Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY, BANGALORE –56

(An Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi)

Skill Laboratory Report 2025-26

on

Title: "Arduino Based Embedded System"

Second-Year 4th Semester Students (Batch: 2024)

Date: 4th April 2026 to 26th April 2026

Venue: Computer Lab

Resource Persons: Mr. Eshwarappa B and Mr. Bhadrappa HR
Company: Himadri Power Control and Embedded System.
Faculty Members: Mr. Rajesh LV and Dr. Mukundaswamy MS
Staff Members: Balakrshnachar and Manjula JG

Coordinator	**HOP**
Dr. Mukundaswamy. MS	**Dr.Arpitha Raju B**

Conducted

by

Department of Electrical and Electronics Engineering

1. INTRODUCTION

Skill Lab on “Arduino-Based Embedded System Using Sensors and Moving Car”

The Six-Day Skill Laboratory on “Arduino-Based Embedded Systems” was conducted from 04-04-2026 to 26-04-2026 at the Department of Electrical and Electronics Engineering, Dr. Ambedkar Institute of Technology, Bengaluru. The program was organized for 4th-semester students with the objective of providing hands-on experience and industry-oriented knowledge in the field of embedded systems.

The training sessions were delivered by expert resource persons, Mr. Eshwarappa B and Mr. Bhadrappa H.R., from Himdri Power Control and Embedded Systems. Their expertise significantly contributed to bridging the gap between theoretical concepts and real-world industrial applications.

The rapid advancement of embedded systems has transformed modern engineering applications, particularly in automation, robotics, and smart technologies. This skill lab titled **“Arduino-Based Embedded System”** is designed to provide hands-on training in developing real-time applications using microcontrollers and various sensors.

The training focuses on the use of the Arduino platform as a flexible and user-friendly tool for designing embedded systems. Students are introduced to interfacing and programming different types of sensors such as temperature and humidity sensors, motion detectors, infrared (IR) sensors, and ultrasonic sensors. These sensors enable the system to interact with the surrounding environment by detecting physical parameters and responding accordingly.

A key highlight of the skill lab is the development of a sensor-based moving car. This involves integrating hardware components like motors, motor drivers, and sensors with Arduino to build an intelligent system capable of navigation, obstacle detection, and automated movement. Through this practical approach, students gain a deeper understanding of sensor integration, signal processing, and control logic.

Overall, this skill lab bridges the gap between theoretical concepts and real-world applications, enhancing students’ skills in embedded system design, programming, and problem-solving.

Brief Overview and Objectives of Skill Lab: “Arduino-Based Embedded Systems”

The Skill Laboratory on “Arduino-Based Embedded Systems” was conducted from 04-04-2026 to 26-04-2026 at the Department of Electrical and Electronics Engineering, Dr. Ambedkar Institute of Technology, Bengaluru. The program was organized for 4th-semester students with the primary objective of providing hands-on experience and industry-oriented knowledge in the field of embedded systems.

The training focused on the use of the Arduino platform as a flexible and user-friendly tool for designing and developing embedded applications. Students were introduced to interfacing and programming various sensors, including temperature and humidity sensors, motion detectors, infrared (IR) sensors, and ultrasonic sensors. These sensors enable systems to interact with the surrounding environment by sensing physical parameters and generating appropriate responses.

A key highlight of the skill lab was the development of a sensor-based moving car. This activity involved the integration of hardware components such as motors, motor drivers, and sensors with the Arduino controller to create an intelligent system capable of navigation, obstacle detection, and automated movement.

Through this hands-on approach, students developed a deeper understanding of sensor interfacing, signal processing, and control logic, thereby enhancing their practical skills and readiness for real-world embedded system applications.

Brief Overview and Objectives of Skill Lab: Hands-on “Arduino-Based Embedded Systems”

The Skill Lab on “Arduino-Based Embedded Systems” was designed to provide practical, hands-on experience to students in developing real-time embedded applications. The program focused on interfacing and programming various sensors such as temperature and humidity sensors, ultrasonic sensors, object detection modules, and light intensity sensors.

The primary objective was to enable students to understand how embedded systems interact with the physical environment by sensing and processing real-world parameters. A key application developed during the lab was a sensor-based moving car, which integrated multiple sensors for obstacle detection, environment sensing, and automated movement.

Through these activities, students gained practical knowledge in sensor interfacing, control logic, and system integration, enhancing their skills in designing intelligent embedded systems.

Importance of Imparting Practical Skills for Second-Year (4th Semester) EEE Students on "ardiuno based embedded systems - various sensors used and Its Applications"

Imparting practical skills to second-year (4th semester) Electrical and Electronics Engineering (EEE) students through a hands-on program on **Arduino-based embedded systems using various sensors and their applications** plays a crucial role in building a strong technical foundation and industry readiness.

