TECHNICAL DOCUMENTATION

Project Title : AI-Powered Story Generation and Narration System
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Introduction

- This document provides a technical overview of the AI-Powered Story Generation and Narration System, a full-stack application leveraging generative AI (Gemini 1.5 Flash, Mistral) to create personalized, age-appropriate stories with multilingual support and text-to-speech (TTS) narration.

Problem Statement

- Traditional storytelling tools lack personalization, interactivity, and accessibility, especially for children and teens. There is no widely available mobile solution that allows users to generate custom stories with engaging, age-appropriate narration using AI.

- **Objective:**
  - Maximize user engagement and app retention.

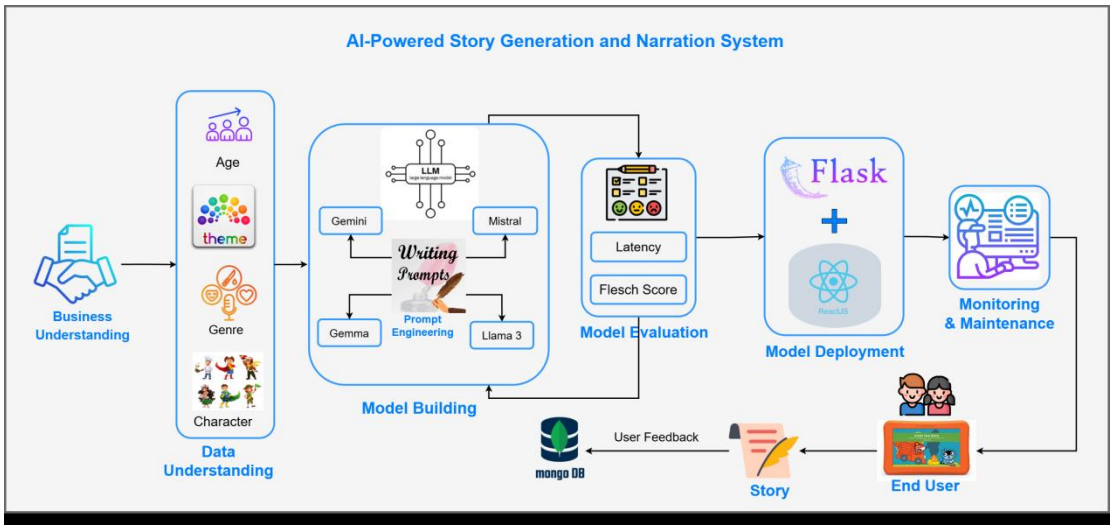
- **Constraints:**
  - Minimize churn

- **Success criteria:**

  - **Business Success Criteria:**
    Achieve 70%+ monthly user retention within 12 months.
  - **ML Success Criteria:**
    Generate coherent, age-appropriate stories with ≥90% user approval.
  - **Economic Success Criteria:**
    10,000 active users and positive unit economics within 12 months.

- Scope:
  - ➢ Real-time story generation using LLMs (e.g., Gemini, Mistral)
  - ➢ Frontend-backend integration
  - ➢ MongoDB data management
  - ➢ Evaluation and monitoring systems

System Architecture



- The system is built on a full-stack architecture:
  - Frontend: React.js
  - Backend: Flask (Python)
  - AI Engine: Gemini 1.5 Flash (Cloud) + Mistral (Local)
  - Database: MongoDB
  - TTS: Google Cloud TTS, ElevenLabs API

Data Understanding

The AI-Powered Story Generation and Narration System primarily relies on user-driven input rather than traditional datasets. Since this project employs prompt-based generation using LLMs instead of training models on labeled data, the data understanding phase involved defining, organizing, and validating user input fields used for generating personalized stories.

