Internship TU-Darmstadt

The team from IDC
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Student exchange program at the Institute of Ergonomics (IAD), Technical University of Darmstadt, Germany

IDCIIT Bombay IAD TECHNISCHE UNIVERSITÄT DARMSTADT

TU-Darmstadt

Six weeks
Various workshops
One main project

IaD Structure TU-Darmstadt

The Institute for Ergonomics is a sub faculty in the Faculty of Mechanical Engineering and is headed by Prof. Ralph Bruder

Main departments

- Mechanical engineering,
- Electrical engineering,
- Architecture etc.

Sub Departments

- Automobile engineering,
- Production engineering etc.

IaD Structure Management

More than 40 Years

- 28 Scientific staff- belonging to research groups
- 15 PhD students
- 6 External from the industry
- 10 Administrative and Technical staff

Design Recommendations

driver-assistance system for cars
reducing road accidents

Proreta

Objectives:

- input methods
- feedback mechanisms

Design Recommendations

Inputs

Design Recommendations

Inputs

Design Recommendations

Feedback Mechanisms

Design Recommendations

Feedback Mechanisms

Rail-side Worker Safety

RE-Designing the visual warning

Edu Mohan,
IDC IIT BOMBAY
in close collaboration with
Joachim Röttger
TU Darmstadt

Rail-side Worker Safety

Introduction to the ALARP system

Objective

Automatic Warning System to improve the safety of railway track side workers. Informs workers about

- Approaching trains on the track
- Maintenance events on power lines and/or safety equipment in the concerned tracks
- Emergencies on tracks
- Keep track of the status and location of the workers.

The Workers will be given three types of warning/alerting signals

- Acoustic
- Visual
- Tactile

The Project

More on the Visual warning side

What it does?

- Primary- A Blinking red light when there is a train on the same track as work being done
- Secondary- A blinking yellow light occurs when a train is passing through the adjacent track of work being done
- System failure- Both the yellow and red light blinks in case of a system failure

The Project

*To **RE**design the existing visual warning system*

Why?

- Existing prototype – Need further evaluation from design perspective
- Include Adaptive Brightness Control

How?

- Expert evaluation of the existing prototypes
- Literature research
- Comparison of existing prototypes
- Market study

The Process

Expert evaluation of existing prototype by

Engineer

- Priority- safety and comfort
- Position of LED not studied
- Wired unit is better
- Would be better if good looking
- Adaptive brightness control is a must

The Process

Expert evaluation of existing prototype by

Design

el

- Safety is priority
- Shouldn't slip off
- Narrow Beam without obstructing view is a possibility
- Comfortable

The Process

Expert evaluation of existing prototype by

Psychologist

- The colour sensitivity of the eye is less in the periphery
- The primary signal should be distracting enough so that immediate action is taken
- The blinking secondary signal can be annoying
- The secondary and tertiary signals can cause distraction in between a precise job
- The position of the signals should be distinguishable to differentiate and take required action immediately

The Process

Expert evaluation of existing prototype by

Comparison of existing products

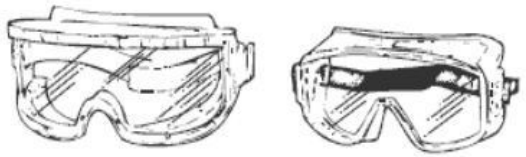
The Process

Class 1A
Spectacles with side protection

Class 1B
Spectacles with side and radiation protection

Class 2A
Direct ventilated goggles

Class 2B
Non-ventilated goggles



Class 2C
Direct/non-ventilated with radiation protection

Nature of Hazard	Hazardous activities involving but not limited to	Spectacles Class 1		Goggles Class 2		
		A	B	A	B	C
Flying objects	Chipping, scaling, stonework, drilling; grinding, buffing, polishing, etc; hammer mills; crushing; heavy sawing, planing; wire and strip handling; hammering, unpacking, nailing; punch press, lathe work, etc.	✓		✓	✓	
Flying particles, dust, wind, etc	Woodworking, sanding; light metal working and machining; exposure to dust and wind; resistance welding (no radiation exposure); sand, cement, aggregate handling; painting; concrete work; plastering; materials batching and mixing	✓		✓	✓	
Heat, sparks, and splash from molten materials	Babbiting, casting, pouring molten metal; brazing, soldering; spot welding, stud welding; hot-dipping operations		✓			✓

