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Smart turn indicators

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Abstract. The paper discusses the development of a turn indicator that engages automatically if not turned on manually by making use of different inputs from the sensors and considering speed as the deciding parameter. The system comprises of an angle sensor, a steering rotary sensor, a speed sensor and a micro-controller. This instrumentation helps in reducing accidents especially caused in the highways.

1. Introduction

Turn signals are lamps mounted near the right and left rear and front corners of a vehicle (Automobile, especially a four wheeler) and on the either sides of the vehicle which blink when turned on. The driver actuates the turn signal to let the trailing drivers know of his intent to change lanes or take a turn[1]. Turn signals are vital components that come as standard on all the vehicles as a safety feature. Their use is made mandatory by the transportation authorities worldwide. Due to the negligence of the drivers the turn signals are not used as they should be and this brings down their usage rate to below a 100%. Despite the above fact no study or data regarding the use of turn signals is not available from National Highway Traffic Safety Administration or from Department of Transportation[4].

2. Need statement

The study is particular about the four-wheeler especially a car. Drivers are required to use the turn signals to indicate their intention to take a turn, lane changing or overtake a vehicle. Almost 50% of the drivers either fail to indicate while changing lanes or do not turn the indicator off. While failing to indicate a turn might seem like a small violation, a number of car accidents are caused while turning without indication or during lane changing.[2]

2.1. Present Study

A study from Society of Automotive Engineers reveals that the failure rate of a driver to indicate a turn during lane changing or failing to turn the indicator off is around 48%. The same study also reveals that the failure rate to indicate the turn while making a turn is around 25%. Further the study brings out that the drivers fail to use the turn signals around 2 billion times a day or 750 billion times annually, making failing to indicate the turn signal a bigger concern than distracted driving[3]. The above numbers describe the gravity of the problem which is ever increasing and persists worldwide. Yet no improvements have been made into the system and present turn signal technology is based on inputs from the driver only. A mistake from the driver on road not only risks the driver's life but also of the trailing vehicles. A number of people are easily affected by a single act of negligence. Especially the accidents that happen during high speed lane changing can be more catastrophic and sometimes may lead to death.

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2.2. The need

The above issue can be illustrated by considering the following scenarios:

Scenario 1:

A vehicle taking an immediate U-turn from rest without any indication of the turn.

Scenario 2:

During lane changing at high speed, the drivers are negligent to use the turn indicators.

Scenario 3:

Driver not indicating the turn in case of dodging an obstacle.

Scenario 4:

Driver takes an immediate turn from parking lane to get on to the main road.

The above cases are events that occur on roads a number of times everyday and also describe the events during which drivers usually fail to signal the turn. The trailing driver in all the above cases has a very little knowledge of the intensions of the driver ahead and him failing to indicate the turn even in one of the cases can lead to fatal accidents. There are systems in the market that automatically switch off once the turn in taken but they do not serve in the above cases.Hence a technology that automatically switches on the indicator even if the driver fails to actuate it manually is necessary.

3. Methodology

The rotation of the wheel or the steering input given to the wheel is speed sensitive. It depends on how fast the vehicle is actually moving. Based on the above criteria the rotation process can be split into two cases:

3.1. Case 1

When the vehicle is slow moving or the in the stand still condition, the wheels of the vehicle tend to rotate more. The steering input given to the wheel is more and the angular movement of the wheel is also more.

Figure 1. Wheels of the vehicle at 90 degrees or without any rotation

Figure 2. Wheels of the vehicle after maximum rotation

Figure 3. The angle made by wheels after rotation

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It is usually observed that the maximum angle at which the wheels rotate in a four wheeler is 50 degrees, if the straight position of the wheels is considered to be at 90 degrees.This angle also depends on the make and dimensions of the vehicle. Hence a threshold of 65 degrees is considered for the actuation of the indicators in the above case.

