

# CROWD MANAGEMENT SYSTEM

## A MINI PROJECT REPORT

*Submitted by*

**AMAL BHAS P (TKM20MCA-2004)**

**to**

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*In partial fulfillment for the award of the degree of*

**MASTER OF COMPUTER APPLICATIONS**



**Thangal Kunju Musaliar College of Engineering  
Kerala**

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## **DECLARATION**

I undersigned hereby declare that the mini project report “CROWD MANAGEMENT SYSTEM”, submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Tech-nological University, Kerala is a bonafide work done by me under supervision of Prof. JASMIN M R. This submission represents my ideas in my own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources. I also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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AMAL BHAS P

# **THANGAL KUNJU MUSALIAR COLLEGE OF ENGINEERING**

## **DEPARTMENT OF COMPUTER APPLICATIONS**



### **Certificate**

This is to certify that, this report entitled "***CROWD MANAGEMENT SYSTEM***" is a bonafide record of the submitted by **AMAL BHAS P(TKM20MCA-2004)**, to the **APJ Abdul Kalam Technological University** in partial fulfillment of the requirements for the award of the Degree of **Master of Computer Applications** is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Internal Supervisor

Mini Project Coordinator

Head of the Department

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**AMAL BHAS P**

## **ABSTRACT**

App to enable social distancing at Shops, religious places and events Organizer (Shops, religious places and events )- Should be able to set location, capacity and set virtual Queue system. User - Book slots, entry and exit Automatics entry & exit, Queue clearance and notifications, Location management Mobile app and cloud service.

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## **Chapter 1**

# **Introduction**

CROWD MANAGEMENT SYSTEM is an application for users and organizers for making the process of managing events online and in a simple way. In which, anyone who wants to book events at various available venues or who wants to list his or her property as a venue can register. It provides ease in booking events at any venue as per users wish and it is completely online. Event Management is one of the most important things which will be carried out by event organizers. There are various events that can be organized by organizers for their customers. Once a user logs in he or she can check the available venues, check cost of each venue, food items and equipment provided by the organizers or venue owner, book events at the venue and can make payments online. On the other hand, organizers can keep records of events booked at their venue. Whenever a user deals with an event booking in a manual way, he or she has very limited options with him or her and may miss the best prices and services offered by various organizers. One of the objectives of our project is to provide transparency while booking events online by providing all information about venue and standard costs of various elements to the user and maintaining equal standards for all venues. The user using the online event management service would be given user id after registration by the system. By using a login password, the customer can login to the system and he or she can maintain his or her dashboard, view notifications, booking history, payment details etc.

# **CROWD MANAGEMENT SYSTEM**

## **1.1 Objective**

Crowd Management System can register Users and Organizers in the system and make it easier to view the information related to the bookings, venues, food items and equipment.

1. User/Organizer registration, User/Organizer login and admin login credential authentication.
2. Users/Organizers need to fill required attributes to register.
3. Admin can add and maintain food items and equipment information.
4. Admin can view all user, organizer, booking and venue details.
5. Users can view venue, food item and equipment details.
6. Users can book events, make payment, view booking history and notifications.
7. Organizers can add and maintain venue details and see event details booked for the venue.

## Chapter 2

# Literature Survey

This section summarizes the contents of the literature review : crowd management systems defined; online event management systems evolution and trend; crowd management Architecture; Benefits of crowd management system(proposed system).

In the existing system the customer contacts the company for event management. He provides the details of the event and its requirements. He explains its aims, how long it will last, its format (Presentation/Workshop and/or Exhibition etc.), expected number of delegates/guests, equipment and furniture required, whether any delegate pack or promotional material is to be distributed, and other facilities required. The Event Manager studies the requirements of the event carefully and using the crowd management system The company offers some readymade packages to choose from. If the customer agrees, the event is booked and the advance deposit is taken by the company. According to the requirements of the event, different bookings are made. A strategic schedule is prepared for smooth conduct of the event. The Crowd Management System helps the manager in different tasks of planning, scheduling and Conducting the event. This system provides instant access to event-related information. Thus, resources are;

Efficiently and economically utilized. Once the event is conducted successfully, the bills are generated by the system. The system is extensible. New functionalities can be added to the system, whenever it is needed due to changing requirements.

