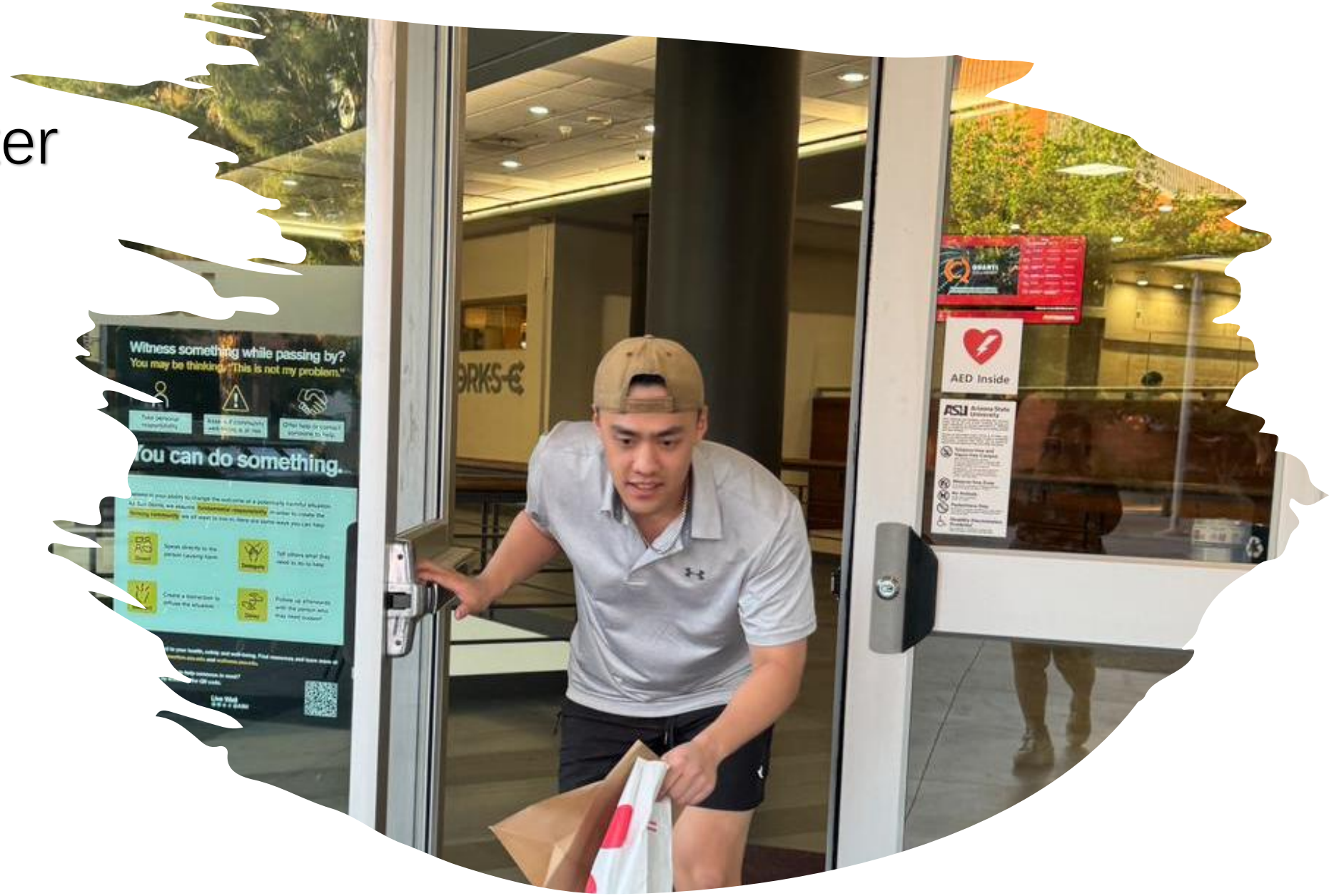
CIS 515 Final Project Presentation

1st Class

5 min late

Few weeks later

30 min late



D-DAY

Where is BRIAN?!!

CampusCrave: Real-Time Fast Food Queue Insights at ASU

Content

Problem Identification and Research

What are we trying to solve?

