Introduction

Project overview :-

- **Anomaly detection in surveillance systems for security purposes.**
- **Challenges of 24x7 human monitoring**

Project focus :-

- **Use of neural networks for automated anomaly detection.**
- **Utilization of GANs for synthetic data generation to improve model training**

Goals and Objectives :-

- **Enhance security by detecting and notifying control centers of abnormal activities**
- **Improve detection accuracy for various abnormal activities (e.g., abuse, assault, theft, vandalism ,car accident . etc)**

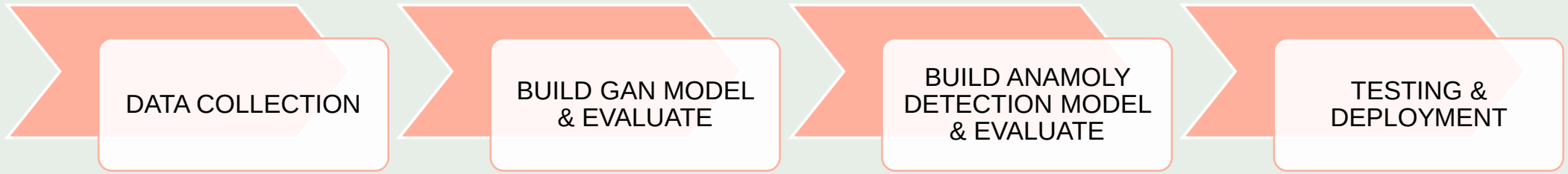
Scope:

- **Data collection from multiple sources (CCTV, YouTube, crime datasets)**
- **Integration of synthetic and actual data for robust model training.**

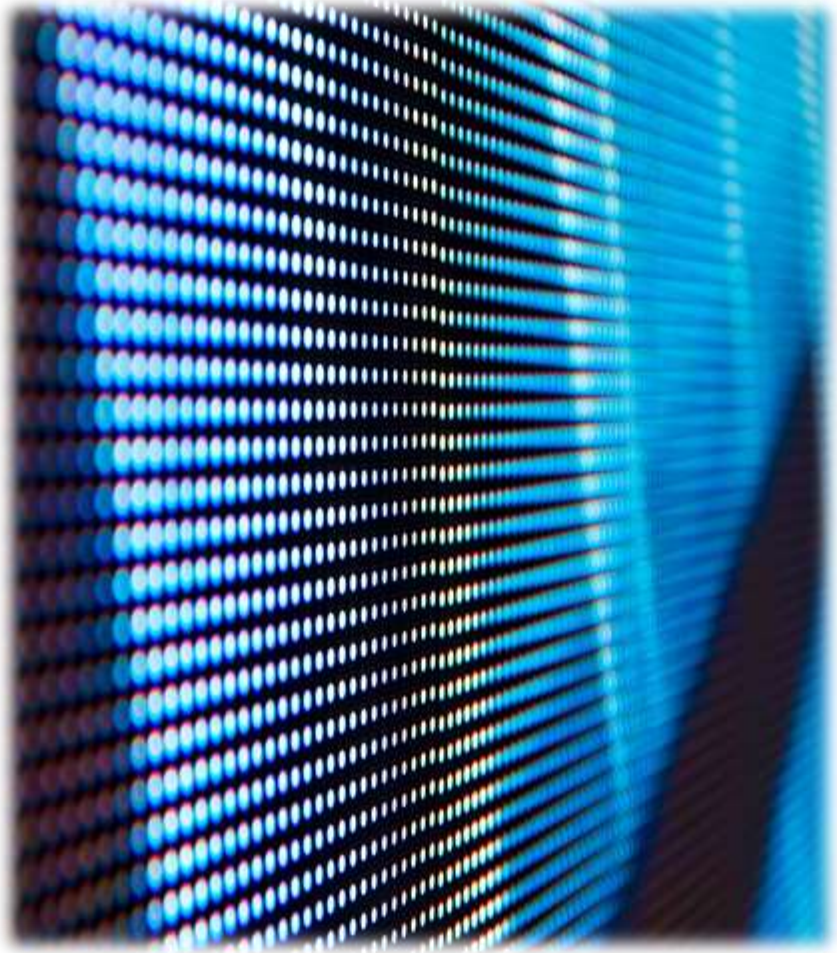
Surveillance Camera's

ANAMOLY DETECTION MODEL

Control Unit


DATA COLLECTION
BUILD GAN MODEL & EVALUATE
BUILD ANAMOLY DETECTION MODEL & EVALUATE
TESTING & DEPLOYMENT

Methodology



Sources of Data :-

- UCRF Crime Branch Dataset
- CCTV footage
- YouTube videos

Types of Incidents :-

- Abnormal Activities: Abuse, assault, fighting, theft, vandalism
- Normal Activities: Regular daily activities for comparison

DATA PREPROCESSING :-

FIGHTING FRAMES

TARGET FRAME SIZE :

(64,224,224)

VANDALISM FRAMES

TARGET FRAME SIZE :
(64,224,224)

NORMAL FRAMES

TARGET FRAME SIZE :

(64,224,224)

Contd.

