Light and Death Situations- Preventing Vehicular Accidents from Improper High Beam Use

AdaptaLight: Fiber Optic Smart Headlight that Automatically Dims

Presentation for Regional Fair Innovation in Action competition

By

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Problem

- According to the National Highway Transportation Safety Administration (NHTSA) Despite 60 percent less traffic on the roads at night, more than 40 percent of all fatal car accidents occur at night.
- A 2017 study from The Insurance Institute for Highway Safety (IIHS) found that up to 30% of accidents at night are due to the bright light from headlights of oncoming vehicles causing a glare in the eyes of the driver
- Exposure to the searing light causes an afterimage to remain in the eye, causing transient blindness. (Troxler effect) .
- A driver who proceeds ahead when blinded and strikes an object may be found negligent, making him criminally liable

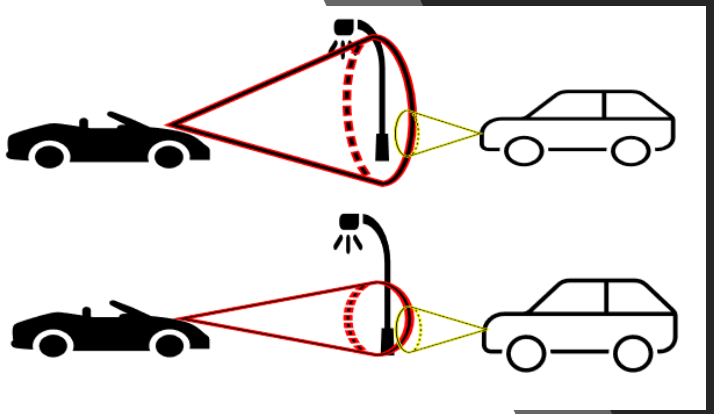
Analysis

- Traditionally the use of dimmers has been manual, with the driver of a vehicle turning on the dimmers when seeing another vehicle approaching head-on.

- The system could be automated by having automatic dimming headlights that can sense light from an oncoming car and automatically turn on the dimming mechanism without the necessity of having to have the driver turn on the headlight dimmer manually.
- Currently, some vehicle manufacturers, especially high-end cars and cars sold as "safe" vehicles for the family, have started to incorporate this auto-dimming technology into their car headlight systems. Still, a vast majority of the older cars on the road do not have this technology.

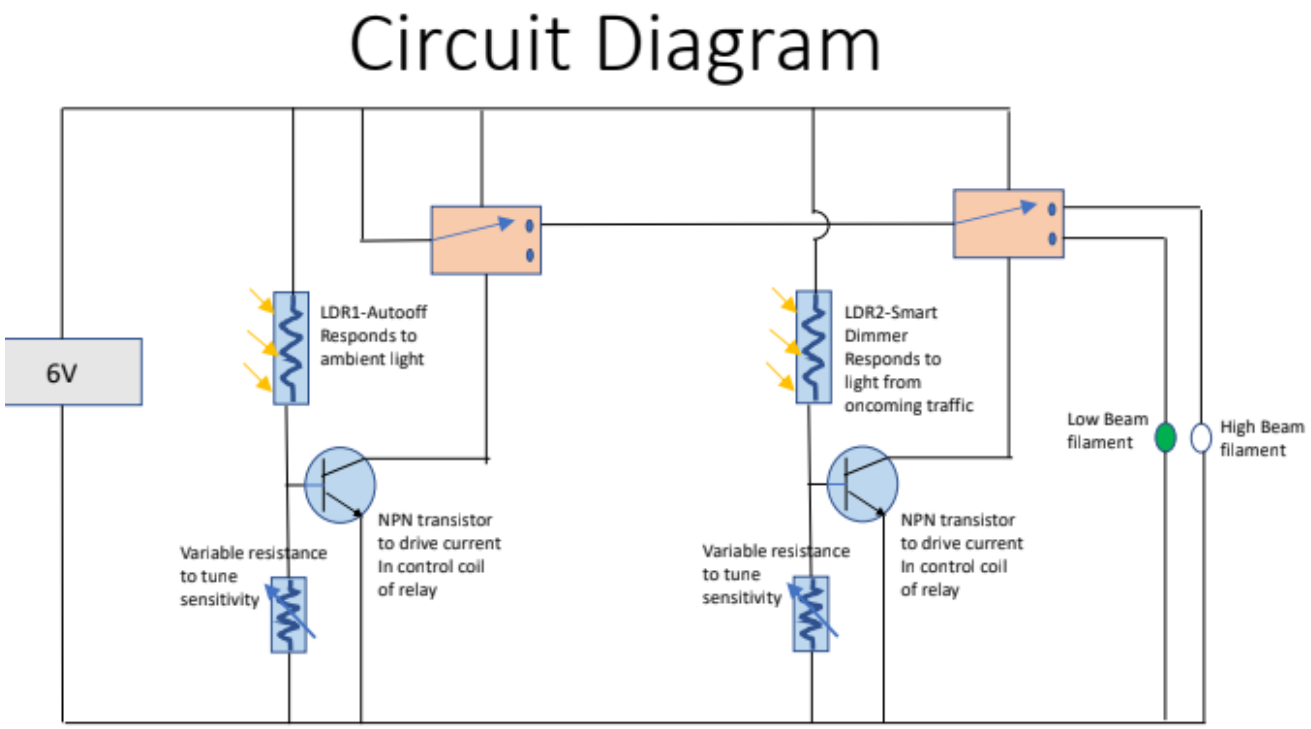
This system automatically switches the headlights setting to low beam from high beam when it detects a vehicle ahead. Frequent usage of high beams allows for earlier detection of pedestrians, supporting safer driving.