- **Data Sources** : -

Input Field	Description
Age Group	Age range of the target user (e.g., 3–8, 9–15, etc.)
Genre	Story type (e.g., comedy, adventure, mystery)
Theme	Moral or message (e.g., honesty, bravery, friendship)
Main Characters	Custom characters input by the user
Language	Desired output language (e.g., English, Telugu, Hindi)

- **Data Mapping and Constraints**

Inputs were mapped manually to enforce constraints, readability standards, and story structure:

Age Group	Target FRE Score Range	Readability Level
3–8	80–100	Easy
9–15	60–80	Moderate
16–19	50–60	Challenging
20+	30–50	Advanced

- **Data Dictionary**

A data dictionary was created to validate and structure user inputs before prompt generation.

Field	Type	Example	Constraints
age_range	String	"9-15"	Must match allowed ranges
genre	String	"Adventure"	Limited to defined genres
theme	String	"Honesty"	Must be meaningful and child-appropriate
characters	List/String	["Ali", "Zebra"]	Max 5 characters
language	String	"Telugu"	Optional

- **Data Flow Diagram**

[User Input (Web UI)]
↓
[Input Validator & Mapper (Flask)]
↓
[Prompt Generator → LLM → Story Output]
↓
[Evaluation: FRE Score, Latency]
↓
[Storage in MongoDB (Story + Metadata)]

Model Building

The system uses prompt-based story generation leveraging large language models (LLMs). No traditional training was done. Instead, model building focused on:

· Selecting and integrating powerful LLMs (cloud + local)

· Designing dynamic prompts

· Validating outputs using readability metrics

- **Models Used**

Model	Type	Usage
Gemini 1.5 Flash	Cloud	Primary model via API for creative and accurate story generation
Mistral	Local (Ollama)	Fallback for offline or quota-restricted use
Gemma / LLaMA 3	Local (Ollama)	Additional support for performance and experimentation

- **Prompt Engineering (Core Logic)**

The prompt includes user inputs (age, genre, theme, characters, language) and ensures story readability using Flesch Reading Ease (FRE) constraints.

