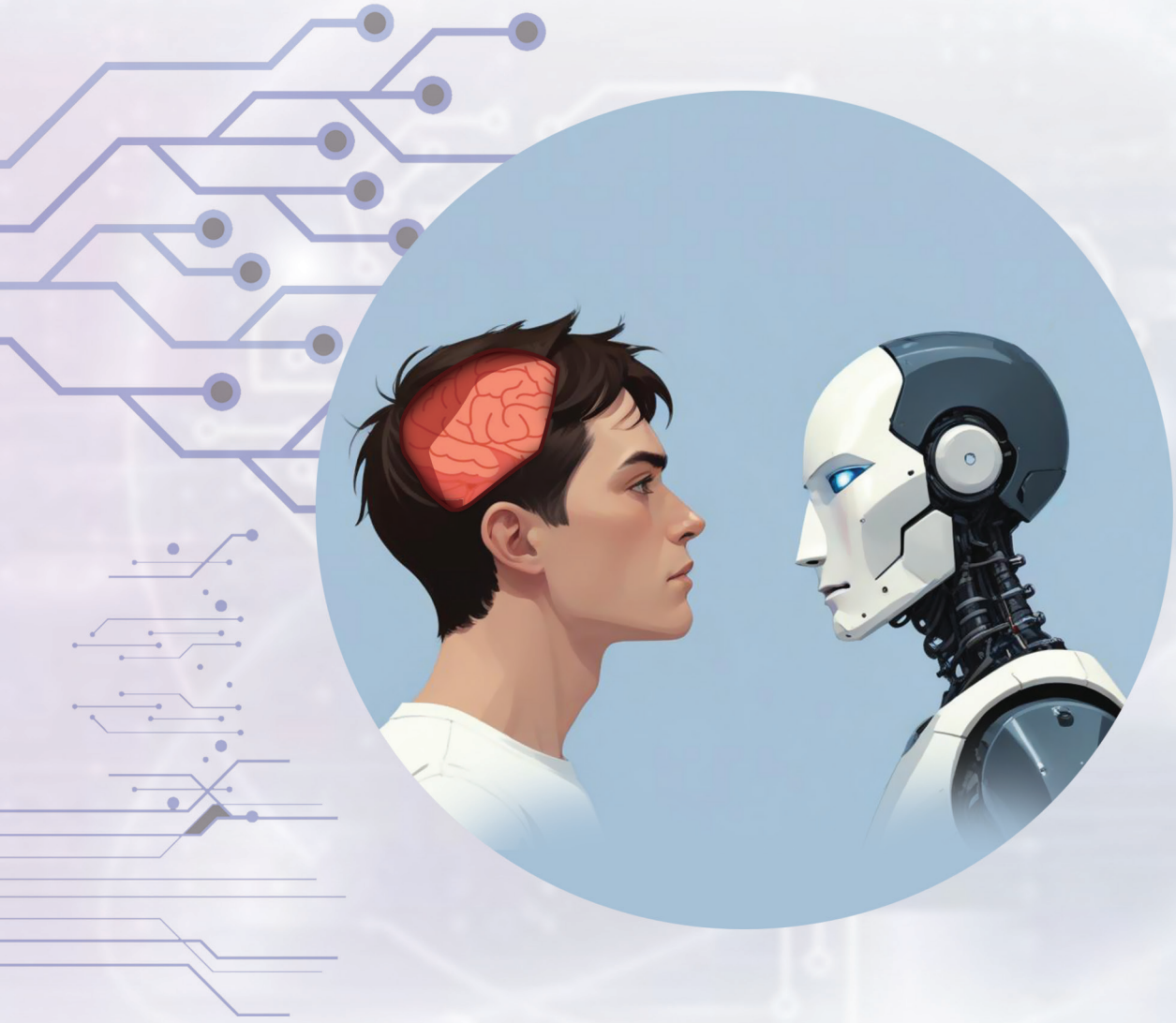
AIIPL
Advanced Innovative Instruments for Professional Learning

AKADEMIKA



ARTIFICIAL INTELLIGENCE & MACHINE LEARNING WORK BENCH

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

ABOUT THE LABORATORY

From predictive analytics to natural language processing, from computer vision to autonomous systems, the potential applications of AI and ML are boundless. However, harnessing this potential necessitates not only theoretical understanding but also practical experimentation and application.

