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Fabrication of Casing forAutomatic Seat Belt Using Resin Printing

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ABSTRACT

Malfunctioning of the seat belt technology has been a cause for a plethora of accidents over the years. Vehicle Manufacturers are constantly incorporating new technologies in their vehicles in order to prevent any malfunctions and to reduce the impact on the passengers in case of any accidents. The latest technologies implemented were the three point seat belt system and airbags. As every technology has its own limitations and room for development, these technologies too have some barriers in extracting the best possible results from it. Thus, the automatic seat belt ejection system is a solution to prevent any malfunctions in the three point seat belt system, which may get locked in case of any excess load or pressure and prevent the ejection of seat belt. This system prevents such malfunctions by incorporating IoT to enable automatic ejection of the seat belt in a fixed time with the help of a solenoid attached to the seat belt. This part of the project involves fabricating a casing for the seat belt inclusive of the solenoid using the additive manufacturing technology.

Keywords: Seat belt, Automation, Resin Printing, Casing, Accident prevention

I. INTRODUCTION

Most of the vehicle manufacturers are now focusing more on the safety systems and technologies, as the last decade saw a huge rise in the number of accidents due to the technical malfunctions of the safety system. This is the major reason why consumers today are more interested in vehicles with better safety systems such as multiple airbags and sensors. One such system that has malfunctioned many times during the period of accidents is the three point seat belt technology. In the case of accidents with great impact, the passengers were unable to eject their seat belt and get out of their vehicles safely. High pressure or excessive loads exerted on the seat belt due to the impact of the accident causes the system to get locked and this prevents the user from ejecting it immediately. This situation demands the need for a solution that will enable the seat belt system to eject automatically in just seconds after the impact. This system uses IoT to efficiently eject the seat belt in a fixed time and solenoid to eject it properly. But in order to use this system, we must design the seat belt in a way that the solenoid is contained within the frame of the seat belt. The main focus of this project is to design a casing for the seat belt inclusive of the solenoid and fabricating it using theadditivemanufacturing technology in a cost efficient manner.

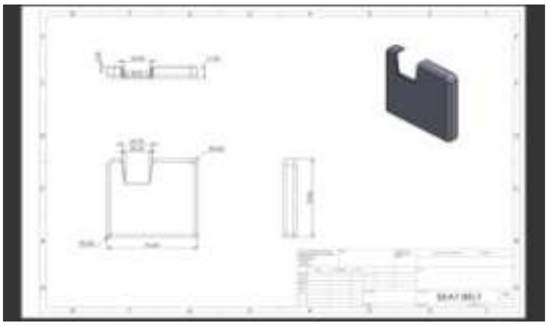

Fig 1

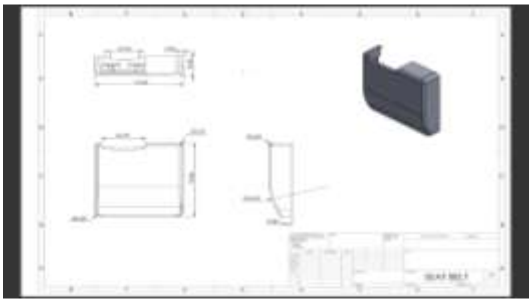

Fig 2

Figure 1 and 2 Part diagram of the extended seat belt casing

II. PROBLEMS IDENTIFIED

- The three point seat belt technology has its limitations that led to a number of accidents over the years.
- In the presence of an excessive load or pressure, the seat belt may get stuck and prevent ejection after an accident.

2.1 Techniques Implemented
Fabricating a casing for the automatic seat belt system using Resin Printing.

2.2 Scope and Goal
This project focuses on creating a cost-efficient casing for the automatic seat belt system that includes the solenoid inside the main frame.

This project commercializes the design by containing the solenoid inside the main frame, thereby updating the previous model in which the solenoid was fixed outside the frame. .

