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Design and Development of a Gymnastics Event Management System

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Abstract – *Gymnastics in India is a relatively niche sport, as a result of which gymnastic athletes face several issues such as registering for events, evaluating performance, scoring, document verification etc. However, it still has a strong following and enough passionate athletes to demand a system that streamlines different procedures related to the sport that will enable players to meet their needs under one central hub.*

The gymnastic event management system was thus designed as a solution to the problems of having to register for events, maintaining a performance report, uploading documents related to the sport, and organizing events. The system can schedule events and inform athletes of their upcoming competitions, allowing them to focus on the training rather than the planning. Judges would be able to use the system in order to score the participants, which the system will use to generate real time results with the help of inbuilt ranking algorithms, thus acting as a live scoreboard which will be updated on the website or app.

This system was designed to help registered athletes plan schedules, evaluate and track performance, and maintain a record of their achievements and accolades on their profiles. It also helps organizers with conducting competitions and events by reducing the overhead of having to manually schedule events, verify documents and update scoreboards.

Key Words: **Gymnastics, athletes, management, schedule, record, documents, events, scoreboard, real time, accolades, profile.**

1. INTRODUCTION

Gymnastics is a sport that requires balance, strength, flexibility, agility, coordination, and endurance. The movements involved in gymnastics contribute to the development of the arms, legs, shoulders, back, chest and abdominal muscle groups. Alertness, precision, daring, self-confidence, and self-discipline are mental traits that can also be developed through gymnastics.

Most forms of competitive gymnastics events are governed by the Fédération Internationale de Gymnastique (FIG). Each country has its own national governing body (BIW) affiliated to FIG. Competitive artistic gymnastics is the best known of the gymnastic events. It typically involves the women's events of vault, uneven bars, balance beam and floor exercise as well as the men's events of floor exercise, pommel horse, still rings, vault, parallel bars, and horizontal bar.

Gymnasts who perform gymnastics face several issues like registering for an event, documents verification, event schedule, etc. With such a mess to just register for an event, It even becomes difficult for the athletes to know their ranking and performance.

Gymnastics Event Management System is a system to help organize competitions and help athletes simplify participating in events and competitions. The system primarily has 4 modules: Registration, Event Day Logistics, Record/Result History and Personal Profile Management for the in-house players.

1. The Registration module allows home players of a club to enrol into upcoming events. Guest athletes can apply for their desired event or sport as per the Age, Apparatus, Element, etc.

2. Event Day Logistics consists of all participant records playing at the event which will be used to schedule players, provide scoresheets, generate ranking, publish scores and update records.

    - Verification: Participant documents are verified and approved.
    - Scheduling: The system schedules the competition as per the Age Group, Apparatus and Gender to display order of events.
    - Scoring: An online scoresheet for Judges to enter scores for each participant and view the next participant. Scoresheets can also be reviewed to settle disputes.
    - Ranking: Once judges finalize the scores, it can be displayed on the scoreboard and ranking will be done to be displayed on the websites.
    - Updating: The results and achievements will be uploaded to the system for in-house players.

3. Record/Result History maintains a log of all events and results of events held at this club till the current date.

4. Personal Profile Management provides a portfolio for its players. In-house players can

upload their certificates and medals won at external clubs into the system.

As part of quality of life features, all database objects such as participation forms, results, history of an athlete, etc could be converted to a different version of soft copy such as PDF or Word file and can be downloaded as and when required.

1.1 Scope

The project was initiated as a means of streamlining and optimizing the processes involved in registering, organizing, and scoring gymnastic events. This in turn saves athletes time and effort in planning and participating in events, as well as helps organizers conduct events much more efficiently due to the system's ability to schedule events and rank performances by acting as a scoreboard. All the event result data is then securely stored at the back end which can later be retrieved by the in-house registered athletes to evaluate their past performances as well as maintain a record of their accolades and achievements. The system is flexible enough to work for a wide variety of competitive gymnastic events.

1.2 Problem Statement

Gymnastics in is still a very niche sport in India but that has not stopped hundreds of people from playing it and participating in gymnastic competitions. Such competitions should have a nice and fluid system to register participants for a competition and be able to record all required information about players digitally so that it can be retrieved as and when required by event staff, judges or even club members to schedule, score or analyze a player's data and maintain and database of all players in that club.

However, such a system is non-existent at the time being which has made the entire process of enrolling into a club and participating in any kind of event a huge chore. All processes from enrollment to registration is done on paper and hence is extremely time consuming. Almost an entire day could be spent easily on just filling registration forms and verifying them. A lot of staff is also needed on the day of the event just to retrieve and distribute these information sheets. All of the staff are also on a separate payroll for the event days which is cost that can be cut down of the system was a bit more streamlined and did not require so many staff doing small jobs.

