



OptoBoticssm

Teaching methods and tools

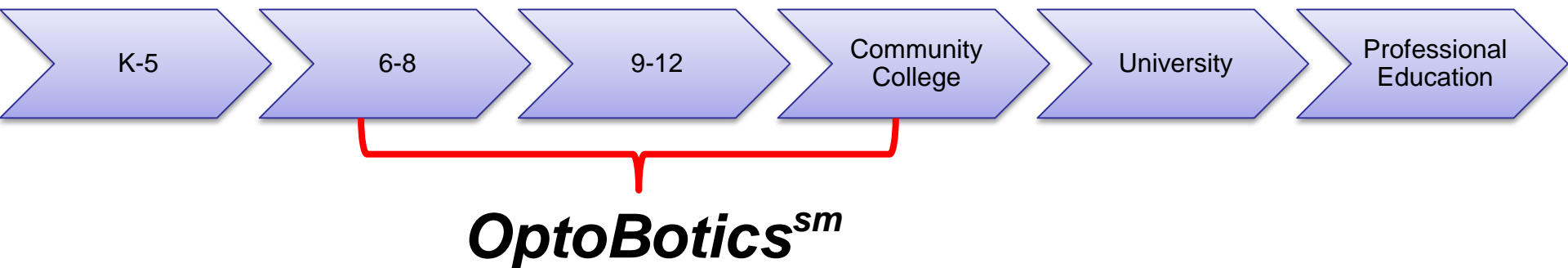
Donn Silberman

2007-2008 President & Fellow; Optical Society of Southern California
Founding Director; Optics Institute of Southern California
Advisory Committee Chair, UC Irvine Optical Engineering
Sr. Applications & Sales Engineer, PI-USA
Sr. Member; SPIE & OSA



Optics Education Overview

- Optics Education Pipeline
 - K-12, Science & Engineering Fairs, Special Events
 - College and University connections
 - Professional Education
 - Career Pathways



EDUCATION

Science Education

Many organizations have drawn attention to the alarming number of jobs in the United States that are or will go unfilled because of a shortage of employees with science, technology, engineering, and math (STEM) skills.

Since enhanced science education and outreach efforts are key to attracting young people to careers and college studies in STEM fields, the Optical Institute of Southern California is focusing on students at the secondary-school level, where decisions about college and career are being made.

A white paper from the alliance promoting the U.S.-based National Photonics Initiative (NPI) has also recommended increased investment in science education and job-training programs.

"A well-trained manufacturing workforce is essential to regaining and maintaining U.S. leadership in advanced manufacturing," the NPI white paper says. STEM education should therefore include a photonics curriculum in high school and two-year institutions, with a focus on photonics-related engineering programs.

Read more about the proposed NPI on page 8.

Optics Outreach Evolves

OptoBotics combines optics, photonics, and robotics to engage high-school students.

By Donn Silberman

After 10 years of bringing optics and photonics to students and the general public, the Optical Institute of Southern California (OISC) (USA) is developing a new outreach program especially for high-school students.

Our mission is to work with young people (mostly high school and college students) and to introduce them to the wonderful world of optics and photonics. Our new OptoBotics program shows students how optics and photonics components are integrated into robotic systems in many areas of everyday life, science, and industry.

OptoBotics materials, presentations, workshops, kits, books, activity guides, and events can help students understand everything from the most basic concepts about photonics to the most complex systems such as those aboard Curiosity, the roving vehicle exploring the surface of Mars.

Epiphany in outreach

Our transition from doing traditional optics outreach presentations began in 2007 when the OISC was invited to present at the University of California at Los Angeles Sci JARt NanoLab Summer Institute for high-school juniors. I used the lenses, polarizers, and other interactive tools from my Optricks Suitcase while a friend from the NASA Jet Propulsion Lab at the California Institute of Technology did a presentation on remote sensing using optics and photonics. My friend Mark was a big hit, and the students were buzzing outside the auditorium during the break.

Ever since then, I knew we had to make significant improvements in our outreach efforts to high-school students, as they are the ones who will go to college and beyond using the optics and photonics that piqued their interests from our interactions.

To make our outreach efforts more appealing to high-school students, we began weaving remote sensing concepts into OISC presentations. However, it still did not create that very special instant recognition and 'ah-ha' moment I was seeking.

A couple of years later, I saw a new science, technology, engineering, and math (STEM) outreach business open its doors near my office at Physik Instrumente (PI) in Irvine, CA. It was called Mathobotix. I was intrigued and stopped by one day to see what was going on.

