Alart App to detect acute phase of schizophrenia ; using GPT4 and BERT based LLM

USB

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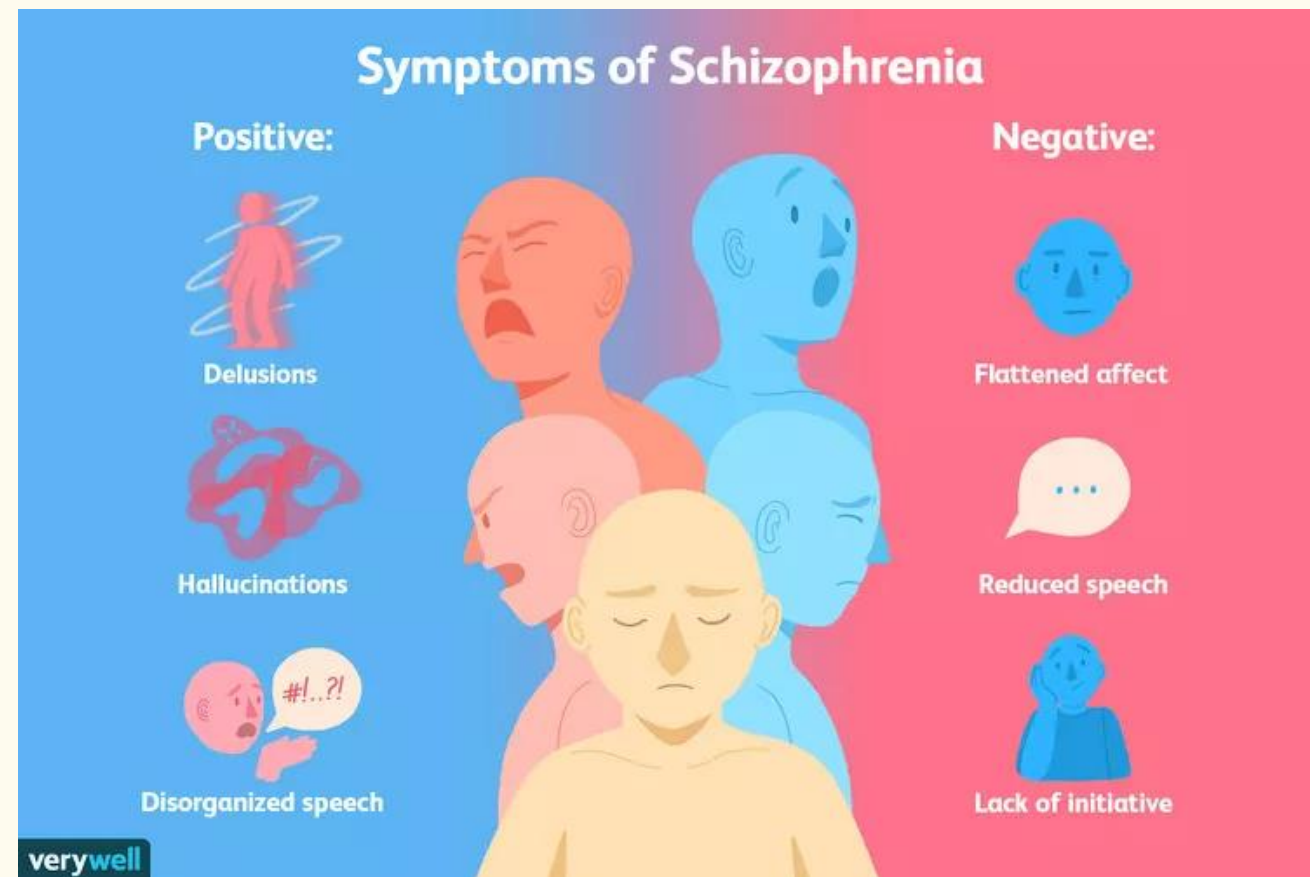
CMO : Wooseong Jeon, Seungyeon Kim

Contents

01 Problem

Inappropriate responses from people around the schizophrenia patient

- Overstimulation may escalate into an emergency situation.
- Without proper intervention, the period of patient's distress can extend.

