[Technical Report] Merchant Service Automation: AI-Driven Reservation & Receipt Pipeline

1. Project Objective & Business Context

- **Industry Insight:** Leveraging professional experience in the hospitality sector, I identified manual receipt reissuance as a high-friction operational bottleneck, often leading to customer dissatisfaction and data entry errors.
- **Objective:** To architect an end-to-end AI automation pipeline that handles real-time reservations and instant document generation, ensuring **100% data integrity** and zero manual intervention.

2. System Architecture & Engineering Stack

- **Frontend (Conversational Interface): Botpress** – Orchestrated LLM-based intent recognition to capture unstructured user data.
- **Integration Layer: Make.com** – Managed complex workflow orchestration via **RESTful Webhooks** and JSON payload routing.
- **Data Persistence: Google Sheets DB** – Served as the primary source of truth for structured transaction records.
- **Output Engine: Google Workspace API** – Dynamically generated and delivered personalized PDF documents via automated SMTP protocols.

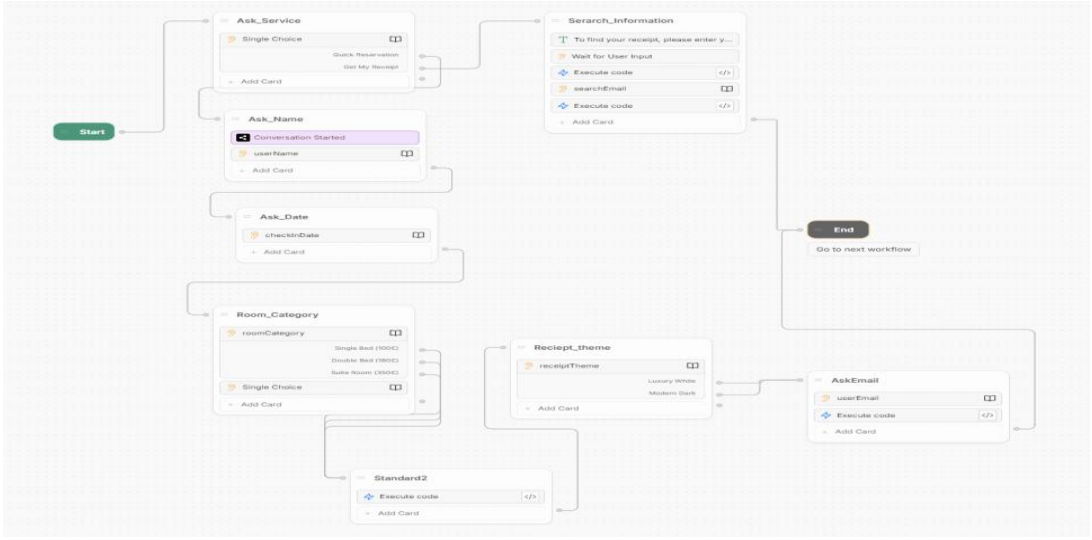


Figure 1. End-to-End System Architecture for Hospitality Service Automation

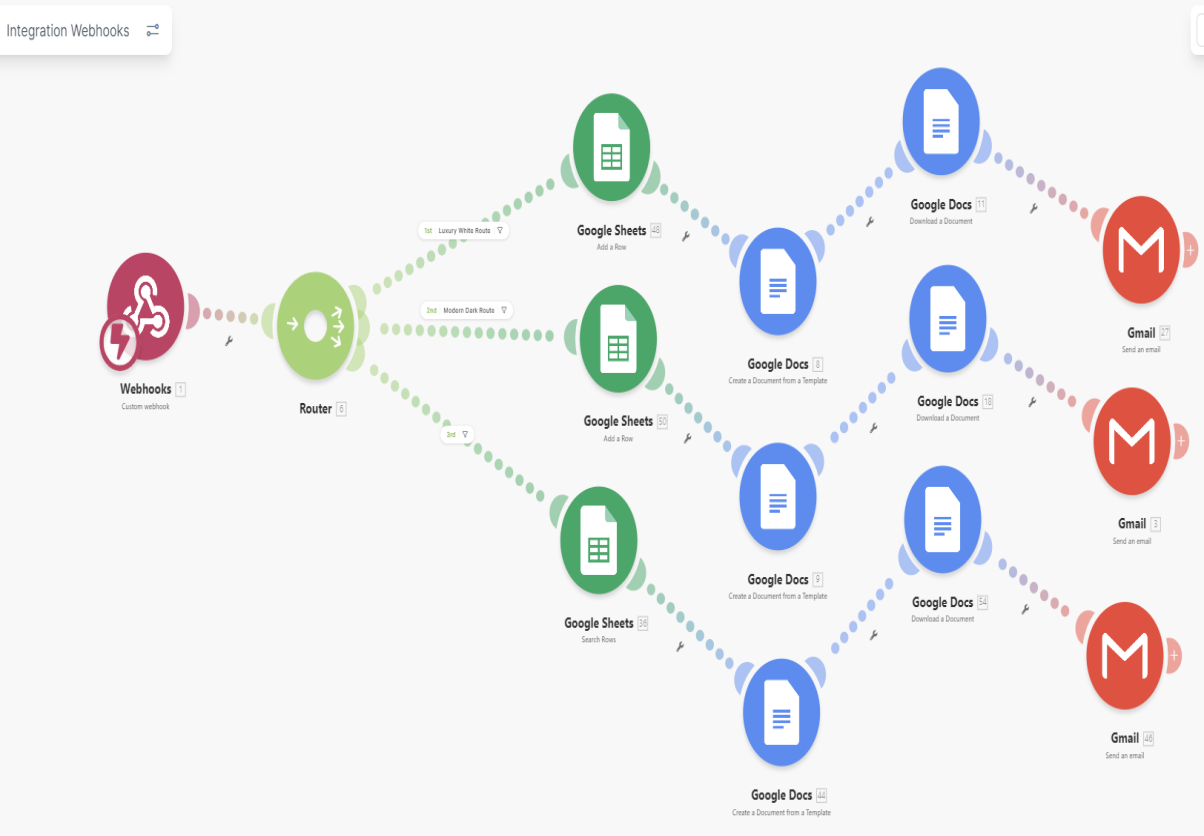
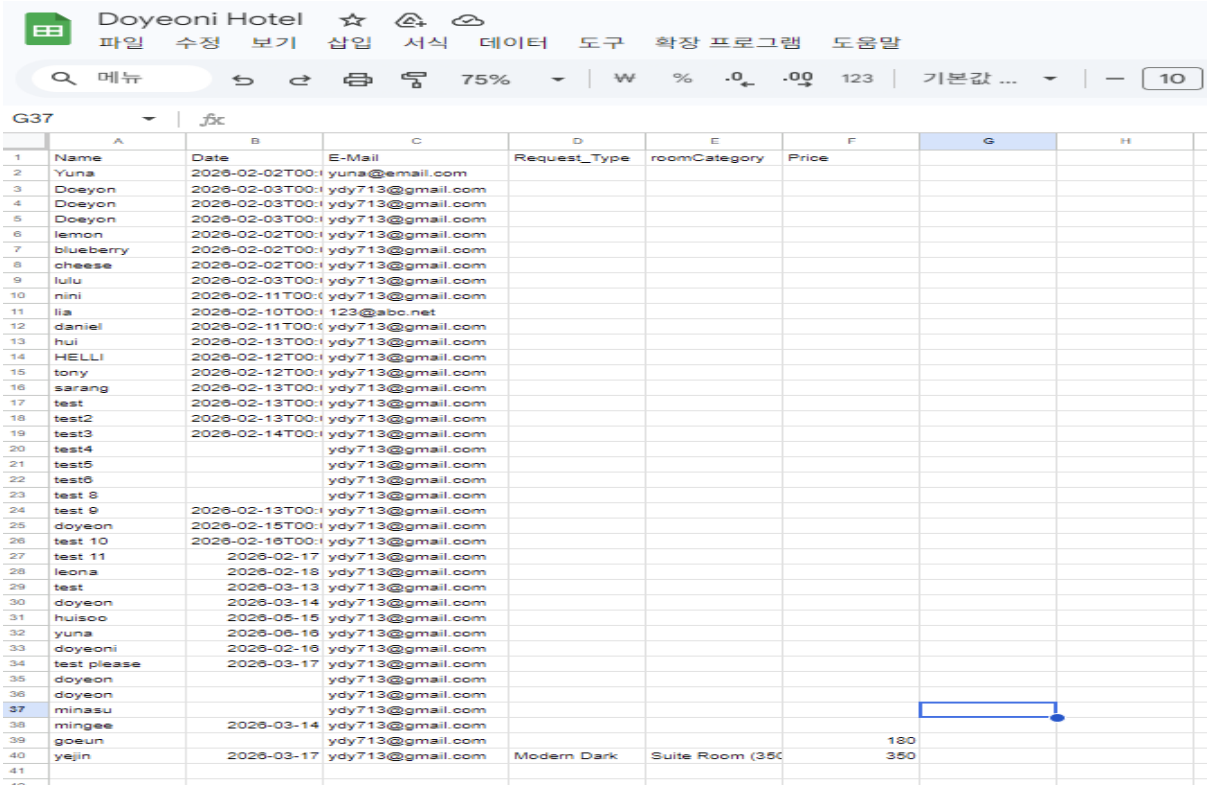


