Pipeline for XAI based Automatic Audio Call Audit

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Call Audit

What?
A metric to define how well the customer interactions are being handled by call-center agents.

Why?
- To ensure the call-quality
- Identify the concerned areas in call center operations → take the preventive steps to improve the customer satisfaction index.
Limitations of Manual Audit

- Manual audits address only \( \sim 6\% \) of the total volume coming to the service desk.
- Time complexity: \textbf{20-30 mins/call} !
- (Manual) Auditor assessments are prone to human bias → uniformity in audit?
Objective

Automate the call audit process so that:

✓ Bulk amount of calls could be handled (faster process and less complexities)
✓ Uniformity in handling: better call handling management and enhanced user experiences
✓ Reducing human interventions and bias
✓ Provide better and explainable insights to reliably identify user concerns: XAI
Call Handling Attributes

Call Opening

[1] Greetings & User Information
[2] Identity verification

Soft skills

[6] Easy to understand and neutral accent
[7] Being warm and friendly
[8] Hold procedure
[9] Professionalism

Trouble Shooting

[3] Paraphrasing users concern
[4] Investigation-Probing
[5] Diagnose and Troubleshooting

Closure

[10] Offering additional assistance
[11] Providing ticket details to the user
[12] Summarize and close the call
[13] Encouraged the customer to provide feedback
[14] Going an extra mile

[15] User Delight
Framework: Automatic Call Audit

- Audio Call
  - Speaker Segmentation and Identification
  - Segmented Audio
    - Segments: Agent (start-time-end-time)
    - Segments: Customer (start-time-end-time)
  - Feature Extraction + Automatic Speech Recognition (ASR)
  - Pre-trained
  - Engine 1
  - Non-linguistic Analysis
    - Engine 3
      - Emotion Recognition
    - Speaking Rate
      - Engine 4
        - Analysis
        - Integration
        - Report Generation
PoC with Customer Calls (from a Pharma Industry)
Development Phases

- Attributes addressed: 15
- Test bed: 80 calls
- Output format: Yes/No for each attribute
- Model (except **LM) adaptation/tuning → target environment: ×
Performance : Automatic Audit

Manual Vs Automated: Parameter wise agreement (%)

<table>
<thead>
<tr>
<th>ID</th>
<th>Parameters</th>
<th>phase#1</th>
<th>phase#2</th>
<th>phase#3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Greeting &amp; User Information</td>
<td>67.5</td>
<td>98.75</td>
<td>98.75</td>
</tr>
<tr>
<td>P2</td>
<td>Identity Verification</td>
<td>87.5</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>P3</td>
<td>Paraphrasing user’s concern</td>
<td>51.25</td>
<td>65.00</td>
<td>95.00</td>
</tr>
<tr>
<td>P4</td>
<td>Investigation - Probing</td>
<td>78.75</td>
<td>92.50</td>
<td>98.75</td>
</tr>
<tr>
<td>P5</td>
<td>Diagnose &amp; Troubleshooting</td>
<td>75.00</td>
<td>91.25</td>
<td>95.00</td>
</tr>
<tr>
<td>P6</td>
<td>Easy to understand and neutral accent</td>
<td>65.00</td>
<td>67.50</td>
<td>86.25</td>
</tr>
<tr>
<td>P7</td>
<td>Being warm and friendly</td>
<td>96.25</td>
<td>97.50</td>
<td>97.50</td>
</tr>
<tr>
<td>P8</td>
<td>Hold Procedure</td>
<td>51.25</td>
<td>72.50</td>
<td>72.50</td>
</tr>
<tr>
<td>P9</td>
<td>Professionalism</td>
<td>90.00</td>
<td>91.25</td>
<td>91.25</td>
</tr>
<tr>
<td>P10</td>
<td>Offering additional assistance</td>
<td>76.25</td>
<td>85.00</td>
<td>85.00</td>
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<tr>
<td>P11</td>
<td>Providing Ticket details to the user</td>
<td>55.00</td>
<td>67.50</td>
<td>88.75</td>
</tr>
<tr>
<td>P12</td>
<td>Summarize and close the call</td>
<td>70.00</td>
<td>92.50</td>
<td>92.50</td>
</tr>
<tr>
<td>P13</td>
<td>Encouraged the customer to provide feedback</td>
<td>50.00</td>
<td>57.50</td>
<td>95.00</td>
</tr>
<tr>
<td>P14</td>
<td>Going an extra mile</td>
<td>21.25</td>
<td>25.00</td>
<td>91.25</td>
</tr>
<tr>
<td>P15</td>
<td>User Delight</td>
<td>30.00</td>
<td>57.50</td>
<td>96.25</td>
</tr>
<tr>
<td></td>
<td><strong>Average Performance</strong></td>
<td><strong>64.33</strong></td>
<td><strong>77.42</strong></td>
<td><strong>92.25</strong></td>
</tr>
</tbody>
</table>
Performance Analysis

- Phase#2: LM tuning resulted into improved performance of 77.42%, from 64.33% (absolute improvement of 13.09%)

- Phase#3, upgraded integration further improved the performance to 92.25%, from 77.42% (absolute improvement of 14.83%)

- Time complexity: $\sim (0.6 \ast \text{call duration}) \ll \text{Manual audit}$

