GAME ON!
ENHANCING REHABILITATION ADHERENCE IN ATHLETES THROUGH A GAMIFIED MOBILE APPLICATION

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INTRODUCTION

If not adequately rehabilitated, sports injuries can sideline athletes for extended periods. Low adherence to prescribed exercises is a significant reason for incomplete or ineffective rehabilitation. This project explores the development of a mobile application that blends physical therapy with the engaging elements of gamification to address the downfalls of traditional rehabilitation. It focuses on physical and mental recovery aspects critical for an athlete's total return to sport [5].

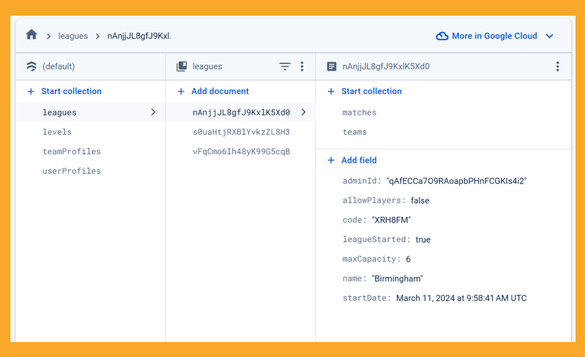
HIGHLIGHTING THE PROBLEM

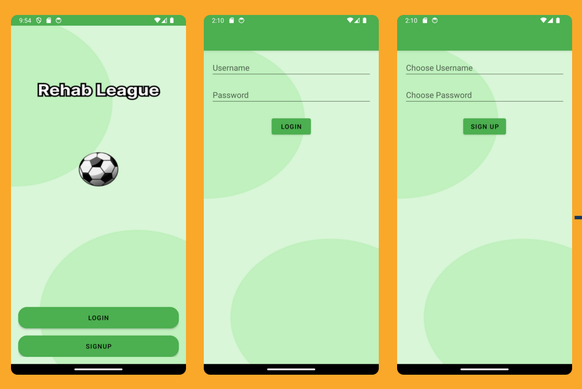
Gamification shown to boost engagement and loyalty [3] → Research into rehab for stroke patients, but VR inaccessible and expensive [4] → Gap in market for accessible sport-specific rehab applications

Boring traditional repetitive rehab [1] → Low patient adherence [1] → Prolonged recovery + ⬆ risk of reinjury [2] → Solution: Gamification rehab app?

METHODOLOGY & APP FEATURES

Developed using Android Studio and was programmed in Kotlin, focusing on a user-friendly interface. Any data collected is stored in a Firebase database.



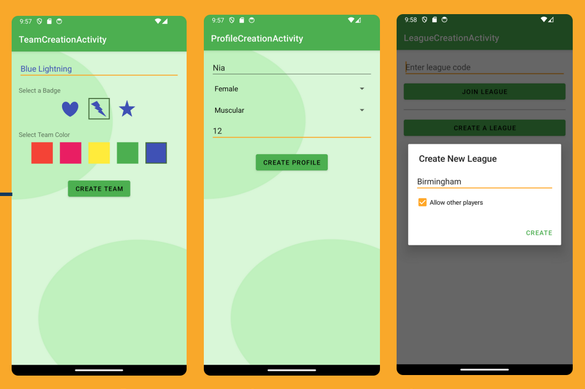


1 Login/Signup:

Users create a unique login for their account. These logins are stored securely using Firebase and authenticated upon login.

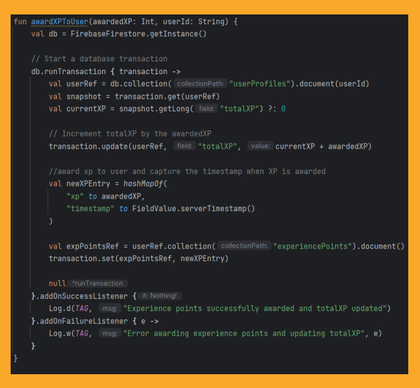
2 Profile, Team and League Creation:

Users create their profiles and set their injury types and expected recovery time. This information is then stored in the database and can be edited later in a profile section. Users can choose to create their league or join a friend's league by entering the uniquely generated code for that league.

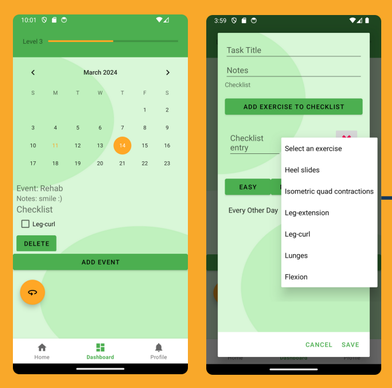



```
fun generateUniqueCode(): String {
    val allowedChars = ('A' ≤ .. ≤ 'Z') + ('0' ≤ .. ≤ '9')
    return (1 ≤ .. ≤ 6)
        .map { allowedChars.random() }
        .joinToString( separator: "")
}
```