The progression of the disease due to the failure of early intervention

Correll CU, Galling B, Pawar A, et al. Comparison of Early Intervention Services vs Treatment as Usual for Early-Phase Psychosis: A Systematic Review, Meta-analysis, and Meta-regression. JAMA Psychiatry. 2018;75(6):555–565. doi:10.1001/jamapsychiatry.2018.0623

Dissease progresses to the point where negative symptoms become apparent because **early detection is often missed**, as demonstrated in studies.

02 Solution_USCHIB

Service Frame

voice detection
&
LLM prediction

Schizo-Patient

Family

Friend

Expected effect

Early intervention leads to better patient outcomes
and **improved prognosis**.

Enables appropriate and effective responses

-removing dangerous objects nearby
-avoiding overstimulating the patient
-Calling emergency services (119)

03 Market analysis

The Journal of
Clinical Psychiatry
CELEBRATING 85 YEARS

ORIGINAL RESEARCH

The Economic Burden of Schizophrenia in the United States

Aditi Kadakia, MS[a],*; Maryaline Catillon, PhD[b]; Qi Fan, MS[a]; G. Rhys Williams, PhD[a]; Jessica R. Marden, ScD[c]; Annika Anderson, MPH[b]; Noam Kirson, PhD[c]; and Carole Dembek, MS[a]

Published: October 10, 2022

Calzavara Pinton, I., Nibbio, G., Bertoni, L., Cicale, A., Necchini, N., Zardini, D., Bosco Ubertino, U., Cerati, C., Deste,G., Barlati, S., & Vita, A. (2024). The economic burden of schizophrenia spectrum disorders: Clinical and functional correlates and predictorsof direct costs. Psychiatry Research, 324, Article 116240. https://doi.org/10.1016/j.psychres.2024.116240

03 Market analysis

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CONCLUSION

The estimated societal burden of schizophrenia in the US in 2019 was $343.2 billion, representing a 100.9% increase in the estimated burden from 2013 to 2019 (inflation adjusted). Indirect costs contributed the most to the overall economic burden of disease, driven largely by costs associated with caregiving ($112.3 billion), which accounted for about a third of the total economic burden. The large societal burden of schizophrenia in the US highlights the importance of effective strategies and treatment options to improve the management of this difficult-to-treat patient population.
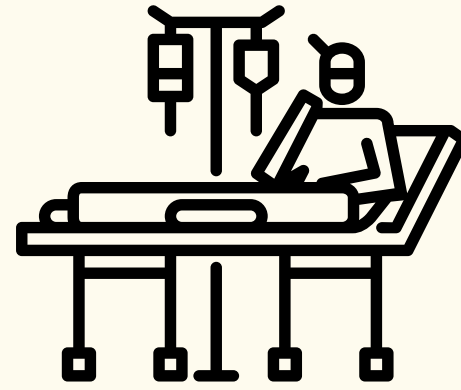
Calzavara Pinton, I., Nibbio, G., Bertoni, L., Cicale, A., Necchini, N., Zardini, D., Bosco Ubertino, U., Cerati, C., Deste,G., Barlati, S., & Vita, A. (2024). The economic burden of schizophrenia spectrum disorders: Clinical and functional correlates and predictorsof direct costs. Psychiatry Research, 324, Article 116240. https://doi.org/10.1016/j.psychres.2024.116240

03 Market analysis

Patient themselves

TARGET

Family and caregivers

Medical professionals

04 Competitor analysis

	MFVB	USCHIB	FOCUS
Target Disease	overall mental disease	schizophrenia	serious mental disease
information needed	8 acoustic properties from 30 sec recording of dialogue	speech recognition of daily conversation	**charts written by user(patient)**
Purpose of app	to check mental health level	to check user's schizophrenia symptom	**to check users' medication management**
Possibility of data augmentation	**MIddle**	**Upper**	**Lower**
convenience and immediacy	**Lower**	**Upper**	**Lower**

