ANNEXURE-II

Syllabus

of

courses to be offered under Departmental Elective (DE) Course (in traditional mode) for

B. Tech. VII Semester

[Information Technology (Artificial Intelligence and Robotics)/ Artificial Intelligence (AI) and Data Science/ Artificial Intelligence (AI) and Machine Learning]

(Batch admitted in academic session 2021 – 22)

ROBOT OPERATING SYSTEM (240731)

COURSE OBJECTIVES

- Use ROS to inspect and debug a robotics system.
- Prototype simple command and control applications for a simulated mobile robot.
- Integrate a new sensor into the robot's ROS ecosystem.

Unit I

ROS Fundamentals: Introduction of Linux/UBUNTU, installation and use of virtual box machine, Linux file system and terminal, various commands, Remote Desktop access commands such as SSID, and use of Compiler/IDE in Linux, OOPs concepts with Linux terminal: C++ and Python in Ubuntu Linux, Introduction to Python Interpreter, review of fundamental of python such as functions, class.

Unit II

ROS architecture and philosophy, installation, ROS master, nodes, and topics, Console commands, Catkin workspace and build system, Launch-files, Gazebo simulator, Programming Tools, ROS package structure, Integration and programming.

Unit III

ROS C++ client library (roscpp), ROS subscribers and publishers, ROS parameter server, TF Transformation System, rqt User Interface, Robot models (URDF), Simulation descriptions (SDF).

Unit IV

ROS services, ROS actions (actionlib), ROS time, ROS bags, debugging strategies, Introduction to ROS2, architecture & philosophy, master, nodes, and topics, Console commands, Catkin workspace and build system

Unit V

ROS services, ROS actions (actionlib), ROS time, ROS bags, Debugging strategies, Introduction to ROS2. Case study: Using ROS in complex real-world applications such as ROS/Gazebo for Maritime Robotics, Home Robotics, UAVs.

RECOMMENDED BOOKS

1. Robot Operating System for Absolute Beginners: Robotics Programming Made Easy.
2. “Programming Robots with ROS” by Quigley, Gerkey and Smart.
3. “The Linux Command Line” by William Shotts.
4. “It-Yourself Guide to the Robot Operating System: Volumes” by Patrick Goebel.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 identify the fundamentals of operating systems dedicated to Robots.
CO2 interpret various case studies of ROS application.
CO3 apply spatial transformation to obtain forward and inverse kinematics through programming.
CO4 determine the robot dynamics problems for path planning and Programming.
CO5 assess the working principle of various ROS debugging processes.
CO6 develop applications of robots in industry.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3			2		2	1		3	2	
CO2	3	3	3	3	1	2		2					3	1
CO3	3	3	3	3			1				1			2
CO4	3	3	3	3		1		1	3		2	2		
CO5	3	3	3	3	2	2			2					
CO6	3	3	3	3			2	2		2	2	3	2	2

HUMANOID ROBOTICS (240732)

COURSE OBJECTIVES

- To introduce students with the mechanism and design of humanoid robots.
- To elucidate the technical challenges with humanoid robots.
- To discuss the potential roles of humanoid robots in society, w.r.t. social and ethical aspects, and applications.

Unit I

Research on Humanoid Robot, Overview of ASIMO and its significance in humanoid robot research, Anatomy and structure of ASIMO, Design considerations for stability, mobility, and dexterity in ASIMO, Actuators, sensors, and hardware components used, Communication Capabilities of ASIMO, Introduction to NAO Humanoid Robotics, NAO Robot Vision and Perception, NAO robot features, capabilities and limitations of the NAO robot, Social and cognitive aspects of human-robot interaction.

Unit II

Humanoid Mechanism and Design, Kinematics and Dynamics of a humanoid robot, Zero Moment Point (ZMP) overview, Measurement of ZMP, 2D and 3D walking pattern generation.

Unit III

Motion Planning and Control: Robot-Whole body motion, Whole body motion patterns to dynamically stable motion, remote operation of humanoid robot.