Prompt Template

```
prompt = f"""
    Write an imaginative and age-appropriate story for Indian
children aged {age_range}.
```

```
    Requirements:
    - Genre: {genre}
    - Main Characters: {characters}
    - Theme: {theme}
    - Story Length: Maximum 350 words.
    - Use simple, clear English vocabulary and sentence
structure that is suitable for children aged {age_range}.
    - The story MUST be written so that its Flesch Reading
Ease (FRE) score is between {flesch_score}.
    - The Flesch score requirement applies ONLY to the English
story.
    - DO NOT include any translation, non-English words, or
translation labels in the English story section.
    - Avoid complex words and long sentences for younger ages;
use more advanced language for older ages.
    - Include a catchy, relevant title at the beginning.
    - End with a moral in the format: Moral: [your moral]
```

```
    - **Do NOT add any label like 'English Story:' or similar.
Only use 'Title:', the story text, and 'Moral:' as shown
below.**
```

```
    Format:
    Title: [Your title]
    [Story text]
    Moral: [your moral]
    """
```

```
    if age_range in ["3-5", "3-8"]:
        prompt += (
            "\n- IMPORTANT: The story MUST have a Flesch
Reading Ease (FRE) score between 80 and 100."
            "\n- Use normal words and keep medium sentences
(6-9 words each)."
            "\n- Avoid any very easy or very complex
vocabulary."
            "\n- Imagine you are writing for a 3–8 year old
who is just learning to read."
            "\n- If the story is  very easy or more difficult,
REWRITE it until it fits the FRE score range."
            "\n- Do NOT write a story that is outside this FRE
score range."
            "\n- If you cannot write a story within this FRE
range, DO NOT RETURN ANY STORY."
        )
    elif age_range in ["9-15"]:
        prompt += (
            "\n- IMPORTANT: The story MUST have a Flesch
Reading Ease (FRE) score between 60 and 80."
            "\n- The FRE score must NEVER be above 80 or below
60 for this age group."
            "\n- Use simple and clear words."
            "\n- Keep sentences short (10–14 words) and easy
to understand."
            "\n- Avoid difficult vocabulary and long
sentences."
            "\n- Do not use advanced or academic words."
            "\n- Imagine you are writing for a school student
aged 9 to 15."
```

```
            "\n- If the story is too easy or too hard, or if
the FRE score is outside 60-80, REWRITE it until it fits the
FRE score range."
            "\n- You absolutely MUST NOT write a story with a
Flesch score above 80 or below 60."
            "\n- Do NOT write a story that is outside this FRE
score range."
            "\n- If you cannot write a story within this FRE
range, DO NOT RETURN ANY STORY."
            "\n- EVEN WHEN TRANSLATING TO ANOTHER LANGUAGE,
NEVER GO OUTSIDE THE FRE SCORE RANGE OF 60-80."
            "\n- Repeat: The story (and any translation) MUST
have a Flesch Reading Ease (FRE) score between 60 and 80."
        )
    elif age_range in ["16-19"]:
        prompt += (
            "\n- IMPORTANT: The story MUST have a Flesch
Reading Ease (FRE) score between 50 and 60."
            "\n- Use clear language with some moderately
advanced vocabulary."
            "\n- Keep most sentences between 10 and 16 words."
            "\n- Mix simple and moderately complex sentences,
but avoid very long or academic sentences."
            "\n- Do not use too many advanced words."
            "\n- Write as you would for a high school student
aged 16 to 19."
            "\n- If the story is too easy or too hard, REWRITE
it until it fits the FRE score range."
            "\n- Do NOT write a story that is outside this FRE
score range."
            "\n- If you cannot write a story within this FRE
range, DO NOT RETURN ANY STORY."
        )
    elif age_range in ["20+"]:
        prompt += (
            "\n- IMPORTANT: The story MUST have a Flesch
Reading Ease (FRE) score between 30 and 50."
            "\n- Aim for a FRE score between 40 and 45. Do NOT
write a story with a FRE score below 35 or above 45."
            "\n- Use advanced vocabulary, medium sentences,
and  complex sentence structures."
            "\n- Do not simplify the language. Write as you
would for college students or adults."
```

```
            "\n- If the story is very too easy (FRE > 50) or
very too hard (FRE < 30), REWRITE it until it fits the FRE
score range."
            "\n- Do NOT write a story that is outside this FRE
score range."
            "\n- If you cannot write a story within this FRE
range, DO NOT RETURN ANY STORY."
            "\n- If you do not follow the FRE rule, your
answer will be rejected and regenerated."
        )
```

```
    if language and language.lower() != "none":
        lang_key = language.lower()
        labels = label_map.get(lang_key, {
            "title": "Title",
            "story": "Story",
            "moral": "Moral"
        })
        prompt += f"""
```

```
After you have finished the English story above, translate
ONLY the English story and its moral into {language} for
Indian children.
```

```
**Translation Instructions:**
- Do NOT translate word-for-word. Use natural, fluent, and
child-friendly {language} as used in everyday conversation.
- Ensure the translated story is easy for children in the
target age group to understand.
- Use age-appropriate vocabulary and grammar for {language}.
- Do NOT include any English words unless they are proper
nouns.
- Write ONLY the translated version, using these labels
(translated in {language}):
    - {labels['title']}: [Translated title]
    - {labels['story']}: [Translated story]
    - {labels['moral']}: [Translated moral]
- DO NOT repeat the English story or moral.
- DO NOT include any English text in this section (except
proper nouns).
- Structure:
    {labels['title']}: [Translated title]
    {labels['story']}: [Translated story]
```

```
    {labels['moral']}: [Translated moral]
- Even when translating to {language}, ensure the story would
have a Flesch Reading Ease (FRE) score in the same range as
required for English. Do NOT make the translation easier or
harder than the English version. Do NOT go outside the FRE
range for the selected age group, even in translation.”””
```