**Amite Sharma et al. / International Journal of Engineering Science and Technology (IJEST)**

Nowadays, the event industry has played a vital role in our society. People have come up with a lot of occasions for organizing events such as educational events, birthdays, international conferences, company parties etc. Generally speaking, events are also a part of human beings' social life because they get to know and talk with different people with different backgrounds. However, in order to organize a good and successful event, it requires a thorough and detailed planning process. Event managers and event coordinators need to collaborate in order to formulate the most viable plan for events. In order to make events successful and well organized, all of the stages in the entire planning process also need to be in harmony and be correlated with one another. Risk management has been of great importance during the entire planning process. Under no circumstances should risk management be underestimated. Additionally, the evaluation process helps event organizers and event managers to realize which aspects should be improved and need further development. The event management industry is a dapper of a dandy. Due to the endless changes and sweeping improvements in current events technology, there's no place for stability.

## Chapter 3

# Methodology

### **3.1. Existing System**

Cities are growing at a dizzying place and they require improved methods to manage crowded areas. Crowd management stands for the decisions and actions taken to supervise and control densely populated spaces and it involves multiple challenges. From recognition and assessment to application of actions tailored to the current situation.

### **3.2. Proposed System**

Modern technology aims not only to make people's lives easier but also more safe. Being in a highly crowded place like stadium, metro stations or holy places on Hajj affects not only the human level of comfort but mainly the human level of safety. The current work introduced a mobile based crowd management system. Proposed System is the app to enable social distancing at Shops, religious places and events. Organizer religious should be able to set location, capacity and set virtual Queue system.

### **3.3. Technologies Used**

#### **3.3.1. Angular**

Angular (commonly referred to as "Angular 2+" or "Angular CLI") [4][5] is a TypeScript-based free and open-source web application framework led by the Angular Team at Google and by a community of individuals and corporations. Angular is a complete rewrite from the same team that built AngularJS.

Angular is used as the frontend of the MEAN stack, consisting of MongoDB database, Express.js web application server framework, Angular itself (or AngularJS), and Node.js server runtime environment. AngularJS was a JavaScript-based open-source front-end web framework for developing single-page applications. It was maintained mainly by Google and a community of individuals and corporations. It aimed to simplify both the development and the testing of such applications by providing a framework for client-side model-view-controller (MVC) and model-view-viewmodel (MVVM) architectures, along with components commonly used in web applications and progressive web applications.

AngularJS was used as the frontend of the MEAN stack, consisting of MongoDB database, Express.js web application server framework, AngularJS itself (or Angular), and Node.js server runtime environment.

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The AngularJS framework worked by first reading the Hypertext Markup Language (HTML) page, which had additional custom HTML attributes embedded into it. Angular interpreted those attributes as directives to bind input or output parts of the page to a model that is represented by standard JavaScript variables. The values of those JavaScript variables could be manually set within the code or retrieved from static or dynamic JSON resources.

AngularJS was built on the belief that declarative programming should be used to create user interfaces and connect software components, while imperative programming was better suited to defining an application's business logic.[7] The framework adapted and extended traditional HTML to present dynamic content through two-way data-binding that allowed for the automatic synchronization of models and views. As a result, AngularJS de-emphasized explicit Document Object Model (DOM) manipulation with the goal of improving testability and performance.

AngularJS implemented the MVC pattern to separate presentation, data, and logic components.[8] Using dependency injection, Angular brought traditionally server-side services, such as view-dependent controllers, to client-side web applications. Consequently, much of the burden on the server could be reduced.

Angular design goals included:

- to decouple DOM manipulation from application logic. The difficulty of this is dramatically affected by the way the code is structured.
- to decouple the client side of an application from the server-side. This allows development work to progress in parallel and allows for reuse of both sides.
- to provide structure for the journey of building an application: from designing the UI, through writing the business logic, to testing.

