A REPORT ON MINI PROJECT EC281

DEVELOPMENT OF DIGITAL CAR WITH ENHANCED SECURITY FEATURES

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ABSTRACT

The automotive industry is witnessing a rapid transformation driven by advancements in digital technologies. One notable aspect of this transformation is the development of digital cars equipped with enhanced security features. This paper presents an overview of the development process and key security features incorporated into modern digital cars.With the increasing connectivity of cars to external networks such as the internet and cloud services, ensuring robust cybersecurity measures is paramount.

This paper presents the development of a digital car featuring an integrated digital lock and automatic gear system, aimed at enhancing convenience and security for vehicle users. The integration of these systems marks a significant advancement in automotive technology, offering seamless functionality and improved safety features.

The integration of these systems into the digital car architecture necessitates robust cybersecurity measures to protect against potential vulnerabilities and cyber threats. Encryption techniques and secure communication protocols are employed to safeguard sensitive data transmitted between the digital lock and automatic gear systems and other vehicle components. Intrusion detection and prevention mechanisms are also implemented to detect and mitigate unauthorized access attempts or tampering.

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INTRODUCTION

The automotive industry is undergoing a profound transformation driven by advancements in digital technology. Traditional mechanical components are being replaced with electronic systems, ushering in a new era of smart, connected vehicles. In line with this trend, our project focuses on the development of a digital car equipped with innovative features aimed at enhancing both security and convenience for users.

MOTIVATION

- *Automatic gear systems can help minimize the risk of driver error associated with gear shifting, potentially leading to fewer accidents.*

- *Automatic headlights activated by light sensors can ensure optimal visibility during low-light conditions, reducing the risk of nighttime accidents.*

- *Automatic gear systems eliminate the need for manual gear changes, simplifying the driving experience.*

- *Light sensors eliminate the need for drivers to manually turn headlights on/off, enhancing convenience and safety.*

- *Digital lock systems provide a convenient and secure way to enter and exit the vehicle without needing a physical key.*

LITERATURE REVIEW

- *Security and Hacking: Studies by [Liu et al., 2021] and [Rad et al., 2020] highlight the increasing concerns over hacking vulnerabilities in digital lock systems. They explore common methods like relay attacks and emphasize the need for robust security measures like multi-factor authentication and encryption.*

- *The study by [Sivaramanet al., 2017] examines the use of smartphone apps as digital keys. They highlight the benefits of convenience and remote access control while acknowledging potential security concerns and the need for secure communication protocols.*

- *[Wang et al., 2019] investigates the impact of environmental factors like dust and moisture on light sensor performance. They propose self-cleaning mechanisms and improved sensor housing designs to mitigate these issues.*

- *The research by [Ibrahimy et al., 2020] examines existing and evolving regulations regarding car safety features and the potential legal considerations of implementing advanced digital technologies. Staying updated on these regulations is crucial for ensuring car manufacturers comply with legal requirements.*

- *Industry reports by [McKinsey & Company, 2023] and [Deloitte, 2022] discuss the future of digital cars, highlighting trends like autonomous driving, vehicle connectivity, and the potential impact on car design and functionality. Understanding these trends can inform the development and implementation of future digital features in cars.*

  Research by [Ma et al., 2018] investigates the use of fingerprint recognition for car access, finding it to be a secure and convenient alternative to traditional keys. Similarly, [Akkaya et al., 2019] explores *facial recognition for car unlocking, emphasizing the importance of user privacy and data security considerations.*

- *[Hu et al., 2019] discusses how data from light sensors can be integrated with ADAS features like automatic high beams and lane departure warnings. This integration can create a more comprehensive safety system by adjusting vehicle behavior in response to real-time lighting conditions.*

WORK DONE

THE DIGITAL CAR HAS TOTAL 3 FEATURES –

1. The first one is unlocking the car using a 4 digit pin lock system.

- To simulate a physical 4 digit number lock with the ability to-
- Show the number entered in a 7-segment display.
- Clear the number entered.
- Display whether the lock is locked or unlocked or the pin can be changed.

A counter will count the number of attempts entered by the user for the correct password and will light the LED signaling a malware alarm after 3 consecutive failed attempts.

