BABEŞ-BOLYAI UNIVERSITY CLUJ-NAPOCA
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SPECIALIZATION COMPUTER SCIENCE IN ENGLISH

DIPLOMA THESIS

Revolutionizing Personal Finance with Smart Technology for Enhanced Budgeting Efficiency

Supervisor
Docent Dr. Crăciun Florin

Author
Șipoș Lucas George

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ABSTRACT

This thesis explores the development and impact of Budget Buddy, an innovative web application designed to revolutionize personal finance management. Budget Buddy addresses common challenges in expense tracking through automation and user-friendly features, enhancing accuracy and efficiency in financial management. The application integrates the 50/30/20 budgeting strategy, tailored to various income levels, to promote balanced financial planning.

Budget Buddy's core objectives include simplifying personal finance, educating users on financial literacy, ensuring cross-device accessibility, and prioritizing data security and privacy. Theoretical foundations encompass expense tracking concepts, financial management theories, and behavioral finance insights, all contributing to the application's robust framework.

The study employs a mixed-method research design, involving qualitative and quantitative approaches to evaluate user needs and application performance. Key features discussed include expense recording, budget setting, and comprehensive reporting through visualizations like donut charts, which offer clear insights into spending patterns by category, payment method, and type.

Comparative analysis with existing solutions highlights Budget Buddy's advantages in terms of accessibility, cost-efficiency, and user engagement. The application leverages modern technologies such as cloud-based systems and secure authentication methods to provide real-time data synchronization and robust security measures.

In conclusion, Budget Buddy represents a significant advancement in the FinTech sector, making personal finance management more accessible, efficient, and user-friendly. The thesis also discusses future development recommendations and the potential for further enhancing the application's capabilities to better serve a diverse user base.

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Chapter 1

Introduction

In the introductory chapter, we begin our exploration of Budget Buddy, an innovative web application that aims to revolutionize personal finance management. Budget Buddy combines visual appeal with simplistic usage, utilizing an intuitive registration process for instant customization and an aesthetically pleasing interface—all without requiring any payments or subscriptions—to address the challenges of adulthood and the need for a more straightforward approach to managing your spending.

The chapter goes into the persistent problem regarding expense tracking, which has typically been compromised by human error and the possibility of inaccuracy. Budget Buddy solves this through automation, with features such as cost classification and financial data analysis to help you spend and save more wisely.

The application's main goals are to simplify personal finance, integrate the budgeting strategy 50/30/20 for balanced financial planning, educate users about financial literacy, guarantee cross-device accessibility, and give security and privacy top priority. Budget Buddy wants to enable everyone to manage their personal finances in an easy, secure, and accessible way by achieving these goals.

This study examines the development and impact of Budget Buddy, focusing on design, functionality, and user feedback. It highlights the application's role in the FinTech sector, enhancing financial understanding and making personal money management simpler and more efficient.

1.1 Overview of the Project

These days, the availability of electronic devices like Personal Computers (PCs), laptops, smartphones, smartwatches, Virtual Reality (VR) headsets, and any other way of displaying software applications has made our lives a lot easier and has dramatically accelerated the time taken for any daily activity.

One task that I was never looking forward to and found it hard and more daunting as I have begun to intersect with it more often, due to the transition to the realm of adulthood after starting university, is managing my own expenses and trying to get through the week without having to think about what I buy and where my money goes.

That is where it all began. I have started looking into this matter and discovered a bunch of ways to save money as well as several methods that can automate some statistics on your overall expenses. I have even found applications that will use many different strategies to lower the amount of money wasted on unnecessary items.

The most frequently encountered problems with the above processes revolve around the following two primary variables:

- the setup takes way too long, and it is visually unpleasant but free;
- the setup is just logging into your account, but the membership is somewhat expensive.

After gathering all the necessary information, I have come up with the concept of creating Budget Buddy, an online web application that will combine the best elements of the points listed above, meaning the app will leverage the login mechanism not just for authentication but also as a trigger for the dynamic setup. This guarantees that user preferences and configurations are established at the very first interaction. Beyond this setup process, the application displays a visually pleasing, futuristic, and simple User Interface (UI), making sure that the design elements are aesthetically pleasing and intuitive for the User Experience (UX). Furthermore, the application will not require any type of membership, subscription, or payment to use it.

1.2 Problem Statement

Keeping track of personal or business expenses is a plan to manage finances more effectively, and it is essential to sticking to a budget. From the beginning of time, people used to keep tabs on their spending by writing it all down using the pen and paper method or by taking notes on a mobile phone or a computer. This type of process would require further computation, and mistakes could have been made along the way.

The goal is to understand spending patterns, identify wasteful spending, and improve budgeting techniques to enhance financial well-being. An effective expense tracking program automates the processes involved in collecting and categorizing

data. It should have features like a database with all personal spending, expense classification, analysis of past financial data, and a clear summary of the user's financial portfolio in an easy-to-understand format. This allows users to cut down on unnecessary costs and increase their savings over time.

Let me give you a real-life example. Let's say the user is a student who juggles between studies and work, and now he finds out that keeping track of personal expenses is a must if he wants to have some savings and maybe set up some goals to go on different holidays. Some people would argue that there are a lot of templates on Microsoft Excel, as shown in (Figure 1.1), but there are several problems with this method such as: taking too much time to set up the template or creating one, a beginner would have a hard time creating a complex template, excel files are exposed to corruption, accidental data deletion and loss if not properly backed up and overall it lacks of visual design.

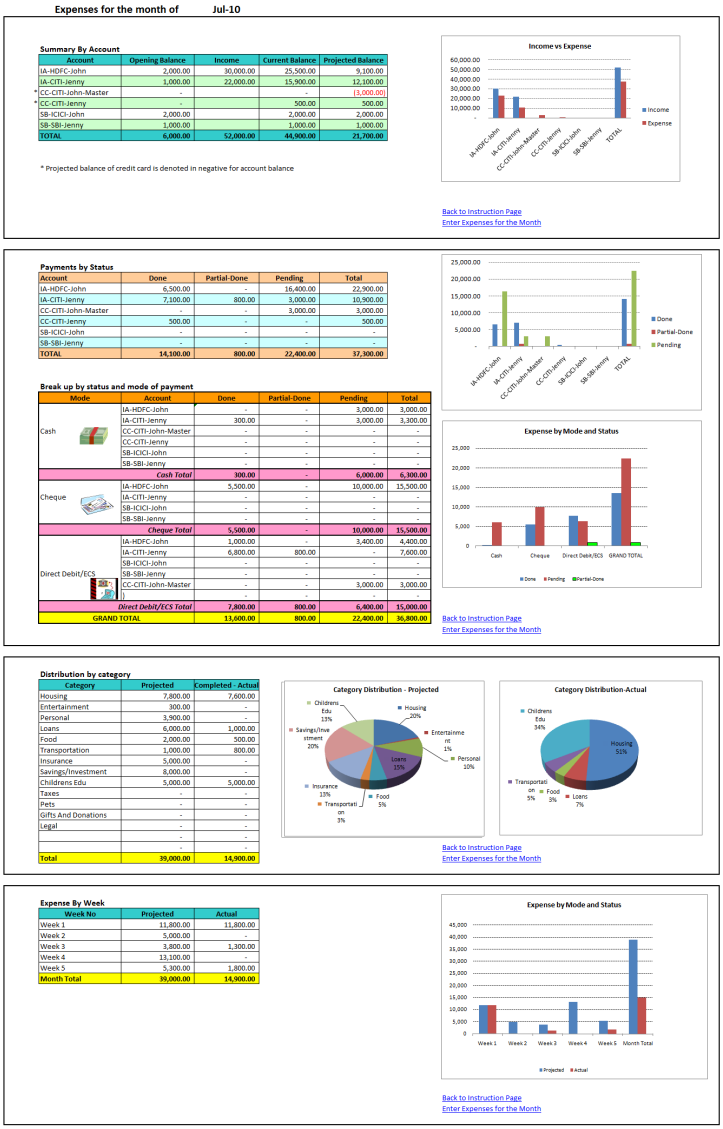

Figure 1.1: Microsoft Excel template to track expenses [aC10]

> "Designing better user interface to improve the system usability has attracted the attention of Human-Computer Interaction (HCI) researchers and practitioners for almost five decades." [Isl15]

1.3 Objectives of the Expense Tracker Application

The primary objective of the Budget Buddy application is to be a sophisticated online web application designed to revolutionize personal finance management. At its very core, the application aims to address common financial planning and budgeting challenging circumstances faced by individuals, offering a user-friendly, efficient, and visually pleasing platform for tracking expenses and managing budgets.

