Department of Artificial Intelligence & Data Science

Date: 23/4/2026

Notice

Sensor for Engineering Applications [1ADPE214]

ISE Activity III

2025-26

All students of **Second Year (SY)** are hereby informed that the **ISE-III** activity for the subject **Sensor for Engineering Applications [1ADPE214]** will be conducted in the form of a Microproject Exhibition and Presentation. Details are as follows:

- **Activity Title:** Micro-project
- **Date:27/4/2026 Time:** 3.15pm to 4.15pm

Activity Details:

1. **Team Formation :** Divide students into small teams (4-5 members per team). Each team will be assigned one real-world scenario. Possible scenarios
2. **Presentation**
3. **Evaluation**

All students are instructed to come prepared as per their respective groups. Each group must bring their microproject hardware and be ready for the presentation and exhibition.

Attendance is mandatory.

Prof. Priyanka S Patil

Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

(NAAC A++) (An Autonomous Institute)

Department of Artificial Intelligence & Data Science

Date:

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ISE-3

Name of Course	Sensor for Engineering Applications			
Course Code	1ADPE214			
Examination	**ISE-3**	Academic Year:2025-26	Class:SY Btech	Semester: EVEN
Activity Undertaking	Micro-project			
Course Outcome	1ADPE214_3,1ADPE214_4, 1ADPE214_5, 1ADPE214_6			

Rubrics

Rubric for Microproject

Criteria	Exemplary	Proficient	Developing	Needs Improvement
Concept and sensor choice CO3	Clear problem definition; appropriate sensor selected with strong justification	Problem and sensor choice are mostly clear with minor gaps	Basic idea present but weak justification or mismatched sensor	Unclear concept or wrong/no sensor selection
4	4	3	2	1
Design and Circuit CO4	Well-structured design; correct circuit; all components properly connected	Design is clear with minor errors in connections	Design incomplete or has noticeable errors	No proper design or non-functional setup
4	4	3	2	1
Implementation CO5	Proper implementation, components integrated smoothly	Minor issues in integration	Partial implementation	No Proper implementation
4	4	3	2	1
Prototype working CO6	Fully functional model; accurate and stable output	Works with minor issues or inconsistencies	Partially working model	Not working or no prototype
4	4	3	2	1
Result & Presentation CO6.	Proper results with analysis; clear report and confident explanation	Results shown with basic explanation	Limited results or weak presentation	No proper results or poor explanation
4	4	3	2	1

Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

(NAAC A++) (An Autonomous Institute)

Department of Artificial Intelligence & Data Science

Photos:

Prof. Priyanka S Patil

ISE-3

Name of Course	Sensor for Engineering Applications			
Course Code	1ADPE214			
Examination	**ISE-3**	Academic Year:2025-26	Class:SY Btech	Semester: EVEN
Activity Undertaking	Micro-project			
Course Outcome	1ADPE214_1, 1ADPE214_2, 1ADPE214_3,1ADPE214_4, 1ADPE214_5, 1ADPE214_6			

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Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)

Department of Artificial Intelligence and Data Science

Micro-project ISE-2 Activity-III.

27/4/2026.

