedback to the user. An ontology can help by creating a common way to describe user data and goals across platforms.

While fitness applications increasingly incorporate motivational strategies, systematic research that formally models these elements within a reusable structure remains limited. Specifically, the conceptual links between user profiles, session data, Goal-Setting Theory (GST), motivational feedback, and their ontological representation, require further attention. Developing such an ontology would facilitate improved fitness application design, interoperability across platforms, and enhanced personalized recommendations based on user behaviour and preferences.

This paper presents an ontology[5], a conceptual model to represent user and session data in running applications, focusing on their representation in relation to fitness goal setting and motivational feedback. Specifically, it investigates the types of data collected by popular fitness apps, how these data are structured and interpreted in existing apps, and how it can be formally represented to support personalization, interoperability, and behaviour change for users.

The ontology was developed through a qualitative analysis of selected running application and a synthesis of relevant literature on goal-setting strategies and user motivation. The project's scope is limited to Android-based running applications that include goal-setting features, and focuses on modelling user data, activity data, and how motivating feedback works in the health domain.

2 PROBLEM STATEMENT

While fitness applications use goal-setting and motivational techniques to encourage healthier habits, a standardized framework for representing the interplay between these elements, user data, and app features is currently absent. Existing research predominantly focuses on behavioural aspects, lacking a conceptual model to ensure consistent app design and data interoperability.

This research addresses this gap by developing an ontology that models user profiles, fitness goals from session data, and motivational feedback within the context of running applications. The study combines application analysis with the theoretical foundation from the two theories, Goal-Setting Theory(GST) and Self-Determination Theory(SDT), to explore how running applications collect and utilize this data for personalized motivation for the users. To guide this research, the following questions were investigated:

- **RQ1**: What types of user and session data are collected by running apps and how are these data conceptualized in the existing literature and app designs to support fitness goal setting and personalized motivation strategies?
- **RQ2**: How are user attributes, session data, fitness goals, and motivational feedback related in the context of running apps?
- **RQ3**: How can an ontology be designed to formally represent user profiles, running sessions, and fitness goal setting in running apps?

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3 RELATED WORK

Extensive research has been conducted on goal setting in fitness apps. Baretta et al.[6] performed a content analysis of popular physical activity apps and found that while goal setting theory is commonly implemented, its alignment with established behavioural theories is often inconsistent. Furthermore, the integration of GST and gamification techniques in mobile fitness apps has been shown to enhance user engagement, especially when goals are well defined and structured. Self-Determination Theory(SDT) also plays a role in understanding how fitness apps can influence behaviour change. In the paper [4], it was found that the features that promote autonomy and competence led to more sustained physical activity.

At the data level, in the paper [2] a survey was conducted on mobile apps used in sports to identify the types of data collected, such as GPS, steps, heart rate, and workout session. While prior work like that of [7] and [3] focuses on how motivational interviewing and app features influence user behaviour, there is limited research of modelling these components into an ontology.

Several studies have applied the principles of Goal-Setting Theory(GST) and Self-Determination Theory(SDT) to enhance user engagement in fitness applications. GST states that clearly defined goals increase user motivation and performance. All running applications integrate GST principles through features such as daily step goals, daily training time targets, progress badges, or weekly running challenges [1]. On the other hand SDT, which provides a deeper understanding of how motivational design can satisfy psychological needs such as autonomy or competences [4, 8]. These theories highlight the importance of how apps structure and present goals for feedback, making them crucial for user retention. These theories suggest that simply showing numbers, such as step counts, calories burned, or measured distance, is not enough to keep some users engaged. Instead, effective apps use interactive elements, personalized motivational reminders combined with rewards, and real-time progress tracking and adjustment that help users visualize and enjoy their progress[9, 10].

While the use of ontologies in modelling physical activity is still limited, Kim et al.[11] developed a Physical Activity Ontology(PACO) to support interoperability between different activities from questionnaires and clinical data sources. This ontology captures essential elements such as activity type, intensity, frequency, and contextual factors, allowing OWL-based reasoning to assess the adequacy of physical activity. However, this document does not address mobile fitness applications and does not incorporate features central to user engagement such as goal-setting mechanisms, personalized feedback, or session-specific metrics. This paper builds on the foundations idea of formalizing physical activity concepts, extending it into the domain of running applications.

