

Patent Analysis of "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" (US 11,630,999 B2): A Technological, Strategic, and Commercial Evaluation

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Patent Analysis of "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" (US 11,630,999 B2): A Technological, Strategic, and Commercial Evaluation

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ABSTRACT

Purpose: To systematically analyze the patent "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" (US 11,630,999 B2) and evaluate its technological innovation, strategic significance, and commercial potential in the field of artificial intelligence. The study examines how the patented invention identifies customer emotions from voice signals during support calls and enables customized, emotion-aware customer support.

Methodology: This study adopts an exploratory qualitative research approach based on the analysis of the selected patent. Relevant information was collected from publicly available sources, including Google Patents, Google Scholar, research publications, and other authentic online resources. SWOC Analysis and ABCDEF Analysis were applied to evaluate the patent's technological capabilities, commercial value, implementation challenges, and future opportunities.

Results & Analysis: The analysis shows that the patent introduces a machine-learning-based framework for identifying customer emotions from voice audio in support calls by extracting acoustic features and classifying emotional states using a trained neural network model. The invention has significant applications in customer experience management, contact-centre operations, telecommunications, banking and financial services, fraud detection, and mental-health-aware customer interaction. The study also identifies challenges related to linguistic and cultural variation in emotional expression, real-time processing demands, data privacy, and the subjectivity of emotion labelling.

Originality & Values: The study provides a comprehensive evaluation of the patent using structured analytical frameworks and highlights its technological, commercial, and societal significance. It demonstrates the patent's contribution toward strengthening emotionally responsive customer service, promoting responsible artificial intelligence, and supporting future advancements in affective computing and customer relationship management.

Type of Paper: Case Study-based Exploratory Research.

Keywords: Patent Analysis, Artificial Intelligence, Emotion Recognition, Speech Emotion Recognition, Customer Experience Management, Machine Learning, Affective Computing, SWOC Analysis, ABCDEF Analysis, Patent Number: US 11,630,999 B2.

1. INTRODUCTION :

1.1 About Patent Analysis:

Patent analysis has emerged as an important exploratory research method for examining technological innovations, intellectual property developments, and competitive advancements across industries. Patent documents provide detailed information regarding an invention's technical design, operational framework, claims, and novelty, enabling researchers to evaluate innovation trends and understand how new technologies are translated into practical applications. Through systematic patent examination, scholars can assess the technological significance, commercial potential, and societal relevance of

inventions while gaining insights into the evolution of emerging fields (Abbas et al. (2014). [1]; Blind et al. (2006). [2]).

The rapid growth of Artificial Intelligence (AI) has transformed numerous sectors by enabling machines to interpret not only data and language but also human emotional states. One significant outcome of these advancements is the development of affective computing systems capable of recognizing emotions from speech, enabling machines to respond appropriately to a person's emotional condition (Picard (1997). [3]). Speech emotion recognition (SER) has become a well-established research area, with acoustic and prosodic features being used to classify emotional states such as anger, sadness, happiness, and fear (Akçay & Oğuz (2020). [4]; El Ayadi et al. (2011). [5]). In customer service contexts specifically, the ability to detect a customer's emotional state during a support call carries significant commercial value, since frustration and anger measurably reduce a caller's ability to process information and can lead to escalations, complaints, and customer churn (Płaza et al. (2022). [6]).

This research case study focuses on US Patent 11,630,999 B2, titled "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions," assigned to Dish Network Technologies India Pvt Ltd (originally filed under Sling Media Pvt Ltd). The patent proposes an intelligent framework for identifying customer emotions in real time from voice audio captured during a customer support call, using acoustic feature extraction and a trained machine-learning classification model. The invention integrates audio signal processing, neural-network-based classification, and an automated flagging mechanism to help service organizations identify calls that require a follow-up, thereby improving customer experience management.

The societal impact of this patent is meaningful because emotionally aware customer support can reduce customer frustration, improve first-contact resolution, and support the mental well-being of both customers and service agents. Technologies capable of automatically identifying elevated emotional states can assist contact centres, telecommunications providers, financial institutions, and healthcare support services in delivering more empathetic and effective assistance. Therefore, innovations in emotion-aware AI play an essential role in supporting customer trust and promoting the responsible use of artificial intelligence in commercial service environments (Schuller (2018). [7]; Khalil et al. (2019). [8]).

This patent analysis adopts an exploratory research methodology to examine the technical structure, innovation characteristics, claims, applications, and significance of US Patent 11,630,999 B2. The paper is organized into sections covering patent bibliographic information, background of the invention, technological architecture, patent claims analysis, novelty assessment, practical applications, societal implications, strengths and limitations, and future research opportunities. Through a systematic investigation of the patent document, the study aims to provide a comprehensive understanding of how patented AI-based emotion-recognition technologies contribute to technological innovation, customer experience management, and the broader intellectual property ecosystem.

1.2 In this Paper:

The scholarly article entitled "Patent Analysis of AI-Based Customer Emotion Analysis and Customized Support Systems" is structured as an exploratory research study that systematically examines the technological and innovative aspects of US Patent 11,630,999 B2. The article begins by discussing the growing adoption of artificial intelligence technologies in customer service and the challenges associated with recognizing human emotion from voice signals. It then presents a detailed analysis of the selected patent, including its objectives, technical architecture, operational framework, and patent claims. By investigating the invention's machine-learning-based approach for identifying customer emotions, the study provides valuable insights into the patent's novelty, technological significance, and contribution to the field of customer experience management.

The analytical section of the article evaluates the practical applications and broader implications of the patented technology across contact-centre operations, telecommunications, banking and financial services, and healthcare-related customer interactions. Particular emphasis is placed on assessing the strengths, limitations, and innovative features of the invention in addressing challenges related to customer frustration, service escalation, and emotionally responsive automation. The study also explores future opportunities for enhancing emotion-aware customer support systems through advancements in artificial intelligence, multimodal signal processing, and affective computing. Through a comprehensive examination of the patent, the article demonstrates how intellectual property

protection supports technological innovation while contributing to the development of more empathetic and effective digital service ecosystems.

2. REVIEW-BASED SELECTION OF SOME PATENTS IN AI-BASED EMOTION RECOGNITION & CUSTOMER EXPERIENCE MANAGEMENT :

Some of the important patents related to AI-based customer emotion analysis and voice-based emotion recognition were searched using Google Patents (<https://patents.google.com/>) and reviewed in Table 1.

Table 1: Some of the important patents related to AI-based customer emotion analysis and customized support systems

S.No.	Patent Number	Patent Title	Inventor / Assignee	Patent Status	Patent Type
1	CN112216307B	Speech emotion recognition method and device	Huawei Technologies Co., Ltd.	Granted & Active	Speech Emotion Recognition; AI [9]
2	US12119022B2	Cognitive Assistant for Real-Time Emotion Detection from Human Speech	Rishi Amit Sinha	Granted & Active	Emotion AI; Cognitive Assistants [10]
3	US11508396B2	Acquiring Speech Features for Predicting Emotional Severity of Adverse Events on Individuals	TQINTELLIGENCE, Inc.	Granted & Active	Speech Emotion AI; Healthcare [11]
4	US11954443B1	Complaint Prioritization Using Deep Learning Model	Wells Fargo Bank, N.A.	Granted & Active	Customer Complaint AI; Deep Learning [12]
5	US12079826B1	Predicting Customer Interaction Using Deep Learning Model	Wells Fargo Bank, N.A.	Granted & Active	Customer Interaction AI [13]
6	US11978475B1	Systems and Methods for Determining a Next Action Based on a Predicted Emotion	Wells Fargo Bank, N.A.	Granted & Active	Emotion-Based Decisioning [14]
7	US12008579B1	Fraud Detection Using Emotion-Based Deep Learning Model	Wells Fargo Bank, N.A.	Granted & Active	Fraud Detection; Emotion AI [15]
8	CN106503646B	Multimodal Emotion Recognition System and Method	Emotibot Technology (Shanghai)	Granted & Active	Multimodal Emotion Recognition [16]

S.No.	Patent Number	Patent Title	Inventor / Assignee	Patent Status	Patent Type
9	US20190253558A1	System and Method to Automatically Monitor Service Level Agreement Compliance in Call Centers	Risto Haukioja	Published	Call-Centre Monitoring; AI [17]
10	US11630999B2 (This Work)	Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions	Dish Network Technologies India Pvt Ltd	Granted & Active	Speech Emotion Recognition; Customer Support AI [18]

3. OBJECTIVES OF A PAPER :

- (1) To examine the technical structure, operational framework, and working mechanism of US Patent 11,630,999 B2 related to AI-based customer emotion analysis.
- (2) To analyze the patent claims, novelty, and innovative features of the invention and evaluate its contribution to the field of artificial intelligence and customer experience management.
- (3) To study the application of machine learning, acoustic feature extraction, and speech signal processing techniques employed in detecting customer emotions from voice.
- (4) To assess the practical significance of the patented technology in contact-centre operations, telecommunications, banking and financial services, and customer support automation.
- (5) To investigate the societal and technological impact of the invention in addressing challenges associated with customer frustration, service escalation, and emotionally responsive digital support.
- (6) To evaluate the strengths, limitations, future scope, and potential research opportunities associated with AI-based emotion recognition and customized customer support technologies.

4. METHODOLOGY :

This study adopts an exploratory qualitative research methodology to analyze US Patent 11,630,999 B2 related to AI-based customer emotion analysis. Relevant information was collected from Google Patents, Google Scholar, research articles, and other publicly available sources. Analytical frameworks such as SWOC and ABCDEF were applied to evaluate the patent's technological innovation, practical applications, and contribution to customer experience management and affective computing [19].

5. BASIC DETAILS OF PATENT CHOSEN FOR ANALYSIS :

5.1 Patent Overview:

US Patent 11,630,999 B2, titled "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions," is an innovative invention developed to address the challenge of recognizing customer emotions during voice-based customer support interactions. The patent was filed on December 19, 2019 and granted on April 18, 2023, and is currently active with an adjusted expiration date of May 1, 2041. The named inventors are Arun Lokman Gangotri, Balarama Mathukumilli, and Debashish Sahoo, and the patent is assigned to Dish Network Technologies India Pvt Ltd (originally assigned under the name Sling Media Pvt Ltd, which was renamed in 2022). This patent contributes to the fields of artificial intelligence, machine learning, speech signal processing, and customer relationship management by providing an automated mechanism for identifying elevated or negative emotional states in customer voice communications.

5.2 Summary of the Patent (From the Abstract):

The patent proposes a method and system for voice emotion identification in audio captured during a customer support call between a customer and a service agent. The system receives an audio stream of

voice samples contained in consecutive frames, extracts a set of voice emotion features from each frame by applying a trained machine-learning model that utilizes neural networks, and classifies each frame's emotion based on the extracted features to label the type of emotion captured in the voice sample. The approach enables efficient, automated detection of customer emotions such as anger, disgust, happiness, fear, sadness, surprise, and neutral states, thereby supporting more responsive and empathetic customer service.

5.3 Description of the Patent:

The patent describes a comprehensive framework that combines audio pre-processing, acoustic feature extraction, and machine-learning-based classification to detect customer emotions in voice communications. The system removes silence and background noise from the received audio, selects the frames with the highest energy content, and extracts a defined set of acoustic features from each selected frame, including spectral flatness, spectral centroid, spectral roll-off, spectral bandwidth, zero-crossing rate, and root-mean-square energy. These extracted features are compared against a trained classification model to determine the likelihood that a given voice sample corresponds to a particular emotional state.

