Aim of the experiment

To construct a cockpit warning light control system using the generalised simulator. The users will be able to state the output condition for a given set of combinations of input. The users will be able to select the correct Boolean expression for a given combinational circuit.

The user will be able to construct and simulate the cockpit warning light control system and verify the results with the generalised simulator.

Theory

1, INTRODUCTION:-

The beauty of basic logic gates is their versatile use that ranges from almost all day to day life examples to highly sophisticated application areas including bio medical field, industrial field, automobile controls and flight control systems. This experiment demonstrates the use of AND-OR-INVERT (AOI) logic in cockpit warning light.

2, APPLICATION: COCKPIT WARNING LIGHT CONTROL:-

A jet aircraft employs a system for monitoring the rpm, pressure and temperature values of its engines using sensors that operate as follows:

RPM Sensor:- A tachometer (revolution-counter, tach, rev-counter, RPM gauge) is an instrument measuring the rotation speed of a shaft or disk, as in a motor or other machine.
RPM (R) sensor output = 0 only when speed < 5500 rpm

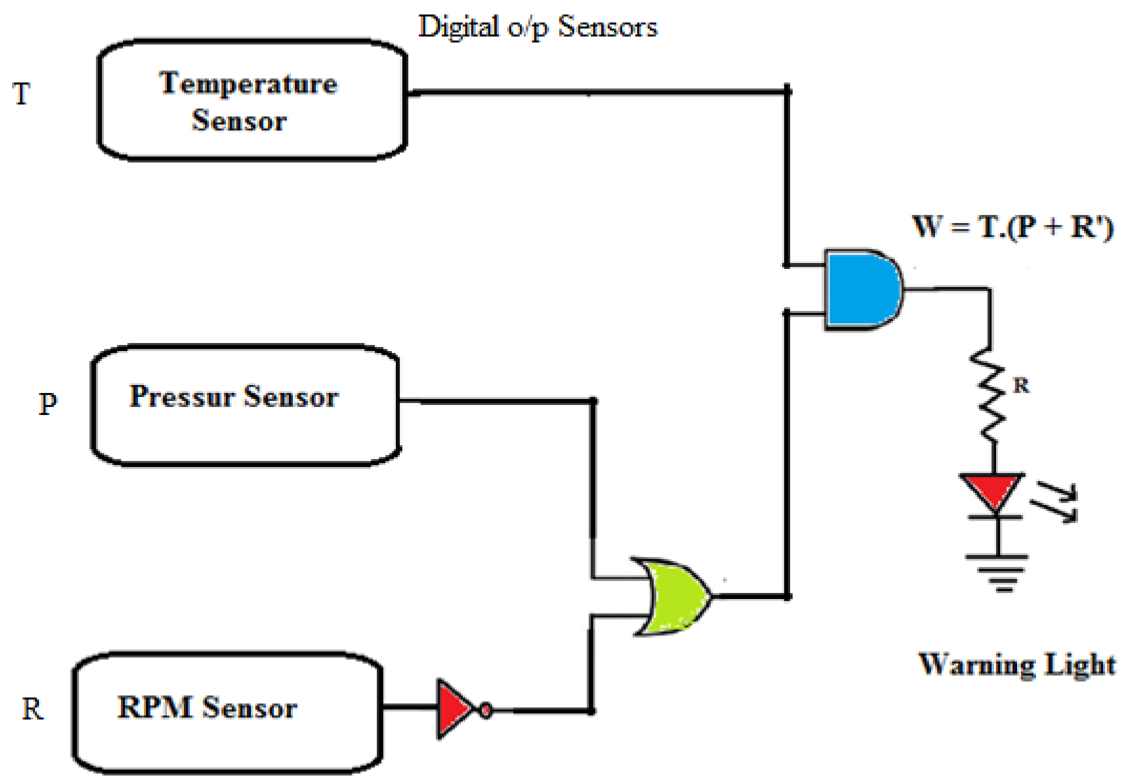
Pressure sensor:- A pressure sensor converts the pressure to a small electrical signal that is transmitted and displayed. These are also commonly called pressure transmitters because of this. Two common signals that are used are a 4 to 20 milliamps signal and a 0 to 5 Volts signal.
Pressure (P) sensor output = 0 only when pressure < 210 psi

Temperature sensor:-A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.
Temperature (T) sensor output = 0 only when temperature < 2100 F

3, CONCEPT:-

A warning light is turned ON and an ALARM is activated whenever the engine temperature exceeds 2100 F AND either the pressure exceeds 210 psi OR the speed drops below 5500 rpm. The truth table is constructed to get the Boolean expression.