4 METHODOLOGY

This analysis focuses on ten widely used Android running applications: Adidas Running: Run Tracker[12], Fitbit[13], Google Fit: Fitness Tracker[14], MapMyRun GPS Running Tracker [15], Nike Run Club - Running Coach[16], Pacer Pedometer & Step Counter[17], ASICS Runkeeper - Run Tracker[18], Running App - GPS Run Tracker[19], Samsung Health[20] and Running & Jogging, Run tracker[21]. These applications were chosen based on the following criteria: their popularity, as indicated by having over 5 million downloads in the Google Play Store at the time this research was conducted; positive user ratings (applications needed to have a score above 4.0 stars to be eligible), as displayed in Google Play Store with the region set to Romania; their support and present of goal setting and tracking, which all match the Goal-Setting Theory [1]; their availability on Android devices, specifically through the Google Play Store; the ability to function independently on a phone, without requiring integration with fitness bands or smartwatches; and the application must be free to use, with goal setting features accessible in the free version, without requiring a paid subscription. These criteria were selected to capture representative, widely used running applications that have a goal setting mechanism and support user motivation.

While many more applications could meet these criteria, a subset of ten was selected to allow better data management and to support a detailed analysis. Although the application were not chosen systematically to cover all platforms, they still reflect a wide range of commonly used running applications that active support user motivation through structure goal-setting mechanisms.

App Name	Downloads	Rating
Adidas Running: Run Tracker	50 mil. +	4.8
ASICS Runkeeper - Run Tracker	10 mil. +	4.8
Fitbit	100 mil. +	4.3
Google Fit: Fitness Tracker	100 mil. +	4.2
MapMyRun GPS Running Tracker	10 mil. +	4.8
Nike Running - Running Coach	50 mil. +	4.3
Pacer Pedometer & Step Counter	10 mil. +	4.9
Running & Jogging, Run tracker	5 mil. +	4.8
Running App - GPS Run Tracker	10 mil. +	5.0
Samsung Health	1 billion +	4.0

Table 1. Downloads and Ratings of Selected Running and Fitness Apps (May 2025)

The applications listed in Table 1 represent a balanced selection of highly rated Android apps that were tested in May 2025. These applications were chosen to reflect a range of design choices related to first-time use by users and goal-setting mechanisms. One application that was completely different from the other when defining the goal of the session was Samsung Health. It is the only application which lets the user define a specific goal before the start of each running session, in addition to the standard daily targets, giving full flexibility for the goal setting. Adidas Running stood out as the only application that asked the user to set a fitness during the initial setup process, whereas the other application allowed goal selection only after the setup was complete. On the other hand, Running App - GPS Run Tracker was the only application in the selection that generated personalized goals based on a survey asking about user's correct activity level and fitness habits. Although apps like Adidas Running and Runkeeper also included a survey in their setup, these were used primarily for user profiling, to recommend training plans, and not to generate goals. Furthermore, Running & Jogging, Run

Tracker distinguished itself by being the only application that gave the opportunity to report how the session went, allowing them to manually input contextual data on the weather condition and an estimated heart rate. The additional feedback allowed the user to get a deeper understanding of their data, to identify patterns, and see when and on what weather conditions they perform better. These distinctions illustrate the variety of personalization and post-session engagement embedded in the user experience, which are crucial for shaping motivation and application usage.

4.1 Review of Personalization and Motivational Design in Running Applications(Answering RQ1)

To investigate how personalization and motivation strategies are embedded in running applications, a literature analysis was performed. The primary goal for it was to map the conceptual techniques used for motivation(e.g. self-monitoring, GST, SDT, feedback, rewards, gamification, etc.) as described in the papers selected. The searches were conducted on Google Scholar and Scopus using queries such as ("fitness app" OR "nutrition app") AND ("personalization" OR "user modelling") AND "user motivation". The inclusion criteria for these articles were to be published after 2010, to provide details on personalization mechanisms, or to describe motivation elements grounded in behavioural theories.

A synthesis tables was created to extract relevant ideas from the studies. Each column represented a study, and rows represented personalization input types, supported behaviours, types of feedback, and whether motivational designs was linked to the two theories, Goal-Setting Theory(GST) and Self-Determination Theory(SDT). This structured analysis helped identify common personalization and motivation strategies present in the literature, which were later used to guide the development of the ontology.

4.2 Comparative Functional Analysis of Fitness Apps(Answering RQ2)

To answer the second research questions, the applications were tested and examined how they integrate user and session data, goal setting, and motivational feedback. The goal was not to identify what features each application has, but to understand how these elements were connected within each application. The 10 applications were each manually tested by simulating an account setup, setting goals, and recording running sessions. Specific attention was given to: when and how user attributes are being recorded(most of them asked for them while setting up the application), how these attributes influence the suggestion for the fitness goals, how session data are used to evaluate the performance, and how feedback is triggered based on the data recorded during each session. To systematically capture the data, a comparison table was created. Each row represented an individual application, while columns documented the presence of key feature and the data collected: data types, supported goal features, and types of motivational feedback. The structure of this table enables an efficient cross-app comparison and helped to identify whether personalization strategies were embedded in the applications.