<table>
<thead>
<tr>
<th>Number of attributes</th>
<th>Agreement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>$&gt;90%$</td>
</tr>
<tr>
<td>3</td>
<td>80-90%</td>
</tr>
<tr>
<td>1</td>
<td>$&lt;80%$</td>
</tr>
</tbody>
</table>

**Table:** Phase#3: Number of attributes with corresponding agreement (%)
Audit Platform Design

**URL:** https://intranet.cloud/tcs-cc-audit/
Demonstration
### TCS Automatic Call-center Call Audit version2

Audio & Speech Processing Research Group @ TCS RnR, Mumbai

#### Download Request

<table>
<thead>
<tr>
<th>Requestor Name</th>
<th>RC</th>
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<tr>
<td>Select</td>
<td>20200903-100118</td>
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</tbody>
</table>

[Download report]
TCS Automatic Call-center Call Audit

Overview

Call audit is a process to ensure the call-quality, a metric to define how well the customer interactions are being handled by call-center agents. The audits are essential, and generally conducted to identify the concerned areas in call center operations of an organization, and to take the preventive steps to improve the customer satisfaction index. Many of such organizations are relying on specialized partners to carry out the audit process and evaluate that. However, manual audit is time-consuming and complex process, thus makes it costly. In fact, manual audits are always prone to human-bias, and becomes less consistent (having lower inter-auditor agreements).

TCS Automatic Call-center Call Audit

We demonstrate an automatic call audit process, mainly to reduce the time complexity and the human-bias in manual auditing. The automated call audit process generates the quality report (marked as Yes/No) against the 15 parameters Call audit automation has been done by integrating several automatic engines (e.g. Speaker diarization, Automatic Speech Recognition (ASR), Speech Emotion Recognition (SER), Speaking Rate), which are researched and developed inhouse by Speech-Team@TCS Research and Innovation-Mumbai.
**System Capabilities**
- Automatic audit of bulk amount of calls
- Generates quality report marked as 'Yes/No' against 15 attributes
- Time complexity: \( \sim (0.6 \times \text{call duration}) \ll \text{Manual audit} \)
- Implicit conversion of GSM to PCM encoding of input call.

**Input format**
- Input: An audio call
  - File extension: '.wav'
  - Sampling frequency: 8kHz
  - Precision: 16 bit
  - Channel: mono
Audit Tool: Descriptions

TCS Automatic Call-center Call Audit version 2

Audio & Speech Processing Research Group @ TCS RnL, Mumbai

<table>
<thead>
<tr>
<th>Audit Tool</th>
<th>Overview</th>
<th>Features</th>
<th>Description</th>
<th>XAI Evaluation</th>
<th>About Us</th>
</tr>
</thead>
</table>

- Greetings & User Information
- Identity verification
- Paraphrasing users concern
- Investigation–Probing
- Easy to understand and neutral accent

Investigation–Probing
To check whether the questions asked by the agent provided the necessary information to identify what the issue was about.
### XAI Interface: Attributes Evaluation

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Integration Logic</th>
<th>Explainable Insight</th>
<th>Evaluation</th>
<th>Confidence Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greeting &amp; User Information</td>
<td>Key = “welcome, helpdesk: thank you, how may I help you, please, “may”, “if”]</td>
<td>Key spotted: [“welcome, helpdesk”]</td>
<td>Yes</td>
<td>0.5</td>
</tr>
<tr>
<td>Identity Verification</td>
<td>Key = [“two, four, “may”, “if”]</td>
<td>Key spotted: [“two, four, “may”, “if”]</td>
<td>Yes</td>
<td>0.7</td>
</tr>
<tr>
<td>Paraphrasing users concern</td>
<td>Key = [green, password; problem; no connection; understood; correctly]</td>
<td>Cond1: True; Cond2: True; Cond3: False; Cond4: False; Cond5: False</td>
<td>Yes</td>
<td>0.6</td>
</tr>
<tr>
<td>Investigation - Probing</td>
<td>Key = [ticket, hold, check, troubleshoot]</td>
<td>Cond1: True; Cond2: False</td>
<td>Yes</td>
<td>0.75</td>
</tr>
<tr>
<td>Diagnose &amp; Troubleshooting</td>
<td>Key = [“may”, “if”]</td>
<td>Cond1: True; Cond2: False</td>
<td>Yes</td>
<td>0.75</td>
</tr>
<tr>
<td>Easy to understand and neutral accent</td>
<td>Agent’s speaking rate in 40 to 150 words per minute; Agent’s overall emotion = Neutral</td>
<td>Cond1: True; Cond2: False</td>
<td>Yes</td>
<td>0.5</td>
</tr>
<tr>
<td>Talking warm and friendly</td>
<td>Key = [sorry, thank you, help, please, understand, inconvenience]</td>
<td>Cond1: True; Cond2: False</td>
<td>Yes</td>
<td>0.75</td>
</tr>
<tr>
<td>Hold procedure</td>
<td>Key = [“hold”]</td>
<td>Key spotted: [“hold”]</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Cond1: Presence of “talking warm and friendly”</td>
<td>Cond1: True</td>
<td>Yes</td>
<td>1</td>
</tr>
</tbody>
</table>
Thank You!!