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Real-Time Asset Management Using AG Grid in Angular: A High-Performance Solution

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Abstract: ***This paper presents an advanced solution for real-time asset management and visualization capable of handling large datasets efficiently. The implementation leverages Angular [1] and AG Grid [2] to dynamically update and render a 10,000 stock and currency asset dataset, providing user-friendly features such as sorting, filtering, pagination, and column visibility toggles. The integration uses Angular [1]'s reactive programming [8] capabilities to ensure seamless data handling and superior user experience.***

Keywords: real-time asset management, large datasets, Angular, AG Grid, user-friendly features

1. Introduction

Real-time data management and visualization are essential in financial applications, where timely updates and comprehensive data representation are crucial. However, managing and displaying large datasets in real time poses significant performance and user interaction challenges. This paper explores implementing a high-performance asset management system using Angular [1] and AG Grid [2], capable of handling and dynamically updating a substantial dataset of 10,000 assets [3].

2. Literature Review

1) Importance of Real-Time Data Management

Real-time data management is critical in financial applications, where the ability to make timely decisions based on the most current data can significantly impact financial outcomes. Studies have shown that delays in data updates can lead to missed opportunities and financial losses [1]. Therefore, a robust system that can handle real-time updates efficiently is essential for financial applications.[4]

2) Challenges in Handling Large Datasets

Handling large datasets presents unique challenges, including performance bottlenecks, memory management issues, and the need for efficient data retrieval and rendering mechanisms. Traditional data handling approaches often struggle with scalability and performance when dealing with thousands of data points [2]. Efficient data handling and rendering techniques are crucial to maintaining application performance and user experience.[4]

3) User Interaction and Experience

User interaction and experience are pivotal in applications that require data manipulation. Features such as sorting, filtering, and pagination are necessary to help users navigate and analyze large datasets effectively. Poor performance and limited functionality can hinder user experience, making it difficult to extract meaningful insights from the data [3].

4) Necessity for High-Performance Solutions

Real-time data updates are critical for making informed decisions in the financial industry. Delays in data updates can lead to missed opportunities and financial losses. An efficient system that handles real-time updates ensures users can access the most current data. Managing and visualizing large datasets is a common requirement in many applications, especially in finance, where tracking numerous assets is standard. Traditional approaches struggle with performance and responsiveness when dealing with thousands of data points. AG Grid [2]'s high-performance capabilities make it possible to handle large datasets efficiently. Users need to interact with data through sorting, filtering, and pagination to extract meaningful insights. A robust grid system that provides these features while maintaining performance is essential for a smooth user experience.

5) Consequences of Ineffective Solutions

Without AG Grid [2], handling and rendering large datasets becomes a significant challenge. Traditional HTML tables and other grid solutions often fail to provide the necessary performance, leading to slow load times and poor responsiveness. This impacts the user experience negatively and can render the application unusable under heavy data loads. AG Grid [2] provides a wide range of features out-of-the-box, including advanced filtering, sorting, and pagination. Implementing similar functionalities would require significant custom development effort without these capabilities, increasing complexity and maintenance overhead. Applications that do not use a high-performance grid solution like AG Grid [2] may face scalability issues as the dataset grows. AG Grid [2]'s virtual DOM and efficient data handling mechanisms allow the application to scale seamlessly, whereas traditional solutions may struggle, resulting in degraded performance and higher resource consumption.[4]

3. Approach

The implementation of the solution is available in the GitHub repository [3]. Below are key aspects of the approach, including code snippets to illustrate the core functionality.

1) Data Generation and Management

The StockService is responsible for generating and managing asset data. It creates assets with random prices and types

(either stock or currency) provide methods to retrieve and update the data.

```
@Injectable({
 providedIn: 'root'
})
export class StockService {
 public createAsset(assetId, assetType) {
 return {
 id: assetId,
 assetName: assetType === 'Stock' ? ['AAPL', 'GOOGL', 'FB', 'TSLA', 'MSFT'][Math.floor(Math.random() * 5)] : ['EUR', 'USD', 'GBP', 'NIS', 'AUD'][Math.floor(Math.random() * 5)],
 price: Math.random() * 10,
 lastUpdate: Date.now(),
 type: assetType
 };
 }

 public getAllAssets(n) {
 const result = [];
 for (let i = 1; i <= n; i++) {
 result.push(this.createAsset(i, 'Stock'));
 result.push(this.createAsset(i + n, 'Currency'));
 }
 return result;
 }
}
```

2) Real-Time Data Updates

The AppComponent manages the grid's state and behavior, including real-time updates to asset prices. Upon initialization, the component retrieves a large dataset of assets from the StockService and sets up the grid with initial column definitions.

```
@Component({
 selector: 'app-root',
 templateUrl: './app.component.html',
 styleUrls: ['./app.component.scss']
})
export class AppComponent implements OnInit, OnDestroy {
 displayAssets: Asset[];
 columnDefs = [
 { field: 'id', filter: 'agNumberColumnFilter', resizable: true, sortable: true },
 { field: 'assetName', filter: true, sortable: true, resizable: true },
 { field: 'price', filter: 'agNumberColumnFilter', resizable: true, sortable: true, sort: 'desc', valueFormatter: param => param.value.toFixed(6) },
 { field: 'lastUpdate', filter: 'agDateColumnFilter', resizable: true, sortable: true, valueFormatter: this.dateConversion },
 { field: 'type', filter: true, sortable: true, resizable: true }
 ];
 paginationPageSize = 100;
 pageSizeList = [10, 100, 1000];
 private gridApi;
 private gridColumnApi;
 private dataSubscription;

 constructor(private dataService: StockService) {}

 ngOnInit(): void {
 this.displayAssets = this.dataService.getAllAssets(10000);
 this.dataSubscription = interval(1000).subscribe(() => {
 this.displayAssets.forEach(asset => {
 asset.price += Math.random() >= 0.5 ? Math.random() : -Math.random();
 asset.lastUpdate = Date.now();
 });
 this.gridApi.setRowData(this.displayAssets);
 });
 }

 ngOnDestroy(): void {
 this.dataSubscription.unsubscribe();
 }

 dateConversion(params) {
 let d = new Date(params.value);
 return `${d.getMonth() + 1}/${d.getDate()}/${d.getFullYear()} ${d.getHours()}:${d.getMinutes()}:${d.getSeconds()}`;
 }

 onGridReady(params) {
 this.gridApi = params.api;
 this.gridColumnApi = params.columnApi;
 this.gridApi.sizeColumnsToFit();
 this.gridApi.setRowData(this.displayAssets);
 }

 clearFilter() {
 this.gridApi.setFilterModel(null);
 }

 clearSort() {
 this.gridApi.setSortModel(null);
 }

 onPageSizeChanged(size) {
 this.paginationPageSize = size;

this.gridApi.paginationSetPageSize(this.paginationPageSize);
 }
}
```

