SMART INDICATOR TURN-OFF SYSTEM FOR TWO-WHEELERS USING PROXIMITY AND LIMIT SENSORS

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Abstract — A turn indicator is an important safety gadget that is installed on a vehicle to indicate to the rider that he wants to change lanes or turn. The level of focus however affects the effectiveness of these signals on two-wheelers by a rider. The error that many bicyclists make is that of forgetting to manually switch off the signal after taking a turn. This careless disregard causes misunderstandings in other drivers resulting in an appreciably increased risk of collision. The traditional indicator system is purely manual, which poses a road-safety risk as it is based on the memory of the person operating it and its accuracy in performing the task. To address this serious safety issue, this paper presents the Smart Indicator Turn-Off System that provides semi-automatic control over the turn signals of the two-wheeler. The technology contributes significantly to the safety on the road since it minimizes human error by automatically turning on or off indicators depending on the circumstances and the dynamics of the vehicle.

Keyword : Proximity Sensor, Limit Switch, Arduino Nano, Two-Wheeler Safety, Smart Indicator Automation.

INTRODUCTION

Nonverbal safety of two-wheelers: vehicle indicators are one of the most important nonverbal safety features of two-wheelers that allows riders with a way of telling other motorist that they intend to change lanes or turn. Traffic is kept flowing and accidents prevented through this type of communication.

The majority of bikes only have manual indicator systems, and, therefore, the rider must always remember to switch on the switch, make the turn, and most importantly, switch off the switch. The system depends on the rider, his memory and attention, rendering it weak. One of the major problems in road safety is the presence of indicators which were not cancelled; the riders usually forget to turn them off after making a turn. These flashing signals convey misinformation, disorientate a fellow driver and increase risk of accidents or poor response. Rider negligence compromises the main objective of the signal system. We require something more intelligent, more modern to be able to guarantee the stability and correct usage of the signals and fix the imperfection of the pure manual control. The Smart Indicator Turn Off System is an attempt to provide a semi-automatic control of turn signals, and it is proposed in this project. The architecture proposed addresses the constraints of the manual operation by integrating advanced sensors and an Arduino Nano microcontroller. It has a proximity sensor that determines the distance covered to enable it to accurately monitor the dynamic condition of the bike. Based on that information, the system is in a position to determine when a turn has been completed with high accuracy and consequently switch off the signal. The objective of the research is to establish a dependable, inexpensive as well as simple to retrofit system that enhances the safety of the riders by essentially eradicating the human factor in the cancellation of the signals. The system allows the rider to concentrate on the traffic and the turns only because it automates the indicators to go off depending on the dynamics of the bike, and a manual switch gives it the full control when necessary. This clever strategy is an important advancement in technology for two-wheeler safety features.

Literature review

1. Basic Control Systems (Based on Time and Handle bars) Mechanical concepts or basic timing mechanisms were the mainstays of early automation attempts:

Time-Based Cancellation: These techniques, which were employed in certain early designs, stop the signal after a set amount of time. However, because a set time does not correspond with the actual execution of a guide, this system is inherently incorrect for motorbikes. A rapid lane shift could leave the indicator on needlessly, while a lengthy, smooth bend could cause it to cancel out too soon. Handlebar Position Sensors: Systems that detect the steering angle and send out a cancellation signal when the handlebar veers back towards the centre position after reaching a maximum turning angle have been the subject of patent applications. Because the rider must continuously adjust the handlebars for balance, these systems can be sensitive and result in false cancellations, especially when the rider is moving slowly or initiating a turn.

2. Advanced Systems Based on Sensors (GPS and IMU) Modern sensors are integrated into more complex solutions to assess the dynamic state of the vehicle:

Units of Inertial Measurement (IMU): Since the tilt angle (roll) of the bike is the defining feature of a motorcycle turn, projects employing IMU sensors (such as the MPU-6050 or BNO-055) and gyroscopes for motion-based signal suppression have shown success. These systems estimate guide completion by analysing the roll angle, acceleration, and yaw rate using intricate algorithms.

However, a significant drawback of pure IMU systems— especially the less expensive ones—is their susceptibility to engine vibration and cumulative sensor drift over time, which might accuracy over the long run. Moreover, high- precision commercial-grade systems can have expensive component costs.GPS/Navigation Systems: Other ideas use GPS to activate and deactivate indicators in response to predetermined waypoints or the proximity to intersections. Because they demand constant navigation input and don't take into consideration lane changes or unexpected, unnavigated turns, these are not useful for everyday riding.