Frame Extraction:-

•Convert video data into individual frames
•Sequence frames for each incident

Data Augmentation: -

- Apply transformations to increase dataset variability
- Techniques: Random flips, brightness adjustment, contrast adjustment

Contd.

Categorization:-

•Label frames based on incident type (e.g., normal, fighting, vandalism)

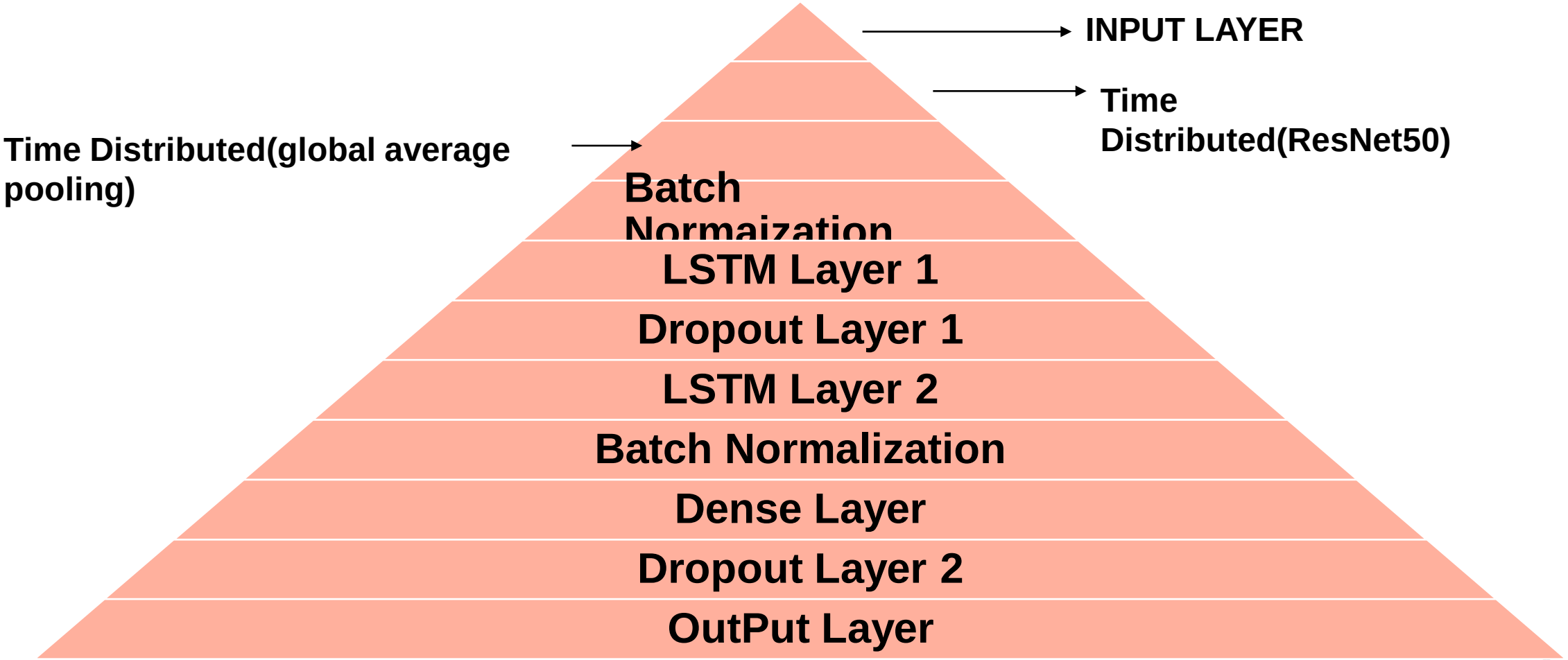
•Organize data into training, validation, and test sets