The patented technology has wide-ranging applications across multiple sectors, including contact-centre operations, telecommunications, streaming and media services, banking and financial services, and healthcare-related customer interactions. By enabling automated identification of elevated emotional states such as anger or frustration, the invention helps organizations flag calls for follow-up at a later, calmer time, thereby improving customer satisfaction, reducing escalations, and supporting the broader goal of emotionally intelligent customer relationship management.

6. TECHNICAL CONTENT ANALYSIS :

6.1 Objective of the Invention:

What Problem Does It Solve?

The patent "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" addresses the challenge of recognizing elevated or negative emotional states, such as frustration or anger, in customers communicating with service agents during support calls. Emotions such as anger can reduce a person's ability to process information coherently, meaning that a customer in an elevated emotional state may not fully comprehend the assistance being provided, even when the information communicated is otherwise clear. Traditional customer-service workflows offer agents limited tools to recognize such elevated emotional states in real time or to determine when a follow-up conversation would be more productive.

The invention seeks to provide an automated and scalable mechanism for detecting customer emotions directly from voice audio during a support call. By extracting acoustic features and applying a trained machine-learning model, the system improves the ability of service organizations to identify customers who may need a follow-up interaction, thereby improving comprehension, satisfaction, and resolution outcomes.

6.2 Key Components / Method:

Describe How It Works (Summary of Claims and Diagrams)

The patented system follows a structured audio-analysis framework that combines pre-processing, feature extraction, and machine-learning-based classification. The major functional components of the invention are summarized below:

(a) Audio Input and Acquisition:

The process begins with the acquisition of an audio stream of a customer support call, received from a media streaming device or communication network as a series of voice samples contained in consecutive frames.

(b) Pre-processing (Silence and Noise Removal):

The system removes silent portions and background noise from the received audio, producing a more compact audio sample that improves the efficiency and accuracy of subsequent processing.

(c) Energy-Based Frame Selection:

From the consecutive frames of the pre-processed audio, the system selects a subset of frames based on their energy content, prioritizing frames that are more likely to carry meaningful emotional information.

(d) Acoustic Feature Extraction:

From each selected frame, the system extracts a defined set of acoustic features, including spectral flatness, spectral centroid, spectral roll-off, spectral bandwidth, zero-crossing rate, and root-mean-square energy, along with related coefficients such as Mel-Frequency Cepstral Coefficients (MFCC).

(e) Machine Learning-Based Classification:

The extracted features are processed through a trained machine-learning model (implemented using neural network architectures such as Convolutional Neural Networks) that classifies each frame into an emotional category, such as angry, disgust, happy, fear, sad, surprise, or neutral.

(f) Flagging and Output Generation:

Based on the classification results and the intensity level of the detected emotion, the system flags a particular call for follow-up by the service agent at a later, more suitable time, supporting proactive and empathetic customer relationship management.

The overall methodology integrates audio signal processing, acoustic feature engineering, and artificial intelligence to create an automated framework for detecting customer emotions during voice-based support interactions.

6.3 Innovative Elements:

What Makes It Novel Compared to Prior Art?

The novelty of the patent lies in its combination of energy-based frame selection with a specific, defined set of acoustic features (spectral flatness, spectral centroid, spectral roll-off, spectral bandwidth, zero-crossing rate, and root-mean-square energy) used together for real-time emotion classification in a customer-service context, together with an automated flagging mechanism tied to the intensity of the detected emotion. Conventional approaches to call-centre quality monitoring have relied primarily on keyword spotting, manual review, or generic sentiment analysis of transcribed text. In contrast, the patented invention analyzes the acoustic properties of the voice signal directly, allowing it to detect emotional cues that may not be evident from transcribed words alone.

Several innovative aspects distinguish the invention from prior technologies:

- **AI-Based Voice Emotion Identification:** Uses a trained machine-learning model to automatically classify customer emotions directly from audio.
- **Energy-Based Frame Selection:** Selectively analyzes only the most information-rich audio frames, improving processing efficiency.
- **Defined Acoustic Feature Set:** Employs a specific combination of spectral and energy-based features tailored for emotion classification.
- **Automated Follow-Up Flagging:** Triggers a flag for later agent follow-up based on the intensity of the detected emotion, rather than requiring manual review.
- **Scalability for Streaming and Telecom Platforms:** Reflects the assignee's streaming-media and set-top-box heritage, enabling application across live and recorded voice/video streams.
- **Integration of Signal Processing and Machine Learning:** Combines acoustic feature engineering with neural-network-based classification models.
- **Support for Customer Experience Management:** Strengthens emotionally responsive customer relationship management in commercial service environments.

These innovative features position the patent as a meaningful advancement in AI-driven voice emotion recognition and customer experience management technologies.

6.4 Technical Field:

Industry or Domain

The patent belongs to multiple interdisciplinary technological domains associated with artificial intelligence, signal processing, and customer relationship management.

Primary Technical Fields

- **Artificial Intelligence (AI):** Application of intelligent algorithms for voice signal analysis and classification.
- **Machine Learning / Neural Networks:** Use of trained convolutional and other neural network models to recognize emotion patterns in audio.
- **Speech and Audio Signal Processing:** Extraction of acoustic and spectral features from voice recordings.

- **Customer Relationship Management (CRM):** Providing customer assistance and after-sales support informed by emotional state.
- **Telecommunications and Streaming Media:** Application within media-streaming and set-top-box based communication systems.
- **Affective Computing:** Recognition and interpretation of human emotional states by computational systems.
- **Contact-Centre Analytics:** Automated quality monitoring and follow-up management in customer support operations.

Therefore, the patent can be broadly classified within the domains of Artificial Intelligence, Machine Learning, Speech Signal Processing, Customer Relationship Management, and Affective Computing. These domains collectively support the patent's objective of enhancing customer experience, improving service responsiveness, and enabling emotionally intelligent automation in commercial communication systems.

7. DETAILED DESCRIPTION OF THE INVENTION :

The invention titled "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" presents an intelligent framework for detecting customer emotions from voice audio captured during support calls. The rapid development of deep learning and audio signal processing has enabled systems to infer a speaker's emotional state from acoustic cues alone, without requiring the speech to be transcribed or its content to be understood. Such systems can be used to improve customer service quality, reduce escalations, and support agents in managing emotionally charged interactions. The invention addresses these needs by providing an automated mechanism capable of analyzing customer voice audio and classifying the emotional content of each portion of a call.

The patented technology operates through a structured audio-analysis process that combines pre-processing, energy-based frame selection, acoustic feature extraction, and machine-learning-based classification. Rather than relying on manual call review or keyword-based sentiment analysis, the system examines the underlying acoustic properties of the customer's voice that indicate emotional state. The overall architecture of the invention consists of several interconnected functional components: an Audio Acquisition Module, a Pre-processing Module, a Frame Selection Module, a Feature Extraction Module, a Machine Learning Classification Module, and a Flagging/Output Module.

(a) Audio Acquisition Module: The first stage of the invention involves receiving the audio stream of a customer support call from a media streaming device, communication network, or set-top-box based streaming platform. The system receives the audio and prepares it for further processing.

(b) Pre-processing Module: The system removes silent portions and background noise from the received voice conversations, producing a more compact audio sample for further analysis and reducing the computational burden of subsequent stages.

(c) Frame Selection Module: The pre-processed audio is divided into consecutive frames, and the system selectively considers only the frames with the highest energy content, since these frames are most likely to contain meaningful acoustic information relevant to emotion classification.

(d) Feature Extraction Module: From each selected frame, the system extracts a defined set of acoustic features, including spectral flatness, spectral centroid, spectral roll-off, spectral bandwidth, zero-crossing rate, root-mean-square energy, and Mel-Frequency Cepstral Coefficients. These features represent measurable acoustic properties that assist in distinguishing between different emotional states.

(e) Machine Learning Classification Module: The extracted features are processed using a trained machine-learning model, which may be implemented using Convolutional Neural Networks or other deep-learning architectures, to classify each frame into an emotion category such as angry, disgust, happy, fear, sad, surprise, or neutral. The classification model is trained using labelled voice-emotion datasets and can be refined over time to improve accuracy.

(f) Flagging and Output Generation Module: The final stage of the invention determines whether the intensity of the detected emotion warrants flagging the call for follow-up. Calls associated with elevated negative emotions, such as anger, can be flagged so that the service agent follows up with the customer at a later time, when the customer is more likely to be in a calmer emotional state and better able to process the assistance provided.

Practical Applications of the Invention:

The invention has significant practical applications across multiple industries and sectors. In contact-centre operations, it can help supervisors identify calls that require quality review or escalation. In telecommunications and streaming services, it can support customer retention efforts by flagging dissatisfied customers for proactive outreach. Banking and financial-services organizations may utilize similar emotion-based deep-learning approaches for complaint prioritization, fraud detection, and predicting customer interactions, as reflected in related patents assigned to Wells Fargo Bank, N.A. Healthcare-related customer support services may also benefit from emotion-aware triage of patient or caregiver calls.

The invention is also valuable in e-commerce, insurance, government service centres, and any organization operating large-scale voice-based customer support operations where emotional responsiveness and service quality are critical for maintaining customer trust and satisfaction.

Significance of the Invention:

The increasing scale and automation of customer service operations has created a need for tools that can help organizations respond appropriately to customer emotional states without requiring constant manual monitoring. Traditional quality-assurance methods are often insufficient for detecting emotional cues at scale. The invention addresses this gap by introducing an automated, efficient detection framework capable of identifying customer emotions directly from voice audio.

Overall, the patent represents a meaningful advancement in Artificial Intelligence, Speech Signal Processing, and Customer Relationship Management. By enabling reliable, automated identification of customer emotions, the invention contributes to improving customer satisfaction, reducing service escalations, and supporting emotionally intelligent digital service ecosystems.

8. CLAIMS OF THE INVENTION :

The patent "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" contains twenty claims that collectively protect a method, a computer program product, and a system for detecting customer emotions from voice audio using acoustic feature extraction and machine-learning classification. The claims focus on audio pre-processing, energy-based frame selection, acoustic feature extraction, emotion classification, and call flagging. Together, these claims establish legal protection for an automated framework capable of identifying customer emotions and supporting emotionally responsive customer service (Gangotri et al. (2023). [20]). The claims further support applications in contact-centre analytics, telecommunications, and customer relationship management, thereby contributing to more effective and empathetic digital customer service.

Claim 1: Independent Claim – Core Method for Emotion Recognition

The principal claim protects a computer-implemented method comprising:

- (1) Receiving customer voice data during a communication session.
- (2) Preprocessing the speech signal to improve audio quality.
- (3) Extracting relevant acoustic features from the speech signal.
- (4) Processing the extracted features using a trained machine learning model.
- (5) Identifying the emotional state of the customer.
- (6) Generating an emotion classification result.
- (7) Providing the emotion information to support customer service and business decision-making.

This independent claim establishes the fundamental concept of automatically identifying customer emotions from speech using Artificial Intelligence and machine learning techniques.

Claim 2: Speech Signal Acquisition

This claim protects the acquisition of customer voice signals during telephone calls or other voice communication channels. It ensures that speech data can be captured for subsequent emotion analysis.

Claim 3: Speech Preprocessing

This claim covers preprocessing operations performed on the speech signal, including noise reduction, silence removal, normalization, and segmentation to improve the quality of input data before feature extraction.

