**1. HTML (Frontend Chat UI)**

* **Why**: You need a **frontend interface** where users can chat with your bot.
* **What It Does**: Embeds the chatbot (usually built in Dialogflow CX) on your website or app.

**2. Dialogflow CX (or ES)**

* **Why**: This is the core chatbot engine that manages the conversation flow.
* **What It Does**: Uses Agents, Intents, Entities, and Flows to understand user messages and respond.

**1. Agent**

* Manages everything (intents, flows, etc.)
* Think of it as the **overall chatbot system**

**🎯 2. Intent = What the user wants**

* User says: “What’s the average salary?” → Bot detects **Intent** = GetAverageSalary
* You create this manually

**🏷️ 3. Entities = Specific details in the user’s question**

* Example: “in Sales department” → Sales is an **Entity** (department)
* Helps refine the intent
* You define/customize entities

**🔁 4. Flow = Steps the bot follows**

* Once the Intent is matched, **Flow** decides what to do
* Ex: Query BigQuery → Get average salary → Show result
* You design the flow manually

**Agent** (brain) handles **Intents** (user goals), extracts **Entities** (details), and follows **Flows** (actions to respond).

**Step 3: Visual Flow & Pages (in Dialogflow CX)**

* You create a **Flow** inside Dialogflow for GetAverageSalary.
* This flow says: “When this intent is triggered, **send the request to Webhook**.”

💡 Think of it like:  
👤 User says something → 🤖 Agent detects intent → 📤 “Send this request to backend”

**🔌 Step 4: Webhook (Cloud Function or Cloud Run)**

* A **Webhook** is your backend code.
* Dialogflow sends the user’s message to the webhook.
* Example: "User asked: What is the average salary of all employees?"

The **Webhook does 2 things:**

1. Sends this question to **Vertex AI (LLM)**
2. Waits for the SQL answer

**🧠 Step 5: Vertex AI (LLM / GenAI)**

* Vertex AI has a **Large Language Model** (LLM) like **Gemini** or **PaLM**.
* LLM takes the user’s question and **converts it into SQL**:

SELECT AVG(SAL) AS average\_salary FROM employees WHERE SAL IS NOT NULL;

* Then it sends this SQL query back to the Webhook.

**🛢️ Step 6: BigQuery**

* The Webhook now **runs the SQL** in **BigQuery**, where your employee data is stored.
* BigQuery processes the query and returns the result:

average\_salary = 5666.67

**📥 Step 7: Webhook Receives the Result**

* Webhook gets the number 5666.67
* It formats the result like this:

👉 "The average salary of all employees is ₹5,667."

**🤖 Step 8: Dialogflow CX Agent**

* Webhook sends this **final answer** back to Dialogflow.
* Dialogflow sends it to the user interface.

**💬 Step 9: HTML Chat UI (Frontend)**

* The **user sees** this in their chat window:

💬 "The average salary of all the employees is ₹5,667."

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| User in HTML Chat UI |

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| Dialogflow CX Agent | <-- Detects intent "calculate\_average\_salary"

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| Visual Flow Routes to |

| Webhook Trigger |

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| Webhook (Cloud Function) |

| Parses query |

| Sends to Vertex AI |

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| Vertex AI LLM (GenAI) |

| "What is average salary"|

| → SQL: SELECT AVG(SAL)...|

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| BigQuery Table |

| "employees" table |

| SQL runs & returns |

| avg = 5666.67 |

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| Webhook Formats Response |

| → "Average salary is ₹5,667"|

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| Dialogflow Sends Response |

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| Chat UI Shows Response |

**FINAL ARCHITECTURE DIAGRAM:**

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| User (HTML) |

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| Dialogflow CX Agent |

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| Visual Flow & Pages |

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| Webhook/API | <== (Google Cloud Function or Cloud Run)

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| Vertex AI| | Document AI | | BigQuery |

| (LLM) | | (PDF Parser) | | (SQL Queries) |

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| RAG Logic |

| (Combine retrieved info |

| with LLM response) |

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| Dialogflow returns response|

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| Chatbot UI |

| (Website HTML) |

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**1. User (HTML / Chatbot UI)**

**What it is:**  
The user interacts with the chatbot via a website or application (built using HTML, JavaScript, etc.).

**Role:**

* This is the **frontend** interface where the user types a message.
* Example: You ask “What is the average salary of employees?”

**✅ 2. Dialogflow CX Agent**

**What it is:**  
This is the **core chatbot engine** built using **Dialogflow CX** (or ES). Think of it as the “brain” that understands and processes user messages.

**Role:**

* Detects the **intent** (what the user wants).
* For example, it identifies your question as: CalculateAverageSalary.
* Routes the request to the right **Flow** or action.

**✅ 3. Visual Flow & Pages (Dialogflow)**

**What it is:**  
A visual builder inside Dialogflow where you define **conversation steps**, **conditions**, and **actions** (like triggering a webhook).

**Role:**

* Directs the conversation to an appropriate **Webhook** when complex logic is needed.
* In this case: **calls Webhook** to handle average salary computation.

**✅ 4. Webhook / API Call (Cloud Function or Cloud Run)**

**What it is:**  
A backend service (usually deployed on Google Cloud) that runs custom logic.

**Role:**

* Receives the request from Dialogflow.
* Decides what service to call: **Vertex AI**, **BigQuery**, or **Document AI**, depending on the need.

Now, the Webhook could talk to any of these:

**✅ 5A. Vertex AI (LLM - Large Language Model)**

**What it is:**  
A powerful model like **Gemini** or **PaLM** that understands natural language and generates SQL, text, or summaries.

**Role:**

* Converts user’s question into SQL:  
  SELECT AVG(SAL) FROM employees WHERE SAL IS NOT NULL;

**✅ 5B. Document AI (Optional - for PDF/Doc data)**

**What it is:**  
A service that extracts structured data from unstructured documents like PDFs, invoices, scanned forms.

**Role:**

* If the question needs to pull data from documents (like contracts or resumes), this is used.
* Not used in the **average salary** example, but useful for HR bots or legal assistants.

**✅ 5C. BigQuery (Data Warehouse)**

**What it is:**  
Google’s powerful data warehouse where structured data (like employee records) is stored.

**Role:**

* Executes the SQL generated by Vertex AI.
* For example:  
  It runs: SELECT AVG(SAL) FROM employees  
  → returns 5666.67

**✅ 6. RAG Logic (Retrieval-Augmented Generation)**

**What it is:**  
A smart technique that **combines retrieved data (from BigQuery or Document AI)** with **LLM’s response**.

**Role:**

* Makes the final answer smarter and context-aware.
* For example:  
  LLM gets the number (5666.67) → formats it as:  
  “The average salary of all employees is ₹5,667.”

**✅ 7. Dialogflow Returns Response**

**What it is:**  
Dialogflow receives the final text and passes it back to the user.

**Role:**

* Sends the formatted message back to the frontend interface.

**✅ 8. Chatbot UI (HTML)**

**What it is:**  
The user sees the final answer displayed in the same chat window.

**Role:**

* Presents: **“The average salary of all employees is ₹5,667.”**