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Final Paper on "Analyzing and Implementing Traffic Safety Measures for Accident Reduction on the Samruddhi Expressway: A Comprehensive Study".

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Abstract— This research paper delves into the critical analysis and strategic implementation of traffic safety measures aimed at reducing accidents on the Samruddhi Expressway. The Samruddhi Expressway stands as a significant infrastructure project, but the rising incidence of accidents necessitates a comprehensive examination of safety measures. To address this, we conduct a detailed literature review, evaluating existing studies on traffic safety and expressway accidents. Our methodology encompasses an examination of historical accident data and an assessment of safety measures that have shown promise in reducing such incidents. The research presents case studies from analogous projects and elucidates strategies for implementing these measures on the Samruddhi Expressway. We implement our methodology i.e. Based on ITS (Intelligent Transportation Systems) in this system we use three types of sensor like Alcohol Detection System in Vehicle to Reduce Drunk Driving, to check the nitrogen air in the tyre in the vehicle, and also the unsafe lane change detection sensor. As well as implementing solution such as to construct the coluful wall outside the road in both side and write the happy as well as motivational quote, Implements the some statue this helps to avoid accident due road hypnosis.

Keywords— Samruddhi Expressway, accident reduction, infrastructure, intelligent traffic management, Highway Traffic Safety, Highway Accidents.

I. INTRODUCTION

The Samruddhi Expressway, a monumental infrastructure project, stands as a testament to progress and development in the region it serves. Stretching across vast expanses of land, this expressway has the potential to revolutionize transportation, foster economic growth, and enhance connectivity. However, amidst the promise of prosperity, the specter of traffic accidents looms large, raising critical concerns about the safety of commuters and the efficient operation of the expressway. This review paper seeks to address the pressing issue of traffic safety on the Samruddhi Expressway. While its construction symbolizes advancement, it is essential to ensure that this progress is not marred by a rising toll of accidents. The aim of this paper is to meticulously analyze the existing conditions, explore safety measures employed on expressways globally, and propose strategies for accident reduction tailored to the unique characteristics of the Samruddhi Expressway. The significance of this research cannot be overstated, as the safety of commuters, economic stability, and the reputation of the expressway project are at stake. Understanding and mitigating the factors that contribute to accidents on the

Samruddhi Expressway is a crucial step toward achieving its full potential while preserving human lives and safeguarding investments. In the sections that follow, we will delve into the existing body of knowledge, conduct a comprehensive analysis of traffic accidents on the Samruddhi Expressway, and present an array of traffic safety measures and implementation strategies. This review paper is intended to serve as a comprehensive resource for stakeholders, policymakers, and engineers who are committed to ensuring the Samruddhi Expressway remains a beacon of development and safety.

Objectives

The aim of this study is to understand the causes of road accidents and thereby to suggest preventive measures for the improvement in highway safety on samruddhi expressway,

The primary objectives of this project can be summarized as follows:

i. To study the major causes of accidents on samruddhi Expressway.
ii. Report on traffic safety measures on the based on ITS, accident causes, and mitigation strategies on expressways.

iii.   Analyze accident data and statistics specific to the Samruddhi Expressway to identify high risk zones and common accident causes.
iv.   Evaluate the effectiveness of current safety measures and policies in place on the samruddhi expressway.
v.   Identify best practices and innovative safety measures implemented on similar expressways globally.
vi.   Propose evidence-based recommendations for enhancing traffic safety on the Samruddhi Expressway, which may include engineering solutions, enforcement strategies, public awareness campaigns, and policy changes.
vii.   Discuss potential challenges and barriers to implementing these recommendations.

II. CAUSES OF ACCIDENTS

From road survey we understand the main causes that majorly contribute to the accidents which occurred on Samruddhi Expressway since its construction, following are the main causes which are responsible for accidents as per study.

1) Highway hypnosis:

It's one of leading cause behind those accident as per our research and study, Highway hypnosis is a trance-like state that drivers can experience during long, monotonous journeys on highways or other uninterrupted roads, it is also called as white line fever. In this state, drivers may become unaware of their surroundings, lose track of time, and even forget that they are driving. It's like being in a daze, where the repetitive scenery and lack of stimulation can lead to decreased attention and alertness, increasing the risk of accidents.