The Process

Literature research

About LED Hazards

- The LED components are only capable of briefly exceeding radiation safety limits, for example, in the event of control circuit failure.
- If optical systems are used, photo biological assessment of the luminaries needs to be performed regardless of the LED radiation data.
- Control gear plays a key role
- The main Hazard LEDs cause is thermal in nature
- Blue and White LEDs may cause eye illness because of the infrared and ultraviolet light
- Red and yellow LEDs are not problematic.
- Prolonged direct viewing into point sources must be avoided especially at short distances
- People will close their eyes or look away in case of long exposure

The Process

Literature research

About Visual Warnings

- The warning should be within an angle of +/- 30° of the main view in horizontal and vertical direction
- The frequency of flashing lights for warnings should be between 2-3 Hz
- Flashing Red light means danger and immediate emergency response is required
- Constant Red is the color for failure
- constant Yellow the one for attention
- For a visual warning to get noticed the light density of it must be brighter than the ambient light density
- If the intensity is too big, the eye gets dazzled

The Process

Literature research

About Safety Glasses

- Should have Impact resistance
- Various coatings for Anti fog, UV protection, Scratch resistance are available
- Polycarbonate lenses are much lighter than glass and has higher impact resistance
- There is no standard yet set for selection of glasses for railway workers even though there are standards in general

The Process

Synchronic and Diachronic analysis

The 4iii

- Sports monitor provides the performance feedback without distracting from your activity
- Coloured LEDs and voice prompts to guide personal targets pre-set
- Helps in staying in the safe zone for sports by giving heads up LED warning
- Could go with any pair of glasses

The Process

Synchronic and Diachronic analysis

Airwave

- Sports monitor provides having Heads up display
- Can be connected to a smartphone
- Provides information like GPS location, live map etc.

Insights and ideations

May Haves

Insights and ideations

May Haves

Helmet clip

Diffused Warning signal

Lighting Fibre

Cushion/Padding

Back strap

Failsafe

Side and periphery protection

LED beam

Comfortable

Not annoying

Environment friendly

Insights and ideations

May Haves

Water Resistance

Helmet clip

Diffused Warning signal

Lighting Fibre

Cushion/Padding

LED film

Back strap

Failsafe

Frame colour

Warning separation

Side and periphery protection

LED beam

Comfortable

Coloured lenses

Carrying case

Environment friendly

Not annoying

Insights and ideations

May Haves

Water Resistance

Helmet clip

External Unit which could go with existing glasses

Diffused Warning signal

Lighting Fibre

Wire connector

Quality and finish

LED film

Cushion/Padding

Failsafe

Temperature Resistance

Back strap

Anti Fogging

Snooze Function

Frame colour

Warning separation

Side and periphery protection

LED beam

EL Wire

Polaroid lenses

Comfortable

Has LED lighting

Coloured lenses

View Angle consideration

Dust Prevention

Carrying case

Environment friendly

Not annoying

Diffused Warning signal

Insights and ideations

Must Haves

Failsafe

Warning separation

Comfort and protection

View Angle consideration

Chosen FactorsWhy?

Factors	Document	Expert
Diffused Warning signal	Optical and Photo biological Safety of LED, CFLs and Other High Efficiency General Lighting Sources, 2012	All
View Angle consideration	DIN EN 842, 2009	Designer, psychologist
Warning separation	DIN EN 981, 2009	All
Side and periphery protection	Occupational Health and Safety Bulletin 2012, Eye safety and Protection, UVEX	Designer, Engineer
Failsafe	Europäische Normung Automatischer Warnsysteme, 2005	Engineer

The Design Brief

Revised after the findings from literature research, expert evaluation and market study

Desired Specifications

- The source of warning light should be diffused and controlled
- The visual warning must be within the view angle range for efficiency of the system
- Type of warning lights and displays should be distinguishably separate
- It should be failsafe
- It should fulfil the protective eyewear requirements of work condition

