Department of Computer Science and Engineering

IoT System Design

2290601

COURSE OBJECTIVES

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- ☐ To introduce the fundamentals of internet of Things.
- ☐ To understand the technologies, system architecture, and communication architecture that propelled the growth of IoT Systems.
- ☐ To develop IoT infrastructure for popular applications.

Unit-1 **Introduction to Internet of Things (IoT):** Vision, Definition, IoT architecture: Layers and protocols, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Sensing, Actuation. IoT communication models: Device-to-device, device-to-cloud, device-to-gateway, Challenges and opportunities in IoT

Unit-2 **Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, microcontrollers, and single-board computers, **Embedded Platforms for IoT:** Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Raspberry pi, Jetson nano Beagle Bone, and Intel Galileo boards.

Unit-3 **IoT Protocols and Arduino Programming:** Wi-Fi, Bluetooth, CoAP, LPWAN protocol. Sensor Networks: Sensor deployment & Node discovery, **Introduction to Arduino Programming:** Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IoT, Integration of Sensors and Actuators with Arduino.

Unit-4: **IoT Data Management and Analytics**: Data generation and collection in IoT systems, IoT data storage, Cloud-based and local storage, Data preprocessing and analysis, Basics of analytics for IoT data, IoT dashboards, Visualization and interpretation of data, Role of machine learning and AI in IoT

Unit-5: **Challenges in IoT Design challenges:** IoT applications: Smart homes, smart cities, healthcare, agriculture, Smart Metering, City Automation, Automotive Applications, home automation, smart cards, and industry, IoT and automation: Role in industrial IoT (IIoT), Emerging technologies: AIoT, Blockchain for IoT, and 5G integration IoT, Development Challenges, Security Challenges.

REFERENCE BOOKS: -

1. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", willey.
2. Jeeva Jose, Internet of Things, Khanna Publishing House.
3. Michael Miller "The Internet of Things" by Pearson.
4. Raj Kamal "INTERNET OF THINGS", McGraw-Hill, 1ST Edition, 2016.
5. Arshdeep Bahga, Vijay Madisetti "Internet of Things (A hands on approach)" 1ST edition, VPI publications,2014.
6. Adrian McEwen, Hakin Cassimally "Designing the Internet of Things" Wiley India.

COURSE OUTCOMES:

After completion of this course, the students would be able to:

1. Understand the basic concepts, principles and challenges in IoT.
2. Describe the functioning of hardware devices and sensors used for IoT.
3. Analyze network communication aspects and protocols used in IoT.
4. Apply IoT for developing real life applications using Arduino programming.
5. Develop IoT infrastructure for popular applications

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List of Experiments

1. Implementation of LED Blinking with arduino/ Rasberry Pi.
2. Implementation of Temperature and Humidity Monitoring.
3. Interfacing between sensors and actuator.
4. Develop an intrusion detection system through motion sensors.
5. Develop an IoT-based Fire Detection System.
6. Develop an IoT-based Air Quality Monitoring.
7. Implementation of IoT-based Home Automation System
8. Implementation of MQTT-based IoT Communication. .
9. Implementing a mechanism for IoT Data Logging to Cloud.
10. Implement a mechanism to control the state of an LED using a Bluetooth-enabled microcontroller.
11. Implementation of RFID-based Access Control System.

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List of Skill Based Mini Projects

1. Smart Home Automation System
2. Weather monitoring system
3. Smart Plant Watering System
4. Health Monitoring Wearable
5. Trash Can Monitoring System
6. Parking Space Availability System
7. Smart Irrigation System
8. Home Security System
9. Energy Consumption Monitoring
10. Air Quality Monitoring
11. Smart Traffic Management System
12. IoT-Based Fire Detection System
13. IoT-Based Attendance System
14. Smart Lighting System
15. Smart Retail Shelf Monitoring
16. Smart Greenhouse
17. IoT-Based Crop Monitoring
18. IoT-Based Object Tracking
19. Water Quality Monitoring in Rivers and Lakes
20. Solar Panel Monitoring System
21. IoT-Based Green Building System

IoT System Design
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- ☐ To introduce the fundamentals of internet of Things.
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- ☐ To develop IoT infrastructure for popular applications.