### 3.3.2. Bootstrap

**Mobile first approach:** Since Bootstrap 3, the framework consists of Mobile first styles throughout the entire library instead of in separate files.

**Browser Support:** It is supported by all popular browsers.

**Easy to get started:** With just the knowledge of HTML and CSS anyone can get started with Bootstrap. Also the Bootstrap official site has good documentation.

**Responsive design:** Bootstrap's responsive CSS adjusts to Desktops, Tablets and Mobiles. More about responsive design in the chapter Bootstrap Responsive Design.

- Provides a clean and uniform solution for building an interface for developers.
- It contains beautiful and functional built-in components which are easy to customize.
- It also provides web based customization.
- And best of all it is open source.

### What Bootstrap Package Includes?

- ❖ Scaffolding: Bootstrap provides a basic structure with Grid System, link styles, background. This is covered in detail in the section Bootstrap Basic Structure
- ❖ CSS: Bootstrap comes with feature of global CSS settings, fundamental HTML elements styled and enhanced with extensible classes, and an advanced grid system. This is covered in detail in the section Bootstrap with CSS.
- ❖ Components: Bootstrap contains over a dozen reusable components built to provide iconography, dropdowns, navigation, alerts, popovers, and much more. This is covered in detail in the section Layout Components.
- ❖ JavaScript Plugins: Bootstrap contains over a dozen custom jQuery plugins. You can easily include them all, or one by one. This is covered in details in the section Bootstrap Plugins.
- ❖ Customize: You can customize Bootstrap's components, LESS variables, and jQuery plugins to get your very own version.

### Bootstrap Environment Setup

It is very easy to set up and start using Bootstrap. It will also discuss the Bootstrap file structure, and demonstrate its usage with an example.

#### Download Bootstrap

You can download the latest version of Bootstrap from <http://getbootstrap.com/>. When you click on this link,

Here you can see two buttons:

- **Download Bootstrap:** Clicking this, you can download the pre-compiled and minified versions of Bootstrap CSS, JavaScript, and fonts. No documentation or original source code files are included.
- **Download Source:** Clicking this, you can get the latest Bootstrap LESS and JavaScript source code directly from GitHub.

If you work with Bootstrap's uncompiled source code, you need to compile the LESS files to produce usable CSS files. For compiling LESS files into CSS, Bootstrap officially supports only Recess, which is Twitter's CSS hider based on less.js.

For better understanding and ease of use, we shall use precompiled version of Bootstrap throughout the tutorial. As the files are compiled and minified you don't have to bother every time including separate files for individual functionality. At the time of writing this tutorial the latest version (Bootstrap 3) was downloaded.

#### 3.3.3. HTML

To publish information for global distribution, one needs a universally understood language, a kind of publishing mother tongue that all computers may potentially understand. The publishing language used by the World Wide Web is HTML (from HyperText Markup Language).

HTML gives authors the means to:

- Publish online documents with headings, text, tables, lists, photos, etc.
- Retrieve online information via hypertext links, at the click of a button.
- Design forms for conducting transactions with remote services, for use in searching for information, making reservations, ordering products, etc.
- Include spread-sheets, video clips, sound clips, and other applications directly in their documents.

HTML was originally developed by Tim Berners-Lee while at CERN, and popularized by the Mosaic browser developed at NCSA. During the course of the 1990s it has blossomed with the explosive growth of the Web. During this time, HTML has been extended in a number of ways. The Web depends on Web page authors and vendors sharing the same conventions for HTML. This has motivated joint work on specifications for HTML.

HTML 4.0 extends HTML with mechanisms for style sheets, scripting, frames, embedding objects, improved support for right to left and mixed direction text, richer tables, and enhancements to forms, offering improved accessibility for people with disabilities.

### 3.3.4. CSS

Cascading Style Sheets, fondly referred to as CSS, is a simply designed language intended to simplify the process of making web pages presentable. CSS allows to apply styles to web pages. More importantly, CSS enables you to do this independent of the HTML that makes up each web page.