The application's first goal is to make personal money management easier and less time-consuming. The program breaks down the processes of budgeting through providing users with simple tools that allow them to manage their spending, income, and savings, making them accessible to the general public of all financial literacy different levels.

The integration of the 50/30/20 budgeting strategy is essential to the operation of the application. According to this plan, one should set aside 50% of their income for necessities, 30% for wants so that they can enjoy life while also planning for the future, and 20% for debt repayment and savings. The application provides real-time feedback and adjustments in order to ensure dedication to these budgetary guidelines, in addition to guiding users through the process of setting up their budgets so that they comply with this principle.

Educating users about financial literacy and discipline is among the primary objectives of the Budget Buddy. Thanks to the use of interactive features, detailed statistics, and personalized guidance regarding finances, the software informs users about the value of careful financial planning and motivates them to develop responsible spending practices.

Budget Buddy is an online web application, therefore it is meant to be globally accessible from a variety of devices, allowing users to manage their expenses from anywhere at any time. The goal of the application's aesthetically beautiful UI and captivating UX is to keep users' levels of happiness and engagement high.

The expense tracker was designed with security and privacy as top priorities. Modern security procedures are used by the program to safeguard user data, guaranteeing that private financial information is kept secure and out of the hands of unwanted outsiders.

In this study, we will explore the development and impact of Budget Buddy, covering its design, functionality, and user impact. The methodology includes a comprehensive analysis of financial management theories, user feedback, and testing

methods employed to refine the application. This will provide a broader viewpoint of the application's effectiveness and areas for future improvement.

This research has significance for its contribution to the Financial Technology (Fintech) sector, which includes in enhancing financial understanding and accessibility through technology. Budget Buddy is a step forward in making personal money management simpler and more efficient to a wide variety of users.

1.4 Structure of the Thesis

This thesis is structured into seven chapters, each covering a distinct aspect of the research:

Chapter 2: Theoretical Framework

This chapter discusses foundational theories and concepts related to expense tracking and financial management.

Chapter 3: Implementation

This chapter provides a comprehensive overview of Budget Buddy's implementation, including architecture, data management, budgeting features, and insightful visualizations for effective financial management.

Chapter 4: Experiments and Discussion

This chapter compares Budget Buddy with existing solutions and explores the impact of technology on personal finance management.

Chapter 5: Conclusion and Future Work

This chapter summarizes achievements, discusses limitations, and provides recommendations for future development.

Chapter 2

Theoretical Framework

In this chapter, we explore the foundational theories and technological frameworks that shape the development of Budget Buddy, an application designed to assist with personal financial management. We start with the basics of expense tracking, defining what it is, how it's done, and why it's so crucial for managing finances effectively. We then dive into various financial management theories, focusing particularly on how the 50/30/20 budgeting rule is adapted within Budget Buddy to suit different income levels. Additionally, we discuss the technologies and methodologies that have been utilized in building the application, including aspects of software development, user interface design, and security measures. This chapter aims to provide a clear understanding of both the theoretical and technical aspects that make Budget Buddy a reliable and user-friendly tool for financial management.

2.1 Concepts of Expense Tracking

Definition and Purpose

When it comes to expense tracking, I always think that it is a systematic process used to record and analyze personal or business spending over a period of time. The primary purpose of this activity is to gain a clear understanding of where money is being spent, which assists individuals or organizations in making informed financial decisions. In personal finance, tracking expenses is crucial for effective budget management, ensuring that spending aligns with financial goals and available resources.

Methods of Expense Tracking

Expense tracking can be executed through various methods, each with its own set of advantages and limitations. The traditional approach involves manual entry

of expenses on a paper or writing it down into a diary. This method, while straightforward, can be time-consuming and vulnerable to human error. In contrast, digital methods, facilitated by software applications and online tools, offer automated tracking features such as categorization of expenses and automatic reminders on recursive payments also known as subscriptions. These digital tools not only enhance accuracy, but also provide real-time insights into one's financial status.

Keeping track of expenses is very important to personal financial management. People are capable of finding unnecessary expenses, minimize overspending, and achieve maximum potential of their savings by maintaining an accurate record of all their transactions. Reducing debt or saving for an important purchase are two scenarios that demonstrate financial objectives that can be met with the help of effective expense tracking. Furthermore, this technique promotes financial discipline, which is essential for establishing long-term financial stability.

Behavioral Impact of Expense Tracking

Continuously keeping an eye on spending habits has a significant influence on how individuals allocate their financial resources. According to the behavioral economics hypothesis [MT00], people are more likely to form wise financial practices when they are continuously conscious of their spending patterns. For instance, you might say keeping a monthly cost record is capable of helping one become more cautious of impulsive buying behaviors and make more thoughtful decisions regarding money. On top of that, seeing a graphic representation of each month's spending could stimulate people to change their financial actions for the benefit of themselves.

The use of technology has moved forward to the point that expense tracking tools have evolved from paper-based systems to more complicated digital ones. Loaded with functionalities and features, expense tracking software includes visual rendering techniques for budgetary limitations, graphical representations of spending patterns, automatic expense statistics, and classification by different categories. These features improve the user's interaction with their financial information as well as simplifying the tracking process.

Evolution of Expense Tracking

The evolution of technology, particularly with the introduction of mobile computing, has significantly had an important effect on the ongoing development of expense tracking. The capability to maintain records of expenses while on the go is now possible with today's technology, which is a major improvement over manual data entry techniques that require being stationary. By providing real-time data syn-

chronization across numerous devices, cloud-based technologies' accessibility has further changed this industry and given people access to their financial information whenever and wherever they need it.

2.2 Financial Management Theories

As one of the inspiring articles for this application clearly stated:

"You don't have to be rich to save money." [MMS+19]

Therefore, there is nothing such as rich people's responsibilities when talking about saving money; therefore, in this section, we will be diving into a more detailed and well-organized manner of the strategies and theories used for the development of Budget Buddy.

Basic Theories of Budgeting

Budgeting is an essential component of effective financial management. It involves budgeting income and expenses over a certain amount of time to ensure financial stability and the accomplishment of objectives. Furthermore, there are several budgeting systems available, each customized to individual financial situations and goals, and here are four of the most important ones, as highlighted in the following article [Ins23]:

- ***Incremental Budgeting:*** Adjusts last year's budget by a particular percentage; straightforward, but may aggravate inefficiency and neglect external factors.
- ***Activity-Based Budgeting:*** Links budget to activities needed to achieve revenue targets, matching expenses with company objectives.
- ***Value Proposition Budgeting:*** Assesses the value each budget item brings to stakeholders, focusing on eliminating non-value-adding costs.
- ***Zero-Based Budgeting:*** Starts from zero each period, requiring justification for every expense, suited for intense cost control scenarios.

These traditional approaches provide a disciplined approach to financial management, but they may not be applicable in all modern economic circumstances, therefore requiring modifications such as the 50/30/20 strategy.

2.2.1 Customizations of the 50/30/20 Rule in Budget Buddy

The 50/30/20 rule, popularized by Elizabeth Warren [WT05], suggests dividing after-tax income into three categories: 50% for needs, 30% for wants, and 20% for savings. Budget Buddy changes this rule in order to reflect more realistic financial scenarios across various categories of income, understanding that the ability to save, invest, and spend on non-essentials may vary tremendously. The following is a detailed look at how Budget Buddy customizes the 50/30/20 guidelines for various income brackets:

Low Level Income

Income Bracket:

- Individuals earning up to $25,000 annually.
- Households earning up to $40,000 annually.

