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INNOVATIVE ANALYSIS

PROBLEM RESOLUTION ON LOW BEAM HALOGEN HEADLIGHT

1. BRIEF DESCRIPTION OF THE SITUATION

An automobile provides transportation for an operator. The person operating the vehicle must know their destination and have a clear sight of the path that they are traveling along. Operating a vehicle during a clear daytime provides adequate visible driving conditions that typically would not require the use of alternate lighting to assist with a clear sight of the traveling path. In difficult sight conditions (rainy, dark, foggy and overcast conditions) headlights assist with the operators' vision which produces the other drivers' ability to see the operator's vehicle.

When difficult visibility conditions occur, this produces a low to no visibility conditions and the headlights must be activated. This activation can happen when activated by the operator or a sensor determines that the driving conditions are adequate to activate the headlights on the vehicle. The headlights must illuminate upon activation. This illumination assists the operator with clear visibility of their driving path as well as the ability for other drivers being able to see the vehicle as well. This illumination is in place to provide safe driving conditions for all drivers.

Difficult visible conditions are also produced when headlights blow out because this produces low to no visibility of an operators' path. Low to no visibility for an operator can result in a citation to the operator which creates awareness for the operator to address the affected headlamp.

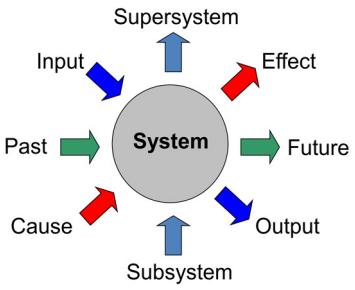
When a headlight blows out and needs to be replaced, an auto parts store being closed would prevent the purchase necessary to drive safely. If a backup low-beam filament were to enable, the driver would be unaware of the primary filament outage and still permit safe driving conditions to the operators' destination. When the operator turns the vehicle off or on the backup filament would incorporate an alert to the operator. This alert would create awareness for the operator to replace the affected headlight.

A backup filament engaging when a primary low beam filament burnt out would assist in being a deterrent to dangerous driving conditions and aid in preventing car accidents as well as citations for an inadequate headlight. The backup filament would provide awareness to the bulb outage.

The backup filament would provide the operator with enough time to get back and forth through their travels and continue to legally and safely operate a vehicle until an auto part store was open to replace the bulb should the primary bulb fail after hours when an auto parts store would normally be closed.

2. DETAILED DESCRIPTION OF THE SITUATION

2.1 SUPERSYTEM/SUBSYSTEM ANALYSIS



Halogen Bulb

The automobile industry currently has an industry standard of halogen bulbs which have a tungsten two -filament bulb. (Higher end vehicles may be equipped with a different type of system.) The current low beam filament has between 450 – 1000 hours of life and has a tendency to blow out without any notice

to the driver. An additional filament to the current low beam filament would engage providing 100 hours of backup filament life when the primary low beam filament blows out. In an added feature to the backup filament, after the automobile shuts off, that particular backup filament would then blink 5 times to alert the driver the backup filament in that affected light has been activated and create better awareness to the driver that the bulb needs to be changed. This would also provide the operator additional time to replace the low beam headlight should the bulb blow out after normal store hours while continuing to reach their destination/s, while providing the lighting that is recommended for their vehicle. The backup filament's activation would also assist the operator with safe operating as well as not receiving a citation for inadequate lighting during that particular time.

2.2 INPUT/OUTPUT ANALYSIS

Halogen Based Bulbs

The required inputs for the Automobile Low Beam Headlight Awareness Bulb would consist of an additional filament to be incorporated with the current primary bulb. The headlight would also have to be installed by either the operator or experienced technician.

With a backup filament as an input, the provided output is an increased safety feature of a backup lighting of an additional 100 hours when a primary filament burns out, which can assist with a decrease in automotive accidents and driving citations.

After the backup filament has detected that the primary filament has burned out, the backup bulb would trigger off 5 slow dimming blinks when the automobile is turned off or on (Much like the notification lights that blink to visually alert an operator that a remote has activated door locks (or an alarm) on a vehicle.) This visual alert creates an increased awareness to the operator alerting that an inadequacy to a bulb needs to be addressed.

A backup filament would provide adequate lighting in dark conditions which could reduce the number of accidents and affect the number of automotive insurance claims.

LED Lighting

My recommendation for LED lighting would be to include a visual sensor similar to an alert that lets the operator know that the trunk (or a door is open). This could be located on the dash near the seatbelt or other various visual alerts.

With LED's there are numerous elements that produce the light so there is not a need for a so called "backup filament". This alert would be present to alert the driver that a light is reaching its end of life or being affected with an outage of some sort and should be addressed.