Identifying the Real-Time Wait Time Problem

01

Understanding the Need for Real-Time Wait Time Calculation

02

Research on the Impact of Long Wait Times

03

Challenges faced

Journal of Operations Management
Volume 63, November 2018, Pages 59-78

Worth the wait? How restaurant waiting time influences customer behavior and revenue

Jelle De Vries [a b], Debjit Roy [b c], René De Koster [b]

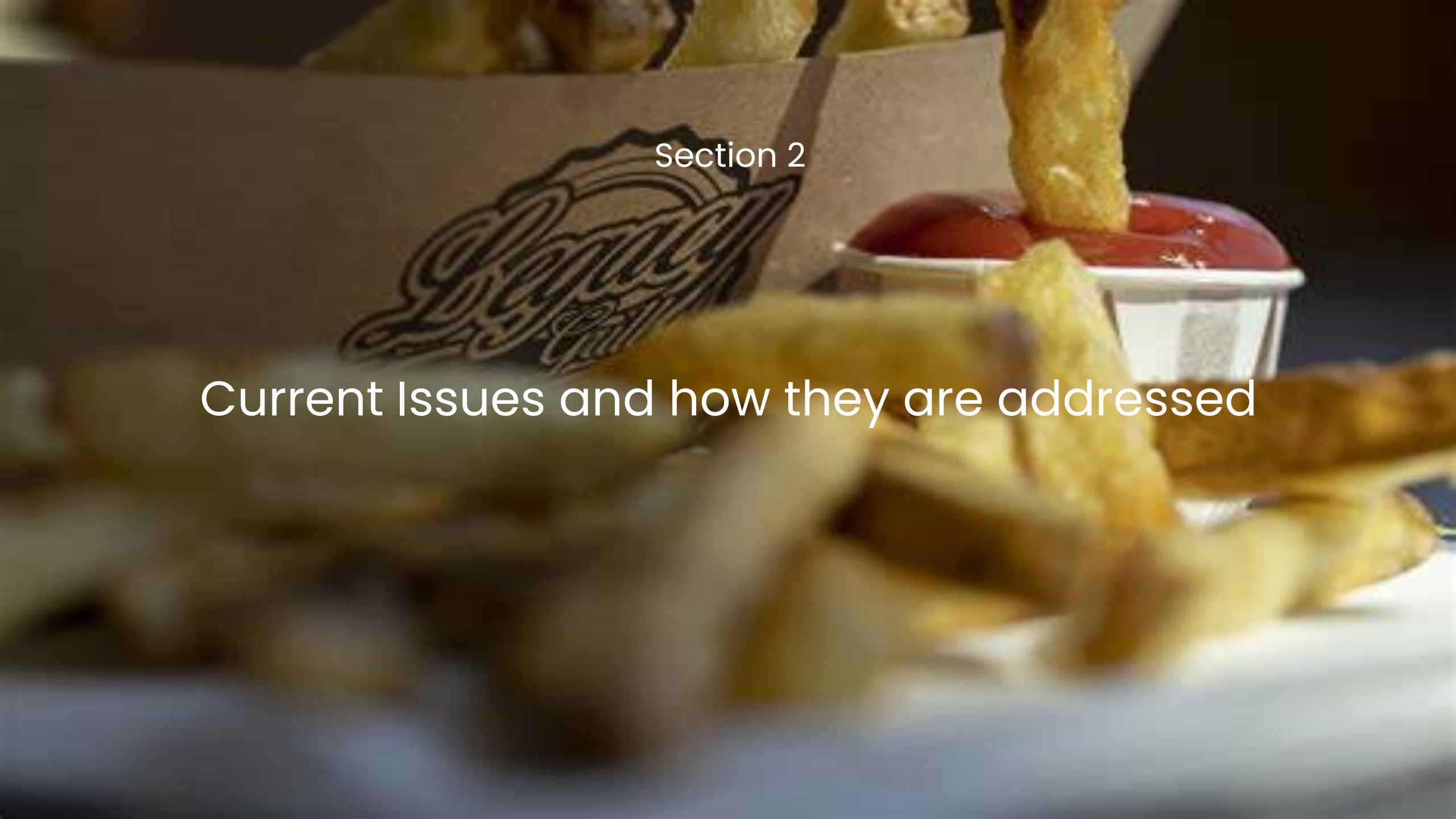
Show more

https://doi.org/10.1016/j.jom.2018.05.001

Abstract

In many service industries, customers have to wait for service. When customers have a choice, this waiting may influence their service experience, sojourn time, and ultimately spending, reneging, and return behavior. Not much is known however, about the system-