- **Local Model Integration (Ollama)**

Step 1: Install Ollama

For Windows/Mac/Linux

Visit: https://ollama.com

Bash

 # Linux/macOS (with curl)

curl -fsSL https://ollama.com/install.sh | sh

 # Windows: Download the EXE and follow setup

Step 2: Pull Models Locally

Bash

ollama pull mistral

ollama pull gemma:2b

ollama pull llama3

Step 3: Run Ollama Server

Bash

ollama run mistral

You’ll get an interactive prompt. Or for API use:

4. Gemini API Setup (Google Generative AI)

Step 1: Sign Up for API Access

Go to: https://makersuite.google.com/app

- Sign in with Gmail
- Click on Get API Key
- Copy the key

Step 2: Install SDK

Bash

```
pip install google-generativeai
```

Step 3: Use Gemini 1.5 Flash via API

Python

```
import google.generativeai as genai

genai.configure(api_key="YOUR_GEMINI_API_KEY")

model = genai.GenerativeModel('gemini-1.5-flash')

response = model.generate_content(prompt)

print(response.text)
```

Input Labels:

Age, Genre, Character, Theme

Age Range	Label	Target Flesch Score	Reading Difficulty
3-8	Early Readers	80–100	Easy
9–12	Pre-teens	70–80	Fairly Easy
13–15	Young Teens	60–70	Standard
16–18	Older Teens	50–60	Fairly Difficult
19+	Adults	30–50	Difficult

Evaluation

The evaluation phase focused on verifying the quality, readability, performance, and structure of generated stories. Since no supervised training was performed, traditional ML evaluation metrics were replaced by content-specific quality checks.

- **Evaluation Goals**
  - Ensure readability using Flesch Reading Ease (FRE)
  - Maintain story structure (Title, Body, Moral)
  - Minimize generation latency
  - Collect and analyze user feedback
  - Track issues using a custom Performance & Suitability Index (PSI)

- **Readability Assessment — Flesch Reading Ease (FRE)**

The FRE score is a standard readability formula used to assess whether generated stories are appropriate for the target age group.

Formula:

$$FRE=206.835-(1.015\times ASL)-(84.6\times ASW)$$

Where:

ASL = Average Sentence Length (words per sentence)

ASW = Average Syllables per Word

Implemented using textstat Python Library:

```
python
from textstat import flesch_reading_ease

score = flesch_reading_ease(story_text)
```

- **Performance Metrics**

Metric	Target	Tools
Latency	≤ 15 seconds	Timestamp tracking in Flask
Story Length	250–350 words	Word count validator
FRE Score	Must be in age-appropriate range	textstat
PSI Score	Should be < 50 for healthy output	Custom formula

- **Performance & Suitability Index (PSI)**

A composite score to measure story suitability and trigger drift warnings

Formula:

$$PSI=(0.3\times Speed)+(0.4\times FRE)+(0.3\times LengthNormalized)$$

PSI > 50 → Flagged as drift in MongoDB (psi_warning_collection)

- **Challenges and Mitigation**

Challenge	Mitigation
LLMs generating stories outside FRE range	Prompt constraints + regeneration logic
Subjective quality of morals	Manual reviews + user feedback
Latency spikes from Gemini	Fallback to local models (Mistral)
Format deviation (missing Title/Moral)	Regex parsing + structure enforcement

Deployment

The AI-powered story generation system is deployed as a full-stack application using Flask (backend), React.js (frontend), and MongoDB (database). It supports both cloud-based LLMs (Gemini 1.5 Flash) and local models (Mistral, Gemma, LLaMA via Ollama) with Text-to-Speech integration.