Design

Concept 1

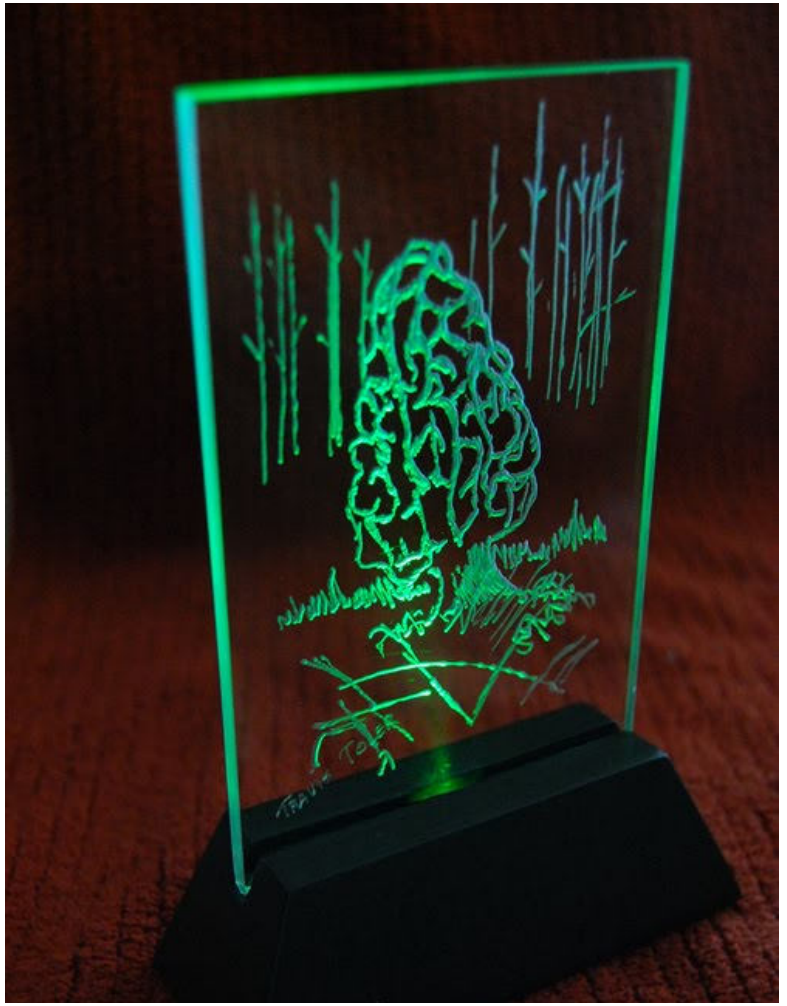
https://dzevsq2emy08i.cloudfront.net/paperclip/technology_image_uploaded_images/9671/default/Light_diffusion_Film.jpg?1335201216

http://www.pakuya.com/upload/20111229/PET_film.jpg

Design

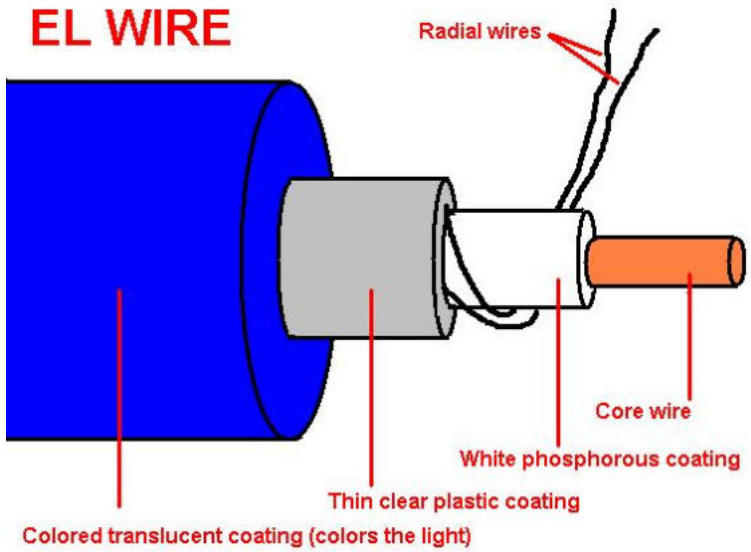
Concept 2

http://i00.i.aliimg.com/photo/v0/632356092/laser_etched_glass_block_with_led_light.jpg