At this stage of their academic journey, students transition from basic theoretical concepts to more application-oriented learning. Introducing platforms like Arduino Uno helps bridge the gap between theory and real-world implementation. By working directly with sensors such as temperature, humidity, ultrasonic, infrared (IR), and light sensors, students gain a deeper understanding of how embedded systems interact with the physical environment.

One of the key benefits is the development of **hands-on technical competence**. Students learn how to interface sensors, write embedded C/C++ programs, and analyze real-time data. For example, working with an Ultrasonic Sensor for object detection or a Infrared Sensor enables them to visualize concepts that are otherwise abstract in textbooks.

Practical exposure also enhances **problem-solving and analytical thinking skills**. Students encounter real-world challenges such as noise in sensor data, calibration issues, and hardware-software integration problems. Solving these issues encourages logical reasoning and debugging skills, which are essential for any engineering role.

Another important aspect is the promotion of **innovation and creativity**. Through mini-projects like obstacle-avoiding robots, smart lighting systems, or environmental monitoring setups, students are motivated to design and develop their own solutions. These activities nurture creativity and foster an engineering mindset focused on innovation.

Additionally, such training improves **interdisciplinary learning**. Arduino-based systems integrate concepts from electronics, programming, control systems, and communication. This holistic exposure prepares students for advanced domains like IoT, robotics, and automation.

The program also contributes significantly to **industry preparedness and employability**. Familiarity with embedded systems, sensor interfacing, and prototyping tools is highly valued in industries related to automation, consumer electronics, and smart technologies. Early exposure gives students a competitive advantage in internships and placements.

Moreover, working in teams during lab sessions promotes **collaboration and communication skills**, while presenting project outcomes builds confidence and technical articulation.

In summary, imparting practical skills on Arduino-based embedded systems equips second-year EEE students with essential technical knowledge, hands-on experience, and problem-solving abilities. It not only strengthens their academic learning but also prepares them for real-world engineering challenges, innovation, and future career opportunities in emerging technological fields.

The need and motivation for imparting practical skills to second-year (4th semester) EEE students on *Arduino-based embedded systems using various sensors and their applications* arise from several academic, technological, and industry-driven factors.

At the second-year level, students typically possess foundational knowledge in electrical circuits, basic electronics, and programming, but often lack exposure to real-time implementation. Using platforms like Arduino Uno creates a strong **need to bridge the gap between theory and practice**. Without hands-on experience, students may struggle to understand how concepts such as signal processing, interfacing, and control systems function in real-world applications.

There is also a growing **motivation driven by rapid technological advancements**. Modern engineering fields increasingly rely on embedded systems, automation, and smart sensing technologies. Learning to work with devices based on principles like Ultrasonic Sensor and Infrared Sensor motivates students to explore real-life applications such as smart homes, robotics, industrial automation, and IoT systems.

Another important need is to **develop core technical competencies early**. At this stage, introducing sensor interfacing, coding, and hardware integration builds confidence and prepares students for advanced subjects in later semesters, such as embedded systems design, control engineering, and communication systems.

From a career perspective, there is strong **motivation linked to employability and industry expectations**. Industries expect graduates to have practical exposure to microcontrollers, sensors, and prototyping tools. Early training helps students become job-ready by equipping them with relevant skills required in domains like automation, electric vehicles, and smart grid technologies.

The program also fulfills the need to **encourage innovation and project-based learning**. When students work on mini-projects—such as obstacle-detecting robots, smart lighting systems, or environmental monitoring—they become motivated to think creatively, experiment, and develop problem-solving abilities beyond textbook learning.

Additionally, there is a **motivation to enhance interdisciplinary learning**. Arduino-based systems combine electrical engineering, electronics, and programming, helping students understand how different domains integrate to create functional systems. This is essential for modern engineering applications.

Finally, such practical training addresses the need for **active learning and engagement**. Compared to passive classroom lectures, hands-on activities increase student interest, participation, and retention of concepts, making learning more effective and enjoyable.

In summary, the need and motivation for this practical skill training lie in bridging theoretical gaps, aligning with modern technological trends, enhancing employability, fostering innovation, and building a strong foundation for future engineering applications.

3. Day wise Report:

3.1. Day 1

The program began with an inauguration session followed by an introduction to robotics and its applications. The session provided an overview of robotics in modern industries and real-world use cases.
In the second session, we learned about embedded systems, which act as the brain of robotic systems by integrating controllers, sensors, and actuators.
The third session covered controllers, focusing on microcontrollers such as Arduino and Raspberry Pi, along with sensors, actuators, and driver circuits used for controlling robotic operations.

