Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 10, No. 4, October : 2023

# AUTOMOBILE TILT DETECTION SYSTEM

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Abstract
A vital part of modern vehicle safety technology, the automotive tilt detecting system works to improve the stability and safety of scooters/bikes under diverse driving circumstances. This device precisely detects and continuously monitors the tilting angle of a vehicle using real time sensor technology and clever algorithms. This system utilizes the MPU6050 sensor, which combines a three- axis accelerometer and a three-axis gyroscope, to measure changes in acceleration and angular velocity, enabling precise tilt angle calculations. The technology can deliver prompt alerts to stop potential rollover incidents and increase overall road safety by continuously analyzing the tilt data. Strategically positioned sensors within the vehicle are in charge of data analysis and make up the main components of the automotive tilt detection system. This technology contributes to overall road safety by providing timely warnings and enhancing vehicle stability during critical driving conditions.

Keywords: Automobile Tilt Detection System, vehicle safety, vehicle stability, tilt sensors, control unit, driver feedback system, vehicle stability control.

## I. Introduction

An automobile tilt detection system is a safety feature that helps to prevent accidents by detecting when a vehicle is about to roll over. The device employs sensors to determine the vehicle's tilt and warn the driver if it is in danger of toppling over. Automobiles with tilt detection systems are becoming more and more widespread because they can reduce the risk of fatalities and serious injuries. Tilt detection systems can actually cut the probability of rollover accidents by up to 50%, according to research by the National Highway Traffic Safety Administration (NHTSA).
Mechanical and electronic tilt detecting systems are the two basic varieties. The angle of the vehicle is measured by mechanical devices using a pendulum or another weight- sensitive instrument. The acceleration and spin of the vehicle are measured by electronic systems using accelerometers or gyroscopes.
Electronic tilt detection methods tend to be more expensive, but mechanical systems are typically less expensive and less accurate. Although more accurate, electronic systems might often be more expensive.
A crucial safety component that can help avoid accidents and save lives is tilt detection technology. Here are some of the benefits of using an automobile tilt detection system:

1. Can help to prevent rollover accidents
2. Can lower the danger of fatalities and major injuries
3. Can be more accurate than mechanical tilt detection systems

## II. Methodology

### 2.1 Materials/Components/Flowchart/Block Diagram/Theory

The Components required in our project are:

1. Breadboard - A vital prototyping tool for circuits is the breadboard, which may be used to build and test circuit connections without the use of soldering. The breadboard offers a practical surface for positioning and arranging the various parts needed for the tilt detection system. It is simpler to learn about and troubleshoot the circuit since the MPU6050 sensor, microcontroller, and supporting circuitry may be arranged and connected in a logical and organized way. A breadboard's modular design makes it simple to rearrange and reconfigure the circuit. By merely rearranging or adding components on the

breadboard, modifications and additions to the circuit can be done as the tilt detecting system develops. This adaptability enables quick experimentation and design improvement of the system.

2. LEDs of 4 different colours - An LED, or light-emitting diode, is a semiconductor device that produces light when an electric current passes through it. LEDs of different colours are used to indicate visual indication of tilt status. Green LED is used to indicate safe tilt angle range while red is used to indicate tilt angle has reached critical threshold. White is used to indicate starting/neutral position. This visual feedback enables the driver or system operator to understand the present status of the vehicle's tilt and take relevant measures.

3. Jumper Wires - Jumper wires are an essential component in electronics that are used to make temporary electrical connections between various spots on a breadboard or other electronic components. Jumper wires can be used for connecting the MPU6050 sensor, microcontroller, and other auxiliary parts on the breadboard.

4. MPU6050 - The MPU6050 is an integrated circuit (IC) that combines a three-axis accelerometer and a three-axis gyroscope in one package. To interface with other sensor devices like a 3-axis magnetometer, a pressure sensor, etc., it features an auxiliary I2C bus. A full 9-axis Motion Fusion output can be provided by MPU6050 if a 3-axis Magnetometer is attached to an additional I2C connection.

