Synopsisfor

Innovative Idea

# Prepared & Designed By-

Shreyash Bhardwaj, VIII-E, Mayoor School Noida

Title- AI’s Role in the Modern World

Sub Topic- Transport and Communication

Innovative Idea Name- TruckSafe360

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# The Problem

* **Truck Overturning & Overspeeding**

Truck overturning and overspeeding are two of the most critical issues contributing to road accidents worldwide. The consequences of these incidents are often severe, resulting in significant loss of life, injuries, and property damage. Given the size and weight of trucks, their accidents tend to be far more devastating than those involving smaller vehicles. Below is an exploration of how these two factors—overturning and overspeeding—contribute to accidents, their causes, and the consequences they bring.

* **Overspeeding and Its Impact**

Overspeeding is a major factor in traffic accidents, and trucks are no exception. The massive size and weight of a truck mean that, once a truck exceeds the speed limit, it is much harder to control than smaller vehicles.

* **Consequences of Truck Accidents**



The consequences of truck accidents, particularly those caused by overturning or overspeeding, are often disastrous.

1. **Severe Injuries and Fatalities**: Due to the size and weight of trucks, any accident involving one is likely to result in more serious injuries or fatalities compared to accidents involving smaller vehicles. Pedestrians, cyclists, and drivers of passenger vehicles are especially vulnerable. In cases of rollovers, the truck may crush smaller vehicles or cause multi-vehicle pile-ups, leading to even more severe consequences.
2. **Traffic Disruptions**: Overturned trucks often block entire lanes or even multiple lanes of traffic, causing major disruptions. This can lead to long traffic jams, especially on busy highways, and can delay emergency response vehicles, exacerbating the severity of the situation.
3. **Economic Losses**: Truck accidents also have significant economic impacts. Not only do they cause damage to infrastructure and vehicles, but they also disrupt the supply chain, especially if the truck is carrying goods. Overturned trucks may lose their cargo, leading to financial losses for the shipping companies and the businesses depending on timely deliveries.
4. **Environmental Hazards**

# Further Justification

* Data from the Ministry of Road Transport and Highways reveals the following trends in fatalities due to truck accidents:
* **1990**: 3,200 deaths
* **1995**: 3,500 deaths
* **2000**: 3,800 deaths
* **2005**: 4,000 deaths
* **2010**: 4,200 deaths
* **2015**: 4,300 deaths
* **2019**: 4,200 deaths
* **2020**: 2,000 deaths
* **2021**: 3,150 deaths
* **2022**: 4,300 deaths
* **2023**: 4,450 deaths
* **2024**: 5,500 deaths (till now)

# What is the need foran AI-powered solution??

Truck overturning and Truck overspeeding are lethal problems that require a smart and effective solution. AI(Artificial Intelligence) enters the picture. It plays a vital role in proving and applying a solution as it analyzes data, identifies patterns, provides effective solutions to complex problems, and validates their effectiveness.Thus, AI is a top-notch solution to truck-overturning and truck-overspeeding problems caused by trucks.

# My Invention

This issue is worsening daily and needs urgent attention. To address this issue, I have developed an invention to prevent truck overturning and stop heavy transport vehicle (HTV) drivers from driving recklessly or speeding. The Invention are:-

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# prototype-1

Note- BOTH OF THESE PROTOTYPE CAN BE MADE UNDER ₹10,000 (Each)

Note- Both of these prototypes fetch voltage or electricity to work through the truck’s battery, also they require vey less voltage to work.

**Prototype-1 (Preventing Overturning):**

- Features a heavy-duty openable diverging thruster.

- Controlled by an MPU-6050 (Accelerometer + Gyrometer).

MPU-6050 Functions:

- Detects any motion and changes in angle using the accelerometer.

- Calculates the change in angle using the gyrometer.

Overturn Detection and Correction:

- Upon detecting an overturn, MPU-6050 sends the angle data to MATLAB and **TTC-1000**



- MATLAB performs complex calculations using the formula (T=I⋅)(T is equal to I dot alpha){Given by great scientists& Mathematics}

Note- MATLAB is just being used for review purposes and the finished product will not have MATLAB, it is being used to calculate if the thrust being released at the testing stage is equivalent to what the diverging thruster is releasing.

- After the MPU-6050 detects a change in angle the TTC-1000 Embedded with the thruster works thus it is designed to interface with the MPU-6050(3-axis Acclerometer+3 axis Gyrometer), using AI it identifies the tilt side(direction) through angle data given by MPU-6050 and then supply voltage or electricity through the truck’s battery to the appropriate side of the thruster.

Note- MPU-6050 provides the angle change in x,y,z format or Cartesian space format, thus it is easier to identify the tilt side using AI.

- Angle sensor with current measurement also detects the change in an angle because truck overturning occurs in mere seconds thus relying on one system for operating all mechanisms seems a hazard for the system to work properly also the angle change given by MPU-6050 in Cartesian Space Format cannot be used in the angle sensor with current measurement, thus it again takes out the readings while the TTC-1000 is working. Then, after it senses an angle change it sends voltage to Electronically Controllable Valves and Motors to release their fuels and to make thrust out of it respectively.