Block diagram

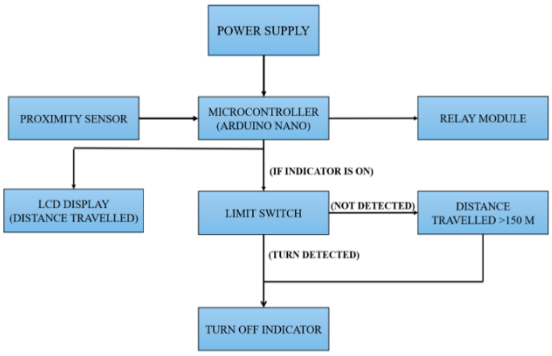

Fig.1 Block diagrams

To a large extent, this block diagram defines how input sensors, the Arduino Nano and the output modules interact with one another. The parts themselves have their job and it must be real-time and accurate. It has a design that is modular and therefore is incredibly easy to fit it into the current two-wheelers. In addition to that, it reduces the number of manual adjustments and enhances stability. After all, it is all about ensuring that the rider is safe and the system is as efficient as it can be. The block diagram depicts the basic electronic design of the Smart Indicator Turn Off System, with the chronological movement of control and data among the key elements of the system. This is a distance-aware architecture meaning that it is a well-built and simplified system.

The system is required since riders tend to forget to turn off their indicators after a maneuver which will create confusion on the road and chances of accidents are high; this demonstrates that traditional indicator system is not really reliable. It also has an Arduino Nano microcontroller which is used as the brain of the whole system and does all the logic. The main input that is used in the cancellation routine is the proximity sensor, which is used in detecting the movement of the wheels to calculate the distance covered by the vehicle. This architecture will provide a reliable and convenient safety enhancement.

Power Source:

The process starts with Power Source that normally utilizes the vehicle battery to provide energy to the whole electronic system.

Microcontroller:

The Microcontroller is the central control. It is the brain which takes the information sent by the Proximity Sensor and implements the programmed distance-based cancellation logic. On this rationale, it stipulates in which instances the indicator should be automatically shut down.

LCD Display:

This unit displays the real time user information like the current indicator status and the distance covered.

Relay Module:

This is the necessary Drive Circuit. It is an electrically controlled switch and is fed by the signals of low voltage control that are sent out by the Microcontroller to safely switch the high-voltage indicator lights ON or OFF.

Proximity Sensor:

This is the Proximity Sensor which is the important input of the distance logic. It is located close to the wheel to sense the movement based on the number of pulses of metallic components. It measures the traveled distance and transmits the same information back to the Microcontroller to implement the cancellation procedure.

Automatic Vehicle Indicator Turn-off System:

The last output block is the successful implementation of the safety procedure. Upon reaching the distance requirements (e.g., having covered a predetermined maximum distance), the Microcontroller will make the Relay Module turn off the indicator to prevent never-ending blinking and increase the general road safety.

Core Operational Flow:

The flow illustrates how the system permits indicators to operate semi-automatically, guaranteeing precise signaling. The microcontroller's monitoring program is activated when the indicator is manually turned on. The proximity sensor's tracked distance is then tracked by the microcontroller. The Relay Module is activated and the indicators are automatically turned off to improve safety by stopping continuous blinking if the vehicle travels a predetermined distance (for example, 150 meters) without the signal being cancelled. The end result is a small and reasonably priced solution.

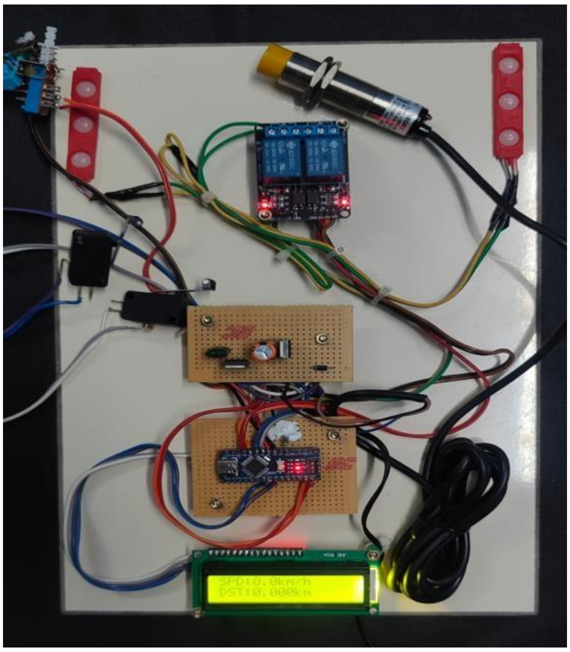

Fig.2 Indicator before turn on

The main input for calculating distance is the proximity sensor, which instructs the microcontroller to count wheel rotations. Verifying the system's operational state requires the LCD Display, which gives the user real-time information: Verification of the Initial State: The LCD display visually verifies the beginning of the distance monitoring procedure, as seen in the attached image. The manual switch is ready to provide input to the system. Readiness for Activation: When the indicator switch is engaged, the corresponding Relay Module is activated, turning the indicator ON. At the same time, the anti-collision safety protocol is initiated by starting the distance monitoring process. Since the entire cancellation logic relies on the precise cumulative distance measured by the proximity sensor to stop dangerous, ongoing false signalling, this initial state verification is essential.