Completion rate = Completed events / Total events



```
fun awardXPToUser(awardedXP: Int, userId: String) {
    val db = FirebaseFirestore.getInstance()

    // Start a database transaction
    db.runTransaction { transaction ->
        val userRef = db.collection( collectionPath: "userProfiles").document(userId)
        val snapshot = transaction.get(userRef)
        val currentXP = snapshot.getLong( field: "totalXP") ?: 0

        // Increment totalXP by the awardedXP
        transaction.update(userRef, field: "totalXP", value: currentXP + awardedXP)

        //award xp to user and capture the timestamp when XP is awarded
        val newXPEntry = hashMapOf(
            "xp" to awardedXP,
            "timestamp" to FieldValue.serverTimestamp()
        )

        val expPointsRef = userRef.collection( collectionPath: "experiencePoints").document()
        transaction.set(expPointsRef, newXPEntry)

        null "runTransaction"
    }.addOnSuccessListener { it: Nothing!
        Log.d(TAG, msg: "Experience points successfully awarded and totalXP updated")
    }.addOnFailureListener { e ->
        Log.w(TAG, msg: "Error awarding experience points and updating totalXP", e)
    }
}
```

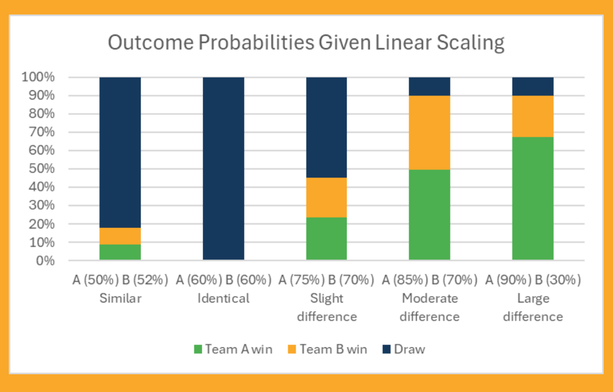


3 Events and Experience Points (XP):

A set of exercises can be stored as an event in the calendar. These exercises are in the form of a checklist and can be selected from a drop-down menu or manually entered. An event can be easy, medium, or hard, and when completed, it will reward the relevant amount of XP. The total experience points and current XP level are stored in the database. Users are sent a notification at 4 p.m. each day if any events remain incomplete.

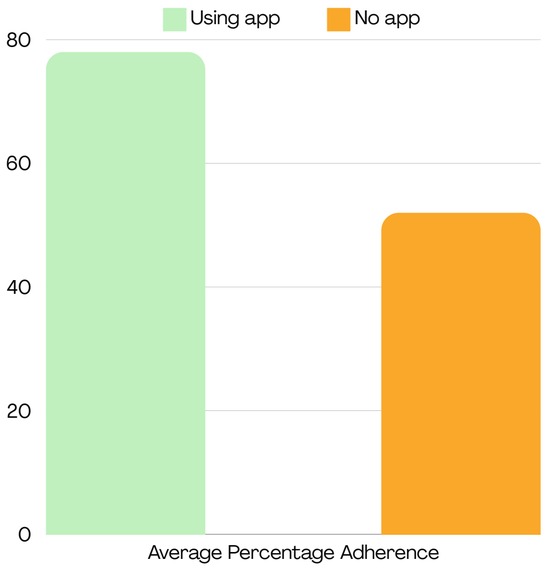
4 League:

On Sundays, match outcomes are determined by linear scaling, which favours teams with higher weekly event completion rates. Draw probability is tied to completion rate differences—a 10% gap gives a 0.1 chance of a draw, with equal rates ensuring a draw. A random number is generated and compared to the probabilities to determine the result. Scores are then generated from the result. Future simulations will explore piecewise or logistic models to balance effort recognition with the randomness of sports. In the future, the model that gives the best average completion percentage will be used.



Note: A/B percentages are the event completion rates

PRELIMINARY RESULTS



User feedback

In a pilot study conducted over three weeks of the app, participants completed more prescribed exercises than users who did not use the app. Most users said the gamification element motivated them to complete their weekly exercises, making rehab more enjoyable and engaging.

CONCLUSION

Gamifying rehabilitation exercises through a mobile app has shown promise in enhancing athlete engagement and adherence. Taking a holistic approach, where both the physical and mental aspects of recovery are addressed, has shown potential in reducing recovery times and improving rehabilitation outcomes.

FUTURE WORK

- Expand the app's exercise library by incorporating an Application Programming Interface (API).
- UI will be iterated in line with user feedback.
- Different variants of the match simulation function will be tested to see which method provides higher motivation rates. The optimal balance between the realistic random nature of sport and rewarding players for high completion rates is essential.
- Conduct studies with more users over longer periods to assess the app's impact on recovery outcomes.

References:

1. Dhillon, H., Dhilllon, S., & Dhillon, M. (2017). Current concepts in sports injury rehabilitation. In Indian Journal of Orthopaedics (Vol. 51, Issue 5). https://doi.org/10.4103/ortho.IJOrtho_226_17
2. Hickey, J. T., Opar, D. A., Weiss, L. J., & Heiderscheit, B. C. (2022). Hamstring Strain Injury Rehabilitation. Journal of Athletic Training, 57(2). https://doi.org/10.4085/1062-6050-0707.20
3. Cloke Harry. (2024, March 7). The Definitive Definition of Gamification (+ 8 Real-World Examples) - Growth Engineering. https://www.growthengineering.co.uk/definition-of-gamification/
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5. Zazulak, B., Katz, D., & Medvecky, M. (2023). Injury-Proof: Current Integrative Concepts of Sports Injury Reduction and Rehabilitation. Connecticut Medicine, 87(1).