Design and fabrication of seat belt-controlled hand brake system with ignition control

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Abstract. Either link or bar linkage is utilized in a hand slowing mechanism to interface the different segments together. The general pattern is to utilize a link for vehicles and vans, and bars just for substantial business vehicles. We don’t change any unique frameworks that are remembered for the vehicle however we incorporate some additional segments into it. As a result of that process changes occurs in the whole safety systems in it. This progression will help the travelers just as the driver to guarantee security while beginning the vehicle from the underlying point itself. In this endeavor a rack and pinion strategy changes over the vertically dropping improvement of the seat strap catch as it is chopped down into rotating development. It is then transmitted to an apparatus joined to the base of the hand brake through a pole. The rigging is associated with a rack. The flat development of the rack is changed over to vertical development used to lock or discharge the discharge switch of the handbrake switch. Additionally, with the assistance of press switch we can control the start on and off procedure. The LED pointers associated with this press switch will give exact situation of hand brake. Henceforth we can undoubtedly control it and start the vehicle. Rack and pinion has been in presence since the improvement of designing. It is one the most significant and basic segment utilized in building.

1. Introduction
Conventional hand brake feat involves the human interference. While not pull or pushing the switch, the hand brake won’t work. Also, generally as a result of negligence or in emergency conditions, we humans have a tendency to usually forget to use parking brakes. This could bring about moving of auto just if there should arise an occurrence of slants and crash with various vehicles in leave [1]. Consistent improvements in dynamic wellbeing and upgrades with connection to the dependableness and extravagance of activity imply that mechanical handbrakes are continuously being supplanted via programmed mechanical gadget frameworks.

In this project a rack and pinion arrangement convert the vertically downward movement of the seatbelt hook as it is clipped down into rotating motion. It is then transmitted to a gear attached to the base of the hand brake through a shaft [2]. The gear is connected to a rack. The horizontal movement of the rack is converted to vertical movement used to lock or release the release switch of the handbrake lever. Also, with the help of press switch we can...
control the ignition on and off process. The LED indicators connected with this press switch will
give accurate position of hand brake. Hence, we can easily control it and start the vehicle [3-4].

Rack and pinion has been around since engineering grew. This is one of the most basic
and important components used in engineering. A rack and pinion are a type of linear actuator
comprising a pair of gears that transform rotational movement into linear movement. A circular
gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion
applied to the pinion causes the rack to move relative to the pinion, thereby translating the
rotational motion of the pinion into linear motion.

We are using rack and pinion mechanism to the hand brake system to lock hand brake
until the seat belt is engaged. This new safety feature resists any vehicle owner to not drive a
vehicle without wearing a seat belt [5-6]. In India many safety features like ABS, airbag is an
additional feature. We want to pay more money to get these features, and yes luxuries vehicles
have them but the common man has to take the risk not having them and also many of them are
ignorant of safety in vehicles. Now in basic model cars which most of us can afford, only
seatbelt is the safety feature available. So, putting them on is most important while in driving
[7].

2. Objectives
1. To develop automation unit to reduce human manual interaction.
2. To make use of seatbelt mandatory
3. Prevent damage of the engine due human error.
4. Make the system available at low cost.
5. To maintain the correctness in hand brake operation in case of hand brake is not fully remove
or lock in case of emergency braking system action

3. Problem statement
Handbrake (Parking brake) is the mechanism used for well-being in the car. The traditional
machine works by manually operating the handbrake lever. Under this setting, the brakes
remain connected even while the car is going because of manual blunders. This condition
causes safety hazards which may cause damage the system components. During travel on the
steep slope in upward direction, if the vehicle accidently goes into neutral or engine stops, the
tendency of the vehicle is roll backwards; here we need the downhill locker. It is compulsory for
the driver to wear safety belt or wellbeing however it is regularly ignored and may demonstrate
deadly if vehicle meets with a mishap.