Mathobotix was all about using the LEGO robotics tools to get kids interested in math and science.

Its success in engaging students in the fun side of STEM got me thinking about ways to get optics and photonics into the mix with robotics.

Then one day in January 2012, while participating in the Irvine Valley College Astounding Inventions competition and exhibition, I saw a student in a high-school robotics team try to put his iPhone on his robot. That was the moment it hit me.

He was having trouble figuring out how to give his robot eyes. The word came into my mind: OptoBotics.

I knew then that teaching students in robotics clubs how to implement optical technologies into their robots would capture their imaginations and encourage them to use optics and photonics in their college studies and careers.

Launching OptoBotics

My new friend from Mathobotix asked me to speak at one of his open houses, so I created a new presentation with the OptoBotics concept and delivered it to a packed house in March 2012. While the presentation went OK — my key wireless video demonstration was all static and

there were several other technical difficulties — I knew I still had to have that killer demonstration to capture the students' attention before I could teach them anything.

Shortly after that, while walking through an airport shop, I saw my first commercially available drone. The Parrot AR.Drone is a flying quadcopter with a wireless, high-definition video camera that you control from your Smartphone or tablet. This was the demo that I needed.

I bought one when I returned home and integrated it into the presentation I had created months before. At our next big event, the University of California, Irvine Beall Center for Art + Technology Family day in November, I tried it out.

It was a big hit with the all-ages audience. We streamed live video onto an overhead LCD projector so the audience could see themselves from the flying camera in real time.

We now have several OptoBotics demonstrations under development and will be beta testing them with high-school robotics clubs. We hope to bring OptoBotics materials, presentations, workshops,

kits, books, activity guides, and events to as many groups as we can manage.

More information: oisc.net/optobotics
See photos from more than 75 OISC outreach events at: picasaweb.google.com/OpticsAge.



—SPIE Senior member Donn Silberman is founding director of the Optical Institute of Southern California (oisc.net), a non-profit promoting math, science, and engineering education through the use of optics. A senior applications engineer for Physik Instrumente (PI), he also founded and serves as the chair of the Advisory Committee for the UC Irvine Optical Engineering and Instrumentation Design certificate programs. Silberman has an MS in technology management from Pepperdine University and a BS in engineering physics from University of Arizona. ■

"Our mission is to work with young people (mostly high school and college students) and to introduce them to the wonderful world of optics and photonics."

SPIE supports education outreach

This Optical Institute of Southern California is one of 25 organizations receiving an SPIE Education Outreach grant so far this year. (See page 33 for the full list.)

As part of its mission, SPIE provides support for optics- and photonics-related education outreach projects that promote optics and photonics awareness.

Qualifying not-for-profit organizations such as universities, optics centers, science centers, primary and secondary schools, youth clubs, industry associations, and international optical societies are eligible for project support.

The next deadline for education outreach grant applications is 31 January 2014.

More information: spie.org/outreach

The drone is a flying quadcopter.