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2. An automatic light sensor which switches ON the headlights of the car at night.

With this a headlight feature will be implemented for the car improving the visibility in less light regions and thus enhancing safety.

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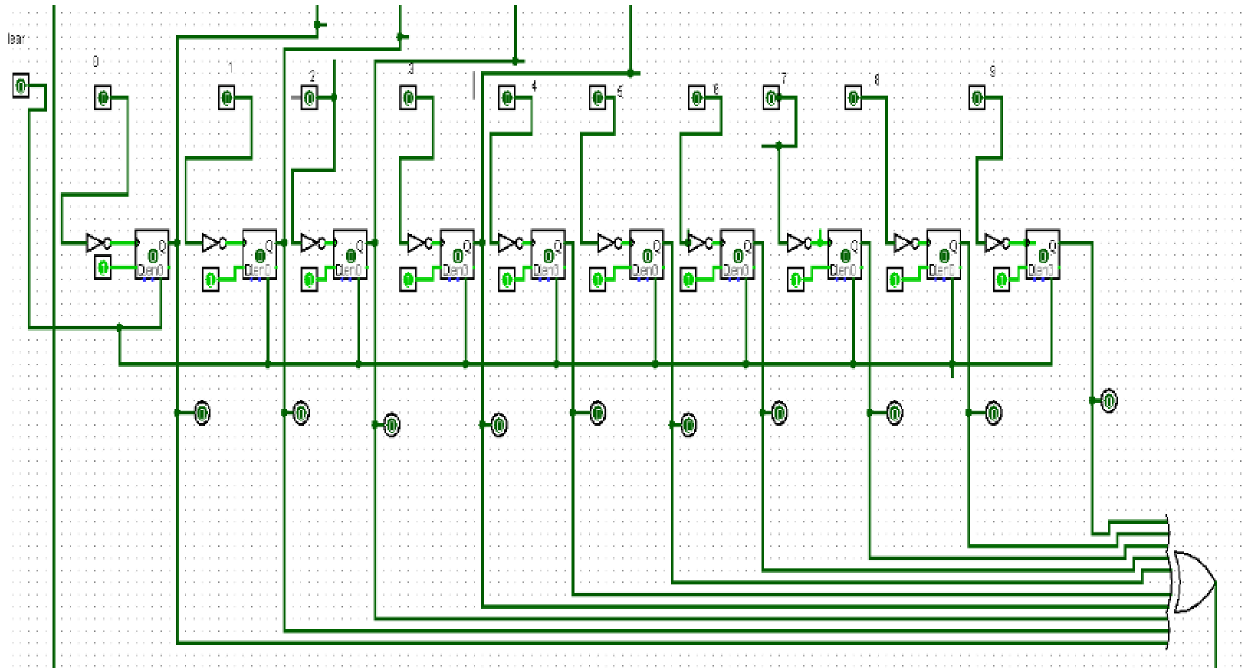
3. A automatic gear system-

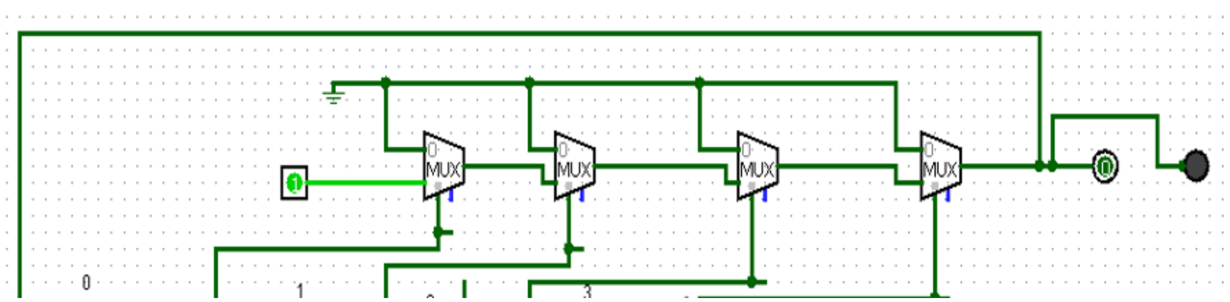
- Ignition = 0, Car will be in OFF position. Thus, SPEED = 0. Acts as a power button of the vehicle.
- When A = 1, B = 0: On application of each clock pulse, the SPEED will get incremented by 10 kmph till a maximum limit of 150 kmph.
- When A = 0, B = 1: Every clock pulse will decrement the SPEED by 5 kmph
- As the load(weight) of the vehicle keeps increasing, irrespective of the application of more power or gear changes, the maximum speed of the vehicle decreases.

