

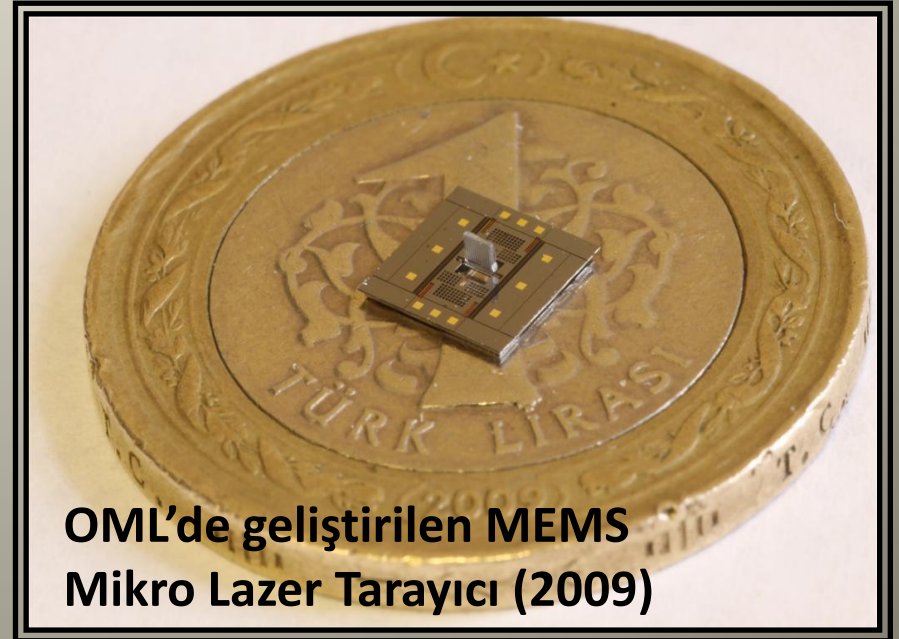
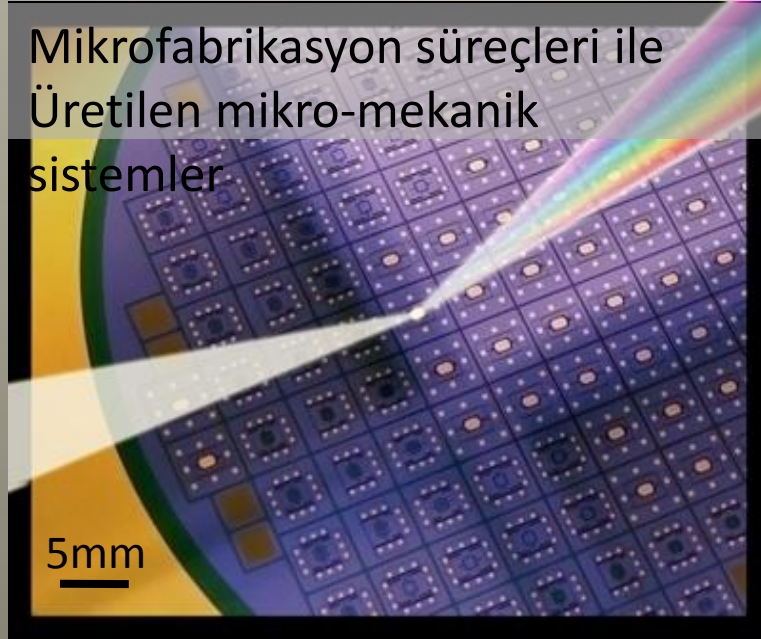
# Koç Üniversitesi'nde Geliştirilen Optik MEMS Sistemler ve Uygulamaları

Prof. Dr. Hakan Ürey

Koç Üniversitesi

Elektrik-Elektronik Mühendisliği

Optik Mikrosistemler Laboratuvarı (OML)