Circuit



Truth Table

T	P	R	W = T.(P + R')
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Procedure

The non optimal conditions are conveyed through high signal i.e. 1.

The RPM sensor is OFF when the speed of the aircraft drops below 5500 rpm it gives a low signal i.e 0 as output, since the non optimal condition here is given out as low output by the sensor it is inverted using a not gate.

When the pressure exceeds 210 psi the pressure sensor is ON i.e. it gives high output i.e 1 and when the pressure is less than or equal to 210 psi the sensor is OFF and gives a low output i.e 0.

The temperature sensor is ON when the temperature exceeds 2100F and gives a high signal i.e. 1 and is OFF when the temperature is below 2100F and gives a low output i.e. 0.

Since the warning conditions are either speed drops below 5500 rpm or pressure exceeds 210 psi and Temperature exceeds 2100F.

The inverted RPM sensor signal & Pressure sensor signal are combined using OR gate, this combined signal is combined with the temperature signal using the AND gate.

The output signal of inverted RPM sensor signal OR'ed with Pressure sensor signal, which is ANDED temperature signal is received by the photodiode which emits red light as input signal.

The photodiode is activated & emits red light if the received input signal is high i.e. 1 when the either speed drops below 5500 rpm or pressure exceeds 210psi and temperature exceeds 2100F.

The photodiode is OFF & does not emit red light if it receives a low input i.e 0

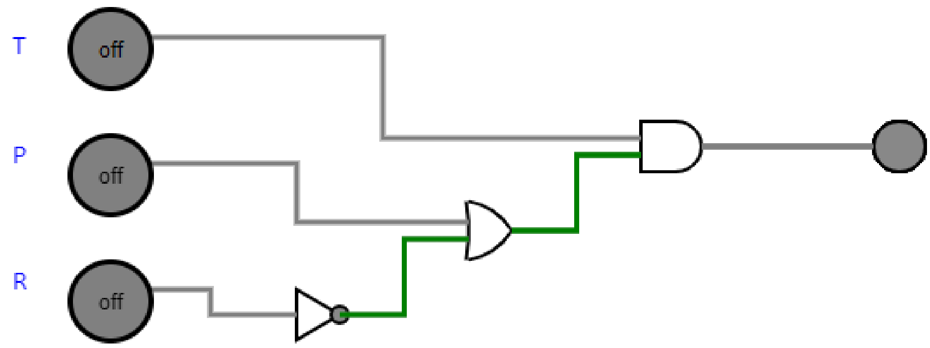
Simulation

Cockpit simulation using gates refers to the process of creating a simulation of an aircraft cockpit, where the inputs and outputs are controlled by electronic gates.

The simulation provides a realistic representation of the cockpit environment and systems, allowing pilots to practice and improve their skills without the need for a physical aircraft.

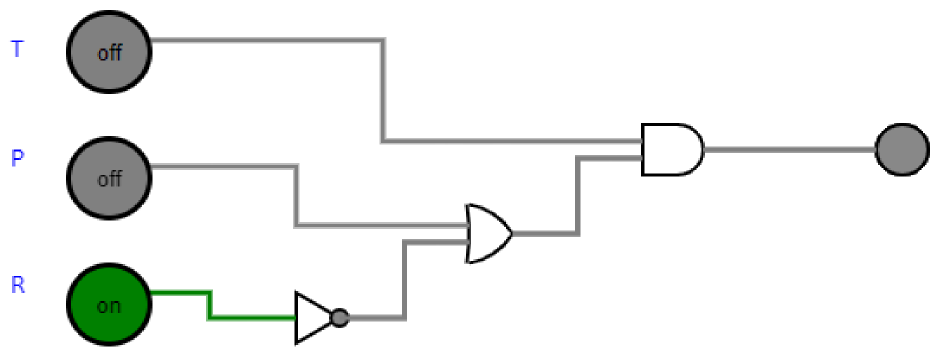
Following are the simulation cases for a cockpit simulation:

Case 1: All three temperature, pressure and RPM sensors are OFF.