Figure 2. Automated Workflow Orchestration and Router-based Logic in Make.com



Doyeoni Hotel

파일 수정 보기 삽입 서식 데이터 도구 확장 프로그램 도움말

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	A	B	C	D	E	F	G	H
1	Name	Date	E-Mail	Request_Type	roomCategory	Price		
2	Yuna	2026-02-02T00:(	yuna@email.com					
3	Doeyon	2026-02-03T00:(	ydy713@gmail.com					
4	Doeyon	2026-02-03T00:(	ydy713@gmail.com					
5	Doeyon	2026-02-03T00:(	ydy713@gmail.com					
6	lemon	2026-02-02T00:(	ydy713@gmail.com					
7	blueberry	2026-02-02T00:(	ydy713@gmail.com					
8	cheese	2026-02-02T00:(	ydy713@gmail.com					
9	lulu	2026-02-03T00:(	ydy713@gmail.com					
10	nini	2026-02-11T00:(	ydy713@gmail.com					
11	lia	2026-02-10T00:(	123@abc.net					
12	daniel	2026-02-11T00:(	ydy713@gmail.com					
13	hui	2026-02-13T00:(	ydy713@gmail.com					
14	HELLI	2026-02-12T00:(	ydy713@gmail.com					
15	tony	2026-02-12T00:(	ydy713@gmail.com					
16	sarang	2026-02-13T00:(	ydy713@gmail.com					
17	test	2026-02-13T00:(	ydy713@gmail.com					
18	test2	2026-02-13T00:(	ydy713@gmail.com					
19	test3	2026-02-14T00:(	ydy713@gmail.com					
20	test4		ydy713@gmail.com					
21	test5		ydy713@gmail.com					
22	test6		ydy713@gmail.com					
23	test 8		ydy713@gmail.com					
24	test 9	2026-02-13T00:(	ydy713@gmail.com					
25	doyeon	2026-02-15T00:(	ydy713@gmail.com					
26	test 10	2026-02-16T00:(	ydy713@gmail.com					
27	test 11	2026-02-17	ydy713@gmail.com					
28	leona	2026-02-18	ydy713@gmail.com					
29	test	2026-03-13	ydy713@gmail.com					
30	doyeon	2026-03-14	ydy713@gmail.com					
31	huisoo	2026-05-15	ydy713@gmail.com					
32	yuna	2026-06-16	ydy713@gmail.com					
33	doyeoni	2026-02-16	ydy713@gmail.com					
34	test please	2026-03-17	ydy713@gmail.com					
35	doyeon		ydy713@gmail.com					
36	doyeon		ydy713@gmail.com					
37	minasu		ydy713@gmail.com					
38	mingee	2026-03-14	ydy713@gmail.com					
39	goeun		ydy713@gmail.com			180		
40	yejin	2026-03-17	ydy713@gmail.com	Modern Dark	Suite Room (350	350		
41								

Figure 3. Real-time System Monitoring and Resource Usage Tracking

3. Critical Troubleshooting: Resolving the "Data Integrity" Challenge

The Issue: Null Values in Production Outputs

During initial stress testing, reissued receipts were found with missing **Price** and **Room Category** fields. This resulted in invalid financial documents, a critical failure for merchant-facing services.

Root Cause Analysis (RCA): Schema Mismatch

I identified a **data schema mismatch** in the asynchronous pipeline. The initial "Make Reservation" logic was capturing only identity data (Name/Email) and failing to commit transactional metadata (Price/Category) to the persistent database.