Thus to make it this entire process a lot simpler, a software system can be introduced which enrolls players into a club, maintains records of all enrolled players, can conduct events and provide judges with an interface to score the participants, all the while eliminating the need for hardcopies and need for extra staff that would otherwise be required. It also makes it extremely beneficial for a club if the software can maintain and help coaches analyze every player's strengths and weaknesses to help them get better results.

2. LITERATURE SURVEY

2.1 Established Sports Management Systems

1. **MindFire Solutions:**

   Our [1] client was aiming to, streamline management of various sporting events held at schools, and make it easily accessible for the users. Schools can buy this product from him and efficiently manage details of various games/sports played. Apart from this the client also wanted to keep track of the results of various events and also there mapping with many-to-many relations. There was also requirement to create different statistical reports, charts, graph of different games, students, schools against their opponents thus providing every minute detail of the event. He also was interested in providing a video upload and image upload feature to the application which can be viewed by the users later. He was keen to implement these features both for game and students.

   With these many number of objectives and critical business logic implementation in mind, the client approached Mindfire Solutions Adobe team to find and propose them with a feasible solution. Mindfire's experts took no time to start discussing about the specifications sent by the client and finally proposed a way to get a robust application in place.

   Technologies used: Adobe Flex 3.0, ActionScript 3.0, ColdFusion 8.0, MySQL.

2. **DreamzTech Solution:**

   We delivered a high-quality and result-oriented Web development Solution. We offered the following functional features:[2]

   - Configurable product
   - Advance Search with Apache
   - Ubercart Commerce
   - Memcache
   - Livechat

Technologies used:
User Interface: jQuery, HTML, CSS
Business Logic: Drupal, Webform, Views, Block etc.
Communication: Google SMTP Server
Persistence (DB): MySQL

2.2 Our System

Our system will be comprised of the following technologies:

1. **Angular JS**

AngularJS is a structural framework for dynamic web apps. With AngularJS, designers can use HTML as the template language and it allows for the extension of HTML's syntax to convey the application's components effortlessly. Angular makes much of the code you would otherwise have to write completely redundant. Despite the fact that AngularJS is commonly related to SPA, you can use Angular to build any kind of app, taking advantage of features like: Two-way binding, templating, RESTful api handling, modularization, AJAX handling, dependency injection, etc.[3]

2. **NodeJS**

As an asynchronous event driven JavaScript runtime, Node is designed to build scalable network applications. In the following "hello world" example, many connections can be handled concurrently. Upon each connection the callback is fired, but if there is no work to be done, Node will sleep.[4]

```
const http = require('http');
const hostname = '127.0.0.1'
const port = 3000;
const server = http.createServer((req, res) => {
res.statusCode = 200;
res.setHeader'Content-Type', 'text/plain');
res.end('Hello World\n');
});
server.listen(port, hostname, () => {
console.log(`Server running at
http://${hostname}:${port}/`);
});
```

This is in contrast to today's more common concurrency model where OS threads are employed. Thread-based networking is relatively inefficient and very difficult to use. Furthermore, users of Node are free from worries of dead-locking the process, since there are no locks. Almost no function in Node directly performs I/O, so the process never blocks. Because nothing blocks, scalable systems are very reasonable to develop in Node.

3. **Apache JMeter**

The Apache JMeter™ application is open source software, a 100% pure Java application designed to load test functional behavior and measure performance. It was originally designed for testing Web Applications but has since expanded to other test functions.[5]

Apache JMeter may be used to test performance both on static and dynamic resources, Web dynamic applications. It can be used to simulate a heavy load on a server, group of servers, network or object to test its strength or to analyze overall performance under different load types.

Apache JMeter features include:

- Ability to load and performance test many different applications/server/protocol types:
- Web - HTTP, HTTPS (Java, NodeJS, PHP, ASP.NET, …)
- SOAP / REST Webservices
- FTP
- Database via JDBC
- LDAP
- Message-oriented middleware (MOM) via JMS
- Mail - SMTP(S), POP3(S) and IMAP(S)
- Native commands or shell scripts
- TCP
- Java Objects

4. **PrimeNG**

PrimeNG is a collection of rich UI components for Angular. All widgets are open source and free to use under MIT License. PrimeNG is developed by PrimeTek Informatics, a vendor with years of expertise in developing open source UI solutions.