Claim 4: Acoustic Feature Extraction

This claim protects the extraction of acoustic characteristics from speech, including features such as Mel Frequency Cepstral Coefficients (MFCC), spectral centroid, spectral bandwidth, spectral roll-off, zero-crossing rate, and root mean square (RMS) energy for emotion recognition.

Claim 5: Machine Learning-Based Emotion Classification

This claim protects the application of a trained machine learning model to classify customer emotions based on the extracted speech features and generate emotion recognition results automatically.

Claim 6: Identification of Multiple Emotional States

The invention further protects the capability of recognizing different emotional categories expressed by customers during conversations, enabling more accurate analysis of customer behaviour and service interactions.

Claim 7: Real-Time Emotion Analysis

This claim protects the ability to perform emotion recognition while customer conversations are in progress, allowing organizations to respond immediately to emotionally sensitive situations.

Claim 8: Customer Service Decision Support

This claim covers the use of detected emotional information to assist customer service representatives and organizations in improving complaint resolution, service quality, and customer engagement.

Claim 9: Automated Customer Interaction Analysis

This claim protects the automatic evaluation of customer conversations without continuous human intervention, reducing manual effort while improving operational efficiency.

Claim 10: Integration with Customer Support Systems

The invention protects integration of the emotion recognition system with customer support platforms, enabling organizations to incorporate emotion analytics into existing customer service workflows.

Claim 11: Intelligent Data Processing

This claim protects the automated processing and management of speech data, extracted features, and classification results to improve system performance and analytical efficiency.

Claim 12: Continuous Machine Learning Improvement

The claim covers updating and improving machine learning models using additional training data, allowing the system to achieve higher recognition accuracy over time.

Claim 13: Customer Behaviour Analysis

This claim protects the use of emotion recognition results for analysing customer behaviour, identifying dissatisfaction, and supporting customer relationship management strategies.

Claim 14: Service Quality Monitoring

The invention protects the application of emotion analysis for monitoring customer service quality, evaluating agent performance, and identifying areas requiring operational improvement.

Claim 15: Enterprise Decision Support

This claim covers the use of emotion recognition outputs to support managerial decision-making, business intelligence, and customer experience optimization.

Claim 16: Scalable System Architecture

The invention protects a scalable computing architecture capable of processing large volumes of customer interactions across multiple communication channels and enterprise environments.

Claim 17: Secure Processing of Customer Information

This claim protects mechanisms for securely handling customer speech data and emotion recognition results while maintaining confidentiality and system reliability.

Claim 18: Integration with Artificial Intelligence Platforms

The invention supports integration with Artificial Intelligence applications, customer analytics systems, and enterprise software solutions for enhanced automation and intelligent decision support.

Claim 19: Automated Reporting and Analytics

This claim protects the generation of analytical reports, emotional trends, and performance insights based on customer interaction data to support continuous service improvement.

Claim 20: System Implementation

The final claim protects the overall implementation of the invention as an integrated Artificial Intelligence system combining speech processing, feature extraction, machine learning, emotion recognition, and customer support functionalities within a unified platform.

Summary of the Claims:

The **20 claims** collectively establish legal protection for an **Artificial Intelligence-based Speech Emotion Recognition System** designed to analyse customer voice interactions using machine learning techniques. The claims cover speech acquisition, audio preprocessing, acoustic feature extraction, emotion classification, real-time analysis, customer behaviour assessment, service quality monitoring, enterprise integration, secure data processing, reporting, and decision support. Together, these claims define an innovative framework that enhances customer experience, enables intelligent customer service, and supports data-driven decision-making through automated emotion recognition.

9. CITATIONS & SIMILAR INVENTIONS :

9.1 Number of Citations in the Patent:

The patent US 11,630,999 B2 -- "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" cites several patent and non-patent references that were examined during the patent prosecution process. These references include earlier inventions related to voice analysis, emotion detection, call-centre monitoring, and audio signal processing, such as JP2009003162A (Panasonic Corp., force voice detector), CN106503646A/B (multimodal emotion identification system), CN108346436A (Tencent, speech emotional detection method), US20190253558A1 (SLA compliance monitoring in call centers), CN111145786A (speech emotion recognition method), CN112216307A/B (Huawei, speech emotion recognition method and device), US20210051401A1 (Wistron Corp., microphone array processing), and US11132993B1 (Noble Systems Corporation, detecting non-verbal audible communication).

The references indicate that the invention was developed within a rapidly evolving technological environment where researchers and organizations are actively working on detecting emotional and non-verbal cues in voice communications. The patent builds upon existing knowledge in audio signal processing, pattern recognition, and machine learning while introducing a specific combination of energy-based frame selection and acoustic feature extraction tailored for customer-service emotion detection.

9.2 Number of Citations for the Patent:

Based on Google Patents' forward-citation data, US 11,630,999 B2 has been cited by at least 27 subsequent patent families as of the time of this analysis, spanning a wide range of assignees. This includes multiple patents assigned to Wells Fargo Bank, N.A. covering complaint prioritization, predicting customer interaction, fraud detection, and next-action determination based on predicted emotion; a patent assigned to Meta Platforms Technologies, LLC concerning stylizing text-to-speech voice responses for assistant systems; a patent assigned to Qualcomm Incorporated concerning voice or speech recognition using contextual information and user emotion; and a patent application assigned to Amazon Technologies, Inc. concerning automated preview generation for video entertainment content.

Table 2: Citation Categories of the Patent

Citation Category	Description
Patent Documents Cited by the Patent	Prior patents and applications related to voice analysis, multimodal emotion detection, and call-centre monitoring technologies
Non-Patent Literature	Research articles and technical publications related to speech emotion recognition and affective computing
Forward Citations	27+ subsequent patent families citing the invention as prior art, including Wells Fargo Bank, Meta Platforms, Qualcomm, and Amazon Technologies
Technology Domains	Artificial Intelligence, Speech Signal Processing, Customer Relationship Management, Affective Computing, Fraud Detection

The substantial forward-citation activity surrounding the patent, particularly from large financial-services and technology organizations, demonstrates its significance in the emerging field of emotion-aware customer interaction analytics. The patent's influence is reflected through its relevance to complaint management, fraud detection, customer retention, and voice-assistant personalization.

9.3 List of Similar Inventions:

Several patents and patent applications address technologies that are closely related to the present invention. The most relevant similar inventions are summarized below.

(1) US20210192332A1:

- Title: Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions
- Description: This is the earlier published application corresponding to the present invention, from which US 11,630,999 B2 was subsequently granted.

(2) US12119022B2:

- Title: Cognitive Assistant for Real-Time Emotion Detection from Human Speech
- Assignee: Rishi Amit Sinha
- Description: This invention focuses on real-time emotion detection from human speech to support a cognitive assistant, extending voice-emotion analysis into conversational-agent applications.

(3) US11508396B2:

- Title: Acquiring Speech Features for Predicting Emotional Severity of Adverse Events on Individuals
- Assignee: TQINTELLIGENCE, Inc.
- Description: This patent applies speech-feature-based emotion analysis to predicting the emotional severity of adverse events, extending the technology into healthcare and wellbeing monitoring.

(4) US11954443B1 and related Wells Fargo patents (US12079826B1, US11978475B1, US12008579B1):

- Title: Complaint Prioritization / Predicting Customer Interaction / Next Action Determination / Fraud Detection Using Deep Learning Models
- Assignee: Wells Fargo Bank, N.A.
- Description: This family of patents applies emotion-based deep-learning models to banking-sector customer interaction management, complaint handling, and fraud detection, illustrating the commercial extension of voice/emotion analytics into financial services.

(5) CN106503646B:

- Title: Multimodal Emotion Recognition System and Method
- Assignee: Emotibot Technology (Shanghai) Co., Ltd.
- Description: This patent, cited as prior art in the subject patent, extends emotion recognition beyond voice to include multiple modalities such as facial expression and text.

Analysis of Similarity:

The above inventions and research contributions primarily focus on artificial intelligence, emotion detection, speech signal processing, customer relationship management, and financial-services analytics. Most of these technologies aim to identify emotional or behavioural cues through feature extraction, machine-learning algorithms, and pattern-recognition techniques.

However, US 11,630,999 B2 distinguishes itself through its specific combination of energy-based frame selection with a defined set of spectral and energy acoustic features -- spectral flatness, spectral centroid, spectral roll-off, spectral bandwidth, zero-crossing rate, and root-mean-square energy -- applied specifically within the context of customer support calls, coupled with an automated flagging mechanism tied to detected emotion intensity for later agent follow-up (Gangotri et al. (2023). [20]). This combination of efficient frame selection, targeted feature extraction, and actionable flagging represents the primary innovative contribution of the patent and differentiates it from broader or more generic emotion-recognition approaches.

10. BASIC ANALYSIS :

10.1 Importance of the Invention:

The invention described in US 11,630,999 B2 -- "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" is significant because it addresses a widespread and commercially consequential challenge: the difficulty of consistently recognizing customer emotional states across large volumes of voice-based support interactions. As organizations scale their customer-service operations and increasingly rely on automation, the ability to detect frustration or distress in real time, without requiring manual review of every call, has substantial value for customer retention, service quality, and operational efficiency.

10.2 Description of the Invention:

As previously described, the invention operates through a pipeline of audio acquisition, noise and silence removal, energy-based frame selection, acoustic feature extraction, and machine-learning classification, culminating in an intensity-based flagging mechanism for follow-up. This structured pipeline allows the system to process live or recorded voice streams efficiently while focusing computational resources on the most emotionally informative portions of a call.

10.3 Design Analysis:

From a design perspective, the invention reflects a modular architecture consisting of distinct functional units -- an emotion identification application, a feature extraction module, a training module, a testing module, a dataset module, and a neural-network (CNN) module -- that can be deployed on a server in communication with streaming media infrastructure. This modularity reflects the assignee's heritage as a streaming-media and set-top-box technology provider (Dish Network Technologies / Sling Media), and suggests that the architecture is designed to integrate directly into live and placeshifted audio/video streaming pipelines rather than functioning only as a standalone offline analysis tool. The use of an energy-based frame-selection step before feature extraction is a notable design choice intended to reduce computational load, which is particularly relevant for real-time or near-real-time deployment at scale.

10.4 New Innovations & Value Addition in the Patent:

The patent adds value by combining several previously discrete techniques -- silence removal, energy-based frame prioritization, a specific multi-feature acoustic descriptor set, neural-network classification, and intensity-based flagging -- into a single, cohesive, and commercially deployable pipeline for customer-emotion detection. This integrated approach reduces the manual effort historically required for call-quality monitoring and creates a foundation for downstream applications such as automated complaint triage, proactive customer outreach, and emotion-aware fraud detection, as evidenced by the range of downstream patents (particularly the Wells Fargo Bank family) that build upon or cite this technology.

11. STRUCTURAL ANALYSIS :

11.1 SWOC Analysis:

About SWOC Analysis:

SWOC Analysis is a strategic evaluation framework used to examine the internal and external factors influencing a technology, innovation, or organization. It assesses Strengths, Weaknesses, Opportunities, and Challenges to provide a comprehensive understanding of the subject under study. In patent analysis, SWOC helps identify technological advantages, limitations, future prospects, and implementation challenges associated with an invention. By systematically examining these factors, researchers can evaluate the practical significance, commercial potential, and long-term sustainability of a patented technology (Aithal & Kumar (2015). [21]).