Sr.No.	Group No.	Roll No.	Name	Topic Name	Sign	Marks(20)
1	1	2028	Tanmay Arjun Salunkhe	Smart Radar System,		
2		2022	Chidanand Guruprasad Telsan			17
3		2025	Kunal Ankush Pisal		K.A.Pisal	17
4		2019	Kunal Maruti Shitole			17
5		2023	Rajwardhan Dipak Kadam		Rajkadam	18
6	2	2018	Sarang Satish Patil	Automatic Irrigation System		18
7		2001	Prem Satish Salunkhe			18
8		2020	Pratik Machindra Bikkad			18
9		2021	Rushikesh Shashikant Kaware			18
10	3	2016	Sanika pawar	Smart dustbin		19
11		2015	prajkta shinde			19
12		2006	Saniya Shaikh			19
13		2036	pooja jadhav			17
14	4	2024	Sushant Aladar	Smart Sanitizer		18
15		2026	Ayaz Ahmad			18
16		2035	Amit Kadam			18
17		1034	Sharvil Ghatage			18
18	5	2002	Nikita Pawar	Fire Alarm ~~Automatic Street Light~~ sensor.		17
19		2010	Amruta More			17
20		2011	Piyusha Salawanakar			17
21		2014	Vedanki Karande		Karande.	17
22	6	2004	Pradnya Yavatkar	Smart Water level monitoring system		17
23		2013	Shreya Shete			17
24		2033	Prerna Zagade			17
25		2027	Anjali Mohite			17
26	7	2007	Prachi Ankush Jagadale	automatic stair light		18
27		2008	Aishwarya Shrikrishna More			18
28		2009	Vaishnavi Jaywant deshmukh			18
29		2012	Sukhada Sadanand Kulkarni			18
30	8			health monitoring system		
31		2005	sanika balkrishna kumbhar			18
32		2031	nandini balkrishna shrivas			18
33		2031	snehal vijay jagdale			18
34	9	2037	Chinmay Girish Deshmukh	Smart Home		
35		2003	Pranav Dyaneshwar Patil		Patil	
36		2017	Sumit Chandrasen Thorat		S.C.Thorat	
37		2030	Tejas Satish Jadhav			
38		2029	Aditya Ravindra Salve			

Course Coordinator

Sant Dnyaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

ISE III Micro-Project Report

Smart Sanitizer

An Autonomous Proximity-Triggered Hygiene System

Subject: Sensors for Engineering Applications

Subject Teacher: Prof. Priyanka S. Patil

Department of Artificial Intelligence & Data Science

Sr. No.	Name	Roll No.
1	Sushant Aladar	2024
2	Ayaz Ahmad	2026
3	Sharvil Ghatage	2034
4	Amit Kadam	2035

Academic Year 2024–25

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1. Introduction

Automated hygiene systems have become a cornerstone of modern public infrastructure, driven by a global shift toward contactless interaction and infection prevention. The COVID-19 pandemic accelerated demand for touchless dispensing solutions across hospitals, offices, schools, and transit hubs.

The Smart Sanitizer is a micro-project developed as part of the course Sensors for Engineering Applications at Annasaheb Dange College of Engineering and Technology (ADCET), Ashta. It presents a fully hardware-driven, autonomous sanitizer dispenser triggered by infrared proximity detection — eliminating the need for any microcontroller, software, or firmware.

Sensor-Based Automation

Infrared and ultrasonic sensors enable hands-free triggering, drastically reducing cross-contamination at high-touch points in public spaces. By leveraging IR sensor technology, the system achieves near-instantaneous response with minimal power consumption.

Infrared Technology

IR sensors offer a reliable, low-cost, and robust contactless trigger mechanism — ideal for compact, standalone hygiene systems. The operating range of 5–30 cm provides an optimal detection zone for hand-based interaction at sanitizer dispensing stations.

Hardware-Driven Control

Self-contained, hardware-only control systems eliminate software dependencies, ensuring instant response and simplified maintenance. The design philosophy prioritizes simplicity, reliability, and accessibility — enabling deployment without embedded systems expertise.

2. Problem Statement

Existing sanitizer dispensing solutions present a range of technical, economic, and practical challenges that limit their effectiveness in real-world deployment. The following key issues were identified during the project conception phase:

Contact-Based Infection Risk

Manual dispensers require physical contact with a shared surface, creating a direct vector for pathogen transmission — the very problem they aim to solve. This fundamental design contradiction undermines their utility in high-risk hygiene environments.

Inconsistent Dispensing

Without automated control, users dispense variable amounts — leading to either wasteful over-dispensing or insufficient sanitization coverage. Consistent dose control is critical for both hygiene effectiveness and resource optimization.

High Cost of Commercial Solutions

High-end automated dispensers rely on complex electronics, microcontrollers, and power adapters — making them expensive and infrastructure-dependent. This limits their deployment in low-resource settings such as rural schools, community centres, and small businesses.