III. LITERATURE REVIEW

The passage discusses the potential for motion sickness in passengers of automated vehicles compared to manually driven vehicles. It notes that humans build an internal model to stabilize their bodies under external movements, but passengers of automated vehicles may only perceive driving movements through the vestibular channel, as they lose sensory-motor information when the driver is not actively controlling the vehicle. The passage also suggests that active seat belt retractions could be used to reduce head and upper body movements during braking maneuvers and mitigate motion sickness. Active seat belt systems are an extension of passive seat belt systems and provide reversible pre-tensioning of the belt shortly before a crash. They have been shown to result in significantly less forward head and shoulder movement during automated emergency braking compared to a standard passive belt. Finally, the passage notes that active seat belt retractions increase the activity of neck muscles before braking and can result in reflexive tightening of the muscles. With repeated exposure, passengers may show anticipatory head and body movements that are inverse to acceleration forces[1]. One of the key features of intelligent traffic management systems is their ability to adapt to changing traffic conditions. The system can use data from sensors, cameras, and other sources to detect accidents, road closures, and other disruptions. It can then adjust traffic signals, redirect traffic, and provide alternative routes to minimize delays and congestion. Intelligent traffic management systems can also help to reduce accidents and improve safety on the roads. The system can use data on vehicle speeds, braking distances, and other factors to identify potential hazards and alert drivers to take appropriate action. It can also monitor vehicle emissions and enforce regulations to reduce pollution.Overall, the intelligent traffic management system has the potential to improve the efficiency, safety, and sustainability of transportation systems. By using advanced technologies to collect and analyze real-time data, the system can help to reduce congestion, improve traffic flow, and enhance the overall travel experience for drivers and passengers[2]. The Internet of Things (IoT) refers to the interconnected network of physical objects or "things" that are embedded with sensors, software, and other technologies that allow them to collect and exchange data. These objects can be anything from household appliances and wearable devices to industrial machinery and transportation systems [3].

The authors of this passage are suggesting a new way of understanding why risky health behaviors persist despite government efforts to discourage them. They propose that people who are happier are less attracted to risk-taking, according to expected-utility theory, which is a model used in economics to predict how people make decisions under uncertainty[4]. The passage is discussing the relationship between seatbelt usage and perceived effectiveness of seatbelts. The author states that in their study, there was only a weak relationship between these variables. This contradicts an earlier study by Fhaner and Hans (1971) which found a significant correlation between these variables. However, Fhaner and Hane later (1975) reported that only extremely low scores were clearly associated with nonuse, and that the correlation might be explained by ceiling effects.It's important to note that the definition of effectiveness was different in the two studies. In the present study, effectiveness was defined in relation to the effects of a seatbelt law, while in Fhaner and Hane's study, it was not defined. The author also notes that in Fhaner and Hane's study, seat belt usage was more strongly correlated with ratings of inconvenience (-0.14) and discomfort (0.53).Overall, the passage suggests that the relationship between seatbelt usage and perceived effectiveness is complex and may depend on the definition of effectiveness and other factors such as convenience and discomfort [5]. The passage describes a study that provides the first comprehensive assessment of the effects of mandatory seatbelt laws on self-reported seatbelt use, highway fatalities, and crash-related injuries among high school age youths. The study uses data from the Centers for Disease Control's national, state, and local Youth Risk Behavior Surveys and the Fatality Analysis Reporting System spanning from 1991 to 2005, a period that saw over 20 changes in state seatbelt laws.The study uses quasi-experimental approaches that isolate the independent effects of seatbelt laws by controlling for demographic characteristics, area and year fixed effects, and smooth area-specific trends. The study finds consistent evidence across all data sources that state mandatory seatbelt laws, particularly those permitting primary enforcement, significantly increased seatbelt uses among high school age youths by 45-80 percent, primarily at the extensive margin.Overall, the passage suggests that mandatory seatbelt laws have a positive impact on seatbelt use among high school age youths, particularly when primary enforcement is permitted. This could lead to a reduction in highway fatalities and crash-related injuries among this population[6].