5. Arduino - Arduino is a microcontroller- based development board equipped with input/output (I/O) pins, an Atmel AVR or ARM CPU, and other elements required for creating electronics projects. The Arduino board serves as the tilt detection system's central processing unit, collecting data from the MPU6050 sensor, analysing the tilt angles, and regulating the output devices based on the tilt condition that has been identified. For programming the Arduino boards, the Arduino Integrated Development Environment (IDE) offers an easy-to-use code editor, compiler, and uploader.

6. Resistors - LEDs (Light Emitting Diodes) are frequently used with resistors to ensure optimum operation and prevent damage.

2.2 Synthesis/Algorithm/Design/Method

The MPU6050 is a multifunctional sensor with acceleration in all three dimensions and the ability to monitor direction.

1. Gather the necessary components like Arduino, MPU6050 sensors, breadboard, etc

2. Make the necessary connections - MPU6050 has I2C pins. Hence it is to be connected to the I2C pins of the Arduino. Connect the ground and VCC of MPU6050 to the respective GND and VCC of the Arduino board. Connect the digital pins of Arduino to the LEDs. The anode of the LED is connected to the resistor and cathode to the GND. Check to make sure there are no loose connections.

3. Study the appropriate calculations for calculating the tilt angle.

4. Install the required libraries - Install the necessary version of Arduino IDE. Include the <wire.h> library. Define the essential variables with their datatype.

5. Write code for calculations to determine the required tilt angle. Implement the setup() function to initialize the serial communication, LEDs, and sensor. To read sensor data, calculate tilt angles, and control LEDs based on tilt state, create the main loop() function.

6. Use conditional statements for displaying the different tilt angles and control the LEDs accordingly. Upload the code to the Arduino board and ensure there are no compilation errors.

7. Test the system - Make sure the connections are proper before turning on the Arduino board. Observe the behavior of the LEDs when you tilt the tilt detection system while it is mounted on a solid surface. To get the required sensitivity and responsiveness, modify the threshold values or other code parameters as necessary. Verify that the LEDs react to changes in tilt angles properly.

8. Test the system's stability, reactivity, and accuracy in a variety of tilt situations. If necessary, alter or improve the code, calibration values, or hardware connections. Repeat the testing and improvement steps up until the system satisfies the required requirements.

2.3 Characterization/Pseudo Code/ Testing

Here is code to display the tilt angle as output using conditional statements -

```
if(angle_pitch_output > 0 && angle_pitch_output < 5)
{
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,LOW);
  digitalWrite(8,HIGH);
  digitalWrite(9,LOW);
  digitalWrite(10,LOW);
  digitalWrite(11,LOW);
  digitalWrite(12,LOW);
  digitalWrite(13,LOW);

}
else if(angle_pitch_output >= 5 && angle_pitch_output <= 20)
 {
  digitalWrite(3,LOW);
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,HIGH);
  digitalWrite(8,HIGH);
  digitalWrite(9,LOW);
  digitalWrite(10,LOW);
  digitalWrite(11,LOW);
  digitalWrite(12,LOW);
  digitalWrite(13,LOW);
 }
```

```
else if(angle_pitch_output <= 0 && angle_pitch_output >= -5)
{
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,LOW);
digitalWrite(6,LOW);
digitalWrite(7,LOW);
digitalWrite(8,HIGH);
digitalWrite(9,LOW);
digitalWrite(10,LOW);
digitalWrite(11,LOW);
digitalWrite(12,LOW);
digitalWrite(13,LOW);
}
else if(angle_pitch_output <= -5 && angle_pitch_output >= -20)
{
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,LOW);
digitalWrite(6,LOW);
digitalWrite(7,LOW);
digitalWrite(8,HIGH);
digitalWrite(9,HIGH);
digitalWrite(10,LOW);
digitalWrite(11,LOW);
digitalWrite(12,LOW);
digitalWrite(13,LOW);
}
```