Allocation Strategy:

- **Essentials (60-70%):** This category might take up a larger portion of the budget due to the relatively fixed costs of essentials like housing, utilities, and food.
- **Debt Repayment (10-15%):** Focus on minimum payments and use any debt relief programs available to lower interest rates or negotiate better terms.
- **Discretionary Spending (5-20%):** Limited, with careful planning around non-essential expenses to ensure there's room for enjoyment.
- **Savings (10-15%):** Saving might be more challenging, emphasizing the importance of building an emergency fund even if it's a small amount each month.

Middle Level Income

Income Bracket:

- Individuals earning between $25,000 and $75,000 annually.
- Households earning between $40,000 and $125,000 annually.

Allocation Strategy:

- **Essentials (50-60%):** There may be a bit more flexibility in housing and transportation choices, but it's still important to live within or below one's means.

- **Debt Repayment (10-20%):** Continue to focus on paying down high-interest debts and consider using extra funds to accelerate repayment.
- **Discretionary Spending (10-20%):** More room for discretionary spending, but still important to make mindful choices to support savings goals.
- **Savings (20-30%):** With increased income, there's more opportunity to save for emergencies, retirement, and other financial goals.

High Level Income

Income Bracket:

- Individuals earning between $75,000 and $200,000 annually.
- Households earning between $125,000 and $250,000 annually.

Allocation Strategy:

- **Essentials (40-50%):** High earners may spend a lower percentage of their income on essentials, giving them greater flexibility in lifestyle choices.
- **Debt Repayment (5-10%):** Preferably, high earners will have minimal high-interest debt, allowing for more funds to be allocated towards savings or investments.
- **Discretionary Spending (10-15%):** While there's more room for discretionary spending, maintaining discipline ensures long-term financial health and goal achievement.
- **Savings (30-40%):** The ability to save significantly more provides opportunities for aggressive investment in retirement accounts, stock portfolios, and other wealth-building tools.

Very High Level Income

Income Bracket:

- Individuals earning above $200,000 annually.
- Households earning above $250,000 annually.

Allocation Strategy:

- **Essentials (30-40%):** Essentials may represent an even smaller portion of the budget, potentially leading to higher quality choices in housing, food, and healthcare.
- **Debt Repayment (0-10%):** Debt is likely to be low-interest or strategic (e.g. mortgage), with the option to pay down faster if desired.
- **Discretionary Spending (10-30%):** There is plenty of room for discretionary spending, but making responsible choices and investing in personal and family growth is extremely important.
- **Savings (40-50%):** At this point, increasing your contributions to accounts with tax advantages and learning about additional investing opportunities become essential as well.

This customized method understands that money management influences how one should ideally budget, allowing Budget Buddy to effectively serve an even wider range of users.

Behavioral Finance in Personal Budgeting

As discussed in [Sta17] behavioral finance studies the effects of psychological influences on individuals' financial decisions and the resulting impact on economics. It explains why people make irrational financial decisions and how to overcome these habits.

- ***Cognitive biases:*** Many financial decisions are influenced by overconfidence, in which people overestimate their financial management skills and place too much attention on past reference points.
- ***Emotional factors:*** Emotions might lead to reckless spending or overly cautious investing.

Understanding these aspects is critical when designing a software like Budget Buddy, which tries to educate users toward more rational, good financial behaviors through organized budgeting and expense tracking.

2.3 Tech Frameworks in Application Development

Software Development Lifecycle (SDLC)

Budget Buddy used a commonly shortened SDLC. Instead of using traditional iterative methodologies like Agile or Waterfall, the application was developed in a more linear, "all at once" manner. This strategy can come in handy for smaller projects or when working under tight deadlines because it allows for quick development and deployment. However, careful planning and organization will be needed to ensure that all components work together smoothly when launched.

UI & UX Design

Budget Buddy's UI/UX design revolves around simplicity and visual appeal. The goal is to create an intuitive and engaging user interface that improves the user experience without adding unnecessary complexity. The idea behind this design is to ensure that the program is accessible to a wide range of users, thereby increasing its usefulness and satisfaction.

Security and Data Privacy

Security is a critical component of Budget Buddy, especially considering its handling of personal financial data. The application leverages Open Authorization (OAuth) with a Google provider for authentication, allowing users to safely log in without Budget Buddy having to store passwords directly. Furthermore, a middleware is implemented to restrict access to the application, blocking all pages except the main page for users who are not logged in. This not only secures the user data but also simplifies the security model, as unauthorized access to any sensitive information is effectively prevented.

2.4 Research Design

A mixed-method approach was adopted in the study design for Budget Buddy, incorporating aspects of both qualitative and quantitative research. The above technique was utilized in order to test the application's performance and usability statistically and to gain an in-depth understanding of the demands and preferences of the users.

User Research

The first stage of the study includes a detailed review of user viewpoints and

a comprehensive investigation of the most recent financial management software. Throughout this process, several programs were reviewed, and ideas from every component have been taken into consideration to make sure Budget Buddy would be aesthetically pleasing and easy to understand eliminating unnecessary complexity for the average person who uses it.

This method focused into current techniques rather than only surveys and interviews to learn more about user preferences and typical financial management problems. With an emphasis on user-oriented design principles, the research attempted to influence Budget Buddy's development by looking at various perspectives while taking functionality into account straightaway.

In order to guarantee that Budget Buddy smoothly corresponds to the needs as well as interests of its target user base, this in-depth study was indeed extremely important in defining the product's fundamental features and functions.

Prototype Development and Testing

Prototype development involved a rigorous process of testing after a thorough investigation of current apps and user experiences. The testing included deep examinations of animations, transitions, color schemes, back-end responses, and front-end user interface components, borrowing inspiration from an extensive spectrum of popular software applications.

The testing procedure has been carefully designed to guarantee detailed input on each component of the user interface and the functionality of the application. The primary concern was closely examining the subtle aspects of front-end design components, back-end system responses, and interactions with the user. The objective of this technique was to gather complete insights and understand potential places for enhancement within the user experience spectrum.

By closely examining many different aspects that I have talked about earlier, I gradually enhanced Budget Buddy with animations, transitions and Cascading Style Sheets (CSS) for user interface elements. This gave me the opportunity to use the concepts of user-centered design patterns, ensuring that the application both met and exceeded user expectations.

Inspiration for Budget Buddy Development

Mint [Inc07] is a popular personal finance management app that offers features like expense tracking, budgeting tools, and credit score monitoring. It provides insights into spending habits and helps users set financial goals.

PocketGuard [Inc14] is a budgeting app that tracks spending, analyzes bills, and helps users optimize their finances. It provides insights into how much users can

safely spend after accounting for bills and savings goals.

Wally [Inc13] is a simple expense tracking app that allows users to manually log expenses, set budget goals, and visualize spending patterns. It's known for its intuitive interface and customizable budgeting tools.

EveryDollar [Sol15] is a budgeting app created by financial expert Dave Ramsey. It follows a zero-based budgeting approach and helps users plan their monthly budgets, track expenses, and achieve their financial goals.

Chapter 3

Implementation

This chapter delves into the implementation of Budget Buddy, exploring its architectural design, expense and subscription recording functionalities, and data visualization through donut charts. We discuss the application's structure, the MUI-X DataGrid component's role in efficient data management, and the importance of budget setting and monitoring features. The chapter also highlights how donut charts visualize expenses by category, payment method, and type, empowering users with insights for informed financial decision-making. Examining these key aspects provides a comprehensive overview of Budget Buddy's capabilities in promoting financial awareness and effective budgeting.

3.1 Budget Buddy's Architecture

In this section, we will explore the architecture of Budget Buddy, detailing how the components work together, routing within the Next.js framework, database improvements, the database schema, component schema, server-side routing, and layout for the entire application. Additionally, we will touch on middleware functionalities to provide a comprehensive understanding of the application structure.