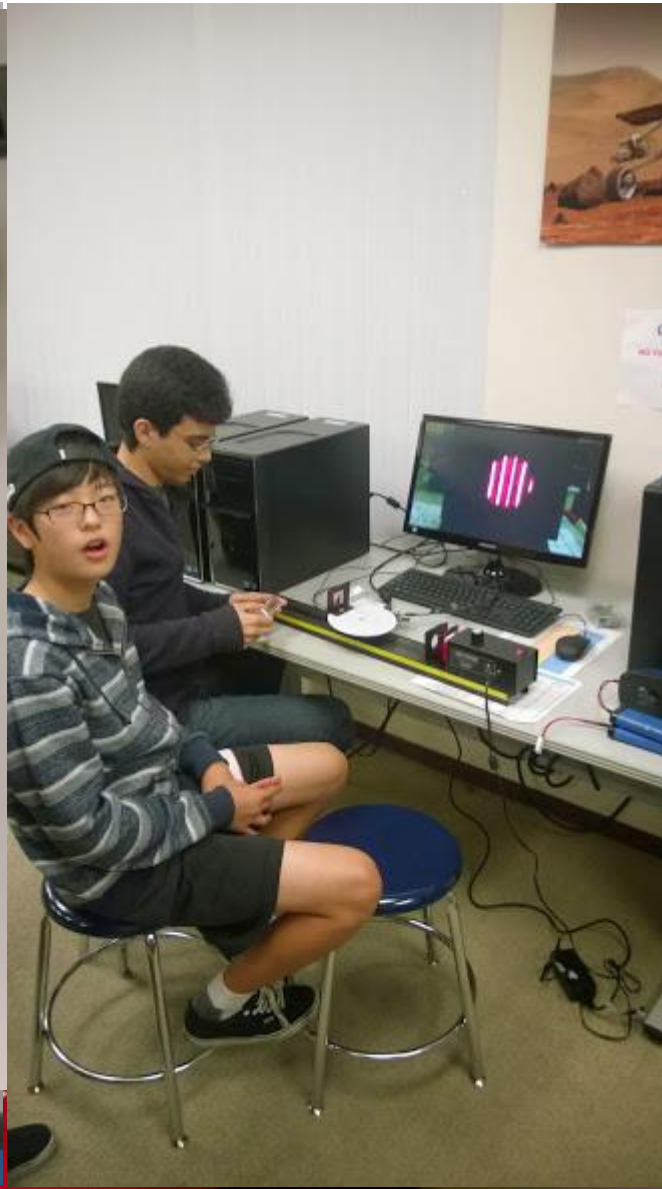
OptoBoticssm

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OptoBotics is a Brand, not an object.

- **Model robot kits; robots for personal, educational and hobby** use and structural parts therefor
- **Books and magazines** in the field of science, technology, engineering, instrument design and robotics; **printed instructional, educational**, and teaching materials in the field of science, technology, engineering, instrument design and robotics
- **Toy robots; toy robot model kits; toy scale model kit for robots;** remote controllable robotic toys; electronic game machines **for teaching children**
- **Educational services, namely, conducting workshops, classes and seminars in the field of science,** technology, engineering, instrument design and robotics, and distribution of course materials in connection therewith; organizing and conducting competitions in the field of science, technology, engineering, instrument design and robotics; providing educational information in the fields of science, technology, engineering, instrument design and ro...

OptoBotics™

Giving your Robots Eyes - A Fun Filled Learning Experience about Light, Lasers, Optics & Robots



OptoBoticssm

Kits, Merchandise and services

- Optricks / OptoBotics Theme Packets
- Optricks / OptoBotics Suitcases for demonstrations
- Photonics Explorer (OptoBotics) Classroom Kits
- OptoBotics video systems for robots
- OptoBotics spectroscopy systems for robots
- OptoBotics polarization systems for robots
- Curriculum and instructions for all the above
- Magazine articles – How to do add optics to your robots
- OptoBotics games, toys, large demonstration systems
- OptoBotics competition rules for the robotic educational field
- Dedicated magazine – on-line & print to OptoBotics
- T-shirts, mouse pads, coffee cups, etc
- After-school programs, presentations, exhibits, science fair concepts

OptoBoticssm

Advanced Amateur Applications

OptoBotics applications with careers for students to explore.

- Intelligence, surveillance, and reconnaissance (ISR)
- Chemical and radiation detection
- Communication repeater node
- Sensor and other payload testing platform
- Area mapping • erosion & environmental monitoring
- Agricultural, farming & commercial fishing management
- Fire & damage assessment
- Border, harbor, & canal security
- Convoy, road & population protection
- Natural resource & wildlife management
- Pipeline monitoring • power line inspection
- Fire fighting observation and infrared heat detection
- Weather mapping and measurement
- High-altitude, high endurance (HALE) applications
- Releasable, intelligent wing-mounted payload applications
- Search & rescue



Optricks >> OptoBotics Theme Packets



(Lens included but not shown)



New OptoBotics Theme Packets now in development / pre-production.

Sponsored by a 2015 SPIE Outreach Education Grant



Optricks / OptoBotics Suitcases for demonstrations



Can make significant changes to create OptoBotics Suitcase that includes video tools.

Design Photonics Explorer Kits into OptoBotics Explorer Kits

- Take the students for a deep dive into the details of the technologies
- That includes giving your Robots Eyes with video and other optical sensors.