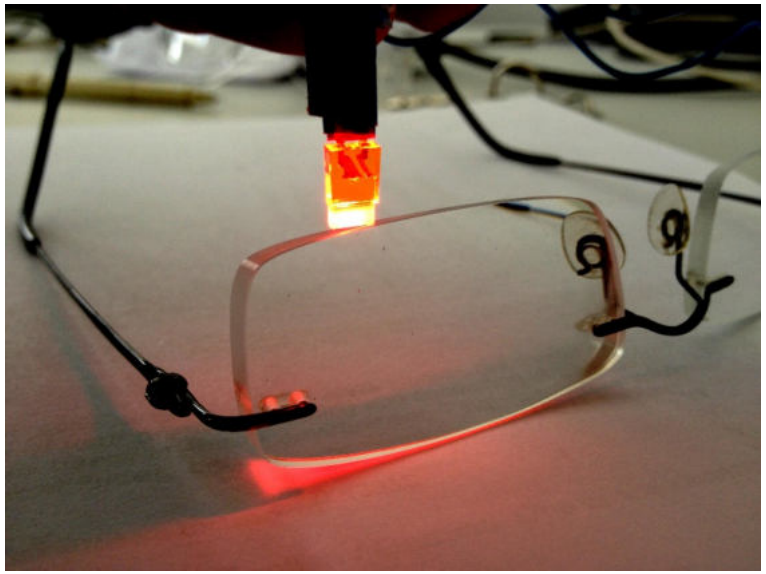
Design

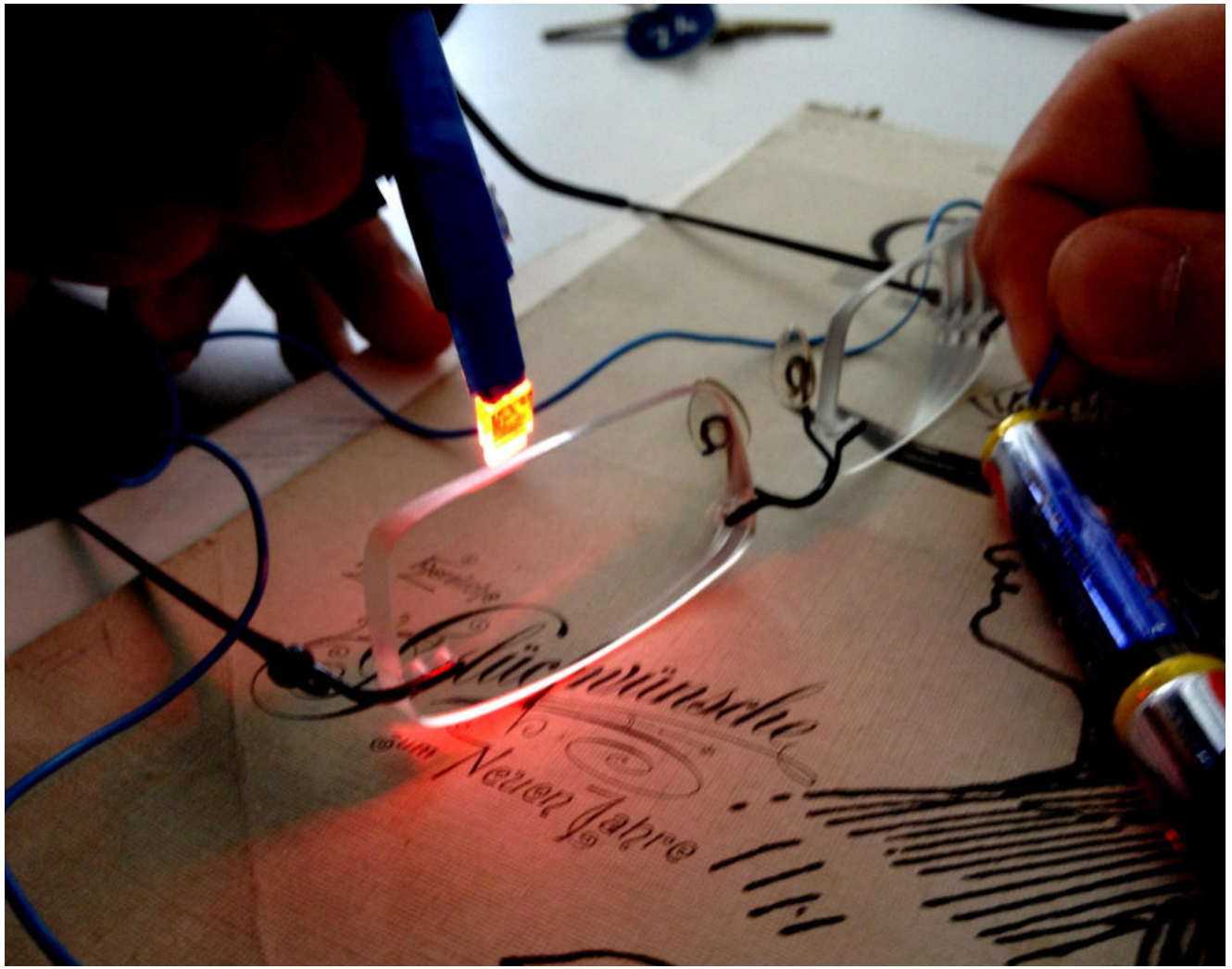
Concept 3



Design

Concept 4





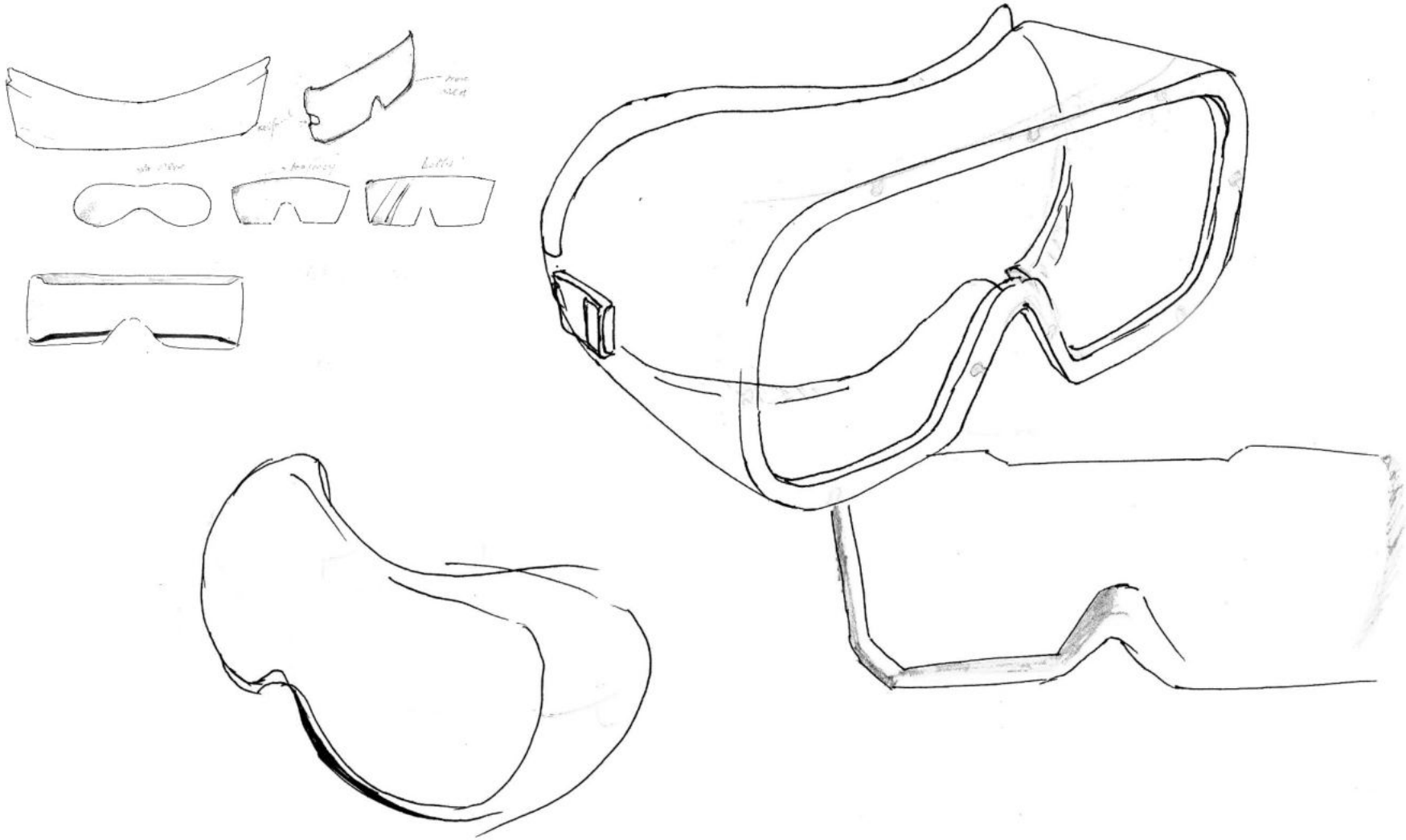
Design

Concept Evaluation

Factors	LED with Pet Film	LED with Etched Glass	Wire Variations	LED throw
Diffusing light	0.3	0.1	0.3	0.3
View Angle Consideration	0.25	0.25	0.25	0.25
Brightness Control	0.4	0.2	0.4	0
Day and Night time compatibility	0.33	0.33	0.33	0
Clear field of vision	0.15	0.2	0.3	0.35
Heating	0.25	0.25	0.25	0.25
Colour Separability	0.25	0.35	0.4	0
Independent unit functionality	0.5	0.5	0	0
Assembly line Complexity	0.1	0.2	0.35	0.35
	2.53	2.38	2.58	1.5