Main Layout

Budget Buddy's primary layout (Figure 3.1) serves as the application's structural backbone. It consists of several particularly important components:

- **Navbar:** The Navbar functions as the primary navigation tool, facilitating user movement between different sections of the application.
- **Providers:** These components operate behind the scenes, managing essential aspects such as user preferences and thematic elements, ensuring a solid and consistent user experience.

```tsx
export const metadata: Metadata = {
    title: "Budget Buddy",
    description: "Streamline your finances with Budget Buddy, your go-to app for effortless expense tracking and budgeting.",
    icons: [
        {rel: 'icon', url: '/icon.png'},
        {rel: 'apple', url: '/icon.png'},
    ],
};

no usages  Sipos-Lucas-George
export default function RootLayout({children}: Readonly<{
    children: React.ReactNode;
}>) {
    return (
        <Provider>
            <html lang="en">
            <body className="h-screen flex flex-col">
            <AppRouterCacheProvider>
                <ThemeProvider theme={theme}>
                    <SettingsProvider>
                        <Navbar/>
                        {children}
                    </SettingsProvider>
                </ThemeProvider>
            </AppRouterCacheProvider>
            </body>
            </html>
        </Provider>
    );
}
```

Figure 3.1: Root Layout code

- **Pages:** The individual pages, such as the Home page, Subscriptions page, and Expenses page, constitute the content areas where users interact with the application's features.

These components communicate and share data effortlessly using React's context API and props mechanism, resulting in efficient exchange of information.

3.1.1 Front-End Routing

The front-end routing in Budget Buddy ensures a straightforward navigation experience for users. The main routes are:

- **Home ("/"):** The home page provides an overview of the application with some introductory text.
- **Subscriptions ("/subscription"):** This page enables users to manage their recurring payments, such as those for streaming services or gym memberships or any kind of repeatable payment. The MUI-X DataGrid component facilitates the convenient addition, editing, and removal of subscription details in a tabular format.
- **Expenses ("/expenses"):** This page provides a comprehensive interface for managing expenses. The user is presented with a visual representation of a

calendar month and can choose the day in which he wants to add data to using the MUI-X DataGrid or, using breadcrumbs, the client can choose to see a visual representation of the data in that month.

3.1.2 Back-End Routing

Server-side routing in Budget Buddy is handled through Next.js API routes. Here are the key API endpoints:

- **"/api/auth/[...nextauth]":** Handles Google sign-in authentication.
- **"/api/daily_expenses/[userId]":** Fetches expenses for a specific day and the possible subscriptions due on that day.
- **"/api/expense/[id]":** Allows adding, updating, and deleting an expense.
- **"/api/expenses":** Enables deletion of multiple expenses.
- **"/api/monthly_expenses/[userId]":** Provides monthly expense data and statistics via a POST request.
- **"/api/subscription/[id]":** Allows adding, updating and deleting subscriptions.
- **"/api/subscriptions":** Enables deletion of multiple subscriptions.
- **"/api/subscriptions/[userId]":** Retrieves a user's subscriptions.
- **"/api/user_settings/[userId]":** Fetches and updates a user's settings.

3.1.3 Database Schema and Component Schema

The database stores all user-related data, including settings, expenses, and subscriptions. The database schema, or structural plan, guarantees that data is organized and returned efficiently (Figure 3.2).

The component schema illustrates how various components interact with each other (Figure 3.3).