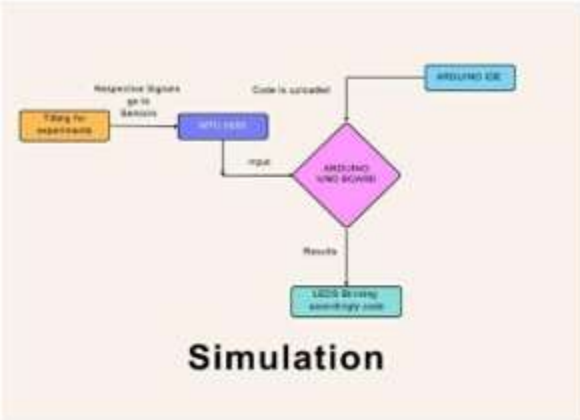
```
else if(angle_pitch_output >= 20 && angle_pitch_output <= 35)
 {
 digitalWrite(3,LOW);
 digitalWrite(4,LOW);
 digitalWrite(5,LOW);
 digitalWrite(6,HIGH);
 digitalWrite(7,HIGH);
 digitalWrite(8,HIGH);
 digitalWrite(9,LOW);
 digitalWrite(10,LOW);
 digitalWrite(11,LOW);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
else if(angle_pitch_output >= 35 && angle_pitch_output <= 50)
 {
 digitalWrite(3,LOW);
 digitalWrite(4,LOW);
 digitalWrite(5,HIGH);
 digitalWrite(6,HIGH);
 digitalWrite(7,HIGH);
 digitalWrite(8,HIGH);
 digitalWrite(9,LOW);
 digitalWrite(10,LOW);
 digitalWrite(11,LOW);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
else if(angle_pitch_output >= 50 && angle_pitch_output <= 65)
 {
 digitalWrite(3,LOW);
 digitalWrite(4,HIGH);
 digitalWrite(5,HIGH);
 digitalWrite(6,HIGH);
 digitalWrite(7,HIGH);
 digitalWrite(8,HIGH);
 digitalWrite(9,LOW);
 digitalWrite(10,LOW);
 digitalWrite(11,LOW);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
else if(angle_pitch_output >= 65 && angle_pitch_output <= 90)
 {
 digitalWrite(3,HIGH);
 digitalWrite(4,HIGH);
 digitalWrite(5,HIGH);
 digitalWrite(6,HIGH);
 digitalWrite(7,HIGH);
 digitalWrite(8,HIGH);
 digitalWrite(9,LOW);
 digitalWrite(10,LOW);
 digitalWrite(11,LOW);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
```

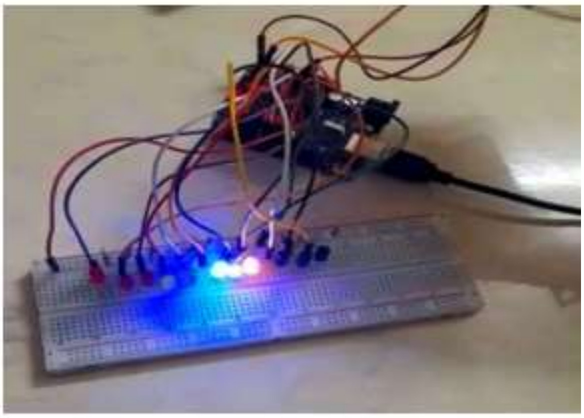
```
lse if(angle_pitch_output <= -20 && angle_pitch_output >= -35)
 {
 digitalWrite(3,LOW);
 digitalWrite(4,LOW);
 digitalWrite(5,LOW);
 digitalWrite(6,LOW);
 digitalWrite(7,LOW);
 digitalWrite(8,HIGH);
 digitalWrite(9,HIGH);
 digitalWrite(10,HIGH);
 digitalWrite(11,LOW);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
lse if(angle_pitch_output <= -35 && angle_pitch_output >= -50)
 {
 digitalWrite(3,LOW);
 digitalWrite(4,LOW);
 digitalWrite(5,LOW);
 digitalWrite(6,LOW);
 digitalWrite(7,LOW);
 digitalWrite(8,HIGH);
 digitalWrite(9,HIGH);
 digitalWrite(10,HIGH);
 digitalWrite(11,HIGH);
 digitalWrite(12,LOW);
 digitalWrite(13,LOW);
 }
```