4.3 Ontology Development and Analysis(Answering RQ3)

The development of the ontology was guided by the paper of Noy and McGuiness [22] that consists of a step-by-step tutorial on how to create your first ontology. To construct and manage the ontology, the Protégé ontology editor was used. Protégé is a widely used open source platform developed by Stanford University that supports the creations and the visualization of ontologies in OWL(Web Ontology Language). Moreover, the tool's reasoning capabilities allowed for validation of class consistency and detection of logical conflicts with the help of the reasoner integrated in the tool. For visualization, two plug-ins available within Protégé were used, mainly OWLViz and OntoGraf. Both plug-ins facilitated the graphical exploration of class relationships and property hierarchies.

4.3.1 Defining the Domain and Scope. The domain of the ontology was defined as the ecosystem of running tracking applications, with a focus on user profiles, running session data, and have a goal-setting mechanism integrated in them. The scope was set to answer the research question, which aims to understand how user and session data are structured to support running goal setting and personalized motivation.

4.3.2 Consider Reuse of an Existing Ontology. At the time when this paper was published, there were no existing ontologies in the domains of running tracking application. Therefore, a new ontology, made specifically for this domain, was developed from scratch to capture the necessary theoretical structure, while being inspired by the design principles and concepts introduced in the PACO ontology [11].

5 RESULTS

5.1 RQ1

5.1.1 User Data. The analysis of user data(Table 6) shows that most of the applications studied collect a basic set of profile information, including name, email, gender, and age. These data are typically used for user account creation and basic personalization of the users. In addition, more than two thirds of the applications collect the weight and height of the users, which are essential for estimating calories during a running session, while they are also a key factor in tracking fitness progress. However, Running & Jogging, Run tracker and ASICS Runkeeper - Run Tracker do not require these physiological inputs or provide them as optional fields for the user. This variability suggests differences in the level of personalization and physiological modelling between applications. According to the literature on personalization in health apps [9], collecting user-specific physiological attributes is important to tailor goal difficulty and feedback methods(e.g. predefining certain goals, such as calories burnt, distance goals, etc.), which aligns with the Goal-Setting Theory[1]. The absence of these data in certain applications may play a key factor in their usage and therefore limiting their capacity to deliver fully personalized and motivating user experience.

5.1.2 Session Data. The analysis of user data (Table 7) shows that all applications track the total distance and workout time, which are the heart of any running session. Most applications also calculate the average pace, calories burned, elevation and the split of each km of the running session, supporting detailed post-session feedback and performance feedback for each of the sessions individually. However, more advanced metrics such as cadence and average speed are available only in some apps: Pacer Pedometer & Step Counter, ASICS Runkeeper - Run Tracker, and Samsung Health. These metrics provide better insight of the session and are usually used in professional training. From a conceptual perspective, session data serves as a quantitative feedback loop to support goal evaluation and self-monitoring, allowing users to see the progress in achieving their goals. These forms of feedback improve users' sense of competence by allowing them to visualize improvements of their workout sessions. Furthermore, by enabling users to recognize patterns and see their progress through session trends(distance progression, pace improvement, workout frequency, etc.), session data motivate users to stay aligned with their personal goals.

While most of the applications collect similar types of session data, the way these data is used for goal setting and motivational feedback is quite different. For instance, Fitbit and Samsung Health integrate session data into broader habit-forming systems such as daily targets or health goals, whereas others like Google Fit present the data in a minimal and a less personalized format. Despite collecting rich user data, few apps seem to use it for adaptive goal adjustment based on user characteristics, which is a missed opportunity identified in the literature about the Self-Determination Theory [4, 8]. This theory highlights the importance of addressing users' needs for autonomy and competence which can be supported when data is not only collected but dynamically used to tailor the user experience.

5.2 RQ2

5.2.1 Concepts. The running applications personalize user experiences in different ways, integrating user attributes, session data, fitness goals, and motivational feedback. These four elements work together to shape how the user interacts with the application in such a way that the user will use the application regularly. User attributes refer to static personal information such as age, gender, weight, and height. Session data is represented by real-time inputs such as running distance, pace, duration, calories burned, average pace, average speed, or even a more detailed graph representing the split by km of each run so that the user can see its pace by km. Fitness goals can be categorized into two types, short-term goals, which are defined by the user at the beginning of each session, such as: completing a run in a week, or improving pace by a small margin. Long-term goals, on the other hand, are broader; these might include training for a marathon or reaching a larger distance over a longer period of time.