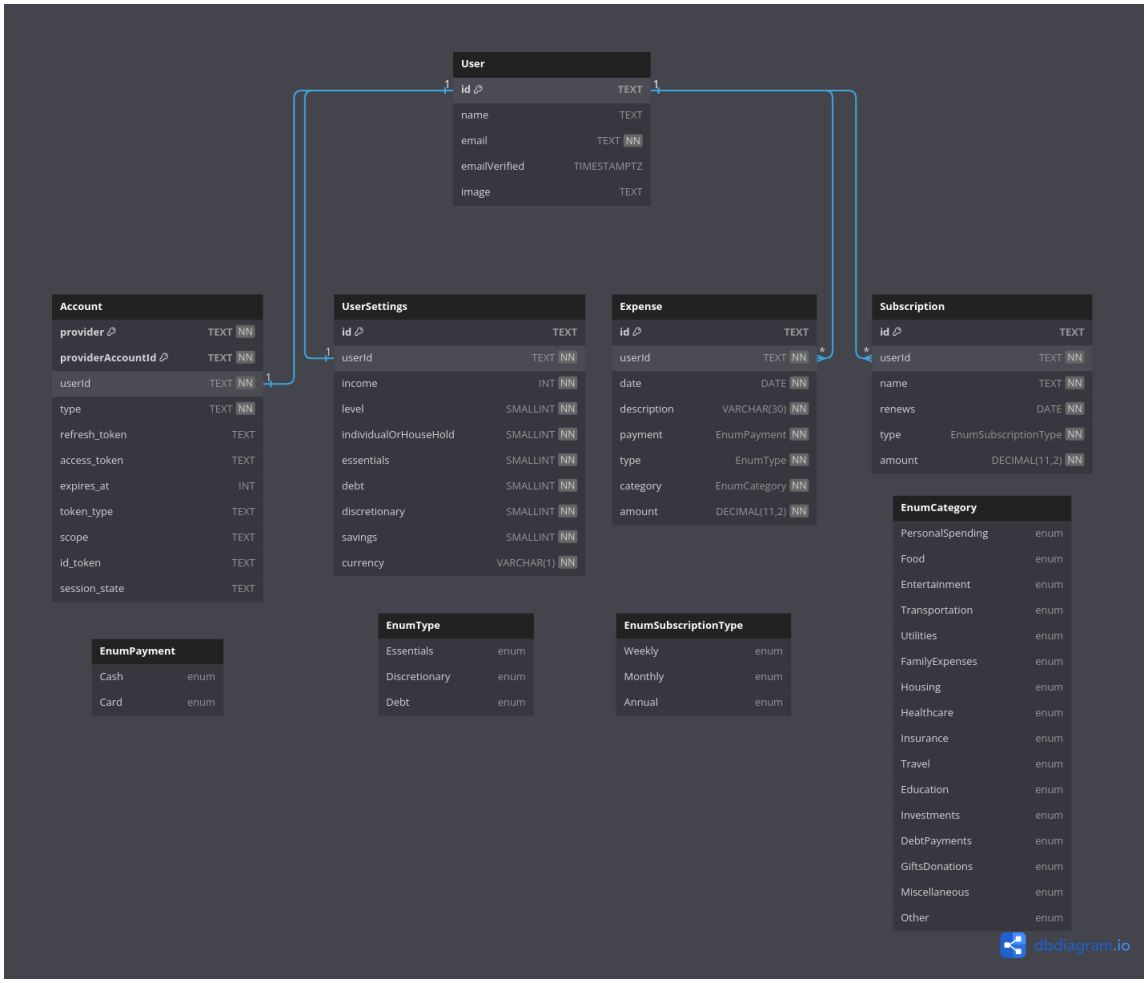

Figure 3.2: Database schema

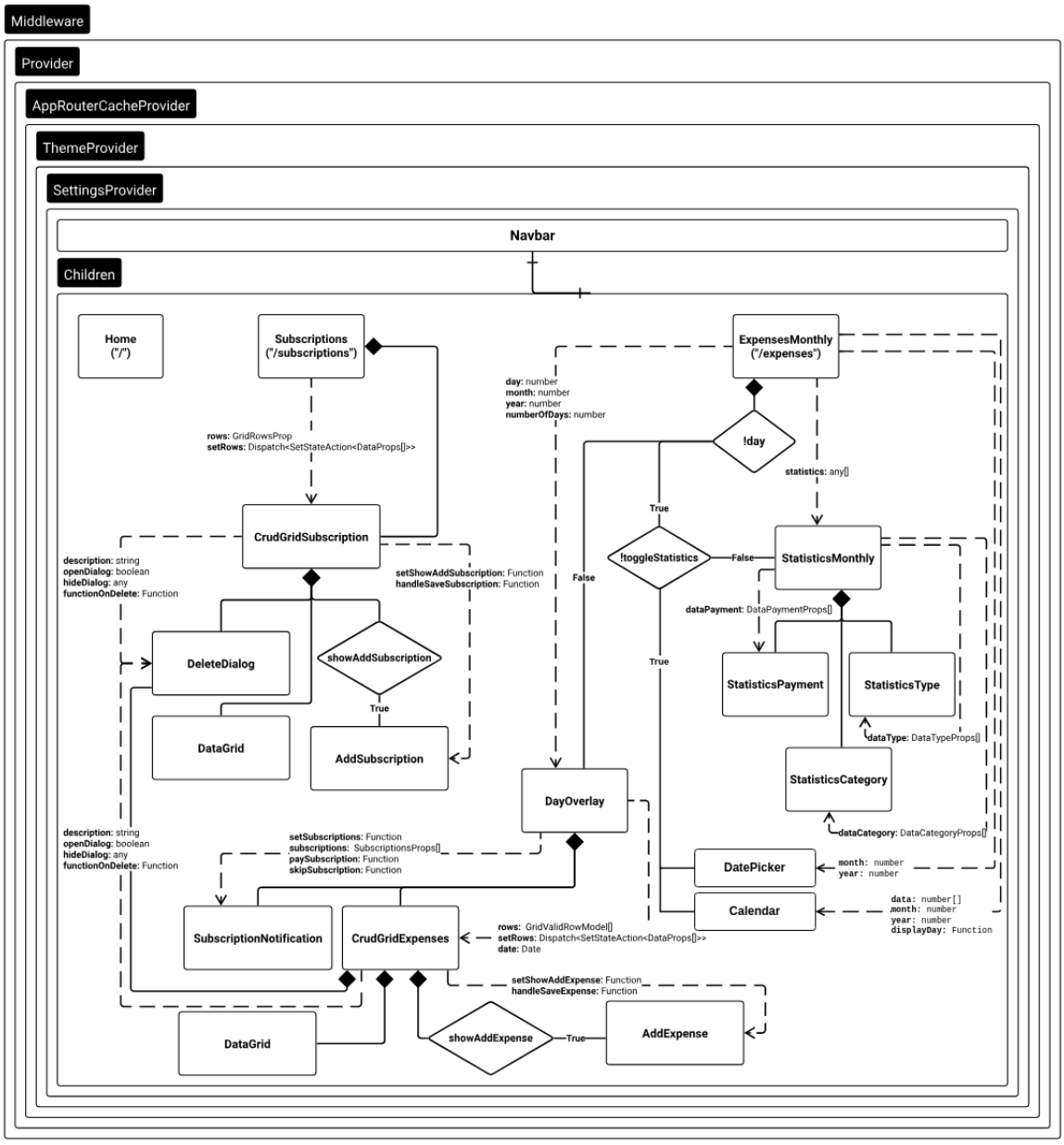

Figure 3.3: Component schema

3.1.4 Code Integration and Design Patterns

In this section, we will explore how various code integration techniques and design patterns are applied in Budget Buddy. These patterns are crucial for maintaining a clean, efficient, and scalable codebase.

Code Integration

The integration of different components is managed through React's context API and custom hooks. This allows for centralized state management and easier maintenance.

The **"Provider"** component ensures that the session management is consistently handled across the application.

The **"SettingsProvider"** component manages user settings and ensures that the changes are spread throughout the application in real-time.

The **"ThemeProvider"** component provides the overall user interface and user experience for the entire application, also the addition of "AppRouterCacheProvider" so that styles are appended to the "head" tag, not the "body" tag, Next.js sends chunks of the ".html" page and makes it more efficient.

Design Patterns

In addition to the core technologies and components, Budget Buddy leverages several design patterns to ensure a well-structured, maintainable, and efficient codebase. These patterns provide established solutions to common software development challenges and contribute to the overall robustness of the application.

Creational Pattern:

Singleton (UserSettings): Budget Buddy uses the Singleton pattern to manage user settings. The "UserSettings" class, is designed to ensure that only a single instance exists throughout the application's lifecycle. This instance "userSettings" is then exported and used globally, providing consistent access to user preferences across various components. By storing user settings in this manner, the Singleton pattern simplifies data management and synchronization across the application.

Structural Pattern:

Proxy (Middleware): The Proxy pattern is implemented as the middleware functions in Next.js. This pattern allows the monitoring and processing of requests and responses before they reach where they are supposed to go. Budget Buddy uses middleware for authentication, which verifies the identity of users before giving ac-

cess to protected routes, redirecting unauthenticated users to the home page (Figure 3.4).

```
export default auth((req : NextAuthRequest ) : undefined | Response  => {
    const {nextUrl : NextURL } = req;
    const isLoggedIn : boolean  = !!req.auth;
    const isApiAuthRoute : boolean  = nextUrl.pathname.startsWith("/api/auth");
    const isPublicRoute : boolean  = nextUrl.pathname === "/";

    if (isApiAuthRoute) return;
    if (isLoggedIn) return;
    if (!isLoggedIn && !isPublicRoute) return Response.redirect(new URL("/", nextUrl));
    return;
})

no usages  Sipos-Lucas-George
export const config : {matcher: string[]}  = {
    matcher: [ '/((?!.*\\..*|_next).*)', '/', '/(api|trpc)(.*)'],
}
```

Figure 3.4: Middleware implementation

Behavioral Patterns:

Iterator (Calendar View Calculation): The Iterator pattern is used to efficiently calculate the positions for each day within a month. In the calendar view of the Expenses page, an iterator traverses the collection of days that don't exist and the days that do, listing the total amount per day and the day number. This approach optimizes the calculation process and avoids unnecessary computations.

Observer: The Observer pattern is utilized to facilitate real-time updates within the application. For instance, changes to user settings or the addition of new expenses trigger notifications to relevant components, ensuring that the user interface remains synchronized with the base data.

Architectural Patterns:

Layered Pattern: Budget Buddy follows the Layered architectural pattern, which separates the application into distinct sections with defined tasks. The layers include:

- **Presentation Layer (UI):** This layer includes the user interface components that render the application's visual features.
- **Application Layer (Code):** This layer offers the application's fundamental logic, which manages interactions between the display and data access layers.

- **Business Logic Layer (Logic):** This layer contains the rules and algorithms that control the application's behavior, including data integrity and business requirements.
- **Data Access Layer (Database (DB)):** This layer manages the interaction with the database, handling the retrieval, storage, and manipulation of data.
- **Communication Layer (Application Programming Interface (API)):** This layer facilitates communication between the front-end and back-end through well-defined API.

Budget Buddy's architecture is modular and maintainable due to the use of these design patterns. For example, the Layered pattern's separation of concerns improves code readability and makes future modifications easier. The beneficial utilization of creational, structural, and behavioral patterns enhances the application's reliability and efficiency.

Conclusion

In summary, Budget Buddy's architecture is designed for efficiency, user-friendliness, and scalability. The combination of Next.js features, well-structured components, effective routing, and a robust database schema provides a solid foundation for managing personal finances. The use of middleware ensures secure and smooth operation, enhancing the overall user experience.

3.2 Expense and Subscription Recording

Expense and subscription recording are crucial features of Budget Buddy, enabling users to keep track of their spending and manage their recurring payments efficiently. This section discusses the implementation details, functionalities, and efficiency of the expense and subscription recording system using the MUI-X DataGrid component.

3.2.1 The MUI-X DataGrid

The MUI-X DataGrid is a powerful and flexible component that enhances the user experience with efficient data handling capabilities. It employs caching mechanisms to improve performance, ensuring that data operations such as sorting, filtering, and pagination are fast and responsive. By utilizing cache, the DataGrid minimizes redundant data fetching, leading to quicker load times and a smoother user experience.