How did I develop the project

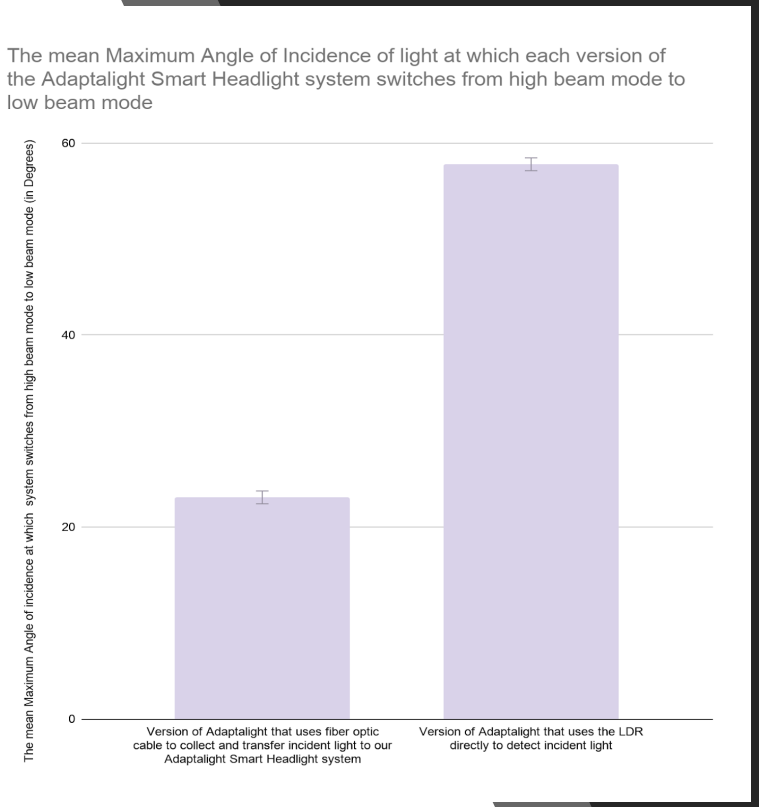


- I decided to build a simple inexpensive proof of concept kit for an automatic headlight dimmer using Light dependent resistor (LDR) and a simple electrical circuit components on a breadboard circuit that can be used to turn traditional headlights into smart headlights that can
  - Turn on the headlight system when they detect that the ambient light is low(indicating that the car is driving in the dark) - based on detection of ambient light by LDR in circuit AND
  - Switch from High beam to Low beam when detecting light from oncoming vehicle and revert to LBM when oncoming vehicle passes by - based on light detected by a second LDR in circuit
- We designed the circuit and built it on a breadboard circuit using hobby electronic components.
- We then went ahead and designed an improved version of our prototype that uses fiber optic cable to act as light tube - accept and transfer light from oncoming vehicle to the second LDR to trigger the system from high beam mode to low beam rather than the using the second LDR itself to detect light from oncoming vehicle and activating the smart headlight system.
- We predicted that by using a fiber optic cable to detect light from oncoming vehicle, we will thus be able to reduce the chances of false activation by sources other than light from oncoming vehicles, like light from street lights or light from other bright sources like billboards (that coming from above is likely to have a higher angle of incidence away from normal) rather than activation due to detection of light from oncoming vehicle (that is more likely to be incident almost normally coming from straight in front).

