

AN EFFECTIVE AUDIO COVID-19 DATA ANALYSIS ON EMPLOYS SENTIMENTAL ANALYSIS AND TOPIC MODELING TO DERIVE CUSTOMER INSIGHTS FOR AN ORGANIZATION

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Abstract

It has been nearly a year since the global pandemic health crisis COVID-19 began, and the crisis's severity is only increasing in many regions of the world. Numerous organizations assist their employees and customers by establishing call centers and collecting data for analysis to comprehend and observe the general symptoms of the COVID-19 and their correlation to COVID crises and how they vary across months. Understanding COVID-19 problems also assists companies and gives data to healthcare organizations in developing the basic procedures that must be performed to ensure the welfare of their employees. The article describes a paradigm for converting call data, conducting sentiment analysis, and reporting. The suggested system seeks to determine the optimal sentiment analysis using predefined libraries and also defined libraries that produce the best results from speech data for coronavirus sentiment analysis for insights and actions. The suggested system is composed of two components: one that converts voice input to textual information processes and then performs sentiment analysis using Python and the existing libraries Vader and TextBlob and a predefined customer-based vocabulary for subject modeling.

Additionally, the method described the knowledge-based system in which consumer dictionaries will be updated in response to input. The various sentiment analysis data sets will be transferred to the reporting system. The user can take action based on the findings and provide data to healthcare organizations for employee guidance.

KEYWORDS: SENTIMENTAL ANALYSIS, TOPIC MODELING.

I. Introduction:

Sentiment analysis:

The sentiment analysis technique is to ascertain the writer's attitude or feeling, i.e., whether it is positive, negative, or neutral. It is examining people's emotions or attitudes toward an event, a topic of conversation, or in general. Sentiment analysis is applied in a variety of contexts. Here, we use it to deduce the human mindset from their interactions with one another. To grasp a human's mindset/mood through a conversation, a computer must first identify who is speaking and what is being said, so we implement a speech recognition system first and then perform sentiment analysis on the data retrieved from preceding processes. Understanding human emotion can be quite beneficial in a variety of situations. For instance, computers are capable of perceiving and responding to non-verbal human communication, such as emotions. In this situation, the computer may tailor the settings to the user's needs and preferences after recognizing their feelings. The research community has transcribed audio sources such as music, discussions, news broadcasts, and political debates.

Additionally, the community collaborated on audio analysis investigations [1,2,3] to examine customer service phone calls and other conversations involving multiple speakers. We transcribe audio recordings

using speech recognition software. Furthermore, sentiment analysis is performed on speaker-specific speech data, allowing the machine to comprehend what humans were saying and how they felt.

We performed sentiment analysis using VADER [4] and TextBlob.

Vader &TextBlob:

VADER [4] (Valence Aware Dictionary and Sentiment Reasoner) is a lexicon and rule-based sentiment analysis tool explicitly tuned to social media sentiments.

VADER integrates a "gold-standard" sentiment lexicon that is particularly well-suited to microblog-like situations, as scientifically evaluated by several independent human judges.

The VADER sentiment lexicon is sensitive to both the polarity and intensity of sentiments expressed in social media environments and can also be used for sentiment analysis in other domains.

The Python code for the rule-based sentiment analysis engine adheres to the paper's grammatical and syntactic standards. Quantification based on empirical evidence is used to determine the effect of each rule on the perceived intensity of sentiment in sentence-level text. Notably, these heuristics go beyond what a standard bag-of-words model would capture. They incorporate term-to-term relationships that are dependent on the word order. For instance, degree modifiers (also known as intensifiers, booster words, or degree adverbs) increase or decrease sentiment intensity.

Additionally, it is beneficial for researchers who wish to establish uniform standards for categorizing statements as positive, neutral, or negative. Typical threshold values (as indicated in the literature on this page) are as follows:

1. **positive sentiment:** compound score ≥ 0.05
2. **neutral sentiment:** (compound score > -0.05) and (compound score < 0.05)
3. **negative sentiment:** compound score ≤ -0.05

The positive, neutral, and negative scores are ratios indicating the percentages of text that fall into each category (so these should all add up to be 1. or close to it with float operation). These are the most valuable metrics if you're looking for multidimensional assessments of a sentence's sentiment.

TextBlob is a Python package for text data processing. It has a straightforward API for performing standard natural language processing (NLP) operations such as part-of-speech tagging, noun phrase extraction, sentiment analysis, classification, and translation. TextBlob is built on top of the colossal shoulders of NLTK and pattern, and it integrates seamlessly with both.

Two attributes are returned by TextBlob's sentiment function: polarity and subjectivity.

Polarity is a float value between $[-1,1]$, where 1 indicates a positive assertion and -1 indicates a negative one. Subjective statements frequently refer to personal feelings, emotions, or judgments, whereas objective sentences refer to factual information. Subjectivity is also a float with a value between $[0,1]$.

Topic modeling:

Topic models are generative models that provide a probabilistic framework in machine learning and natural language processing [5]. Generally, topic modeling techniques are used to automatically organize, comprehend, search for, and summarise extensive electronic archives.

The term "topics" refers to the implicit, estimated, and variable connections between words in a vocabulary and their occurrence in documents. A document is viewed as a collection of distinct themes. Topic models identify latent topics in the group and annotate the documents accordingly. Each term is seen as being derived from one of those subjects. Finally, a document coverage distribution of topics is constructed, enabling a new level of exploration of the data from a topical perspective.

Google API translation:

The Speech Recognition library is remarkably adaptable because it functions as a wrapper for various engines and APIs both online and offline.

One of these—the Google Web Speech API—includes a hard-coded default API key in the Speech Recognition library.

Speech recognition engine/API support:

CMU Sphinx (works offline)

Google Speech Recognition

Google Cloud Speech API

Wit.ai

Microsoft Bing Voice Recognition

Houndify API

IBM Speech to Text

Snowboy Hotword Detection (works offline)

Among the numerous available APIs, Google's Speech Recognition API is the most effective and gives the best results in most scenarios. `recognize_google()` is a class instance used to invoke Google's Speech Recognition service to recognize speech from an audio source.