Distance Measurement Formulas:

Circumference of Wheel:

The distance in which the vehicle would travel in one complete rotation of the wheel is determined by the circumference. It is the most basic constant of the distance calculation.

Circumference = pie * wheel diameter

Total Distance Traveled:

The totality is as the magnitude of the number of rotations taken multiplied by the circumference. The Proximity Sensor registers a given amount of pulses during a rotation.

Total Distance = N pulse * C / Prot

Where:

- N pulse refers to the number of pulses detected at the Proximity Sensor input pin.
- C represents the circumference of the wheel.
- Prot is the quantity of metallic points (magnets or spokes) that were observed by in the sensor per one revolution.

Indicator Cancellation Logic:

The essence of the microcontroller is used for conditional search based on the distance calculate

D total >= D threshold (indicator turn off)

Where:
D threshold This is the predetermined distance limit (e.g. 20 meters of short distance, 150 meters of long-distance safety cancellation). The Microcontroller performs indicator OFF to indicate the Relay Module.

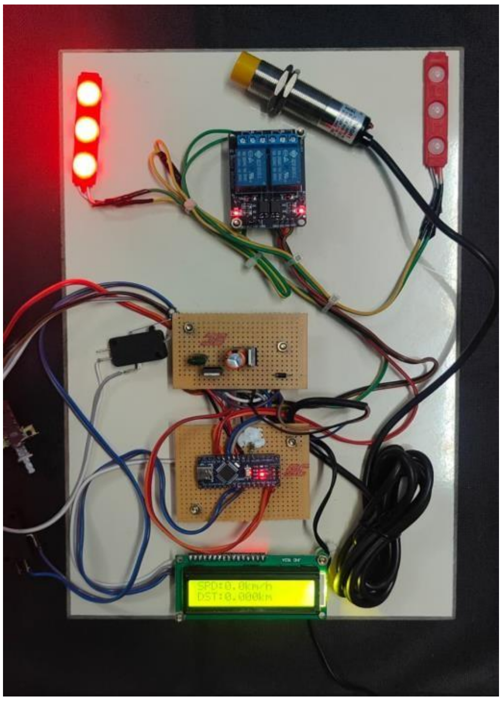

Fig. 3 Left indicator on

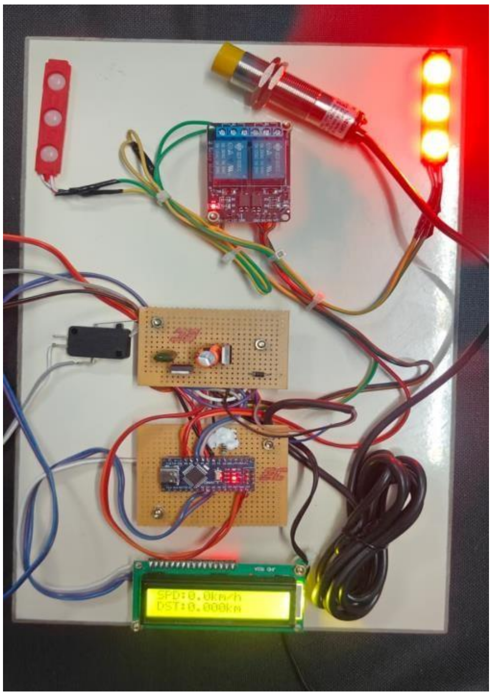

Fig.4 Right indicator on

The Smart Indicator Turn Off System's operation was methodically confirmed on the prototype kit, proving control based only on logical timing and distance measurement. The Arduino Nano microcontroller, which controls the output through the relay module and handles input from the proximity sensor, is in complete control of the system.

Immediate Output State and Manual Activation Initial testing verified that the system's output was accurately interfaced:

Indicator Activation: The prototype testing clearly shows that turning on the left or right manual switch instantly alerts the microcontroller. The CPU immediately instructs the Relay Module to energise the appropriate channel. The images clearly show the operational output of both the Left and Right indicators being successfully turned ON.

Automatic Cancellation Logic Based on Distance: The system instantly enters its monitoring state upon activation, during which the Hall/Proximity Sensor plays a critical role in carrying out the automatic cancellation logic. Therefore there are two important principles of measuring distance that in essence propel the workings of the system.

Inference of Short-Distance Completion: The microcontroller measures the number of pulses generated by the proximity sensor to get the distance travelled by the bike. After the bike has traveled a small distance that has been pre-calibrated, the indicator will automatically switch off through the relay module. That short distance is a stand in, which denotes that the initial turning guide is done.