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04 Competitor analysis

05 Model Structure
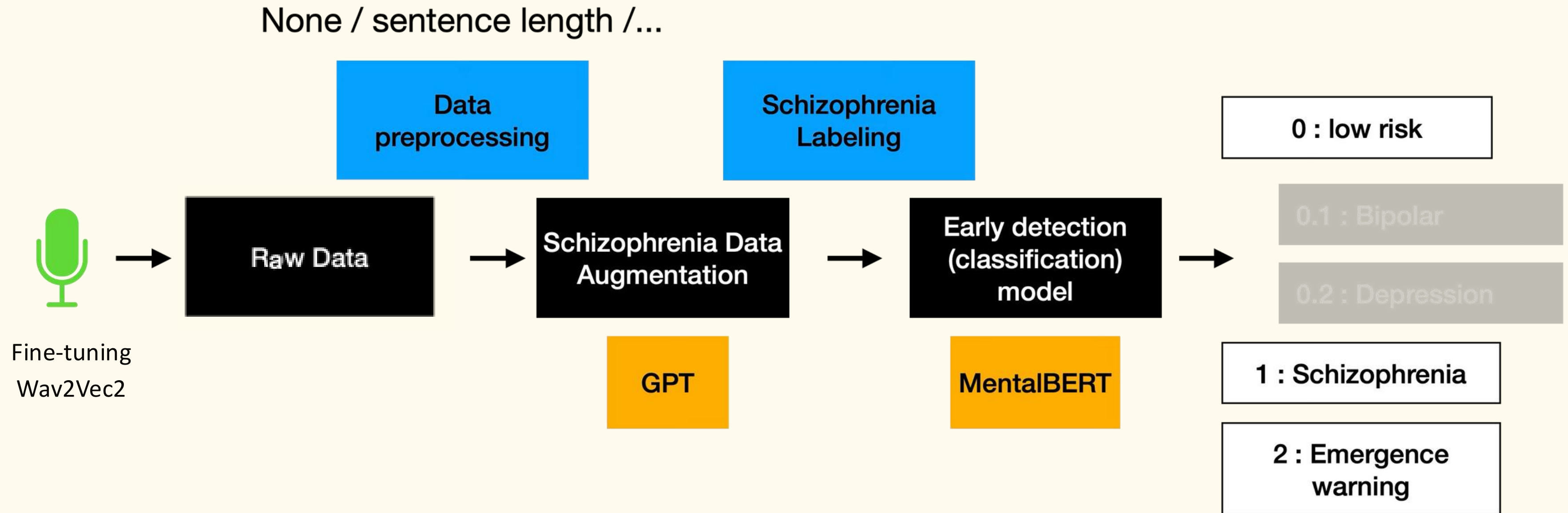
LLM Model for Early Detection and Diagnosis of Schizophrenia

05 Model Structure

LLM Model for Early Detection and Diagnosis of Schizophrenia
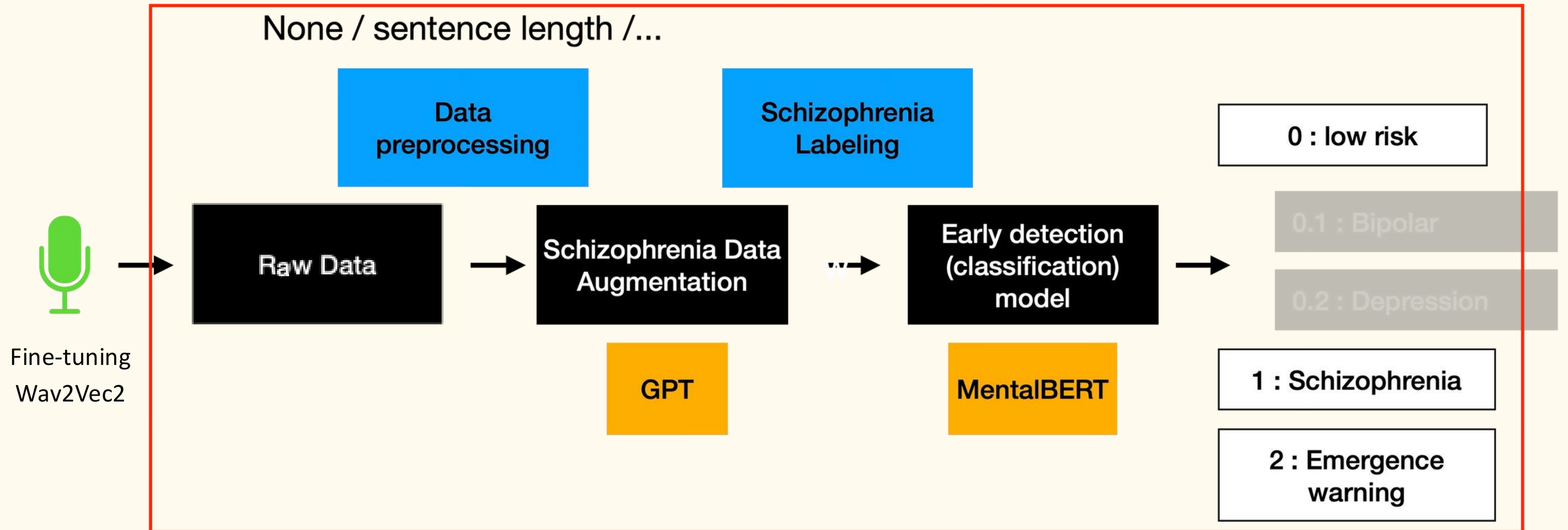
05 Model

LLM Model for Early Detection and Diagnosis of Schizophrenia

Data : SNS posts written by patients with Borderline Personality Disorder (BPD) and Bipolar Disorder

	title	selftext	created_utc	over_18	subreddit
0	Life is so pointless without others	Does anyone else think the most important part…	1650356960	False	BPD
1	Cold rage?	Hello fellow friends 😄\n\nI'm on the BPD spect…	1650356660	False	BPD
2	I don't know who I am	My [F20] bf [M20] told me today (after I said …	1650355379	False	BPD
3	HELP! Opinions! Advice!	Okay, I'm about to open up about many things I…	1650353430	False	BPD
4	help	[removed]	1650350907	False	BPD

source : According to the article "What's the Difference Between BPD and Bipolar Disorder?" by
PsychCentral('https://psychcentral.com/disorders/bpd-vs-bipolar-disorder')

Baseline : MentalBERT

Model pre-trained on mental disease related data

Category	Platform	Dataset	train	validation
Assorted	Reddit	SWMH (Ji et al., 2021a)	34,823	8,706
Depression	Reddit	eRisk18 T1 (Losada and Crestani, 2016)	1,533	658
Depression	Reddit	Depression_Reddit (Pirina and Çöltekin, 2018)	1,004	431
Depression	Reddit	CLPsych15 (Coppersmith et al., 2015)	457	197
Stress	Reddit	Dreaddit (Turcan and McKeown, 2019)	2,270	568
Suicide	Reddit	UMD (Shing et al., 2018)	993	249
Suicide	Twitter	T-SID (Ji et al., 2021a)	3,072	768
Stress	SMS-like	SAD (Mauriello et al., 2021)	5,548	617