Photonics Explorer

➤ Teacher Training Workshop @ Precision Optical in Costa Mesa, CA



**Kathy Johnson, Vital Link President, welcomes the teachers and volunteers.
Form January 2014**

NEW! Vital Link's Photo Gallery (click here to view) -->

DONATE ➔

Events

STEM & the Arts Career Showcase
Dates: April 11 through 13, 2014
Times: TBD
Location: OC Fair & Event Center

Kid 2.0
Dates: June 1, 2014
Times: TBD
Location: California State University, Fullerton

[click here for more](#)



Medical Careers in Action

Welcome to Vital Link

Vital Link provides hands-on, career exploration experiences for high school students, helping them carve out their own unique career path. Not sure what you want to study in school or what you want to do for a living? Attend a Vital Link program and sort through your interests, get excited, and literally try on a career for a day. Students are faced with many [challenges](#) ahead of them and we offer the vital next steps so students can jumpstart their career and education plans. Join us and see where you fit in.

Using the Vital Link process where students: Explore, Discover, and Connect to their future, participants can achieve their Dream Career.

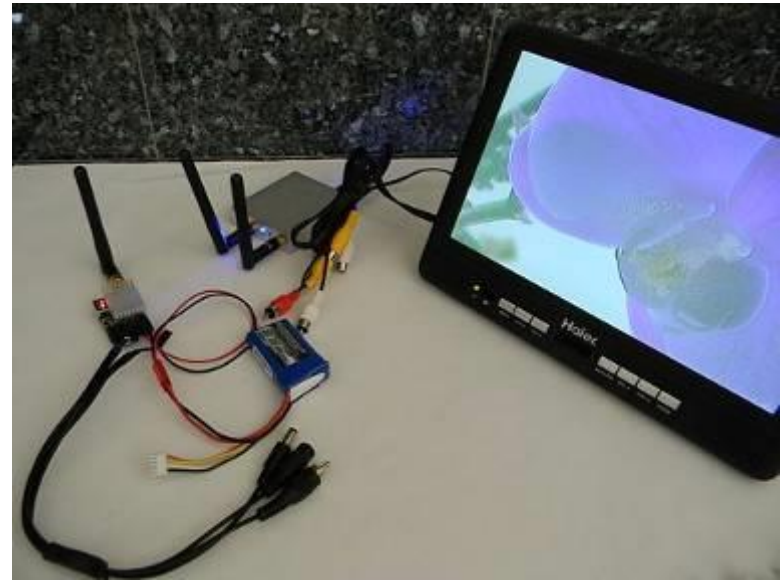
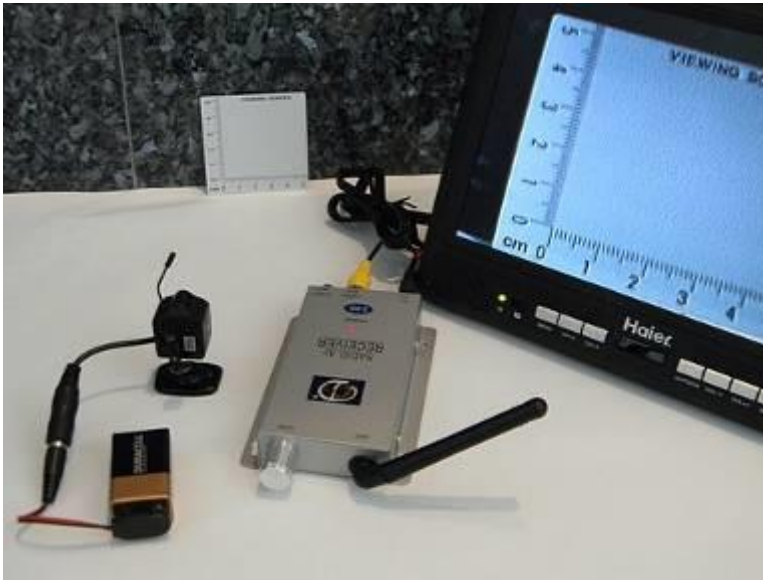
“What is Light?” Exhibit