Unit IV

Introduction to Memory Modeling in Humanoid Robotics, Memory Architectures: Von Neumann architecture, Neural network-inspired memory architectures, Hybrid memory systems, Memory Modeling Applications: Natural language processing and dialogue systems, Object recognition and scene understanding, Behavior adaptation and learning.

Unit V

Application of Humanoids: Humanoid Robots for Entertainment-Theme park, Humanoid Robots in Education-Robots role in teaching, Humanoid-like robot in Special Education, Next generation Industrial Robot, Inclusion of Humanoid Robots in Human Society-Ethical issues.

RECOMMENDED BOOKS

1. Kajita, Shuuji, Hirohisa Hirukawa, Kensuke Harada, and Kazuhito Yokoi. Introduction to humanoid robotics. Vol. 101. Springer Berlin Heidelberg, 2014.
2. Nenchev, Dragomir N., Atsushi Konno, and Teppei Tsujita. Humanoid robots: Modeling and control. Butterworth-Heinemann, 2018.
3. Burdet, Etienne, David W. Franklin, and Theodore E. Milner. Human robotics: neuromechanics and motor control. MIT press, 2013.
4. Henze, Bernd. Whole-Body Control for Multi-Contact Balancing of Humanoid Robots: Design and Experiments. Vol. 143. Springer Nature, 2021.
5. Lynch, Kevin M., and Frank C. Park. Modern robotics. Cambridge University Press, 2017.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 define the technical aspects of various types of humanoid robot.
CO2 explain the details of mechanism and design of humanoid robots.
CO3 interpret the ZMP and the dynamics of humanoid robots.
CO4 examine the Biped walking pattern.
CO5 determine the whole-body motion of a humanoid robot.
CO6 develop the trends of humanoid robots in society.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3			2		2	1		3	2	
CO2	3	3	3	3	1	2		2					3	1
CO3	3	3	3	3	1		1				1			2
CO4	3	3	3	3		1		2	3		2	2		
CO5	3	3	3	3	2	2			2				2	
CO6	3	3	3	3	2			2		2	2	2	2	2

AUGMENTED AND VIRTUAL REALITY (240734/270733/280733)

COURSE OBJECTIVES

- Understand Fundamental Concepts of AR, VR, and MR.
- Study various hardware components, such as tracking systems, motion capture systems, data gloves, and visual displays.
- Identify and address key challenges in AR and VR, including technological, design, and user experience issues.

Unit I

Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR ,VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality. AR / VR Applications

Unit II

Introduction to Virtual Reality (VR): Introduction, History, Basic features of VR systems, Architecture of VR systems, VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays.

Unit III

Physiology of Human Vision & Visual rendering: Physiology of the human visual system, , eye movements & implications for VR, Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.

Unit IV

Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Unit V

Augmented Reality (AR): Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems.

RECOMMENDED BOOKS

1. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
3. Understanding Augmented Reality, Concepts and Applications, Alan B. Craig, Morgan Kaufmann, 2013.
4. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson
5. Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell
6. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 Differentiate Between AR, VR, and MR

CO2 Describe the architecture and components of AR and VR systems

CO3 Develop methods for locomotion, manipulation, and social interaction within virtual environments.

CO4 Analyze how humans perceive depth, motion, and color, and how these perceptions are utilized in AR and VR rendering techniques.

CO5 Illustrate the principles of motion in real and virtual worlds

CO6 Demonstrate the ability to design, develop, and implement AR and VR solutions for practical applications.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3									2	1
CO2	3	3	3	3									2	1
CO3	3	3	3	3	3				3		2	2	2	1
CO4	3	3	3	3	3	2							2	1
CO5	3	3	3	3	3								2	1
CO6	3	3	3	3									2	1

GENERATIVE AI (270731/280731)

COURSE OBJECTIVES

- To understand and implement various generative model architectures, such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and flow-based models.
- To apply generative AI techniques to solve real-world problems in fields such as computer vision, natural language processing, and creative arts.
- To analyze the ethical implications and societal impact of generative AI technologies.

Unit I

Overview of Artificial Intelligence and Machine Learning: Definitions and history, Types of AI (Narrow AI, General AI); Introduction to Generative AI: Definition and scope, Key differences from discriminative models, Capabilities of Generative AI; Basic Concepts of Probability and Statistics.