4. Work methodology
Either cable or rod linkage is used in a hand brake system to link the various components
altogether. The general trend is to use a cable for cars and vans, and rods only for heavy duty
commercial vehicles. We don’t change any original systems that are included in the vehicle but
we include some extra components into it. As a result of that process changes occurs in the
whole safety systems in it. These changes will help the passengers as well as the driver to ensure
safety while starting the vehicle from the initial point itself.

![Figure 1 Fabrication of seatbelt frame](image_url)
4.1 Fabrication and Working
Figure 1, shows the fabrication of seatbelt frame, first the rack is attached to the bottom of the seatbelt buckle such that the vertical movement of the rack can be obtained.

4.2 Hand Brake or Parking Brake
While the foot-slowing mechanism retards or stops a moving vehicle, the hand stopping mechanism forestalls the vehicle moving once it is left. Since the hand-slowing mechanism might be in activity for exceptionally prolonged stretch of time period, a linkage instrument separate from that of the water driven foot-brake circuit is introduced. Stopping brakes are commonly given uniquely on the back-street wheels.

4.3 Pull-twist Handgrip Lever.
This course of action utilizes a roundabout draw bar with ratchet teeth cut on one side. Two pawls draw in these teeth. A peg, embedded close to the lower end of, as far as possible the free bend development to around 90 degrees. For applying the stopping brake, the handgrip is curved to move the wrench teeth from the pawls. This activity causes the pawl edges to interact with the smooth surface bit of the draw-bar. At the point when the bar is pulled out

4.4 Pull-press-button Hand-Lever (Light-duty).
This development, the most well-known sort at present, utilizes a hand-switch. One finish of the hand switch is associated straightforwardly to the brake link while the opposite end shapes the handgrip, with a discharge press button. This switch is turned on a wrench section. At the point when the driver pulls up the switch arm, the spring-stacked pawl slides over the fastener teeth causing most extreme link pressure. Now the switch is discharged, and the vehicle leave pulls up the hand switch somewhat

5. Results and Discussion
The design and fabrication of Seatbelt Controlled hand braking system with ignition control is a simple and cost effective is majorly focused on the automotive safety study and practice of design, construction, equipment and regulation to minimize the occurrence and consequences of traffic collisions involving motor vehicles. Road traffic safety more broadly includes roadway design.

One of the first formal academic studies into improving motor vehicle safety was by Cornell Aeronautical Laboratory of Buffalo, New York. The main purpose is analyzed with this work is the crucial importance of seat belts and padded dashboards. However, the primary vector of traffic-related deaths and injuries is the disproportionate mass and velocity of an automobile compared to that of the predominant victim, the pedestrian.

5.1 Pinion and rack on seatbelt side
1. Outer diameter of pinion = 37mm
2. Outer circle circumference of the pinion = 116.23mm
3. Movement of rack = 13mm
4. Therefore, length of rack = 75mm
5. Number of teeth on pinion = 22
6. Number of teeth required on rack = 15
7. Module = 2
8. For 13 mm movement of rack the pinion rotates 40°
9. Number of teeth that comes in contact with gear = 5
10. Therefore actual number of teeth on rack = 15 (for safety).

5.2 Pinion and rack connected to handbrake
1. Length of rack = 75mm
2. Number of teeth comes in contact with rack = 5
3. Angle rotated by gear = 40°
4. Distance moved by rack = 13 mm

5.3 Dimensions of shafts and hole
1. Diameter of shaft = 8mm
2. Length of shaft connected to handbrake = 65mm
3. Length of rectangular shaft = 60mm
4. Breadth of rectangular shaft = 12mm
5. Height of rectangular shaft = 10mm
6. Diameter of shaft connecting pinion = 8mm
7. Length of shaft connecting pinion = 60mm
8. Diameter of hole on handbrake = 8.5mm

5.4 Movement of rack
1. Movement of the seatbelt clip = 13mm
2. Vertical movement of rack = 13mm
3. Angle rotated by pinion = 40°
4. Horizontal movement of rack = 13mm