2) Tyre burst:

Tyre burst is a dangerous safety hazard that can lead to some
of the worst accidents and injuries on the road. In simple terms, a tire burst, also known as a blowout, occurs when a tire suddenly loses air pressure, leading to a rapid deflation of the tire. This can happen due to various reasons such as overloading, under inflation, excessive wear and tear, or hitting an object on the road. When a tire bursts, it can cause the vehicle to lose control, potentially resulting in a dangerous situation or even an accident.

3) Over speeding:

Speeding stands out as the primary cause of accidents on the
Samruddhi highway, according to research findings. Despite
the designated speed limit being set at 120 kmph, vehicles frequently surpass this threshold, hurtling along at speeds exceeding 120 kmph. The highway's design speed, a staggering 150 kmph, might inadvertently encourage drivers to push the boundaries further. Compounding the issue, the absence of speed breakers removes any deterrent for drivers predisposed to exceeding speed limits.

4) Unsafe Lane Changes:

Improper lane changes, including failure to signal, not checking blind spots, or cutting off other vehicles, can lead to collisions on expressways.

III. IMPLEMENTING SOLUTION FOR SAMRUDDHI EXPRESSWAY SAFETY

By applying below technology-based methods such as sensors and other implementing solution accidents on expressways can besignificantly reduced.

1) Implementing Flags, Statues & Colourful walls

2) To Detect the Nitrogen Air in tyre of the Vehicle

3) Alcohol Detection System in Vehicle to Reduce Drunk Driving

4) To Detect the Unsafe lane changing on expressway by using sensor

1) Implementing Flags, Statues & Colourful walls-

Highway hypnosis, also known as "white line fever," can indeed be dangerous as it leads to reduced awareness and attention while driving. Using flags, statues, and colourful walls can help break the monotony and keep drivers engaged. Here's how you can use these elements effectively:

a) Flags: Place colourful flags along the highway at regular intervals. These flags should be large enough to catch the driver's attention but not too distracting. They can be positioned on the sides of the road or on overpasses. The movement of the flags in the wind can help draw the driver's attention away from the road and prevent them from zoning out.

b) Statues: Install statues or sculptures along the highway, preferably at rest areas or scenic spots. These statues can be unique and eye-catching, providing a visual break for drivers. They not only serve as landmarks but also as points of interest that can help keep drivers alert and engaged.

c) Colourful Walls: Painting sections of highway walls with vibrant colours or murals can also be effective in preventing highway hypnosis. These colourful walls can break the monotony of the landscape and provide visual stimulation to drivers. They can feature artwork, landscapes, or abstract designs that capture attention without being overly distracting.

2) To Detect the Nitrogen Air in tyre of the Vehicle-

- Nitrogen air check stations would be strategically placed at key locations along Samruddhi Expressway, such as Entrance areas, service plazas, or toll booths, to ensure convenient access for motorists.
- Each nitrogen air check station would be equipped with nitrogen generators or tanks, air compressors, pressure gauges, tire inflators, and other necessary tools and equipment.
  The station may also have automated systems for monitoring nitrogen purity levels and dispensing the correct amount of nitrogen into tyres.
- Before vehicles are permitted to access the highway, they would be required to undergo a nitrogen air check at the station. This process may involve automated or manual checks to verify the nitrogen levels in the vehicle's tyres.
- If the vehicle's tires are found to have insufficient nitrogen levels, the station would fill them with nitrogen to the recommended pressure. This is typically done by connecting a hose from the nitrogen generator or tank to the tire valve stem and allowing the nitrogen to flow into the tire until the desired pressure is reached.
- The station would have quality control measures in place to ensure that the nitrogen being dispensed meets purity standards. This may include regular maintenance and calibration of equipment, as well as periodic testing of nitrogen purity levels.
- The station would maintain records of nitrogen air checks conducted, including vehicle information, nitrogen levels, and any additional services provided. This documentation would help track compliance with the nitrogen filling requirement and provide data for analysis and reporting purposes.
- Alongside the nitrogen air check service, the station may also provide educational materials and information to customers about the benefits of nitrogen-filled tires and proper tire maintenance practices. This helps increase awareness and encourages motorists to prioritize tire safety.

