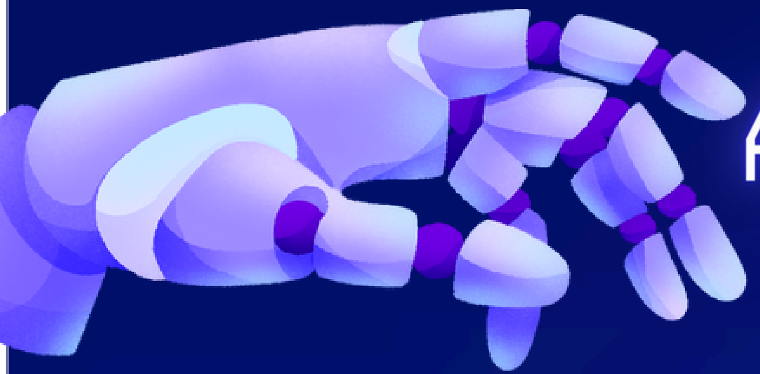
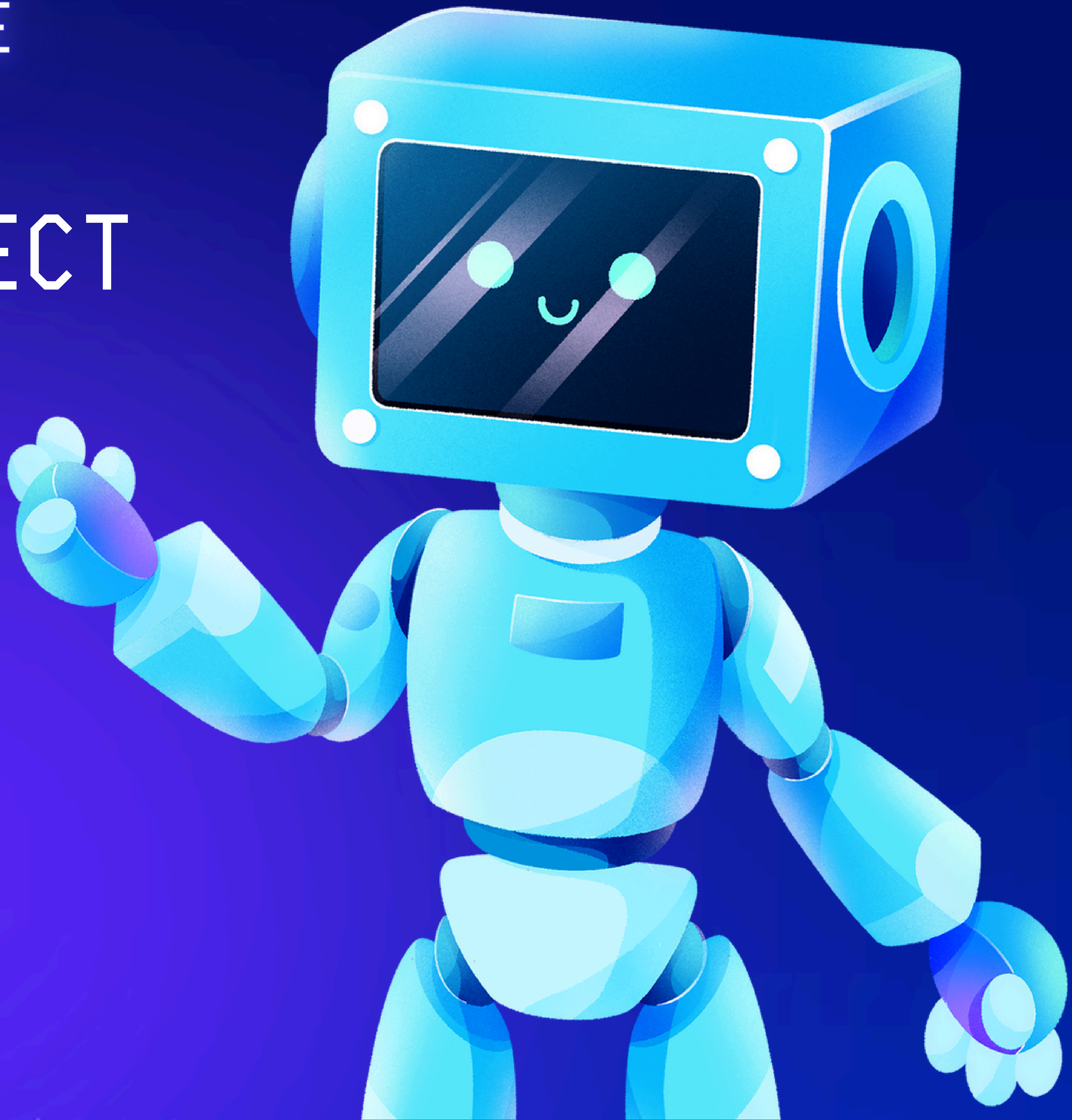