Energy Inefficiency

Most commercial units are not optimized for low-power operation, limiting portability and increasing operational costs in off-grid environments. There is a clear need for battery-friendly designs that maintain performance without continuous mains power.

Maintenance Complexity

Lack of compact, modular, and maintenance-friendly standalone designs makes field servicing difficult without specialized technical knowledge. A simpler architecture reduces downtime and enables non-technical personnel to perform routine upkeep.

3. Project Objectives

The Smart Sanitizer project was developed with the following clearly defined engineering objectives:

Standalone Battery-Powered Design

Design a fully self-contained, portable touchless sanitizer dispenser powered by a compact toy battery pack — requiring no external power supply, wall socket, or mains infrastructure.

Photonic-to-Electromechanical Control Loop

Implement a complete signal chain from IR photon detection through comparator logic to electromechanical relay actuation of the pump — demonstrating a closed-loop hardware control system.

Eliminate Microcontroller Dependency

Achieve full automation using only discrete hardware components — no programming, no firmware, no software stack required. This makes the system accessible, replicable, and maintainable by non-engineers.

Zero-Latency Hardware Response

Leverage hardware comparator logic for instantaneous trigger response — eliminating boot time, interrupt latency, and software overhead present in microcontroller-based alternatives.

Portability & Easy Deployment

Ensure the system is compact, lightweight, and deployable in any public space with minimal installation effort and infrastructure requirements — making it suitable for rapid deployment in emergency or resource-constrained scenarios.

4. System Architecture

The Smart Sanitizer operates as a fully hardware-based closed-loop control system. The signal flows from the IR sensor through a comparator to the relay and pump — with no microcontroller in the loop. The modular architecture ensures each stage can be independently replaced or upgraded.

Signal Path

The system follows a precise, linear signal flow:

- Object detected → IR reflection received by photodiode
- Comparator evaluates photodiode signal vs. preset threshold voltage
- Output goes LOW (Active Low logic) when threshold is exceeded
- Relay coil energized → relay contacts close
- Pump activates → sanitizer dispensed
- Hand removal resets the entire cycle

Power Chain

The power distribution is carefully staged to maintain electrical isolation:

- 4× AA Toy Battery Pack (~6V DC) — primary power source
- Powers IR sensor module (10–20 mA operating current)
- Powers relay coil via sensor output pin
- Relay contacts independently switch the pump circuit
- Pump draws 200–500 mA independently through relay contacts

The power supply chain runs from the toy battery pack to the IR module and relay, then to the submersible pump — maintaining clean electrical isolation between low-current sensing and high-current actuation stages.

5. Hardware Components

The Smart Sanitizer is built from readily available, low-cost electronic components — making it accessible, repairable, and easy to replicate. The following components constitute the complete bill of materials:

Component	Function	Specifications
IR Proximity Sensor Module	Detects hand presence via reflected IR beam	Range: 5–30 cm, Adjustable sensitivity
5V Relay Module	Galvanic isolation between sensing and actuation	Coil current: ~70 mA, 5V DC
Submersible Pump (DC)	Dispenses sanitizer on relay actuation	3–6V DC, 200–500 mA
Toy Battery Pack (4× AA)	Portable primary power supply	~6V DC, no adapter required
Breadboard / PCB & Wiring	Structural and electrical interconnection	Prototyping or final PCB assembly
LED Status Indicator	Visual feedback for power and dispensing	3.3–5V, 5–10 mA (Optional)

6. Principle of Operation

The Smart Sanitizer operates through a precise sequence of photonic detection, analog signal comparison, and electromechanical actuation — all executed in hardware with zero software overhead. The operational cycle proceeds as follows:

Step 1 – IR Emission

The IR LED continuously emits an infrared beam from the sensor module toward the detection zone. This emission is constant during system power-on and does not require any trigger to initiate.

Step 2 – Reflection Detection

The onboard photodiode detects reflected IR signal when a hand enters the proximity range (5–30 cm). The strength of the reflected signal is proportional to the proximity and reflectivity of the detected object.

