Chapter 3:

System Overview and Implementation

3.1 What is BudgetBuddy?

BudgetBuddy is a web-based financial management system designed to help students track, manage, and forecast their expenses using machine learning. The system provides automated expense tracking, predictive analysis, and financial insights to assist students in making informed budgeting decisions.

By leveraging Long Short-Term Memory (LSTM) networks, BudgetBuddy predicts future expenses based on historical data, helping students avoid overspending and plan their budgets effectively. The system also includes multi-role access for students, parents, and experts, allowing financial guidance and monitoring.

3.2 Approaches of BudgetBuddy

Different approaches have been explored in literature for financial forecasting and expense tracking. The most relevant methods include:

- **Statistical Approach**: Traditional budgeting methods use statistical models like **time-series analysis and regression** to predict expenses.
- **Probabilistic Approach**: Bayesian models help estimate the probability of overspending based on past spending patterns.
- **Machine Learning Approach**: Recent studies leverage deep learning models like LSTM, Support Vector Machines (SVM), and Artificial Neural Networks (ANN) for financial forecasting. These models process sequential spending data and provide more accurate predictions.

BudgetBuddy adopts the machine learning approach, specifically using LSTM networks, to improve accuracy in predicting future student expenses.

3.3 How does Budget Buddy work?

BudgetBuddy follows a structured workflow to process and analyze financial data. The key steps include:

1. **Data Collection**: Users input their daily expenses into the system.
2. **Data Preprocessing**: Cleaning and structuring the data for training the machine learning model.
3. **Feature Selection**: Identifying key factors influencing expenses, such as income, spending habits, and category-wise expenses.
4. **Model Training**: The LSTM model is trained on historical expense data to learn spending patterns.
5. **Prediction**: The trained model forecasts future expenses and provides financial insights.
6. **Visualization & Alerts**: The system generates reports, graphs, and alerts when a user nears their budget limit.

A **workflow diagram** (to be included) will illustrate this end-to-end process.

3.4 Long Short-Term Memory (LSTM) Model

The LSTM model is chosen due to its ability to handle sequential data and capture long-term dependencies in spending patterns. The architecture of the LSTM model used in BudgetBuddy consists of:

- **Input Layer**: Accepts past expense records.
- **LSTM Hidden Layers**: Processes sequential data and learns financial patterns.
- **Dense Output Layer**: Predicts future expenses based on learned patterns.

Mathematically, an LSTM cell operates as:

ft=σ(Wf.[ht−1,xt]+bf)f_t = \sigma(W_f . [h_{t-1}, x_t] + b_f) it=σ(Wi.[ht−1,xt]+bi)i_t = \sigma(W_i . [h_{t-1}, x_t] + b_i) Ct~=tanh(WC.[ht−1,xt]+bC)\tilde{C_t} = tanh(W_C . [h_{t-1}, x_t] + b_C) Ct=ft∗Ct−1+it∗Ct~C_t = f_t * C_{t-1} + i_t * \tilde{C_t} ot=σ(Wo.[ht−1,xt]+bo)o_t = \sigma(W_o . [h_{t-1}, x_t] + b_o) ht=ot∗tanh(Ct)h_t = o_t * tanh(C_t)

Where:

- ftf_t is the forget gate,
- iti_t is the input gate,
- CtC_t is the cell state,
- oto_t is the output gate, and
- hth_t is the hidden state.

3.5 Implementation Methodology

Technology Stack

BudgetBuddy is developed using the following technologies:

- **Frontend**: HTML, CSS, JavaScript (Bootstrap for UI design).
- **Backend**: Python-Django framework for handling requests and user authentication.
- **Database**: MySQL for storing user expenses and financial data.
- **Machine Learning**: TensorFlow/Keras for implementing the LSTM model.
- **Version Control**: Git for tracking development progress.

Why These Technologies?

- **Django** provides a robust backend framework for managing user data securely.
- **MySQL** ensures structured storage and fast retrieval of financial records.
- **LSTM (using TensorFlow/Keras)** offers accurate time-series forecasting for predicting student expenses.
- **Bootstrap** enhances the UI, making it user-friendly.

- **Git** enables collaborative development and version control.

3.6 Summary

This chapter outlined the concept, methodology, and implementation details of BudgetBuddy. The system leverages machine learning (LSTM) to provide accurate expense forecasts and assist students in financial planning. The next chapter will discuss experimental results and system evaluation.