Unit II

Generative Models and Architectures: Types of Generative Models: Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), Flow-based models; Deep Learning Foundations: Neural networks, Training and optimization, Regularization techniques; GANs architecture and training process; Common challenges and solutions; Variants of GANs (e.g., DCGAN, CycleGAN).

Unit III

Advanced Generative Techniques: Variational Autoencoders (VAEs): Theoretical foundations, Encoder-decoder architecture, Applications and examples; Flow-based Generative Models: Normalizing flows, RealNVP, Glow models; Other Generative Techniques: Autoregressive models (e.g., PixelRNN, PixelCNN), Transformer-based models for generation (e.g., GPT).

Unit IV

Applications of Generative AI: Image and Video Generation: Style transfer, Image synthesis, Video generation and prediction; Text Generation and Natural Language Processing (NLP): Language models, Text-to-text generation, Chatbots and conversational AI; Music and art generation; Drug discovery and molecular design; Data augmentation and anomaly detection.

Unit V

Ethical and Societal Implications: Ethical Considerations in Generative AI: Bias and fairness, Privacy concerns, Deepfakes and misinformation; Societal Impact: Job displacement, Impact on creative industries, Legal and regulatory aspects; Future Trends and Directions: Current research trends, Future applications and innovations, Multidisciplinary collaboration.

RECOMMENDED BOOKS

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
3. "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani
4. "Ethics of Artificial Intelligence and Robotics" by Vincent C. Müller.
5. "Generative Adversarial Networks" by Ian Goodfellow et al. (2014).
6. "Deep Generative Models" by Jakub M. Tomczak and Tijmen Blankevoort.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1	Illustrate the basic concepts, scope and significance of generative AI.
CO2	Comprehend different types of generative models and their architectures and functioning of GANs.
CO3	Implement the VAEs and flow-based models.
CO4	Explore advanced generative techniques like autoregressive and transformer-based models.
CO5	Apply generative AI techniques to practical problems.
CO6	Analyze the ethical implications, societal impact and challenges associated with generative AI.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1		1				2					
CO2	3	3	3	3	3				3			1	2	1
CO3	3		1		3				3		2	1	2	
CO4	1	3	2	2	3		1	3	3	2	2		3	2
CO5	3	3			3	2	3	3	1	3	2	3	3	3
CO6			2			3	3		3		3		3	3

PATTERN RECOGNITION (270732/280732)

COURSE OBJECTIVES

- To analyze the usability of image processing applications.
- To choose appropriate ML algorithms for specific applications.
- To understand the implementation of python in the real-world application.

Unit I

Introduction to pattern Recognition: Overview of Pattern Recognition, Applications of Pattern Recognition, Pattern Recognition Techniques, Challenges in Pattern Recognition.

Unit II

Data Preprocessing Types of Data, Data Acquisition Techniques, Data Pre-processing Techniques, Image Enhancement Techniques, Feature Selection and Extraction Techniques, Feature Scaling and Transformation, Feature Extraction.

Unit III

Introduction to Deep Learning, Neural Networks and Convolutional Neural Networks, Deep Learning, Transfer Learning, Feature Fusion Techniques, Hyper-parameter Optimization, Ensemble Methods in Pattern Recognition.

Unit IV

Implementation: Overview of Object Detection and Segmentation, Feature-Based Object Detection, Deep Learning-Based Object Detection, Image Segmentation Techniques.

Unit V

Application: Introduction to Time Series Analysis, Applications of Time Series Analysis in Real-world application, Time Series Analysis Techniques, Time Series Analysis.