Speech Recognition currently supports the following file formats:

WAV

AIFF

AIFF-C

FLAC

II. METHODOLOGY

The Problem Formulation

Step 1: Collection and transformation of .wav files

The data is provided as audio files. As a result, the audio files are archived in a database. The audio files extractor is used to extract audio files from the database, and these extracted audio files are then used as input for the audio analysis.

The audio files collected are in raw format. Pre-processing of audio data is required. To ensure that audio data are stored in a standardized file format, convert diverse audio file formats to the .wav format.

After converting audio files to a single format (.wav), an audio transcription module converts them to text. If the audio files are huge, they are chunked and converted to text before combined into a single text output. To ensure that the audio transcription module functions correctly, the language of the input audio file must be supplied, as the audio file will be transformed to text in that language. The audio speech is identical to the text output language in this case. (For instance, convert Hindi audio to Hindi text).

Because the audio files containing the text may be in multiple languages, they are converted to English using a module to ensure uniformity and analysis. Following that, these English-translated texts are employed for analysis.

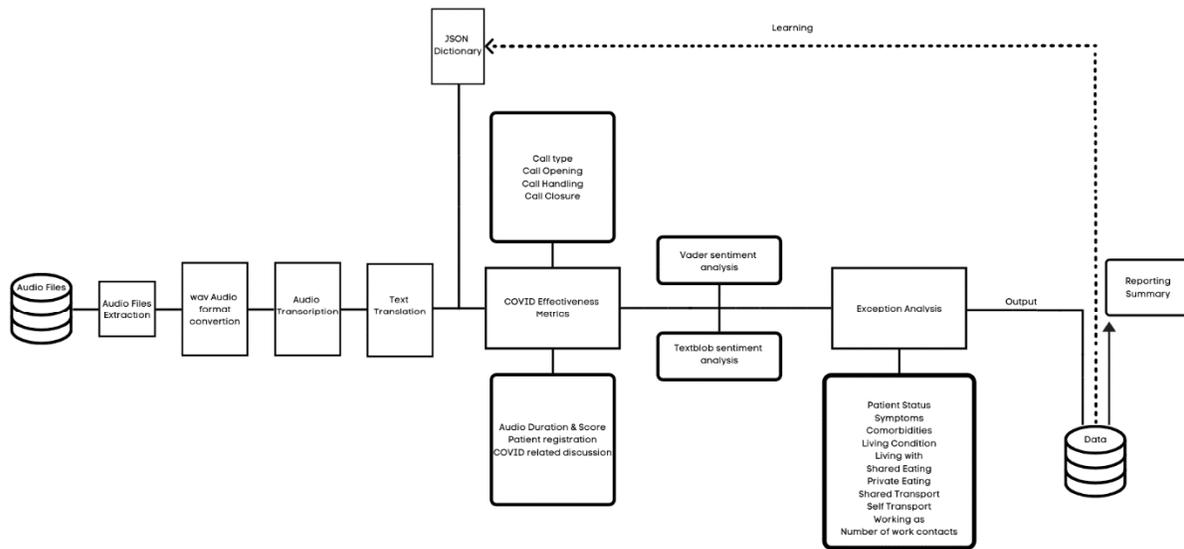


FIG 1: PROPOSAL METHODOLOGY

Step 2:COVID-19Effectiveness metrics

Seven evaluation metrics comprise the Covid Effectiveness Metrics analysis. Call type, Call opening, Call handling, New services, Patient registration, Covid keywords, Call closure. Each metric has sub-metrics that contain keywords from dictionaries used for keyword matching and scoring—all of the sub-metrics and metrics' keywords are kept in a JSON data file.

The first metric is the Call type. This measure is used to determine the call's kind or category. It determines the call type by keyword matching. The submatrix determines the call type with the highest number of keyword matches. When multiple sub metrics return the same number of matches, both are presented as call types. COVID Profiling, IgG Positive Counselling, Immunity Boosting, IgG Negative Counselling, Appointment Booking, and Prescription clarification Message Clarification, Appointment Reminder, Test result/upload, TBCSS Intro are the various sub-metrics in call type.

Call opening; This statistic will return a positive score if the criteria are met. Call opening requirements to include: Call greeting, Self-Introduction, Positive Introduction, Negative Introduction, Identity Confirmation positive, Identity Confirmation negative, Permission/solicitation. If none of the requirements are met, it returns a score of zero.

Call handling; this measure returns a score based on the presence or absence of positive or negative gestures in the audio. It is a positive-valued metric. Call closure; This measure offers a score based on keyword matching against the specified parameters. Additionally, it is a non-negative metric. Confirmation, check on the additional query, reinforcing how we can be reached in the future; pleasantries are the sub-metrics utilized to evaluate ratings.

Audio duration and score; This measure returns the overall time of the audio (ex: Call) and a non-negative score based on the course. Scores are assigned on a scale of 0 to 5. The patient registration; This measure delivers a list of all possible phone numbers mentioned in the call. Covid Related discussion; This metric generates a positive score/count based on the frequency with which the term "Covid" or closely related terms are mentioned in the conversation.

Step 3: Vader and Text blob Sentiment Analysis

Vader sentiment analysis; Vader is a model that has been pre-trained using text data from a variety of social media platforms. The model is fed the English-translated text from the audio. It does sentiment analysis and returns the sentiment using the Vader framework. The idea is produced as a dictionary containing several evaluations: negative score, neutral score, positive score, and compound score.

The Textblob framework is used in conjunction with the Vader framework for sentiment analysis. Textblob is another framework for sentiment analysis that has been trained on standard and legal texts and articles. The Textblob model generates a tuple of text sentiment metrics, polarity and subjectivity.