Key features of the MUI-X DataGrid used in Budget Buddy include:

- **Adding Entries:** Users can add new expense or subscription entries using a button located on the title bar of the DataGrid. This makes the process of entering new data straightforward and accessible.
- **Pagination:** Users can navigate through their data with pagination options of 5, 10, or 25 items per page, with the default set to 5. This keeps the interface clean and manageable, especially for users with large datasets.
- **Multiple Deletion:** Users can select multiple rows using a selection box or by clicking on individual rows, and then delete them all at once. This makes managing entries efficient, especially when needing to remove multiple outdated or incorrect records.
- **Multiple Data Edition:** The DataGrid supports editing multiple entries simultaneously, either through a dedicated button or by double-clicking on rows. This feature is particularly useful for making bulk updates to records, saving time and effort.
- **Column Sorting:** Every column can be sorted, allowing users to quickly organize their data based on different criteria, such as description, amount, category etc. This functionality helps users to find specific entries quickly.
- **Column Hiding and Filtering:** Users can hide columns that are not relevant to their current task, and apply various filters depending on the column type. These filters include options like contains, equals, starts with, and many others, providing flexibility in how users view and manage their data.

3.2.2 Expense Recording

The expense recording system is designed to help users track their daily spending and analyze their financial health through detailed reports and visual representations like donut charts. Users can add up to 200 expense entries per day, ensuring comprehensive tracking of their spending.

The fields used to represent Expense entries are the following:

- **Description:** A text field where users enter a short description of the expense.
- **Payment Type:** A selection field where users choose between 'Card' or 'Cash' for the payment method.
- **Type of Spending:** Users can categorize the expense as 'Essentials', 'Discretionary' or 'Debt', which helps in the overall budget analysis.

- **Category:** A selection field where users can specify the category of the expense, such as 'Personal Spending', 'Food', 'Entertainment' etc.
- **Amount:** A numeric text field for entering the amount spent.

These detailed fields allow users to maintain a clear and organized record of their expenses, making it easier to generate reports and visualize their spending patterns.

3.2.3 Subscription Recording

Subscription recording helps users manage their recurring payments, providing reminders and tracking to ensure timely payments. Unlike expenses, users can add up to 50 subscriptions in total.

The fields used to represent Subscription entries are the following:

- **Name:** A text field for the name of the subscription.
- **Renews:** A date field where users select the renewal date for the subscription.
- **Type:** A selection field to categorize the subscription as 'Weekly', 'Monthly' or 'Annual'.
- **Amount:** A numeric field for the subscription cost.

Subscriptions can serve as reminders for both standard subscriptions and repeatable payments. On the specified renewal date, Budget Buddy presents users with all their recurring payments due that day. Users have the following options:

- **Ignore:** The payment will be presented again on the same renewal date.
- **Skip:** The payment is advanced to the next period (week/month/year) without marking it as paid.
- **Pay:** The payment is marked as paid and advanced to the next period.

This functionality ensures that users stay on top of their recurring payments, preventing missed payments and helping manage their financial commitments effectively.

3.2.4 Efficiency and User Experience

The use of the MUI-X DataGrid significantly enhances the efficiency and user experience of Budget Buddy. Its caching capabilities ensure that data operations are quick, even with large datasets which stands on the base of making such component. Pagination keeps the interface user-friendly and responsive, while features like multiple deletion and editing time-saving data management tasks.

By allowing customization of the view through sorting, hiding, and filtering columns, the DataGrid serves to different user preferences and needs. The ability to add entries directly from the interface ensures that users can quickly update or delete their records without navigating away from the main view.

Conclusion

Overall, the implementation of the MUI-X DataGrid in Budget Buddy's expense and subscription recording system provides a robust, flexible, and efficient way for users to manage their finances. This section highlights the critical features and their benefits, emphasizing how they contribute to a superior user experience and effective financial management.

3.3 Budget Setting and Monitoring

Budget Buddy makes an effort to make simpler the budgeting process through implementing a comprehensive settings system that allows users to customize their financial management experience. This section will go over Budget Buddy's budgeting and monitoring capabilities, with the focus being on the initial setup, adjustable settings, and continuous operation tracking techniques that help users stay on track with their financial goals.

Initial Setup

Upon creating a new account on Budget Buddy, users are required to complete a mandatory setup process. This initial setup is crucial as it lays the foundation for effective budget management. Users cannot bypass this step without inputting their income information, ensuring that all financial calculations and recommendations are personalized from the start.

Settings Provider

The core of Budget Buddy's customizable settings is powered by a settings provider built into the Next.js application. This provider ensures that any changes made

to the settings are immediately reflected throughout the app, providing a seamless and dynamic user experience. The real-time updating feature guarantees that users always have the most current data and recommendations based on their input.

3.3.1 Customizable Settings

The settings interface includes several customizable options designed to fit the unique needs of each user. These settings include:

- **Currency Selection:** A toggle button allows users to choose their preferred currency from Euro (€), US Dollar ($), or British Pound (£). This feature ensures that all financial data and reports are presented in the user's preferred currency, making it easier to understand and manage their finances.
- **Individual or Household:** Another toggle button lets users specify whether they are managing an individual budget or a household budget. This distinction is important as it affects the recommended budget allocations and savings targets, taking into account the different financial dynamics of single versus multiple income sources.
- **Income Input:** Users must input their income through a numeric text field. This information is vital as it serves as the basis for all budget calculations and recommendations. Accurate income reporting ensures that the budget allocations are realistic and achievable.
- **Budget Sliders:** The settings also include four budget sliders that help users allocate their income to different spending categories based on their level of income. These sliders are essential for overall money management and will be discussed in detail in the following subsection.

3.3.2 Budget Sliders

To provide a detailed and user-friendly budgeting experience, Budget Buddy includes four budget sliders:

- **Essentials Budget:** This slider allows users to allocate a portion of their income to essential expenses such as housing, utilities, food, healthcare etc.
- **Discretionary Spending Budget:** This slider is used for non-essential expenses such as entertainment, dining out, hobbies, personal spending etc.

- **Debt Repayment Budget:** This slider helps users allocate funds for repaying any debts, such as loans or credit card balances. Ensuring a portion of the income is dedicated to debt repayment can help users reduce their debt load over time.
- **Savings Budget:** The final slider allows users to set aside a portion of their income for savings. This can include emergency funds, retirement accounts, or other long-term savings goals. The savings budget is critical for financial stability and future planning.

The preset ranges for these sliders are dynamically adjusted based on the user's income and whether they are managing an individual or household budget. This customization helps users create a balanced and realistic budget that aligns with their financial goals.

Monitoring and Alerts

Budget Buddy continuously monitors users's expenses and provides real-time feedback on budget adherence. If a user exceeds their allocated budget in any of the four areas, the application highlights the amount spent or the overspent category in red. This immediate visual feedback helps users adjust their spending behavior and stay on track with their financial goals.

Conclusion

The budget setting and monitoring features of Budget Buddy are designed to provide users with a comprehensive and customizable budgeting experience. By requiring an initial setup, offering dynamic settings, and providing continuous monitoring, Budget Buddy helps users manage their finances effectively. This system not only simplifies budget management but also promotes financial discipline and awareness, ultimately leading to better financial health for its users.

3.4 Visualizing Data with Donut Charts

Data visualization is a crucial component of financial management, providing clear insights into spending patterns, income sources, and overall financial health. In this chapter, we explore the implementation and importance of three specific donut charts: Total Expenses by Category, Total Expenses by Payment Method, and Total Expenses by Type. These visualizations help users in understanding how their

funds are allocated, revealing areas for potential savings and highlighting financial habits.

3.4.1 Total Expenses by Category

The "Total Expenses by Category" chart offers a comprehensive view of how expenses are distributed across different categories. This visualization is essential for users aiming to identify major spending areas and optimize their budgets.

Importance of Category Analysis

Understanding expenses by category helps users to:

- Identify significant spending areas: This allows for targeted budget adjustments.
- Optimize budget allocations: Ensures that funds are being used efficiently across various needs and wants.
- Detect unusual patterns: Uncover any unexpected or irregular expenses that may need attention.

Implementation Overview

In Budget Buddy, the "Total Expenses by Category" chart aggregates user expenses and segments them into predefined categories such as Personal Spending, Food, Entertainment, Transportation, Utilities, Family Expenses, Housing, Healthcare, Insurance, Travel, Education, Investments, Debt Payments, Gifts/Donations, Miscellaneous and Other. Each segment of the donut chart represents the proportion of total expenses attributed to a particular category, providing a clear visual representation of spending patterns.