How does my project work?



- We built a prototype using the circuit diagram we designed
- Let me show you a video of my product in action



Proof : Trial - results

- For this we set out comparing the modified version of our system that uses the Fiber Optic cable against the version that uses the LDR directly to detect light.
- We performed 20 trials to find the maximum angle of incidence (from normal) that would activate the device from low beam to high beam. We then calculated the mean maximum angle for each version.
- Comparing the mean of the two groups we used a One tailed t-Test to show that the results were statistically significant. Null Hypothesis (assuming no difference between the two versions) was REJECTED since t Critical one-tail was lesser than t-Stat, the p-value was less than 0.05. We accepted the alternative hypothesis that :
- The version of Adaptalight using a fiber optic cable to collect and transfer incident light to our Adaptalight Smart Headlight system has a mean Maximum angle of incidence (from normal) of 23.1 ° that triggers the system to switch from a high-beam mode to a low-beam mode, compared to 57.8 °in the version without the fiber optic cable that uses the LDR directly to detect incident light from oncoming vehicles.

t-Test: Two-Sample Assuming Equal Variances		
	Group 1 (fiber optic)	*Group 2 (Without Fiber Optic)*
Mean	23.1	57.8
Variance	0.988888889	0.844444444
Observations	10	10
Pooled Variance	0.916666667	
Hypothesized Mean Difference	0	
df	18	
t Stat	-81.04174009	
P(T<=t) one-tail	7.90273E-25	
t Critical one-tail	1.734063607	
P(T<=t) two-tail	1.58055E-24	
t Critical two-tail	2.10092204	
ACCEPT or REJECT Null Hypothesis?	REJECT	

- We were successful in creating a proof-of-concept prototype for an inexpensive a kit which can be used to retrofit older cars and other cars that are sold without this feature.
- This will allow for the safest driving experience as the headlights are in high beam at all times, where seeing far in the dark is needed, and in low beam when it detects oncoming cars. This can reduce accidents by preventing glare in the eyes of the driver of the approaching vehicle (the Troxler Effect).
- Ultimately, retrofitting older cars with our auto dimming circuit will allow for the precise switching of high-beam to low-beam to ensure the safety of drivers on the road.

What makes my solution unique: It solves a problem in a reliable and inexpensive way!

- Our system uses LDR to detect light from oncoming vehicles with the modified prototype using a fiber optic cable to capture and transfer light to the LDR.
- Other proposed solutions have tried using infra red echo location or camera-based solutions either using infra-red heat cameras or AI with image interpretation to recognize oncoming vehicles.
- These are inordinately expensive that will preclude wide adoption of the technology.
- Our system uses a very simple technique that has been refined in the modified prototype to give optimized results but achieving the entire goal under a budget of $50 which make the technology widely adaptable.
- A big selling point for our system is that it does not require any proprietary software or high end electronic hardware.
- It can form a plug and play system for retrofitting older cars on the road that do not have this technology

Future Plans

Our current design was only a proof-of-concept prototype.

We used a breadboard circuit with a 6-volt system.

Our next step for further research in the future would be to create an actual working system based on our proof-of-concept prototype that uses a 12-volt current system similar to one that is used in current car headlight systems and uses an actual car headlight with dual filaments to create a working model that can be used to retrofit older models of cars still on the roads

Why should the panel fund my idea? What would be your next steps to make my project a product if you are funded?

- I think that my plans deserve to be funded because this is a safety feature that is still only available in high end cars or as a special package.
- If I receive the funding, I Plan to meet up with technology entrepreneurs who would be able to help us complete the R & D to develop a marketable version of the kit that is plug-and -play that can be used to retrofit older cars directly.
- Even if technically successful and inexpensive, how would we promote mass adoption of auto-dimming technology because this solution to the problem of dazzling by light from oncoming cars works only if most cars on the street have auto-dimmers. This would require public service messages and possibly legal mandates like emissions standards.

- **Who or what is the primary target audience?**

- Our primary audience would be people with older cars or cars which do not have this as a standard feature. Additional audience could be the car insurance industry with a stake in reducing automobile accidents and auto safety technology companies and auto clubs.