Step 4: Exception analysis & Defining customized dictionary

The text blob and Vader sentiment analysis modules are employed on the English-translated text to provide the effective output sentiment. However, it only outputs minimal metric information in the Vader model, such as negative, positive, neutral, compound sentiment, polarity, and subjectivity in the Text blob.

Additionally, Exception Analysis is used to elicit numerous insights. Eleven metrics are available. Patient Status, Symptoms, Comorbidities, Living Condition, Living with, Shared Eating, Private Eating, Shared Transport, Self-Transport, Working as, number of work contracts. Each metric includes predefined sub-metrics. They contain dictionaries containing a collection of keywords for matching and scoring—all the keywords associated with sub-metrics and metrics are kept in a JSON data file. The metrics in exception analysis are achieved using keyword matching.

If a keyword match is discovered for particular audio transcription, it is added to the keyword matched list, and the sentence is added to the matched sentence list. The score is calculated using the number of terms that were reached.

A JSON dictionary allows for the addition or deletion of keywords for any metric in Covid Effective or Exception Analysis. The JSON dictionary enables you to check more terms, have a deeper understanding of the audio, and perform more efficient analysis.

JSON Dictionaries:

```
# Call type dict
call_type = dict()
# Adding metrics and their keywords respectively
call_type['COVID Profiling'] = ['Containment', 'COVID positive', 'Contact', 'Hotspot', '55', 'Comorbid', 'HCQ', '100 m', 'Visitor', 'Warrior', 'market', 'Married', 'Red zone', 'green zone', 'gym', 'railway station', 'bus stand', 'hospital']
call_type['IgG Positive Counselling'] = ['Positive', 'Reactive', 'Equivocal', 'Present', 'Found', 'IgG', 'Test', 'Result', 'ELISA', 'Blood Test', 'Antibody', 'Antibodies']
call_type['Immunity Boosting'] = ['Turmeric', 'Milk', 'Chyawanprash', 'Hot Water', 'Warm Water', 'Peepli', 'Tulsi', 'Vitamin C', 'Amla', 'Ginger', 'Lemon', 'Orange', '8 hours', 'Kadha', 'meditation', 'yoga', 'immunity', 'pranayam', 'multivitamin']
call_type['IgG Negative Counselling'] = ['Negative', 'Non reactive', 'Absent', 'Not found', 'IgG', 'Test', 'Result', 'ELISA', 'TMH', 'Blood Test', 'Antibody', 'Antibodies']
call_type['Appointment Booking'] = ['Doctor', 'Virtual Consultation', 'VC', 'Consultation', 'Appointment', 'Link', 'Click', 'Audio Consultation', 'Audio', 'Time', 'SMS', 'Message']
call_type['Prescription clarification'] = ['Phone', 'mobile', 'OTP', 'log in', 'TATA Bridgital App', 'group.tatabridgital', 'Chrome', 'Android', 'My Files', 'Download', 'PDF', 'Prescription', 'Medicine', 'Case Summary']
call_type['Message Clarification'] = ['SMS', 'Message', 'I don't know', 'Why', 'What', 'Who', 'How', 'Where', 'When']
call_type['Appointment Reminder'] = ['Remind', 'Tomorrow', 'Today', 'Appointment', 'Doctor', 'Scheduled', 'Time', 'Lab Appointment', 'Reminder', 'Video Icon', 'TATA Bridgital app', 'group.tatabridgital', 'SMS', 'link', 'click']
call_type['Test result / upload'] = ['Phone', 'mobile', 'OTP', 'log in', 'TATA Bridgital App', 'group.tatabridgital', 'Chrome', 'Android', 'My Files', 'Download', 'PDF', 'IgG', 'Test', 'Result', 'ELISA', 'Antibody', 'Investigation', 'Report']
call_type['TBCSS Intro'] = ['18002664119', 'Toll Free', 'TATA Bridgital', 'COVID Safety', 'Partner', '9 am to 7 pm', 'Information', 'Query', 'Counselling', 'Doctor', 'Consultation', 'Appointment', 'App', 'group.tatabridgital']

# Call opening dict
call_opening = dict()
```

```

# Adding metrics and their keywords respectively
call_opening['Call greeting'] = ['Namashkar', 'Good morning', 'Good afternoon', 'Good Evening']
call_opening['Self Introduction'] = ['My name is']
call_opening['Company Introduction positive'] = ['Bridgital']
call_opening['Company Introduction negative'] = ['TATA Group']
call_opening['Identity Confirmation positive'] = ['Am I talking to', 'May I know your phone number', 'Please can you let me know your registered mobile number', 'may I know your name please', 'please share your employee ID/RW number', 'are you registered with us']
call_opening['Identity Confirmation negative'] = ['What is your phone number', 'what is your name']
call_opening['Permission/solicitation'] = ['Can I take a few minutes of your time', 'Can I ask you a few questions']

# Call handling dict
call_handling = dict()
# Adding metrics and their keywords respectively
call_handling['Guestures positive'] = ['Glad to know you are feeling well', 'Nice to hear you are healthy', 'So good to know you are fine', 'That's good to hear']
call_handling['Guestures negative'] = ['Are you fine', 'is your family fine']

# New services dict
new_services = dict()
# Adding metrics and their keywords respectively
new_services['New Services'] = ['Emergency', 'Oxygen', 'Physiotherapy', 'Dermat', 'Gynae', 'Pediatric', 'Psych', 'Pharma', 'COVID Test', 'Hospital', 'OPD', 'Ophthal', 'Ortho', 'Neuro', 'Vaccine']

# Covid keywords dict
covid_keywords = dict()
# Adding metrics and their keywords respectively
covid_keywords['Covid Keywords'] = ['COVID', 'Kovid', 'COVID-19', 'Corona', 'Krona', 'Korona']

# Call closure dict
call_closure = dict()
# Adding metrics and their keywords respectively
call_closure['Confirmation'] = ['Have I answered your question']
call_closure['Check on additional query'] = ['Is there anything else I can help you with']
call_closure['Expressing thanks'] = ['Thanks for your time']
call_closure['Reinforcing how we can be reached in future'] = ['Please call our toll free number']
call_closure['Pleasantries'] = ['Have a good day']

# Exception analysis dict
exception_analysis = dict()
# Adding metrics and their keywords respectively
exception_analysis['Patient Status'] = ['Quarantine', 'Home Quarantine', 'Quarantine Centre', 'Institutional Quarantine', 'Hospital', 'Admitted', 'Discharged', 'COVID Test', 'COVID positive', 'COVID negative', 'Antibody positive', 'Self Isolation', 'Isolation', 'Isolating', 'Ward', 'Funeral', 'Operation', 'Demise', 'Death', 'Surgery', 'Self Quarantine', 'Critical', 'Emergency', 'Expire', 'SPO2', 'Heart Rate', 'Pulse Rate', 'Oxygen Saturation']
exception_analysis['Symptoms'] = ['Fever', 'cold', 'pain', 'eye', 'arm', 'back', 'bodyache', 'headache', 'constipation', 'shortness', 'shoulder', 'sore', 'throat', 'injury', 'vomit', 'abdominal symptoms', 'acidity', 'anxiety', 'nervousness', 'depression', 'fear', 'asthma', 'asymptomatic', 'disease', 'blurred', 'breathing difficulty', 'brain haemorrhage', 'breathlessness', 'burning sensation', 'cancer', 'cardiac', 'change of season', 'change of weather', 'chest pain', 'chicken pox', 'cough', 'itchiness', 'complaints', 'dehydration', 'depressed', 'discomfort', 'sleep', 'ear', 'fatigue', 'tired', 'lazy', 'irritation', 'itchy', 'restlessness', 'uneasiness', 'problem', 'loose motion', 'loss of appetite', 'diet change', 'loss of', 'smell', 'taste', 'nervous', 'stomach', 'pregnancy', 'premature', 'running nose', 'runny nose', 'chest', 'heaviness', 'sleep habit', 'sleeping habit', 'SPO2', 'tightness', 'sputum', 'upset', 'strain', 'sprain', 'suffering', 'temperature', 'infection', 'vomiting', 'swallowing', 'urine', 'bleeding', 'nausea', 'diarrhoea', 'wound', 'ucler', 'abdomen']
exception_analysis['Comorbidities'] = ['BP', 'Blood Pressure', 'High Blood Pressure', 'High BP', 'Low Blood Pressure', 'Low BP', 'Pressure', 'Hypertension', 'Sugar', 'Diabetes', 'Diabetic', 'TB', 'Tuberculosis', 'Thyroid', 'Filaria', 'Malaria', 'Eosinophilia', 'T2DM', 'Asthma', 'congenital heart disease', 'cardiac disease', 'heart problem', 'hear', 'COPD', 'pulmonary', 'bronchial asthma', 'cholesterol', 'hypothyroidism']
exception_analysis['Living Condition'] = ['Hostel', 'quarters', 'company quarters', 'hall', 'barracks', 'company guesthouse', 'plant', 'camp', 'apartment', 'own house', 'rented house', 'bungalow', 'personal toilet', 'common toilet', 'shared toilet']
exception_analysis['Living with'] = ['Family', 'alone', 'mother', 'father', 'parents', 'brother', 'sister', 'sister in law', 'brother in law', 'husband', 'wife', 'kids', 'daughters', 'daugher', 'sons', 'son', 'children', 'child', 'room mates', 'friends', 'room mate', 'friend', 'cousin', 'uncle', 'aunty', 'grandparents', 'grand mother', 'grand father', 'nephew', 'niece', 'son in law', 'daugher in law', 'grand children', 'grand daughter', 'grand son', 'relative']
exception_analysis['Shared Eating'] = ['Mess', 'canteen', 'cafeteria', 'outside food', 'restaurant', 'hotel', 'order online', 'tea stall']