Microvision (ABD) Destekli Projeler

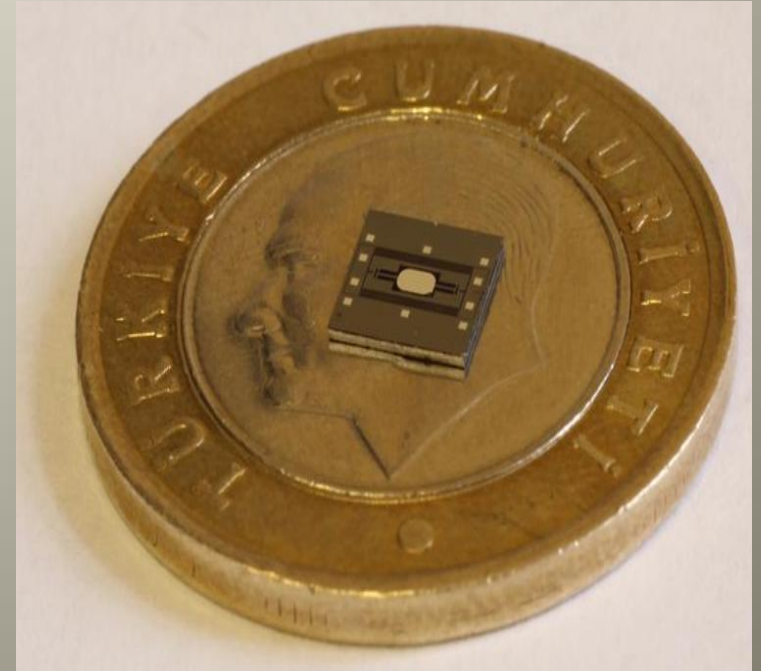
# MEMS VE FR4 TARAYICILAR

# Microvision Destekli Projeler



- Pico Projektörler ve Barkod okuyucular
  - Microvision (ABD) destekli (2002-devam ediyor)
  - Cep telefonu ile entegre olduğunda >10 Milyar USD'lik Pazar
  - >10 patentimiz firmaya lisanslandı

MEMS Tarayıcı  
Tasarım ve üretimi Koç Üniv.  
öğrencilerine ait



# Microvision Lisanslanan Patentlerden

## Örnekler

( 4 of 33 )

United States Patent Application 20080237349  
Kind Code A1  
Urey; Hakan ; et al. October 2, 2008

### Scanning Light Collection

#### Abstract

A barcode scanner includes a scanning platform coupled to a fixed platform by flexible members. The scanning platform, fixed platform, and flexible members are made of a polymer such as is commonly used for printed circuit boards. The scanning platform has a laser light source, focusing lens, photodetector, and light collection optic mounted thereto. The polymer qualities and the moment of inertia of the scanning platform can be controlled to achieve a desired mechanical resonance.

Inventors: Urey; Hakan; (Istanbul, TR) ; Sprague; Randall B.; (Hansville, WA) ; Isikman; Serhan; (Istanbul, TR)

Correspondence Name and Address: MICROVISION, INC.  
6222 185TH AVENUE NE  
REDMOND  
WA  
98052

(54) METHOD AND APPARATUS FOR MAKING AND USING 1D AND 2D MAGNETIC ACTUATORS

(76) Inventors: Hakan Urey, Istanbul (TR); Olgac Ergeneman, Ankara (TR)

Sprague; Randall B. ; et al.

Variable Laser Beam Focus

#### Abstract

An imaging device includes a scanning platform coupled to a fixed platform by flexible members. The scanning platform, fixed platform, and scanning platform has a laser light source, focusing lens, variable focus mechanism, photodetector, and light collection optic mounted thereto. A scan angle may be modified in response. 3D imaging may also be performed.

Inventors: Sprague; Randall B.; (Hansville, WA) ; Urey; Hakan; (Istanbul, TR) ; Isikman; Serhan; (Istanbul, TR)

Correspondence Name and Address: MICROVISION, INC.  
6222 185TH AVENUE NE  
REDMOND  
WA  
98052  
US

Assignee Name and Address: Microvision, Inc.  
Redmond  
WA

Serial No.: 134915  
Series Code: 12  
Filed: June 6, 2008

U.S. Current Class:  
U.S. Class at Publication:  
Intern'l Class:

Claims

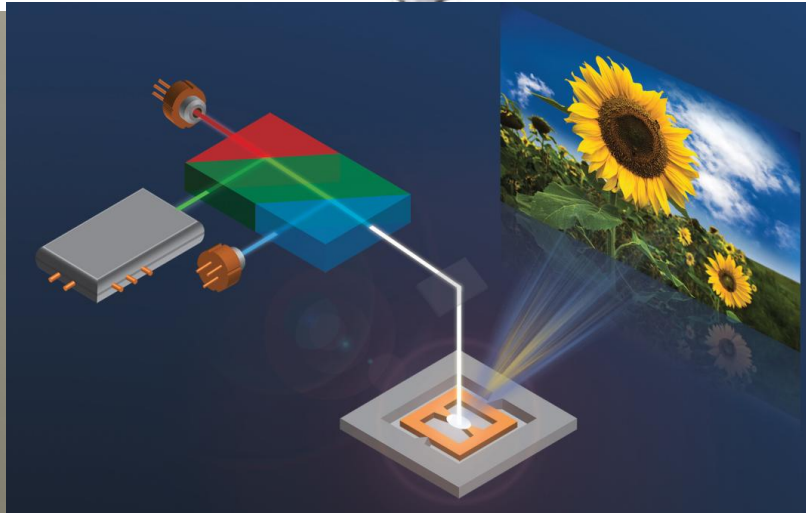
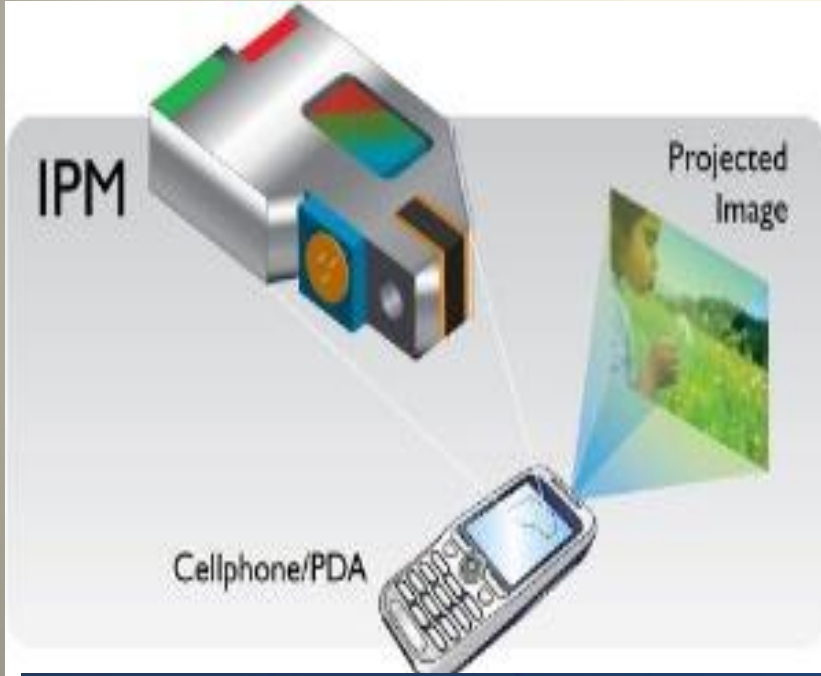
**n** (10) Pub. No.: US 2007/0257565 A1  
(43) Pub. Date: Nov. 8, 2007

#### Related U.S. Application Data

(60) Provisional application No. 60/771,586, filed on Feb. 9, 2006.