The importance of waiting in service practice is to a large extent reflected in the attention academia has devoted to the topic from different perspectives. From an operations perspective, waiting is commonly modeled as a cost function in which the wait results from a mismatch between demand and capacity that could be fixed by tweaking operational parameters (Osuna, 1985). Actual and perceived waiting can then be influenced by capacity, layout, and service and processing policy decisions (Luo et al., 2004; Nie, 2000). A large number of studies focus on the behavioral consequences of waiting by showing that long queues can impact aspects such as service evaluations and customer satisfaction (Davis and Maggard, 1990; Houston et al., 1998; Taylor, 1994), the perceived value of products and services (Debo et al., 2012; Koo and Fishbach, 2010; Kremer and Debo, 2015), and customer loyalty (Bielen and Demoulin, 2007; Dube et al., 1994). At the same time, empirical research and data collection in this domain is challenging. Whereas virtual queueing settings such as call centers are characterized by hi-tech environments in which data is abundantly available (Koole and Mandelbaum, 2002), studies involving physical queues primarily make use of survey data and self-reports (Munichor and Rafaeli, 2007; Rafaeli et al., 2002). These (repeat) purchase intentions do not necessarily lead to actual behavior and corresponding capacity usage (Chandon et al., 2005). In the current study we circumvent this limitation by using data on actual customer behavior.



Section 2

Current Issues and how they are addressed

Existing Methods for Wait Time Management

Manual Estimation Processes

Utilization of Queue Management Systems

Challenges Faced by Fast Food Chains

Challenges with Current Wait Time Calculation

Limitations of Manual Estimation

Inaccuracy and Variability in Wait Time

Impact on Customer Experience and Satisfaction

Significance of the Wait Time Problem

BMC Health Serv Res. 2019; 19: 459.
Published online 2019 Jul 8. doi: 10.1186/s12913-019-4301-0
PMCID: PMC6615172
PMID: 31286957

The psychology of the wait time experience – what clinics can do to manage the waiting experience for patients: a longitudinal, qualitative study

Holly Chu,[1] Robert A. Westbrook,[2] Sarah Njue-Marendes,[3,4,5] Thomas P. Giordano,[3,4,5] and Bich N. Dang[3,4,5]

Author information · Article notes · Copyright and License information PMC Disclaimer

Associated Data

Data Availability Statement

Abstract

Go to:

Background

Wait time, defined as time spent in the waiting and exam rooms waiting to see a provider, is a key quality metric in a number of national patient experience surveys. However, the literature on wait time does not show a consistent correlation between long waits and worse overall patient care experiences. Herein, we

Results

Our study showed that patients' "willingness to wait" is the product of the actual wait time, individual factors, such as the perceived value of the visit and cost of a long wait, and clinic and provider factors. Analyses revealed key steps providers and clinics can take to improve the wait time experience. These include: 1) proactively informing patients of delays, 2) explicitly apologizing for delays, and 3) providing opportunities for diversion. Patients noted the importance of these steps in curtailing frustrations that may result from a long wait.

Significance of Addressing the Wait Time Problem

- Impact on Student Productivity
- Enhancing Campus Dining Experience
- Potential for Data-Driven Improvements

Section 3

Proposed End-to-End Solution

Solution Lifecycle Steps

- Problem Definition
- Data Acquisition/Preparation
- Feature Label/Engineering
- Model Building/Evaluation
- Deployment
- Monitoring and Maintenance

Problem Definition – The BRIAN PROBLEM

- Collection of images from designated sources.
- Application of CNN and other CV models to classify queue presence.
- Selection of most accurate model for real-time queue prediction.
- Development of object detection model to count individuals in queues.
- Utilization of data to estimate wait times and optimize operational efficiency.