It is used to style and lay out web pages — for example, to alter the font, color, size, and spacing of your content, split it into multiple columns, or add animations and other decorative features.

#### Advantages of CSS:

- **CSS saves time** – One can write CSS once and then reuse same sheet in multiple HTML pages. A style can be designed for each HTML element and apply it to as many Web pages as required.
- **Pages load faster** – While using CSS, no need to write HTML tag attributes every time. Just write one CSS rule of a tag and apply it to all the occurrences of that tag. So less code means faster download times.
- **Easy maintenance** – To make a global change, simply change the style, and all elements in all the web pages will be updated automatically.
- **Superior styles to HTML** – CSS has a much wider array of attributes

than HTML, so a far better look can be given to the HTML page in comparison to HTML attributes.

- **Multiple Device Compatibility** – Style sheets allow content to be optimized for more than one type of device. By using the same HTML document, different versions of a website can be presented for handheld devices such as PDAs and cell phones or for printing.
- **Global web standards** – Now HTML attributes are being deprecated and it is being recommended to use CSS. So it's a good idea to start using CSS in all the HTML pages to make them compatible with future browsers.

### 3.3.5. Spring Boot

Spring Boot is an open source Java-based framework used to create a micro Service. It is developed by Pivotal Team and is used to build stand-alone and production ready spring applications.

1. Spring Boot came into existence when in October 2012, a client, Mike Youngstrom made a Jira request asking for bootstrapping the spring framework so that it can be quickly started. And hence in early 2013, Spring Boot was made.
2. In April 2014, Spring Boot 1.0 was created followed by various versions.
3. Spring Boot 1.1 on June 2014,
4. 1.2 in March 2015,
5. 1.3 in December 2016,
6. 1.4 in January 2017 and
7. Spring Boot 1.5 in February 2017.

## Features

- **It avoids heavy configuration of XML which is present in spring:**

Unlike the Spring MVC Project, in spring boot everything is auto-configured. We just need to use proper configuration for utilizing a particular functionality.

For example: If we want to use hibernate(ORM) then we can just add `@Table` annotation above model/entity class(discussed later) and add `@Column` annotation to map it to table and columns in the database

- **It provides easy maintenance and creation of REST endpoints:**

Creating a REST API is very easy in Spring Boot. Just the annotation `@RestController` and `@RequestMapping(/endPoint)` over the controller class does the work.

- **It includes embedded Tomcat-server:**

Unlike Spring MVC projects where we have to manually add and install the tomcat server, Spring Boot comes with an embedded Tomcat server, so that the applications can be hosted on it.

- **Deployment is very easy, war and jar file can be easily deployed in the tomcat server:**

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War or jar files can be directly deployed on the Tomcat Server and Spring Boot provides the facility to convert our project into war or jar files. Also, the instance of Tomcat can be run on the cloud as well.

- **Microservice Based Architecture:**

Microservice, as the name suggests is the name given to a module/service which focuses on a single type of feature, exposing an API(application peripheral interface).

### Setup Spring Boot

1. Setup Java JDK from Oracle's official site.
2. Download and Setup STS(Spring Tools Suite).
3. Start a new spring starter project
  - Click on File -> New -> Spring starter project
  - Fill the appropriate details and add dependency and finish.
  - Edit the application properties.
  - Run the main file as a Java application.

### 3.3.6. Spring JDBC

Spring JDBC module.

All the classes in Spring JDBC are divided into four separate packages:

- **core** — the core functionality of JDBC. Some of the important classes under this package include `JdbcTemplate`, `SimpleJdbcInsert`, `SimpleJdbcCall` and `NamedParameterJdbcTemplate`.
- **datasource** — utility classes to access a data source. It also has various data source implementations for testing JDBC code outside the Jakarta EE container.
- **object** — DB access in an object-oriented manner. It allows running queries and returning the results as a business object. It also maps the query results between the columns and properties of business objects.
- **support** — support classes for classes under *core* and *object* packages, e.g., provides the `SQLException` translation functionality.