```

exception_analysis['Private Eating'] = ['Home cooked food', 'home made food', 'eat at home', 'I cook myself', 'I carry tiffin to work', 'Home cooked meals', 'home made meals']
 exception_analysis['Shared Transport'] = ['Uber', 'auto', 'car pool', 'rickshaw', 'ola', 'ola auto', 'company bus', 'company cab', 'company van', 'company driver', 'bus', 'tempo']
 exception_analysis['Self Transport'] = ['Bike', 'car', 'vehicle', 'walking', 'personal transport', 'personal vehicle', 'scooty', 'self vehicle', 'cycle', 'scooter', 'bicycle', 'private cab', 'private vehicle', 'motorcycle', 'motorbike', 'two wheeler']

exception_analysis['Working as'] = ['Duty', 'manager', 'assistant manager', 'captain', 'flight operation', 'emergency pharmacy', 'dispensary', 'chemist', 'plant', 'retired', 'security', 'junior', 'superior', 'senior', 'vendor', 'contractor', 'crew', 'staff', 'editor', 'IT', 'retired', 'projects & instrumentation', 'field', 'patrolling', 'waiter', 'cook', 'farming', 'agriculture', 'nurse', 'doctor', 'specialist', 'critical care', 'staff nurse', 'sister', 'housekeeping', 'supervisor', 'security guard', 'cabin crew', 'driver', 'ward boy', 'lab technician', 'security personnel', 'police commando', 'police', 'flight attendant', 'pursor', 'air hostess', 'hostess', 'ambulance driver', 'driver', 'welder', 'maintenance', 'carpenter']

exception_analysis['Number of work contacts'] = ['Around 1-2 people', 'around 2-3 people', 'around 3-4 people', 'around 4-5 people', 'around 5-6 people', 'around 6-7 people', 'around 7-8 people', 'around 8-9 people', 'around 9-10 people', 'around 10-11 people', 'around 10-12 people', 'around 10-15 people', 'around 15-20 people', 'around 20-25 people, around 40-50 people', 'around 50-100 people', 'hundreds of people', 'around 1000 people', 'around 1000-1200 people', 'around 2000-3000 people', 'around 3000-4000 people', 'around 4000-5000 people', 'about 1-2 people', 'about 2-3 people', 'about 3-4 people', 'about 4-5 people', 'about 5-6 people', 'about 6-7 people', 'about 7-8 people', 'about 8-9 people', 'about 9-10 people', 'about 10-12 people', 'about 10-15 people', 'about 15-20 people', 'about 20-25 people', 'about 40-50', 'about 50-100', 'hundreds of people', 'about 1000 people', 'about 1000-1200 people', 'about 1000-2000 people', 'about 2000-3000 people', 'about 3000-4000 people', 'about 4000-5000 people']