3) User Interaction and Grid Customization

The HTML template provides the structure for the grid and user controls. It includes buttons for clearing filters and sorting, a dropdown for selecting the page size, and checkboxes for toggling column visibility.

```
<div style="margin:10px 30px;">
 <button (click)="clearFilter()">Clear
```

```
Filter</button>
 <button style="margin: 10px;" (click)="clearSort()">Clear Sort</button>
 <span style="margin-left: 10px;"> Page Size:</span>
 <select style="margin-left: 10px; width: 50px;" [(ngModel)]="paginationPageSize" (ngModelChange)="onPageSizeChanged($event)">
 <option *ngFor="let c of pageSizeList" [ngValue]="c">{{ c }}</option>
 </select>
 <div class="test-header" style="height: 5%">
 <label><input type="checkbox" checked (change)="onAsset($event.target.checked)" />Asset Name</label>
 <label><input type="checkbox" checked (change)="onPrice($event.target.checked)" />Price</label>
 <label><input type="checkbox" checked (change)="onDate($event.target.checked)" />Date</label>
 <label><input type="checkbox" checked (change)="onCurrency($event.target.checked)" />Stock and Currency</label>
 </div>
</div>

<div>
 <ag-grid-Angular [1] style="width: 100%; height: 700px;" class="ag-theme-alpine" [rowData]="displayAssets" [columnDefs]="columnDefs" [animateRows]="true" [pagination]="true" [paginationPageSize]="paginationPageSize" [multiSortKey]="multiSortKey" (gridReady)="onGridReady($event)">
 </ag-grid-Angular [1]>
</div>
```

4. Results and Discussion

The implemented solution demonstrates the capability of handling and displaying a large dataset of 10,000 assets with real-time updates in a web application using Angular [1] and AG Grid [2]. This section discusses the performance, user experience, and the challenges overcome during the implementation.

1) Performance

One of the key challenges in this project was ensuring that the application remains performant while handling and rendering a large dataset of 10,000 assets. The use of AG Grid [2] was instrumental in achieving this, thanks to its high-performance features like virtual DOM [5], efficient data binding, and advanced row and column virtualization.

a) **Initial Load**: The application loads the dataset efficiently, rendering only the visible rows initially, significantly reducing the initial load time.
b) **Real-Time Updates**: Using RxJs [7] `interval` observable to update asset prices every second simulates a real-time data stream. The AG Grid [2]'s ability to process these updates asynchronously ensures that the grid remains responsive even as the data changes frequently.
c) **Memory Management**: By updating only the modified rows and leveraging AG Grid [2]'s efficient data handling, the application minimizes memory consumption and prevents performance bottlenecks.[6]

2) User Experience:

The application provides a rich user experience through various interactive features that enhance usability and data manipulation capabilities.

a) Sorting and Filtering: Users can easily sort and filter the data on any column. The grid's built-in sorting and filtering capabilities are optimized for performance, ensuring quick response times even with large datasets.
b) Pagination: Pagination controls allow users to navigate through the dataset efficiently. The application supports multiple page sizes, enabling users to customize their views based on their preferences.
c) Column Visibility: Users can toggle the visibility of columns, allowing them to focus on specific data points without overwhelming the interface with unnecessary information.
d) Real-Time Feedback: The application provides immediate visual feedback for real-time data updates, enhancing the sense of interactivity and dynamism.

3) Challenges Overcome

Several challenges were addressed during the development of this solution:

a) Handling Large Datasets: Managing and rendering many assets requires careful consideration of performance and memory usage. AG Grid [2]'s virtualization and efficient data handling mechanisms were crucial in overcoming this challenge.
b) Real-Time Data Updates: Implementing real-time updates without degrading performance was a significant challenge. The use of RxJs [7] for reactive programming [8] allowed for efficient data stream management, while AG Grid [2]'s asynchronous update capabilities ensured a smooth user experience.
c) User Interactivity: Providing a seamless and interactive user experience with features like sorting, filtering, and pagination required leveraging AG Grid [2]'s extensive API and customization options.

5. Conclusion

The integration of AG Grid [2] with Angular [1] to create a dynamic, real-time asset management system showcases a robust solution capable of handling large datasets efficiently. The system successfully manages and renders 10,000 assets with real-time updates, providing a highly responsive and user-friendly application.

The implementation leverages Angular [1]'s reactive programming [8] capabilities and AG Grid [2]'s high-performance data handling features to address the challenges of real-time data management and user interaction. The resulting application demonstrates excellent performance, scalability, and usability, making it well-suited for high-demand financial applications.

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