05 Model Selection

LLM Model for Early Detection and Diagnosis of Schizophrenia

Schizophrenia Data Augmentation

EleutherAI / gpt-neo

GPT-4

Limitations in generating high-quality data

```python
# text generation prompt
schizo_prompts = [
    "Describe what a person hears when they experience auditory hallucinations.",
    "Generate an example of a person experiencing paranoid delusions.",
    "Write a short story about someone who believes they are being followed by unknown forces.",
    "Explain the thoughts of someone experiencing disorganized thinking due to schizophrenia."
]
```

```python
# text generation
def generate_schizo_text(prompts, max_length=100, num_return_sequences=10, temperature=1.0, top_k=50, top_p=0.95):
    augmented_texts = []
    for prompt in prompts:
        input_ids = tokenizer.encode(prompt, return_tensors="pt")
        outputs = model.generate(
            input_ids,
            max_length=max_length,
            num_return_sequences=num_return_sequences,
            temperature=temperature,
```

```
Generated_Text
"I hear whispers of people calling my name, but there's no one around."
"The walls seem to talk to me, giving commands in an unknown language."
"Laughter echoes in my ears, though I'm completely alone in the room."
"A booming voice keeps telling me I'm not safe, that I need to leave immediately."
"Songs from the past play in my head, but they seem distorted and eerie."
"I feel like someone is watching me, but I can't see them anywhere."