Circuit diagrams and design implementation using logisim

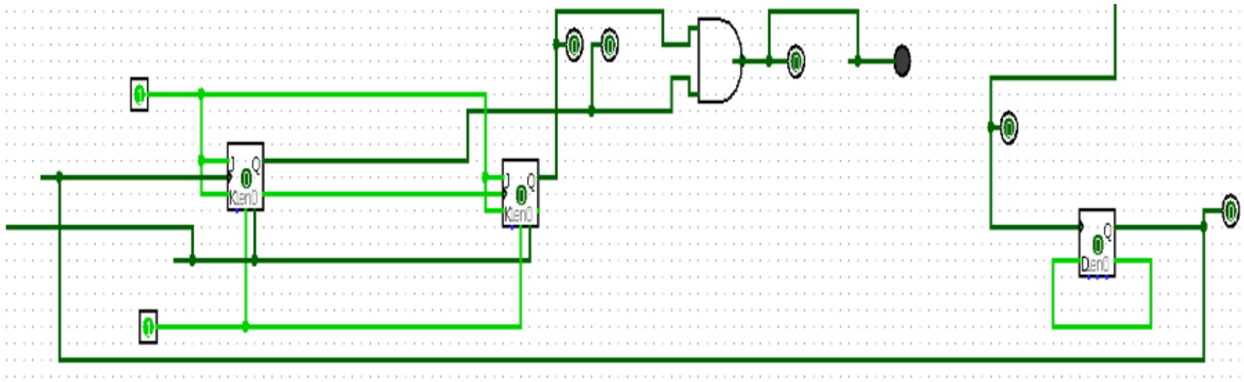
DIGITAL LOCK



Keypad which has a clear option along with the input pins.
When the button in pressed 1 is the input to the circuit. When the button is released 0 is the input to the circuit.
The clock for all sequential circuits are taken from the input of the keypad as we press one key at a time.
A memory element to store the current input and the correct pin.



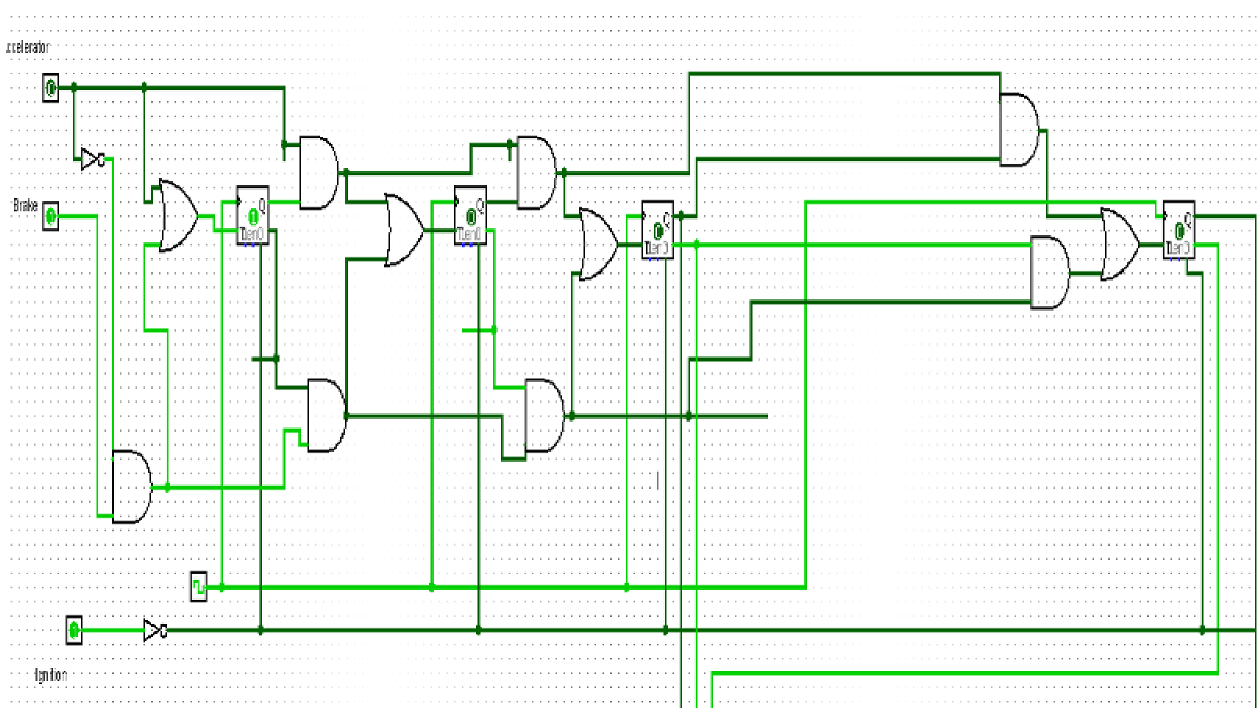
This circuit checks if the entered password is correct.
The LED glows if the password entered is correct