3.2. Case 2
If the speed of the vehicle is substantially high, then the wheels of the vehicle don't actually deviate much in terms of angular movement. The angular rotation of the wheels is very small and hence the use of angle sensor is not helpful. At high speeds the steering input given to the wheels is also very small. It can also be said that the steering just tilts to steer the vehicle in required direction. This serves as the base for the second condition. This holds good in lane changing scenarios. It is noticed that the response of the steering is fairly changed after the vehicle has reached the speed of 30kmph and hence it serves as our deciding factor. Hence the tilt of the steering can be utilized to actuate the indicator. This is accomplished by means of a Steering rotary sensor.

Considering the above cases the system is designed to make use of 3 sensors, a speed sensor, an angle sensor and asteering rotary sensorinterfaced with a microcontroller. Speed of the vehicle serves as the deciding factor for the consideration of inputs to the microcontroller, as the steering response is different based on speed as discussed above. When the speed of the vehicle is less than 30kmph the steering is rotated more and the wheel undergoes larger angular movementwhich constitutes for the scenarios 1 and 4 from the need statement, whereas when the speed is high the wheel's angular displacement is less so is the steering rotation. The steering undergoes just a tilt and the vehicle moves in that specified direction as discussed earlier. This usually happens during lane changing and constitutes for scenarios 2 and 3 mentioned in the need statement. Based on the above comparison the microcontroller selects the input as follows:

- If i1<30kmph, then it selects the input from angle sensor
- If i1>30kmph, then it selects input from steering rotary sensor

The microprocessor then switches on the indicator if the value for the selected inputs exceeds the threshold value in case 1 or if the there is a circuit completion in case 2.

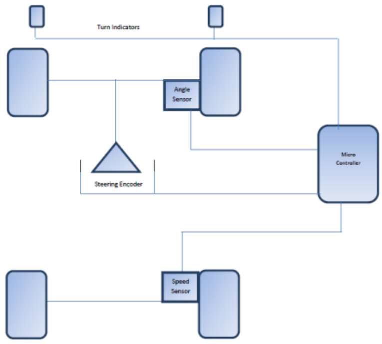

Figure4. Block Diagram

4. Advantages and disadvantages

4.1. Advantages
- It can minimize the stress of merging traffic
- Automation of the indicators reduces driver effort
- Avoids miscommunication between drivers
- Helps ensure lane discipline
- Helps to avoid accident
- Improves driving experience

- The system is quick and responsive
- False indication is avoided

4.2. Disadvantages

- The indicators are supposed to switched on before taking a turn
- May result in a scenario wherein the turn signals might be over used

5. Results and conclusion

5.1. Time Analysis

As discussed above the indicators have two different conditions to satisfy

5.1.1. The speed of the vehicle being less than 30kmph. In this case it is observed that the indicators are engaged as soon as the wheels sweep the pre-set threshold angle of 65 degrees. The reaction time of the system is observed to be minimal when compared to the conventional method that includes manually engaging the indicator that is comparatively time consuming.

5.1.2. The speed of the vehicle being greater than 30kmph. In this case the steering tilt is serving as the input to the microcontroller. Small movements of the steering results in the change in orientation of the vehicle and hence switch on the indicator. The steering tilt is measured to be 15 degrees for the movement of the vehicle in other direction. The indicator is observed to switch on instantaneously in the above case also.

Table 1. Results

Case	Conventional Indicators (s)	Smart Indicators(s)
1	1.03	Instantaneously
2	1.03	Instantaneously

5.2. False Indication

False indication is usually observed due to human negligence and error sometimes in conventional turn indicating systems. Since the human aspect is absent in the working of the above system the system is very much accurate and responsive. False indications are completely ruled out because the system engages the indicators only when the pre-set conditions are satisfied. This also makes the system more reliable when compared to conventional indicators.

Unintended consequences could be a consideration to be made in the context of Smart Turn Indicators. There might be a scenario where in the driver would over use the indicators, but it cannot cause any problems. It only improves reckless driving and makes you a better driver. A vison of the road where in every driver actuates the turn signal on time and accurately is both promising and safe, but at the same time might annoy certain people by overriding their mistakes[4].

References

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