In another recommendation, if the car manufacturers do not wish to upgrade the dashboard for this type of alert, then I would recommend that the blinking of the lights, as an alert to the driver on startup or shutdown of the vehicle, be employed.

2.3 CAUSE/EFFECT ANALYSIS

Automobile halogen bulbs have a usable life of 450-1000 hours. Bulb and weather temperatures, vibrations, ventilation space and usable light hours the amount (or length) of usable light will cause the halogen bulbs usable life to decrease less than its projected hours of usage causing operators to change out bulbs often.

Temperature conditions can have an effect on how long a halogen bulb may have. Extreme hot and cold temperatures can stress the bulb and cause a filament to blow. An inadequately vented space for a vehicle can cause a bulb to run hot and shorten the usable life. Vibrations to a bulb can cause limited light life as the filament inside the bulb stresses and fractures rendering a shorter usable bulb.

When a driver is operating an automobile the need for headlights to be in working order are dependent upon the visibility conditions outside of the vehicle. In dark, overcast, rainy and foggy conditions the headlights are not only used as for other drivers' awareness of an oncoming car or motorcycle, but also a primary safety feature to illuminate the path for the operator. These situations arise and all the headlights of an automobile need to be in working order.

If a driver activates the headlight system in a light to moderately dark visibility situation, it is not always evidently clear to the driver behind the wheel that one or both of the headlights are not in working order. If one headlight was not operating correctly, the safety of the operator of the vehicle as well as the safety of the other drivers sharing the road is jeopardized. For this reason, Police Officers spotting these vehicle inadequacies are inclined to create awareness to the operators by issuing a warning or in worst case scenarios, a citation.

In a visibly dark situation, an inadequate headlamp may be more prevalent if it is located on the operator's side of the vehicle as this provides the primary line of sight for the operator. In this dark visibility, an inadequate headlamp located on the passenger side of the vehicle may or may not be as obvious to the operator. This scenario would also result to be a hazard which could also result in an accident or a citation.

If drivers safely arrive to a destination having realized along their travels that a headlight is inadequate, then they must make a decision to either drive their own vehicle to an automobile parts store hazardously (assuming that an automobile parts store is open at that time and also assuming that this destination is not the operators final destination) to purchase a new bulb. The operator could also borrow a vehicle or get a ride in a properly lit vehicle to an automobile parts store (again, assuming the store is open at this time) to purchase a replacement bulb for their vehicle. In the scenario that the operator has reached their final destination when they realize the safety hazard, the decision to not travel until the headlights are not needed to make this purchase is an option, but an inconvenience to the operator should the need to travel during dark conditions suddenly arise. (All of these scenarios take into consideration that the driver can replace a headlight on their own. If the operator cannot replace a headlight on their own, they must have an experienced technician replace the headlight.)

Another situation to consider is that the driver has not reached their final destination when they realize that the headlight/s are inadequate and make the decision to continue to their final destination and take the chance that they are not spotted by a Police Officer and that the inadequacy does not interfere with their travels or cost them a citation or even worse get into an accident. All of these situations listed are less than desirable situations.

If an operator utilized a bulb that activated a backup filament, the primary filament could burn out during the operators' travels or also at the startup of the vehicle and the backup filament would then provide an additional 100 hours of light life to the operator. Also as an additional feature when the operator turned the vehicle on or off, the affected filament would emit 5 slow dimming blinks so as to create a better awareness to the operator of which bulb has activated it's backup filament and needed to be addressed as soon as possible while providing a 100 hour safety feature to the operator and assisting to reduce an accident or an opportunity to receive an unwanted citation.

2.4 PAST/FUTURE ANALYSIS

The first headlamp used on an automobile was a carbide (acetylene) lamp from about the 1800's – 1898. Basically this was an oil burning lantern that used a mirror to reflect the light. The acetylene proved to be a more efficient resource than oil which was also a resource used in these lamps for burning. (2)

Electric lamps were introduced in 1898, but one of the main drawbacks and reason that they were short lived was that they broke fairly easy and did not have a focus lens for light. They were used until 1962 when halogen bulbs were introduced.

The most commonly used automobile bulb is the halogen bulbs which use a tungsten two -filament bulb with a metal background which scatters light in numerous directions. The current halogen bulb has two filaments inside, one low – beam filament and a high beam filament and the presence of halogen gas assists with longer lasting use. Halogen bulbs give off small amounts of light compared to the power they consume which is one of the reasons it has been and is still so widely used. The halogen bulb was introduced in 1962 and in the 1990's became a worldwide industry automotive standard .

Current low beam filaments operate at 45 watts and the high beam filaments operate at 65 watts. The average current usable life is 450 – 1000 hours.