Recent studies have demonstrated the effectiveness of SWOC analysis in evaluating technological innovations, digital systems, and emerging technologies by providing structured insights into internal capabilities and external environmental factors (Noreen et al. (2021). [22]). The framework has also been applied to assess advanced technological domains, including blockchain systems and sustainable innovation models, where it assists researchers in understanding opportunities for growth while recognizing operational and strategic challenges (Punia et al. (2025). [23]; (Chandrakala et al. (2026). [24]). Therefore, SWOC analysis serves as a valuable research tool for examining the strengths, weaknesses, opportunities, and challenges associated with the patent "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions."

SWOC Analysis of the Patent:

1. Strengths of the Patent:

(1) Intelligent Real-Time Emotion Recognition: The patent employs machine learning and neural network models to automatically identify customer emotions directly from voice signals during customer support interactions. This enables organizations to respond proactively and improve customer satisfaction.

(2) Efficient Audio Processing Framework: The invention incorporates silence removal, background noise filtering, and energy-based frame selection before emotion analysis. This improves computational efficiency while increasing the accuracy of emotion detection.

(3) Comprehensive Acoustic Feature Extraction: The system extracts multiple speech features, including spectral centroid, spectral flatness, spectral bandwidth, spectral roll-off, zero-crossing rate, root-mean-square energy, and MFCCs. These features provide reliable indicators for classifying various emotional states.

(4) Automated Customer Support Enhancement: The patented system automatically flags emotionally distressed customers for follow-up interactions based on detected emotion intensity. This supports more empathetic customer service and improves customer relationship management.

(5) Scalable AI-Based Architecture: The modular design integrates audio acquisition, preprocessing, feature extraction, machine learning classification, and output generation. The architecture can be deployed across large-scale contact centres, telecommunications networks, and cloud-based customer service platforms.

(6) Wide Industrial Applicability: The technology can be applied across multiple industries including banking, telecommunications, healthcare, insurance, e-commerce, and customer support services, significantly increasing its commercial value and practical relevance.

2. Weaknesses of the Patent:

(1) Dependence on Voice Quality: The effectiveness of the system depends heavily on the quality of voice recordings. Background noise, poor network conditions, low-quality microphones, and distorted audio may reduce emotion recognition accuracy.

(2) Limited to Voice-Based Emotion Analysis: The invention primarily analyzes speech signals and does not incorporate facial expressions, body language, physiological signals, or textual information, which may provide additional emotional context.

(3) Dependence on Training Data: The performance of the machine learning model relies on the availability of large, diverse, and accurately labelled emotional speech datasets. Poor-quality datasets may reduce classification accuracy.

(4) Cultural and Linguistic Variations: Emotional expression varies across languages, accents, cultures, and communication styles. The model may require continuous adaptation to maintain high performance across diverse user populations.

(5) High Computational Requirements: Real-time speech processing, feature extraction, and neural network inference require significant computational resources, particularly in large customer service environments handling thousands of simultaneous calls.

(6) Privacy and Ethical Concerns: Continuous analysis of customer conversations involves processing sensitive voice data, creating concerns regarding customer privacy, informed consent, data security, and regulatory compliance.

3. Opportunities for the Patent:

(1) Expansion of AI-Powered Customer Service: The rapid adoption of artificial intelligence in customer support creates significant opportunities for integrating emotion recognition into intelligent contact centres and virtual customer assistance platforms.

(2) Integration with Generative AI and Conversational Agents: The patented technology can be combined with Generative AI, chatbots, and intelligent virtual assistants to provide emotionally adaptive and personalized customer interactions.

(3) Growth in Banking and Financial Services: Financial institutions can utilize emotion-aware customer analytics for complaint prioritization, fraud detection, customer retention, and service quality improvement.

(4) Development of Multimodal Emotion Recognition: Future enhancements may combine voice analysis with facial recognition, text sentiment analysis, eye movement tracking, and physiological signals to improve overall emotion recognition accuracy.

(5) Adoption in Healthcare and Mental Well-being Services: Healthcare providers, telemedicine platforms, and mental health support centres can utilize the technology to identify emotional distress and prioritize patient interactions more effectively.

(6) Smart Contact Centres and Industry 5.0 Applications: The invention aligns with intelligent customer experience management, Industry 5.0, cloud computing, and digital transformation initiatives, creating opportunities for large-scale commercial deployment worldwide.

4. Challenges of the Patent:

(1) Rapid Advancement of Artificial Intelligence Technologies: Continuous improvements in deep learning algorithms, speech processing techniques, and multimodal AI require regular updates to maintain technological competitiveness.

(2) Data Privacy and Regulatory Compliance: Organizations implementing the technology must comply with privacy regulations governing voice data collection, storage, processing, and customer consent across different countries.

(3) Cybersecurity Risks: Customer voice recordings, emotional profiles, and communication data may become targets for cyberattacks, requiring robust encryption, secure storage, and access control mechanisms.

(4) Maintaining Recognition Accuracy Across Diverse Populations: Variations in language, accent, age, gender, speaking style, and emotional expression present ongoing challenges in developing universally accurate emotion recognition systems.

(5) Ethical Issues and Public Acceptance: Customers may have concerns regarding automated emotional monitoring, algorithmic bias, transparency, and the ethical use of artificial intelligence in customer interactions.

(6) Competition from Emerging AI Technologies: Rapid development of multimodal foundation models, advanced speech intelligence systems, and next-generation customer analytics platforms may increase competition and require continuous innovation.

Overall SWOC Assessment:

The patent demonstrates significant strengths in AI-based speech emotion recognition, automated customer support enhancement, efficient audio signal processing, and scalable deployment across multiple industries. While challenges related to voice quality, privacy protection, computational requirements, and ethical considerations remain, the invention offers substantial opportunities for commercialization through intelligent customer service, conversational AI, healthcare applications, banking, and Industry 5.0. Overall, the patent represents a strategically valuable innovation in **Artificial Intelligence, Speech Emotion Recognition, Affective Computing, and Customer Experience Management**, with strong potential to support the future development of emotionally intelligent digital service ecosystems.

11.2 ABCDEF Analysis of the Patent:

ABCDEF Analysis—an acronym for Advantages, Benefits, Constraints, Disadvantages, Effectiveness, and Future Financial Value—is a comprehensive framework used to evaluate the overall impact and potential of an innovation. It is an extension of the ABCD analysis methodology proposed by P. S. Aithal (2017) and provides a systematic approach for examining the technical strengths, practical usefulness, implementation limitations, operational drawbacks, performance effectiveness, and future commercial prospects of a patented technology (Aithal (2017). [25]; Aithal (2016). [26]). The framework has also been applied in organizational performance evaluation and strategic business analysis to assess the value and sustainability of innovations (Aithal & Kumar (2016). [27]; Raj & Aithal (2018). [28]). In patent studies, the ABCDEF framework enables researchers to evaluate how an invention contributes to technological advancement while identifying its practical applications, commercialization potential, future opportunities, and implementation challenges [29-31]. For a patent such as US 11,630,999 B2 – "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions," the ABCDEF framework provides a holistic understanding of its significance in artificial intelligence, speech signal processing, affective computing, and customer experience management.

(i) Advantages of the Patent from Stakeholders' Perception:

Under the ABCDEF Analysis Framework, the **Advantages** dimension evaluates the technological strengths and strategic benefits perceived by stakeholders, including customers, customer service organizations, contact centre operators, financial institutions, healthcare providers, and technology developers. The patent introduces an intelligent framework that combines speech signal processing, acoustic feature extraction, machine learning, and automated emotion classification to improve customer support through emotion-aware decision-making.

Table 3: Advantages of the Patent from the Stakeholders' Perspective

S. No.	Key Advantage	Description
1	Automated Emotion Recognition	The patented system automatically identifies customer emotions from voice signals using machine learning techniques, reducing dependence on manual monitoring and enabling timely intervention during customer interactions.

2	Efficient Speech Processing Framework	By removing silence and background noise and selecting high-energy audio frames, the invention improves processing efficiency while maintaining reliable emotion recognition performance.
3	Improved Customer Experience Management	The system enables organizations to identify emotionally distressed customers and schedule appropriate follow-up interactions, leading to better customer satisfaction, reduced complaints, and stronger customer relationships.
4	Intelligent Decision Support	Emotion classification results provide valuable decision-support information for customer service agents and supervisors, enabling faster resolution of customer issues and more effective service management.
5	Scalable AI-Based Architecture	The modular design allows seamless integration with contact centres, telecommunications networks, banking systems, and cloud-based customer support platforms, supporting large-scale commercial deployment.
6	Wide Industrial Applications	The invention can be applied across telecommunications, banking, healthcare, insurance, e-commerce, government services, and customer relationship management, significantly increasing its commercial and practical value.

Table 4: Summary of Advantages from Stakeholders' Perspective

Stakeholder	Key Advantage
Customers	Faster, more personalized, and empathetic customer support
Customer Service Organizations	Automated emotion detection and improved service quality
Contact Centre Operators	Reduced manual call monitoring and improved operational efficiency
Business Organizations	Enhanced customer retention and customer relationship management
Technology Developers	Scalable AI framework for speech emotion recognition
Society & Service Ecosystem	Improved digital customer experiences through emotionally intelligent AI

Overall, the patent provides substantial advantages by integrating artificial intelligence, speech signal processing, and emotion recognition into customer support operations. Its capability to automate emotion analysis, improve decision-making, enhance customer satisfaction, and support scalable deployment makes it a valuable innovation in the fields of **Artificial Intelligence, Speech Emotion Recognition, Customer Experience Management, and Affective Computing**.

(ii) Benefits of the Patent from Stakeholders' Perception for Realization:

Within the ABCDEF Analysis Framework, **Benefits** refer to the practical value, operational improvements, and positive outcomes realized by stakeholders through the implementation of the patented technology. While advantages describe the inherent strengths of the invention, benefits focus on the measurable gains experienced by customers, service organizations, contact-centre operators, financial institutions, healthcare providers, technology developers, and society. The patent integrates speech signal processing, acoustic feature extraction, machine-learning-based emotion recognition, and automated follow-up mechanisms into a unified framework for enhancing customer experience management.

Table 5: Benefits of the Patent from the Stakeholders' Perception

S. No.	Key Benefits	Description
1	Improved Customer Satisfaction and Service Quality	The patented system enables organizations to identify customers experiencing negative emotions during support interactions and initiate timely follow-up actions. This leads to faster issue resolution, reduced customer frustration, and improved overall service quality.

2	Enhanced Operational Efficiency	By automating emotion recognition and call analysis, the invention reduces the need for continuous manual monitoring of customer interactions. Contact centres can optimize workforce utilization, improve productivity, and lower operational costs while maintaining high service standards.
3	Better Decision-Making for Customer Support Teams	The system provides real-time emotional insights that assist customer service agents and supervisors in prioritizing critical interactions and selecting appropriate response strategies. This supports more informed and effective decision-making during customer engagement.
4	Reduced Customer Churn and Improved Retention	Early identification of customer dissatisfaction enables organizations to implement proactive retention strategies before complaints escalate. This strengthens customer loyalty and contributes to long-term customer relationship management.
5	Scalable Deployment Across Multiple Industries	The modular architecture allows implementation across telecommunications, banking, healthcare, insurance, e-commerce, and government service organizations. This broad applicability enhances the commercial value and adoption potential of the technology.
6	Support for Data-Driven Business Intelligence	Emotion recognition data generated by the system can be integrated with customer analytics platforms to identify behavioural patterns, evaluate service performance, and support strategic business planning through evidence-based decision-making.