Fig. Nitrogen in tyre

3) Alcohol Detection System in Vehicle to Reduce Drunk Driving:-

a) Alcohol Sensor :

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple; all it needs is one resistor. A simple interface could be a 0- 3.3V AD. Sensitive material of MQ-3 gas sensor is SnO_2, which with lower conductivity in clean air. When the target alcohol gas exist, the sensor's conductivity gets higher along with the gas concentration rising. Users can convert the change of conductivity to correspond output signal of gas concentration through a simple circuit. MQ-3 gas sensor has high sensitivity to alcohol gas and can resistant to the interference of gasoline, smoke and vapor. It is with low cost and suitable for various applications of detecting alcohol at different concentration.

b) Digital Display :

Liquid Crystal show that is often referred to as {lcd|liquid crystal show, LCD, digital display, alphanumeric display} is a display it means it will display Alphabets, Numbers similarly as special symbols therefore {lcd|liquid crystal show|LCD|digital show|alphanumeric display} may be a user friendly show device which might be used for displaying varied messages not like seven section display which might display solely numbers and a few of the alphabets. Here we've used sixteen a pair of {alphanumeric show|digital show|display} which suggests on this display we are able to display 2 lines with most of sixteen characters in one line

c) DC Motor :

A DC motor may be a automatically commutated motor steam-powered from DC (DC). In DC motor, operation is predicated on easy electromagnetism. A current-carrying conductor generates a field; once this can be then placed in associate degree external magnetic field, it'll expertise a force proportional to the present within the conductor, and to the strength of the external field. Opposite (North and South) polarities of magnet attract, whereas like polarities (North and North, South and South) repel. the inner configuration of a DC motor is intended to harness the magnetic interaction between a current-carrying conductor associate degreed an external field to come up with motility motion.

#### d) Micro controller (AT89S52):

Microcontroller could be a general purpose device, that integrates variety of the parts of a microchip system on to single chip. it's constitutional central processing unit, memory and peripherals to create it as a mini pc. A microcontroller combines on to an equivalent microchip:

- The central processing unit core
- Memory (both memory board and RAM)
- Some parallel digital i/o Microcontrollers can mix different devices such as:
- A timer module to permit the microcontroller to perform tasks certainly time periods.
- A serial I/O port to permit knowledge to flow between the controller and different devices like a PIC or another microcontroller.
- An ADC to permit the microcontroller to simply accept analogue computer file for process. Microcontrollers are:
- Smaller in size
- Consumes less power
- cheap small controller could be a standalone unit, which might perform functions on its own with none demand for added hardware like I/O ports and external memory.

The heart of the microcontroller is that the central processing unit core. within the past, this has historically been supported a 8-bit microchip unit. as an example Motorola uses a basic 6800 .microchip core in their 6805/6808 microcontroller devices. AT89S52 is that the forty pins, eight bit Microcontroller factory-made by Atmel cluster. it's the flash kind reprogrammable memory. Advantage of this nonvolatile storage is we are able to erase the program inside couple of minutes. it's 4kb on chip memory board and 128 bytes internal RAM and thirty two I/O pin as organized as port zero to port three every has eight bit bin .Port zero contain eight knowledge line(D0-D7) furthermore as low order address line(AO-A7). Port a pair of contain higher order address line (A8-A15). Port three contains special purpose register like serial input receiver register SBUF, interrupt INT0,INT1 and timers T0 , T1 several of the pins have multi performs which might be used as general purpose I/O pins (or) Special purpose function may be determined by the applied scientist itself.

e) Block diagram :

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC
voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.
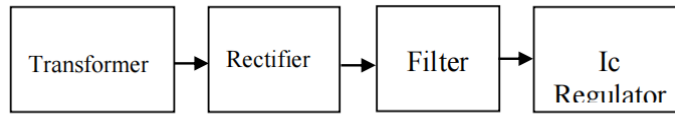
f) Working principle:-

- **Transformer :**

The potential electrical device can step down the facility offer voltage (0-230V) to (0-6V) level. Then the secondary of the potential electrical device are connected to the exactness rectifier, that is built with the assistance of op– amp. the benefits of victimisation exactness rectifier area unit it'll provide peak voltage output as DC, remainder of the circuits can provide solely RMS output.