HID (High Intensity Discharge) lighting has proven its efficiency for the operator by providing more usable light. It has also been proven to have negative affects to blinding the oncoming driver due to the lighting intensity of the HID bulb. Another advantage of the HID is the useable hours of life are 2800 hours compared to the 450 – 1000 hours for halogen system.

LED (Light Emitting Diode) lighting is currently used in higher end vehicles. LED lighting was invented in 1962 and has really making a push toward being the automotive industry standard. Currently LED lighting is being used in

taillights and traffic signals. The advantages of LED lighting are lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. The LED light can last anywhere from 25,000 to 100,000 hours. The disadvantages to these lights are the intense temperatures that the bulb can reach as well as the direction of the light can be easily pointed in an alternate direction creating a glare to the oncoming drivers. Another disadvantage of LED lighting is the initial cost to upgrade to this lighting. LED lighting seems to be the future of lighting but will not phase out halogen lights completely for many years to come.

3. RESOURCES, CONSTRAINTS, AND LIMITATIONS

3.1 AVAIALBLE RESOURCES

Incandescent bulbs	tungsten filaments	halogen gas
halogen cycles	halogen bulb temperatures	atmospheric conditions
bulb deficiencies	safety	voltage performance
light spectrum	DMV regulations	DMV requirements
Low Beams	High Beams	Light Aiming
reflective lighting	luminance	light efficacy
lighting compatibilities	environment standards	glare
past/future trend of lighting	condition based reactions	lighting experts
weather conditions	lighting necessities	light projection
automotive insurance industry		

3.2 ALLOWABLE CHANGES TO THE SYSTEM

One of the changes that is allowable to this system is the addition of a backup filament to the current two filament halogen headlight system making it a three filament halogen headlight system.

Another allowable change to the current halogen bulb is one in which the backup filament, which has been enabled after a primary low beam filament has burnt out, would blink 5 times on start up or shut down of the engine.

The idea of a sensor that would alert the operator of an inadequate headlamp similar to that of a car door being open is an option as a visual alert, but requires auto makers to implement this feature on the current dash and may not be as readily adaptable.

The desired goal of the change to the current halogen system would be to assist with operator safety in the event of a bulb outage by providing safe lighting. The next desire is, through implementing an alert it will create the awareness to that operator that a headlight is affected and needs to be addressed. This would assist the operator in avoiding a potential citation for an inadequate headlight because they were unaware of the outage. The additional 100 hours of life

would provide the operator with an additional working filament to continue safe travels to and from their destination.

3.3 CONSTRAINTS AND LIMITATIONS

The number of lighting options available to operators is a contradiction in and of itself. With the current global standard of lighting as halogen bulbs, the analysis is based upon that global standard. Although the future of lighting is turning to LED lighting within a predicted 10 years, there will still exist almost 80 years of automobiles that consist of halogen lights and this provides a focus towards the current standard of automotive lighting (halogen bulbs).

