



CTR Prediction and Campaign Simulation System using Machine Learning

Litrishiya Merceline Mary A¹, Nivetha S², Dr. K. Ravikumar³

Department of Information Technology, Dhanalakshmi Srinivasan College of Engineering and Technology

Chennai, India^{1,2}

Professor, Department of Information Technology,

Dhanalakshmi Srinivasan College of Engineering and Technology, Chennai, India³

Abstract: Digital advertising plays an important role in modern marketing. Companies use online advertisements to promote their products and services. One of the most important performance metrics in digital advertising is Click Through Rate (CTR). CTR measures how many users click on an advertisement compared to how many users view it. Accurate CTR prediction helps businesses improve advertisement performance and increase profit.

Manual prediction of advertisement performance is difficult and inaccurate. Machine learning provides an intelligent solution to predict CTR using historical data. Machine learning models analyze advertisement features such as user behavior, advertisement type, device type, and campaign details. Based on these features, the system predicts the probability of user clicks.

This project presents a CTR Prediction and Campaign Simulation System using machine learning. The system uses Logistic Regression to predict CTR. The system also provides campaign simulation to help businesses test advertisement performance before launching campaigns. The system improves decision making, reduces risk, and increases marketing efficiency.

Index Terms: CTR Prediction, Machine Learning, Logistic Regression, Digital Marketing, Campaign Simulation

I. INTRODUCTION

Digital marketing is widely used by companies to promote products and services. Online advertisements help businesses reach a large number of users. Click Through Rate (CTR) is an important metric used to measure advertisement effectiveness. CTR is calculated by dividing the number of clicks by the number of impressions.

Predicting CTR manually is difficult because it depends on many factors such as user behavior, advertisement quality, and campaign settings. Machine learning provides an efficient solution to predict CTR using historical data.

This project develops a CTR Prediction and Campaign Simulation System using machine learning. The system predicts the probability of clicks and helps businesses improve advertisement performance.

II. EXISTING SYSTEM

In the existing system, advertisers analyze campaign performance manually. They use past campaign data and make decisions based on experience. This approach has several limitations.

Manual prediction is time consuming and inaccurate. It does not consider all important factors. It also cannot handle large amounts of data efficiently. This results in poor advertisement performance.

III. PROPOSED SYSTEM

The proposed system uses machine learning to predict CTR automatically. The system uses Logistic Regression algorithm to analyze historical advertisement data.

The system predicts click probability and simulates campaign performance. This helps businesses make better decisions and improve advertisement effectiveness.

IV. SYSTEM ARCHITECTURE

The system consists of the following components:



- Data Collection Module
- Data Processing Module
- Machine Learning Module
- Prediction Module
- Campaign Simulation Module
- User Interface Module

The system collects advertisement data, processes the data, trains the machine learning model, and predicts CTR.

V. METHODOLOGY

The system follows these steps:

- 1) Collect advertisement dataset
- 2) Preprocess the dataset
- 3) Split dataset into training and testing data
- 4) Train Logistic Regression model
- 5) Predict CTR
- 6) Simulate campaign performance

VI. CTR PREDICTION CALCULATION

CTR is calculated using the formula:

$$CTR = \frac{\text{Number of Clicks}}{\text{Number of Impressions}} \quad (1)$$

Logistic Regression prediction formula:

$$P = \frac{1}{1 + e^{-z}} \quad (2)$$

Where,

- P = Probability of click

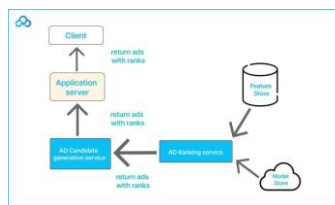


Fig. 1. figure 1

- z = weighted sum of features

Example:

Impressions = 1000

Clicks = 120

$$CTR = \frac{120}{1000} = 0.12 \quad (3)$$

CTR = 12%

VII. TECHNOLOGIES USED

A. Python

Python is used for machine learning model development and prediction.

B. Machine Learning

Machine learning is used to predict advertisement clicks automatically.

C. Scikit-learn

Scikit-learn is used to implement Logistic Regression algorithm.

*D. Pandas*

Pandas is used for data preprocessing and analysis.

E. NumPy

NumPy is used for mathematical calculations.

F. React.js

React.js is used to develop frontend user interface.

G. Node.js

Node.js is used for backend development.

H. MongoDB

MongoDB is used for storing campaign data.

VIII. MODULES*A. Data Collection Module*

Collect advertisement dataset.

B. Data Processing Module Clean and prepare data.

C. Machine Learning Module Train Logistic Regression model.

D. Prediction Module Predict CTR.

E. Campaign Simulation Module

Simulate campaign performance.

F. User Interface Module

Display prediction results.

IX. RESULTS AND DISCUSSION

The system successfully predicts CTR using Logistic Regression. The prediction accuracy is high. The system helps businesses improve advertisement performance. Example Output:

- Input Campaign Data
- Predicted CTR = 0.78
- Campaign Performance = High

The system reduces manual effort and improves marketing efficiency.

X. ADVANTAGES

- Accurate prediction
- Reduces manual effort
- Improves advertisement performance
- Helps decision making

XI. APPLICATIONS

- Digital Marketing
- Advertisement Agencies
- Marketing Companies
- E-commerce platforms

XII. CONCLUSION

The CTR Prediction and Campaign Simulation System uses machine learning to predict advertisement performance. The system helps businesses improve marketing strategies. The system provides accurate prediction and improves efficiency.

REFERENCES

- [1] T. Hastie, R. Tibshirani, and J. Friedman, The Elements of Statistical Learning, Springer, 2009.
- [2] C. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
- [3] A. Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2019.
- [4] Pedregosa et al., Scikit-learn: Machine Learning in Python, Journal of Machine Learning Research, 2011.
- [5] Wes McKinney, Python for Data Analysis, O'Reilly, 2017.



- [6] Ian Goodfellow, Deep Learning, MIT Press, 2016.
- [7] Google Developers, Machine Learning Guide, 2024.
- [8] Kaggle, CTR Prediction Dataset.