### Configuration

Let's start with some simple configuration of the data source.

We'll use a MySQL database:

```
@Configuration
@ComponentScan("com.baeldung.jdbc")
public class SpringJdbcConfig {
    @Bean
    public DataSource mysqlDataSource() {
        DriverManagerDataSource dataSource = new DriverManagerDataSource();
        dataSource.setDriverClassName("com.mysql.jdbc.Driver");
        dataSource.setUrl("jdbc:mysql://localhost:3306/springjdbc");
        dataSource.setUsername("guest_user");
        dataSource.setPassword("guest_password");

        return dataSource;
    }
}
```

Alternatively, we can also make good use of an embedded database for development or testing.

Here is a quick configuration that creates an instance of H2 embedded database and pre-populates it with simple SQL scripts:

```
@Bean
public DataSource dataSource() {
    return new EmbeddedDatabaseBuilder()
        .setType(EmbeddedDatabaseType.H2)
        .addScript("classpath:jdbc/schema.sql")
        .addScript("classpath:jdbc/test-data.sql").build();
}
```

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Finally, the same can be done using XML configuring for the *datasource*:

```
<bean id="dataSource" class="org.apache.commons.dbcp.BasicDataSource">  
    <destroy-method>close</destroy-method>  
    <property name="driverClassName" value="com.mysql.jdbc.Driver"/>  
    <property name="url" value="jdbc:mysql://localhost:3306/springjdbc"/>  
    <property name="username" value="guest_user"/>  
    <property name="password" value="guest_password"/>  
</bean>
```

### 3.3.7. JavaScript

JavaScript is a cross-platform, object-oriented scripting language used to make webpages interactive (e.g., having complex animations, clickable buttons, popup menus, etc.). There are also more advanced server side versions of JavaScript such as Node.js, which allow you to add more functionality to a website than downloading files (such as real time collaboration between multiple computers). Inside a host environment (for example, a web browser), JavaScript can be connected to the objects of its environment to provide programmatic control over them. JavaScript contains a standard library of objects, such as Array, Date, and Math, and a core set of language elements such as operators, control structures, and statements.

JavaScript can be extended for a variety of purposes by supplementing it with additional objects; for example:

Client-side JavaScript extends the core language by supplying objects to control a browser and its Document Object Model (DOM). For example, client-side extensions allow an application to place elements on an HTML form and respond to user events such as mouse clicks, form input, and page navigation.

Server-side JavaScript extends the core language by supplying objects relevant to running JavaScript on a server. For example, server-side extensions allow an application to communicate with a database, provide continuity of information from one invocation to another of the application, or perform file manipulations on a server.

### 3.3.8. MySQL

MySQL is an open-source relational database management system that works on many platforms. It provides multi-user access to support many storage engines and is backed by Oracle. So, you can buy a commercial license version from Oracle to get premium support services.

The features of MySQL are as follows:

**Ease of Management** – The software very easily gets downloaded and also uses an event scheduler to schedule the tasks automatically.

**Robust Transactional Support** – Holds the ACID (Atomicity, Consistency, Isolation, and Durability) property, and also allows distributed multi-version support.

**Comprehensive Application Development** – MySQL has plugin libraries to embed the database into any application. It also supports stored procedures, triggers, functions, views and many more for application development.

**High Performance** – Provides fast load utilities with distinct memory caches and table index partitioning.

**Open Source & 24 \* 7 Support** – This RDBMS can be used on any platform and offers 24\*7 support for open source and enterprise editions.

**Secure Data Protection** – MySQL supports powerful mechanisms to ensure that only authorized users have access to the databases.