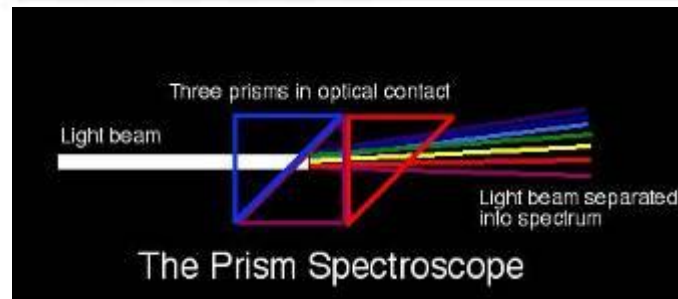
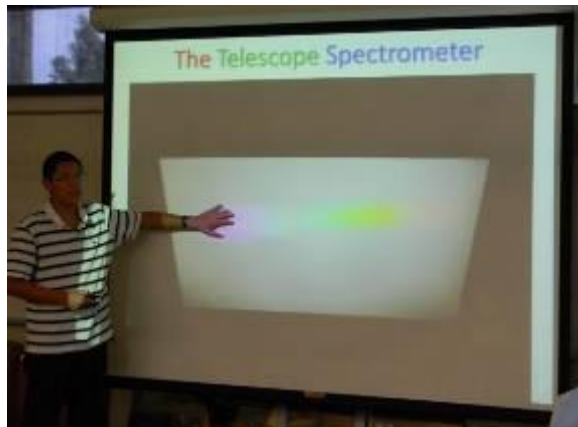
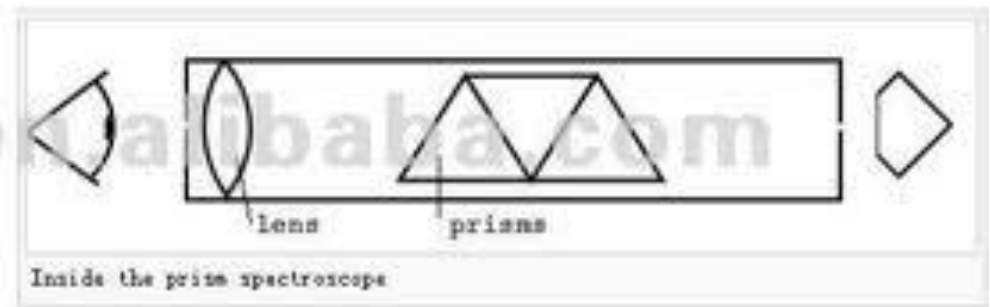
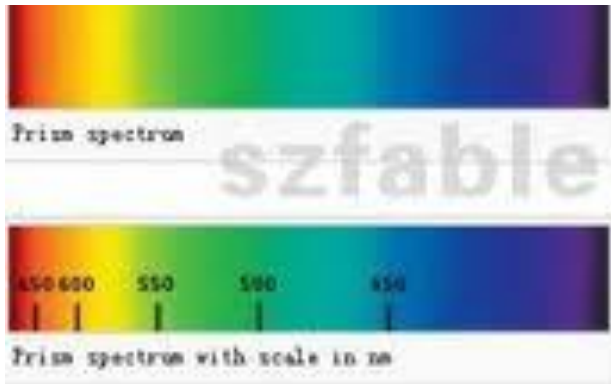
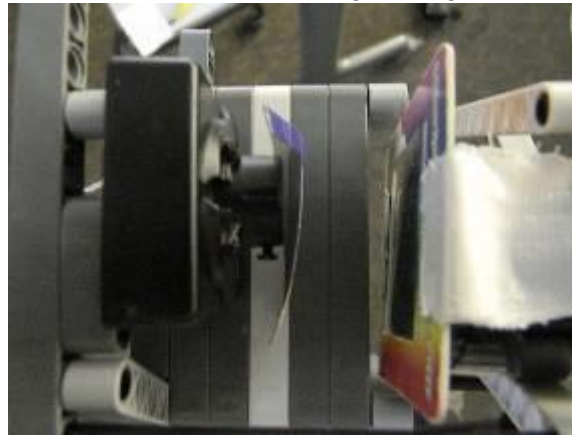
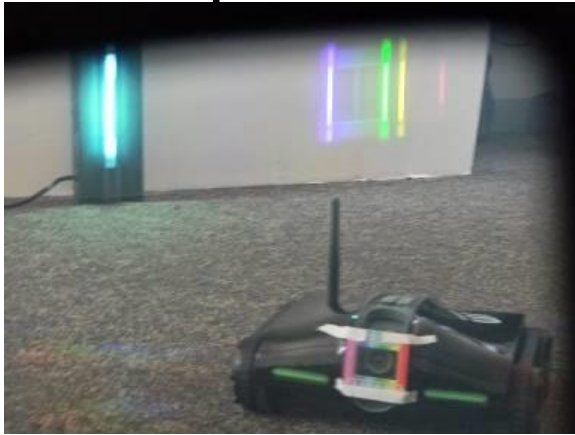
Example Vital Link Exhibit Days