Hence, we Propose this Laboratory that will give Students and Industrial Infrastructure to nurture their Skill sets that are highly relevant to the current and future job market.

AI is best learned through hands-on experience and experimentation. A well-equipped AI lab provides students with access to cutting-edge hardware and software tools, allowing them to gain practical experience in developing and implementing AI algorithms and systems.

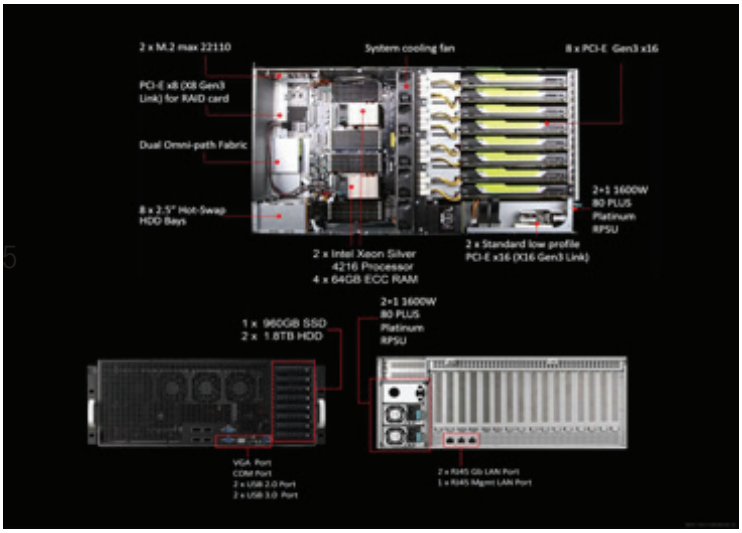
Opportunities in Research: The Proposed Laboratory Facility will enable faculty and students to conduct research in various subfields of AI, such as machine learning, natural language processing, computer vision, and robotics.

Sl. No.	Item	Qty
1	Artificial Intelligence and Machine Learning Laboratory Set-up with AI-DL-ML Software Libraries / Tools and OS - High Performance Computing Server with Required OS installed, Software Libraries and Tools	01
2	Artificial Intelligence on Embedded System Platform for Edge Computing - High end Embedded System with required Software to deploy AI - Different Types of Cameras like Thermal Camera , Night Vision Camera, IP Camera (Wireless), 3D Stereo camera for various applications	01
3	Artificial Intelligence on VLSI Platform for Edge Computing - High end FPGA Development Board with required Software & Accessories to deploy AI	01
4	Industrial Implementation of Artificial Intelligence in Video Analytics - High End Workstation - Core Vision Platform Software - Various Software Engines like Face Recognition, Advanced Intrusion Detection, People Counting - Router - IP Cameras and NVR	01
5	Artificial Intelligence in Robotics (Robotic Operating System) - Robotic Arm - Autonomous Robotic Car - Software and Accessories	01
6	Instructor Training Module	01

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

HPC MACHINE SPECIFICATION

- Server Chassis supporting GPU
- CPU: 2 x Intel® Xeon® Silver 4216 Processor
- GPU: 2 x NVIDIA® RTX A5000
- RAM: 256GB DDR4 ECC
- STORAGE:
- 1.92 TB SATA SSD for Operating System
- 2 x Enterprise Class 2 TB SATA SSD with Raid support
- Gigabit Ethernet card
- Redundant Power supply
- Monitor
- USB Mouse, USB Keyboard