The voice of someone I don't know speaks directly into my thoughts.
"Random phrases echo in my mind, words that don't make sense together."
"I hear someone shouting warnings, but nobody else can hear them."
"It feels like my own thoughts are being spoken back to me, as if they are not mine."
```

05 Model Selection

LLM Model for Early Detection and Diagnosis of Schizophrenia

MentalBERT

Text Classification Task

	Example sentence	Data From	Label
Low risk	"The weather is nice!"	From SNS data	0
Schizophrenia	"I feel like people are watching me all the time."	Data Augmentation	1
Emergency Warning	"I'm going to kill them before they can get to me"	Data Augmentation	2

If there's an emergency situation(level 2), USCHIB automatically sends alerts to the caregivers and 911

! USCHIB !

High-risk behavior detected from [Kebin]. Ensure their safety and contact professional help immediately.

05 Model Result

None / sentence length /...

Data preprocessing

Schizophrenia Labeling

0 : low risk

Raw Data → Schizophrenia Data Augmentation → Early detection (classification) model →

0.1 : Bipolar

0.2 : Depression

GPT

MentalBERT

1 : Schizophrenia

2 : Emergence warning
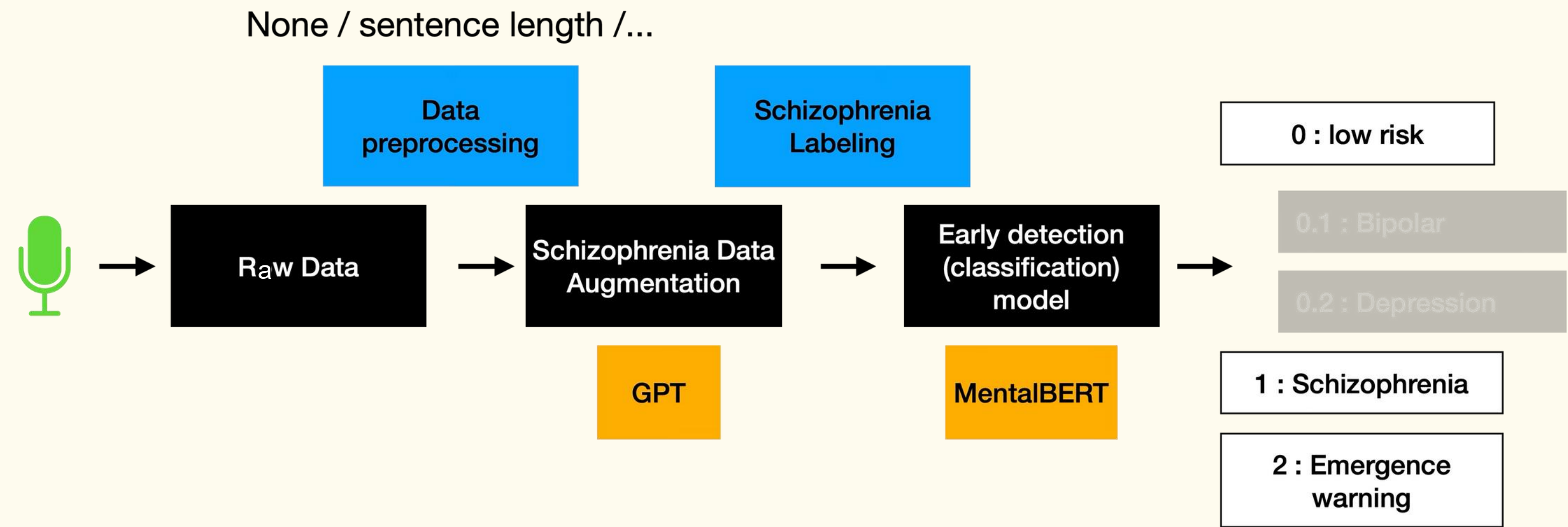
```
Epoch 0: 100%|        | 4940/4940 [08:43<00:00,  9.43it/s, loss=0.000153]
Epoch 1: 100%|        | 4940/4940 [08:07<00:00, 10.13it/s, loss=0.00122]
Epoch 2: 100%|        | 4940/4940 [08:42<00:00,  9.45it/s, loss=0.0014]
```