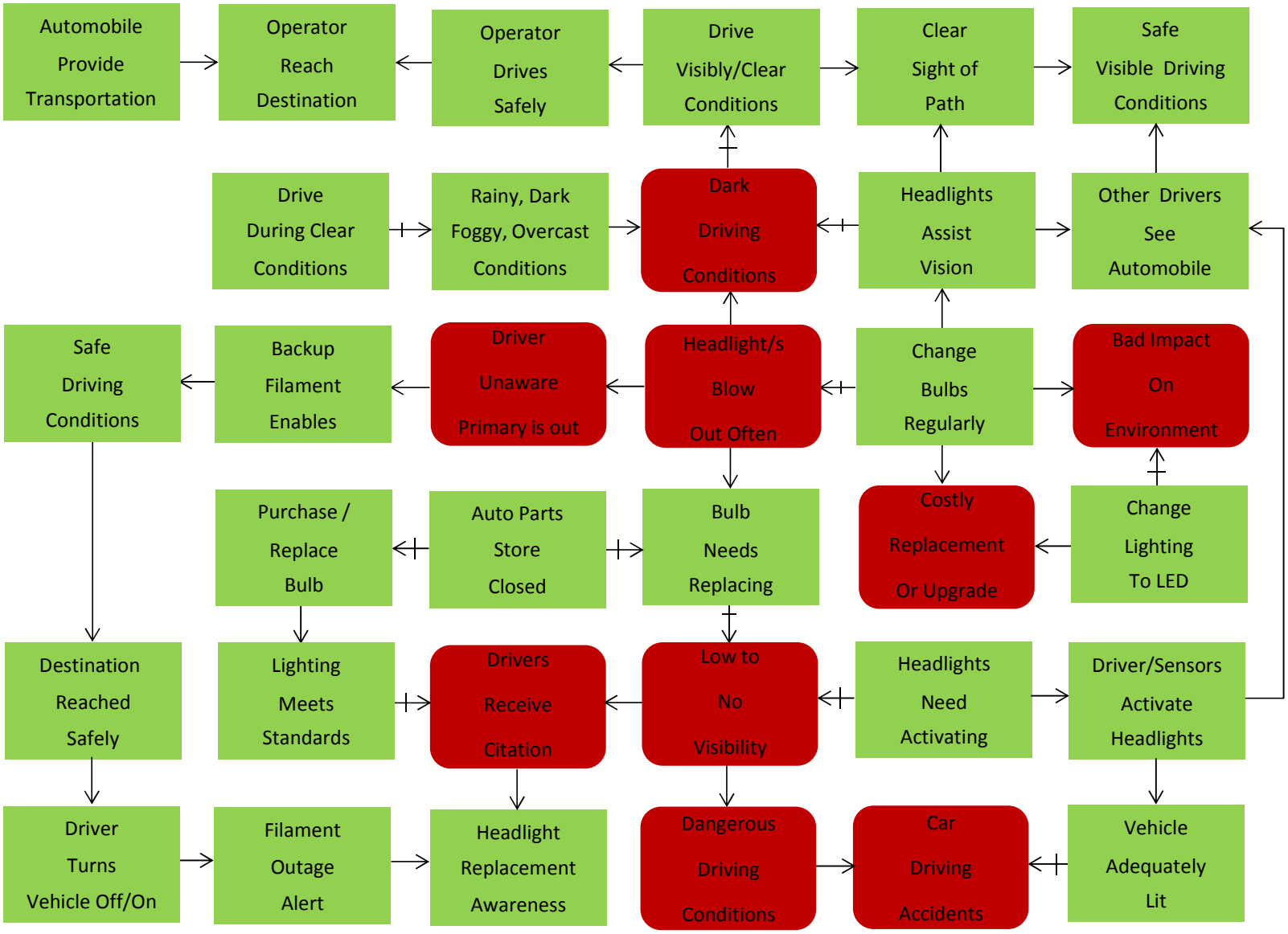
Allowing the high beam to be a backup light to the low beam is not viable solution to being a backup to the low beam filament burning out as there are laws in place stating that failure to dim lights is a driving hazard to oncoming drivers and can result in a citation to the operator.

The idea of an alternate backup system to the primary system is also not a feasible change to the current system as auto makers would have to reconstruct the front end to accommodate space for another backup headlamp as a well as implement an additional power source to provide power to that additional backup headlamp.

The backup filament included in the proposed three filament system would switch on when the primary filament was not in a useful state anymore. The backup filament would provide an additional 100 hours of useable light life. The backup filament would also contain a trigger to alert the operator that the backup filament has been activated. This trigger would engage as the operator turned the vehicle off or on and would alert the driver by blinking 5 times. This action would happen much like the current remote system that enables alarms on a vehicle. When the alarm has been activated by remote the lights blink to alert the operator that the alarm is engaged or disengaged (remote door locks also contain this alert feature). When the vehicle was turned off or on this would trigger that affected light to blink 5 times creating the awareness.

As an alternative action to high costs to upgrade an automobile to LED lighting from Halogen based lighting, the insurance industry could get involved in replacements/ upgrades to automobiles. This would assist with the insurance industry being so affected by inadequate lighting as being the cause of numerous nighttime accidents occurring by reducing the number of vehicular accidents by providing the superior lighting available to the operators. This combined with the previous mentioned alert system would reduce the number of accidents occurring from inadequate lighting thus reducing insurance claims for automotive accidents.

PROBLEM FORMULATION



5. IDEAS

Innovative ideas and the I-TRIZ operators that triggered those ideas.

Resolution Operator
11/10/2010 Idea #1: Daytime Driving/ Visible Conditions
Separate in time: Separate opposite requirements in time

Alternative Operator
11/10/2010 Idea #2: Backup Low Beam Filament
Enhance Useful Parameters: Duplicate critical elements

Resolution Operator
11/10/2010 Idea #2: Backup Low Beam Filament Activates
Separate based on conditions

Elimination Operator
11/10/2010 Idea #2: Backup Low Beam Filament Activates
Enhance Useful Parameters: Add an object for a period of time

Resolution Operator
11/11/2010 Idea #3: Filament Outage Alert
Separate in Time: Create and use pauses

Elimination Operator
11/12/2010 Idea #4: Driver Receives a Citation
Reduce harmful effects: Turn harm into a benefit
Harmful: Driver receives a citation
Benefit: Awareness of inadequate lighting

Resolution Operator
11/11/2010 Idea #5: Drivers Activates Headlights
Separate on conditions: Separate opposite requirements on conditions

Resolution Operator
11/11/2010 Idea #6: Change bulbs Regularly
Separate on conditions: Separate opposite requirements on conditions