- **Technology Stack Overview**

Layer	Tools/Technologies
Frontend	React.js, HTML, CSS, JS
Backend	Flask (Python)
Database	MongoDB (local or Atlas)
LLMs	Gemini 1.5 Flash (cloud), Mistral/Gemma (local via Ollama)
TTS	Google Cloud TTS, ElevenLabs API
Monitoring	Power BI (optional)

- **Backend Setup (Flask)**

Prerequisites

Python 3.10+

requirements.txt file with dependencies like Flask, pymongo, textstat

bash

 # 2. Create virtual environment

python -m venv venv

source venv/bin/activate # Windows: venv\Scripts\activate

 # 3. Install dependencies

pip install -r requirements.txt

 # 4. Add Gemini API key and Mongo URI in config.py

 # Example config.py

GEMINI_API_KEY = "your_api_key"

MONGO_URI = "mongodb://localhost:27017/"

Run the Flask Server

bash

python app.py

Server runs at: http://localhost:5000

- **Frontend Setup (React.js)**

Prerequisites

Node.js & npm (Download from https://nodejs.org)

Steps

bash

 # 1. Go to frontend folder

cd storygen/frontend

 # 2. Install dependencies

npm install

 # 3. Start development server

npm start

Runs at: http://localhost:3000

Connect to Flask Backend

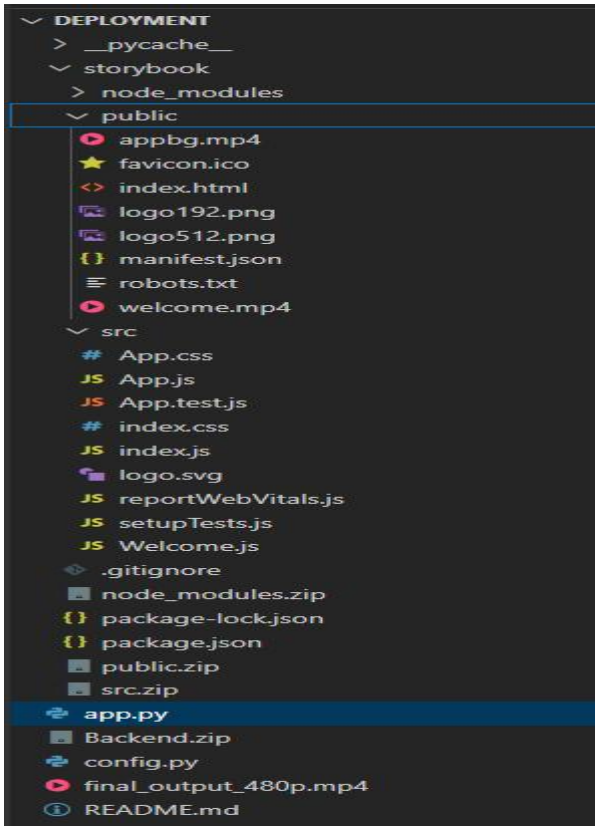
React fetches from Flask at http://localhost:5000. Ensure CORS is handled in Flask:

python

from flask_cors import CORS

CORS(app)

- **Final Folder Structure**



Power BI Integration and Monitering

To monitor content quality, system performance, and user engagement, Power BI was used for building interactive dashboards. It provides real-time visualization of FRE scores, latency, PSI drift, and user feedback.

Objectives

- Track story readability by age group
- Monitor average latency across themes/genres
- Detect content drift using PSI thresholds
- Analyze user ratings and feedback

MongoDB to Power BI Integration

Required Tools:

- MongoDB (local or Atlas)
- Python (for ETL)
- Power BI Desktop

Repeat this for other collections like psi_warning_collection or login_logs_collection.