Table 6: Summary of Benefits from Stakeholders' Perspective

Stakeholder	Major Benefit
Customers	More responsive, personalized, and empathetic customer support
Customer Service Organizations	Improved service quality and enhanced customer satisfaction
Contact Centre Operators	Automated call analysis and increased operational efficiency
Business Organizations	Better customer retention and informed business decisions
Technology Developers	Commercial opportunities for scalable AI-based emotion recognition systems
Society & Service Ecosystem	Improved digital customer experiences through intelligent and emotionally aware customer support

Overall, the patent delivers significant benefits by enabling intelligent emotion recognition, improving customer satisfaction, enhancing operational efficiency, supporting data-driven decision-making, and strengthening customer relationship management. These benefits increase the commercial attractiveness and practical applicability of the invention, positioning it as a valuable innovation in the fields of **Artificial Intelligence, Speech Emotion Recognition, Affective Computing, and Customer Experience Management**.

(iii) Constraints of the Patent from Stakeholders' Perception for Realization:

Within the ABCDEF Analysis Framework, **Constraints** represent the technical, operational, organizational, and regulatory factors that may limit the successful implementation and commercialization of the patented innovation. Although the patent introduces an intelligent framework for recognizing customer emotions using speech signal processing and machine learning, its practical deployment depends on reliable audio acquisition, computational infrastructure, high-quality datasets, secure communication systems, and seamless integration with customer service platforms. These dependencies create several constraints that may influence adoption from the perspective of customers, contact-centre operators, business organizations, technology developers, investors, and regulatory authorities.

Table 7: Constraints of the Patent from the Stakeholders' Perspective

S. No.	Key Constraints	Description
1	Dependence on High-Quality Voice Data	The effectiveness of the patented system depends on receiving clear voice recordings with minimal background noise and distortion. Poor audio quality, unstable network connections, or low-quality recording devices may reduce the accuracy of emotion recognition, affecting customer service outcomes.
2	Requirement for Large and Diverse Training Datasets	The machine learning model requires extensive labelled speech datasets representing different languages, accents, age groups, and emotional expressions. Developing and maintaining such datasets is resource-intensive and may limit system performance in diverse environments.
3	Integration with Existing Customer Service Infrastructure	The patented framework must be integrated with existing contact-centre software, customer relationship management (CRM) systems, telecommunications platforms, and cloud services. Achieving seamless interoperability may require additional customization, technical expertise, and financial investment.
4	Dependence on Reliable Computing and Network Infrastructure	Real-time emotion analysis requires continuous communication between audio acquisition systems, processing servers, machine learning models, and customer support platforms. Network failures, server downtime, or insufficient computing resources may interrupt service and reduce operational reliability.
5	Privacy and Regulatory Compliance Requirements	Since the invention processes customer voice data to identify emotional states, organizations must comply with data protection regulations, obtain appropriate user consent, and implement secure data management practices. These compliance requirements may increase implementation complexity and operational costs.
6	Variability in Human Emotional Expression	Emotional expression differs across languages, cultures, accents, and individual communication styles. Such variations may affect the consistency of emotion classification, requiring continuous model refinement and adaptation to maintain high recognition accuracy.

Table 8: Summary of Constraints from Stakeholders' Perspective

Stakeholder	Major Constraint
Customers	Dependence on clear voice communication and privacy protection
Customer Service Organizations	Integration with existing customer support infrastructure
Technology Developers	Requirement for large, diverse, and accurately labelled training datasets
Contact Centre Operators	Dependence on reliable computing resources and network connectivity
Investors	High implementation, infrastructure, and maintenance costs
Regulators	Ensuring compliance with data privacy, security, and ethical AI standards

Overall, the patent faces constraints associated with voice data quality, machine learning dataset requirements, system integration, computing infrastructure, regulatory compliance, and the variability of human emotional expression. Although these factors may influence large-scale implementation, they do not diminish the technological significance of the invention. Instead, they highlight important considerations that stakeholders must address to ensure the reliable deployment and commercial success of AI-based speech emotion recognition systems in customer experience management.

(iv) Disadvantages of the Patent from Stakeholders' Perception for Realization:

Within the ABCDEF Analysis Framework, **Disadvantages** refer to the potential limitations, operational risks, and stakeholder concerns that may arise despite the technical strengths of the patented

invention. The patent integrates **speech signal acquisition, acoustic feature extraction, machine learning-based emotion recognition, and intelligent customer interaction analysis** into a unified Artificial Intelligence framework. Although the invention significantly enhances customer experience and service quality, stakeholders may perceive certain disadvantages related to implementation complexity, privacy concerns, model accuracy, infrastructure requirements, and regulatory compliance.

Table 9: Disadvantages of the Patent from the Stakeholders' Perception

S. No.	Key Disadvantages	Description
1	High Initial Investment and Deployment Costs	Implementing AI-based speech emotion recognition requires investment in computing infrastructure, cloud services, machine learning models, software integration, and skilled technical personnel. Organizations, particularly small and medium-sized enterprises, may face financial challenges during deployment and maintenance.
2	Privacy and Data Security Concerns	The system processes customer voice recordings and emotional information, which may raise concerns regarding privacy, confidentiality, and data protection. Organizations must implement strong security measures and comply with applicable data protection regulations to maintain customer trust.
3	Variation in Emotion Recognition Accuracy	The accuracy of emotion detection may be affected by differences in language, accent, speech quality, background noise, and individual communication styles. Incorrect emotion classification may influence customer service decisions and reduce system reliability.
4	Dependence on High-Quality Voice Data	The effectiveness of the patented system depends on receiving clear and high-quality speech signals. Poor network connectivity, noisy environments, or low-quality recordings may reduce the performance of the machine learning model and affect analytical outcomes.
5	Complex Integration with Enterprise Systems	Integrating the patented technology with existing Customer Relationship Management (CRM), contact centre software, cloud infrastructure, and enterprise applications may require significant customization, increasing implementation time and operational complexity.
6	Regulatory and Ethical Challenges	The use of Artificial Intelligence for analysing customer emotions may raise ethical concerns related to transparency, fairness, informed consent, and algorithmic bias. Organizations must ensure responsible AI practices and comply with evolving legal and regulatory requirements.

Table 10: Summary of Disadvantages from Stakeholders' Perspective

Stakeholder	Major Disadvantage
Customers	Privacy concerns and possible emotion recognition errors
Organizations	High implementation and maintenance costs
Customer Service Agents	Dependence on AI-generated recommendations
Technology Providers	Complex system integration and continuous model updates
Investors	Significant investment with uncertain short-term returns
Regulators	Ensuring privacy, ethical AI usage, and legal compliance

Thus, from the stakeholders' perspective, the principal disadvantages of the patent include **high implementation costs, privacy and cybersecurity concerns, variability in emotion recognition accuracy, dependence on high-quality speech data, enterprise integration complexity, and regulatory and ethical challenges**. Although the patented invention represents a significant

advancement in **Artificial Intelligence-driven customer experience management**, addressing these technical, operational, and governance issues will be essential for successful commercialization, responsible deployment, and long-term adoption across diverse industries.

(v) Effectiveness of the Patent from Stakeholders' Perception:

Within the ABCDEF Analysis Framework, the **Effectiveness** dimension evaluates how successfully the patented invention performs in practical environments with respect to functionality, accuracy, reliability, scalability, adaptability, integration capability, and stakeholder satisfaction. The patent establishes an intelligent framework that integrates audio acquisition, speech preprocessing, acoustic feature extraction, machine learning-based emotion classification, and automated follow-up mechanisms to support customer experience management. From the perspective of customers, contact-centre operators, business organizations, technology developers, investors, and regulatory authorities, the effectiveness of the invention can be assessed through the following six key dimensions.

Table 11: Effectiveness of the Patent from the Stakeholders' Perspective

S. No.	Key Effectiveness	Description
1	Efficient Real-Time Emotion Recognition	The patent effectively identifies customer emotions during live support calls by integrating speech signal processing with machine learning techniques. The automated analysis enables timely recognition of customer frustration, satisfaction, or distress, supporting faster and more appropriate service responses.
2	Reliable Speech Processing Framework	The invention improves emotion recognition accuracy by removing silence and background noise, selecting high-energy audio frames, and extracting multiple acoustic features before classification. This structured processing framework enhances the reliability and consistency of emotion detection across customer interactions.
3	Scalable AI-Based Customer Support System	The modular architecture enables seamless deployment across large contact centres, cloud platforms, telecommunications networks, and customer relationship management systems. The scalable design allows organizations to process large volumes of customer interactions without significant changes to the underlying framework.
4	Improved Customer Relationship Management	The system automatically flags emotionally sensitive customer interactions for appropriate follow-up, enabling organizations to improve complaint resolution, customer retention, and overall service quality. This proactive approach strengthens long-term customer relationships and organizational performance.
5	Adaptability Across Multiple Service Sectors	The patented technology can be effectively implemented in telecommunications, banking, healthcare, insurance, e-commerce, government services, and other customer support environments. Its flexible architecture supports diverse operational requirements and enhances its practical applicability across industries.
6	Enhanced Decision-Making and Operational Efficiency	The emotion classification results provide valuable insights for customer service agents and management teams, supporting informed decision-making, efficient resource allocation, and continuous improvement of customer service operations. The automation of emotion analysis also reduces manual workload and improves operational productivity.

Table 12: Summary of Effectiveness from Stakeholders' Perspective

Stakeholder	Effectiveness Outcome
Customers	Faster, more personalized, and emotionally responsive customer support
Customer Service Organizations	Improved service quality and customer relationship management

Contact Centre Operators	Automated emotion analysis and enhanced operational efficiency
Business Organizations	Better customer retention and data-driven decision-making
Technology Developers	Scalable and reliable AI-based speech emotion recognition framework
Investors	Strong commercialization potential across multiple service industries
Regulators	Improved transparency, responsible AI implementation, and better service quality monitoring

Overall, from the stakeholders' perspective, the patent demonstrates high effectiveness through accurate speech emotion recognition, reliable audio processing, scalable system architecture, proactive customer relationship management, adaptability across multiple service sectors, and improved operational efficiency. These capabilities indicate that the invention is both technically robust and commercially viable, making it a significant innovation in the fields of **Artificial Intelligence, Speech Emotion Recognition, Affective Computing, and Customer Experience Management**.

(vi) Future Financial Value of the Patent (Stakeholder Perspective):

The patented invention integrates speech signal processing, acoustic feature extraction, machine learning, and automated emotion recognition into an intelligent customer support framework. By enabling organizations to identify customer emotions during voice interactions and support proactive decision-making, the patent creates significant opportunities for commercialization across customer service, banking, healthcare, telecommunications, insurance, and other service-oriented industries. As organizations increasingly adopt Artificial Intelligence and customer analytics, the long-term financial value of this patent is expected to increase through software licensing, cloud-based services, strategic collaborations, and AI-driven customer experience solutions.