5. **MongoDB**

- MongoDB stores data in flexible, JSON-like documents, meaning fields can vary from document to document and data structure can be changed over time
- The document model maps to the objects in your application code, making data easy to work with
- Ad hoc queries, indexing, and real time aggregation provide powerful ways to access and analyze your data
- MongoDB is a distributed database at its core, so high availability, horizontal scaling, and geographic distribution are built in and easy to use
- MongoDB is free and open-source. Versions released prior to October 16, 2018 are published under the AGPL. All versions released after October 16, 2018, including patch fixes for prior versions, are published under the Server Side Public License (SSPL) v1.[6]

6. **ExpressJS**

Express.js, or simply Express, is a web application framework for Node.js, released as free and open-source software under the MIT License. It is designed for building web applications and APIs. It has been called the de facto standard server framework for Node.js. You can then use a database like MongoDB with Mongoose (for modeling) to provide a backend for your Node.js application. Express.js basically helps you manage everything, from routes, to handling requests and views.

3. SYSTEM DESIGN

3.1 Proposed System

The proposed Gymnastic Event Management System will help in-house registered athletes to register for competitions, plan competition dates and maintain a profile. It will also enable organizers to register participants, schedule events and calculate participant scores to display ranking results.

- **Registration**
  - Players Registration Form:- Online Forms for the Registration of the players from other teams.
  - In-house Players Registration:- The in-house players could register automatically using internal portal.

- **Event day process**

  - **Documents Verification**:- Verification will be done of the documents submitted by the players on the event day.

  - **Scheduling**:- After the verification, the software will arrange the players in the certain categories and schedule their events. The Scheduling will be done according to the No. of participants, Age Group, Gender, Events and Apparatus. The schedules will be displayed on Website.

  - **Scoring System**:- At the event Judges are able to see the players score card according to the apparatus and events as per the schedule. Score card will be displayed where judges can enter the scores. After finalizing the scores, judges can confirm the final scorecard. After confirmation of the scorecard judges can view the scorecard of the next player immediately.

  - **Displaying Result**:- After each performance scores will be updated. At the end of the particular event, judges will finalize the scores and the scores will be displayed. If any changes in scores, judges can edit the scores and confirm it finally.

  - **Ranking**: After end of the event finalized scores will be computed and ranking will be generated.

  - **Distribution of Certificates and Medals**:- Once the final Rankings are decided, the software will print the certificates. Organizers can keep track of distributed Certificates and Medals.

- **In-house Players Profile Management**
  This feature records the achievements and details of the players and information of coaches.

3.3 Methodology

To develop the Gymnastic Management System Software, we decided on three different layers- Presentation Layer, Logical Layer and Database Layer

1. **Presentation Layer**: To design the interface of the software.

2. **Logical Layer**: To decide and write the program for performing the whole management task execution under the decision module.

3. **Database Layer**: To analysis and design the database of the module.

   - The Client-side webapp is developed in AngularJS using Visual Studio Code. In this, the tasks of collecting the information from user i.e. registration and verification, displaying their slots and results is carried out.

   - HTML is great for declaring static documents, but it falters when we try to use it for declaring dynamic views in web-applications. AngularJS lets you extend HTML vocabulary for your application. The resulting environment is extraordinarily expressive, readable, and quick to develop.

   - In angular JS, we are using angular seed which is an application skeleton for a typical AngularJS web app. You can use it to quickly bootstrap your angular webapp projects and dev environment for the projects.
   - Node JS is used for handling server-side task in the Gymnastic Management Software. As an asynchronous event driven JavaScript runtime, Node is designed to build scalable network applications. In this, many connections can be handled concurrently. Upon each connection the callback is fired, but if there is no work to be done, Node will sleep.

   - For the Database we are using MongoDB, MongoDB is a free and open-source cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schemata. MongoDB is developed by MongoDB Inc. and is published under a

combination of the Server Side Public License and the Apache License.

All the information collected will be stored in database in json files. Json follows the same framework as angular JS, therefore there is no need of converting the data to store into database. When exchanging data between a browser and a server, the data can only be text. JSON is text, and we can convert any JavaScript object into JSON, and send JSON to the server. We can also convert any JSON received from the server into JavaScript objects. This way we can work with the data as JavaScript objects, with no complicated parsing and translations.

3.4 Designs

Data flow diagram can dive into progressively more detail by using levels and layers, zeroing in on a particular piece. DFD levels are numbered 0, 1 or 2, and occasionally go to even Level 3 or beyond. The necessary level of detail depends on the scope of what you are trying to accomplish. A data flow diagram can dive into progressively more detail by using levels and layers, zeroing in on a particular piece. DFD levels are numbered 0, 1 or 2, and occasionally go to even Level 3 or beyond. The necessary level of detail depends on the scope of what you are trying to accomplish.

3.4.1 Data Flow Diagram (Level 0)

A level 0 data flow diagram (DFD), also known as a context diagram, shows a data system as a whole and emphasizes the way it interacts with external entities.