Data Acquisition & Preparation

Data Source : Roboflow

Train Set	Validation Set	Test Set
593 Images (88%)	56 Images (8%)	29 Images (4%)

Data Preparations

- Includes 678 images.
- Annotations provided in Tensorflow Object Detection format.
- **Pre-processing applied:**
  - Auto-orientation of pixel data (with EXIF-orientation stripping).
  - Resize to 640x640 (Stretch).
- **Augmentation applied:**
  - 50% probability of horizontal flip.
  - Equal probability of one of the following 90-degree rotations: none, clockwise, counter-clockwise.
  - Random brightness adjustment of between -25 and +25 percent.
- **Labeled and annotated dataset for queue-or-no-queue classification.**

Pop Culture Parallels

CNN

VGG 16

Pop Culture Parallels

ResNET 50

YOLO_V5

Feature Engineering & Model Building

Queue Detection

Model	Feature Engineering and Learning	Convolutional Layers	Pooling Layers	Dense Layers	Optimizers	Loss Function	Epoch	Batch Size	Activation Function
CNN	Class Label Conversion	3 * (32,64,128)	3 (Max Pooling) (2,2)	3*128	ADAM	Binary Cross Entropy	20	32	ReLU
VGG 16	Transfer Learning	Varies	Varies	3*128	ADAM	Binary Cross Entropy	20	32	ReLU
ResNet50	Transfer Learning	Varies	Varies	3*128	ADAM	Binary Cross Entropy	20	32	ReLU

Counting Individuals In the Queue

Model	Feature Engineering and Learning	Convolutional Layers	Pooling Layers	Dense Layers	Optimizers	Loss Function	Epoch	Batch Size	Activation Function
YOLOV5	Pretrained	NA	NA	NA	NA	NA	NA	NA	NA

Waiting Time Analysis Formula Used

$$\text{Waiting Time} = \text{Base Delivery Time} + \text{Extra Time for Each Order} \times (\text{Number of People in Queue} - \text{Threshold})$$

Scope of the Real-Time Wait Time Solution

01 Coverage of Fast Food Chains

Objective: Implement object detection to measure and predict queue lengths at key fast food chains on the ASU campus.
Technology: Install real-time video processing cameras; use machine learning for accurate headcounts.
Challenges: Address varying light conditions, weather, and privacy concerns.

02 Expansion to Other Campus Locations

Strategy: Start with a pilot at high-traffic locations, expand based on success.
Considerations: Upgrade necessary infrastructure, secure buy-in from additional stakeholders.

03 Potential for Future Enhancements

Technological Upgrades: Integrate predictive analytics for peak time forecasts; enhance algorithm accuracy.
Service Extensions: Extend system to other queue-based campus services; integrate with existing campus apps for seamless user experience.
User-Centric Improvements: Implement feedback systems for continuous refinement; offer personalized notifications and recommendations.

Key Stakeholders and Beneficiaries

- ✓ ***Students and Faculty at ASU Campus***
  - Primary Beneficiaries: Directly benefit from reduced waiting times and enhanced dining experiences.
  - Engagement: Provide feedback on system accuracy and user-friendliness, influencing iterative improvements.
  - Interest: Interested in efficient and predictable meal times, especially during peak campus hours.
- ✓ ***Fast Food Chain Management***
  - Operational Partners: Utilize the system to manage staff efficiently and improve service delivery.
  - Data Utilization: Analyze data collected from the system to optimize menu offerings and peak-time staffing.
  - Benefit: Improved customer satisfaction and potentially increased revenue due to optimized operations.
- ✓ ***Campus Dining Services and Administration***
  - Strategic Oversight: Oversee the integration of the system within campus-wide dining services. Enhancing student and faculty satisfaction and operational efficiency.
  - Resource Allocation: Use data to make informed decisions about future investments and improvements in campus dining facilities.