3.4.2 Total Expenses by Payment Method

Tracking expenses by payment method helps users understand their spending habits across different modes of payment, such as cash or credit.

Importance of Payment Method Analysis

Analyzing expenses by payment method is beneficial because it:

- Reveals preferred payment methods: Helps users understand which payment methods they rely on most.

- Assists in managing credit use: Allows users to monitor and control their use of credit cards, avoiding excessive debt.
- Identifies potential savings: Users can identify if they are paying unnecessary fees for certain payment methods.

Implementation Overview

The "Total Expenses by Payment Method" chart categorizes user expenses based on the method of payment. This visualization provides insights into which payment methods are most frequently used, helping users to manage their payment habits effectively.

3.4.3 Total Expenses by Type

The "Total Expenses by Type" chart segments expenses into types, such as essentials, discretionary spending, debt repayment, and savings. This view is essential for aligning spending with financial goals and ensuring balanced financial health.

Importance of Type Analysis

Segmenting expenses by type allows users to:

- Align spending with financial goals: Ensures that spending on essentials, discretionary items, and savings is balanced.
- Monitor debt repayment: Keeps track of how much is being allocated to debt repayment, helping to manage and reduce debt effectively.
- Promote savings: Visualizes savings contributions, encouraging users to save more consistently.

Implementation Overview

In this chart, expenses are divided into types such as essentials, discretionary spending, debt repayment, and savings. This segmentation helps users to see if they are spending within their means and meeting their savings goals. The chart also provides a clear indication of whether the total expenses exceed the user's monthly income, highlighting areas that need financial adjustment.

Goals of Data Visualization with Donut Charts

Donut charts play a pivotal role in financial management by providing intuitive and visually appealing representations of expense data. By analyzing expenses by category, payment method, and type, users gain valuable insights into their spending habits, enabling more informed financial decisions and promoting better financial health. These visualizations not only enhance the user experience but also contribute to a more disciplined and efficient approach to personal finance management.

Chapter 4

Experiments and Discussion

This chapter outlines Budget Buddy's advantages over other kinds of expense tracking software, emphasizing its user-friendly design, free access, and individualized financial recommendations. It investigates the innovative effects of technology on personal money management via digitization, real-time information, and behavioral feedback. The chapter also emphasizes the importance of security and privacy in digital financial tools. Finally, it highlights how Budget Buddy uses cloud-based technologies and efficient database indexing to provide fast data retrieval and real-time updates, making it a significant improvement in the field of personal money management.

4.1 Comparison with Existing Solutions

When comparing Budget Buddy to existing expense tracking and budgeting applications, several key distinctions and advantages become apparent. Traditional applications like Mint and You Need a Budget (YNAB) offer robust features but often come with limitations such as subscription costs and complex setup processes.

- ***Mint*** [Inc07] provides comprehensive credit monitoring, budget planning, and expense tracking. But additionally, unless customers have a premium subscription plan, potential customers have to put up with an excessive amount of advertising. Furthermore, given its large feature set, those who are new may find the setup to be challenging as well.

- ***YNAB*** [Mec04] assists users in allocating each and every dollar, with an emphasis on forward-thinking budgeting. It makes use of a subscription model, which might be expensive, especially when consumers are in a tight financial situation. Its features require a large amount of effort to properly take advantage of due to its steep learning curve.

- ***Budget Buddy***, in contrast, provides a user-friendly, free platform that doesn't require a subscription. The straightforward registration procedure enables immediate customization to accommodate customers with different degrees of financial comprehension. By integrating the 50/30/20 rule and customizing it for different earning brackets, Budget Buddy offers individualized financial guidance that is in line with each user's particular economic situation. Its user-friendly, graphically appealing design further improves the user experience by making financial management easier to understand.

As you can see, Budget Buddy tackles common problems found in other financial applications, like high costs and complexity, by providing a simpler, more accessible solution. It focuses on being easy to use and promoting financial literacy, making it a more user-friendly option for managing personal finances.

4.2 Technology's Effect on Handling Personal Finances

The exponential growth of technology has drastically changed the field of personal finance management. Modern technologies have transformed how people track expenses, budget, and make financial decisions, resulting in more efficient and successful financial management strategies. Budget Buddy reflects these improvements by integrating technology to provide comprehensive, user-friendly, and secure budget management software.

Automation and Accuracy

One of the most important benefits of technology in personal finance management is the automation of financial procedures. Traditional systems, such as manually entering spending into journals or spreadsheets, are vulnerable to human error and can be quite time-consuming. Budget Buddy uses automated algorithms to categorize spending and provide real-time financial information. This automation not only decreases the possibility of errors, but it also saves users important time that would have been used for manually entering data.

Furthermore, Budget Buddy includes features like automatic reminders for recurring payments and subscriptions. This ensures that users never miss a payment, allowing them to avoid late fees and maintain excellent money management. The precision and efficiency given by automation improve the overall accuracy of financial data, permitting users to make choices that are more knowledgeable.

Real-Time Insights

The integration of cloud-based technology in Budget Buddy enables real-time synchronization across various devices. Users can access their financial data from any device, including tablets, laptops, and computers. This real-time access guarantees that customers are always aware of their financial situation, helping them to make efficient and informed decisions.

Real-time analytics also offer up-to-date visualizations of spending habits and complying with the budget. Budget Buddy offers graphical representations of users' money-related information, making it easier to understand and evaluate their financial behaviors. These visual tools allow users to quickly identify areas where they may be overspending and change their lifestyles accordingly.

Behavioral Changes

Technology plays an important role in influencing and modifying financial decisions. Budget Buddy has tools that encourage positive financial habits through constant tracking and visually intuitive UI feedback.

For example, if a user exceeds the budget allocated to one of the four main categories: essentials, debt repayment, discretionary spending, or savings, the customer will be visually alerted with the color red on the statistics page, suggesting that they have gone over the allocated amount of money for that payment category.

In addition, the consumer will be provided with a percentage, which will be useful when trying to reduce their payments. The integration of behavioral insights in Budget Buddy encourages users to make more careful and educated monetary choices.

Security and Privacy

Concerns about data security and privacy have grown as more people use digital financial software. Budget Buddy solves these concerns by adding strong security techniques that protect user information. The application uses OAuth with a Google provider for authentication, allowing a secure login without Budget Buddy needing to store passwords directly. Furthermore, all user data can only be seen by the logged-in customer, protecting it from illegal access and having a middleware to restrict attackers.

Overall Impact of Technology

In conclusion, technology has had an enormous effect on the way people manage their personal finances. Budget Buddy exemplifies these technology improvements

by offering a safe, user-friendly, and efficient platform for financial planning. The application's automation and accuracy reduce the pressure of human tracking while also minimizing errors. Real-time data and behavioral feedback enable users to make more educated choices and establish healthier financial habits.

Budget Buddy protects the user's sensitive financial information by prioritizing security and privacy before anything else. The application's user-friendly and welcoming design makes it an essential instrument for people of all financial understanding levels, allowing them to take charge of their finances and achieve their monetary goals.

Furthermore, the use of cloud-based technology and proper database indexing enables quick data retrieval and real-time modifications, ensuring that users have the most up-to-date information at their disposal. Budget Buddy marks a major advance in personal finance management because of its unique use of technology, which makes it easier and more effective for users to manage their money.

Chapter 5

Conclusion and Future Work

This chapter examines the difficulties encountered in integrating diverse financial data from various sources and how these inconsistencies necessitated custom solutions. The chapter also covers the challenges in database indexing, designing a user-friendly interface, and encouraging users to adopt new financial behaviors.

Future recommendations for Budget Buddy include expanding compatibility with more financial institutions, incorporating machine learning for personalized advice, developing a mobile app, enhancing security, and providing more educational resources. These improvements aim to boost the app's functionality and user engagement.