Table 13: Future Financial Values of the Patent from the Stakeholders' Perspective

S. No.	Key Future Value	Description
1	Commercialization of AI-Based Customer Experience Platforms	The patent provides the technological foundation for developing AI-powered customer experience management platforms capable of recognizing customer emotions during voice interactions. Software providers can commercialize this technology through enterprise licensing, subscription-based services, and cloud-hosted customer support solutions, creating sustainable long-term revenue streams. Stakeholders Benefited: Technology companies, software vendors, investors, customer service organizations.
2	Expansion of Intelligent Contact Centre Solutions	Increasing adoption of digital customer service creates strong market opportunities for intelligent contact centres that utilize emotion recognition to improve service quality and operational efficiency. Organizations adopting the patented technology can reduce customer churn, improve productivity, and strengthen customer loyalty, leading to higher financial returns. Stakeholders Benefited: Contact centre operators, business organizations, investors, customers.
3	Growth Opportunities Across Multiple Service Industries	The patented technology has wide commercial applicability in banking, healthcare, insurance, telecommunications, e-commerce, and government services. As demand for AI-driven customer support continues to grow, organizations across these sectors can generate additional revenue by delivering personalized and emotionally intelligent customer experiences. Stakeholders Benefited: Financial institutions,

		healthcare providers, telecommunications companies, government agencies, customers.
4	Monetization Through AI Software Licensing and Integration	The machine learning models and emotion recognition framework can be licensed to software developers, cloud service providers, CRM vendors, and enterprise solution providers. Organizations can generate recurring revenue through software licensing, API integration, Software-as-a-Service (SaaS), and technology partnerships without directly providing customer support services. Stakeholders Benefited: Patent holders, software companies, technology partners, investors.
5	Development of Advanced Business Intelligence Services	Emotion recognition data can be integrated with customer analytics and business intelligence platforms to provide valuable insights into customer behaviour, service performance, and market trends. These analytics services create opportunities for premium consulting, predictive analytics, and strategic decision-support solutions. Stakeholders Benefited: Business organizations, analytics providers, management consultants, investors.
6	Long-Term Strategic Value in Artificial Intelligence and Affective Computing	As Artificial Intelligence, conversational AI, affective computing, and intelligent automation continue to evolve, the commercial value of the patent is expected to appreciate through technology licensing, strategic partnerships, mergers, acquisitions, and international commercialization. The invention represents a valuable intellectual property asset within the rapidly growing AI ecosystem. Stakeholders Benefited: Technology companies, venture capitalists, patent holders, governments, shareholders.

Table 14: Summary Table: Future Financial Values

Future Financial Value	Key Stakeholders	Expected Economic Impact
AI-powered customer experience platforms	Technology companies, software vendors, investors	Recurring software licensing and subscription revenues
Intelligent contact centre solutions	Contact centre operators, business organizations	Improved productivity, customer retention, and profitability
Multi-industry commercialization	Banking, healthcare, telecom, insurance, government	Expansion into high-growth service markets
AI software licensing and SaaS	Patent holders, software developers, technology partners	Continuous royalty income and enterprise licensing revenue
Business intelligence and customer analytics	Analytics providers, enterprises, consultants	Premium analytics services and data-driven decision-making
Artificial Intelligence and affective computing ecosystem	Technology firms, investors, governments	Long-term strategic value, commercialization, and acquisition opportunities

Overall, from the stakeholders' perspective, the patent possesses substantial future financial value by enabling the commercialization of AI-based emotion recognition systems for customer experience management. Its potential for enterprise software licensing, cloud-based customer support solutions, intelligent analytics, and cross-industry adoption positions the invention as a strategically valuable intellectual property asset. As the adoption of **Artificial Intelligence, Conversational AI, Customer Analytics, and Affective Computing** continues to expand, the patent is expected to generate significant long-term economic value through innovation, technology partnerships, and global commercialization opportunities.

11.3 Business Opportunities in the Industry Environment:

The patent “**Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions**” (US 11,630,999 B2) introduces an intelligent framework that combines speech signal processing, acoustic feature extraction, machine learning, and automated emotion recognition to improve customer support services. By enabling organizations to detect customer emotions during voice interactions and provide timely interventions, the invention creates numerous business opportunities across customer service, banking, healthcare, telecommunications, insurance, and artificial intelligence industries.

(1) AI-Powered Customer Experience Management:

The patent enables organizations to automatically recognize customer emotions during support interactions, allowing businesses to provide proactive and personalized customer service. Companies can commercialize AI-driven customer experience management platforms that improve customer satisfaction, strengthen brand loyalty, and enhance service quality across multiple industries.

(2) Intelligent Contact Centre Solutions:

The invention creates significant opportunities for developing intelligent contact centre platforms capable of automatically identifying emotionally distressed customers, prioritizing critical interactions, and assisting customer service agents with real-time decision-making. Such solutions can improve operational efficiency while reducing customer complaints and service escalation.

(3) Enterprise Software and SaaS Solutions:

The patented technology can be commercialized as enterprise software or Software-as-a-Service (SaaS) solutions for customer relationship management (CRM), business process outsourcing (BPO), and customer support organizations. Subscription-based AI services provide recurring revenue opportunities while enabling businesses to adopt advanced emotion recognition without significant infrastructure investment.

(4) Banking and Financial Service Applications:

Financial institutions can utilize the patented emotion recognition technology for complaint management, fraud prevention, customer retention, loan servicing, and relationship management. Emotion-aware customer analytics enable banks to improve service quality, prioritize sensitive customer interactions, and strengthen long-term customer relationships.

(5) Healthcare and Mental Well-being Applications:

The invention offers promising opportunities in telemedicine, mental health counselling, emergency helplines, and healthcare support services by identifying emotional distress during voice interactions. Healthcare providers can improve patient engagement, prioritize urgent cases, and enhance the quality of remote healthcare services through emotionally intelligent communication systems.

(6) Integration with Conversational AI and Virtual Assistants:

The patented framework can be integrated with conversational AI, intelligent virtual assistants, and customer service chatbots to deliver emotionally adaptive responses during customer interactions. Such integration enhances user engagement and supports the development of next-generation human-centred AI systems.

(7) Business Intelligence and Customer Analytics:

Emotion recognition data generated by the system can support advanced customer analytics, sentiment analysis, service quality evaluation, and behavioural prediction. Organizations can leverage these insights to improve strategic decision-making, optimize marketing strategies, and enhance customer retention initiatives.

(8) Growth Opportunities in Artificial Intelligence and Affective Computing:

As global investment in Artificial Intelligence, speech analytics, and affective computing continues to increase, the patent provides a strong foundation for future innovations in emotionally intelligent computing systems. Opportunities exist through software licensing, strategic partnerships, technology commercialization, cloud-based AI platforms, and international expansion, positioning the invention as a valuable asset within the rapidly growing AI ecosystem.

Challenges in the Competitive Environment:

Despite its significant commercial potential, the patent faces several challenges in the highly competitive fields of **Artificial Intelligence, Speech Emotion Recognition, Customer Experience**

Management, and Customer Analytics. As organizations increasingly adopt AI-powered customer support solutions, maintaining technological superiority, regulatory compliance, and customer trust will be essential for long-term success.

(1) Intense Competition from AI and Customer Experience Solution Providers:

The market for AI-powered customer support is highly competitive, with major technology companies such as **Google, Microsoft, Amazon, IBM, Salesforce, NICE, Genesys, and Cisco** continuously investing in conversational AI, speech analytics, and customer experience platforms. Competing with these well-established organizations requires continuous innovation and technological differentiation.

(2) Rapid Evolution of Artificial Intelligence Technologies:

Artificial Intelligence, deep learning, speech processing, and affective computing technologies continue to evolve rapidly. New algorithms, multimodal emotion recognition systems, and foundation models may outperform existing approaches, requiring continuous model improvement and technology upgrades to maintain competitive advantage.

(3) Data Privacy and Regulatory Compliance Challenges:

The patent processes customer voice data to identify emotional states during support interactions. Organizations implementing the technology must comply with evolving data protection regulations governing voice recording, biometric information, informed consent, and responsible AI practices across different countries and jurisdictions.

(4) Accuracy Across Diverse Languages and Cultures:

Human emotional expression varies considerably across languages, accents, cultures, age groups, and communication styles. Maintaining consistent emotion recognition accuracy across diverse populations remains a significant technical challenge that requires continuous dataset expansion and model refinement.

(5) Integration with Existing Enterprise Systems:

Successful deployment requires seamless integration with existing Customer Relationship Management (CRM) platforms, contact centre software, cloud infrastructure, telecommunications systems, and business intelligence solutions. Integration complexity may increase implementation costs and extend deployment timelines for organizations.

(6) High Computational and Infrastructure Requirements:

Real-time speech processing, acoustic feature extraction, and machine learning inference require robust computing infrastructure, cloud resources, and high-performance servers. Small and medium-sized enterprises may face financial and technical challenges in deploying and maintaining such AI systems.

(7) Cybersecurity and Data Protection Risks:

The patented system processes sensitive customer conversations and emotional information through digital communication networks. Cyberattacks, unauthorized access, data breaches, and model manipulation may compromise customer privacy, organizational reputation, and regulatory compliance, making cybersecurity a critical competitive requirement.

(8) Ethical Concerns and Customer Acceptance:

Some customers may feel uncomfortable knowing that Artificial Intelligence systems analyse their emotions during conversations. Concerns regarding transparency, algorithmic bias, informed consent, fairness, and responsible AI usage may influence public acceptance and organizational adoption of the technology.

(9) Dependence on High-Quality Speech Data:

The effectiveness of the invention depends on receiving clear voice recordings with minimal background noise and distortion. Poor audio quality, unstable communication networks, or inaccurate speech signals may reduce emotion recognition performance and affect customer service outcomes.

(10) Increasing Price Competition in AI Software Markets:

As Artificial Intelligence technologies become more accessible through open-source frameworks and cloud-based AI services, numerous vendors may introduce competing speech analytics and emotion recognition solutions. Organizations must differentiate their products through superior accuracy, reliability, scalability, customer experience, and continuous innovation to sustain profitability.

Overall, the patent presents a significant technological advancement by integrating **speech signal processing, acoustic feature extraction, machine learning, and emotion recognition** into an intelligent customer support framework. Its greatest industry opportunities lie in **AI-powered customer**

experience management, intelligent contact centres, conversational AI, customer analytics, healthcare applications, and affective computing. However, achieving long-term competitive success will require addressing challenges related to **rapid technological evolution, data privacy, multilingual emotion recognition, enterprise system integration, cybersecurity, ethical AI implementation, and increasing competition within the global Artificial Intelligence market.** With continuous innovation and responsible deployment, the patent possesses strong commercial potential and is well positioned to contribute to the future development of **emotionally intelligent digital service ecosystems and AI-driven customer relationship management.**

11.4 Market and Business Value Estimation:

The patent "**Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions**" (US 11,630,999 B2) presents an intelligent framework that combines speech signal processing, acoustic feature extraction, machine learning, and automated emotion recognition to enhance customer experience management. By enabling organizations to analyze customer emotions in real time and provide proactive service interventions, the invention offers significant commercial value across customer support, banking, healthcare, telecommunications, insurance, and other service-oriented industries. The growing adoption of Artificial Intelligence, conversational AI, cloud computing, and customer analytics further strengthens the market potential of the patented technology.

(1) Commercial Applications:

A. AI-Powered Customer Experience Management

The patented technology enables organizations to recognize customer emotions during live support interactions, making it suitable for:

- AI-powered customer support platforms
- Customer Experience Management (CXM) systems
- Customer Relationship Management (CRM) solutions
- Customer complaint management systems
- Voice-based customer satisfaction monitoring
- Customer retention and loyalty platforms
- Enterprise customer service automation
- Business Process Outsourcing (BPO) solutions

The emotion recognition framework enables organizations to deliver personalized, responsive, and emotionally intelligent customer support while improving service quality and operational efficiency.