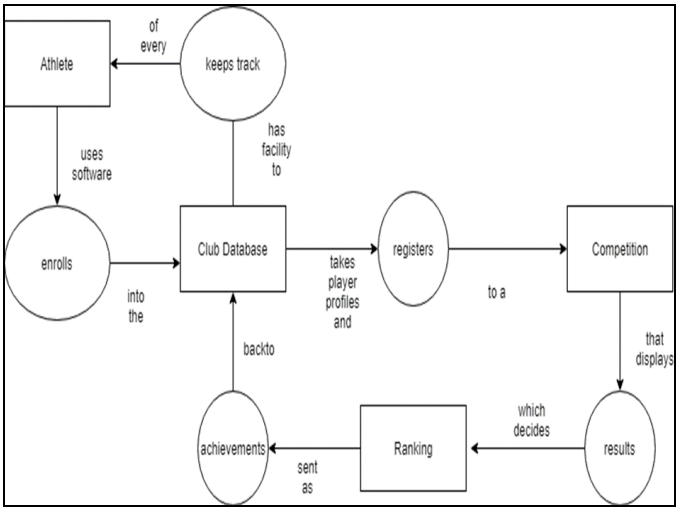

Figure -1: DFD Level 0

3.4.2 Data Flow Diagram (Level 1)

As described previously, context diagrams (level 0 DFDs) are diagrams where the whole system is represented as a single process. A level 1 DFD notates each of the main sub-processes that together form the complete system. We can think of a level 1 DFD as an "exploded view" of the context diagram.