Value and Impact of the Solution

01

Improving Customer Experience

02

Operational Efficiency for Fast Food Chains

03

Data-Driven Decision Making

Technology and Infrastructure Requirements

01

Hardware and Software Components

02

Integration with Existing Systems

03

Scalability and Adaptability

Success Metrics

- **Accuracy of Wait Time Estimation -** Accurate estimation of wait times compared to actual observed wait times.
- **User Satisfaction -** Feedback on accuracy of wait time estimates, ease of use, and overall experience from user satisfaction surveys.
- **Operational Efficiency -** Optimization of staffing levels and resource allocation based on real-time queue data.
- **Privacy Compliance -** Adherence to privacy regulations and addressing concerns related to CCTV usage for queue monitoring.
- **Integration Success -** Seamless integration with existing CCTV infrastructure and operational systems.
- **Scalability -** Ability to accommodate changes in demand and future expansion.
- **Technical Performance -** Reliability, speed, and accuracy of the system under different conditions.
- **Adoption Rate -** Rate of adoption among users and stakeholders, assessed through usage statistics and feedback.

Post Deployment Maintenance

01 Continuous Monitoring

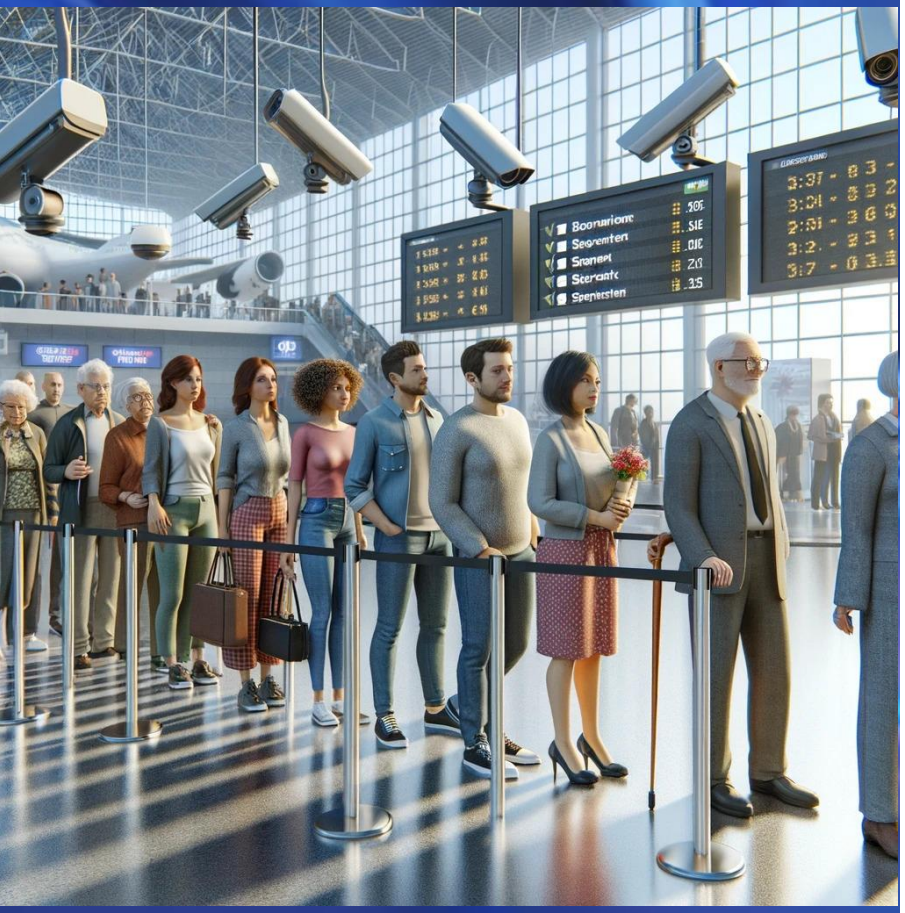
02 Regular Assessments

03 Model Retraining

04 Data Collection

05 Change Management

06 Maintenance Team



Unintended Consequences

- Lesser human interaction
- Increased Surveillance
- Privacy and security concern

