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**DOMAIN 3:**

**ECONOMIC EMPOWERMENT THROUGH AI**

**GRABBUDDY – A CONTEXT-AWARE VOICE ASSISTANT FOR SAFER AND SMARTER DRIVING**

**Table of Contents**

[**1.0 Introduction** 3](#_Toc195387272)

[**2.0 Problem Statements & Objectives** 3](#_Toc195387273)

[**3.0 Solution Overview** 4](#_Toc195387274)

[**4.0 Architecture Diagram & User Interaction Flow** 5](#_Toc195387275)

[**5.0 Data Utilization** 6](#_Toc195387276)

[**6.0 Component Descriptions** 7](#_Toc195387277)

[**7.0 Key Features & Modules** 8](#_Toc195387278)

[**1. Trip-Aware Voice Assistant** 8](#_Toc195387279)

[**2. Accent Personalization** 9](#_Toc195387280)

[**3. Noise-Aware Listening Mode** 9](#_Toc195387281)

[**4. Partial Input Recovery (Smart Guessing)** 9](#_Toc195387282)

[**5. Companion Personality** 9](#_Toc195387283)

[**6. Driver Performance Tips** 10](#_Toc195387284)

[**7. Safety Voice Alerts** 10](#_Toc195387285)

[**8. UI** 10](#_Toc195387286)

[**8.0 Core Functions Summary** 11](#_Toc195387287)

[**9.0 Tech Stack** 12](#_Toc195387288)

[**10.0 Current & Figma Prototype** 12](#_Toc195387289)

[**11.0 Future Work** 12](#_Toc195387290)

[**12.0 Demo Video** 13](#_Toc195387291)

**1.0 Introduction**

GrabBuddy is a hands-free, voice-controlled AI assistant for Grab drivers (DAX). It allows drivers to operate the system using just voice, creating safer and more convenient trips. GrabBuddy is fin-tuned for Southeast Asian environments and takes in typical driving commands with voice responses that do not require physical contact. Although assistant branding incorporates the words "Hey Buddy," the current prototype invokes voice input via button press, as opposed to passive voice detection.

# **2.0 Problem Statements & Objectives**

**Problem Statement:**

* Safety risks from physically interacting with the app while driving.
* Not being able to use voice commands in heavy traffic or during rain.
* Failure to understand local accents such as Malaysian English, Singlish, or Taglish.
* Lack of personalized support based on driving behaviour or context (e.g., pickup vs. idle).
* Lack of intelligent voice assistant that adapts to the different stages of a trip.

These limitations affect driver productivity and road safety, especially in Southeast Asian conditions.

**Objectives:**

* Enables drivers to make safe conversation using voice during trips
* Offers contextually appropriate information while driving (e.g., pickup, on the way)
* Processes incomplete voice commands and Southeast Asian accents
* Gives positive feedback, performance advice, and safety reminders

# **3.0 Solution Overview**

GrabBuddy contains the following modules:

• **ASR**: Voice Input – captures and speech-writes out driver voice utilizing Vosk speech recognition engine.

• **Intent Recognition**: Identifies driver intent based on transcribed text (e.g., "How much income today?

• **Context Awareness**: Dynamically adjusts accessible commands and responses as a function of trip stage.

• **TTS**: Voice Output – responds via natural speech by means of text-to-speech.

• **Smart Companion Logic**: Comprises performance summaries, reminders, and safety alerts.

• **User Interface**: Simulated ususing Kivy, with buttons, status indicators, and label-based feedback.

# **4.0 Architecture Diagram & User Interaction Flow**

A screenshot of a computer program

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Figure : System Architecture

The GrabBuddy system architecture is a lean voice interaction pipeline. It starts from the microphone, where the voice of the driver is detected and processed by the Speech-to-Text (STT) module using Vosk into text. This text is forwarded to the Intent Logic, where the assistant resolves the driver's intent. The Application Core processes this intent, updates the UI, and sets a response. That response is then converted to speech by the Text-to-Speech (TTS) engine and read aloud through the speaker. The User Interface (UI) ties all layers together by providing real-time feedback on different screens like Home, Contact, and Map. This modular flow causes GrabBuddy to operate in a natural, responsive, and hands-free way.