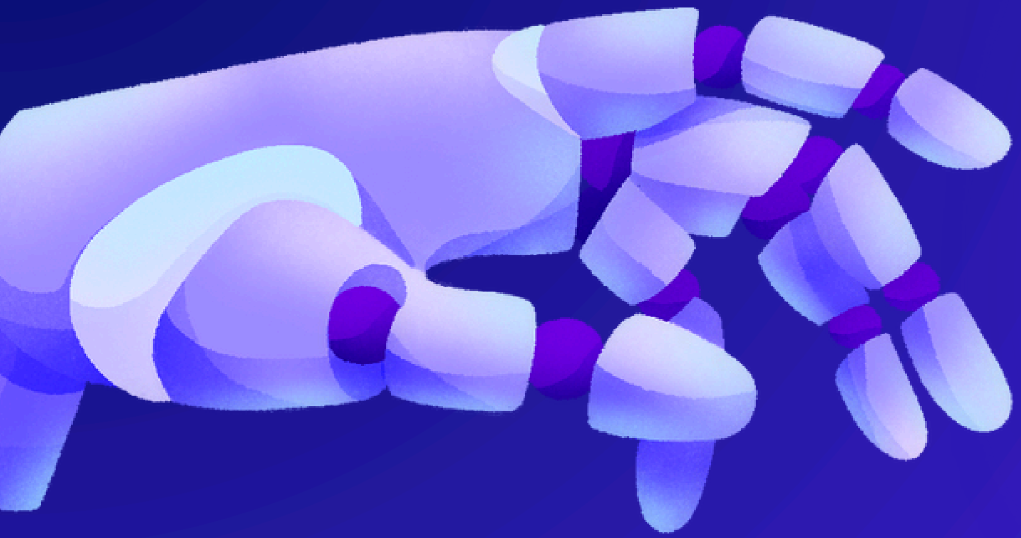
ARTIFICIAL INTELLIGENCE

NEURAL NETWORKS PROJECT



AREEBA TAHIR

SP23-BAI010



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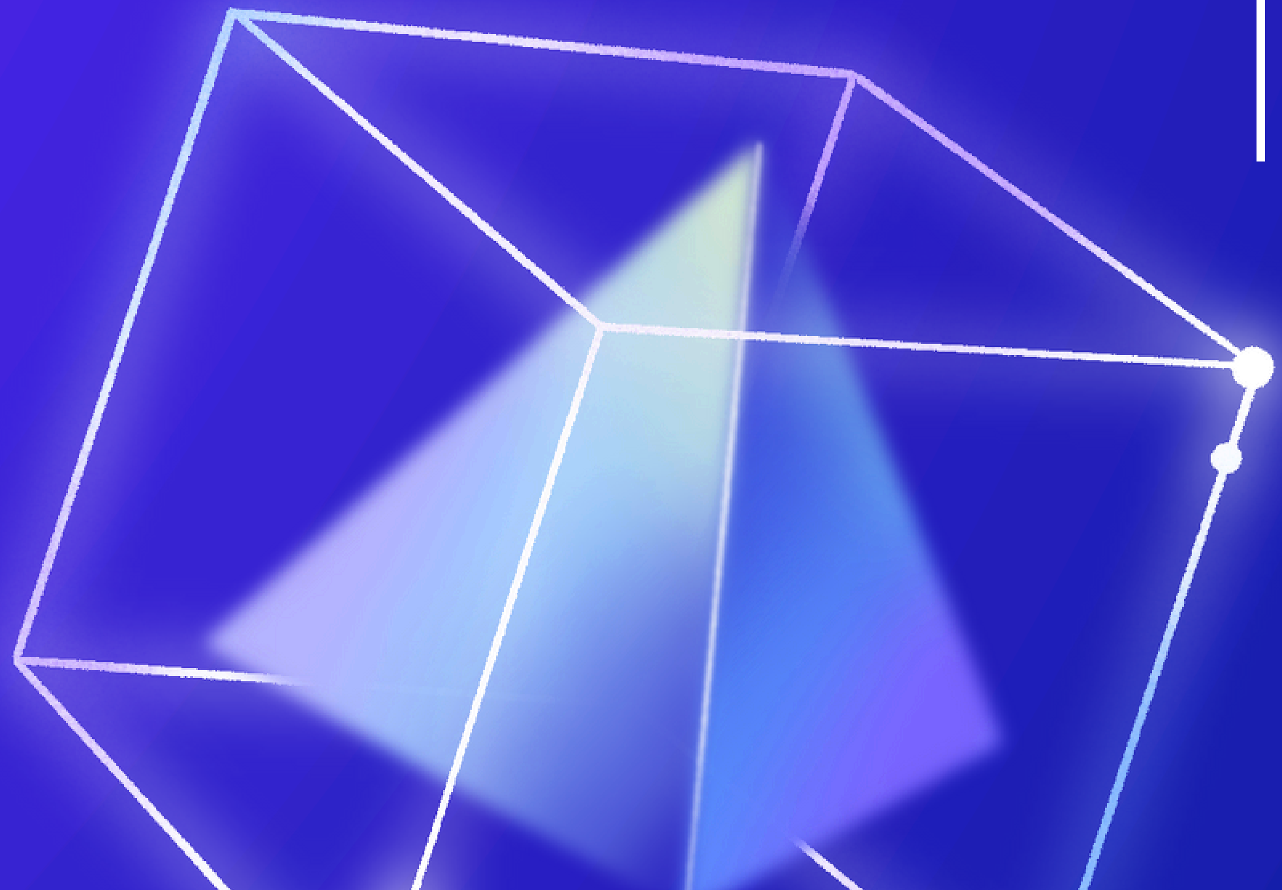