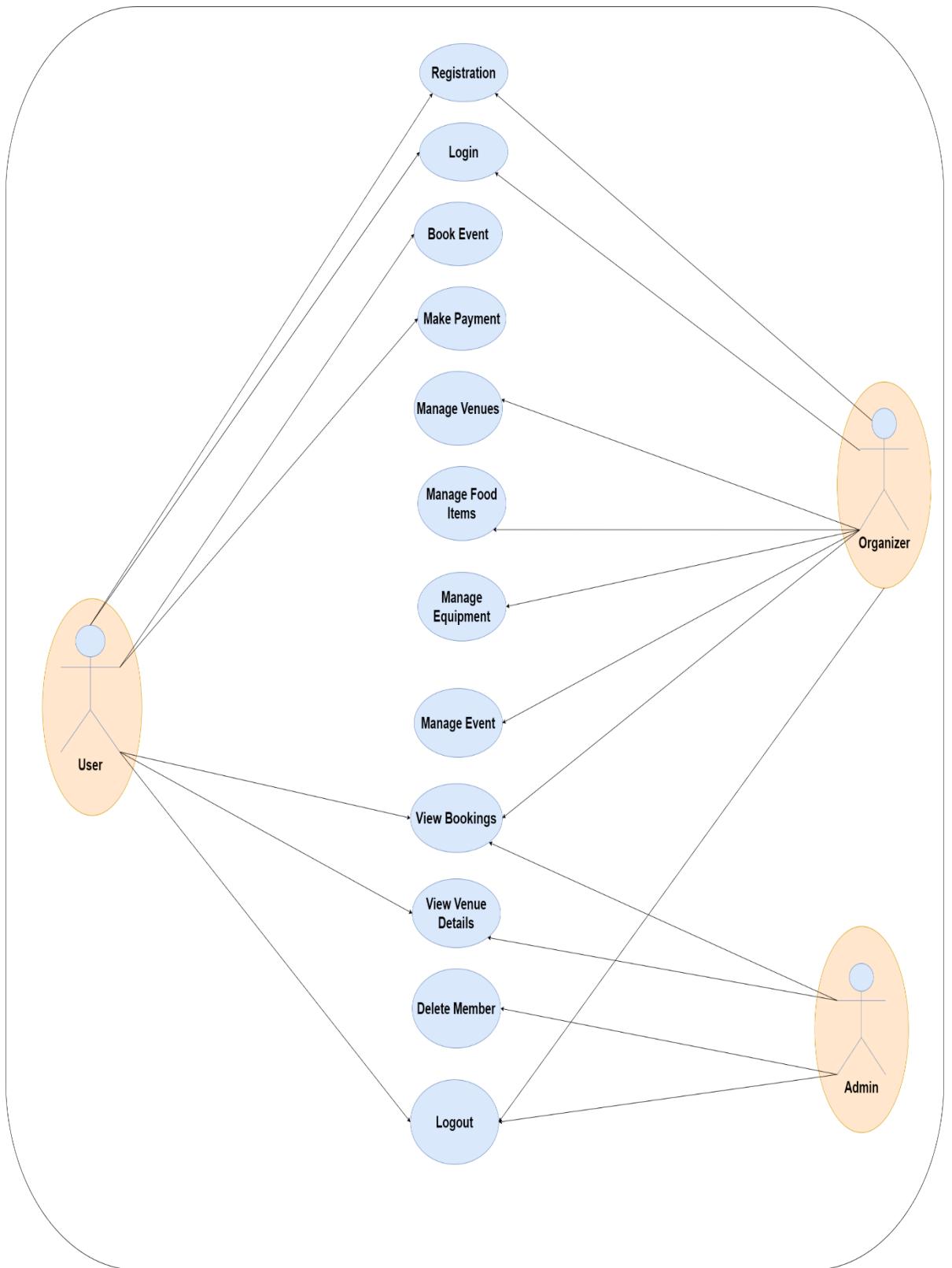
**High Availability** – MySQL can run high-speed master/slave replication configurations and it offers cluster servers.

**Scalability & Flexibility** – With MySQL, one can run deeply embedded applications and create data warehouses holding a humongous amount of data.

