MAGNETIC POSITION DETECTOR

Non-Contact Sensing via Hall Effect & Op-Amp Window Comparator

Dept. of Electronics & Communication Engineering | NIT Raipur

THE PROBLEM & SOLUTION

- Mechanical switches fail — dirt, corrosion, wear over thousands of cycles
- Hall Effect sensor outputs analog voltage proportional to magnetic flux — zero mechanical contact
- **Window Comparator** defines exact detection proximity, not just presence

Components

- **SS49E** → Hall Effect Sensor
- **LM358N ×2** → U5 (Buffer) + U6 (Window Comp.)
- **7805A** → +5V Voltage Regulator
- **R1–R6, C1–C3** → Passive Network
- **Custom PCB** → Single-Layer, Hand-Etched

EasyEDA | Single-Layer PCB

HOW IT WORKS

(Decision Logic)

Permanent Magnet
Approaches SS49E sensor

↓

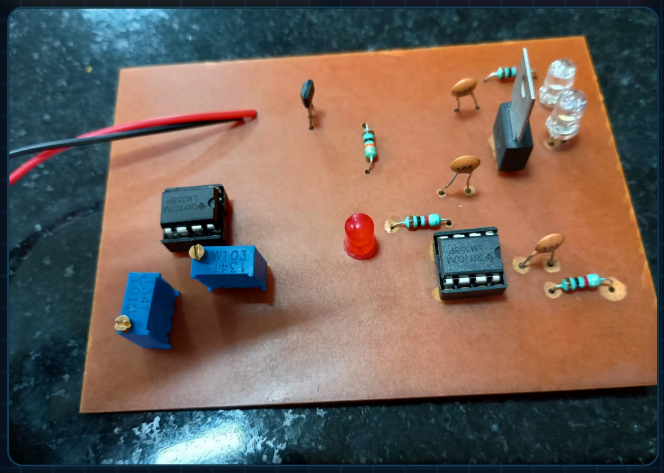
SS49E Hall Sensor (U2)
V_{sensor}: 0–5V analog output
Rests at ~2.5V with no field

↓

U5.1 — LM358N Buffer
Voltage Follower – Isolates sensor output

↓

U6.2 — LM358N	U6.1 — LM358N
Lower Bound	Upper Bound
$V_{sensor} > V_L$	$V_{sensor} < V_H$
(Comparator)	(Comparator)
↓	↓
YELLOW LED (D2)	RED LED (D1)
Field Approaching	Position Confirmed
Direct output	Direct output



FABRICATED PROTOTYPE
Hand-Etched Copper-Clad PCB | Single-Layer

- GREEN — Power On / Idle
- YELLOW — Field Approaching ($V_{sensor} > V_L$)
- RED — Detection Confirmed ($V_L < V_{sensor} < V_H$)

REAL-WORLD APPLICATIONS

Laptop Lid Detection
Magnet in display bezel detects lid closure, triggers sleep mode — zero mechanical contact

Industrial Position Sensing
Through-wall piston position detection in pneumatic and hydraulic actuators

Automotive ABS
Wheel speed sensing via rotating magnetic encoder ring

Smartphone Flip Cover
Screen auto-lock triggered by magnetic proximity of smart case

FUTURE SCOPE

- IoT via ESP32
- OLED Distance Readout
- Power MOSFET Output
- Multi-axis 3D Detection

Minor Project
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Submitted by:

Tripti Patel (24116102) | **Sai Santosh** (24116104)

B.Tech — Electronics & Communication Engineering

Dept. of ECE
NIT Raipur