RECOMMENDED BOOKS

1. Pattern Recognition and Machine Learning by Christopher Bishop.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio Aaron Courville, 2016.
3. Deep Learning with Python by Francois Chollet.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1. explain the basic principle of image processing

CO2. apply the advance pattern recognition algorithms on images

CO3. analyse the potential of basic image processing

CO4. compare different pattern recognition algorithms on different domain

CO5. develop the real world application of pattern recognition

CO6. design basic programming structure for image processing using python

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3			2		2	1		3	2	
CO2	3	3	3	3	1	2		2					3	1
CO3	3	3	3	3			1				1			2
CO4	3	3	3	3		1		1	3	2	2	2	2	
CO5	3	3	3	3	2	2			2					
CO6	3	3	3	3	2		2	2		2	2	3	2	2

ANNEXURE-III

Syllabus
of
courses to be offered under Open Category (OC)
Courses (in traditional mode) for
B. Tech. VII Semester
for students of other departments
(Batch admitted in academic session 2021 – 22)

STATISTICAL PROGRAMMING WITH R (OC-2)

COURSE OBJECTIVES

- To understand the principles of traditional and computational statistics
- To develop proficiency in R programming, and apply computational statistics techniques

Unit I

Introduction to R: R Commands, Objects, Functions, Simple Manipulations, Matrices and Arrays, Factors, Lists, Data Frames. Introduction to Statistics: Traditional vs. Computational Statistics, Data Import and Manipulation in R, Exploratory Data Analysis (EDA).

Unit II

Scripts, Logical Operators, Conditional Statements, Loops in R, Switch Statement, Creating List and Data Frames, List and Dataframe Operations, Recursive List, Function Creation in R, Statistical Functions in R.

Unit III

Data Visualization in R, Implementing Statistical Functions in R, Implementing algorithms for estimation and hypothesis testing, Utilizing R packages for specialized statistical techniques.

Unit IV

Estimation Techniques, Implementing estimation techniques in Parameter Estimation in Practice, Application of estimation techniques to real-world datasets, Interpretation of estimated parameters within the context of the problem domain, Strategies for model selection and validation in computational statistics.

Unit V

Introduction to Randomization Techniques, Random sampling and random assignment principles, Bootstrapping and permutation tests as randomization techniques, Implementing Randomization Techniques in R, Randomization in Large Datasets, Efficient algorithms for random sampling and permutation in R.

RECOMMENDED BOOKS

1. Givens, G. H. and Hoeting, J. A. (2013). Computational Statistics (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.
2. Gentle, J. E. (2009). Computational Statistics. New York, NY: Springer.
3. An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics) by Gareth James (Author), Daniela Witten (Author), Trevor Hastie (Author), Robert Tibshirani (Author)
4. Wendy L. Martinez and Angel R, "Martinez Computational Statistics," Chapman & Hall/CRC, 2002.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1: Compare and contrast traditional and computational statistics, explaining the role of computation as a tool of discovery
CO2: Implement computational statistics techniques using the software R.
CO3: Estimate statistical functions or parameters by selecting and implementing appropriate computational statistics techniques
CO4: Evaluate the choice of applying a specific computational statistics technique to a given problem.
CO5: Apply randomization techniques to extract information from large data sets.
CO6: Generate graphical displays as a tool for analyzing both large data sets and computational statistics techniques.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	1	2	3	3	2	3	3	2
CO2	3	3	3	3	3	3	2	1	2	3	3	2	3	3
CO3	3	3	3	3	3	2	1	2	3	3	2	3	3	3
CO4	3	3	3	2	2	1	2		3	2	2	3	2	3
CO5	3	2	2	3	3	1	2		2	3	2	2	2	2
CO6	3	3	3	3	3	3	2		2	2		2	3	3

Centre for Artificial Intelligence

DATABASE MANAGEMENT SYSTEM (OC-2)

COURSE OBJECTIVES

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical and network models.
- To understand and use data manipulation language to query, update and manage a database.

Unit I

DBMS: Database Approach v/s Traditional File Approach, Advantages of Database System, Database Users and Administrator, Database System Environment, Application Architectures, Schemas, Instances, Data Independence, Data Models: Hierarchical Data Model, Network Data Model & Relational Data Model, Comparison between Models. Entities and Relationship Model: Entity types, Entity sets, Attributes and Keys, Relationship Types and Sets, Constraints, Design issue, E-R Diagram, Weak Entity Sets.