5.2.2 User Attributes and Goal Personalization. The user attributes serve as the core for personalized goal recommendations. During setup, most applications ask for key information such as age, weight, height, and gender in order to calibrate performance expectations and recommend goals. Applications that include a fitness quiz usually offer more personalized plans compared to those that rely only on the input of the user. This type of personalization plays a crucial role in promoting user motivation. According to Self-Determination Theory(SDT)[4], one of the key aspects is the need for competences. By setting initial targets that align with the user's physical condition and experience level, the application helps the user to feel more capable of achieving certain goals while also supporting early engagement and long-term usage of the applications.

5.2.3 Session Data and Goal Monitoring. Once a fitness goal is established, the application uses session data to track the user's progress. Session data, which consists of duration, distance, average speed, average pace, cadence, calories burned, and elevation gain is recorded during every running session. For example, Nike Run Club keeps track of the total distance the user ran during its training sessions, while Google Fit and Samsung Health focus more on the cumulative distance or the total number of sessions recorded each week. These differences reflect how applications interpret session data to provide feedback, update streaks, or unlock certain achievements so that the user is rewarded regularly.

5.2.4 Feedback as Motivational Mechanism. Motivational feedback is a critical outcome of the analysis session data. Most applications use real-time and post-session feedback to keep users engaged at all times. Audio encouragement during workouts, virtual badges, and a community leader board were among the most common forms of feedback in the applications. These interactions reflect the feedback loop present in the Goal-Setting Theory; performance is measured, feedback is delivered, and future behaviour is influenced. To wrap up, applications vary in delivering feedback, some are offering celebratory messages instantly, after the session was ended, and, others are using progressive charts to show the overall progress. This type of feedback supports autonomy and gives the user the feeling that they are in control of their training journey.

In summary, running applications create a feedback personalization loop by dynamically linking static data, such as user attributes, to evolving data, such as session data, fitness goals, or motivation feedback. These mechanisms reflect theoretical models like Goal-Setting Theory(GST), which promotes feedback and progress monitoring, and Self-Determination Theory(SDT), which highlight how users remain motivated when they feel they can meet certain goals and they are autonomous. By analysing multiple applications, the core structure remains consistent across platforms: user inputs defines starting points, activity data drives evaluation, and motivational responses help sustain behavioural change.

5.3 RQ3

The developed ontology provides a conceptual model for structuring the relationships between users, running sessions, goals, applications, and session metrics within running mobile applications. It supports reasoning about session tracking and goal achievement across different applications.

5.3.1 Representation of User Profile. The central User class models the individual who uses the running application. It includes data properties(e.g., 'hasAge','hasGender','hasHeight', etc.) and object properties linking the user to a session, goals, and the application. The user class is semantically connected to:

- **Session**: through the property 'doneBy', which indicates that the session was performed by a particular user.

- **Goal**: through the property 'goalRelated', representing which goal the user is following or is associated with at a given time.
- **Applications**: through the property 'usedBy', which indicates which app the user has interactions with.

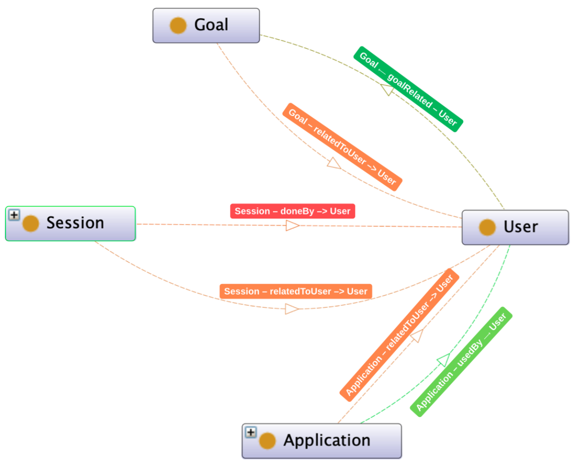

Fig. 1. User Representation

This formal design supports reasoning such as retrieving all sessions performed by a user, identifying which applications support specific user goals, or determining whether multiple users share the same application or goal structure.

