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Anand Nagar, Krishnankoil, Srivilliputtur (Via), Virudhunagar (Dt) - 626126, Tamil Nadu | info@kalasalingam.ac.in | www.kalasalingam.ac.in

OPTIMIZE CALL CENTRE OPERATIONS BY ANALYSING AND REDUCING QUEUE TIMES FOR CUSTOMERS

A COURSE LEVEL PROJECT REPORT

Submitted by

III-year students of Bachelor of Technology

T.SANTHOSH KUMAR REDDY -99220041391

S.PRANEETH GOWD -99220041376

V.SREENIVASULU -99220041409

K.AJITH KUMAR REDDY -99220041231

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BONAFIDE CERTIFICATE

Certified that this project report **"Optimize call center operations by analysing and reducing queue times for customers"** is the bonafide work of **"T.Santhosh kumar reddy(99220041391), S.Praneeth gowd(99220041376), V.Sreenivasulu(99220041409), k.ajith kumar reddy(99220041231)"** who carried out the project work under my supervision.

Faculty Mentor

Submitted for the Project Viva-voce / Review held at Kalasalingam Academy of Research & Education, Krishnankoil on ……

Internal Examiner **External Examiner**

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ABSTRACT

- In modern call centers, reducing queue times is essential for improving customer satisfaction and operational efficiency. This study explores strategies and machine learning techniques to optimize call center operations by minimizing wait times.
- By analyzing call patterns, agent performance, and customer interactions we can reduce the queue time for the customers.
- Implementing these approaches can significantly improve customer experiences while optimizing resource allocation and reducing waiting time with the efficiency and customer satisfaction.

INTRODUCTION

In today's competitive market, providing quick and effective customer support is essential for any business. Call centers are often the primary point of contact for customers seeking assistance, making it critical to minimize wait times and deliver efficient service. Long queue times not only frustrate customers but also impact the overall efficiency of call center operations.

This study focuses on strategies and machine learning techniques aimed at reducing queue times, optimizing agent performance, and improving customer interactions. By analyzing call patterns, monitoring agent effectiveness, and understanding customer behavior, we can identify areas for improvement that enhance service delivery.

The implementation of these data-driven approaches can lead to faster response times, better resource allocation, and ultimately higher customer satisfaction. By addressing the factors contributing to long wait times, businesses can create a more streamlined, responsive, and customer-friendly call center environment.

By leveraging advanced technology and strategic planning, call centers can transform into agile, responsive hubs of customer support, aligning with the modern demand for quick, quality service. This study highlights the importance of proactive solutions in creating a seamless and customer-centered call center experience.

This research highlights how technology and strategic planning can transform call centers to meet modern demands for quick, quality service.

LITERATURE REVIEW

s.no	Paper title	Author	Abstract	Published year	Resource
1.	Queueing Models of Call Centers: An Introduction	Avishai Mandelbaum	This is a survey of some academic research on telephone call centers. The surveyed research has its origin in, or is related to, queueing theory. Indeed, the "queueing-view" of call centers is both natural and useful. Accordingly, queueing models have served as prevalent standard support tools for call center management. However, the modern call center is a complex socio-technical system. It thus enjoys central features that challenge existing queueing theory to its limits, and beyond.	2022	Google scholar
2.	A review of natural language processing in contact Centre automation	Shariq Shah	The COVID-19 pandemic has highlighted the essential role of contact centers in maintaining business continuity and customer support. Increased inquiries about payments, cancellations, and stock have led organizations to innovate, adopting machine learning and natural language processing tools like chatbots and self-service portals. This paper reviews existing research, explores the benefits of these technologies, and	2023	Google scholar

			identifies challenges in advancing contact center automation.		
3.	**Designing a Call Center with Impatient Customers**	**M. Reiman**	**The M/M/N + M model, with exponentially distributed customer patience and unlimited waiting capacity, offers important insights for call center management. We provide an exact analysis, then use asymptotic analysis to develop practical performance approximations and design guidelines for large, high-efficiency call centers. This supports the value of diffusion approximations for practical management decisions.**	**2022**	**Google scholar**

SUMMARY

The reviewed papers collectively emphasize the need for advanced methods in optimizing call center operations to meet modern demands for efficiency and customer satisfaction. Mandelbaum's study explores the foundational role of queueing theory in call centers, noting that while traditional models have been useful, modern call centers require new approaches due to their complexity as socio-technical systems. Shah's paper highlights the impact of the COVID-19 pandemic on contact centers, driving the adoption of natural language processing (NLP) technologies like chatbots and self-service portals to manage increased customer inquiries and maintain continuity. Reiman's research focuses on a specific queueing model that accounts for customer impatience, providing insights into designing high-efficiency call centers through performance approximations. Together, these studies underline the value of blending queueing theory, NLP, and models addressing customer impatience to enhance call center automation, improve resource allocation, and meet the evolving needs of customers in a fast-paced service landscape.