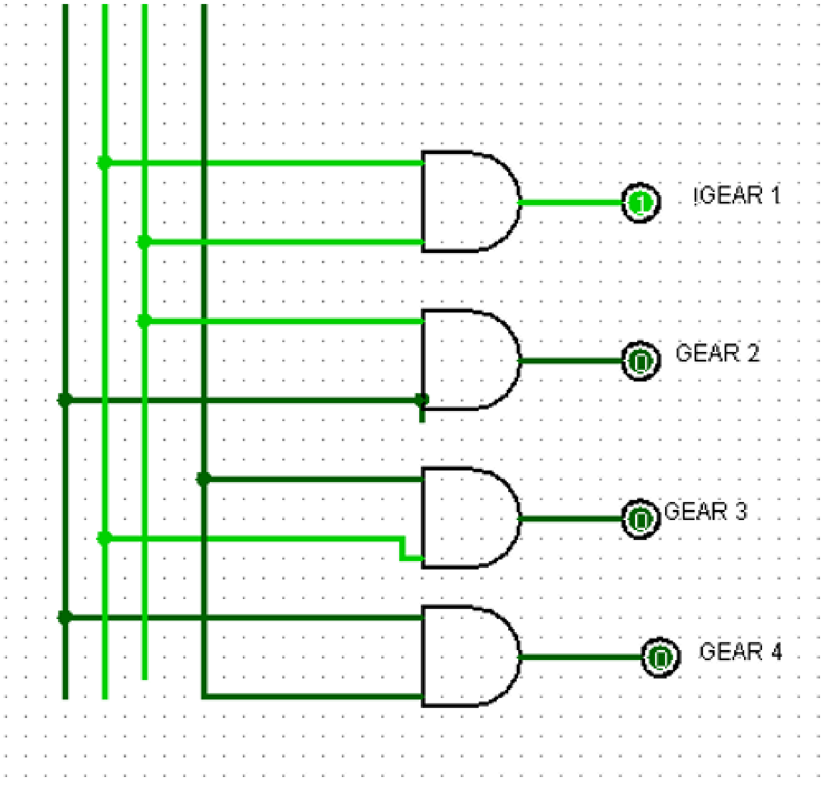


The counter counts the number of attempts.
LED glows if there are 3 failed attempts.
Count is reset to zero after correct password is entered