A diagram of a software development process

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Figure : User Interaction Flow

The conversation begins when the driver touches the "Hey Buddy" button on the screen. It causes the system to start listening using the microphone. The "Call Hey Buddy” button mimics a wake word by hand. The assistant won't begin to listen until the user clicks on the button, rather than capturing the phrase by ear. The captured voice is sent to the Speech-to-Text (STT) module, which transcribes it into text. The text is interpreted by the Intent Engine to discover what the user wishes to command. Following the pairing, the App Core generates an ensuing response, refreshes the user interface, and sends the message to the Text-to-Speech module, which verbalizes it through the speaker. Finally, the voiced response is played out, completing the hands-free process.

# **5.0 Data Utilization**

GrabBuddy handles user data to enable real-time voice interaction. The assistant takes in microphone input and converts it to text through Vosk, and this is processed by an intent recognition engine to determine appropriate actions. System state such as the stage of the trip (e.g., idle, pickup) is tracked internally to restrict or permit context-dependent commands. Driver performance reports (e.g., completed trips, revenue) are fake data now, but future releases can dynamically pull this. All are done locally with saved preferences and trip reports in JSON format. No user information is saved or transmitted remotely in this version.

# **6.0 Component Descriptions**

**1. Voice Input Layer**

•Captures real-time voice commands through a microphone.

•Captures audio through sounddevice.

**2. Speech Recognition Module**

•Transcribes spoken input to text through:

* Vosk for multilingual & accent-robust transcription
* lightweight, offline operation

**3. Intent Detection Engine**

•Maps phrases to pre-defined commands through:

* Rule-based pattern matching
* Fuzzy logic (e.g., fuzzywuzzy) for partial input recovery

**4. Trip Context Manager**

•Detects current trip status of driver (idle, pickup, enroute, drop-off)

•Suppresses permitted commands depending on trip status

•Provides system reminders (e.g., "Take a break" after X trips)

**5. Noise-Aware Listener**

•Passively detects decibel level while in the background

•Reaction to changes in system behavior:

* Slows down TTS
* Makes things louder
* Confirms intent amid loud noises

**6. Companion Logic & Feedback Engine**

•Imparts human-like behaviour:

* Encouragement positivity
* Learning summaries about performance
* Safety advise depending on duration or time of day

**7. Text-to-Speech (TTS) Engine**

• Converts system output to voice output

* pyttsx3 (offline, cross-platform)
* Optional fallback: gTTS (Google TTS, online)

**8. Front-End Simulation**

* Kivy UI

Provides:

* Button-based quick actions
* Dynamic text display for guidance and response
* Listening status bar
* Integrated map and contact view per phase

# **7.0 Key Features & Modules**

## **1. Trip-Aware Voice Assistant**

**Purpose**: Adjusts assistant behaviour based on the driver’s current trip phase.

**States**: idle, pickup, enroute, drop-off

* During pickup allows “ETA to passenger”, blocks “drop-off review”
* During enroute: supports “traffic update”, “re-route”, etc.
* After drop-off offers trip summary or rest suggestion

*Example*: "You’re on the way to your passenger. It’s a 6-minute drive with light traffic."

## **2. Accent Personalization**

Purpose: Supports drivers with different SEA backgrounds by allowing the assistant to support multiple English dialects (e.g., Malaysian English, Singlish, Taglish).

• Accent or auto-detect accent mode (e.g., accent\_mode = "my\_en")

• Intent dictionary and phrasing adaptation

• Colloquial phrase matching like:

* "Pickup liao?" → "Passenger has been picked up."

## **3. Noise-Aware Listening Mode**

**Purpose:** Capturing high ambient noise (traffic, rain) and adapting interaction style.

• Monitors real-time decibel level through sounddevice and NumPy

• When noise is above threshold (e.g., 80 dB):

* Shortens responses
* Slows TTS
* Asks to repeat unclear inputs

Example: "It's a bit noisy—can you repeat that?"