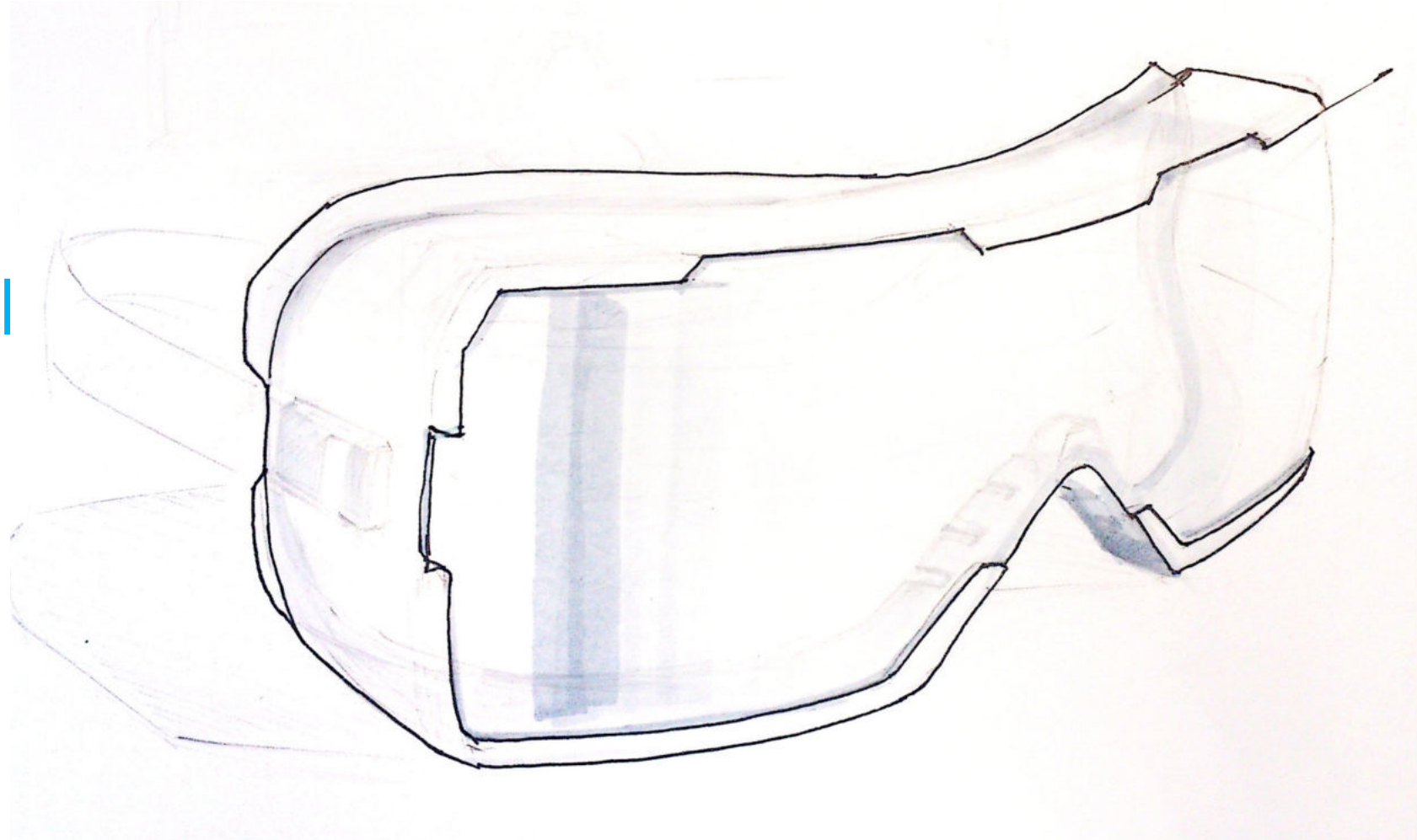
Design

Form Explorations



Design

Final Fo



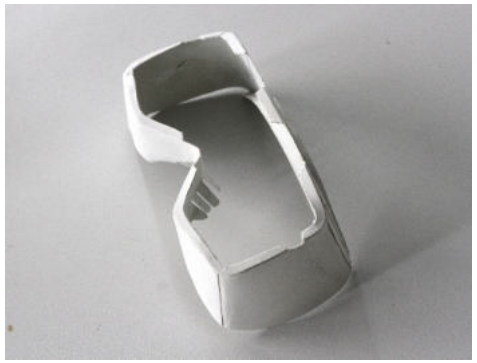
Design

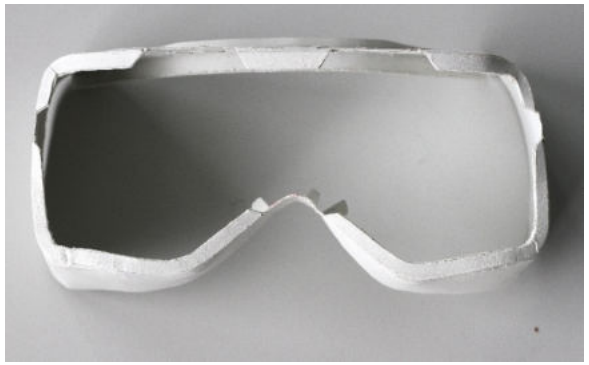
Final Product

- Poly carbonate lenses
- Latex shell
- The nose pad part is in ribs form – comfortable and perfect fitting for all face sizes
- The Product would cost about 500-600 INR

Design

Final Product





How it wo

Primary warning

- The RED spot seeks more attention as it is in the major field of vision.
- It doesn't block the view as it is just on one side

How it wo

Secondar y warning