5.3.2 Representation of Goal-Setting Logic. The goal setting logic is supported through several object properties that represent the dynamic relationship between the components, feedback, and user engagement to achieve a certain goal. The goal class is connected to:

- **Distance Goal, Custom Goal, Duration Goal,and Step Goal**: which are subclasses of the class Goal and represent the different types of goal available in the applications.
- **Application**: through the property 'hasGoal' and represents the relationship of the application having a goal.
- **Feedback**: through the property 'supportGoal' which states that a goal is reinforced by feedback.
- **User**: through the property 'isDefined', since a goal is defined by a user.

5.3.3 Representation of Applications. The class Application represents the central entity of the ontology, linking user interactions, feedback generation, manages goals, records sessions, and uses different motivation strategies. The application has a relationship with the following classes:

- **User**: through the property 'usedBy' and 'motivates' indicating that one application has a user and the application is motivating the user achieve their goals.
- **Goal**: through the property 'hasGoal', supporting a particular goal, which objective is being tracked or promoted.

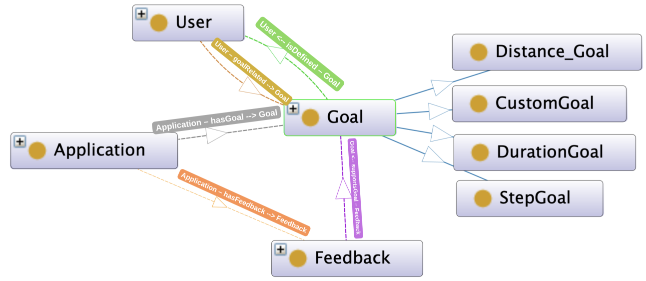

Fig. 2. Goal Representation

- **Session**: through the property 'trackSession', associating the application with the measurements being tracked during a session, allowing the data to be further analyzed.
- **MotivationStrategy**: through the property 'usesStrategy', which is implemented to support user engagement. In addition, a certain type of motivation strategy is being used in the application.
- **Feedback**: through the property 'hasFeedback', enabling insights that support goal achievement. The application is also the creator of the feedback which is based on the data available in it.

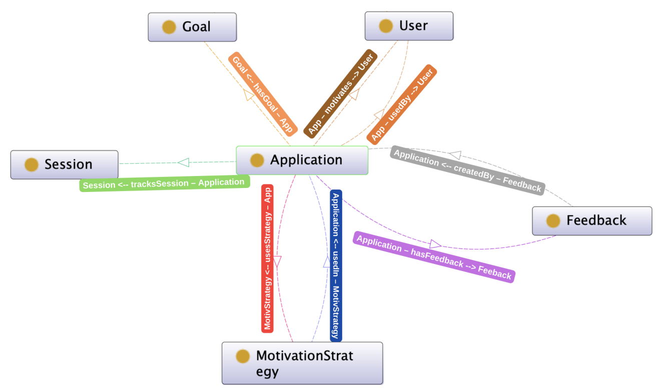

Fig. 3. Application

5.3.4 Final Remarks. The developed ontology represents a structured way in representing user profiles, running sessions, goal setting mechanisms, motivational feedback. Furthermore, it offers a reusable conceptual structure that future applications or studies can make use of and improve the consistency and transparency of goal setting and motivation strategies in running applications.

6 ONTOLOGY EVALUATION

To test the quality of the ontology, a dual approach was carried out. Firstly, a functional approach was conducted to check if the ontology satisfies the technical requirements. Secondly, a semiotic approach was employed, as described in [23] to test the practical and communicative quality of the ontology. The syntactic and logical correctness were verified using Protégé's reasoner, Hermit version 1.4.3.456. This confirmed that all classes, object properties, and data properties were properly defined, having the right domain ranges with no logical inconsistencies. This guarantees the **syntactic quality** of the ontology. The next step was to populate the ontology with data collected from applications such as Nike Run Club, Asics, Samsung Health, and Fitbit. Individuals were created representing user profiles, sessions, goals, metrics, types of motivational strategies, and different feedback types. These individuals were linked through object properties(e.g., 'doneBy', hasGoal', 'hasMetric', etc.) while also defining the data properties such as('hasAge', 'hasName', etc.). The resulting design, highlights a strong **semantic quality** through clear and meaningful relationships. To test the **pragmatic quality**, a set of competency questions was formulated and answered with the help of SPARQL Queries[24]:

6.0.1 *What user data is recorded for a specific user?*

```
SELECT ?user ?age ?gender ?height ?weight ?email ?name WHERE {
  ?user rdf:type :User .
  OPTIONAL { ?user :hasAge ?age . }
  OPTIONAL { ?user :hasGender ?gender . }
  OPTIONAL { ?user :hasHeight ?height . }
  OPTIONAL { ?user :hasWeight ?weight . }
  OPTIONAL { ?user :hasEmail ?email . }
  OPTIONAL { ?user :hasName ?name . }
}
```

User	Age (years)	Gender	Height (m)	Weight (kg)	Name
User01	22	male	1.78	72.0	Michael
User02	22	female	1.64	54.2	Maria

Table 2. Personal attributes of User01 and User02 retrieved from the ontology

6.0.2 *What session data is recorded during one session for each apps?*

```
SELECT ?app ?session ?metric ?value ?unit WHERE {
  ?session :usedInApp ?app .
  ?session :hasMetric ?metric .
  ?metric :hasValue ?value .
  ?metric :hasUnit ?unit .
}
```

Nr	App	AvgPace	Cad	Calories	Distance	Duration	ElevGain	Split
1	Nike	3.30	132	654	5.0	30	9	6
2	ASICS	4.00	126	500	5.2	32	4	5
3	Samsung_H	–	132	654	–	–	9	–
4	Fitbit	–	–	123	5.4	23	8	5

Table 3. Extracted metrics for each session, including application and key performance indicators

6.0.3 *Which sessions has a specific user completed?*

```
SELECT ?user ?session ?date WHERE {
  ?session :doneBy ?user .
  ?user rdf:type :User .
  OPTIONAL { ?session :hasDate ?date . }
}
```

User	Session	Date
User01	Session01	2025-05-18
User01	Session02	2025-06-14
User02	Session03	2025-06-12
User02	Session04	2025-06-12
User01	Session05	2025-06-04

Table 4. The sessions recorded by each user

6.0.4 *Which motivational strategies are implemented in each application?*

```
SELECT ?app ?strategy ?strategyType WHERE {
  ?app :usesStrategy ?strategy .
  ?strategy :hasStrategyType ?strategyType .
}
```

App	Strategy Instance	Strategy Type
ASICS	Motivation_badges	Badges
ASICS	Motivation_Community	Community Leaderboards
Nike	Motivation_badges	Badges
Nike	Motivation_Streaks	Run Streaks
Nike	Motivation_Community	Community Leaderboards
Samsung	Motivation_Streaks	Run Streaks
Samsunng	Motivation_Community	Community Leaderboards
Fitbit	Motivation_Community	Community Leaderboards

Table 5. Motivational strategies implemented in each application

6.0.5 *What type of personalized goals does each application support?*

```
SELECT ?app ?goal WHERE {
  ?app :hasGoal ?goal .
}
```

App	Supported Goal Type
Nike_Run_Club	DurationGoal
Nike_Run_Club	RunningGoal
ASICS_Runkeeper	DurationGoal
ASICS_Runkeeper	StreakGoal
ASICS_Runkeeper	RunningGoal
Samsung_Health	DurationGoal
Samsung_Health	RunningGoal
Fitbit	RunningGoal
Fitbit	CaloriesGoal

Table 6. Types of personalized goals supported by each application

The result of these queries demonstrated that the ontology support practical use cases relevant to user behaviour, personalized feedback, and application specific feature.

Finally, to support **social quality**, the ontology is available on GitHub[1], enabling reuse and extension for future development.

[1]https://github.com/alex19689/Ontology-Development-for-User-Data-and-Motivation-Goal-Setting-in-Running-Application.git

7 DISCUSSION

This research has several limitations that should be acknowledged. First, the scope of the selection of applications was limited to only ten, which may not fully represent the diversity of goal setting and motivation strategies present in other applications. Additionally, the analysis focused on free-to-use applications available in the Google Play Store, which had the region set to Romania. This could have excluded other apps used in other parts of the world or being available only on other platforms(e.g. App Store). Furthermore, all selected applications are required to function independently on smartphones without the integration of smartwatches, health bands, fitness rings, etc. This limited the analysis of more advanced features, such as heart rate feedback, oxygen saturation, better motion sensors, or other wearable specific features. Another key limitation is the short duration of the study. Conducted over a 11 week period, the research was not able to asses whether the goal-setting features available in these applications actually allowed to increase user's motivation or better engagement over time. A study conducted over several months or a year could provide better insight into how users respond to different motivational strategies. Beyond these limitations, this research may benefit several audiences. First, researchers can build on the current version of the ontology and the methodology used to investigate the representation of user data in running applications. Secondly, individuals studying Health Informatics, or HCI(Human-Computer Interaction), can use this project as a foundation case study to understand the intersection of user modelling and health technologies. Lastly, app developers can use this research and information on goal setting features to enhance user experience, develop other motivation strategies, and use different personalization techniques.

