Reg. No.: 23BRS1131

Name :

VIT

Vellore Institute of Technology

Continuous Assessment Test CAT – II – March 2025

Programme	:	B.Tech (BRS)	Semester	:	Winter 2024-2025
Course Title	:	Robot Programming	Code	:	BCSE423L
			Class Nbr(s)	:	CH2024250502632
Faculty(s)	:	Dr. Santoshi Ganala	Slot	:	G1 + TG1
Time	:	1 ½ Hour	Max. Marks	:	50

Answer All questions

Q.No.	Sub. Sec.	Question Description	Marks
1		In a 3D environment, consider a robot tasked with navigating a complex indoor space and performing precision-based tasks (such as picking and placing objects). Using your understanding of sensors, algorithms, and mathematical concepts, design a method for determining the robot's pose, position, and orientation. Explain how you would integrate different sensors (e.g., LIDAR, cameras, IMUs) and computational algorithms (e.g., SLAM, sensor fusion) to achieve accurate real-time localization. Additionally, provide a scenario where failure in determining any of these elements would lead to a breakdown in task performance.	10
2		In the context of the Robot Operating System (ROS), explain the following concepts: Workspace, Packages and Bags. Provide an example scenario in which you would use workspaces, packages, and bag files to develop and test a robot's navigation system. How do these components interact within the ROS ecosystem?	10
3		Write programs for Action Server and Action Client to control a mobile robot's movement to a specified target in a 2D plane. The Action Client should send the target coordinates (x, y) to the Action Server. The Action Server will calculate the distance between the robot's current position and the target using the Euclidean distance formula. As the robot moves towards the goal, the Action Server should provide continuous feedback with the current distance to the target. The robot is assumed to always be oriented towards the target, and it moves in that direction. When the robot reaches the target, the Action Server will indicate success (i.e., return a successful result). Additionally, write an Action file that defines the input (goal coordinates), feedback (current distance), and output (success/failure) for the Action communication. Euclidian distance (d) $=\sqrt{[(x2-x1)^2+(y2-y1)^2]}$	10

4 Write ROS service nodes to control the movement of a simple turtlesim or bot. You need to create two services: /target_distance and /target_distance_with_velocity.

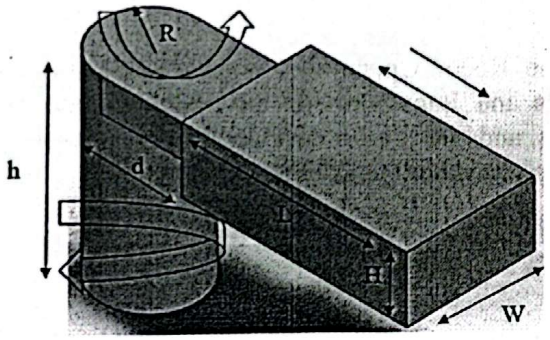
/target_distance service: This service should be called with a target distance (in meters). The turtlesim should move forward by the specified distance if the linear velocity is positive. If the linear velocity is negative, the turtlesim should not move. Once the turtlesim has moved the specified distance, the service should return true and wait for the next call.

/target_distance_with_velocity service: This service should be called with both a target distance (in meters) and a change in velocity value. The turtlesim should move toward the target distance at the specified velocity and change velocity as per the provided change_velocity value. The service should return true once the turtlesim reaches the target distance.

In both services, the server should handle the movement logic and return true when the goal is reached. Make sure the turtlesim moves appropriately based on the velocity values provided by the client. 10

distance= velocity *(current_time – previous_time)

5 Create an URDF (Universal Robot Description Format) model of manipulator that looks like a picture shown below. Assume that origin of each object is at its centre of mass.



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Continuous Assessment Test CAT – I – JAN 2025

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Course Title	: Robot Programming	Code	:	BCSE423L
		Class Nbr(s)	:	CH2024250502632
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Q.No.	Sub. Sec.	Question Description	Marks
1		Appraise in detail about the validity of seven criteria to qualify a self-operating, software-controlled device as a robot.	10
2		Draw a simplified skeleton for a ground based robot. Summarize the working mechanism of programmable components with a suitable example.	10
3		Clarify the applications of robots that work in ROS and popular sensors that support ROS.	10
4		Write and explain the basic code for advertising a topic, publishing and subscribing on ROS1. Publisher node should publish any two consecutive integers along with system time on the topic counter at a rate of 2 Hz. Subscriber nodes to receive and display the information on terminal.	10
5		List the steps (beginning from workspace creation) and changes need to be done in system files to define a custom message for the following. {Name, Age, Weight and Gender}. Write the code for a publisher to publish the above custom defined message.	10