AUTOMATIC GEAR SYSTEM

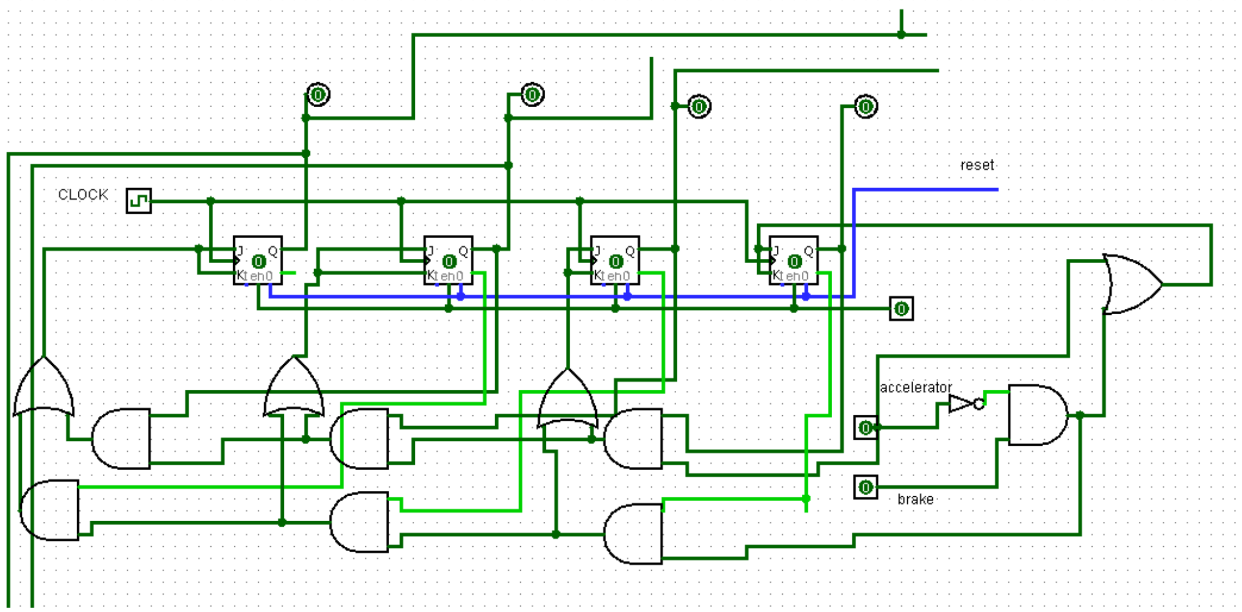
Counter that detects the increment/decrement of speed by 10km/hr.



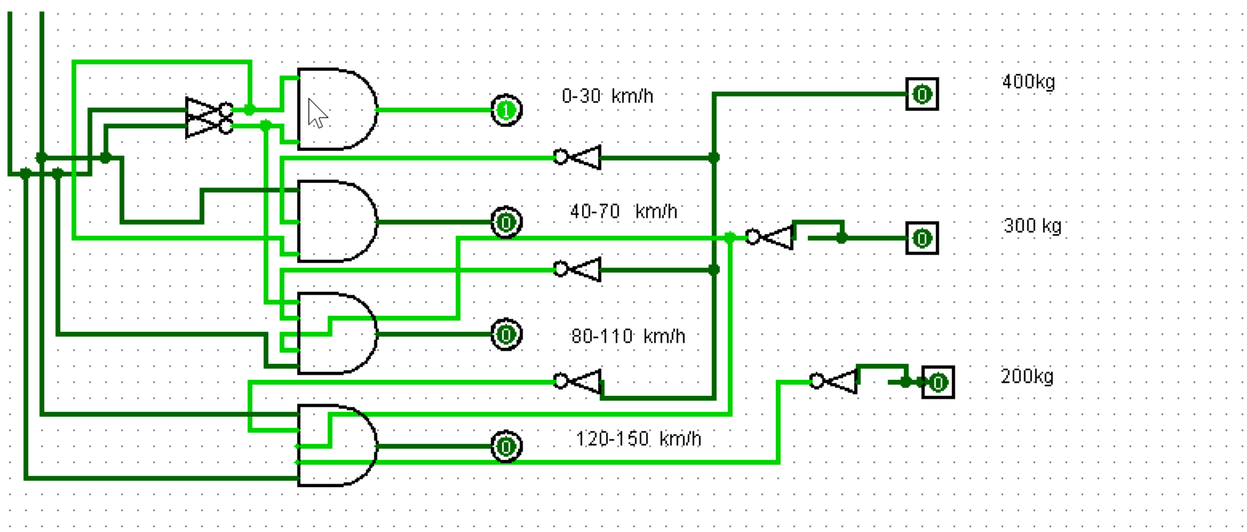


Gear system that shows the current gear.
0-30-GEAR 1
40-70-GEAR 2
80-110-GEAR 3
120-150-GEAR 4