## **CROWD MANAGEMENT SYSTEM**

### **3.4. Schematic Diagram**

## CROWD MANAGEMENT SYSTEM



### 3.5. Design

## CROWD MANAGEMENT SYSTEM

### 3.5.1. Table Structure

#### Admin

Field Name	Field Type	Data Type	Mandatory	Possible Values
admin_id	Text	varchar	Yes	Pre-loaded
admin_pwd	Text	varchar	Yes	Pre-loaded

#### Members

Field Name	Field Type	Data Type	Mandatory	Possible Values
member_id	Numeric	int	Yes	Autogenerated
member_type	Drop Down	varchar	Yes	
first_name	Text	varchar	Yes	
last_name	Text	varchar	Yes	
phone_number	Text	varchar	Yes	
email	Text	varchar	Yes	
password	Text	varchar	Yes	

#### Venues

## CROWD MANAGEMENT SYSTEM

Field Name	Field Type	Data Type	Mandatory	Possible Values
venue_id	Numeric	int	Yes	Autogenerated
venue_name	Text	varchar	Yes	
venue_place	Text	varchar	Yes	
venue_cost	Numeric	int	Yes	
venue_contact	Text	varchar	Yes	
member_id	Numeric	int	Yes	

## Bookings

Field Name	Field Type	Data Type	Mandatory	Possible Values
booking_id	Numeric	int	Yes	Autogenerated
event_type	Drop Down	varchar	Yes	
event_date	Date	date	Yes	
guest_count	Numeric	int	Yes	
venue_cost	Numeric	int	Yes	
equipment_cost	Numeric	int	Yes	
food_item_cost	Numeric	int	Yes	
total_cost	Numeric	int	Yes	
payment_status	Text	varchar	Yes	
member_id	Numeric	int	Yes	
venue_id	Numeric	int	Yes	
foodItem_id	Numeric	int	Yes	
equipment_id	Numeric	int	Yes	

## Equipment

## CROWD MANAGEMENT SYSTEM

Field Name	Field Type	Data Type	Mandatory	Possible Values
equipment_id	Numeric	int	Yes	Autogenerated
equipment_name	Text	varchar	Yes	
equipment_cost	Numeric	int	Yes	

## Food\_Items

Field Name	Field Type	Data Type	Mandatory	Possible Values
food_item_id	Numeric	int	Yes	Autogenerated
food_item_name	Text	varchar	Yes	
food_item_cost	Numeric	int	Yes	