Unit II

Relational Model: Structure of Relational Databases: Relation, Attribute, Domain, Tuples, Degree, Cardinality, Views, Database Relations, Properties of Relations, Attributes, Keys, Attributes of Relation, Domain Constraints, Integrity Constraints. Relational Algebra: Concepts and Operations: Select, Project, Division, Intersection, Union, Division, Rename, Join etc.

Unit III

SQL: Purpose of SQL, Data Definition Language (DDL) Statements, Data Manipulation Language (DML) Statements Update Statements & Views in SQL, Data Control Language (DCL), Triggers.

Unit IV

Relational Database Design: Purpose of Normalization, Data Redundancy and Update Anomalies, Functional Dependency, Process of Normalization, Various Normal Forms: 1NF, 2NF, 3NF, BCNF, Decomposition, Desirable Properties of Decomposition: Dependency Preservation, Lossless Join, Problems with Null Valued & Dangling Tuple, Multivalued Dependencies.

Unit V

Transaction Management: Transaction Concept, Transaction State, Concurrent Executions, Serializability: Conflict and View Serializability, Concurrency Control: Lock-Based Protocol, Recovery: Log-Based Recovery.

RECOMMENDED BOOKS

1. Database System Concepts, Abraham Silberschatz Henry F. Korth S. Sudarshan, McGraw-Hill 6th Edition.
2. Database Management System, Raghu Ramakrishnan Johannes Gehrke, McGraw Hill 3rd Edition.
3. Fundamentals of Database System, Elmasri & Navathe, Addison-Wesley Publishing, 5th Edition.
4. An Introduction to Database Systems, Date C. J, Addison-Wesley Publishing, 8th Edition.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 demonstrate the concepts of different types of database systems.
CO2 apply relational algebra concepts to design database systems.
CO3 make use of queries to design and access database systems.
CO4 analyze the evaluation of transaction processing and concurrency control.
CO5 determine the normal form of the relation.
CO6 design an ER diagram/database system for a real world application.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3			2		2	1		3	2	
CO2	3	3	3	3	1	2		2					3	1
CO3	3	3	3	3			1				1			2
CO4	3	3	3	3		1		1	3		2	2		
CO5	3	3	3	3	2	2			2					
CO6	3	3	3	3			2	2		2	2	3	2	2

ANNEXURE-IV

Experiment list/ Lab manual
for
Departmental Laboratory Course (DLC) of
B. Tech. VII Semester
[Information Technology (Artificial Intelligence and Robotics)/ Artificial Intelligence (AI) and Data Science/ Artificial Intelligence (AI) and Machine Learning]

(Batch admitted in academic session 2021 – 22)

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

Deemed to be University

(Declared under Distinct Category by Ministry of Education, Government of India)

NAAC Accredited with A++ Grade

Centre for Artificial Intelligence

DEPARTMENTAL LAB (ROS Lab) (240701)

Program List

1. Implement basic Linux commands for terminal operations in ROS environment
2. Implement virtual machine concepts and Installation of ROS environment.
3. Creation of basic inter nodes communication between Talker listener nodes.
4. Create ROS2 nodes using the Turtlesim simulator of the ROS environment.
5. Executing Turtlesim for running nodes, teleoperations, swamping and remapping of nodes.
6. Implementation of Mitsubishi Robotic Arm, calibration and Melfa programming basics.
7. Perform object Pick and Drop operations through Mitsubishi robotic arm.
8. Perform various operations on Smorphy robotic kit and implement its remote navigation process.
9. Design a voice based action synchronization for a humanoid Robot.

COURSE OUTCOMES

After completing this, the students will be able to:

CO1. illustrate the basics of Robot operating system simulation interface.

CO2. explain basic Linux commands for ROS installation.

CO3. demonstrate node concepts in multi-Robot system communication.