5.5 Calculation of shaft diameter
Torque \( T = \frac{\pi d^3}{16} \)
\( T = 2000 \text{Nmm}; \tau = 30 \text{N/mm}^2 \)
\( 2000 = \frac{\pi d^3}{16} \times 30 \)
\( d = 6.97 \text{mm} \)
Standard diameter = 8mm

5.6 Design of spur gear

| Table 1 Design of spur gear procedure |
|--------------------------------------|
| step 1 | Gear ratio | \( i = \frac{z_1}{z_2} \) | \( i = 1 \) |
| step 2 | Selection of material | carbon steel |
| step 3 | Calculation of gear life | \( n = 20000 \text{hrs} \) |
| step 4 | Initial design torque [\( mt \)] | \( t = \frac{p \times 60}{z_1 \times \pi \times n} \)
| & \( mt = 0.167 \times 10^3 \text{n/mm} \) |
| step 5 | Calculation of \( \text{eqq}, (ob), (oc) \) | \( \text{eeq} = 2.15 \times 10^5 \text{n/mm}^2 \)
| & \( \text{(ob)} = 169.16 \text{n/mm}^2 \)
| & \( \text{(oc)} = c_{hrck} c_1 = 823.48/\text{mm}^2 \) |
| step 6 | Calculation of centre distance (a) | \( a \geq (i + 1) \left( \sqrt{\frac{0.74^2}{\text{oc}} \times \frac{\text{eeq}}{\text{mt}^2}} \right) \)
| & \( a = 39.6 \text{mm} \) |
| step 7 | Pinion and gear teeth \( (z_1, z_2) \) | \( z_1 = 22 \text{teeth} \)
| & \( z_2 = i z_1 = 22 \text{teeth} \) |
| Step 8 | module (m) | \( m = \frac{z_1}{z_2} \)
| & \( m = 1.8 \approx 2 \) |
| Step 9 | Revision of centre distance | \( a = m \left( \frac{z_1 + z_2}{2} \right) \)
| & \( a = 44 \text{mm} \) |
| Step 10 | calculation of \( b, d_1, v, \text{and} \varphi_p \) | \( \varphi = \frac{b}{a}, b = 13.2 \text{mm} \)
| & \( d_1 = m z_1, d_1 = 44 \text{mm} \)
| & \( v = \frac{z_1}{60 \times 1000}, v = 0.02 \text{m/s} \)
| & \( \varphi_p = \frac{b}{a}, \varphi_p = 0.3 \) |
| Step 11 | Selection of quality of gear | "is quality 10", is selected |
| Step 12 | Revised design torque[\( mt \)] | \( [mt] = \text{mt, k, kd} \)
| & \( [mt] = 0.242 \times 10^3 \text{n/mm} \) |
Table 1, shows the design of spur gear is safe. So, we can proceed the following design, for the design of rack and pinion the diameter of the pinion, the pitch, module etc. has to be calculated. The movement of the rack and the corresponding rotation of the pinion have to be calculated. Now the movement of the pinion is transmitted to the second pinion which in turn rotates the second rack that is used to lock the handbrake. First the rack is attached to the bottom of the seatbelt buckle such that the vertical movement of the rack can be obtained; the vertical movement of the rack rotates the pinion. The rotation of the pinion is transmitted to the second pinion using a shaft. Now the rack connected to the second pinion moves horizontally.

A rod connected to the end of this rack is inserted top the handbrake and thus the handbrake is locked into place. When the seatbelt clip is inserted the process is reversed and the hand brake will be free to be engaged. The whole arrangement is mounted on a frame. The design of the seatbelt clip is altered for easier working of the system. With the help of press switch we can control the ignition system. The controlling will be indicated with the help of led lights.

**6. Conclusions**

Some have proposed that the number of deaths was influenced by the development of risk compensation, which says that drivers adjust their behavior in response to the increased sense of personal safety wearing a seat belt provides. In one trial subjects were asked to drive go-karts around a track under various conditions. It was found that subjects who started driving unbelted drove consistently faster when subsequently belted. Similarly, a study of habitual non seat belt wearers driving in freeway conditions found evidence that they had adapted to seatbelt use by adopting higher driving speeds and closer following distances.

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