Day 2 (Tuesday)

The focus of the day was **Sensors and Actuators Integration**. We studied how sensors and actuators work together to enable robots to interact with their environment.
Topics included:

- Integration techniques in robotics
- The **Perception–Action Cycle**, where sensors collect real-time data and actuators perform actions
- Types of sensors (cameras, LiDAR, IMU) and actuators (motors, grippers)

Day 3 (Wednesday)

The session introduced **3D modeling and 3D printing**. We explored how CAD tools are used to design robotic components.
Key learning points:

- Designing functional and aesthetic parts using CAD software
- Basics of additive manufacturing
- Use of tools like Fusion 360 and Blender
- Concepts of robotic applications and large-scale automated production

Day 4 (Thursday)

This day focused on **PCB design and assembly**.
Topics covered:

- Understanding printed circuit boards (PCBs)
- Designing layouts for robotic components
- Surface Mount Technology (SMT) and through-hole components
- Solder paste application and soldering techniques
- Inspection and testing of PCB assemblies
- Role of robotic PCB assembly in improving efficiency and accuracy

Day 5 (Friday)

The topic for the day was **Basic IoT (Internet of Things) Connectivity**.
Key concepts:

- Introduction to IoT and its role in robotics
- Connecting robots to the internet for data exchange

- Autonomous systems and cloud integration
- Applications such as remote monitoring, control, and predictive maintenance
- Importance of data in improving robotic decision-making

Skills Hands-on: Basic IoT (Internet of Things) Connectivity in Robotics

Overview:

This hands-on module introduces students to the fundamentals of *Internet of Things (IoT)* connectivity and its integration with robotic systems. The focus is on enabling robots to communicate with external devices, cloud platforms, and users through the internet. Students learn how data collected from sensors can be transmitted, monitored, and utilized for intelligent decision-making in real-time applications.

Key Concepts and Practical Skills:

• Introduction to IoT and Its Role in Robotics

Students understand the concept of IoT as a network of interconnected devices that communicate and share data. The role of IoT in robotics is emphasized, highlighting how connectivity enhances automation, intelligence, and remote accessibility of robotic systems.

• Connecting Robots to the Internet for Data Exchange

Hands-on activities include interfacing microcontrollers (such as Wi-Fi-enabled boards) with sensors and actuators, and establishing communication using protocols like HTTP or MQTT. Students learn to send and receive data between robots and external systems.

• Autonomous Systems and Cloud Integration

Students explore how robotic systems can operate autonomously by integrating with cloud platforms. They gain exposure to storing sensor data, processing it in the cloud, and triggering automated responses based on predefined conditions.

• Applications: Remote Monitoring and Control

Practical exercises demonstrate how robots can be monitored and controlled remotely using mobile apps or web dashboards. Examples include controlling a robot's movement or monitoring environmental parameters from a remote location.

• Predictive Maintenance Concepts

Students are introduced to how IoT data can be used to predict system faults or maintenance needs by analyzing trends and performance data from robotic components.

Day 6 (Saturday)
The final day focused on **Mini Integrated Build and Demonstration**.
Activities included:

- Building a complete robotic system by integrating hardware and software
- Combining sensors, motors, and microcontrollers
- Introduction to ROS (Robot Operating System) and AI integration
- Final evaluation of the training program
- Valedictory session, certificate distribution, and feedback

Skill Hands-on: Robotics and Its Applications – Final Day Activities (For 2nd Semester EEE Students)

Overview:
The final day of the Skill Lab on *Robotics and Its Applications* was dedicated to a **Mini Integrated Build and Demonstration**, where students applied all the concepts learned during the training. This session emphasized the complete development cycle of a robotic system—from design and assembly to testing and demonstration—providing a comprehensive hands-on experience.

Activities Conducted:

• Building a Complete Robotic System

Students worked in teams to design and develop a functional robotic model by integrating both hardware and software components. This activity helped consolidate their understanding of robotic system architecture.

• Integration of Sensors, Motors, and Microcontrollers

Participants combined various components such as sensors (IR/ultrasonic), DC motors, motor drivers, and microcontrollers to create a working system. They learned real-time interfacing, signal processing, and control mechanisms.

• Introduction to ROS (Robot Operating System) and AI Integration

Students were introduced to the basics of ROS and its significance in advanced robotics. A brief overview of Artificial Intelligence (AI) applications in robotics—such as decision-making and automation—was also provided to give insight into future technologies.

• Testing, Demonstration, and Performance Evaluation

Each team demonstrated their robotic model, showcasing functionalities such as movement control, obstacle detection, or line following. Evaluation was carried out based on design, implementation, teamwork, and performance.

• **Valedictory Session and Certificate Distribution**

The program concluded with a valedictory session, where faculty members appreciated the efforts of the students. Certificates were distributed to participants in recognition of their successful completion of the training.

• **Feedback and Reflection**

Students shared their feedback and learning experiences, highlighting the practical knowledge gained, challenges faced, and suggestions for improvement. This helped in assessing the effectiveness of the skill lab.

Outcome:
The final day activities enabled students to gain confidence in building and demonstrating a complete robotic system. It reinforced teamwork, problem-solving, and practical implementation skills, marking a successful culmination of the robotics skill training program.