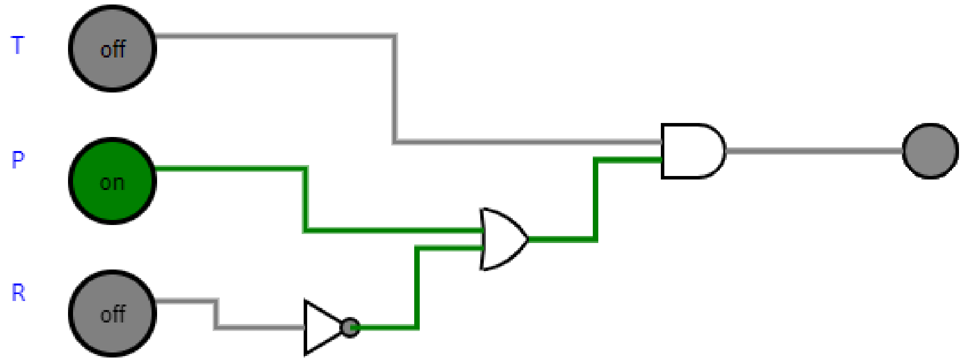
Here, RPM sensor gives low signal as input which passes through NOT gate to give high signal as output, which then combines with the low signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's low signal using AND gate to give low signal as output. Since the photodiode receives low input, it is not activated so the warning light remains OFF.

Case 2: The temperature and pressure sensors are OFF and the RPM sensor is ON.



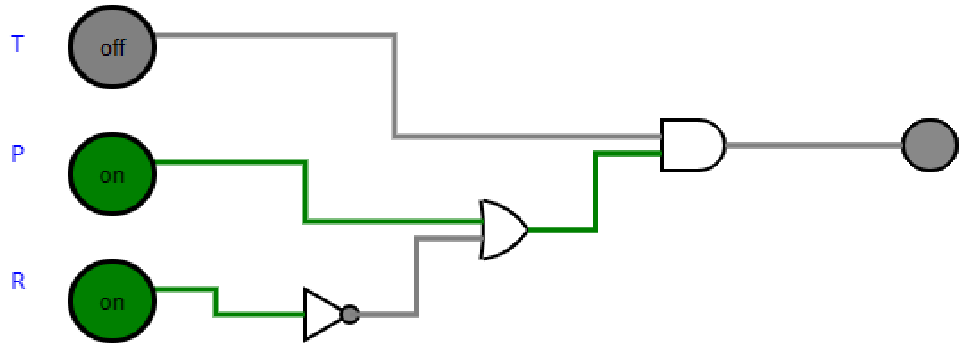
Here, RPM sensor gives high signal as input which passes through NOT gate to give low signal as output, which then combines with the low signal of pressure sensor using OR gate to give low signal as output. This low signal then combines with the temperature sensor's low signal using AND gate to give low signal as output. Since the photodiode receives low input, it is not activated so the warning light remains OFF.

Case 3: The temperature and RPM sensors are OFF and the pressure sensor is ON.



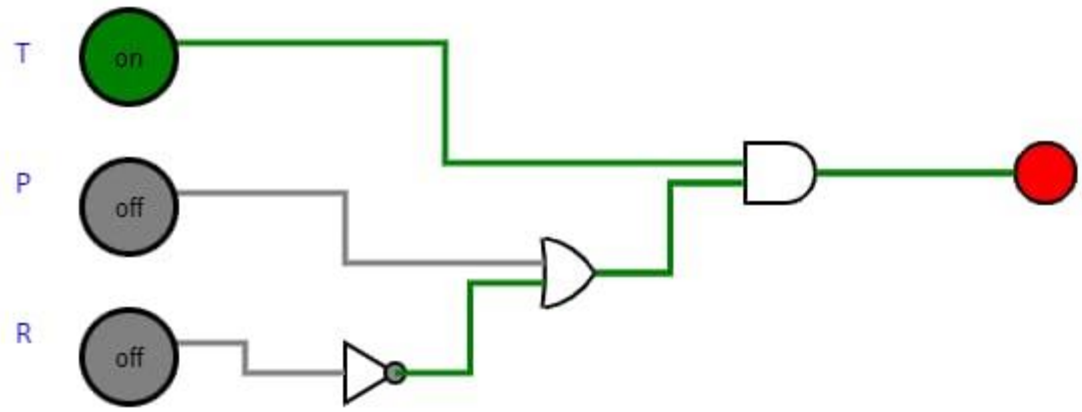
Here, RPM sensor gives low signal as input which passes through NOT gate to give high signal as output, which then combines with the high signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's low signal using AND gate to give low signal as output. Since the photodiode receives low input, it is not activated so the warning light remains OFF.