SOFTWARE LIBRARIES

- **Included OS :** Ubuntu Operating System
- **Software Libraries :**
  Essentials Utilities: CUDA, cuDNN, TensorRT
- **Machine Learning :**
  vowpal wabbit, XGBoost,
  Numpy, Scikit, Pandas, other relevant Python libraries
- **Deep Learning :**
  NVidia DIGITS,
  Tensor Flow,
  Caffe, Caffe2,
  PyTorch, Theano
- **Dataset :**
  Image Net, CIFAR-10, KITTI Pre-Loaded for development

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

ARTIFICIAL INTELLIGENCE ON EMBEDDED PLATFORM

Embedded Module :

Inference Application Hardware

- 8-core Arm® Cortex®-A78AE v8.2
- 1024 Ampere GPU @ 918 with 64 Tensor Cores
- Dual Deep Learning Accelerator
- (DLA) engines
- Vision Accelerator
- 16 GB LPDDR5
- MIPI CSI-2 lanes
- UART, SPI, I2C, I2S, CAN, GPIOs

Research Areas:

- Machine Vision
- Robotics
- Deep Learning Model Inference
- Machine Learning
- Medical Imaging
- Gaming
- Virtual Reality
- NLP \And Many More

OpenCV
Image Processing

OpenGL
Image Rendering

NVIDIA CUDA
Parallel Computing

NVIDIA VISIONWORKS™
Hardware Accelerated Graphics

Vulkan.
Hardware Accelerated Image Rendering

CAMERA SETUP

Camera Setup:

Camera setup to enhance & implement AI skills for image/vision field.

- Thermal Camera
- 3D-Stereo Camera
- Night Vision Camera
- IP Wireless Camera
- USB Camera

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

ARTIFICIAL INTELLIGENCE ON VLSI PLATFORM

FPGA Module :

Inference Application Hardware

- Device: Zynq™ UltraScale+™ MPSoC with Thermal cooling solution Active (Fan + Heatsink
- System logic cells: 256K
- Block RAM blocks :144, UltraRAM blocks: 64
- Ethernet interface: One 10/100/1000 Mb/s
- Image sensor processor: OnSemi AP1302 ISP, IAS MIPI sensor interfaces: x2
- Raspberry Pi camera interface x1
- Pmod 12-pin interface x1
- USB3.0/2.0 interface x4
- 13MP Auto Focus RGB Camera Module
- MicroSD card and MicroSD to SD Adapter

INDUSTRIAL IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE IN VIDEO ANALYTICS

Core Vision Platform Software License-

Includes video search dashboard, real-time alert dashboard, heat map dashboard, smart hash tag, camera health mgmt., outdoor/indoor map, live view, VMS/NVR playback, LDAP, privacy protection, cluster/federation, false detection report, detail extraction, smartphone AP

SOFTWARE ENGINES

Advanced Intrusion Detection Engine

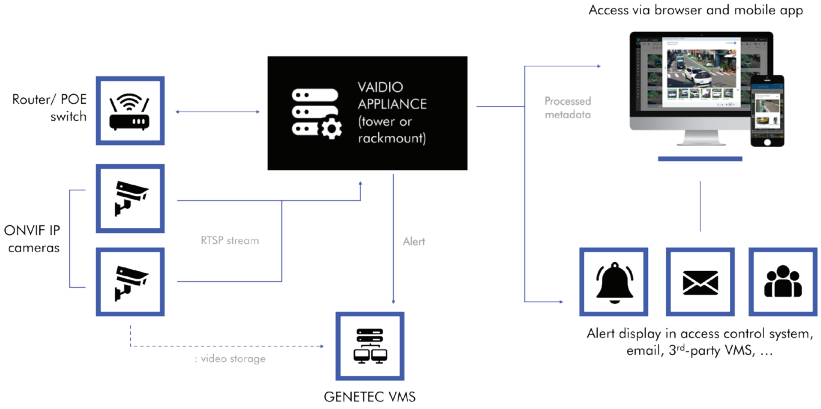
Intrusion Detection (ID) software license per channel- Includes multiple ROIs, "with/without objects" filter

Face Recognition Engine

Face Recognition & Face Search (FRS) software license per channel- Includes Facemask/Emotion detection and a max database of 10,000 FR entries (in all FR lists per server)

People Counting Engine

People Counting and Occupany



ROBOTIC SETUP

This hardware setup includes Robotic Arm and Car which can used to implement AI skills using Embedded GPU Kit & Robotic Operating System (ROS) by building applications.