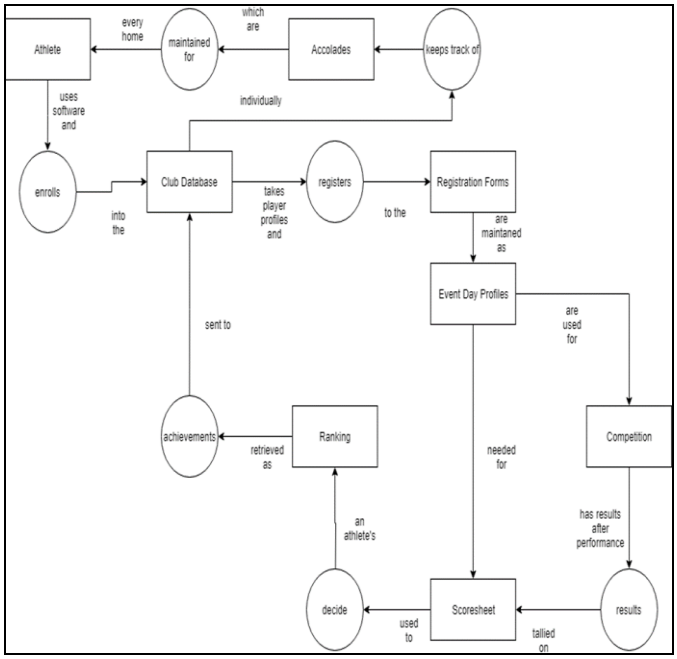

Figure -2: DFD Level 1

3.5 UML DIAGRAMS

3.5.1 Use Case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.

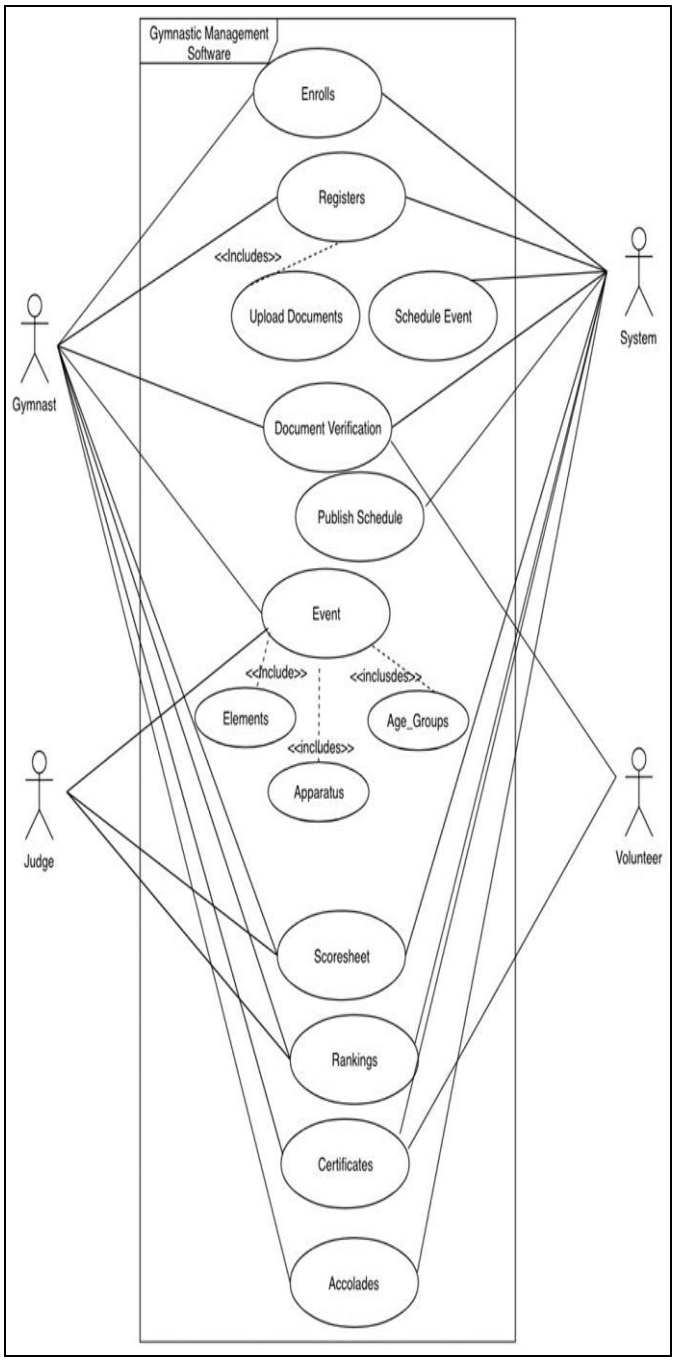

Figure -3: Use Case Diagram

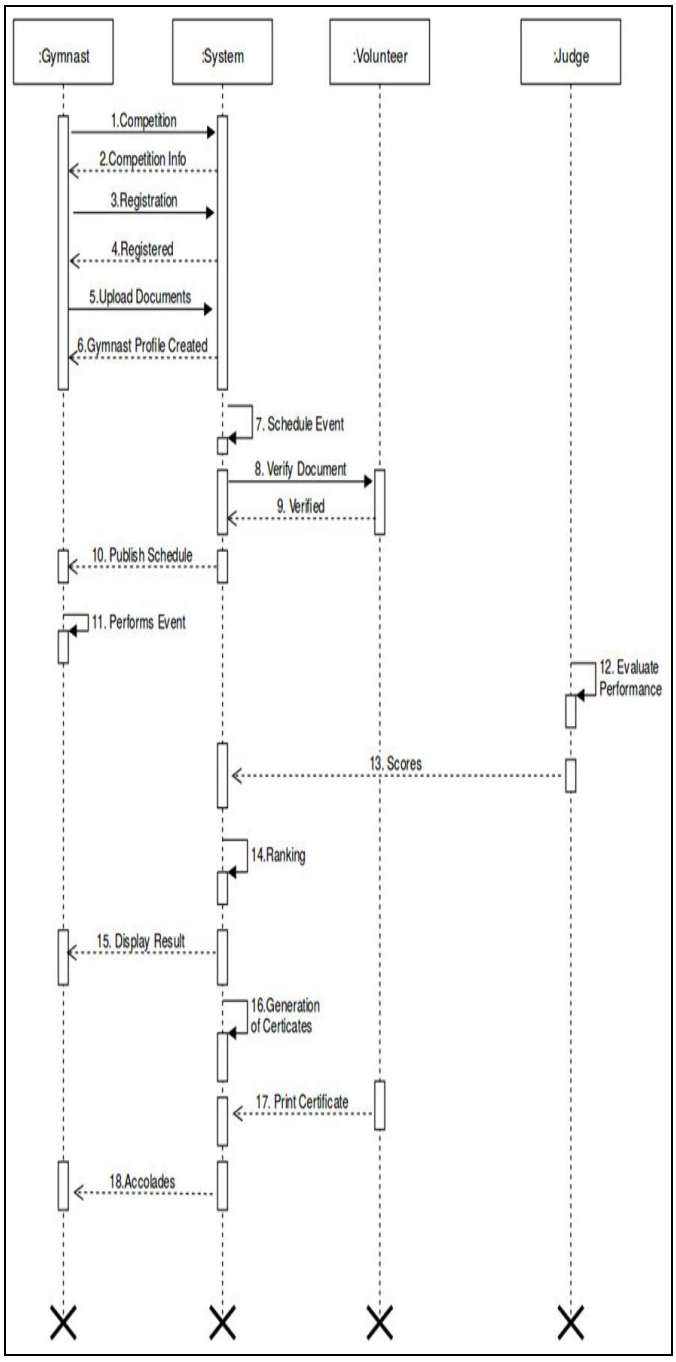

Figure -4: Sequence Diagram

3.5.2 Sequence Diagram

Sequence diagram is an interaction diagram that emphasizes the time ordering of messages. A sequence diagram is a structured representation of behavior as a series of sequential steps over time. It is used primarily to show the interactions between objects in the sequential order. The sequence diagram is also called as Message Sequence Chart.