Unit-1 **Introduction to Internet of Things (IoT):** Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Sensing, Actuation. **Design Principles for Connected Devices:** IoT/M2M systems layers and design standardization, communication technologies, data enrichment and consolidation, ease of designing and affordability.

Unit-2 **Hardware for IoT:** Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, wireless sensor networks, participatory sensing technology. **Embedded Platforms for IoT:** Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, NetArduino, Raspberry pi, Beagle Bone, Intel Galileo boards and ARM cortex.

Unit-3 **Networking & Communication aspects in IoT:** Wireless Medium access issues, MAC protocol survey, Survey routing protocols. **Sensor Networks:** Sensor deployment & Node discovery, Data aggregation & dissemination. Machine-to-Machine Communications

Unit-4: **Interoperability in IoT:** Device Interoperability and user Interoperability, Syntactic and semantic Interoperability. **Introduction to Arduino Programming:** Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IoT. Integration of Sensors and Actuators with Arduino.

Unit-5: **Challenges in IoT Design challenges:** Development Challenges, Security Challenges, Other challenges IoT Applications: Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city.

REFERENCE BOOKS: -

1. Olivier Hersent, David Boswarthick, Omar Elloumi "The Internet of Things key applications and protocols", willey.
2. Jeeva Jose, Internet of Things, Khanna Publishing House.
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After completion of this course, the students would be able to:

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CO2. Describe the functioning of hardware devices and sensors used for IoT.

CO3. Analyze network communication aspects and protocols used in IoT.

CO4. Apply IoT for developing real life applications using Arduino programming.

CO5. Develop IoT infrastructure for popular applications

Department of Computer Science and Engineering

Artificial Intelligence & Machine Learning

2290602

COURSE OBJECTIVES:

1. To provide the fundamental knowledge of Artificial Intelligence and Machine Learning.
2. To understand the basic areas of AI & ML including problem solving, knowledge representation, reasoning, models, Loss functions.
3. To apply machine learning and optimization techniques to make predictions

Unit – I:

Introducing Artificial Intelligence: Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, simulated annealing search, Local Search in Continuous Spaces. Games - Optimal Decisions in Games, Water-Jug problem, Travelling salesman problem, Alpha–Beta Pruning.

Unit – II:

Knowledge Representation in AI: Need for Knowledge representation. Types of Knowledge. Knowledge and Intelligence, AI Knowledge cycle. Various approaches to Knowledge Representation. Requirements of Knowledge Representation System. Intelligent agent.

Constraint Satisfaction: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

Unit – III:

Introduction to Machine Learning: Learning, Traditional vs Machine Learning, Types of ML, Classification and Regression model, Challenges faced by ML, Steps of developing an ML model, Bias and Variance, Regularization, Testing and validating, K cross validation, Hyper parameter tuning, Model Selection.

Model optimization and Evaluation: Confusion matrix, Recall, accuracy, precision, Model optimization, Cost/Loss Function, Derivative of cost function and non-derivative cost function, Gradient descent.

Unit – IV:

Supervised Machine Learning Algorithm with python: Supervised Machine Learning Algorithms, k-Nearest Neighbors, Linear Regression, Logistic Regression, Support Vector Machine, Decision Trees,Ensemble learner, Random Forests.

Unit –V:

Unsupervised Machine Learning with python: The Curse of Dimensionality, Projection, Clustering, K-Means, Limits of K-Means, Clustering for Image Segmentation, Clustering for Preprocessing, Clustering for Semi-Supervised. Explainable AI (XAI) or AI, Ethical AI, AutoML, Capstone Project and Case Studies: Build an intelligent agent or a knowledge-based chatbot

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RECOMMENDED BOOKS:

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, Prentice Hall.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill.
3. Pattern Recognition and Machine Learning, Christopher M. Bishop
4. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow by Aurélien Géron
5. Introduction to Machine Learning with Python by Andreas C. Müller & O'reilly

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COURSE OUTCOMES: After completing the course, the student will be able to:

CO1: Define basic concepts of Artificial Intelligence & Machine Learning.

CO2: Illustrate various techniques for knowledge representation and processing.

CO3: Apply various model optimization and tuning approaches.