Overall, Budget Buddy has significantly advanced personal finance management by integrating technology and user-centered design, and it's assurance for further enhancements to better serve users.

5.1 Limitations and Challenges

Even though Budget Buddy offers a fresh and innovative approach to personal finance management, there were several limitations and challenges faced during its development and implementation.

Integration Challenges

One of the most significant difficulties with integration encountered was the diversity and inconsistency of financial data categories between the platforms. Financial institutions most frequently categorize expenses differently, complicating the process of constructing only one structure. As an example, some institutions might classify an expense as ”entertainment,” while others might identify it as ”recreational services”, which leads to distinctions regarding the collection of data and analytics.

- **Housing**: Includes rent or mortgage payments, property taxes, insurance, and maintenance costs.
- **Utilities**: Covers all essential services like electricity, water, and internet.
- **Food**: Features groceries, dining out, and smaller purchases like coffee.
- **Transportation**: From fuel and public transit to auto insurance and parking fees.
- **Healthcare**: Includes insurance, out-of-pocket medical costs, and prescriptions.
- **Insurance**: Broadly covers life, health, auto, and disability insurance.
- **Personal Spending**: Supplies personal care, clothing, and hobbies.
- **Entertainment**: Covers movies, concerts, and various subscriptions.
- **Education**: Captures expenses related to tuition, school supplies, and online learning.
- **Savings and Investments**: Accounts for contributions to savings, retirement funds, and other investments.
- **Debt Payments**: Involves managing credit card, student loan, and other personal loan payments.
- **Gifts and Donations**: Reflects charitable giving and personal gifts for occasions.
- **Family Expenses**: Includes childcare, pet care, and elder care.
- **Travel**: Captures all travel-related expenditures like airfare and accommodations.
- **Miscellaneous**: Covers a variety of infrequent expenses such as postage and banking fees.

Each of these categories requires specific handling to ensure accurate financial tracking and reporting. Integrating data from multiple sources necessitated the development of custom solutions to reconcile these variations. This not only increased the complexity of the integration process but also restricted the application's ability to effectively gather and categorize data from all possible sources, leading to potential gaps in financial insights.

Choosing the Right Index Strategy

Another important technological challenge encountered was figuring out the most effective indexing approach for the database. Proper indexing has become essential in order to enhance the performance and speed of data retrieval operations, and that has a direct impact on the user experience by ensuring that financial data is easily accessible in real time.

Block Range Index (BRIN): For the ”Expense” model, a BRIN was used on date columns where data is ordered sequentially. BRIN type of indexes are efficient for large tables with natural clustering of data, which reduces storage space and improves query performance over large datasets.

```
@@index([userId, date(ops: DateMinMaxMultiOps)],
        map: "index_for_between", type: Brin)
```

B-Tree Index: It was also necessary to make use of indexes that addressed a specific query pattern. For example, the B-Tree index in the ”Expense” model is designed for query filtering by user and specific dates, which makes it common in personal finance applications that evaluate transactions on a daily basis.

```
@@index([userId, date], map: "index_for_eq")
```

Selecting the right index involved analyzing the query patterns typically used in the application, understanding the nature of the data, and predicting the scaling needs as the number of users grows. It was essential to strike a balance between the speed of write operations and the efficiency of read operations, especially considering the dynamic nature of financial data where both timely updates and quick access are crucial.

This complex decision-making process not only improved the application’s performance, but also ensured that system resources were used efficiently, contributing to a smoother user experience and more reliable data processing.

UI/UX Design Complexities and User Adoption Challenges

Developing an intuitive and user-friendly design was particularly challenging, given the requirement to appeal to a diversified user base with varying levels of financial understanding. The application’s accessibility and effectiveness relied on maintaining an appropriate balance between simplicity and functionality. In addition to the user interface, getting users to stick to new financial habits and constantly use the program presented additional challenges. Despite implementing behavioral

finance principles to promote appropriate financial practices, the obstacles to changing long-standing habits demonstrated that technology alone cannot drive improvement. Both areas required careful consideration to not only attract users but also make sure they gained continued advantages thanks to Budget Buddy, supporting commitment over time and an encouraging shift in financial management behaviors.

5.2 Recommendations for Future Development

To make Budget Buddy even better and overcome the identified limitations, here are several recommendations for future development:

Expand Financial Data Source Compatibility

Budget Buddy's utility and reach must be enhanced by making it more compatible with a broader range of financial institutions and services. This could be accomplished by setting up standardized data exchange protocols and collaborating with various financial institutions. These measures would improve integration and data coverage, allowing the application to provide more detailed and accurate financial analysis.

Incorporate Machine Learning for Personalized Advice

Integrating machine learning algorithms into Budget Buddy could revolutionize how users receive financial advice. By analyzing individual spending patterns and financial behaviors, the application could generate personalized recommendations for budgeting, saving, and investing. This proactive approach to personal finance could help users achieve their financial goals more efficiently.

Development of a Mobile Application

To increase accessibility and user engagement, a mobile version of Budget Buddy should be developed. A mobile app would allow users to manage their finances on the go. Features could include real-time notifications and updates, which would make financial management more integrated into users' daily lives.

Continuous Improvement of Security Measures

Security is paramount in the digital age, especially when handling sensitive financial data. It is crucial that Budget Buddy continuously improves its security measures. This could involve implementing encryption techniques, performing regular

security audits, and keeping an eye on the latest cybersecurity threats. Such measures will ensure the integrity and confidentiality of user data.

Enhancing User Education and Support

To truly empower users, providing additional educational resources and support is essential. By offering tutorials, webinars, and responsive customer support, Budget Buddy can help users improve their financial literacy. This support will assist users in navigating the application's features more effectively and maximize the benefits they derive from using the application.

5.3 Summary of Achievements

Budget Buddy has made significant advancements in the field of personal financial management. By including a straightforward budgeting customised strategy known as the *50/30/20 rule* as well as user-friendly features, it has influenced the way users manage their personal finances, making the process both accessible and efficient. Here are some of the main accomplishments of Budget Buddy:

Enhancing Financial Literacy

Budget Buddy has played a crucial role in simplifying the budgeting process. Through its easy-to-understand interface and the provision of valuable educational resources, it has equipped users with the knowledge to make well-informed financial decisions. This has significantly improved their financial literacy, enabling them to handle their finances more confidently and effectively.

Cross-Device Accessibility

Budget Buddy uses cloud technologies to ensure users have uninterrupted access to their financial data across multiple devices. This feature offers the benefit of real-time synchronization, which means that any changes made on one device immediately show up on the others. This convenience is essential for users who handle their finances on the go.

User-Centric Design

The application has been intentionally designed to satisfy the expectations of a wide range of users, from beginners to those with more experience in managing

finances. Its user-friendly layout and adjustable features allow users to personalize their experience according to their financial needs, increasing its usability and appreciation.

Behavioral Finance Integration

Budget Buddy additionally implements behavioral finance concepts that help users develop rational financial behaviors. The software encourages users to make reasonable financial decisions based on their budgeting strategies, encouraging the development of healthy financial habits.

Conclusion

In summary, Budget Buddy has effectively tackled many common challenges faced in personal finance management through its innovative use of technology and user-centered design. The application's achievements have laid a strong foundation for its continued success. Looking ahead, planned enhancements such as expanding data compatibility, incorporating cutting-edge technologies like machine learning, and providing even greater support to users are expected to reinforce Budget Buddy's standing as a top tool in the Fintech sector. These ongoing improvements will undoubtedly continue to support users in achieving their personal financial goals.

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Acronyms

API Application Programming Interface. 22

BRIN Block Range Index. 37

CSS Cascading Style Sheets. 13

DB Database. 22

Fintech Financial Technology. 5, 40

HCI Human-Computer Interaction. 4

OAuth Open Authorization. 12, 33

PCs Personal Computers. 1

SDLC Software Development Lifecycle. 12

UI User Interface. 2, 4, 12, 21, 33, 37

UX User Experience. 2, 4, 12, 37

VR Virtual Reality. 1

YNAB You Need a Budget. 31