Load CSV into Power BI

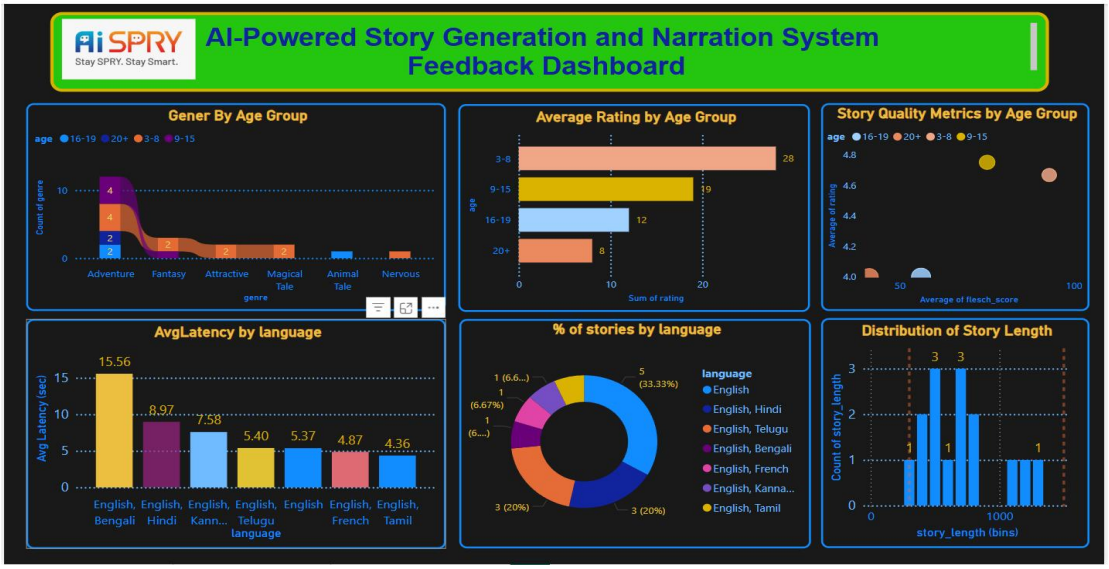
Open Power BI Desktop

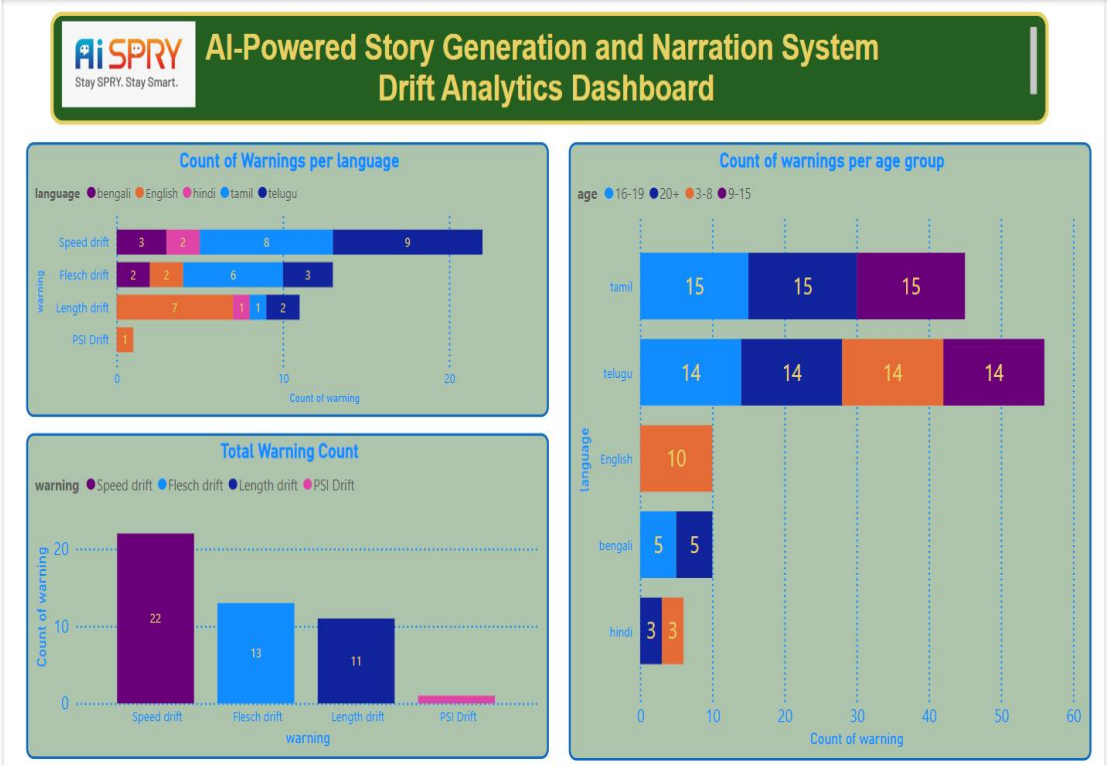
Click “Get Data” → “Text/CSV”