Engineering Solution: Pipeline Re-engineering

1. **Database Schema Optimization:** Expanded the backend schema to include specialized columns for full transactional metadata.
2. **Upstream Logic Refinement:** Re-engineered the Botpress data collection logic to ensure 100% of the required data payload is validated and committed at the first point of contact.
3. **Validation Layer:** Implemented conditional branch logic within the workflow to verify data completeness before triggering the document generation engine.

Outcome

Successfully eliminated the "Empty Field" failure mode, achieving **100% automated data accuracy** and ensuring system robustness for production-scale

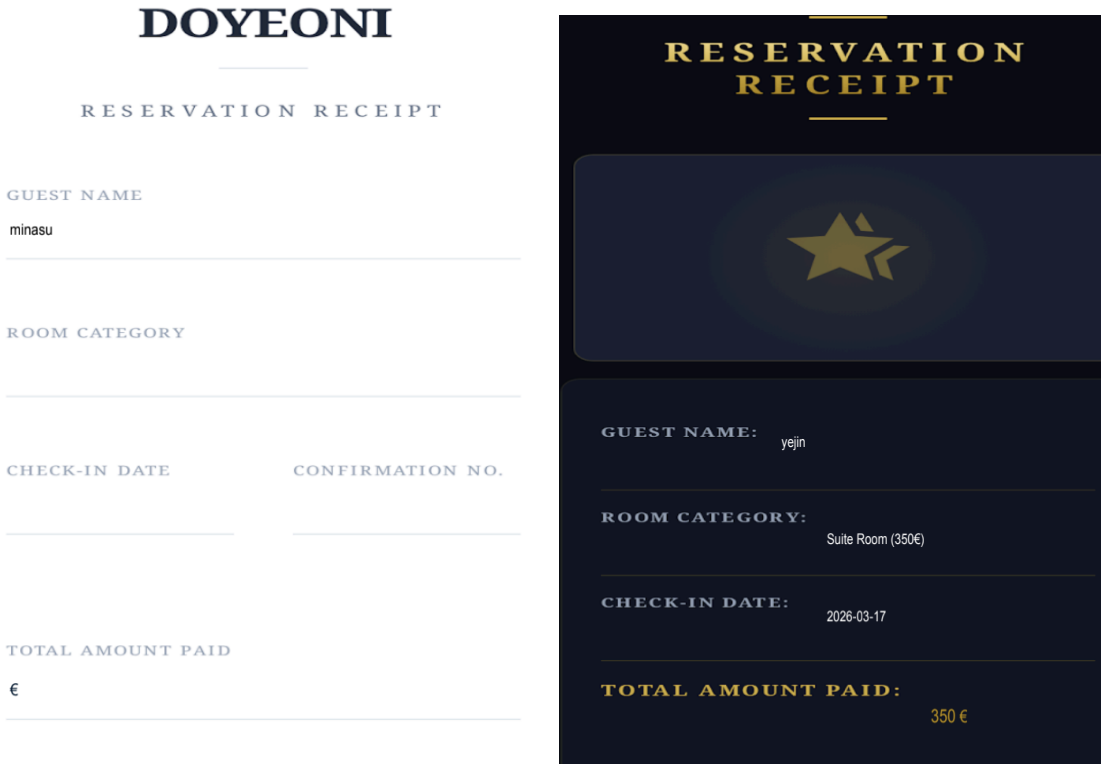

Figure 4. Comparison of Output Integrity: Failed Null Values (Left) vs. Validated Transactional Data (Right)

4. Professional Impact & Scalability

- **Operational Excellence:** Eliminated manual intervention for repetitive merchant tasks, significantly reducing human error and operational latency.
- **Engineering Growth:** Demonstrated the ability to solve complex, ambiguous problems by bridging the gap between operational field experience and technical system implementation.
- **Future Scalability:** The current API-driven architecture is designed to integrate with further ML models for predictive guest insights or advanced revenue management.

5. User Interaction & Intent Classification (Emulator)

Logic Implementation: I designed a **Conversational UI** using the Botpress emulator to classify user intents at the first touchpoint. The system identifies whether a user requires a "New Reservation" or a "Receipt Reissuance" through Natural Language Understanding (NLU).