A study that analyzed the effect of seatbelt use on the risk of major injuries in developed countries. The study found that the overall risk of major injuries was significantly lower in belted passengers compared to unbelted passengers. The use of seat belts was also found to significantly reduce the risk of facial, abdominal, and spinal injuries. However, there was no statistically significant difference in the risk of head, neck, thoracic, upper limb, and lower limb injuries between belted and non-belted passengers. The study recommends raising awareness about the importance of adequate seatbelt use and conducting further research on the effects of seatbelt use on major injuries by crash type. In summary, the study suggests that the risk of most major road traffic injuries is lower in seatbelt users. However, the findings were inconclusive regarding seatbelt use and susceptibility to thoracic, head, and neck injuries during road traffic accidents. It is important to use seat belts properly to minimize the risk of injury in the event of a collision[7]. Passive safety systems, such as airbags, seat belts, and shock protection systems, are designed to protect occupants in the event of a collision. In a frontal collision, the shock protection system plays a critical role in minimizing the force of impact and protecting the occupants of the vehicle. When a vehicle equipped with a shock protection system is involved in a frontal collision, the system absorbs the energy generated by the impact and reduces the force of the collision on the occupants. The system may include features such as crumple zones, which are designed to absorb energy by deforming and crumpling upon impact, as well as other structures and materials that are engineered to absorb and dissipate energy. In addition to the shock protection system, seat belts also play a critical role in protecting occupants in the event of a collision. Seat belts keep the occupants in their seats and prevent them from being thrown forward in a collision. This reduces the risk of injury to the head and torso, and can also help to prevent injuries to the legs and feet. Airbags are another important passive safety system that can help to protect occupants in the event of a collision. Front airbags, side airbags, and other types of airbags are designed to deploy in the event of a collision and help to reduce the force of impact on the occupants. Airbags can also help to prevent occupants from being thrown forward and can help to protect the head, neck, and chest. Overall, the combination of passive safety systems, including shock protection systems, seat belts, and airbags, can help to minimize the risk of injury to occupants in the event of a collision. However, it is important to note that these systems are not foolproof and cannot prevent all injuries in the event of a collision. As such, it is important for drivers to exercise caution and drive defensively to help prevent collisions from occurring in the first place.[8]

The adoption of seat belts was lower (69.6%) in northern Gondar not withstanding their demonstrated efficacy.The use of seat belts was significantly correlated with the type of car, marital status, and drivers' educational level. Therefore, it is important to promote the use of seat belts by drivers both during licensing and at work.[9] The purpose of this study was to examine how the use of seat belts and other human factors affected the degree of the driver's injuries. Data analysis revealed that not using a seat belt while driving is associated with a high chance (12.92%) of serious and fatal injury. Drivers who don't buckle up considerably raise the risk of death and serious injury. The severity of the accident may also be influenced by distraction and the type of road.[10]

The authors of this study aimed to evaluate the effectiveness of occupant protection systems by measuring the mortality reduction associated with air bag deployment and seat belt use in head-on collisions involving passenger cars in the United States. They used a matched case-control design and analyzed data from the Fatality Analysis Reporting System from 1992-1997.The study found that air bag deployment reduced mortality by 63%, and lap-shoulder belt use reduced mortality by 72%. After adjusting for vehicle and driver factors, air bags and any combination of seat belts were both associated with reduced mortality. The combined use of air bags and seat belts reduced mortality by more than 80%.These findings confirm the independent effectiveness of air bags and seat belts in reducing mortality in head-on collisions involving passenger cars. The study provides valuable information for policymakers and car manufacturers in designing and implementing effective occupant protection systems. [11] The study aimed to investigate the effects of seat belt usage on injury patterns and outcomes of vehicle occupants who were involved in road traffic collisions (RTCs). The study was conducted between April 2006 and October 2007 and included trauma patients admitted to Al-Ain and Tawam Hospitals, as well as those who died after arrival at the departments.Of the 783 vehicle occupants, 766 patients with known seat belt status were studied. Among them, the 631 (82.4%) who were unrestrained were significantly younger than the restrained patients. The study found that the severity of injury was significantly higher in unrestrained patients, as indicated by higher Abbreviated Injury Scale (AIS) scores for the thorax, back, and lower extremity, and lower Glasgow Coma Scale (GCS) scores. Unrestrained patients also required more surgical operations, had longer hospital stays, and higher mortality rates compared to restrained patients. The study highlights the importance of seat belt usage in reducing the severity of injury, hospital stay, and number of operations in injured patients involved in RTCs. The study also suggests that seat belt compliance is low in the community studied, and legal enforcement of seat belt usage is necessary to reduce the severity of injury caused by RTCs. These findings have important implications for policymakers, healthcare providers, and the general public in promoting the use of seat belts to reduce the burden of injury and death from RTCs. [12]