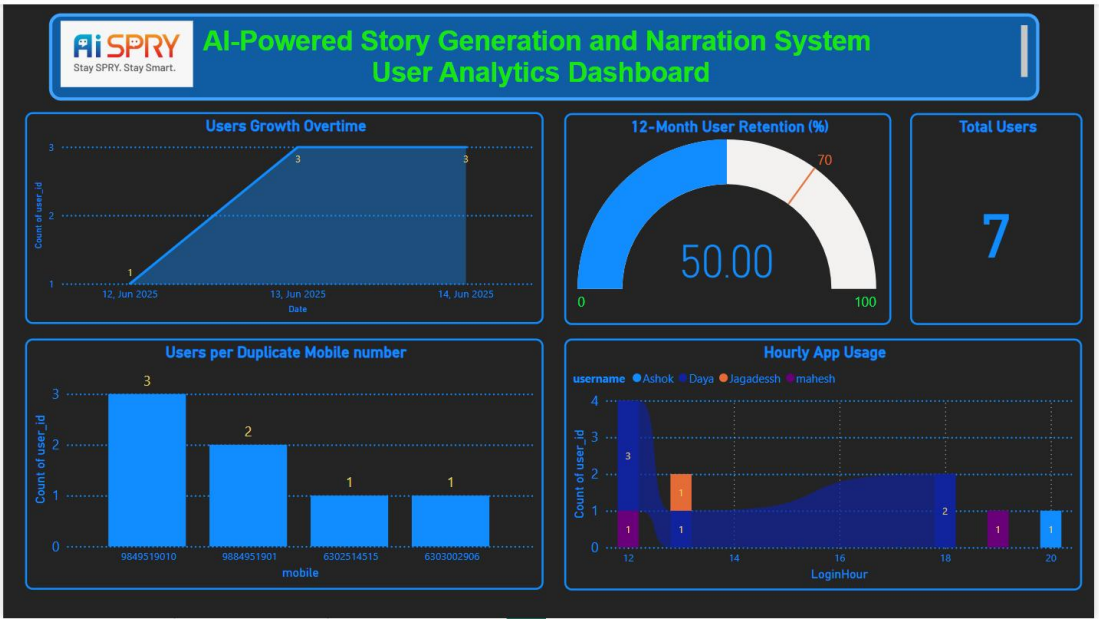
Load feedback_data.csv, psi_data.csv, etc.

Click “Transform Data” to clean and format fields

Key Dashboards & Visuals







ETL Script (Python + PyMongo → CSV)

Python:

```
from pymongo import MongoClient
import pandas as pd
# Connect to MongoDB
client = MongoClient("mongodb://localhost:27017/")
db = client["storygen_db"]
# Example: Load feedback collection
collection = db["feedback_collection"]
data = list(collection.find())
df = pd.DataFrame(data)
# Clean up and export to CSV
df.drop(columns=["_id"], inplace=True, errors="ignore")
df.to_csv("feedback_data.csv", index=False)
```

To achieve and visualize 70%+ monthly user retention within 12 months using Power BI Gauge Chart, follow this complete step-by-step implementation using your login logs.

Goal:

Use a Gauge chart to track and visualize the percentage of users retained monthly for the past 12 months with a target of ≥ 70%.

STEP 1: Load Data into Power BI

Open Power BI.

Click Home → Get Data → Text/CSV.

Load your login data CSV.