Step 5: Suffixes and prefixes:

Assume that any positive keyword match is discovered in the audio transcription compared to exception analysis's keyword metrics. In this situation, the suffix and prefix of keyword matches in transcription are recorded to the database used for exception analysis. Saving the keyword match and the transcribed sentence in which it appeared is extremely important for establishing a new dataset or rapidly examining how the terms appear in sentences and gaining a more profound contextual knowledge of the keywords utilized.

How do keyword prefixes and suffixes work?

If for a specific audio transcription, the following keywords are matched: ['BP,'sugar,' 'thyroid'], in addition to the keywords, the prefix and suffix of the keywords are kept in the database: ['one in your house has BP sugar asthma, thyroid disease,' 'in your house has BP sugar asthma, thyroid disease and,' 'house has BP sugar asthma, thyroid disease and eats medicine.']

Step 6: Database storage and reporting:

The Covid Effective Analysis and Exception Analysis metrics are saved to the database and later used in the report summary.

To summarise, audio files are saved to a database. These are then pre-processed and forwarded to Covid Effective Analysis, followed by Exception Analysis, with all results being kept in a database for report summary purposes. The metrics data can be modified by adding new data to or deleting existing JSON files.

An illustration of exception analysis.

The proposed exception analysis can illustrate the model's inner workings.

Step 1: The model is fed the call transcripts.

Consider the transcription of an audio recording.

"Hello hello Ji Dinesh Ji talks How many Thakur Coordinators spoke to Anjana Tata Digital Health, then let us also work as a defense service through Tata Can I give you a little time because right now to talk Just a few days ago you must have also received a call from our clinical team So right now I would like to answer the question on health-related to you, but first of all, where you live, it comes in your green zone, or you can make it home. OK, no message around you Please are you not taking any medicines for a long time sir OK and nobody reached but got into contact OK And if you go to such duty, you take your car and go by auto

rickshaw. OK I remember from CK Watch Abhishek doing his war, right, that's fine And how many people live in the family alcohol 2 kids 22:00 just OK And no one in your family has any such problem with BP sugar thyroid GK someone else is working in the front line when the doctor cheers the police technician Essay Apart from you, someone else in the family is also working in the front line like the doctor, police force live pregnancy OK OK Where Asha is coming is your own house, you live in a rented house and pack food and carry it Good means go home More new in april right now You have to go to Patna more and more at this time Tea is OK take care OK And then there is nothing like tapping you right or going to a crowded place. Jagdish OK OK If you are working today, there are more or less people working with you. HD Take more than Punjabi is less than brother OKOK And if someone in your family has had peace or there is no such thing before. And I have questions along with those who have been asked to update your denominations, so don't worry Whatever you said to use in safety, keep on following It is OK to take care of Madhuri Maiya more than any other person. Apart from this, send some more videos, you can use it at home, I would like to tell you about your job. It will remain public from the Congressman. First of all, then you must have taken warm water, etc. OK, good thing said, you have to take water for at least 40 days without you Our body is good to hydrate the wheel. In addition to that it happened Ginger happens to be past you, no matter what happened to it, it can be taken by making a decoction. Apart from this, bring turmeric milk also Yes baby was eating, he can have homemade food, get more midday no, also take care People eat ginger and garlic in black and eat more, do not take more, it is good. And besides What kind of wealth is getting the fruits and vegetables, nowadays, if we want to get more vitamin C from more people, then it is good nowadays, was our body perfect? Nothing else found You can say chicken fish and egg, that is also fine, please take the play, it is perfect, you can get a photo from it. All the rest of you should have a little physical activity. OK Wallpaper Nagaur Dudhakhedi should not be a sitting job Yoga The rest is the most important thing to you and your family. Staying free is not something to be fond of. Suppose you want to get any health related information. In that case, there will be a doubt Can talk to hemant If you want to talk now you can tell your time What is such a thing Come closer if You take a chance of Shivji, tension is so lovely to someone in the family If you want to consult the lady doctor We can have psychiatric doctors here Come on, good thing should not be a problem, if ever there seems to be such a problem, you want to do such a thing. You can talk OK Any man ask what Make a presentation work, work from home on behalf of Tata Bill now Good good Arjun Teacher Before our Tested 2 months ago Latest watch Assistant exam was called Yes, we keep calling from here every month and keep asking whether there is any problem and there is no problem and keep giving the information, we have come from time to time to call the airport. Yes yes Did Dharmendra Gandhi call us With freedom And there is no problem lying down from her sleep Alka moong job OK, let's have a good thing, it is also important to sleep because our body needs to get 8 hours of sleep from the whole body down What kind of problem did you see in today's people? The problem is not there, if ever such problem seems to be a problem, you or your family are not unhappy, we have experienced doctors running Muslim clinics as well, so talk to them. Can OK Nothing will go as if any of your health batteries are a problem, then you take them to the Tata Man Hospital for check-ups. Official Before compassion Minus triglyceride was slightly larger How much did he call for that Tendulkar OK, good thing but no one should have any more trouble, but if you have TMH for checkup at the moment you have someone else it's OK to me Dr. Vishveshwari of the parrot vein had much experience from a drink, but we also knew that he is doing excellent health facilities for the employees, which is Pradhan ji So if the healthcare facilities offered by the ATM So if you get it at home, there is a problem, not a little problem, for that you should say that you do not have to go to the heart, if you stay at home, then video call to discuss the thing online. So what do you think it's good for you and your family Right now say It is a problem to be seen especially in the present day and who will be in danger of coming tomorrow. This kind of facility at the place which is available in the house, if you have a small minister, you will not have to go to the hospital tomorrow. It's all good isn't it Exactly said Don't want to go now OK wait to go, apart from this, there should be some more ads that you and your family got from us. What else he said Like if you feel that from your side someone else can tell you if you want me anytime Actually, the object that is given to whom is not Tata Tata Sky We do it ourselves Means the fragrance gives the temple then gets there good Poems Ask abhishek Hey your Now what i Are you sitting Sir, I do not understand your word Said that your jo Title Thakur Anamika Thakur Yes make battery I'm speaking the same Eminem good Street picture And Sir, I would like to ask you that this special mantra started by commenting for you, you can talk to the doctor's head or make an audio call and make a video call. You used all this stuff, you used it, you know something about you My camera Well, no problem, this tuition has been started only for employees by using the Umang app, you can download it and use it. Yes, you can download it by typing our kajal, OK, that too has come in the Play Store now, so many astrology updates keep coming. So that you can see what Aditya can see to keep you and your family healthy And along with that you will have given a toll free number, you can call and contact that number from 9 am to 7:00 pm. Nice to talk now thank you your day for listening"