- The yellow light glows on the top side.
- It doesn’t blink

How it wo

Secondar y warning

- There is a battery point inside the glasses.
- If any circuit gets opened or system fails the blue light glows.
- It can be turned of after the user acknowledges

Scope

Testing and validation

Prototyping

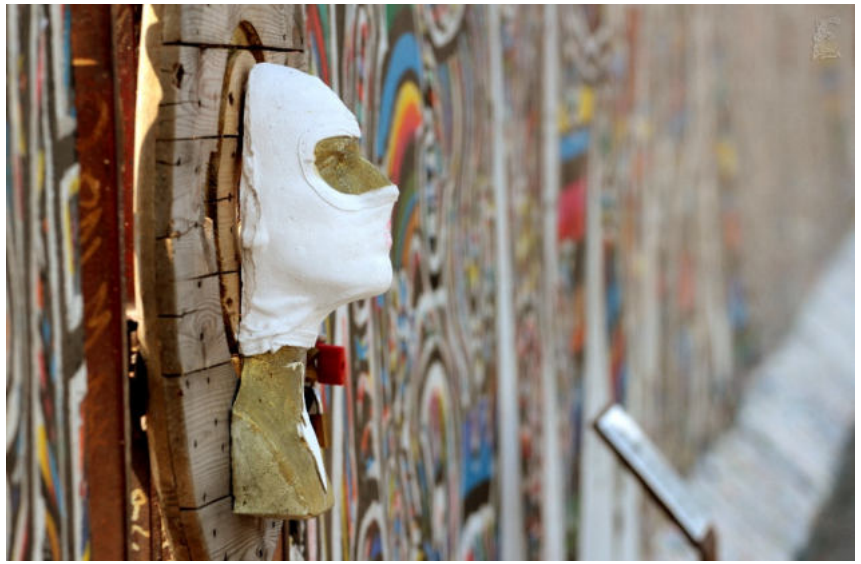
Reflections

Totally different!

- Culture – planned, end to end
- Working environment, calm & quiet
- Social Aspects
- Travel systems
- Survival

About the pla

History



About the pla
Architecture

About the pla
Technology

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