Future work could include using the paid or the premium version of the applications, which supports a richer feedback system because of the additional data collected, available for the user to interpret. Additionally, integrating multi-platform support(e.g., IOS and Android), or evaluation apps with wearable devices to explore richer data streams.

8 CONCLUSION

This research explored how running applications assemble and structure user and session data to encourage effective goal setting by implementing various motivational approaches. One of the core objectives of this paper was to identify the types of data gathered by running applications and to construct an ontology that systematically represents these elements to promote user engagement and influence behaviour change.

Through the analysis of the ten previously mentioned Android running applications, different types of patterns were identified in the implementation of motivational features, including goal tracking, constant feedback, and the use of a reward system to support both goal achievement and long-term user commitment.

To address this, an ontology was developed by formalizing key connections between elements like: the user profile, running session, goals, feedback, and motivational strategies. The conceptual model illustrates how these concepts are linked and how they support user interaction and shifts in behavioural patterns. The ontology provides a reusable representation of goal-related personalization in the running domain, laying a foundation for future development and research.

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REFERENCES

[1] P. M. A. Pg Arshad, R. Baharun, and N. Zaidin, "Goal-setting theory (gst) and gamification relationship in increasing mobile fitness apps engagement: A conceptual discussion," *Journal of Business and Social Review in Emerging Economies*, vol. 5, no. 1, pp. 155–164, 2019. [Online]. Available: https://doi.org/10.26710/jbsee.v5i1.548

[2] M. P. Shaw, L. P. Satchell, S. Thompson, E. T. Harper, C. Balsalobre-Fernández, and D. J. Peart, "Smartphone and tablet software apps to collect data in sport and exercise settings: Cross-sectional international survey," *JMIR mHealth and uHealth*, vol. 9, no. 5, p. e21763, May 2021.

[3] Y. Yang and J. Koenigstorfer, "Determinants of fitness app usage and moderating impacts of education-, motivation-, and gamification-related app features on physical activity intentions: Cross-sectional survey study," *Journal of Medical Internet Research*, vol. 23, no. 7, p. e26063, Jul. 2021.

[4] T. Zeng, J. Y. Ng, D. R. Lubans, C. Lonsdale, F. F. Ng, and A. S. Ha, "A family-based physical activity intervention guided by self-determination theory: Facilitators' and participants' perceptions," *International Journal of Educational Research*, vol. 127, p. 102385, 2024.

[5] T. R. Gruber, "A translation approach to portable ontologies," *Knowledge Acquisition*, vol. 5, no. 2, pp. 199–220, 1993. [Online]. Available: http://tomgruber.org/writing/ontolingua-kaj-1993.htm

[6] D. Baretta, P. Bondaronek, A. Direito, and P. Steca, "Implementation of the goal-setting components in popular physical activity apps: Review and content analysis," *DIGITAL HEALTH*, vol. 5, p. 2055207619862706, Jan. 2019.

[7] Y. M. Cheong, Y.-L. Theng *et al.*, "Effects of motivational interviewing and wearable fitness trackers on motivation and physical activity: A systematic review," *American Journal of Health Promotion*, vol. 35, no. 3, pp. 432–445, 2021. [Online]. Available: https://journals.sagepub.com/doi/abs/10.1177/0890117120939030

[8] L. Busch, T. Utesch, and B. Strauss, "Normalised step targets in fitness apps affect users' autonomy need satisfaction, motivation and physical activity – a six-week rct," *International Journal of Sport and Exercise Psychology*, vol. 20, no. 1, p. 223–244, Jan. 2022.

[9] S. Asimakopoulos, G. Asimakopoulos, and F. Spillers, "Motivation and user engagement in fitness tracking: Heuristics for mobile healthcare wearables," *Informatics*, vol. 4, no. 1, p. 5, Jan. 2017.

[10] S. Liu and J. F. Willoughby, "Do fitness apps need text reminders? an experiment testing goal-setting text message reminders to promote self-monitoring," *Journal of Health Communication*, vol. 23, no. 4, p. 379–386, Apr. 2018.

[11] H. Kim, J. Mentzer, and R. Taira, "Developing a physical activity ontology to support the interoperability of physical activity data," *Journal of Medical Internet Research*, vol. 21, no. 4, p. e12776, Apr. 2019.