March		
3/7	fri	Fontana HS Exhibit Day
3/20	Thurs	Laguna Hills HS Exhibit Day
3/27	thurs	Buena Park JHS Exhibit Day
April		
4/11- 13/2013	fri-sun	STEM and the Arts Career Showcase
		Design Build
		Performance Engineering
		DMA - Career Photo
		OC Maker Challenge
		Robotics
4/23	wed	Talbert Middle School Exhibit Day
4/24	Thur	Los Alisos MS Exhibit Day
May		
5/16	Fri	Alder MS Exhibit Day
5/20	tues	Irvine Int. Exhibit Day
5/22	thur	Utt Middle School Exhibits
5/28	wed	Brea Olinda HS Exhibits

OptoBotics video systems for robots



OptoBotics spectroscopy systems for robots

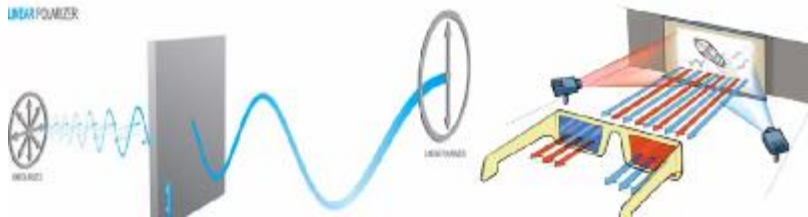


**Replace human eye with CCD camera and appropriate lens
And fixture to mount on robots.**

OptoBotics polarization systems for robots

What is a Polariser?

- Works by blocking out light of a certain polarization
- Polarized light is light that moves in only one direction
- 3-D glasses
- Lakes, windows, etc.

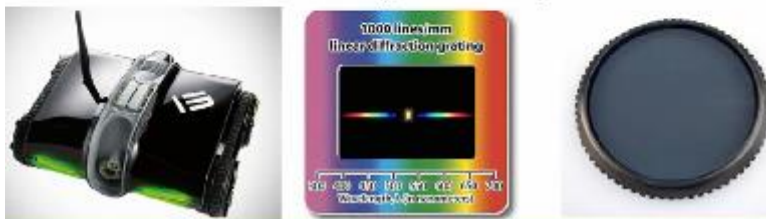


Polarized Tree



Rover 2.0 Spectrum Viewer

- Uses Rover 2.0, linear diffraction grating, and 2 polarisers
- Rover for movement and pictures
- Diffraction grating to split light
- Polariser to lower brightness of picture



Product could be a slowly rotating (motorized) polarizing filter in front of a wireless video camera.

SPARKY

OPTICS & ROBOTICS EDUCATIONAL OUTREACH TOOLS



"Sparky" is a new robot: designed and built by Cory Hague, an Irvine Valley College Photonics Technology student.

STEM Educational Outreach Tool

- ❖ Combines Optics, Imaging & Robotics
- ❖ Instantly attracts students attention
- ❖ Educates & Entertains students to keep them interested in learning more.
- ❖ Allows students to explore science, technology, engineering & math, with an artistic flare.
- ❖ Available for use by students of all ages
- ❖ Excellent for career pathways exploration events

World class optics & robotics systems

Based on a commercially available 'motorized wheelchair', "Sparky" is powered by 2x 200 watt motors. Four separate computer systems work together to provide video processing, communications and managing relays, sensors and servo-actuators for motion control.

Multiple imaging systems

Sparky includes seven (7) separate video imaging systems, each with different functions and capabilities. Real-time data display is available at any time for any one of the three (3) main cameras. All cameras have IR LEDs for illumination enhancement and mechanical in/out placement of IR filters.

Laser Gatlin Gun

A six (6) barrel laser Gatlin gun that emits 'eye-safe' violet (405 nm) laser light as a special effect. The inside of each barrel is also illuminated with programmable RGB LEDs for additional effect.