Step 2: Comorbidities metric calculation in Exception analysis

Comorbidities has several keywords,

```
exception_analysis['Comorbidities'] = ['BP', 'Blood Pressure', 'High Blood Pressure', 'High BP', 'Low Blood Pressure', 'Low BP', 'Pressure', 'Hypertension', 'Sugar', 'Diabetes', 'Diabetic', 'TB', 'Tuberculosis', 'Thyroid', 'Filaria', 'Malaria', 'Eosinophilia', 'T2DM', 'Asthma', 'congenital heart disease', 'cardiac disease', 'heart problem', 'hear', 'COPD', 'pulmonary', 'bronchial asthma', 'cholesterol', 'hypothyroidism']
```

All words under comorbidities must be matched against the audio transcription using the keyword match function. If a positive match is found, it is added to the list of comorbidities and the score is increased by one.

Step3: Append the results to Exception analysis

```
Comorbidities_keywords = ['BP', 'sugar', 'thyroid']
```

Comorbidities_score = 3

Following the execution of keyword matching, the positive match-list and score are attached to the exception analysis report.

This procedure is repeated for each metric in the Exception analysis.

III. Results & Analysis:

Audio Duration	Audio Score	Call Type	Call Opening	Patient Registration Number	Call Handling	New Services	COVID Related Discussion	Call Closure
625.0 Sec	5	{'Message Clarification': 3}	1	['1800 264 119']	1	0	1	0
732.0 Sec	5	{'Immunity Boosting': 5.0}	1	['1800 2001 19']	1	1	2	0
425.0 Sec	5	{'Test result / upload': 3.0}	0	['899 34134 312 993 193', '700 499 4349', '1987 496 926']	1	0	1	0
822.0 Sec	5	{'Immunity Boosting': 5}	0	[]	1	1	0	0
830.0 Sec	5	{'Message Clarification': 3.0}	3	[]	1	0	1	0
1674.0 Sec	5	{'Message Clarification': 3.0, 'Appointment Reminder': 5.0, 'Test result / upload': 3.0}	2	['1016 - 2020']	1	1	0	0
641.0 Sec	5	{'Immunity Boosting': 5}	1	[]	1	1	0	1
1654.0 Sec	5	{'Immunity Boosting': 5, 'Message Clarification': 3}	0	[]	1	1	1	0
847.0 Sec	5	{'Immunity Boosting': 5}	0	[]	1	1	0	0

Vader Negative Sentiment	Vader Neutral Sentiment	Vader Positive Sentiment	Vader Compound Sentiment	Text Blob Polarity	Text Blob Subjectivity
0.038	0.826	0.136	0.9979	0.270553	0.52744655
0.021	0.846	0.133	0.9986	0.216421	0.44332092
0.044	0.772	0.184	0.9968	0.289543	0.56488095
0.045	0.76	0.195	0.9997	0.326351	0.51318523
0.028	0.895	0.077	0.9956	0.201045	0.49071765
0.054	0.824	0.122	0.9986	0.198387	0.50312728
0.046	0.828	0.126	0.9981	0.180501	0.48589574
0.05	0.843	0.107	0.9995	0.147236	0.50456675
0.057	0.802	0.14	0.9985	0.11107	0.47720073

Patient_Status_key	Patient_Status_description	Symptoms_key words	Symptoms_description

