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Developing a Vector Light Sensor Structured Light Sensors for 3-D Robot Vision (Classic Reprint) A Vector Light Sensor for 3D Proximity Applications Selected Sensor Circuits Design of an Enhanced Air Data Sensor for a Very Light Heat-activated Plasmonic Chemical Sensors for Harsh Environments Dong Hao Zhuo J. T. Schwartz Ibrahim El-chami Peter Baumann Oriol Castro Arnau  
Developing a Vector Light Sensor Structured Light Sensors for 3-D Robot Vision (Classic Reprint) A Vector Light Sensor for 3D Proximity Applications Selected Sensor Circuits Design of an Enhanced Air Data Sensor for a Very Light Heat-activated Plasmonic Chemical Sensors for Harsh Environments Dong Hao Zhuo J. T. Schwartz Ibrahim El-chami Peter Baumann Oriol Castro Arnau

over the past few decades numerous sensors have been invented for the measurement of light intensity in most cases a setup external to the sensor is required to detect the direction of an incoming beam of light in this work the design fabrication and characterization of a novel light sensor is described the three dimensional structure of the sensor allows it to detect both the intensity as well as the direction of the incident light beam hence becoming a vector light sensor vls the sensor structure is based on creating photodiodes on sidewalls of miniaturized raised or inverted pyramids etched in silicon each photodiode was formed by selective doping of the material on each facet of the pyramid forming a photodiode with the p type substrate a set of signal processing algorithms was developed to estimate the direction and the distance of a light source from the sensors the light sensing devices with both raised and inverted pyramid structures were then fabricated in a cleanroom based on silicon microfabrication technologies throughout the process the lithography step for the textured surface needed to be optimized an interface circuit was designed and used to amplify and process the signals from the devices the device operation was verified experimentally to estimate the direction of a light beam the small size and low power consumption of the individual sensors make them suitable for applications where simple distance and direction estimation is

required the sensors can be arrayed to provide light field information in the plane of sensor

excerpt from structured light sensors for 3 d robot vision a structured light or active illumination visual sensor is one which illuminates objects using non uniform beams of light on which properties varying from point to point through the geometric extent of the beam have been impressed any observable property can be used to form such a beam among properties which one might think of exploiting are intensity polarisation spectral distribution of optical energy coherence and temporal modulation structured light sensors can be used to achieve 3 d vision that is to build visual sensors that report the true position in 3 dimensional space of points on the surface of a body or bodies being observed besides giving information on object proximity sensor output of this kind should be very useful for identifying the objects present in a scene and determining their positions and orientations the simplest form of structured light approach is the striped light scheme originally introduced by p will and k pennington of ibm research in this sensor see fig 1 a plane  $p$  of light formed by passing collimated light from a source  $s$  through a slit is used to illuminate a body  $b$  the resulting illuminated stripe on the body  $b$  is observed through a camera  $c$  offset from the source  $s$  then the 3 d position of each illuminated point  $x$  can be calculated as the unique point of intersection of the plane  $p$  with the known line  $l$  from the camera through  $x$  note that  $l$  is known since it is determined geometrically by the point at which the image of  $x$  falls on the retina of  $c$  see fig 1 below we also suppose this wedge of light to be structured in the sense that some measurable property  $q$  is imposed upon its separate rays this property is assumed to be constant in each vertical plane of the wedge  $w$  but to vary monotonically from left to right across the wedge which is to say monotonically with the geometric parameter  $h$  shown in fig 2 which defines the vertical plane in which a given point of  $w$  lies in the will pennington scheme the whole surface of the body  $b$  can be determined by panning the plane  $p$  over the whole visual field an improved scheme which allows this whole surface to be determined more rapidly is as follows suppose that the body  $b$  is illuminated by a wedge  $w$  of light as in fig 2 below about the publisher forgotten books publishes hundreds of thousands of rare and classic books find more at forgottenbooks.com this book is a reproduction of an important historical work forgotten books uses state of the art technology to digitally reconstruct the work preserving the original format whilst repairing imperfections present in the aged copy in rare cases an imperfection in the original such as a blemish or missing page may be replicated in our edition we do however repair the vast majority of imperfections successfully any imperfections that remain are intentionally