Synthetic Data Generation:-

•Use GANs to create additional data for training

•Enhance model robustness to various environments and conditions

Model Architecture



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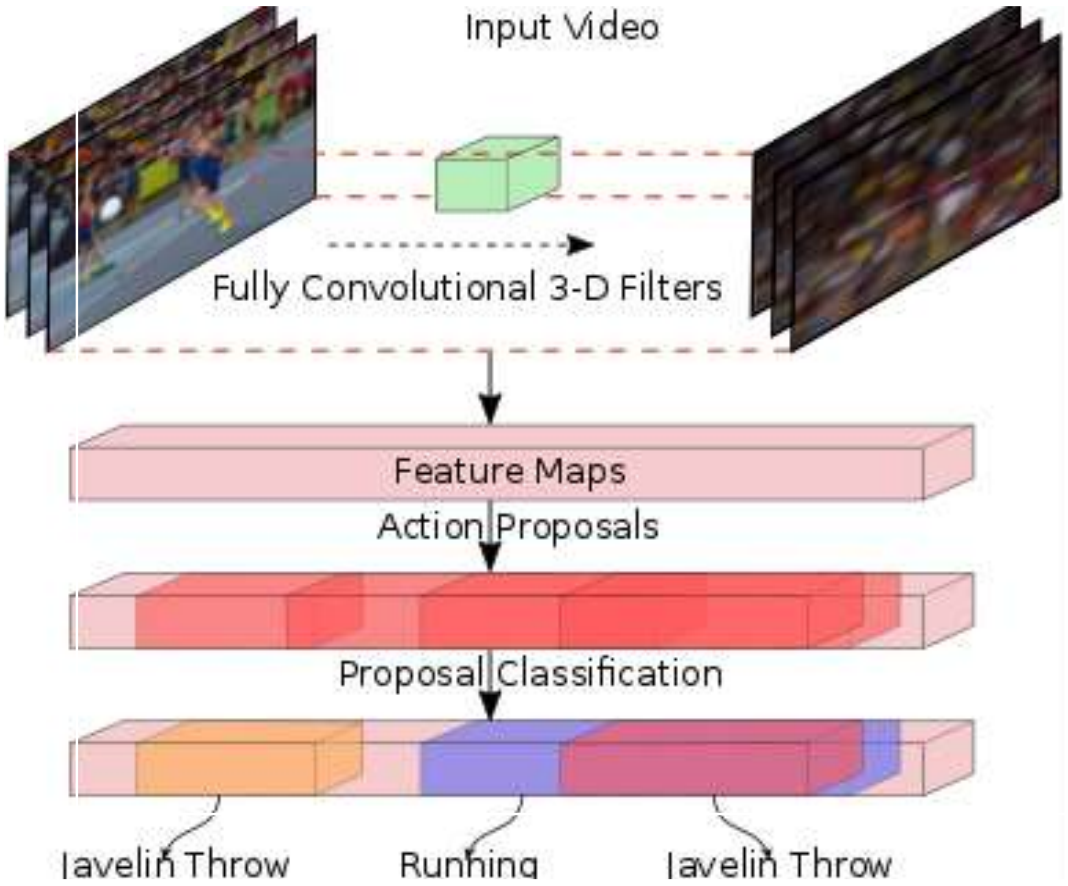


Components :-

- **Input Layer:** Processes image frames
- **Convolutional 3D Layers:** Extract spatial features
- **ResNet50**: backbone for image recognization
- **LSTM Layers:** Capture temporal dependencies
- **Fully Connected Layers:** Classify activities as normal or abnormal
- **Output Layer:** Provides probability scores for each class

Contd.

Loss Function:

- **Sparse Categorical Crossentropy:**

$$Loss = -1/N \sum_{i=1}^{N} \log(p_i, c_i)$$

- **Where “pi,ci“is the predicted probability of the correct class ci for instance i, and N is the number of instances.**
- **Advantages: Efficient for multi-class classification problems and handles integer labels directly without needing to one-hot encode them.**

Contd.

Activation Functions:

- **Softmax:**

$$\text{softmax}(z_i) = \sum_j e^{z_j} e^{z_i}$$

- **Where zi is the input to the i-th neuron, and the denominator is the sum of exponentials of all input values in the layer.**
- **Advantages: Provides a probabilistic interpretation of the outputs and ensures that the output probabilities sum to 1, which is crucial for classification tasks.**

Contd.