06 Basic Prototype_patient user
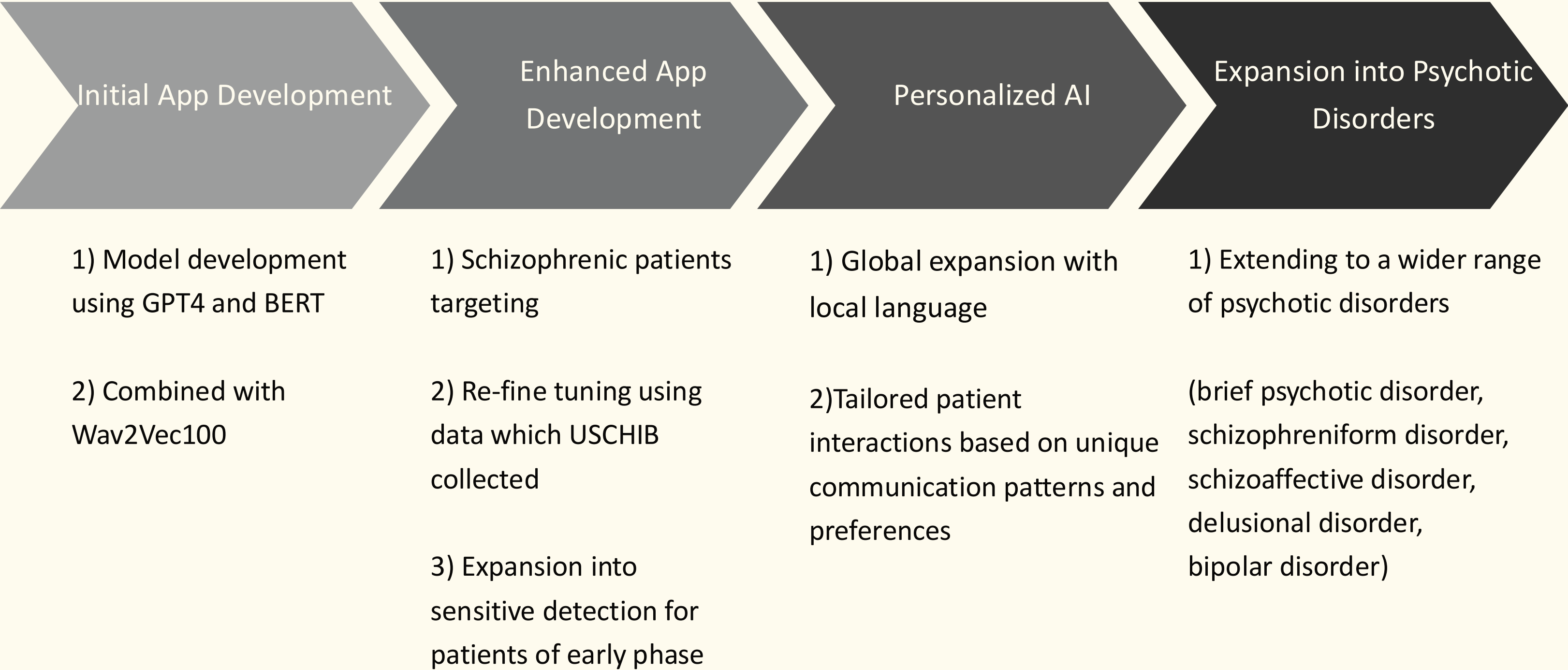

USCHIB

Detecting

Background
Detecting

Warning
with smooth vibration

Emerengy warning
with big sound

07 Development Plan

Initial App Development	Enhanced App Development	Personalized AI	Expansion into Psychotic Disorders

Initial App Development

1) Model development using GPT4 and BERT

2) Combined with Wav2Vec100

Enhanced App Development

1) Schizophrenic patients targeting

2) Re-fine tuning using data which USCHIB collected

3) Expansion into sensitive detection for patients of early phase

Personalized AI

1) Global expansion with local language

2)Tailored patient interactions based on unique communication patterns and preferences

Expansion into Psychotic Disorders

1) Extending to a wider range of psychotic disorders

(brief psychotic disorder, schizophreniform disorder, schizoaffective disorder, delusional disorder, bipolar disorder)

reference

Ehlen F, Montag C, Leopold K, Heinz A. Linguistic findings in persons with schizophrenia-a review of the current literature. Front Psychol. 2023 Nov 21;14:1287706. doi: 10.3389/fpsyg.2023.1287706. PMID: 38078276; PMCID: PMC10710163.

Correll CU, Galling B, Pawar A, et al. Comparison of Early Intervention Services vs Treatment as Usual for Early-Phase Psychosis: A Systematic Review, Meta-analysis, and Meta-regression. JAMA Psychiatry. 2018;75(6):555–565. doi:10.1001/jamapsychiatry.2018.0623

Kayi, E. S., Diab, M., Pauselli, L., Compton, M., & Coppersmith, G. (2018). Predictive linguistic features of schizophrenia. arXiv preprint arXiv:1810.09377.

Kadakia A, Catillon M, Fan Q, Williams GR, Marden JR, Anderson A, Kirson N, Dembek C. The Economic Burden of Schizophrenia in the United States. J Clin Psychiatry. 2022 Oct 10;83(6):22m14458. doi: 10.4088/JCP.22m14458. PMID: 36244006.