Case 4: The temperature sensor is OFF and the pressure and RPM sensors are ON.



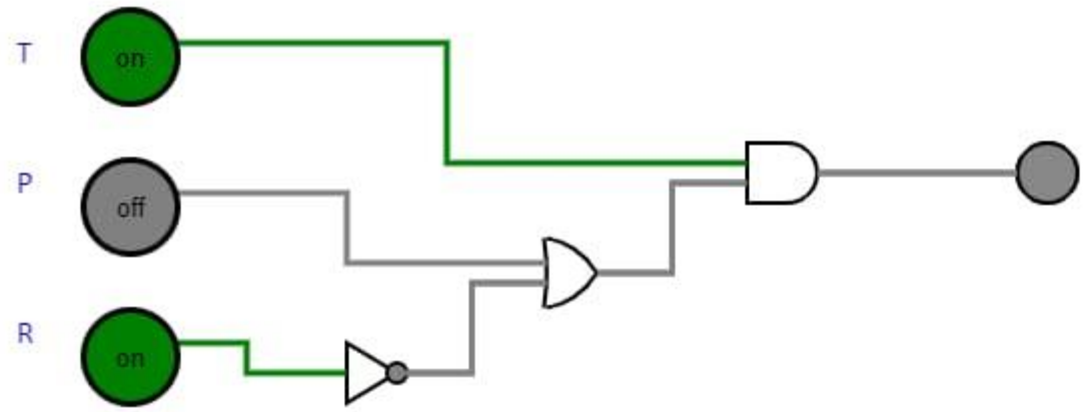
Here, RPM sensor gives high signal as input which passes through NOT gate to give low signal as output which then combines with the high signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's low signal using AND gate to give low signal as output. Since the photodiode receives low input, it is not activated so the warning light remains OFF.

Case 5: The RPM sensor and pressure sensors are OFF and the Temperature is ON.



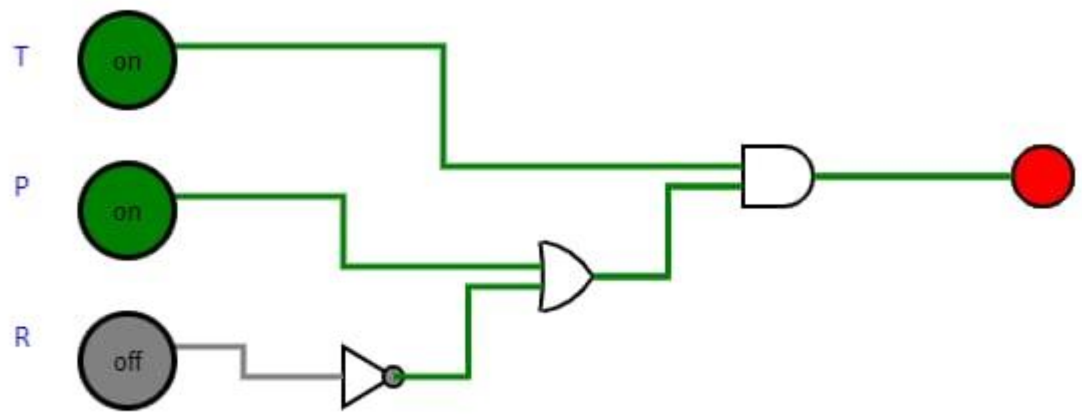
Here, RPM sensor gives low signal as input which passes through NOT gate to give high signal as output, which then combines with the low signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's high signal using AND gate to give high signal as output. Since the photodiode receives high input, it gets activated so the warning lights up.