3.5.3 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational process.

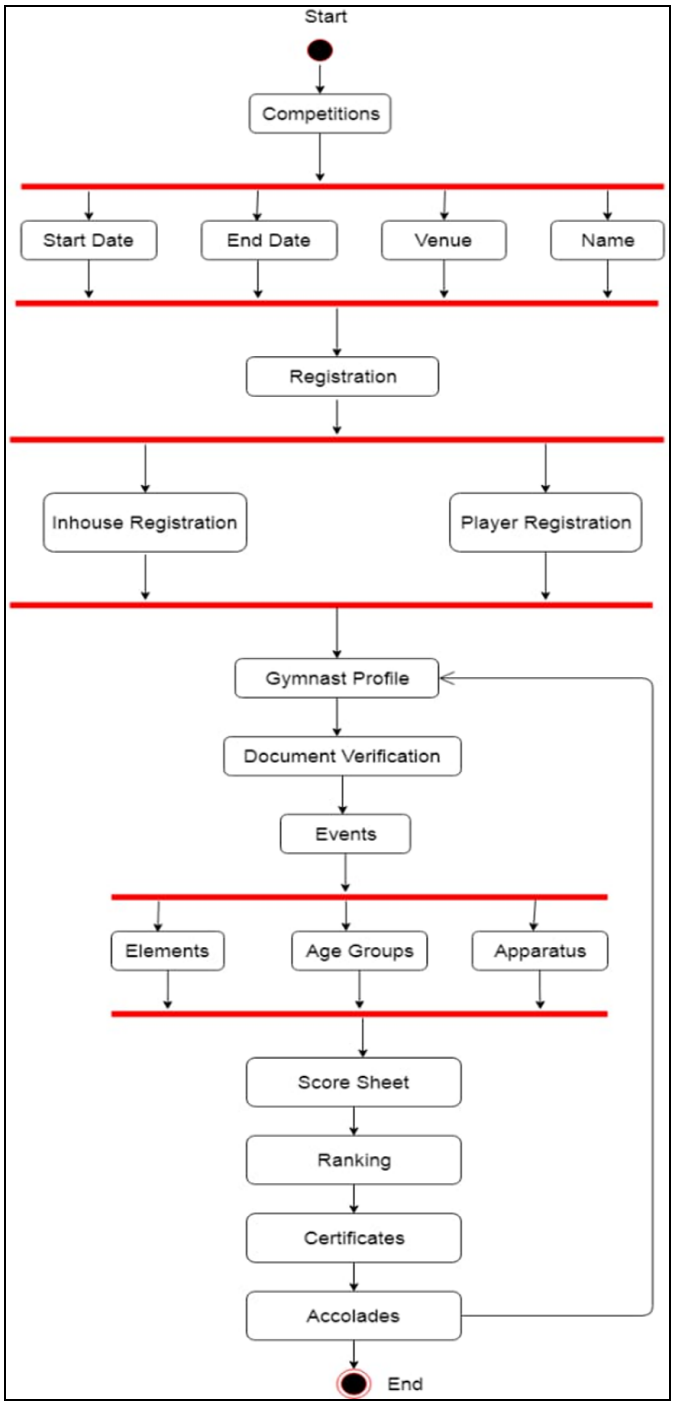

Figure -5: Activity Diagram

3.5.4 Enhanced Entity-Relationship Diagram

It reflects the data properties and constraints more precisely. It includes all modeling concepts of the ER model. Diagrammatic technique helps for displaying the EER schema.