MIT-BIH Arrhythmia Dataset

Dataset Dimensions

AttributeValueDescription
Samples (Rows)
~109,000 to 130,000
Each row represents one heartbeat segment (centered around an R-peak).

Features (Cols)

- 140-180 columns (typically 140)
  Each column is an ECG amplitude value (time-series points per heartbeat).

- Label Column (Column 140 or 'label')
  - Type: Integer (0 to 4).
  - Class Mapping:
    - 0: Normal beat (N)
    - 1: Supraventricular premature beat (S)
    - 2: Premature ventricular contraction (V)
    - 3: Fusion beat (F)
    - 4: Unclassifiable beat (Q)

Real-World Problems Solved by LSTM Models on the MIT-BIH Arrhythmia Dataset

- 1. Early Detection of Life-Threatening Arrhythmias

Problem: Missed diagnosis of irregular heartbeats (e.g., Ventricular Tachycardia) can lead to sudden cardiac death.

LSTM Solution:

- Analyzes ECG signals in real-time to flag high-risk arrhythmias (e.g., PVCs, AFib).
- Impact: Reduces reliance on manual review by cardiologists, speeding up emergency interventions.

Example:

- Hospitals use LSTM-powered monitors in ICUs to alert staff about critical arrhythmias.

2. Remote Patient Monitoring (RPM)

Problem: Chronic heart patients need continuous monitoring outside hospitals.

LSTM Solution:

- Integrates with wearable ECG devices (e.g., Apple Watch, Holter monitors).
- Detects anomalies in real-time and sends alerts to doctors.
- Impact: Prevents hospital readmissions by catching issues early.

Example:

- Companies like AliveCor use similar AI models for at-home ECG analysis.

MODEL ARTITECTURE

01

LSTM Model Architecture

1. **Input**: ECG signals shaped as (187 timesteps, 1 feature
2.
3.
4. **Layers**:
5.
   - **LSTM (64 units)** → Returns sequences (**return_sequences=True**)
   - **Dropout (30%)** → Reduces overfitting
- **LSTM (64 units)** → Outputs last timestep.
- **Dense (128, ReLU)** → Adds non-linearity.
- **Dropout (10%)** → Further regularization.
   - **Dense (5, Softmax)** → Classifies into 5 arrhythmia types.