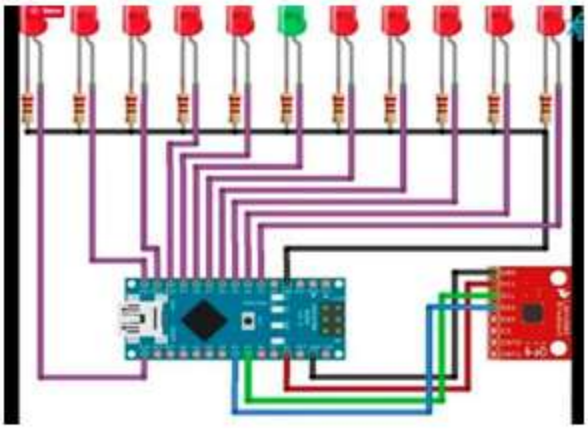
Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 10, No. 4, October : 2023

## III. Results And Discussion

An automotive tilt detection system's capacity to identify and stop rollover occurrences is one of its main outcomes. The technology can considerably improve occupant safety by continuously monitoring the tilt angle of the vehicle and issuing early warnings or triggering interventions to prevent rollovers. The tilt detection technology helps drivers become more aware of the vehicle's stability limits by giving them crucial information regarding the tilt angle of the vehicle. By being aware of their surroundings, drivers can modify their driving style, take the proper safety measures, or take corrective action to stay in control and avoid collisions.





## IV. Future Scope

An automotive tilt detecting system has many advantages. The device can improve vehicle safety by giving early notice of potential rollover dangers by continuously monitoring the tilt angle. It enables drivers to have a better understanding of the vehicle's stability limits and take the necessary precautions to avoid collisions. By enhancing stability control systems to maintain optimal grip and stability in dynamic driving circumstances, the system also helps to improve handling and performance.

Automobile tilt detection systems are anticipated to develop in sophistication and be integrated into larger vehicle control systems as automotive technology continues to grow. Integration with ADAS (Advanced Driver Assistance Systems) and autonomous driving technologies can improve vehicle stability and safety even more, allowing for proactive interventions to avoid accidents and guarantee peak performance. When driving in erratic scenarios, such turning or evasive maneuvers.

The device can apply targeted brakes, activate stability control systems, change suspension settings, or detect excessive tilt angles to maintain stability and avoid losing control. It can collaborate with electronic stability control (ESC), traction control, or anti-lock braking systems to collectively optimize stability and traction during challenging driving conditions.

## V. Conclusion

The automatic tilt detection system is a useful device that aids in keeping track of and detecting the tilting or inclination of structures or items. It is frequently employed in a variety of fields and situations where upholding stability and safety is essential. Providing real-time information regarding the magnitude and axis of tilt or inclination is the primary function of a tilt detection system. Usually, sensors that measure changes in position or orientation are used to get this data.
A tilt detection system has several advantages, including increased operational efficiency, decreased risks of equipment failure or collapse, improved safety, and cost savings by reducing potential damages. It makes proactive monitoring possible and aids in putting preventative maintenance plans into action.

## VI. ACKNOWLEDGMENT

The project idea and implementation has been concluded with many useful contributions from many people. Execution of the project has been successfully carried out with many attempts and intentions. Guidance of our guide has been inimitable. Thanks to all my Group members and guides for support and their benefactions and offering.

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