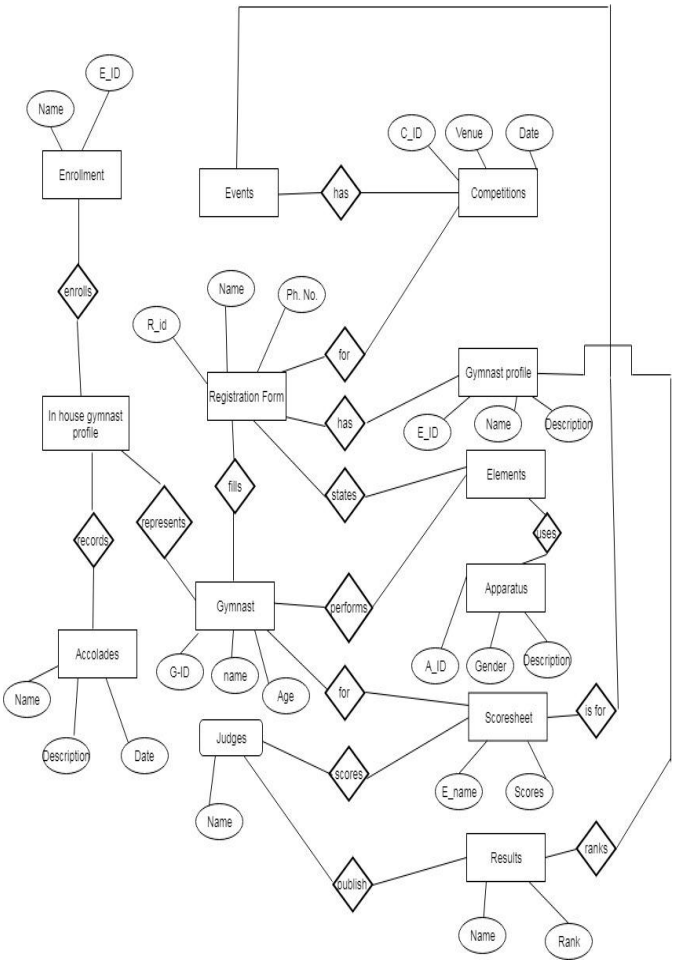

Figure -6: EER Diagram

4. RESULTS

The aim of this section is to present results of the empirical analysis done for characterization of contextual features which contributes to various fields in an application. In this section, accuracy of results is displayed that holds significance for the effectiveness of the proposed solution approach.

- **Login**: This is the login Page of our system, if user is a valid user and have their login credentials then user(gymnast/ judge) can directly login into the system using their login credentials.

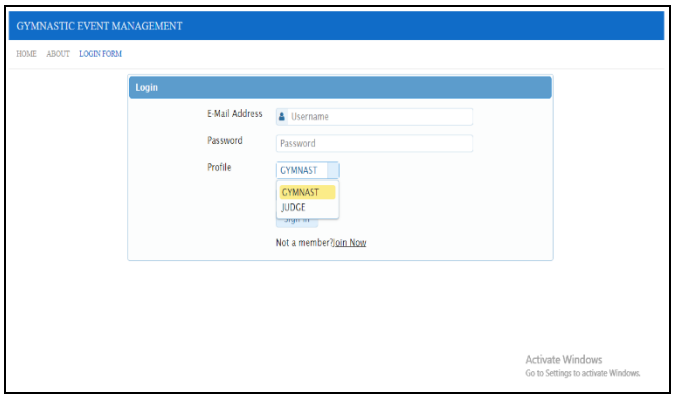

Figure -7: Login Page

- **Gymnast Dashboard:** Once the user(gymnast) Logs in into the system successfully using their valid credentials, the gymnast can see the following gymnast dashboard

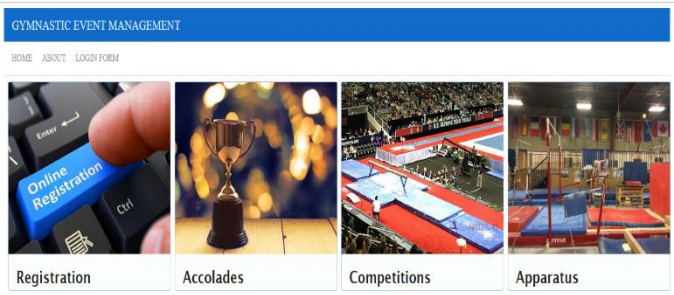

Figure -8: Gymnast Dashboard

- **Gymnast Registration Form:** Once the gymnast login themselves into the system successfully, Gymnast can fill registration form in order to participate into various competitions and events.

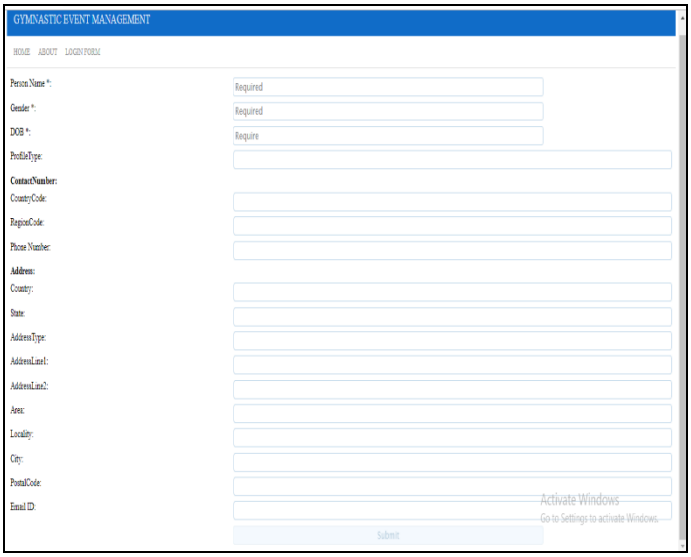

Figure -9: Gymnast Registration Form

- **Competitions**: Below screenshot displays the list of competitions available, so that participants can register in the competitions.