Step 3 – Comparator Evaluation

An internal op-amp comparator evaluates the photodiode signal against a preset threshold voltage, adjustable via the onboard potentiometer. When the reflected signal exceeds this threshold, the comparator output changes state.

Step 4 – Relay Trigger

The output pin goes LOW (Active Low logic) — energizing the relay coil and closing the pump circuit. This is the standard behaviour of most IR proximity modules and must be accounted for in relay wiring.

Step 5 – Pump Activation

Relay contacts close → pump runs → sanitizer is dispensed. Hand removal causes the reflected IR signal to drop below threshold, resetting the comparator output to HIGH, de-energizing the relay, and stopping the pump. The entire cycle is complete.

Note: Active Low Logic — The IR sensor output pin goes LOW (0V) when an object is detected, and HIGH when no object is present.

7. Electrical Design & Isolation

A critical design challenge is the large current differential between the sensing and actuation stages. The relay provides the essential galvanic isolation that protects the IR sensor from pump inrush currents.

Current Budget

Component	Current Draw	Voltage
IR Sensor Module	10–20 mA	5V DC
Relay Coil	~70 mA	5V DC
Submersible Pump	200–500 mA	3–6V DC
LED Indicator	5–10 mA	3.3–5V

Protection Mechanisms

Two key protection mechanisms are incorporated into the electrical design:

Galvanic Isolation

The relay coil is energized by the sensor signal while the relay contacts independently switch the pump — there is no direct electrical connection between the sensing and actuation circuits. This prevents high pump currents from back-feeding into the sensitive IR sensor module.

Flyback Diode

A freewheeling diode is placed across the relay coil to suppress the Back EMF spike generated when the relay de-energizes. Without this protection, the collapsing magnetic field in the relay coil generates a reverse voltage spike that can permanently damage the IR sensor output pin. This protection is considered mandatory in the design.

The result is a safe, stable, long-life circuit that operates reliably without complex electronics, voltage regulators, or active protection ICs — demonstrating elegant hardware engineering through careful component selection.

8. Advantages & Limitations

A balanced technical assessment of the Smart Sanitizer system — highlighting its engineering strengths and identifying areas for future improvement.

Advantages

- Touchless Operation — Eliminates physical contact, directly reducing germ transmission at the point of use.
- Portable & Cost-Effective — Toy battery pack makes the system fully portable with a very low bill of materials cost.
- Zero-Latency Response — Hardware comparator logic triggers instantly with no boot time, interrupt latency, or software delay.
- Simple Construction — Modular design with off-the-shelf components makes maintenance and repair straightforward.
- No Programming Required — Fully hardware-driven; deployable by anyone without embedded systems or coding knowledge.

Limitations

- Fixed Detection Range — IR sensor operates within a fixed range of approximately 5–30 cm, limiting flexibility in different installation geometries.
- Battery Life Constraints — Continuous use depletes the AA battery pack relatively quickly, requiring periodic replacement in high-traffic locations.
- Ambient Light Interference — Strong ambient IR sources (direct sunlight, incandescent bulbs) may cause false triggers in the current design.
- No Fluid Level Monitoring — The current design lacks a fluid level sensor; the system cannot alert users when the sanitizer reservoir is empty.

9. Conclusion & Future Scope

Conclusion

The Smart Sanitizer project successfully designed and demonstrated a hardware-only autonomous sanitizer dispenser using IR sensing and relay-based electromechanical control. The project conclusively proves that effective automation does not require microcontrollers or software — discrete hardware logic is sufficient for reliable closed-loop control.