ADDED LOAD INPUT TO CHECK VELOCITY VARIATION



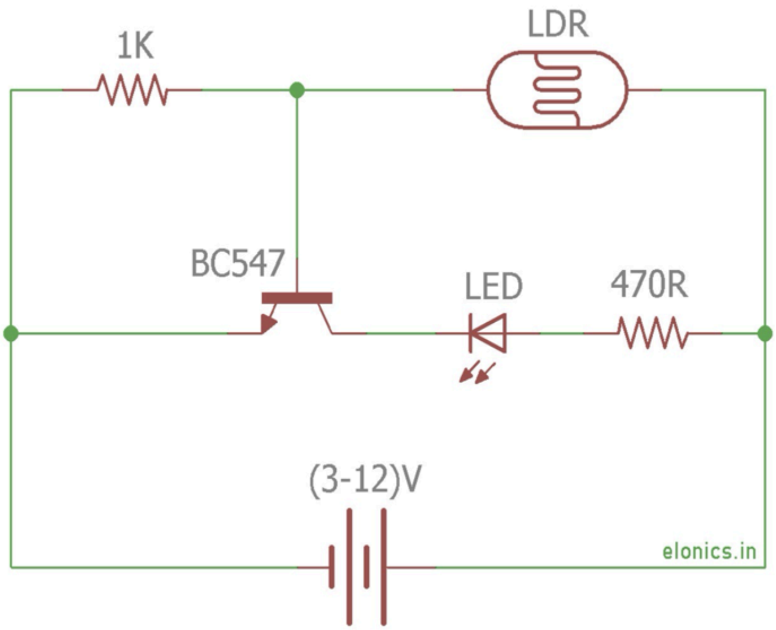
Clock implemented using j k ff. There are 2 inputs of acceleration and brake. As we accelerate, velocity increases and vice versa.



The output consists of 4 ranges of velocities in which the car can be-
0-30 km/hr - Top speed 30 km/hr when load = 400kg
40-70 km/hr - Top speed 70 km/hr when load= 300kg
80-110 km/hr - Top speed 110 km/hr when load= 200kg
120-150 km/hr - Top speed 150 km/hr when unloaded i.e 100kg

The max speed attainable reduces with the increasing load of the vehicle. Dropping of load midway makes the vehicle regain the original velocity.

LIGHT SENSOR ENHANCING VISIBILITY (HEADLIGHTS)



LIGHT SENSOR SCHEMATIC

Light sensor detector which turns on the headlight of the car during night time automatically

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HARDWARE REQUIRED

The circuit above will be implemented using logic gates and normal flip flops available in the Digital Design Lab.

CONCLUSION

A Digital Car Ushering in a New Era of Security and Automation

- **It outlines the intended features of the car, including a digital lock system, automatic gear system, and light sensor.**
- **The development of a digital car with enhanced security and automation features represents a significant step towards a future of safer, more convenient, and technologically advanced transportation.**

SOME ADVANCES IN FUTURE

We will be doing the hardware implementation of the above circuit and will be adding more features like display of the digits on a 7 segment display in our Logisim for a better understanding. Also verilog/vhdl codes may be implemented if time permits.
We will be trying to further improve the security and accuracy of the features in the car.
We will be integrating all the features of the car together in the end.

Looking ahead, the success of this project lays the foundation for further advancements in digital car technology. As the automotive industry continues to evolve, we remain committed to pushing the boundaries of innovation and delivering solutions that meet the needs and expectations of modern vehicle users.

References

- ***G. K. Verma and P. Tripathi, "A digital security system door lock system using RFID technology," International Journal of Computer Application, vol. 5, no. 11, pp. 6-8, Aug. 2010.***

- ***D. M. Harris and S. L. Harris, Digital System Design and Computer Architecture. [Online]. Available: https://books.google.com/books?id=f1O3SwEACAAJ***