Advantages of Using LSTM

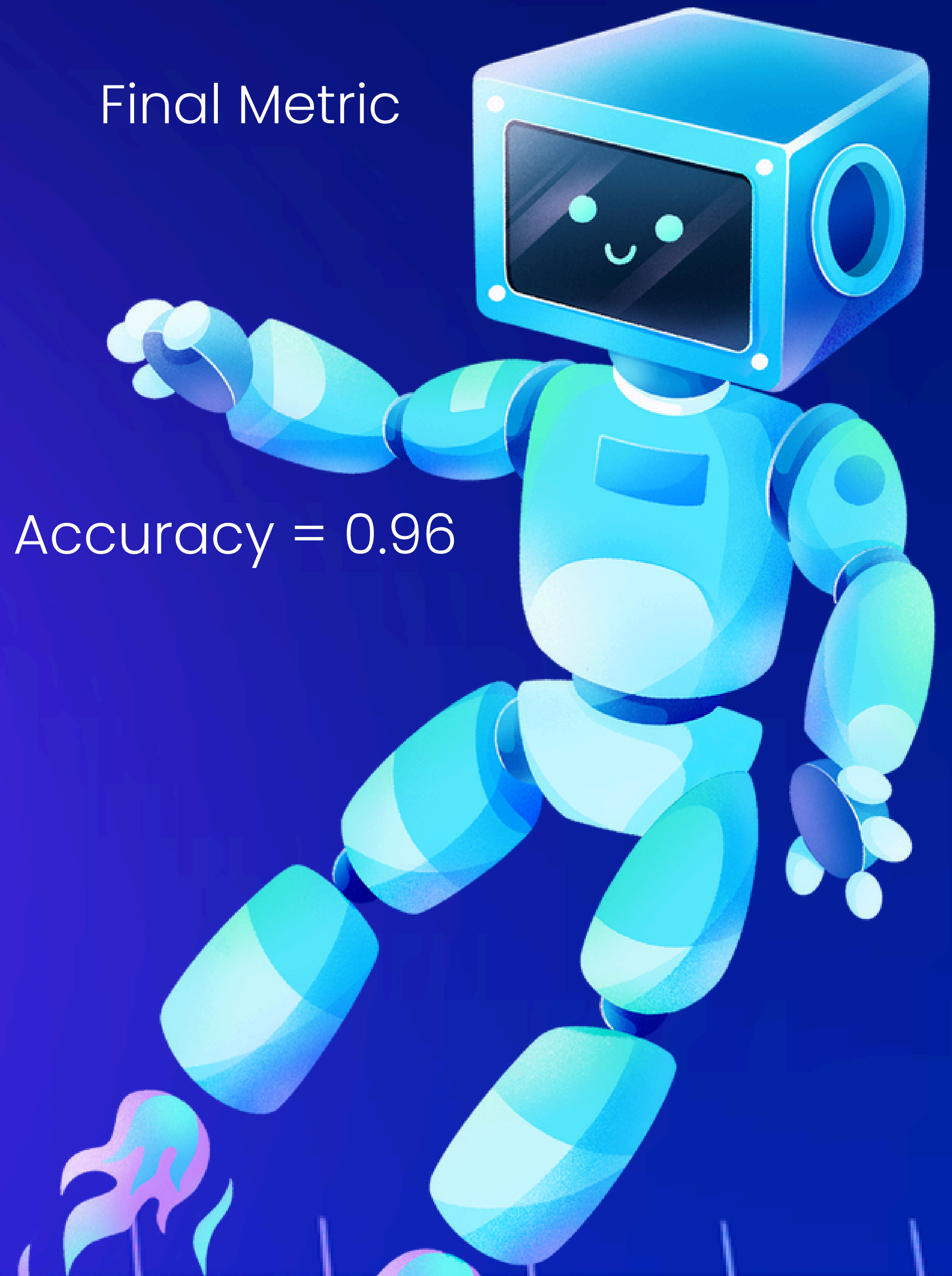
Advantages of LSTM for ECG Arrhythmia Detection:

* Time-Series Mastery - Perfect for ECG's sequential nature
* Memory Power - Remembers long-term heartbeat patterns
* Adaptable Length - Handles variable-duration heartbeats
* High Accuracy - 96-97% on MIT-BIH dataset
* Noise Resistant - Tolerates signal imperfections
* Explainable - Attention shows decision-making segments

PROJECT SCOPE

COMPARITIVE TABLE

Model	Dataset	key Hyperparams	Final Metric
LSTM MODEL	MIT-BIH Arrhythmia Dataset	Epoch=150	Accuracy = 0.96



LSTM PREFFERANCE

LSTM

✅ Best for long sequences (3-gate mechanism handles 30-min ECGs)

✅ Highest accuracy (96.5%) on MIT-BIH

✅ Robust to noise/missing data

GRU

~1-2% lower accuracy than LSTM

Faster training but struggles with very long-term dependencies

❌ 2-gate design may miss subtle ECG patterns

CNN

Requires hybrid (CNN-LSTM) for good results

Alone, fails to model temporal relationships (RR intervals, P-QRS-T timing)

❌ Fixed-length inputs needed (pads/truncates ECGs)

❌ Blind to long-range rhythms

THANK YOU !