B. Banking and Financial Services

The invention has significant commercial applications within financial institutions, including:

- Customer complaint resolution
- Fraud detection support
- Loan and credit service interactions
- Digital banking customer support
- Wealth management advisory services
- Insurance customer claim assistance

Financial institutions can improve customer engagement, reduce service escalation, and strengthen long-term customer relationships through emotion-aware customer interactions.

C. Healthcare and Mental Health Services

The patented system can support healthcare organizations by providing emotion-aware communication in applications such as:

- Telemedicine consultations
- Mental health counselling
- Psychological assessment support
- Patient care helplines
- Emergency response call centres
- Elderly care monitoring services

Emotion recognition enables healthcare professionals to identify emotional distress and prioritize patient interactions more effectively.

D. Intelligent Contact Centres and Telecommunications

The patent is well suited for deployment in customer service environments, including:

- AI-enabled contact centres
- Telecommunications customer support
- Technical support services
- Help desk automation
- Interactive Voice Response (IVR) systems
- Voice analytics platforms
- Quality assurance and call monitoring systems

The technology improves operational efficiency while reducing manual call evaluation and enhancing customer satisfaction.

E. AI Analytics and Software Platforms

The patented framework creates opportunities for developing intelligent software products, including:

- Speech emotion recognition platforms
- Customer behaviour analytics systems
- AI-based decision support tools
- Business intelligence platforms
- Cloud-based emotion recognition APIs
- Software-as-a-Service (SaaS) solutions
- Conversational AI platforms
- Enterprise AI integration services

These solutions enable technology providers to commercialize the invention through software licensing, subscription services, and enterprise partnerships.

Business Value Rating:

★★★★★ (Very High)

(2) Current Implementations:

Is it Used in a Current Product or Business?

Although the complete patented framework has not been publicly reported as a standalone commercial product, many of its core technologies—including speech emotion recognition, voice analytics, machine learning-based customer sentiment analysis, and intelligent customer support—have already been adopted by leading technology companies. These organizations incorporate similar capabilities into customer experience management, contact centre analytics, and conversational AI platforms, demonstrating the growing commercial relevance of the patented invention.

Existing Implementations:

Google Cloud Contact Center AI

Provides AI-powered speech analytics, call transcription, sentiment analysis, and intelligent customer service solutions that assist organizations in improving customer interactions and operational efficiency.

Microsoft Dynamics 365 Contact Center

Integrates conversational AI, speech analytics, customer sentiment analysis, and intelligent service recommendations to enhance customer experience and support decision-making.

NICE CXone

Offers advanced speech analytics, emotion detection, customer interaction analysis, and workforce optimization solutions widely used in enterprise contact centres.

Genesys Cloud CX

Provides AI-enabled conversation analytics, sentiment analysis, quality monitoring, and intelligent routing for customer service organizations across multiple industries.

IBM Watson Speech and AI Solutions

Supports speech recognition, natural language processing, and conversational AI technologies that assist organizations in understanding customer interactions and improving service delivery.

Amazon Connect Contact Lens

Provides speech analytics, customer sentiment detection, automatic call categorization, and performance analytics for cloud-based contact centres, demonstrating commercial adoption of AI-assisted customer interaction technologies.

Commercial Adoption Level:

High

Speech analytics, customer sentiment analysis, and AI-powered customer experience management solutions are already widely deployed across banking, healthcare, telecommunications, retail, insurance, and Business Process Outsourcing (BPO) industries. While the exact architecture described in the patent may not be publicly commercialized in its entirety, its fundamental technologies are actively implemented by leading enterprise software providers.

Business Value Rating:

★★★★★ (Very High)

(3) Competitor Landscape:

Are Competitors Working on Similar Technologies?

The competitive landscape for AI-based speech emotion recognition and customer experience management is highly dynamic. Leading technology companies are investing significantly in conversational AI, speech analytics, sentiment analysis, and intelligent customer support solutions. While many organizations provide speech and sentiment analytics, the patented invention differentiates itself through its integration of **speech preprocessing, acoustic feature extraction, machine learning-based emotion classification, and automated customer follow-up mechanisms** within a unified framework.

Table 15: Comparison with Similar Commercial Capabilities Offered by Competing Technology Companies

Company	Similar Capability
Google Cloud	Contact Center AI, speech analytics, sentiment analysis, conversational AI
Microsoft	Dynamics 365 Contact Center, AI-driven customer service, speech analytics
Amazon Web Services (AWS)	Amazon Connect Contact Lens, customer sentiment detection, call analytics
IBM	Watson AI, speech recognition, conversational AI, customer interaction analytics
NICE	CXone speech analytics, emotion detection, workforce optimization
Genesys	AI-powered contact centre analytics, conversation intelligence, sentiment analysis
Cisco	Webex AI Assistant, intelligent customer support, conversation analytics
Verint	Voice analytics, customer engagement intelligence, speech emotion analysis
Talkdesk	AI contact centre solutions, real-time conversation intelligence
Observe.AI	AI-powered call monitoring, agent coaching, speech analytics

Emerging Competitors

- AI-powered speech emotion recognition startups
- Conversational AI platform providers
- Customer experience analytics companies
- Cloud-based contact centre solution providers
- Emotion AI and affective computing technology firms
- Large Language Model (LLM)-based customer support platforms

Competitive Advantage of the Patent

The unique strength of the patent lies in integrating:

1. **Speech signal acquisition and preprocessing**
2. **Noise removal and energy-based frame selection**

3. **Acoustic feature extraction (MFCC, spectral centroid, spectral bandwidth, spectral roll-off, RMS energy, zero-crossing rate, etc.)**
4. **Machine learning-based emotion classification**
5. **Automatic identification of emotionally sensitive customer interactions**
6. **Intelligent follow-up recommendations for customer service improvement**

within a **single AI-driven emotion recognition framework**.

Unlike conventional speech analytics systems that primarily focus on transcription or sentiment analysis, the patented invention emphasizes **real-time emotion recognition** to support proactive customer engagement, enhance service quality, and improve customer relationship management.

Competitive Intensity:

Very High

The markets for **Artificial Intelligence, Speech Analytics, Conversational AI, Customer Experience Management, and Affective Computing** are expanding rapidly, attracting substantial investments from established technology companies and innovative startups. Continuous technological advancements, increasing enterprise adoption, and the emergence of multimodal AI solutions contribute to intense competition within this sector.

Business Value Rating:

★★★★★ (Very High)

(4) Licensing Potential:

Could it Generate Royalties or Partnerships?

The patent possesses substantial licensing potential because it introduces an intelligent framework for speech emotion recognition that can be integrated into customer support systems, contact centres, conversational AI platforms, and enterprise software solutions. Rather than being limited to a single industry, the invention can be licensed across multiple service sectors where understanding customer emotions improves decision-making, service quality, and customer relationship management.

Potential Licensees

Artificial Intelligence and Cloud Service Providers

- Google Cloud
- Microsoft Azure
- Amazon Web Services (AWS)
- IBM
- Oracle Cloud

These organizations can integrate the patented technology into cloud-based AI services, speech analytics platforms, and enterprise customer support solutions.

Customer Experience and CRM Solution Providers

- Salesforce
- SAP
- Zendesk
- ServiceNow
- HubSpot

These companies can incorporate AI-driven emotion recognition into Customer Relationship Management (CRM) and Customer Experience Management (CXM) platforms to enhance customer engagement and service quality.

Contact Centre Solution Providers

- NICE
- Genesys
- Cisco
- Talkdesk
- Five9

These organizations can license the technology to improve speech analytics, intelligent call routing, customer sentiment analysis, and quality monitoring within enterprise contact centres.

Banking, Healthcare, and Telecommunications Organizations

- Commercial banks
- Insurance companies
- Telemedicine providers
- Hospital networks
- Telecommunications service providers

These sectors can adopt the patented system to improve customer support, patient communication, complaint management, fraud detection, and service personalization.

Business Process Outsourcing (BPO) Companies

- Teleperformance
- Concentrix
- Foundever
- TTEC
- Alorica

Large BPO organizations can integrate the patented technology into customer service operations to improve customer satisfaction, workforce performance, and operational efficiency.

Royalty Opportunities

Revenue can be generated through:

- Enterprise software licensing
- Software-as-a-Service (SaaS) subscriptions
- Cloud API licensing
- Customer Relationship Management (CRM) platform integration
- Contact centre software partnerships
- Technology licensing agreements
- AI consulting and implementation services
- Strategic partnerships with enterprise software vendors

Licensing Attractiveness:

Very High

The patent addresses one of the fastest-growing segments of the Artificial Intelligence industry, namely **speech emotion recognition and intelligent customer experience management**. Its broad applicability across banking, healthcare, telecommunications, retail, insurance, and government services significantly increases its licensing potential. The modular architecture also enables straightforward integration into existing enterprise software platforms, making it attractive for commercial partnerships and technology licensing.

Business Value Rating:

★★★★★ (Very High)

(5) Market Trends:

Is the Domain Growing?

The patent operates at the intersection of several rapidly expanding technology sectors, including **Artificial Intelligence (AI), Speech Analytics, Customer Experience Management (CXM), Conversational AI, Customer Relationship Management (CRM), and Affective Computing**. The increasing adoption of intelligent customer support systems, digital transformation initiatives, and AI-driven business solutions has created strong market demand for technologies capable of recognizing and responding to customer emotions during voice interactions.

Growth Drivers

(i) Artificial Intelligence and Machine Learning

Artificial Intelligence continues to transform customer service operations through advances in:

- Deep learning algorithms
- Speech recognition technologies
- Natural Language Processing (NLP)
- Emotion recognition models
- Intelligent automation

These developments significantly enhance the adoption of AI-powered customer support systems.

(ii) Growing Demand for Enhanced Customer Experience

Organizations increasingly focus on delivering personalized and emotionally intelligent customer interactions through:

- Customer Experience Management (CXM)
- Customer Relationship Management (CRM)
- Personalized customer engagement
- Customer retention strategies
- Service quality improvement

The patented technology directly supports these business objectives.

(iii) Expansion of Intelligent Contact Centres

Modern contact centres are rapidly adopting AI-based technologies for:

- Speech analytics
- Real-time emotion detection
- Intelligent call routing
- Automated quality monitoring
- Agent performance optimization

This trend creates significant commercial opportunities for the patented invention.

(iv) Growth of Conversational AI and Voice Technologies

The widespread adoption of conversational AI, virtual assistants, and voice-enabled services has increased the demand for technologies capable of understanding customer emotions. Integrating emotion recognition into conversational systems enables more natural, adaptive, and human-centred communication experiences.

(v) Cloud Computing and Software-as-a-Service (SaaS)

Cloud-based customer service platforms and enterprise AI solutions are expanding rapidly due to:

- Scalable cloud infrastructure
- Subscription-based software models
- API-driven integration
- Enterprise digital transformation
- Remote customer support services

The patented technology can be efficiently deployed through these cloud-based environments.

(vi) Growth of Customer Analytics and Affective Computing

Organizations increasingly rely on customer analytics and affective computing to understand customer behaviour, improve business decision-making, and enhance service performance. Emotion-aware analytics represent one of the fastest-growing areas within Artificial Intelligence and business intelligence, creating substantial long-term opportunities for commercialization.

Future Market Potential:

The patent addresses several transformative technology trends that are expected to shape the future of customer service and Artificial Intelligence, including **emotion-aware computing, intelligent customer analytics, conversational AI, cloud-based enterprise software, speech intelligence, and human-centred AI systems**. As organizations continue to invest in digital transformation and emotionally intelligent customer support solutions, the commercial value and market relevance of the patented technology are expected to increase significantly over the coming decade.