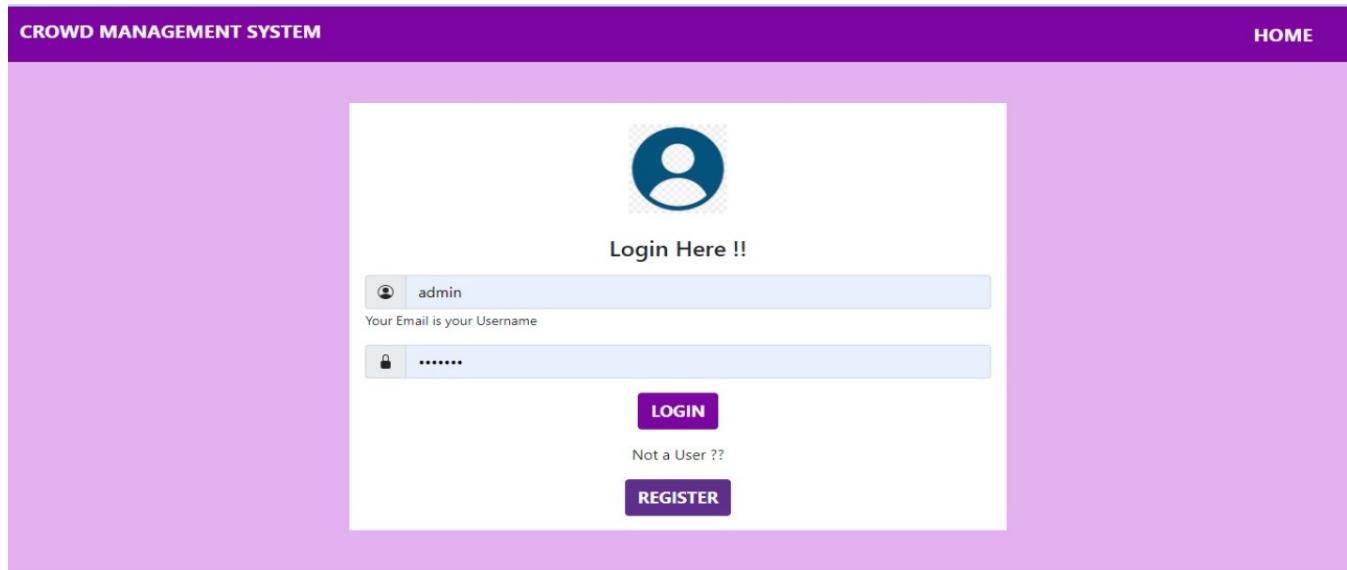
## Notifications

Field Name	Field Type	Data Type	Mandatory	Possible Values
noti_Id	Numeric	int	Yes	Autogenerated
member_id	Numeric	int	Yes	
time	Date	datetime	Yes	
notification	Text	text	Yes	

## Chapter 4

# Outputs

### 4.1. Login



*Dashboard*

## CROWD MANAGEMENT SYSTEM

### 4.2. View Bookings

The screenshot shows the 'All Bookings' page of the Crowd Management System. The left sidebar has a purple background with icons for Home, View Bookings, View Venues, Organizers, and Users. The main content area has a white background. At the top, there are three user status indicators: admin, admin, and Logout. Below this, the page title 'All Bookings' is centered. A table lists three booking entries:

#	Venue	Booked By	Payment Status
6	Govt Hospital	Blessy Roy	Processed
7	Park	Blessy Roy	Pending
8	Govt Hospital	BLESSY user	Processed

The table columns include: #, Venue, Booked By, and Payment Status. The rows are numbered 6, 7, and 8. The 'Details' button for each row is highlighted with a green box.

## CROWD MANAGEMENT SYSTEM

### 4.3. View Venues

The screenshot shows the 'View Venues' page of the Crowd Management System. The left sidebar has links for Home, View Bookings, View Venues (which is selected and highlighted in purple), Organizers, and Users. The main content area shows a table with three rows of venue data:

Name	Place	Contact	Action
Govt Hospital	Trivandrum	8767898767	Details
Park	Kollam	9876567898	Details
Park	ernakulam	9898767876	Details

### 4.4. Organizers

The screenshot shows the 'Organizers' page of the Crowd Management System. The left sidebar has links for Home, View Bookings, View Venues, Organizers (selected and highlighted in purple), and Users. The main content area shows a table with one row of organizer data:

4	sree s	VIEW
4	sree s	VIEW

## 4.5. Users

The screenshot shows the 'CROWD MANAGEMENT SYSTEM' interface. The top navigation bar includes 'admin', 'admin', and 'Logout'. On the left, a sidebar menu lists 'HOME', 'VIEW BOOKINGS', 'VIEW VENUES', 'ORGANIZERS', and 'USERS'. The main content area displays a 'Home / Users' breadcrumb and a 'USERS' section. This section contains two entries in a table:

1	Blessy Roy	<button>VIEW</button>
5	BLESSY user	<button>VIEW</button>

# Reference

- [https://www.udemy.com/share/104y4S3@wYymVIIKvciCuJTXYibBKQpSubnOhcMmhDC\\_A\\_E1mc\\_71Ma83DW3-MpqnFmIWf4xF/](https://www.udemy.com/share/104y4S3@wYymVIIKvciCuJTXYibBKQpSubnOhcMmhDC_A_E1mc_71Ma83DW3-MpqnFmIWf4xF/)
- [https://www.researchgate.net/publication/318058287\\_A\\_Mobile\\_Based\\_Crowd\\_Management\\_System](https://www.researchgate.net/publication/318058287_A_Mobile_Based_Crowd_Management_System)
- <https://www.mdpi.com/2071-1050/14/1/303/pdf>