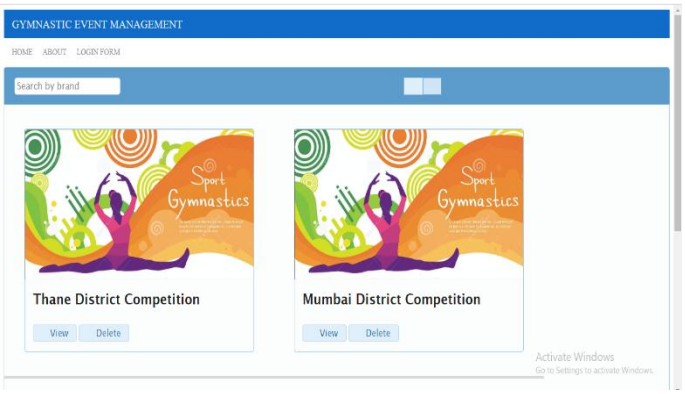

Figure -10: Competitions

- **Apparatus :** The following screenshot shows the Apparatus, gymnast uses the apparatus to perform gymnastics.

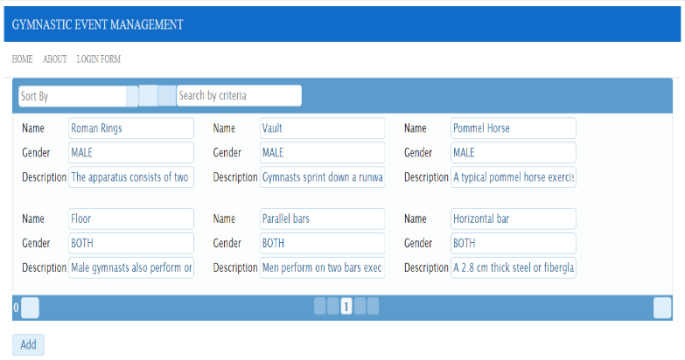

Figure -11: Apparatus Selection Page

- **Scores:** After selecting the participant judge can give scores to the partipants. As shown in the below screen shot, D1, D2,D,3,D4 and E1,E2,E,3,E4 are the judging scretia in term of gymnastics. D1, D2,D,3,D4 are the DIFFICULTY LEVELS. E1,E2,E,3,E4 are EXECUTION LEVELS

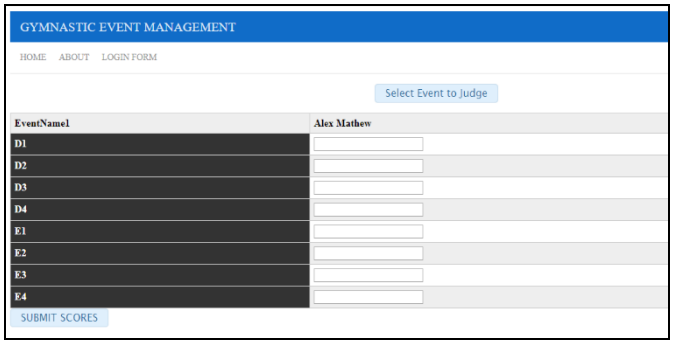

Figure -12: Scoring Page

- **Results:** Following Screenshot shows the final results and ranking of the participants.

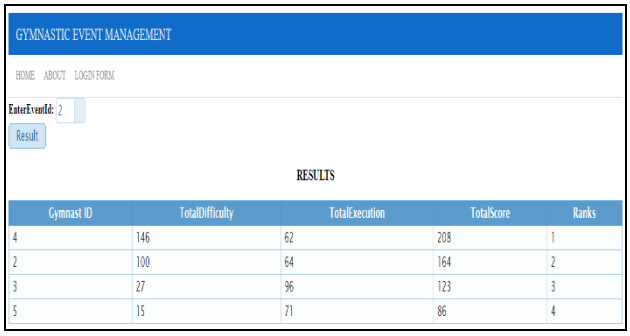

Figure -13: Results and Ranking Page

5. CONCLUSION

By taking into account all the problems athletes and organizers both face when it comes to participating and holding gymnastic competitions and events, we designed a system that trivializes the effort needed to take part in a gymnastic event or organize a gymnastic competition. Athletes are able to create profiles to register and upload documents on a single website, which can also be used by organizers to plan competitions, schedule events of the day, record scores and calculate rankings of the participating athletes and display scoreboards.

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