

## **Artificial Eyesight for Semi-Blind People**

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**Type:** Feasibility Study, Exploration  
**Student time:** Ten weeks  
**Location:** At school

### **Summary**

Students, in groups of 4-5, will explore the possibility of designing/constructing devices/aids to help semi-blind people to be able to see as best as possible. Students will examine the biology of the eye and optical signal processing. They will find engineering solution to the problem considering the available technologies. They may have to interview experts of various specialties to formulate the problem and generate alternatives for present or future implementation. Based on the cost and user friendliness, they will select a design.

### **ABET Descriptors**

**Engr Sci Content:** Multidisciplinary engineering  
**Type:** System  
**Elements:** Alternatives, economics, human factors, social and ethical issues.  
**Features:** Need identification, open-ended, written and oral communication  
**Constraints:** Affordability and user friendliness  
**Effort:** Team

## Artificial Eyesight for Semi-Blind People

Memorandum

**To:** Engineering Students  
**From:** NSF Commission on Biosystems  
**Subject:** RFP for Artificial Eyesight for Semi-Blind People

A number of people in the world are blind or semi-blind, unable to enjoy the visual world of humans and creatures. The root cause is thought to be due to damage to macula resulting in loss of central vision, but in many cases peripheral region is intact. The medical community attributes this to hereditary defects. Many argue that eyes are windows to the brain and attribute this as a mind/body interface problem. There are many possibilities from system engineering point of view. As light enters the eye, it is processed by rods and cones in the eye after being absorbed/processed by pigments in the eye. You are being challenged to study the optical system of the eye, including chemical and physical elements. Study the time behavior of visual process as person ages. Examine the possibilities from physics, chemistry, biology, computer, image processing point of view and generate possibilities for malfunctions. Present a conceptual design of the aid/process/system to solve this problem.

NSF will consider an multidisciplinary multi-million-dollar research award after reviewing your feasibility study. Please submit your Request for Proposal (RFP) after exploring the problem. You will be asked to present your ideas to us in a written report followed by an oral presentation by the team in order for us to evaluate your leadership skills on a national scale. Your written report is due within 10 weeks. Following the report, you will be invited for oral presentation at NSF expenses.

### **Evaluation Criteria:**

- A survey of biological feature of the eye for image processing.
- Tradeoffs between artificial and biological systems
- Economic, social, moral, and ethical issues involved
- Oral report to the Commission (participation by all team members, visual aids required). Supporting written report required.

## Artificial Eyesight for Semi-Blind People

### Engineering Notes:

- **Ergonomics:** The scientific, interdisciplinary study of humans and importance of eye in human interactions.
- **Biological factors:** The scientific, interdisciplinary study of human eye and its functionality for image processing. Eyes as windows to the brain-The role of brain in visualization process.
- **Environmental Factors:** The effect of environment-pollution, radiations, etc. on the eye.
- **Cultural factors:** Differences in visualization based on race or culture.
- **Technology:** Ways technology can help us to find alternative solutions. Chemical, physical, biomedical, and psychological instruments in solving the problem.

### Design Competency Outcomes

- **Group Dynamics:** Understand their own and other members' style of thinking and how they affect teamwork; roles and responsibilities of each member of the team; effective listening, speaking, and visual information processing to be an effective communicator in a group; creating supportive workplace environment.
- **Data, Information, and Knowledge Engineering:** Gather data from various sources-internet, journals, surveys, newspapers, government databases, visits to other places, etc. Organize data in a way to give useful information to the group and public at large and put sufficient knowledge into it to make intelligent choices.
- **Needs Analysis:** Understand open-ended nature of problems, develop specific goal statements, and recognize need for an appropriate design as opposed to the existing paradigms, views, and human norms.
- **Generating Alternatives:** Create conducive environment for idea generation, brainstorming, understanding constraints of each idea, and synthesis of the ideas to make whole larger than the sum of its components.
- **Evaluation and Decision Making:** Iterative approach for evaluating design and designing a process of continuous improvement. Develop a follow-up plan.
- **Implementation:** Time and resource management to complete the project and make changes in the design as the project progresses to various phases. Sources of funding, resource sharing by several institutions to derive the maximum benefit, ergonomics and other human factors for using resources.
- **Communication:** Production of records, technical papers, memos, ideas in an acceptable and comprehensible style; presentation techniques to peers and public at large; nonverbal interpersonal communications; personal appearances.