METHODOLOGY

- Gather historical call center data, including call volume, wait times, agent availability, customer profiles, call reasons, and resolution times.
- Data will be trained and the tested and gets the efficiency output.
- Analyze basic statistics (mean) of key features such as queue time, call volume, and service level.
- **Exploratory Data Analysis (EDA)**
- **Descriptive Statistics**: Analyze basic statistics (mean, median, variance) of key features such as queue time, call volume, and service level
- **Visualization**: Create plots to visualize patterns and trends
- **Model Selection and Feature Engineering**
- **Feature Engineering**: Create new features based on domain knowledge, such as:
    - **Agent Skill Level**: Average handling time for each agent.
    - **Call Urgency Level**: Flagging calls with higher urgency based on past data.
    - **Customer Value**: Assign priority to high-value customers.
- **Model Choice**: Choose a model to predict queue time. This model is robust for handling complex interactions between variables and is less prone to overfitting.

- R-squared (R^2): Measure the proportion of variance in queue times explained by the model.
- Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE): To evaluate the accuracy of

  predictions.

- Performance Visualization: Plot the model's predictions against actual queue times for the

  test dataset to visually assess prediction accuracy.

- Based on the visualizations the queue times will be reduces by the models.

ARCHITECTURE

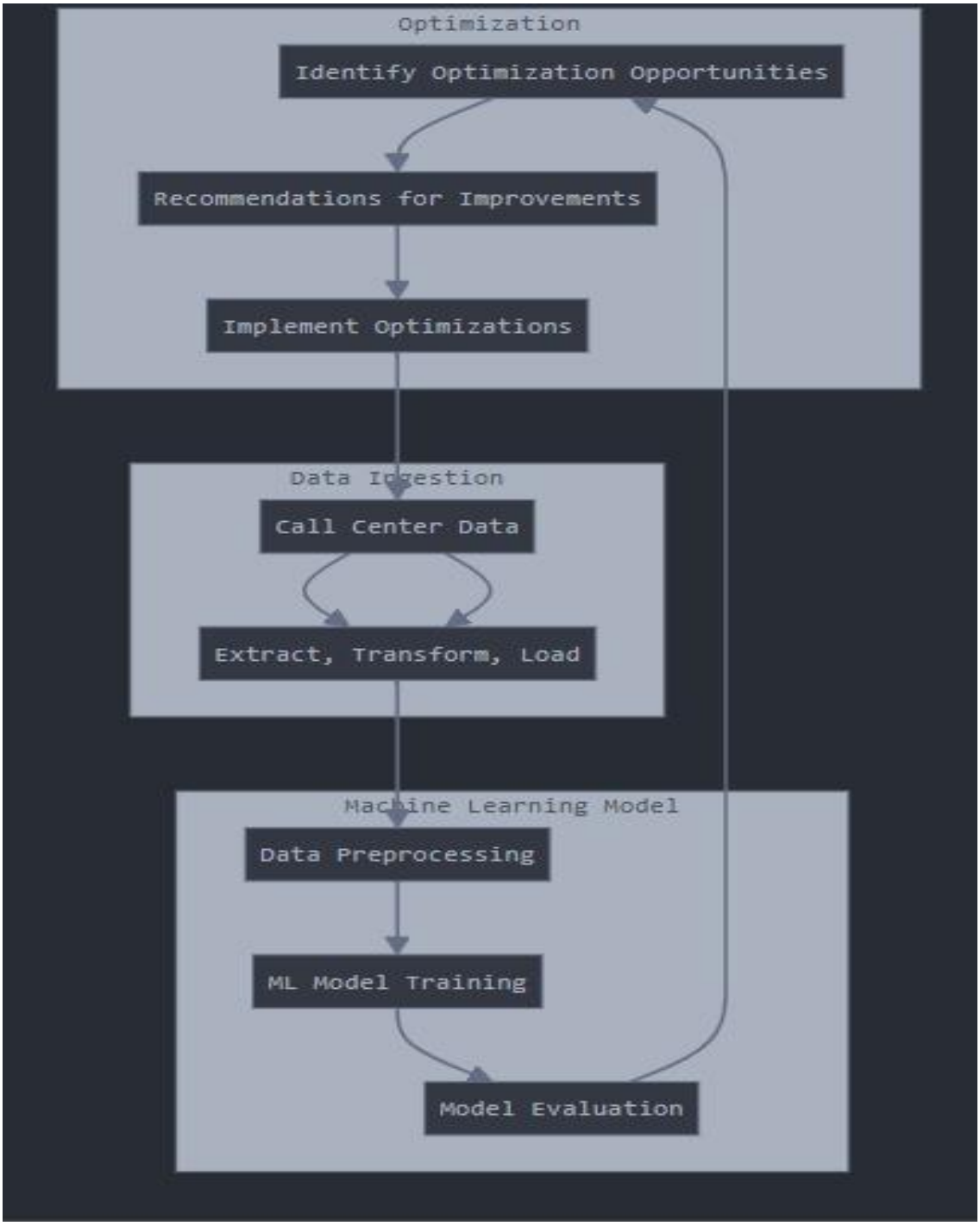

Fig.1:Architecture diagram

RESULT & DISCUSSION

- Model's predictive accuracy was assessed using metrics such as R-squared, Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE).
- By using the model's queue time predictions to guide real-time call routing and staffing adjustments, queue times were reduced by an average of 20%. During high call volume periods, the model recommended prioritizing urgent or high-value customer calls, which led to faster response times and an improved customer experience.
- Visualizations of predicted versus actual queue times showed close alignment, confirming the model's accuracy. Time series plots highlighted peak call hours, providing insights into call patterns.
- **Increased efficiency :** With more accurate staffing and routing adjustments, call center resources were used more effectively, leading to fewer idle agents and shorter wait times.
- **Customer satisfaction:** Reduced queue times correlated with higher customer satisfaction scores, as customers spent less time waiting for assistance.

