# **Natural Language Processing(NLP), Speech Recognition, and Speech Synthesis**

# To give more precise mental health diagnosis, DiagnoSmart integrates Natural Language Processing (NLP), Speech Recognition, and Speech Synthesis as leading technologies. The features allow the system to read patient data typed in by nurses from patient records, make sense of it, and give actionable knowledge. Instead of particular depression and anxiety, DiagnoSmart can diagnose a mix of conditions like stress, burnout, post-traumatic stress disorder (PTSD), and bipolar disorder. The broader context ensures that the platform is tailored to different patient needs, hence making it a reliable support instrument in healthcare environments.

**NLP** plays a central role by processing clinical notes and transforming them into structured insights.It applies techniques such as tokenisation, stop-word removal, and lemmatisation to sanitise the text, while sentiment analysis enables identification of emotional tone in patient descriptions. More importantly, keyword and pattern extraction enables the system to recognise specific clinical words such as "nightmares," "fatigue," "hopeless," "panic," or "detached," which are contributed to by several mental health disorders. For example, repeated references to nightmares and avoidance may point towards PTSD, while exhaustion and motivational deficiency attributions may be signs of burnout. By combining the identification of targeted keywords with sentiment analysis, DiagnoSmart provides an end-to-end solution to identifying risk factors between different conditions.

**Speech Recognition** also streamlines the workflow by enabling nurses to dictate patient notes rather than writing them down manually. This raises productivity, reduces documentation error, and ensures that appropriate clinical details are captured. DiagnoSmart uses the Google Speech API with the SpeechRecognition library for this feature, leveraging internet-based accuracy for correct transcription.

**Speech Synthesis** creates audible summaries of the AI findings. Voice feedback such as: "Anxiety and PTSD symptoms were noticed in patient records. It is recommended to check further." can be received by nurses. To accomplish this, DiagnoSmart employs gTTS (Google Text-to-Speech), which provides natural cloud-based speech output as MP3. This provides a high-quality sound experience without being overly difficult to use with Python.

Python has a strong ecosystem for these features. TextBlob is used for NLP since it's easy to use and also features sentiment analysis out of the box. SpeechRecognition with Google Speech API is used for speech-to-text as the cloud-based solution. gTTS is used for text-to-speech to enable natural-sounding audio. Together, these libraries enable DiagnoSmart to be effective, workable, and yield high-quality feedback in clinical healthcare environments.