left to preserve the state of such historical works

in this thesis a three dimensional design of a vector light sensor for angular proximity detection applications is realized 3d printed mesa pyramid designs along with commercial photodiodes were used as a prototype for the experimental verification of single pixel and two pixel systems the operation principles microfabrication details and experimental verification of micro sized mesa and cmos compatible inverse vector light pixels in silicon are presented where p n junctions are created on pyramid s facets as photodiodes the one pixel system allows for angular estimations providing spatial proximity of incident light in 2d and 3d a two pixel system was further demonstrated to have a wider angle detection multilayered carbon nanotubes graphene and vanadium oxide thin films as well as carbon nanoparticles based composites were studied along with cost effective deposition processes to incorporate these films onto 3d mesa structures combining such design and materials optimizations produces sensors with a unique design simple fabrication process and readout integrated circuits compatibility finally an approach to utilize such sensors in smart energy system applications as solar trackers for automated power generation optimizations is explored however integration optimizations in complementary si pv solar modules were first required in this multi step approach custom composite materials are utilized to significantly enhance the reliability in bifacial silicon pv solar modules thermal measurements and process optimizations in the development of imec s novel interconnection technology in solar applications are discussed the interconnection technology is used to improve solar modules performance and enhance the connectivity between modules cells and components this essential precursor allows for the effective powering and consistent operations of standalone module associated components such as the solar tracker and internet of things sensing devices typically used in remote monitoring of modules performance or smart energy systems such integrations and optimizations in the interconnection technology improve solar modules performance and reliability while further reducing materials and production costs such advantages further promote solar si pv as a continuously evolving renewable energy source that is compatible with new waves of smart city technology and systems

this book shows the steps from data sheets of sensors to the extraction of model parameters for the program pspice in order to realize circuit analyses physical entities as temperature humidity light pressure and sound are included by equations the simulation concerns temperature displays characteristics of humidity sensors light to voltage converters strain gauges

reed relays and piezoelectric sounders us converters and saw components

a passive plasmonics based chemical sensing system to be used in harsh operating environments was investigated and developed within this program the initial proposed technology was based on combining technologies developed at the suny polytechnic institute colleges of nanoscale science and engineering cnse and at the university of minnesota um specifically a passive wireless technique developed at um was to utilize a heat activated plasmonic design to passively harvest the thermal energy from within a combustion emission stream and convert this into a narrowly focused light source this plasmonic device was based on a bullseye design patterned into a gold film using focused ion beam methods fib critical to the design was the use of thermal stabilizing under and overlayers surrounding the gold film these stabilizing layers were based on both atomic layer deposited films as well as metal laminate layers developed by united technologies aerospace systems utas while the bullseye design was never able to be thermally stabilized for operating temperatures of 500°C or higher an alternative energy harvesting design was developed by cnse within this program with this new development plasmonic sensing results are presented where thermal energy is harvested using lithographically patterned Au nanorods replacing the need for an external incident light source gas sensing results using the harvested thermal energy are in good agreement with sensing experiments which used an external incident light source principal component analysis pca was used to reduce the wavelength parameter space from 665 variables down to 4 variables with similar levels of demonstrated selectivity the method was further improved by patterning rods which harvested energy in the near infrared which led to a factor of 10 decrease in data acquisition times as well as demonstrated selectivity with a reduced wavelength data set the combination of a plasmonic based energy harvesting sensing paradigm with pca analysis and wavelength down selection offers a novel path towards simplification and integration of plasmonic based sensing methods using selected wavelengths rather than a full spectral analysis integration efforts were designed and modeled for thermal and mass transport considerations by utas which led to the 3D printing of scaled models that would serve as the housing for the alternative energy harvesting plasmonic chemical sensor design developed by cnse

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