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Specifications "Sparky"

Mechanical			
Main Motors (2x)	200 Watts		
Actuators (6x)	Linear	125 lbs force	2x Shoulders, elbows, grippers
Mobility Systems			
Linux computer	Motherboard	Video Processing	
2x Arduino Mega	Communications	Coding-decoding	Protocols, RF Signals
Arduino Mega	Relays, Sensors	Capacitive Sensors	PWM Drivers & Servos
Wired & Wireless Systems			
Bluetooth			
2x Antennas	RF communications	Video 1.2 GHz	
Xbox 360	controller		
Data Storage	On-Board	40 GB Solid State HD	
Camera Systems			
2x Mast Mounted	All Vis / IR	One with diffraction	Grating for spectroscopy
One rear mounted	Two Side mounted	One mounted on the	Gripper w/ laser dot to locate
Laser Gatlin Gun			
6x Barrels	405 nm Laser Diodes	RGB LEDs	Wireless EM Coil for Power
Hazard Lights	On arm for safety	Turn on when laser	is activated
Lighting Systems			
Dual 24 V Head	Lights	Front Mounted	
Under Glow	LED based system	Bottom Mounted	
Sound System			
MP3 Based	On-board mic	Special Effects	Remote triggers



We are seeking monetary donations so we can donate Sparky to Vital Link of Orange County for their Career Exploration Events at local middle and high schools.

When we reach our fundraising goal, we will transfer ownership of Sparky to Vital Link and build the next system for the same purpose with another non-profit educational outreach organization.

On-Line Donations are accepted at: www.optobotics.com & <http://oisc.net>

Or contact us at that phone number or email address below.

The OISC is proud to be a Project of www.oisc.net and www.oisc.net is a 501 (c) (3) non-profit corporation in the State of California. Please visit our websites for more information.



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Robots need eyes too.

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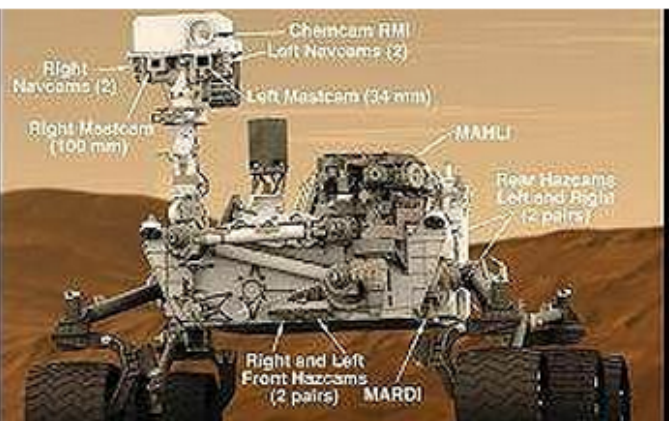
DONATE

OptoBotics are our methods of teaching people about optics & photonics and how they are used in everyday life, science, education and industry.

After many years of bringing optics & photonics to students and the general public, it became clear we were missing a key demographic; High School Students. So this website and the associated OptoBotics materials, presentations, workshops, kits, books, activity guides, events are our next stop on **our journey to bring the fascinating world of optics & photonics to more people around the globe.**

A free Webinar (from December 2012) provided by [UC Irvine Extension Optical Engineering](#) OPTOBOTICS - Precision Motion for the OpticsAge - A look around the Martian Surface [click to view the Webinar on YouTube](#)

This presentation is highly technical and aimed at professional engineers. It is about 1 hour in length and will take about 1 minute to load. Please contact us if you have any questions.



This famous photograph of the Mars Rover Curiosity (Courtesy of NASA/JPL CalTech) is a fine example of integrating optics & photonics into an extreme robotic system.

OptoBotics is a method of teaching

developed by [Optics Institute of Southern California \(OISC\)](#) founder Donn Silberman. The OISC is an Optics Education Outreach partner of the [Optical Society of Southern California](#).



And an [amazing video of Sparky](#) - an OptoBotics creation of Cory Hague - Irvine Valley College Photonics Technology student

Our current goal is to raise \$25,000 to donate Sparky to [Vital Link of Orange County](#) for their Career Exploration Educational Outreach events. Vital Link goes to Middle and High Schools in Orange County with special exhibits to showcase careers students may find interesting.

[See some examples here](#) and [here](#)

Our efforts are to showcase career opportunities in fields related to optics and robotics.

Additional funds will be put towards our other OptoBotics educational materials, programs and outreach tools.

Donation Levels

Founders Circle - \$10,000 and above

Platinum \$5,000 to \$9,999

Gold \$1,000 to \$4,999

Silver \$500 to \$999

Bronze \$250 to \$499

Supporter \$100 to \$249

Friend \$25 to \$99

You can also make monthly payments to help support our programs. Just click on the [Donate](#) button at the top of this page and follow the instructions.



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Your donations will help bring these teaching tools to teachers and students.

www.optobotics.com

<http://oisc.net>