CO4. apply basic robotic actions with Robotic arm

CO5. analyze the robotic prototypes used in various industries

CO6. demonstrate various actions using humanoid robots.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3			2		2	1		3	2	
CO2	3	3	3	3	1	2		2					3	1
CO3	3	3	3	3			1				1			2
CO4	3	3	3	3		1		1	3		2	2		
CO5	3	3	3	3	2	2			2					
CO6	3	3	3	3			2	2		2	2	3		

DEPARTMENTAL LAB (ROS Lab) (240701)

Skill based Mini Projects

Micro Project:

- Study of Raspberry pi board
- Understanding the line follower system.
- Create an electronic obstacle avoidance system.
- Implement a SLAM model.
- Implement GaZebo in ROS
- Perform kinematics for Robotics arm
- Design a Gesture control flow in Robotic Applications
- Implement various functions of Drones.

Macro Projects:

- Perform operations with Raspberry pi board sensor interfacing units
- Implement different sensors used in line follower.
- Design a SLAM and Turtle sim node navigation system
- Implement path planning with Turtle sim node system
- Perform various functions pertaining to drone kinematics
- Design a joint coordinate system for Robotic Arm
- Implement a Lidar sensor in robot Navigation.
- Perform Humanoid Calibration.

Mini Project:

- Design of Line Following Robot using ROS with Raspberry Pi.
- Design of obstacle avoidance Robot using ROS with Raspberry Pi.
- Implementation of SLAM using ROS TurtleSim.
- Path Planning robot using Raspberry and ROS.
- Drone simulation using Gazebo and ROS
- Robotic Arm simulation using ROS
- Gesture controlled robot using ROS
- Design an Autonomous mobile robot using ROS

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

Deemed to be University

(Declared under Distinct Category by Ministry of Education, Government of India)

NAAC Accredited with A++ Grade

Centre for Artificial Intelligence

DEPARTMENTAL LAB (AR-VR Lab) (270701/280701)

COURSE OBJECTIVES

- Enable students to develop practical skills in creating and manipulating 3D models and animations for use in AR and VR environments.
- Enable students to create intuitive and responsive user interfaces for interacting with virtual objects.
- Support students in developing projects that showcase their ability to innovate and think critically.

List of Experiments

1. Overview and setting up Unity for AR/ VR development
2. Develop a scene in Unity that includes: cube, plane and sphere, apply transformations on the 3 game objects.
3. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene.
4. Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component, material and Box collider to the game Objects
5. Study on enhancement and improving markers with Vuforia engine.
6. Implement and visualize scaling and rotation transformations on a 3D object in an AR environment.
7. Implementing Marker-less and Marker-Based AR with Vuforia engine
8. Implementing Animations in AR/VR Using Vuforia
9. Creating 3D objects using Blender.

COURSE OUTCOMES

After completing this, the students will be able to:

CO1. Create new projects and properly configure them for AR/VR application development

CO2. Develop Marker-Based and Markerless AR Applications

CO3. Develop and import 3D models into AR/VR environments

CO4. Integrate VR input and output hardware to enhance the user experience.

CO5. Develop applications that simulate real-world scenarios, such as a virtual gym or training simulations.

CO6. Identify areas for improvement and implement changes to optimize performance and user satisfaction.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3				2	1	2	2	2	1
CO2	3	2	3	2	3				2	1	2	2	2	1
CO3	3	2	3	1	3				2	1	2	2	2	1
CO4	3	2	3	1	3				2	1	2	2	2	1
CO5	3	3	3	2	3	2	1		2	3	2	3	2	1
CO6	3	3	3	3	3	2	1		2	3	3	3	2	1

DEPARTMENTAL LAB (AR-VR Lab) (270701/280701)

Skill based Mini Projects

Micro/ Macro Projects : Game Development

(The developed game should be a single player game .Score Card is to be displayed for each game. Apply your creativity for making game interesting)

1. Develop a VR Golf Game. The scene should contain a play area (golf course), which consists of a series of cups/holes each having different scores. Display the score card.
2. Develop a VR game in Unity such that on each gun trigger click, destroy the cubes placed on the plane and gain a score point .
3. Develop a VR Basketball Game.
4. Develop an AR bowling game with one image target .

Mini Projects

1. Develop a VR environment for flying helicopter
2. Develop a VR environment for moving car simulation.
3. Develop a VR environment to visit a zoo
4. Develop a VR environment for virtual Gym
5. Create a multiplayer VR game (battlefield game).