at u s	wo rds		m s		
0	[]	[]	2	['fever', 'cold']	['if it means You have fever with your grandmother GG', 'care of washing eyes with cold water. Massage your eyes.']
0	[]	[]	3	['cold', 'back', 'sleep']	['do all this and put cold water in the eyes', 'is a corporation in the back 100 meters admission? No', 'you work, then at least sleep well Hey, before dinner,']
0	[]	[]	1	['Eye']	['Hello 198749 Pintu Singh 192 Eye 1987 496 926 No']
1	['H osp ital']	['them to the Tata Man Hospital for check-ups. Official Before']	2	['sleep', 'pregnancy']	['problem lying down from her sleep Alka moong job OK,', 'the doctor, police force live pregnancy OK OK Where Asha']
1	['op er at ion']	['give any suggestion. What the operation would like to give']	6	['Fever', 'cold', 'sleep', 'stomach', 'chest', 'vomiting']	['Tata Steel Inquiries Sardar Stomach Fever If you Those who', 'look after your eyes with cold water Apart from this,', 'water too Yes Sir Proper sleep for 8 hours How', 'I get out of my stomach at 5:00 am, I', 'you i talk to my chest to talk about it', 'eat lemon Apps to increase vomiting further Kali does not']
2	['H osp ital' , 'sur ger y']	['Mata Show Ajmer Sophia Video Hospital Hospital Pressure Android Phone', 'Automobile Right Overy Baby after surgery after losing weight Semantics']	4	['pain', 'fear', 'Sleep', 'pregnancy']	['ronak bicycle bike bicycle Fast pain contractor in Delhi's colleagues', 'online OK yes to no fear video photo Little don't', 'I am the caustic gynecologist Sleep good night My name', 'get more liters OK again pregnancy pick up the calling']
1	['ho spit al']	['have to go to the hospital railway station near bus']	4	['cold', 'disease', 'sleep', 'stomach']	['for Jayaprada Give eyes with cold water Massage the eyes', 'The medicine is not a disease yet The first disease', 'that even sleeping cannot reach sleep You go to the', 'non-govt related diseases, head ache, stomach pain related to fever,']
2	['H osp ital' , 'op er at ion']	['go to TMH Tata Memorial Hospital Someone to show you', 'treatment will be done without operation in it, forever means']	1 1	['fever', 'cold', 'back', 'headache', 'sore', 'throat', 'disease', 'burning sensation', 'Cough', 'stomach', 'chest']	['get too much Combat picture fever Winter Wagaira Coaching Fever', 'you have a lot of cold Does not happen frequently', 'or it is like coming back up, whatever it is', 'too much weight, light pain, headache This type of weather', 'mean Kabar mean Have a sore throat today Khandala You', 'Kabar mean Have a sore throat today Khandala You always', 'say that there is a disease of sugar which no', 'say that there is a disease of sugar which no', 'some people are rigorous. Cough Keeps on blowing air', 'that you are on empty stomach once or twice before.', 'a burning sensation in the chest or it is like']
1	['ho spit al']	['Deepanshu Chacha Is in the hospital now Because of Berlin,']	2	['back', 'sleep']	['what time do you come back Shivaji Returned at 6:00', 'Woke up at 1:30 No sleep nowadays Yes i don't']

Co mo rbi dit ies	Comorbidi tes_keywords	Comorbidities_description	Living Con diti on	Living _Con diti on_ keywo rds	Living_Co ndition_de scription
2	['BP', 'sugar']	['you take if you had BP sugar thyroid? BP Sugar', 'medicine but I am feeling sugar Is sugar Sir to']	0	[]	[]
4	['BP', 'sugar', 'thyroid', 'Malaria']	['name someone in your family BP sugar thyroid And in', 'someone in your family BP sugar thyroid And in Mam's', 'in your family BP sugar thyroid And in Mam's Aap', 'speak What do you say Malaria Such Something like a']	0	[]	[]
0	[]	[]	1	['hoste l']	['Four-five days stay in GT hostel Who is on time']
3	['BP', 'sugar', 'thyroid']	['has any such problem with BP sugar thyroid GK someone', 'any such problem with BP sugar thyroid GK someone else', 'such problem with BP sugar thyroid GK someone else is']	2	['own house' , 'rente	[]

				d house']	
1	['BP']	['I taking any medicine, like BP girlfriends You did not']	1	['plant']	['I roam around in the plant area looking at the']
5	['BP', 'blood pressure', 'Pressure', 'Diabetes', 'Thyroid']	['hard complete My All Medical BP Solitaire Baby I not,' 'hard complete My All Medical BP Solitaire Baby I not,' 'Ajmer Sophia Video Hospital Hospital Pressure Android Phone to Tech,' 'Problem In ETV Plus Images Diabetes blood pressure Nobody no,' 'friend Avni New Family Horror Thyroid Problem In ETV Plus']	0	[]	[]
3	['BP', 'sugar', 'thyroid']	['one in your house has BP sugar asthma, thyroid disease,' 'in your house has BP sugar asthma, thyroid disease and,' 'house has BP sugar asthma, thyroid disease and eats medicine.']	0	[]	[]
5	['blood pressure', 'pressure', 'sugar', 'diabetes', 'diabetic']	['uncle's sugar, but yes blood pressure is your grandmother, no," 'a blood test done for sugar 100 KM After 2,' 'little under control which means diabetes Vinod Singh Desi54 Whatever,' 'ask call on hold Lemon diabetic people shopping diabetes Hello']	0	[]	[]
2	['BP', 'sugar']	['if I thought about work BP Thinking about any good,' 'Ashok Ji, do you drink sugar or not? Sugar mill']	0	[]	[]

Living_with_keywords	Living_with_description	Share_Eating	Shared_Eating_keywords	Shared_Eating_description	
2	['family', 'Father']	['No doctor in the city family has a police technician,' 'sugar thyroid? BP Sugar BP Father Take a spell 40']	0	[]	[]
4	['family', 'alone', 'brother', 'friend']	['And name someone in your family BP sugar thyroid And,' 'work together marriage We live alone Hey I said how,' 'family Like cultural Thank you, brother, for giving information In,' 'will be together without your friend till 4:00 pm If']	0	[]	[]
0	[]	[]	0	[]	[]
3	['family', 'brother', 'kids']	['many people live in the family alcohol two kids 22:00,' 'than Punjabi is less than brother OKOK And if,' 'in the family alcohol two kids 22:00 just OK And']	0	[]	[]
6	['family', 'Mother', 'father', 'brother', 'friends', 'uncle']	['home if anyone gives their family lukewarm water too Yes,' 'you go to your work Mother Public Transport use, you,' 'Good thing sir How much father am I working for,' 'of Stylish pamphlet, Already Hey brother put in group Which', 'your house, what do your friends come from, no idea,' 'get vegetables from the market uncle In the matriculation, when']	0	[]	[]
7	['Family', 'Mother', 'father', 'husband', 'child', 'friends', 'friend']	['Amend me friend Avni New Family Horror Thyroid Problem In', 'for 2 seconds Information about Mother Temple with Lohawat Bagdi', 'vacation of my mother and father The olympics Ahil problem', 'kg two and cause two husband during period class', 'painting employee Monday's turn of child right Interrogative planning ITT', 'and 2019 Or your two friends at 2:00 or 2:00', 'Is On 2 October After friend tanked weight loss between']	0	[]	[]
3	['family', 'mother', 'Wife']	['helpful for you and your family sir Ma'am telling you", 'Boy Girl Wife Hey my mother Good how old will', 'house Amma A Boy Girl Wife Hey my mother Good']	0	[]	[]
5	['mother', 'Brother', 'son', 'child', 'friend']	['then it is in the mother border line If you', 'of everyone is very less. Brother who is older than', 'OK this has happened, your son has been tested, something', 'on a sheet Yes same child Whenever it is good', 'you write you have a friend Taking Hba1c Search for']	0	[]	[]