[12] Adidas Runtastic, "Adidas running app," https://play.google.com/store/apps/details?id=com.runtastic.android&hl=ro, accessed: May 2025.

[13] Google LLC, "Fitbit app," https://play.google.com/store/apps/details?id=com.fitbit.FitbitMobile&hl=ro, accessed: May 2025.

[14] ——, "Google fit app," https://play.google.com/store/apps/details?id=com.google.android.apps.fitness&hl=ro, accessed: May 2025.

[15] Under Armour, "Mapmyrun app," https://play.google.com/store/apps/details?id=com.mapmyrun.android2&hl=ro, accessed: May 2025.

[16] Nike, Inc., "Nike run club app," https://play.google.com/store/apps/details?id=com.nike.plusgps&hl=ro, accessed: May 2025.

[17] Pacer Health, "Pacer app," https://play.google.com/store/apps/details?id=cc.pacer.androidapp&hl=ro, accessed: May 2025.

[18] ASICS Digital, Inc., "Asics runkeeper app," https://play.google.com/store/apps/details?id=com.fitnesskeeper.runkeeper.pro, accessed: May 2025.

[19] Fitness22, "Running app - gps run tracker," https://play.google.com/store/apps/details?id=running.tracker.gps.map&hl=ro, accessed: May 2025.

[20] Samsung Electronics Co., Ltd., "Samsung health app," https://play.google.com/store/apps/details?id=com.sec.android.app.shealth&hl=ro, accessed: May 2025.

[21] Zeopoxa, "Running & jogging, run tracker," https://play.google.com/store/apps/details?id=com.zeopoxa.fitness.running&hl=ro, accessed: May 2025.

[22] N. F. Noy and D. L. McGuinness, “Ontology development 101: A guide to creating your first ontology,” Stanford Knowledge Systems Laboratory and Stanford Medical Informatics, Tech. Rep. KSL-01-05, 2001. [Online]. Available: https://corais.org/sites/default/files/ontology_development_101_aguide_to_creating_your_first_ontology.pdf
[23] A. Burton-Jones, V. C. Storey, V. Sugumaran, and P. Ahluwalia, “A semiotic metrics suite for assessing the quality of ontologies,” *Data & Knowledge Engineering*, vol. 55, no. 1, p. 84–102, Oct. 2005.
[24] W3C, “SPARQL 1.1 Query Language,” https://www.w3.org/TR/sparql11-query/, 2013, w3C Recommendation, 21 March 2013.

A AI STATEMENT

During the preparation of this work, I used ChatGPT to help learn how to use the software Protégé. Moreover, Grammarly was used to correct any spelling errors. After using these services, I reviewed and edited the content as needed, taking full responsibility for the final result.

App Name	Name	Email	Gender	Age	Weight	Height
Adidas Running: Run Tracker	✓	✓	✓	✓	✓	✓
ASICS Runkeeper - Run Tracker	✓	✓	✓	✓	Optional	Optional
Fitbit	✓	✓	✓	✓	✓	✓
Google Fit: Fitness Tracker	✓	✓	✓	✓	✓	✓
MapMyRun GPS Running Tracker	✓	✓	✓	✓	✓	✓
Nike Run Club - Running Coach	✓	✓	✓	✓	✓	✓
Pacer Pedometer & Step Counter	✓	✓	✓	✓	✓	✓
Running & Jogging, Run tracker			✓	✓	✓	✓
Running App - GPS Run Tracker	✓	✓	✓	✓	✓	✓
Samsung Health	✓	✓	✓	✓	✓	✓

Table 7. Overview of user data collected by different running apps

App Name	Workout Time	Total Distance	Avg. Pace	Avg. Speed	Cadence	Calories	Elevation	KM Split
Adidas Running: Running Tracker	✓	✓	✓	✓		✓	✓	✓
ASICS Runkeeper - Run Tracker	✓	✓	✓		✓	✓	✓	✓
Fitbit	✓	✓				✓	✓	✓
Google Fit: Fitness Tracker	✓	✓	✓			✓		
MapMyRun GPS Running Tracker	✓	✓	✓			✓	✓	✓
Nike Run Club - Running Coach	✓	✓	✓		✓	✓	✓	✓
Pacer Pedometer & Step Counter	✓	✓	✓	✓	✓	✓	✓	✓
Running & Jogging, Run tracker	✓	✓	✓	✓		✓	✓	✓
Running App - GPS Run Tracker	✓	✓	✓	✓	✓		✓	✓
Samsung Health	✓	✓	✓	✓	✓	✓	✓	✓

Table 8. Overview of session data collected by different running apps