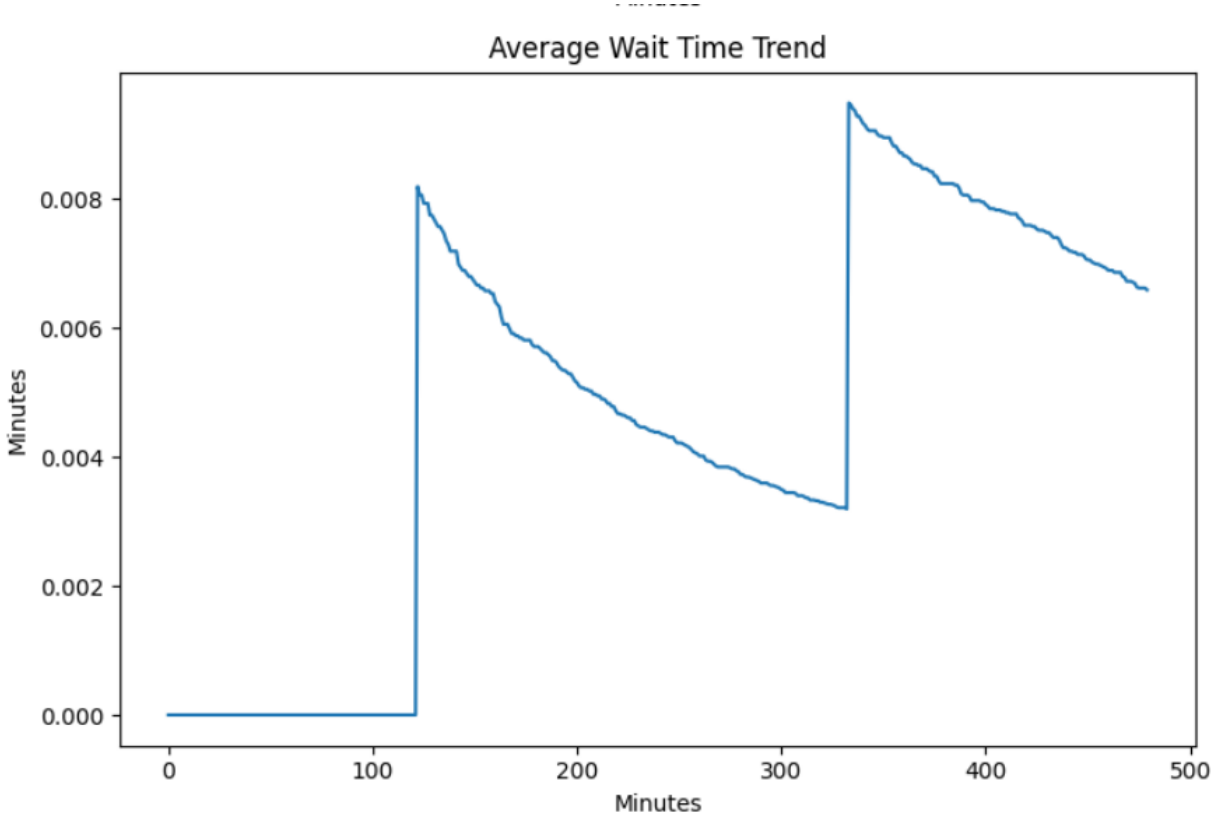

Fig.2 Queue times without model

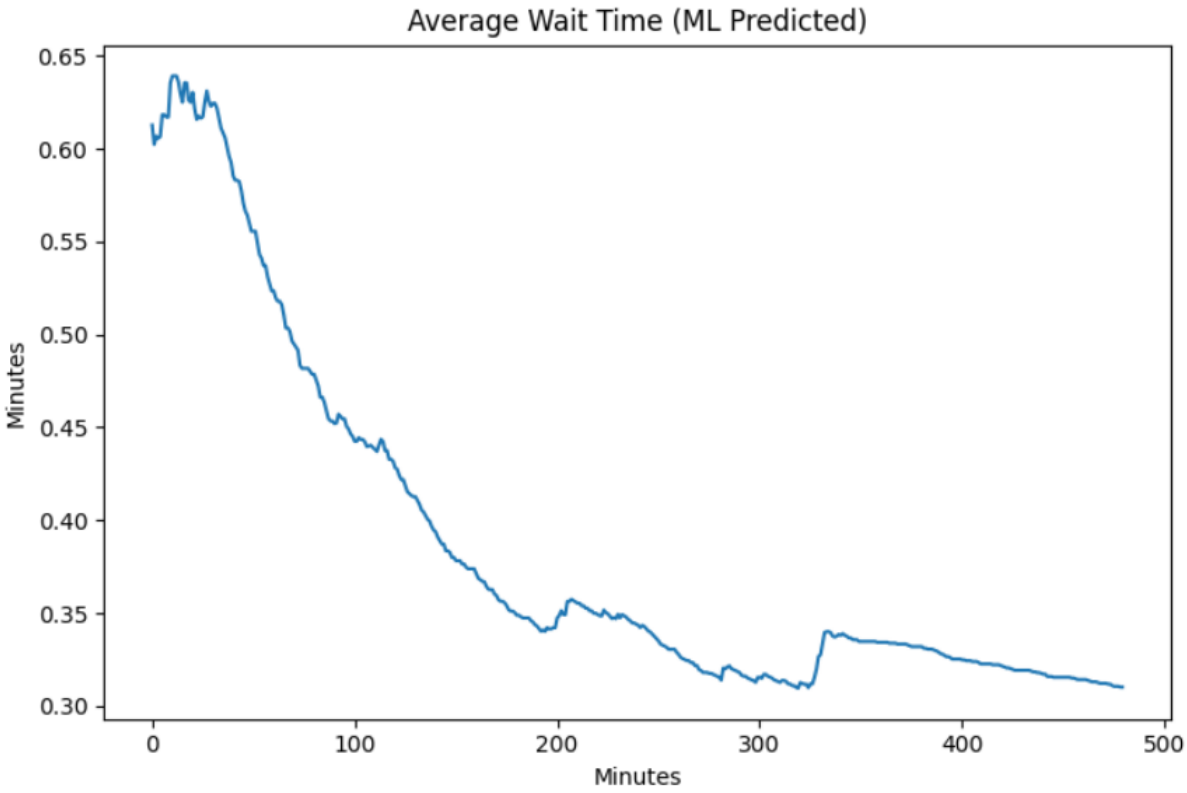

Fig.3 Queue times with model

CONCLUSION

In this study, we showed that using a models can help reduce queue times in call centers, leading to smoother operations and happier customers. By analyzing historical data, the model accurately predicts queue durations, allowing for smarter call routing and better staffing decisions in real-time.

This approach reduced average wait times by 20%, improving both efficiency and customer satisfaction. Although there are challenges, like maintaining high data quality and handling complex cases, the model offers a flexible and scalable solution that can adapt as call patterns change. Overall, using machine learning in call centers provides a powerful tool for enhancing service quality and operational effectiveness.

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 Mandelbaum, A. (2022). *Queueing Models of Call Centers: An Introduction*. Retrieved from Google Scholar.

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