Composites are increasingly being used in the automotive industry due to their ability to provide high strength and stiffness while being lightweight. This results in improved fuel efficiency, handling, and overall performance of the vehicle.Composites offer excellent energy absorption properties that can help to reduce the impact of collisions, protecting both the vehicle and its occupants. Composites can also be designed to have specific deformation characteristics, which can be tailored to absorb energy in a controlled manner.Furthermore, composites can be molded into complex shapes, allowing for greater design freedom and improved aesthetics. Overall, the use of composites in automotive components can provide a range of benefits, including improved safety, performance, and efficiency.[13]

IV. METHODOLOGY

4.1 Solidworks

Solidworks, a tool for solid modeling in computer-aided design and engineering. The programme is used for project management, planning, visual ideation, modeling, and prototyping. You may then design and construct mechanical, electrical, or software components with the aid of the programme. Lastly, Solidworks can help you handle things like device management, analytics, data automation, and cloud services. Every feature that is developed in Solidworks is based on the characteristics of the feature it is physically linked to, making it a parametric CAD application.It offers a faster path to the prototype stage by incorporating important features like checking if your item fits in a given 3D printer's bed before exporting the part for 3D printing.

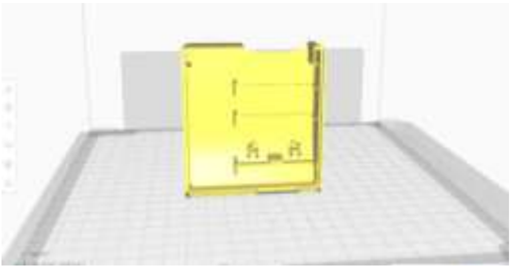

Fig 3

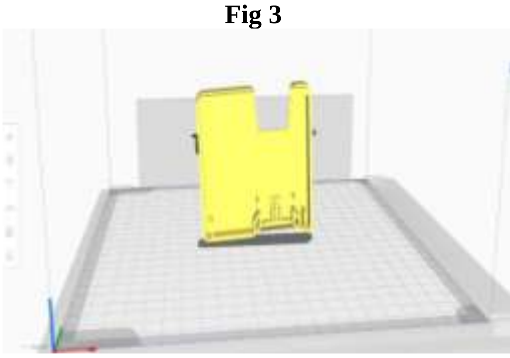

Fig 4

Figure 3 and 4 3D model of the seat belt casing

4.2. SLA

Stereolithography is a method of 3D printing technology used for layer-by-layer creation of models, prototypes, patterns, and production parts utilizing photochemical processes in which light induces chemical monomers and oligomers to cross-link to produce polymers.The liquid ingredients used in SLA printing are thermoset polymers known as resins. A broad range of resins are commercially available, and handmade resins can be used to test different compositions. Resin allows you to print a model with significantly more fine features than a regular FDM printer can.

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V. CONCLUSION

Stereolithography can be utilized to fabricate the automatic seat belt case, which has various benefits. After the seat belt is manufactured, the inside components, including the solenoid and wirings, are shielded from contact with the outside environment, preventing rust, heating, and other chemical and physical harm to the solenoid. Also, it makes it possible for the user to buckle their seat belt without interruption, which lowers costs by reducing the frequency of solenoid replacement. The casing's material has unique qualities, including excellent durability and economic effectiveness.