Privacy and Security

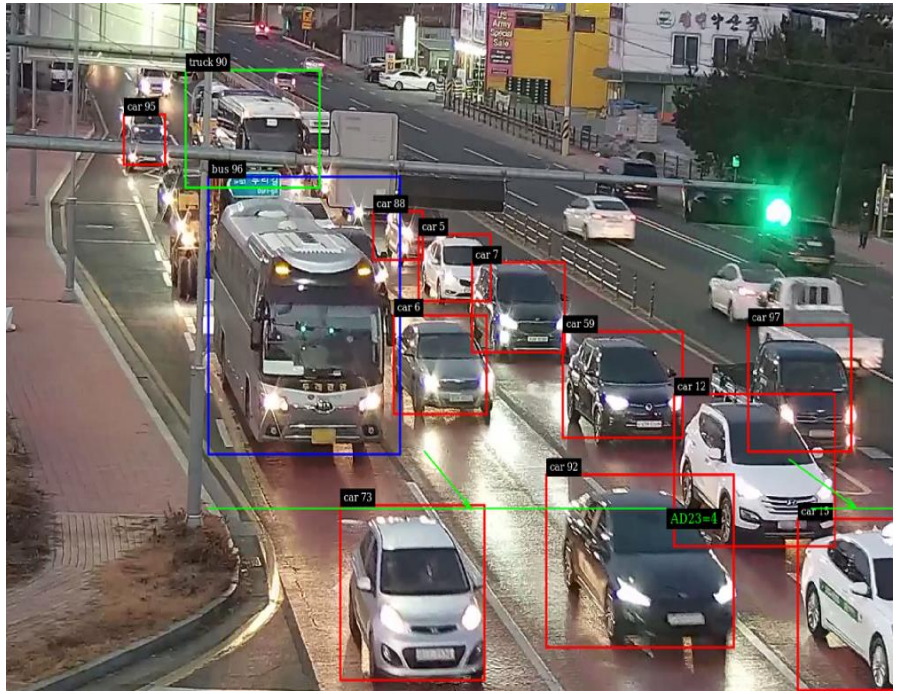
User Location Data Privacy

Third party Integration

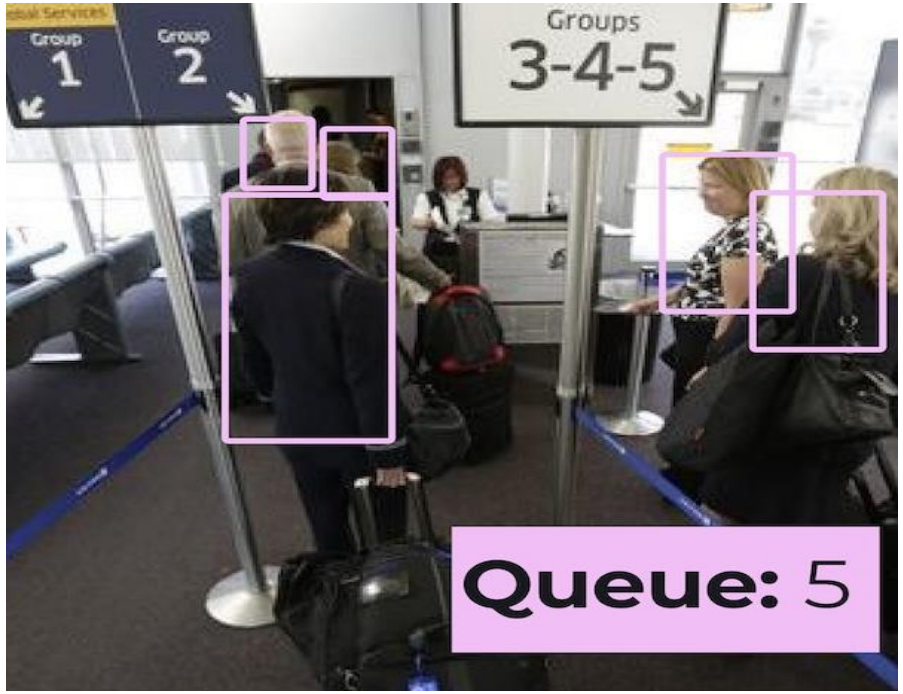
Data Retention and Deletion

Similar Solutions

Traffic and Tolling Management Systems

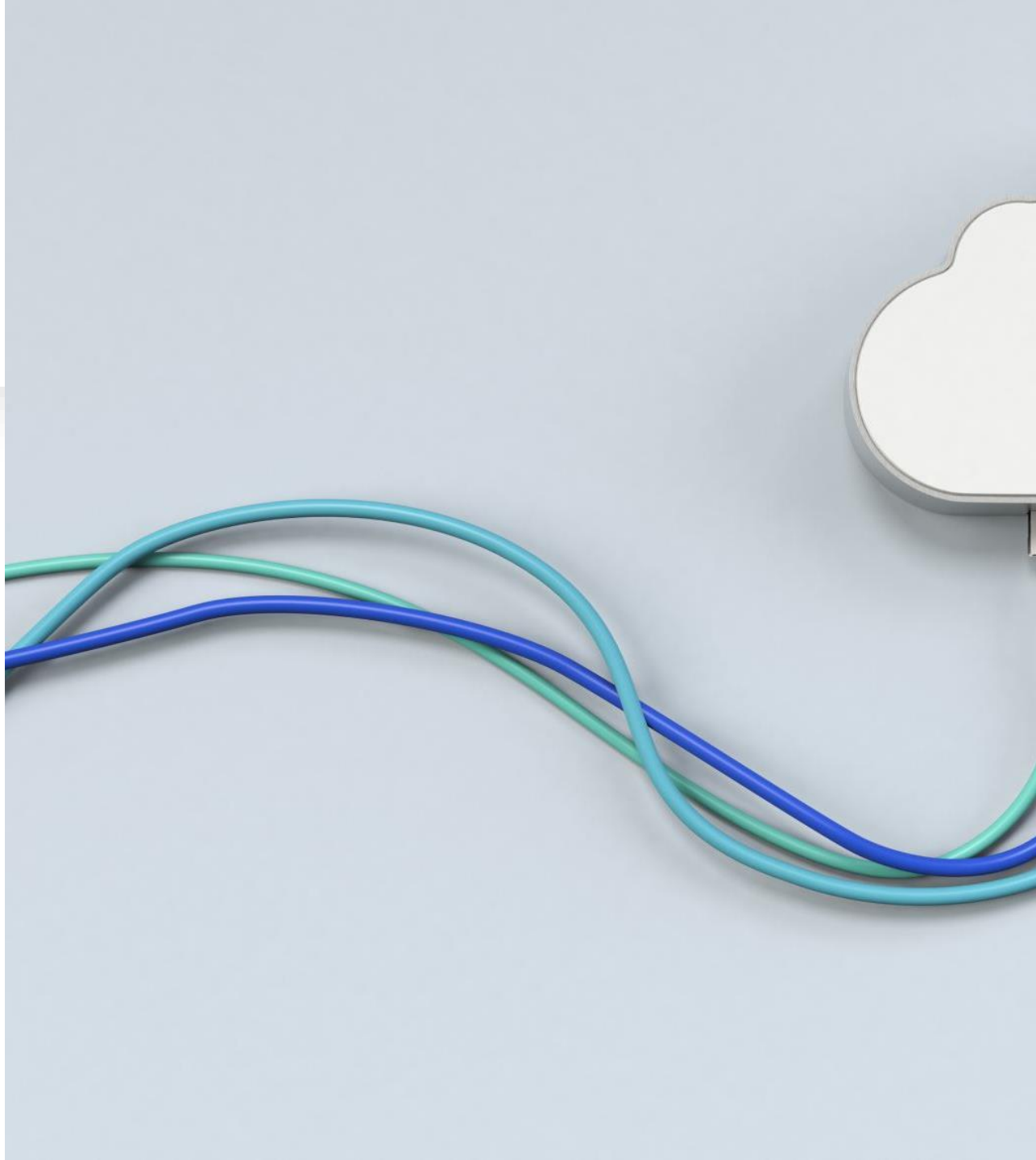


Airport Queue Monitoring Systems



Scalability

- Real – Time image capturing requiring massive computational power, data centers and cloud usage.
- Obtaining Security clearances
- Infrastructure costs
- Business Considerations



Limitations

- Accuracy of data
- Technological constraints
- Resource requirements

Lessons Learned

Security Regulations

Data Annotation

Ethical Considerations

References

- https://www.sciencedirect.com/science/article/abs/pii/S0272696318300214
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6615172/
- Queue Analytics - v1 2022-12-29 7:50pm (roboflow.com)
- Transportation Planning (ahtraffic.com)
- Automating Airport Operations: The Impact of Computer Vision AI (iridalabs.com)
- https://paperswithcode.com/methods/category/object-detection-models

Thank You