In Power Query, ensure your data looks like:

user_id datetime username password device_type

STEP 2: Format the Date Column (Power Query)

In Power Query:

Right-click on datetime → Change Type → Date/Time

Create a new column (optional but preferred for clean logic):

Add Column → Date → Date Only

Name it login_date

Click Close & Apply

STEP 3: Create Calculated Table – UserFirstLogin

Go to Modeling → New Table:

```dax
UserFirstLogin =
SUMMARIZE(
    LoginData,
    LoginData[user_id],
    "FirstLogin", MIN(LoginData[login_date])
)
```

STEP 4: Create Retention Mapping Table

This maps every login within 12 months of first login.

Go to Modeling → New Table:

```dax
RetentionMapping =
GENERATE(
    SELECTCOLUMNS(
        UserFirstLogin,
        "uf_user_id", [user_id],
        "FirstLogin", [FirstLogin]
```

```
    ),
    FILTER(
        LoginData,
        LoginData[user_id] = [uf_user_id] &&
        DATEDIFF([FirstLogin], LoginData[login_date], MONTH)
<= 11
    )
)
```

STEP 5: Add MonthDiff Column

Go to RetentionMapping → New Column:

```
dax
MonthDiff = DATEDIFF([FirstLogin], [login_date], MONTH)
```

STEP 6: Create Retention Measure

Go to Modeling → New Measure:

```
dax
Retention12MonthPercent =
VAR BaseUsers =
    CALCULATE(
        DISTINCTCOUNT(RetentionMapping[uf_user_id]),
        RetentionMapping[MonthDiff] = 0
    )

VAR RetainedUsers =
    CALCULATE(
```

```
    DISTINCTCOUNT(RetentionMapping[uf_user_id]),
    RetentionMapping[MonthDiff] = 11
  )

RETURN
DIVIDE(RetainedUsers, BaseUsers, 0) * 100
```

STEP 7: Create the Gauge Chart

In Report View, select the Gauge visual.

Assign fields:

Value → Retention12MonthPercent

Target value → 70

Min → 0

Max → 100

Show data label as percentage

Result

You'll see a gauge showing % of users retained after 12 months.

For it to work:

You must have:

At least some users with MonthDiff = 11

First logins (MonthDiff = 0)

If your dataset has only recent dates (like June 2025), you won't see any MonthDiff = 11. Use sample data or wait until data accumulates.

Challenges

Data Understanding

Challenge	Mitigation
No publicly available datasets	Used user-input-driven system and created a data dictionary manually
Mapping age groups to readability (FRE)	Created custom FRE brackets using multiple academic sources
Ambiguous user inputs (e.g., complex characters or themes)	Used dropdowns and validation at frontend to limit inputs

Model Building (Prompt Engineering)

Challenge	Mitigation
FRE score not matching age group	Enforced FRE range directly inside the prompt + regenerated up to 3 times
Output format inconsistent (Title, Story, Moral missing)	Strict regex-based parsing and clear prompt structure instructions
Gemini API rate limits / latency	Integrated fallback models (Mistral, Gemma via Ollama)
Language translation drift (loss of meaning or readability)	Used language-specific labels and added FRE-based constraints in translated prompts
Incoherent or weak morals in stories	Reinforced age-specific moral clarity with strict prompt guidance

Deployment

Challenge	Mitigation
Gemini API rate limiting during peak hours	Added secure API key management with retry logic + offline model fallback
Latency beyond 15 sec	Monitored generation time and routed to

Challenge	Mitigation
during high load	local models if delay is detected

Monitoring & Maintenance

Challenge	Mitigation
Hard to track which stories failed or drifted	Stored drift logs (PSI, FRE violations) in psi_warning_collection
Limited observability of user behavior	Integrated Power BI for feedback, FRE score trends, and usage analytics
Need for modular upgrades (e.g., mobile app later)	Designed API and frontend as loosely coupled components for scalability

- **Future Enhancements**
  - Docker containerization
  - CI/CD integration
  - Mobile app version
  - Image/video generation (multimodal)
  - Advanced voice synthesis

- **Contact**

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