- **Working:**

The alcohol device that is connected to port one,3rd pin has wood spirit share. Whenever the alcohol share of the motive force exceeds the limit of alcohol device, then the ignition(motor) that is connected to port one.0 stops mechanically. A message showing "Detected" is displayed on the digital display that is connected to port zero. At constant time buzzer that is connected to port one,5th pin is ON acting as a
warning to the motive force. If the alcohol share of the motive force doesn't exceed the device alcohol content, then a message "no alcohol motor on" is displayed on the digital display screen.
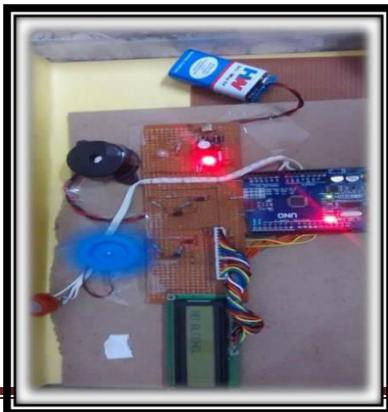
Fig. No alcohol Contents   **Fig. No alcohol Contents**

4) To Detect the Unsafe lane changing on expressway by using sensor-

One possible way to detect unsafe lane changing on expressways using sensors is to install cameras and radar sensors along the roadway. These sensors can monitor the movement of vehicles and detect sudden lane changes or erratic driving behavior.

The cameras can capture images of vehicles changing lanes without signaling or cutting off other vehicles. The radar sensors can measure the speed and distance between vehicles, alerting authorities to any unsafe maneuvers.

Additionally, vehicle-to-vehicle communication technology can be used to detect unsafe lane changes. This technology allows vehicles to communicate with each other and share information about their position, speed, and intended maneuvers. If a vehicle detects another vehicle making an unsafe lane change, it can alert the driver or automatically adjust its own speed and position to avoid a collision.

Overall, a combination of cameras, radar sensors, and vehicle-to-vehicle communication technology can help detect unsafe lane changing on expressways and improve road safety.

IV. FUTURE SCOPE

- Integrate flags, statues, and colorful walls strategically along the expressway to enhance visibility and aesthetics.

- Position installations near nitrogen air check stations and detection sensor sites to create visual landmarks and improve awareness.

- Implement alcohol detection sensors at key points such as toll booths and rest areas to prevent drunk driving incidents.

- Deploy unsafe lane change detection sensors at critical sections to mitigate accidents caused by reckless driving maneuvers.

- Utilize advanced sensor technology for real-time monitoring and detection of alcohol levels and unsafe lane changes.

- Integrate sensor data with central control systems for immediate response and alert mechanisms to authorities and drivers.

- Use flags, statues, and colorful walls as visual aids to reinforce safety messages and promote responsible driving behavior.

- Embrace technological advancements to enhance the effectiveness of alcohol detection and lane change detection systems.

- Explore the integration of AI and predictive analytics to anticipate potential hazards and prevent accidents proactively.

- Foster collaborations with government agencies, law enforcement, and technology providers to ensure seamless implementation and operation of safety measures.

RESULT

Implementing an Intelligent Transportation System (ITS) with solutions like a nitrogen check station, alcohol detection sensor, unsafe lane change sensor, along with colorful walls and statues to prevent hypnosis, effectively reduced the accident rate on the Samruddhi Expressway. Nitrogen check stations equipped with sensors have contributed to preventive maintenance measures, these stations have preempted tire-related accidents such as tyre bursting, blowouts, enhancing overall road safety and reducing the risk of accidents caused by tire failures. The integration of alcohol sensors and unsafe lane change sensors has played a pivotal role in reducing the accident rate on the Samruddhi Expressway. By detecting instances of drunk driving and unsafe lane maneuvers in real-time, these sensors have enabled swift intervention, thereby preventing potential collisions and mitigating road hazards. In additionally colorful walls, statues, and flags along the Samruddhi Expressway has significantly reduced accidents attributed to road hypnosis. These are all technology based implementing solution significantly reduced the accident rate on samruddhi expressway.

IV. CONCLUSION

The comprehensive implementation of flags, colorful walls, statues, nitrogen check stations, alcohol detection sensors, and unsafe lane change sensors on the Samruddhi Expressway has yielded substantial reductions in accident rates. By combining aesthetic enhancements with advanced safety technologies, this project has not only improved the visual appeal of the expressway but also effectively addressed critical safety concerns. The integration of these measures has enhanced visibility, enforced vehicle emission standards, detected and deterred impaired driving, and monitored and corrected unsafe driving behaviors. As a result, the Samruddhi Expressway now stands as a model for innovative infrastructure design that prioritizes both safety and aesthetics, ultimately saving lives and minimizing accidents.

V. PHTOGRAPHS WITH PROSPECTIVE MODEL

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