https://www.kaggle.com/code/sasakitetsuya/how-difficult-is-it-to-classify-bpd-and-bipolar/notebook Ji, S., Zhang, T., Ansari, L., Fu, J., Tiwari, P., & Cambria, E. (2021). Mentalbert: Publicly available pretrained language models for mental healthcare. arXiv preprint arXiv:2110.15621.
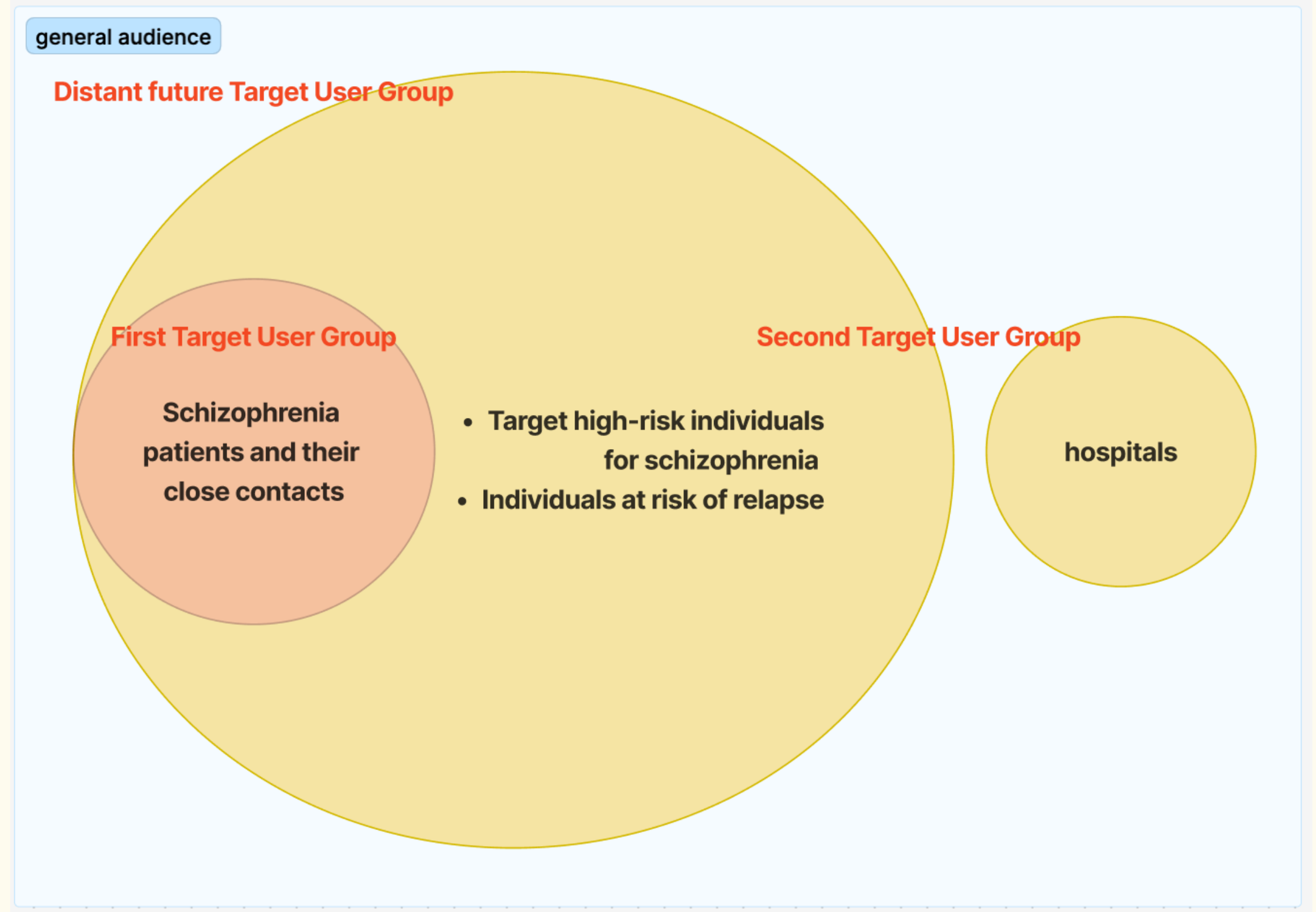
https://www.frontiersin.org/journals/psychiatry/articles/10.3389/fpsyt.2018.00039/full

Appendix

a. Target User Expansion Plan

건강

1. Current Focus:

2. Mid-Term Goals:

3. Long-Term Vision:

general audience

Distant future Target User Group

First Target User Group

Schizophrenia patients and their close contacts

Second Target User Group

- Target high-risk individuals for schizophrenia
- Individuals at risk of relapse

hospitals

Appendix

b. challenges of Model training

1. Lack of Schizophrenia NLP dataset

Data generation with LLM - The **stylistic differences** between the original data and the augmented data.
Retrained model (MentalBERT)
Use unsupervised model (zero-shot classification)

2. Schizophrenia is complex mental disorder with highly variable symptoms and manifestations

Appendix

c. Privacy problem

-Solution

cooperation with other company

voice mark technology

Artificial intelligence voice security technology that applies an watermark to the voice file itself so that only the speaker's voice can access to medical data.

#Medical #Voice #AI