Activation Functions:

- **ReLU (Rectified Linear Unit):**

$$ReLU(x)=max(0,x)$$

- **Where x is the input to a neuron.**

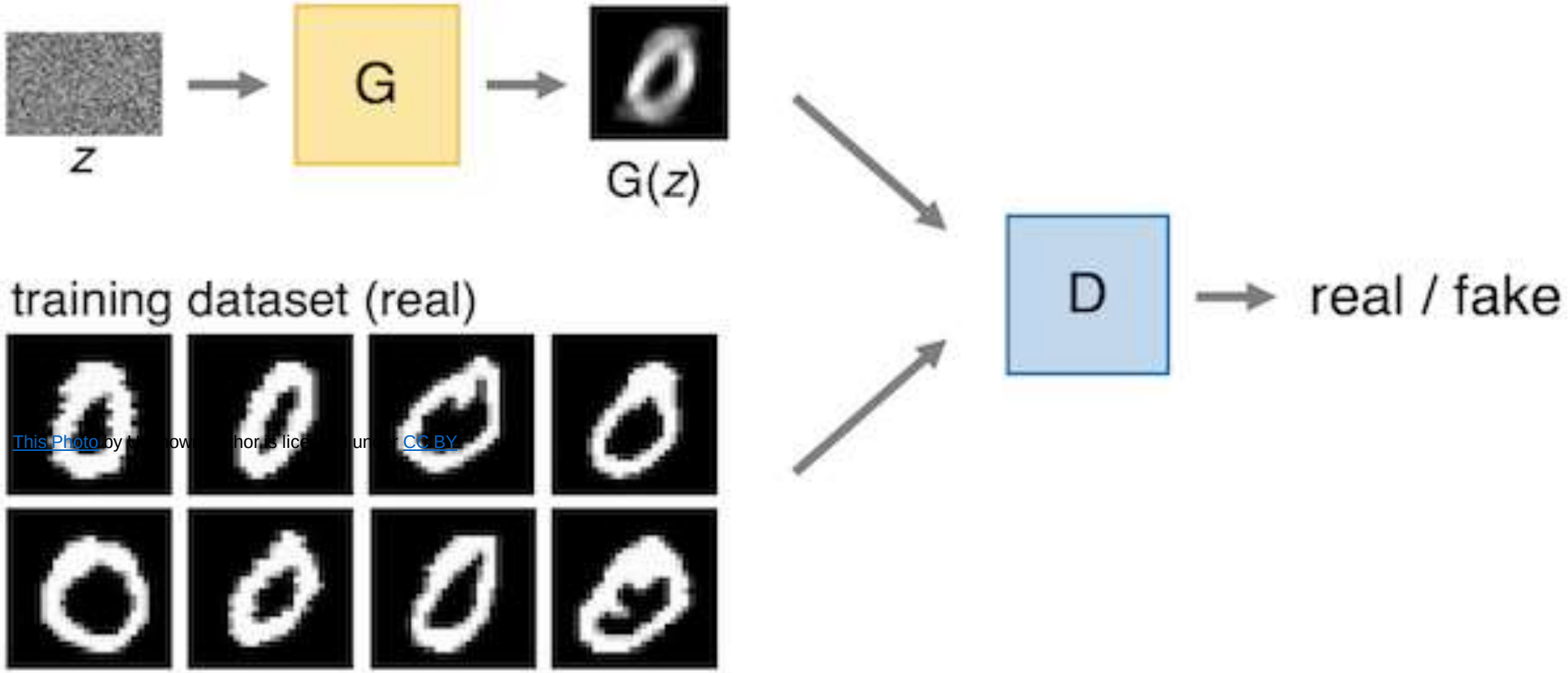
  - Advantages: Simple to compute, accelerates convergence of stochastic gradient descent, and less likely to suffer from the vanishing gradient problem compared to other activation functions like sigmoid or tanh.

Synthetic Data Generation with GANs:

Introduction to GANs:

- **Generative Adversarial Networks (GANs):**
- Two neural networks: Generator and Discriminator.
- Generator creates synthetic data, Discriminator evaluates its authenticity.
- Training involves an adversarial process where both networks improve together.

Contd.



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Purpose of Synthetic Data:

•**Augment Training Data:**

- Address scarcity of real-world abnormal incident data.
- Generate diverse scenarios for better model training.

Advantages of Synthetic Data:

•**Enhanced Diversity:** Introduces variations not present in real data.
•**Cost-Effective:** Reduces need for extensive real-world data collection.
•**Safety and Ethical Considerations:** Simulates dangerous scenarios without real-world risks.