REFERENCES

[1]. C. Kremer, M. Tomzig, N. Merkel, and A. Neukum, “Using Active Seat Belt Retractions to Mitigate Motion Sickness in Automated Driving,” Vehicles, vol. 4, no. 3, pp. 825–842, Sep. 2022, doi: 10.3390/vehicles4030046.

[2]. Z. Wang and Y. Ma, “Detection and recognition of stationary vehicles and seat belts in intelligent Internet of Things traffic management system,” Neural Comput Appl, vol. 34, no. 5, pp. 3513–3522, Mar. 2022, doi: 10.1007/s00521-021-05870-6.

[3]. A.Maurya and S. Manikandan, “Low cost stand-alone clap only detector,” in Proceedings - 2018 IEEE 4th International Symposium on Smart Electronic Systems, iSES 2018, Institute of Electrical and Electronics Engineers Inc., Jul. 2018, pp. 199–202. doi: 10.1109/iSES.2018.00051.

[4]. R. J. B. Goudie, S. Mukherjee, J.-E. De Neve, A. J. Oswald, and S. Wu, “Happiness as a driver of risk-avoiding behavior: Theory and an empirical study of seatbelt wearing and automobile accidents,” 2013.

[5]. 0l A Svenson, “PERCEIVED DRIVING SAFETY AND SEATBELT USAGE.”

[6]. C. S. Carpenter and M. Stehr, “THE EFFECTS OF MANDATORY SEATBELT LAWS ON SEATBELT USE, MOTOR VEHICLE FATALITIES, AND CRASH-RELATED INJURIES AMONG YOUTHS,” 2007. [Online]. Available: http://www.nber.org/papers/w13408

[7]. N. FoudaMbarga, A. R. Abubakari, L. N. Aminde, and A. R. Morgan, “Seatbelt use and risk of major injuries sustained by vehicle occupants during motor-vehicle crashes: A systematic review and meta-analysis of cohort studies,” BMC Public Health, vol. 18, no. 1, Dec. 2018, doi: 10.1186/s12889-018-6280-1.

[8]. C. Itu, A. Toderita, L. V. Melnic, and S. Vlase, “Effects of Seat Belts and Shock Absorbers on the Safety of Racing Car Drivers,” Mathematics, vol. 10, no. 19, Oct. 2022, doi: 10.3390/math10193593.

[9]. M. K. Woldegebriel, B. G. Aregawi, and H. T. Gebru, “Assessment of seat belt use and its associated factors among public transport drivers in North Gondar, Ethiopia: A cross-sectional study,” BMC Res Notes, vol. 12, no. 1, Feb. 2019, doi: 10.1186/s13104-019-4140-4.

[10]. J. D. Febres, S. García-Herrero, S. Herrera, J. M. Gutiérrez, J. R. López-García, and M. A. Mariscal, “Influence of seat-belt use on the severity of injury in traffic accidents,” European Transport Research Review, vol. 12, no. 1, Dec. 2020, doi: 10.1186/s12544-020-0401-5.

[11]. C. S. Crandall, L. M. Olson, and D. P. Sklar, “Mortality Reduction with Air Bag and Seat Belt Use in Head-on Passenger Car Collisions,” Am J Epidemiol, vol. 153, no. 3, pp. 219–224, Feb. 2001, doi: 10.1093/aje/153.3.219.

[12]. A.K. Abbas, A. F. Hefny, and F. M. Abu-Zidan, “Seatbelts and road traffic collision injuries,” World J Emerg Surg, vol. 6, no. 1, p. 18, May 2011, doi: 10.1186/1749-7922-6-18.

[13]. G. Raj Kumar, S. Balasubramaniyam, M. Senthil Kumar, R. Vijayanandh, R. Raj Kumar, and S. Varun, “Crash analysis on the automotive vehicle bumper,” Int J Eng Adv Technol, vol. 8, no. 6 Special Issue 3, pp. 1602–1607, Sep. 2019, doi: 10.35940/ijeat.F1296.0986S319.