Fig. 5 Display

Display Status:

As observed in the image, the user is able to view real-time data on LCD screen, where the status of speed is displayed and the distance travelled is also displayed. It simplifies the visual observation of the way the system is running in case of movement of the car. This gives valuable user feedback when doing testing and even when usable.

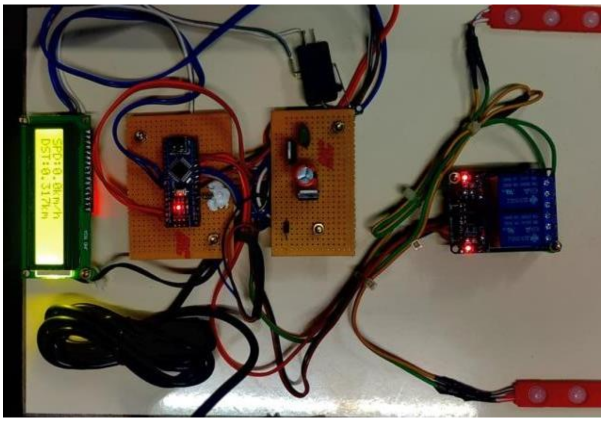

Fig. 6 Indicator turn off at 150m

The primary safety measure of the system is, frankly, the strict adherence to the maximum distance limit that does not allow to keep making mistakes with erroneous signalling. This is an important mechanism particularly when traveling in long or highway routes as the indicator may have been left on accidentally.

Condition Monitoring: The system is simple a recorder of the total distance covered with time after manually activating the indicator. The microcontroller then counts these pulse signals every time the wheel spins and hence it tracks it.

Threshold Trigger: Under the condition when the car travels a rather large fixed maximum range 150 meters, and I do not step on the brake, the safety system thereof is activated. The picture I have attached is literally the system status when this test was run and this demonstrates the accuracy of the distance counter.

Automatic Intervention: The 150-meter limit is an automatic trigger for the proximity sensor to command the microcontroller to switch off the indicator. As a result, the microcontroller signals the relay module to stop the indicator lamps. As an electrically controlled switch, the relay immediately disconnects the 12 V power supply to the indicator lamps.

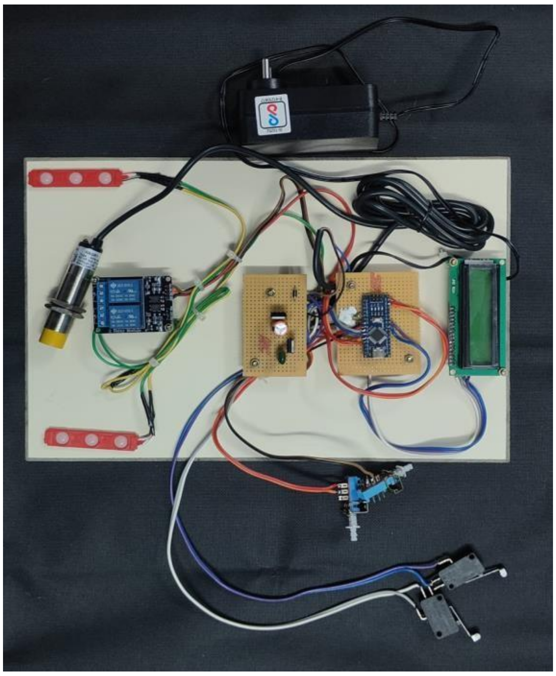

Fig. 7 Prototype kit

The fully assembled prototype kit in the project image showcases all components neatly organized onto a compact platform. An Arduino Nano microcontroller acts as the central processing unit, managing all input and output signal pathways. The proximity sensor is the main distance input component, supplying the CPU with key information on the distance traveled. The relay module is the primary driver circuit that provides electrical isolation and safely cuts control to high power indicator lamps.

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CONCLUSION:

The Smart Turn Off Indicator System. effectively addresses a key case of safety in two-wheelers by removing an aspect of lack of reliability in manual cancellations of indicators that are the biggest source of miscommunication and accidents. The strong sensor-fusion approach adopted by the project is the primary strength of the project in terms of distance travelled to complete manoeuvre by integrating a Wheel Encoder Proximity Sensor. Going beyond either time-based or steering-angle systems, a microcontroller that handles this combined logic ensures a sure automated response to deactivation of signals. The implementation enhances road safety by reducing false signalling, improving the concentration of the riders by eliminating a constant mental issue and provides a practical, small and reasonably priced solution that can easily be fitted to current two-wheelers. To the point, with this project in place, there will be an effective means of enhancing the safer, easier riding experience through the modernsation of a simple safety control and the presence of a vital Manual Switch override.

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