Dynamic Decision Branching: Based on the identified intent, the pipeline generates specific **JSON payloads** that trigger divergent workflows in the integration layer (Make.com). This ensures that the system only executes the necessary API calls, optimizing resource usage and system response time.

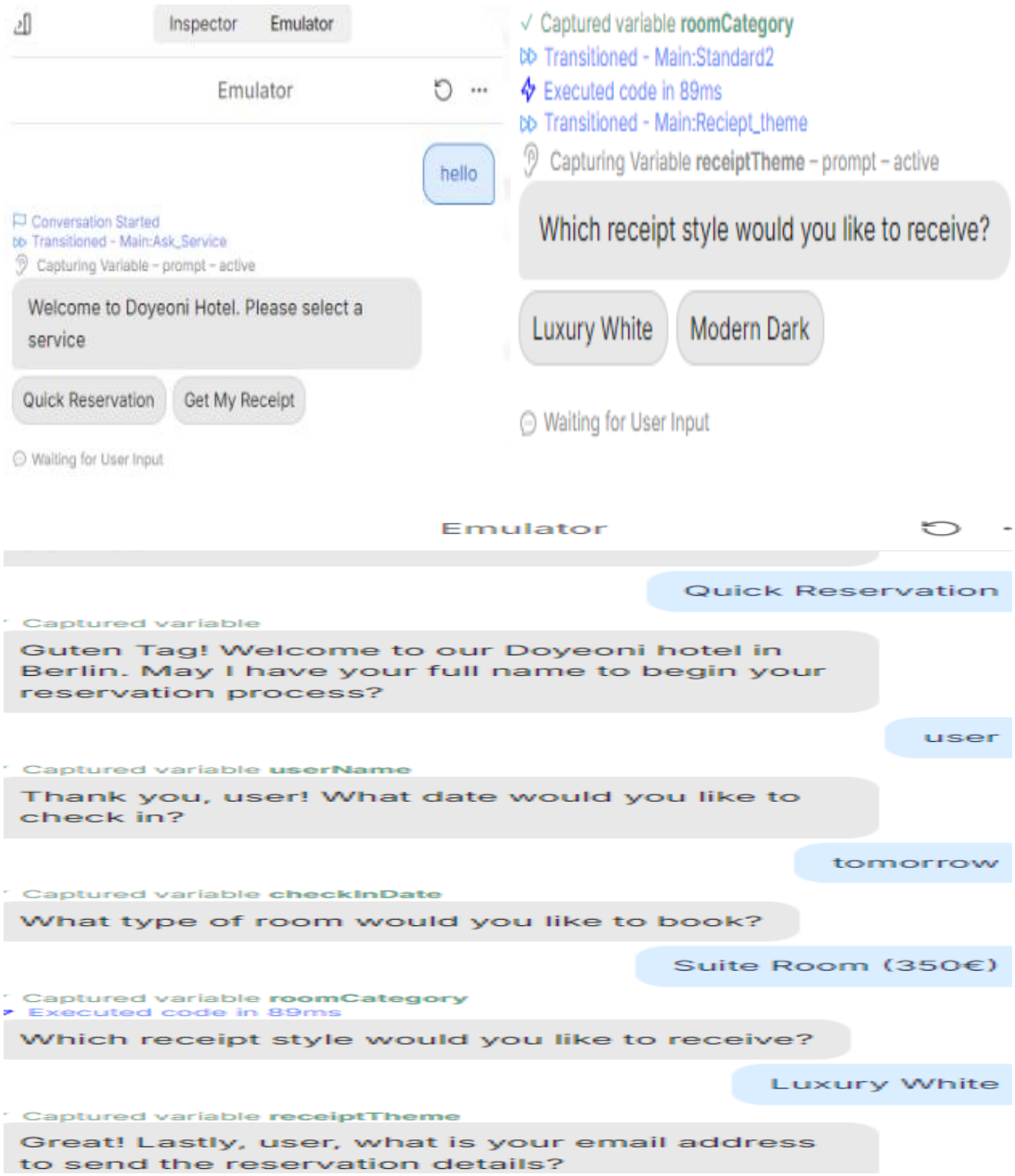

Figure 5. Conversational UI for Intent Classification: Diverging Workflows for New Reservations and Receipt Reissuance

Project Repository & Implementation Details

The full system architecture, logic configurations, and detailed workflow implementation are documented at: github.com/Doyeonyeon/AI-Merchant-Automation-System