INSTRUCTOR TRAINING MODULE

ADMIN TRAINING:

- Login to AI-DL Machine as Administrator
- Managing User accounts
  - User Creation/Delete
  - Hardware parameter visualization
  - Managing Hardware resources
- Training on Docker/container
  - Checking available Docker Images
  - Adding/managing various Libraries/
  - Software versions in specific docker Images
- Backup/Restore Docker Images
- Backup/Restore user DATA to/from user space to/ from server database
- Script based management for ease of operation

USER TRAINING:

- Login to AI-DL Machine as Administrator
- Training on Docker/container
  - Checking available Docker Images
  - How to User Docker Images
  - Check available libraries/ software
  - Running simple example using Digits
  - Running simple example using Jupyter-notebook
  - How to run your own example on AI-DL Machine
- Data Management
  - Transferring DATA to/from AI-DL computing Machine to/ from user node machine
  - Manage storage space

LAB TUTORIALS

Machine Learning:

- Implementation of Linear Regression
- Implementation of Polynomial Regression
- Implementation of Logistic Regression
- Implementation of k-NN (k-Nearest Neighbors)
- Implementation of K-Means Clustering Algorithm
- Implementation of SVM (Support Vector Machine) Classification Algorithm
- Introduction to Gradient Descent
- Introduction to Newton's Method
- Study of MLE (Maximum Likelihood Estimation)
- Study of MAP (Maximum A Posteriori)
- Implementation of PCA (Principal Component Analysis) in Dimensionality Reduction.
- Implementation of L1Regularization (Lasso Regression)
- Implementation of L2Regularization (Ridge Regression)
- Implementation of Decision Trees Classification Algorithm
- Implementation of Random Forest Classification Algorithm
- Implementation of ANN (Artificial Neural Network) using TensorFlow
- Implementation of Naïve Bayes Classification Algorithm
- Implementation of Kernel SVM (Support Vector Machine)
- Implementation of Apriori using Association Rules
- Implementation of Eclat using Association Rules
- Implementation of Upper Confidence Bound (UCB) in Reinforcement Learning (RL)
- Implementation of Thompson Sampling in Reinforcement Learning (RL)

Deep Learning:

- Implementation of CNN (Convolutional Neural Network) using TensorFlow
- Implementation of Sentiment analysis using Natural Language Processing (NLP)
- Implementation of Face detection and recognition using Computer Vision
- Implementation of Object tracking using PyCharm
- Image generation with Stable Diffusion
- Implementation of RNN (Recurrent Neural Network) using LSTM
- Image Classification with DIGITS
- Object Detection with DIGITS
- Object Detection over KITTI dataset with DIGITS
- Semantic Segmentation using DIGITS

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

LAB TUTORIALS

- Medical Image Segmentation using DIGITS
- Signal Processing using DIGITS
- Train a Generative Adversarial Network using DIGITS
- Training an image autoencoder with DIGITS
- Binary Segmentation using DIGITS
- Linear Classification with TensorFlow
- Image Classification using TensorFlow
- Demonstrating the implementation of remote inference of a trained deep learning model on embedded GPU board/platform
- Demonstrating the edge computing concept using AI-DL machine and Embedded GPU board/platform.

Artificial Intelligence:

- Implementation of A* Search Algorithm
- Implementation of Hill Climbing Optimization Algorithm
- Implementation of Simulated Annealing Optimization Algorithm
- Implementation of Genetic Optimization Algorithm
- Implementation of Fuzzy Logic Algorithm
- Implement Adversarial search using min-max Algorithm
- Identify suitable Agent Architecture for the problem.
- Provide the PEAS description and TASK Environment for a given AI problem
- Implement a Planning Agent.
- Design a prototype of an expert system
- Case study of an existing successful AI system

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