Thrust Generation:

- The thrust is generated under pressure and passed through motor pumps into the combustion chamber.

- Released through the diverging thruster to correct the truck's angle.

Stabilization:

- The process continues until the truck is brought back to 0 degrees.

- MPU-6050 detects when the truck is at 0 degrees.

- The angle sensor with current measure also senses the 0-degree angle change and stops the Thrust production, stabilizing the truck.

Outcome:

- Prevents the truck from overturning and potential accidents.

# What makes prototype-1 different from other system??

Few other systems (Like-ESC and Anti-Rollover Mechanisms) are available in the market, but the main points that make my prototype different and better than theirs are:-

* **Anti-lock braking system (ABS) issues**

If your ABS is not working properly, it can affect the ESC's operation. This can happen if your brake linings are worn or if there's air or dirt in your brake fluid.

* **Poor tires**

Tires with low tread or that aren't in good condition can reduce the effectiveness of the ESC.

* **Defective brake light switch**

A defective brake light switch can trigger the ESC light, and most trucks in India have defective brake lights due to rigorous driving in tough terrains.

* **Steering input**

During high-performance driving, steering input may not always indicate the intended direction of travel. In these cases, the ESC can intervene when it's not wanted.

* **Cornering**

ESC is designed for controlled cornering and won't help with faster cornering.

* **Aggressive driving**

The ESC may interfere unnecessarily when driving aggressively in a closed environment.

* **Complacent driving**

Drivers may feel like pushing the car over the limits with the ESC on, but the safety feature may not be able to help if the cornering speed is too high.

* **Availability of System In old Trucks**

There are a massive number of trucks in India and more than 60% of trucks do not have these systems thus making ESC ineffective in these cases, whereas a 10,000rs. The invention can be manually arranged in these trucks(prototype-1).

Thus, proving my point Prototype-1 can be much more effective in these situations.

# prototype-2

**Prototype-2 (Preventing Over Speeding):-**

System Components:

1. Heavy-duty night vision Waterproof Speed Camera:

- Mounted on the truck bumper.

- Equipped with advanced AI for road-type recognition.

- Runs of solar energy.

2. Electronic Speed Limiter (ESL):

- Controls the vehicle's speed.

- Traditionally set by the driver, but in this prototype, it is controlled by AI

Functionality:

- Using pre-installed data, the AI-enabled camera identifies different types of roads (single-lane, four-lane, bridges).

- It sends signals to the ESL based on government speed limits for the recognized road type.

- The ESL then controls the truck's speed, preventing the driver from overspeeding.

- If the driver tries to accelerate beyond the limit, the truck does not increase speed but instead adjusts to maintain the set limit.

Advantages of Prototype-2 Over GPS-Based Speed Limiters:

- GPS-based systems can be ineffective in rural areas due to incomplete mapping (20-22% of India unmapped) and potential signal loss.

- This AI-controlled system does not rely on GPS, making it more reliable in diverse driving conditions, mainly in regions with poor internet or no internet services(around all highways in India and some rural areas don’t provide internet services).

- Also, to provide more security to the ESL and prevent it from being tampered it is kept in a place that is far reached from a local mechanic or the truck driver and it is secured by a password that is non-changeable and is set by the manufacturer and is not enclosed with the fleet owner or the driver

- Though many products are available in the market regarding this problem they can be easily tampered with or removed by the driver or use too many sensors and take too much time before any accident occurs.

limits for trucks on different types of roads:-

**National Highways and Expressways**:

Speed Limit: 80 km/h

Data and speed limits that would be inserted in the A.I System

**State Highways**:

Speed Limit: 70 km/h

**Other Roads (Rural Roads and Urban Roads)**:

Speed Limit: 50 km/h

**Residential Areas and School Zones**:

Speed Limit: 20 Km/h

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# flowchart

**Of Prototype-1 (Preventing Over Turning):-**

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# flowchart

**Of Prototype-2 (Preventing Over Speeding):-**

**CONCLUSION**

* TruckSafe360 is an innovative AI-driven solution, that addresses two major issues in heavy vehicle transport: truck overturning and overspeeding. By integrating AI-based sensors and control mechanisms, TruckSafe360 detects and corrects tilt to prevent rollovers and manages speed based on road type to prevent overspeeding. This solution offers a cost-effective, easily installable alternative for trucks without existing safety systems, promoting road safety, reducing fatalities, and minimizing accident-related disruptions. With minimal maintenance, TruckSafe360 improves safety for drivers and pedestrians alike, setting a new standard for heavy vehicle safety at an accessible price.

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# Photos

Prototype 1+ Prototype 2

Prototype-1

Prototype-2

Prototype-1 (with open diverging Thruster)



The space between the pipe and the axle(the iron strip) would be used to setup the diverging thruster

Proposed place of the diverging thruster (prototype-1)

The Place between the two tires would be used to setup the fuel tanks and the entire system of prototype-1(except the Diverging Thruster

Proposed place of the entire system (prototype-1)



This place would be used to set prototype-2, as the system would be in depth thus the mechanic has to remove the engine to remove the prototype also The ESL is near the engine, so it can perform its actions easily

Proposed place of the entire system (prototype-2)

-Thank You-