2	['Sister', 'Son']	['what did you do Do Sister Exercise, Think Something Positive,', 'mean this Watch youtube all Son worry worry No Brahmagiri']				0	[]	[]
Private_Eating	Private_Eating_keywords	Private_Eating_description	Shared_Transport	Shared_Transport_keywords	Shared_Transport_description			
0	[]	[]	0	[]	[]			
0	[]	[]	1	['bus']	['you go elsewhere Railway station bus stand Sona I want']			
0	[]	[]	0	[]	[]			
0	[]	[]	1	['auto']	['your car and go by auto rickshaw. OK I remember']			
0	[]	[]	1	['bus']	['I am talking to Sarwate bus stand Yes sir Sir,']			
0	[]	[]	1	['Auto']	['Or listen to non-melodious songs Auto golden Badri and Book']			
0	[]	[]	1	['bus']	['the hospital railway station near bus stand for some reason']			
0	[]	[]	0	[]	[]			
0	[]	[]	1	['bus']	['sauce Between 9:30 Government 9 bus goes to 1520 good']			

Number_of_work_contacts	Number_of_work_contacts_keywords	Number_of_work_contacts_description
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]
0	[]	[]

Self_Transport	Self_Transport_keywords	Self_Transport_description	Working_as_keywords	Working_as_keywords	Working_as_description
1	['car']	['Yes, do not leave your car Go by your car']	5	['duty', 'security', 'it', 'doctor', 'police']	['is happening at home Doing duty is nothing Nice little', 'We in Delhi 5050 in security 1000 2000 man meets', 'take your 5 minutes Yes it is OK Sir, your', 'take an appointment with our doctor sir With the doctor,' 'the city family has a police technician like Crona warrior']
1	['walking']	['Helping like drinking tea, start walking 50 days Yes drink']	5	['Staff', 'it', 'nurse', 'doctor', 'police']	['come in contact with Kuwait Staff Money anywhere Working in,' 'know what kind of name it is Area Physical Live,' 'who works as a doctor nurse police force hanging character,' 'you who works as a doctor nurse police force hanging,' 'works as a doctor nurse police force hanging character Come']
1	['Bike']	['can tell while sharing Sujata Bike What is their number']	1	['it']	['test took place on 21st, it is not known yet.']
1	['car']	['such duty, you take your car and go by auto']	3	['it', 'doctor', 'police']	['of all, where you live, it comes in your green,' 'the front line when the doctor cheers the police technician,' 'when the doctor cheers the police technician Essay Apart from']

2	['Bike', 'car']	['to reach you Patna cart Bike bike Someone in your,' 'Transport use, you have a car to reach you Patna']	6	['duty', 'plant', 'security', 'it', 'cook', 'police']	['parrot sitting Such is the duty morning in the company,' 'I roam around in the plant area looking at the,' 'been appointed for safety and security by Tata Steel, am,' 'daily routine Santa Banta Do it as if you were,' 'house, then I had to cook myself and eat and,' 'Doctors nurses him in the police force Our elder brother,']
3	['bike', 'Cycle', 'bicycle']	['hello baby after Ronak bicycle bike bicycle Fast pain contractor,' 'Battery Dasam then my Mysore Cycle Showroom Sudarshan Village Shastri,' 'you my dear regular cycle bicycle of overdue by fey']	5	['duty', 'contractor', 'editor', 'it', 'doctor']	['Any Problem How are you duty Configuring light on Allahabad,' 'bicycle bike bicycle Fast pain contractor in Delhi's colleagues Ina,' 'your number Who was the editor sitting on my bike,' 'dance What do you think it is the medicine Dhananjay', "']
0	[]	[]	2	['duty', 'it']	['Yes do we go from duty to profit Take vegetables,' 'you take vegetables, you take it from a crowded place']
1	['walking']	['days Whatever the exercise or walking is about to do']	3	['it', 'doctor', 'specialist']	['Is perfectly normal 150 means it can also be a', 'the report was spoken, the doctor said nothing This may,' 'them what to do Ent specialist will have to show']
0	[]	[]	3	['it', 'doctor', 'Sister']	['leave your houses only when it is essential. Hello', 'dizzy Then Went to the doctor No, we are not,' 'what did you do Do Sister Exercise, Think Something Positive,']

Conclusion:

To conclude, the sentiment analysis system can be integrated into various organizations and extract meaningful information from audio(call) data. The system will generate very sophisticated reports on customer sentiments based on call data and numerous performance and assessment criteria. These comprehensive customer insights and analysis reports on covid-19 call data can help organizations improve their professional health services, client relationships, and in turn, revenue margins. Additionally, the new data insights generated by the model on customer call data can be gathered and saved in a database for training and improving the model's output. A sufficient amount of data collected from covid-19 calls or any customer calls, in general, can be used to create unique, customized NLP data sets tailored to an organization's specific needs. Moreover, the new keywords and phrases that appeared in the data can be integrated into JSON files to produce more nuanced results.

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