## **4. Partial Input Recovery (Smart Guessing)**

**Purpose:** Ensures assistant to guess noisy or incomplete inputs.

• Leverages keywords and fuzzy logic (fuzzywuzzy)

• Context-sensitive guesser (takes advantage of current trip phase to determine meaning)

**Example:** Input: "ETA. destination?"

**Response:** "Estimated time to your drop-off is 9 minutes."

## **5. Companion Personality**

**Purpose**: Makes the assistant sound friendly, supportive, and human.

* Random supportive phrases
* Personalized greetings based on time or trip count
* Custom voice identity (e.g., named “Buddy” or “GrabPal”)

***Example*:** "Morning! Let’s start the day strong."

## **6. Driver Performance Tips**

**Purpose**: Gives a motivational summary of driving stats after a few trips.

**Data (mock)**:

* Number of trips
* Average ETA
* Passenger ratings
* Tips earned

*Example*: "You’ve completed 3 rides today! Great job! Your average trip time was 6 minutes."

## **7. Safety Voice Alerts**

**Purpose**: Prevents fatigue or burnout by monitoring driving duration and trip count.

**Triggers**:

* 3 consecutive trips without break
* Extended driving session (e.g., >2 hours)
* Voice fatigue patterns (optional advanced feature)

*Example*: "You’ve been driving for a while. Would you like to rest?"

## **8. UI**

**Purpose**: Simulates how the assistant would look and behave in a real car system.

Kivy app

**Features:**

* Voice input
* Text display
* Trip status toggle
* Real-time mic noise level
* Assistant response box

*Demo Example*: An animated "Start Trip" button toggles state to pickup → voice command initiates ETA check → output is vocalized + displayed on screen.

# **8.0 Core Functions Summary**

|  |  |
| --- | --- |
| Functions | **Description** |
| Voice Command Recognition (Quiet) | Provide commands like "Where is my next pickup?" in a soundproof room |
| Intent Detection | Verify that commands are being properly matched to intended actions |
| Text-to-Speech Output | After command is processed, assistant speaks the response aloud |
| Trip Phase Logic | Change trip phase (Idle, Pickup, Enroute, Drop-off) and provide context-based commands |
| Noise Resilience | Replay rain traffic sound on command input |
| Accent Handling | Test normal local speech patterns ("pickup liao", "ETA my place") |
| Partial Input Recovery | Provide incomplete sentence like "ETA. destination?" |

# **9.0 Tech Stack**

|  |  |  |
| --- | --- | --- |
| **Layer** | **Tool/Library** | **Purpose** |
| Audio Input | sounddevice | Captures and processes microphone input |
| ASR (Speech-to-Text) | Vosk | Transcribes spoken commands into text |
| NLP / Intent Matching | re, Python dicts | Recognizes user intent from partial or accented input |
| Noise Detection | sounddevice, NumPy | Analyses ambient noise to trigger adjustments |
| Text-to-Speech | pyttsx3, gTTS (fallback) | Speaks assistant responses aloud |
| UI (optional) | Kivy | Simulated car dashboard interface |
| Data Handling | JSON | Stores user trips, summaries, preferences |

# **10.0 Current & Figma Prototype**

# **11.0 Future Work**

To evolve GrabBuddy into a production-ready voice assistant, the following enhancements are proposed:

Note: The following features are proposed for future development and are **not implemented** in the current preliminary round prototype.

1. **Wake Word Activation ("Hey Buddy")**

* Enables true hands-free functionality
* Firmly aligned with your safety-first mission

1. **Multilingual/Mixed Input Support (e.g., English + BM)**

* Even straightforward phrase recognition in Bahasa can show local relevance
* Update intent dictionary accordingly

1. **UI Refinement Based on Figma**

* Enhanced usability
* Streamline buttons, response display, and instructions

# **12.0 Demo Video**