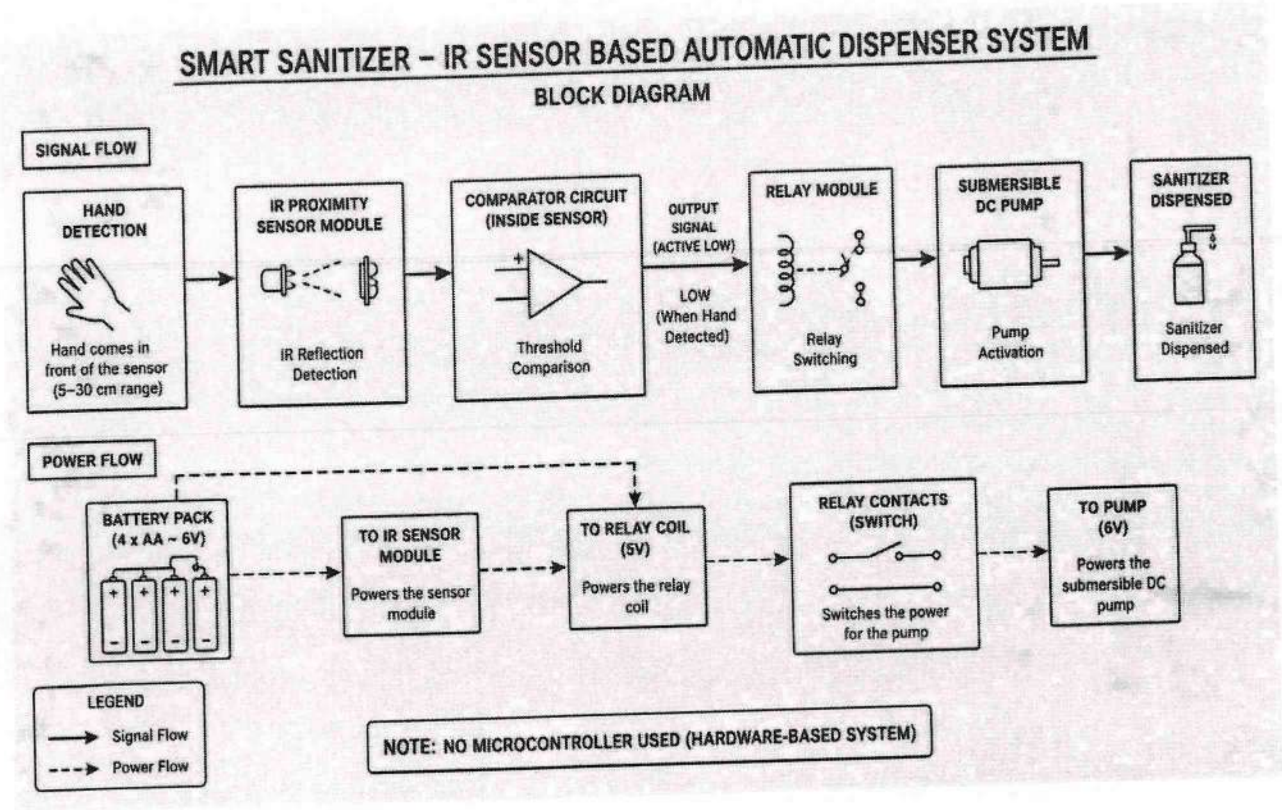
The system delivers a low-cost, portable, and immediately deployable hygiene solution with minimal infrastructure requirements and no programming expertise needed. It is directly applicable to public spaces, educational institutions, healthcare facilities, and community settings where accessible hygiene infrastructure is critical.

This project demonstrates that engineering elegance lies in simplicity — achieving reliable, real-world automation through thoughtful hardware design rather than software complexity.

Future Scope

- Ultrasonic Level Sensor — Integrate real-time fluid level monitoring to alert users before the reservoir runs empty, enabling proactive refilling.
- IoT Connectivity — Add an ESP8266/ESP32 module for remote usage tracking, analytics, and maintenance alerts via a web dashboard.
- Solar Power — Upgrade to a solar-powered supply for sustainable, off-grid operation in outdoor environments, extending field deployment range.
- Adjustable Sensitivity — Incorporate variable IR sensitivity control to adapt to different ambient light conditions and installation distances.
- Compact PCB Design — Design a custom PCB for mass production — reducing size, improving reliability, and enabling commercial deployment at scale.

BLOCK DIAGRAM :



— End of Report —