CO4:Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering

CO5: Evaluate performance of machine learning algorithms on various data sets of a domain.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	1	1	-	1	1	2	3	3	1
CO2	3	3	3	1	2	1	-	-	1	1	3	3	3	1
CO3	3	3	3	2	3	1	1	-	1	1	2	3	3	2
CO4	3	3	2	2	3	1	-	-	1	1	2	3	3	3
CO5	2	2	3	3	3	1	-	-	2	3	3	3	3	2

1 - Slightly; 2 - Moderately; 3 – Substantially

Artificial Intelligence & Machine Learning

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List of Experiment

1. Implement Depth first search for water jug problem
2. Write a Program to find the solution for travelling salesman Problem
3. Write a program to implement 8 puzzle problem
4. Write a program to implement Hill Climbing Algorithm
5. Write a program to implement A* Algorithm and AO* Algorithm
6. Perform exploratory data analysis and visualization after importing a .CSV file.
   - ☐ Handle missing data by detecting and dropping/ filling missing values.
   - ☐ Transform data using different methods.
   - ☐ Detect and filter outliers.
   - ☐ Perform Vectorized String operations on Pandas Series.
   - ☐ Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.
7. Implement Various Regression algorithm for House Price Prediction (USA housing Dataset) and compare there accuracy using scikitlearn
   - ☐ Linear Regression
   - ☐ Polynomial Regression
   - ☐ Support Vector machine
8. Implement Regularized Regression for house price prediction and evaluate there accuracy using sckitlearn.
   - ☐ Ridge Regression
   - ☐ Lasso Regression
9. Implement Various Classification algorithm for iris data set and evaluate there performance.
   - ☐ Navie Bayes Classifier
   - ☐ Logistic Regression
   - ☐ Support vector Machine
   - ☐ Decision tree
10. Implement Various ensemble on housing and iris dataset and evaluate there performance
    - ☐ Voting classifier
    - ☐ Random Forest (Bagging and pasting)
11. Implement principle component analysis on any choosen dataset
12. Implement various clustering algorithm on choosen dataset
    - ☐ K-Mean
    - ☐ DBSCAN

Artificial Intelligence & Machine Learning

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List of Skill Based Mini Project

Artificial Learning Project

1. Build a bot which provides all the information related to students in college.
2. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python.
3. Build a Banking Bot
4. Online Assignment Plagiarism Checker

Supervised learning projects

5. Implement a regressor for any Medical disease diagnosis.
6. Implement a Cervical Cancer Risk Classifier
7. Regression model for Video Game Sales Prediction
8. Calories Burnt Prediction using Machine Learning
9. Vehicle Count Prediction From Sensor Data
10. Regression model for predicting if song will be popular
11. Regression model for Customer Behavior Analysis
12. Regression model to predict health insurance cost
13. Titanic Survival Prediction

Unsupervised Learning Projects

14. Spam and not Spam Classifier
15. Spotify Music Recommendation System
16. Online Payment Fraud Detection using Machine Learning in Python
17. Customer Segmentation using Unsupervised Machine Learning in Python
18. Target Customer segmentation.
19. Topic Modeling for Twitter Customer Reviews
20. Bank-Note Authentication

Department of Computer Science and Engineering

Artificial Intelligence & Machine Learning

290603(OLD)

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Model optimization and Evaluation: Confusion matrix, Recall, accuracy, precision, Model optimization, Cost/Loss Function, Derivative of cost function and non-derivative cost function, Gradient descent, Mini-batch Gradient, Descent (sckit-learn), Stochastic Gradient descent (sckit-learn), Momentum (sckit-learn).

Unit – IV:

Supervised Machine Learning Algorithm with python: Supervised Machine Learning Algorithms, k-Nearest Neighbors, Linear Regression, Logistic Regression, Log Loss, Support Vector Machine, Hinge Loss, Kernel Trick, polynomial Kernel, Decision Trees, Gini impurity, Ensemble learner, Random Forests.

Unit –V:

Unsupervised Machine Learning with python: The Curse of Dimensionality, Projection, Manifold Learning Principal component analysis, Clustering , K-Means, Limits of K-Means, Clustering for Image Segmentation, Clustering for Preprocessing, Clustering for Semi-Supervised

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