Case 6: The RPM sensor and temperature sensors are ON and the pressure sensor is OFF.



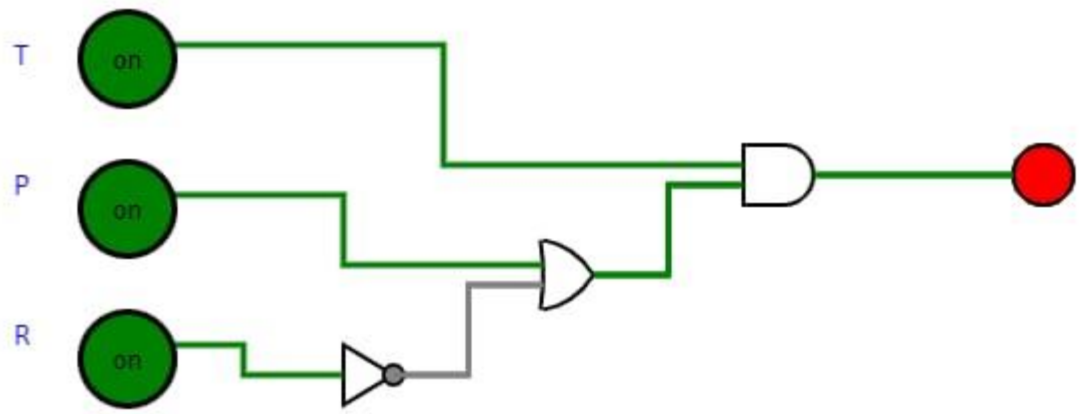
Here, RPM sensor gives high signal as input which passes through NOT gate to give low signal as output, which then combines with the low signal of pressure sensor using OR gate to give low signal as output. This low signal then combines with the temperature sensor's high signal using AND gate to give low signal as output. Since the photodiode receives low input, it does not get activated so the warning light is off.

Case 7: The pressure sensor and temperature sensors are ON and the RPM sensor is OFF.



Here, RPM sensor gives low signal as input which passes through NOT gate to give high signal as output, which then combines with the high signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's high signal using AND gate to give high signal as output. Since the photodiode receives high input, it gets activated so the warning light is on.

Case 8: All the three sensors are On.



Here, RPM sensor gives high signal as input which passes through NOT gate to give low signal as output, which then combines with the high signal of pressure sensor using OR gate to give high signal as output. This high signal then combines with the temperature sensor's high signal using AND gate to give high signal as output. Since the photodiode receives high input, it gets activated so the warning light is on.

Project Review Report

Subject:
Cockpit warning light control using basic logic gates.

Introduction:
This report presents the results of a review of a project aimed at analysing what students learned from their participation. The project was designed to provide students with hands-on experience and to enhance their knowledge and skills in the area of logic gates and their application in real life situations.

What we learnt:
Students learnt about the implementation of logic gates in the cockpit warning light. Students also learnt about the sensors used in its mechanism. This setup uses the basic logic gates i.e, OR- AND- and NOT- gate. An LED is used to indicate when the cockpit conditions become extreme. Depending upon the conditions in the truth table the LED glows indicating that conditions are not suitable to maintain flight. This experiment demonstrates the use of AND-OR-INVERT (AOI) logic in cockpit warning light.

Results:
The results of the review indicate that the students gained a deeper understanding of the topics covered in the project and improved their knowledge and skills in these areas. In particular, the students reported that they gained a better understanding of the importance of teamwork, communication, and problem-solving skills, as well as the importance of taking initiative and being proactive in their learning.

The students also reported that they appreciated the hands-on experience they gained from the project and felt that it helped them better understand the material they had learned in the classroom. They also reported that they felt more confident in their abilities to apply the knowledge and skills they learned in the project to real-world situations.

Conclusion:
Overall, the results of the review suggest that the project was successful in providing students with a deeper understanding of the topics covered and in enhancing their knowledge and skills in various areas of study. The hands-on experience and the opportunity to apply their learning in a practical setting was also valued by the students and helped them better understand the material.