Business Value Rating:

★★★★★ (Very High)

Table 16: Overall Business Value Assessment of the Patent

Dimension	Rating
Commercial Applications	★★★★★
Current Implementations	★★★★★
Competitor Landscape	★★★★★
Licensing Potential	★★★★★
Market Trends	★★★★★

Estimated Overall Business Value Score: 9.6/10 (Excellent Commercial Potential)

The patent possesses **exceptionally high strategic and commercial value** because it integrates **speech signal processing, acoustic feature extraction, machine learning, and automated emotion recognition** into a unified framework for intelligent customer experience management. The invention addresses one of the fastest-growing domains of Artificial Intelligence by enabling organizations to understand customer emotions during voice interactions and deliver more personalized, proactive, and efficient services.

The technology has broad commercialization potential across **customer relationship management (CRM), contact centres, banking, healthcare, insurance, telecommunications, retail, government services, and Business Process Outsourcing (BPO)**. Its scalable architecture supports deployment through cloud-based platforms, enterprise software solutions, and Software-as-a-Service (SaaS) models, creating opportunities for technology licensing, strategic partnerships, API integration, and recurring subscription-based revenue.

As global investment in **Artificial Intelligence, Conversational AI, Speech Analytics, Customer Experience Management, and Affective Computing** continues to grow, the patent is well positioned to become a foundational technology for **emotion-aware customer support systems, intelligent conversational platforms, and next-generation digital customer engagement solutions**. Consequently, the invention demonstrates strong long-term business value and significant potential for commercialization, technology transfer, and sustainable competitive advantage within the rapidly evolving AI ecosystem.

12. SUGGESTIONS :

12.1 Suggestions for Implementation:

Based on the architecture described in the patent, which integrates **speech signal acquisition, audio preprocessing, acoustic feature extraction, machine learning-based emotion classification, and automated customer support mechanisms**, the following implementation suggestions are proposed. The patent workflow includes modules for speech processing, feature extraction, emotion recognition, decision support, and customer interaction management.

(1) Develop a Cloud-Based Emotion Recognition Platform:

Instead of deploying the system only within individual organizations, develop a cloud-based platform that enables enterprises to access speech emotion recognition services through secure web applications and APIs. This will:

- Improve scalability
- Reduce infrastructure costs
- Enable remote deployment
- Support organizations of different sizes

(2) Integrate Advanced Deep Learning Models:

Future implementations should incorporate advanced Artificial Intelligence techniques such as transformer-based models and multimodal deep learning to improve emotion recognition accuracy. This can help:

- Improve classification performance
- Recognize complex emotional states
- Reduce false predictions
- Adapt to evolving speech patterns

(3) Develop Multilingual Emotion Recognition Systems:

The current framework can be extended to support multiple languages, regional accents, and dialects. This will:

- Increase global applicability
- Improve recognition across diverse populations
- Support multinational organizations
- Enhance customer inclusiveness

(4) Integrate with Enterprise Customer Relationship Management (CRM) Systems:

The patented technology should be integrated with existing CRM and customer service platforms to provide real-time emotional insights during customer interactions. Such integration can:

- Improve customer relationship management

- Support personalized customer engagement
- Enhance complaint resolution
- Increase customer retention

(5) Implement Privacy-Preserving Artificial Intelligence:

Since the patent processes sensitive customer voice information, future implementations should incorporate privacy-preserving AI techniques such as data encryption, secure storage, anonymization, and federated learning. This will:

- Protect customer privacy
- Improve regulatory compliance
- Reduce cybersecurity risks
- Increase user confidence

(6) Develop Real-Time Customer Support Dashboards:

Interactive dashboards should display live emotion analysis results, customer satisfaction indicators, and conversation trends for supervisors and customer service managers. Such dashboards can:

- Improve operational monitoring
- Support rapid decision-making
- Identify critical customer interactions
- Enhance workforce management

(7) Integrate with Conversational AI and Virtual Assistants:

The patented framework can be integrated with AI-powered chatbots, virtual assistants, and voice assistants capable of adapting responses according to detected customer emotions. This will:

- Deliver emotionally intelligent conversations
- Improve user engagement
- Enhance customer experience
- Reduce dependence on manual intervention

(8) Develop Predictive Customer Behaviour Analytics:

Future implementations should combine emotion recognition with predictive analytics to identify customers at risk of dissatisfaction or service abandonment. This will:

- Support proactive customer retention
- Improve service planning
- Enable personalized recommendations
- Strengthen business decision-making

(9) Build an AI-as-a-Service (AIaaS) Platform:

Transform the invention into a cloud-based AI service where organizations can integrate emotion recognition through APIs and subscription-based services. This platform can allow:

- Enterprise software integration
- Third-party developer access
- Scalable AI deployment
- Recurring revenue generation through Software-as-a-Service (SaaS)

(10) Develop Industry-Specific Solutions:

Customized implementations of the patented technology can be developed for different sectors, including:

- Healthcare and telemedicine
- Banking and financial services
- Telecommunications
- Insurance
- Retail and e-commerce
- Government citizen support services
- Business Process Outsourcing (BPO)
- Education and online learning platforms

These industry-specific solutions can improve customer engagement, operational efficiency, and service quality while addressing the unique requirements of each sector.

12.2 Suggestions for Related New Ideas & Patents:

The patent provides a strong technological foundation for future innovations in **Artificial Intelligence, Speech Emotion Recognition, Customer Experience Management, Conversational AI, and Affective Computing**. Building upon its core concepts of speech signal processing, acoustic feature extraction, machine learning, and automated emotion recognition, several novel and commercially valuable patentable ideas can be developed.

A. Multimodal Emotion Recognition System:

Proposed Patent Title

"System and Method for Multimodal Emotion Recognition Using Speech, Facial Expressions, and Physiological Signals"

Novel Features

- Fusion of speech, facial expressions, and biometric signals
- Real-time multimodal emotion recognition
- Context-aware emotional intelligence
- Adaptive customer interaction framework

Commercial Potential

★★★★★

B. AI-Based Customer Behaviour Prediction Platform:

Proposed Patent Title

"Artificial Intelligence System for Predicting Customer Behaviour Using Speech Emotion Analytics"

Novel Features

- Customer churn prediction
- Behavioural risk assessment
- Personalized service recommendations
- Predictive customer engagement analytics

Commercial Potential

★★★★★

C. Emotionally Intelligent Conversational AI Assistant:

Proposed Patent Title

"Emotion-Adaptive Conversational Artificial Intelligence System for Intelligent Customer Support"

Novel Features

- Emotion-aware dialogue generation
- Adaptive response selection
- Intelligent conversation management
- Personalized virtual assistant interactions

Commercial Potential

★★★★★

D. Healthcare Emotion Monitoring Platform:

Proposed Patent Title

"Artificial Intelligence-Based Emotional Health Monitoring System Using Speech Analysis"

Novel Features

- Early emotional distress detection
- Mental health risk assessment
- Telemedicine integration
- Continuous patient emotion monitoring

Commercial Potential

★★★★★

E. Secure Privacy-Preserving Emotion Recognition Framework:

Proposed Patent Title

"Privacy-Preserving Artificial Intelligence Framework for Secure Speech Emotion Recognition"

Novel Features

- Federated learning architecture
- Voice data anonymization
- Secure AI model training
- Regulatory compliance support

Commercial Potential

★★★★★

F. Intelligent Contact Centre Decision Support System:

Proposed Patent Title

"Machine Learning-Based Decision Support System for Emotion-Aware Contact Centres"

Novel Features

- Automatic call prioritization
- Real-time supervisor alerts
- Intelligent agent assistance
- Dynamic workload optimization

Commercial Potential

★★★★☆

G. Cloud-Based Emotion Analytics Platform:

Proposed Patent Title

"Cloud-Based Emotion Analytics Platform for Enterprise Customer Experience Management"

Novel Features

- Software-as-a-Service (SaaS) deployment
- Enterprise API integration
- Cloud-native speech analytics
- Scalable AI processing

Commercial Potential

★★★★★

H. AI-Based Voice Fraud and Stress Detection System:

Proposed Patent Title

"System and Method for Detecting Voice Stress and Fraud Using Artificial Intelligence"

Novel Features

- Voice stress analysis
- Fraud risk prediction
- Security threat identification
- Banking and financial service integration

Commercial Potential

★★★★★

I. Real-Time Employee Performance Analytics Platform:

Proposed Patent Title

"Artificial Intelligence System for Employee Performance Evaluation Using Customer Emotion Analytics"

Novel Features

- Agent performance assessment
- Emotion-based service quality evaluation
- Workforce optimization
- Continuous training recommendations

Commercial Potential

★★★★☆

J. Emotion-Aware Smart City Citizen Support Platform:

Proposed Patent Title

"Artificial Intelligence-Based Emotion Recognition System for Smart City Citizen Support Services"

Novel Features

- Citizen helpline emotion analysis
- Emergency response prioritization
- Government service optimization
- AI-enabled public service management

Commercial Potential

★★★★★

Overall Future Innovation Potential

The patented invention establishes a robust foundation for next-generation innovations in **Artificial Intelligence, Speech Emotion Recognition, Customer Experience Management, Conversational AI, Healthcare Analytics, and Affective Computing**. Future research and commercialization can expand the technology through **multimodal emotion recognition, predictive customer analytics, privacy-preserving AI, intelligent decision-support systems, cloud-based AI services, and emotionally adaptive conversational platforms**. These proposed extensions possess substantial commercial potential through enterprise software licensing, Software-as-a-Service (SaaS), cloud APIs, healthcare technologies, financial services, and strategic industry partnerships. As the global demand for emotionally intelligent AI systems continues to grow, these future patent concepts are expected to contribute significantly to the advancement of **human-centred Artificial Intelligence and digital customer engagement**.

12.3 Overall Suggestion:

Overall, US 11,630,999 B2 represents a well-structured and commercially validated contribution to the field of AI-based customer emotion analysis. Its combination of efficient acoustic feature extraction and actionable, intensity-based flagging has demonstrably influenced a wide range of subsequent innovations across banking, technology, and telecommunications. Continued development should focus on multilingual robustness, multimodal integration, and privacy-conscious deployment to sustain its long-term commercial and societal value.

13. CONCLUSION & RECOMMENDATION :

This patent analysis of US 11,630,999 B2 -- "Method and System for Analyzing Customer Calls by Implementing a Machine Learning Model to Identify Emotions" -- demonstrates that the invention makes a meaningful contribution to the fields of artificial intelligence, speech signal processing, and customer experience management. By combining energy-based frame selection, a defined acoustic feature set, and machine-learning-based classification with an actionable, intensity-based flagging mechanism, the patent provides an efficient and commercially validated framework for detecting customer emotions in voice-based support interactions.

The SWOC and ABCDEF analyses conducted in this study highlight the patent's strengths in automation and efficiency, its opportunities for extension into multimodal and cross-industry applications, and its challenges related to linguistic diversity, data privacy, and evolving deep-learning techniques. The substantial forward-citation activity from major financial-services and technology organizations further confirms the patent's practical relevance and commercial significance. Overall, the study concludes that US 11,630,999 B2 represents a technologically sound, commercially valuable, and societally relevant contribution to the growing field of emotion-aware artificial intelligence and customer relationship management.

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