#### Publication Classification

# MEMS LASER Tarayıcılar ve Displayler



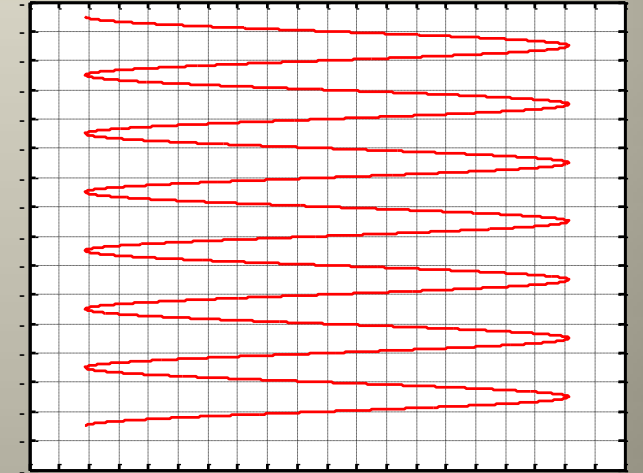
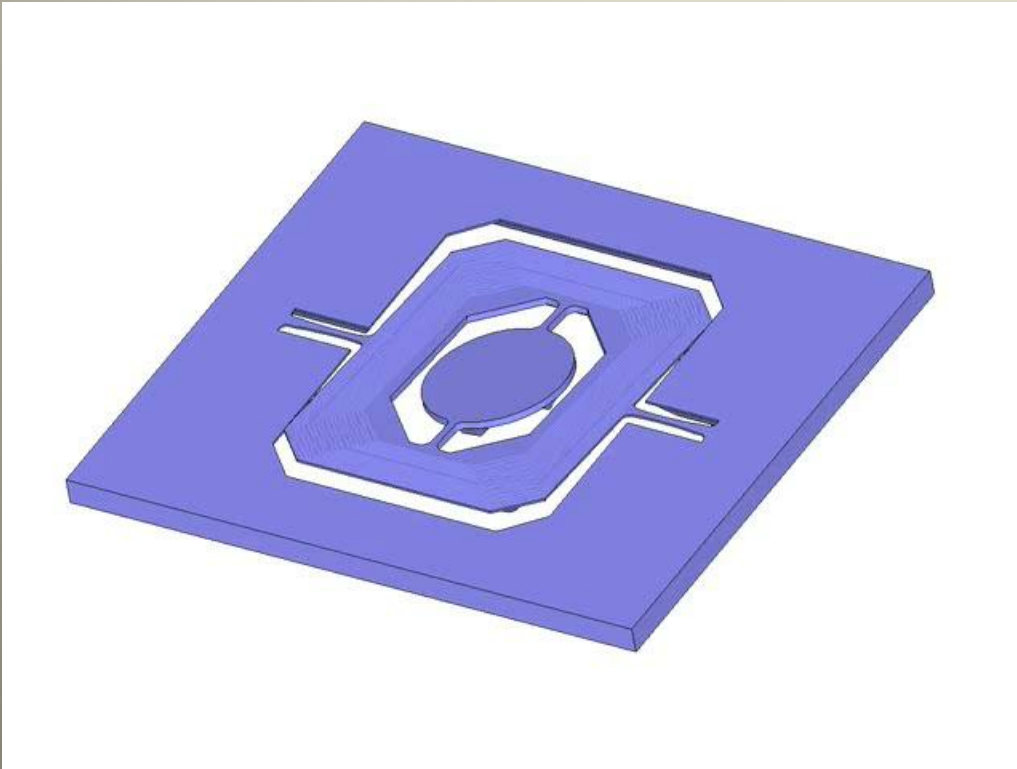
# İki Eksenli Tarama

SVGA 60fps Display

Yatay eksen 20-25 KHz

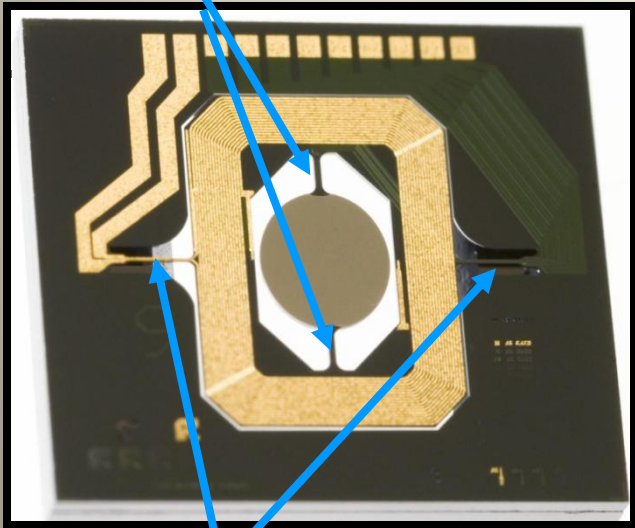
Düsey eksen 60 Hz

2D Raster



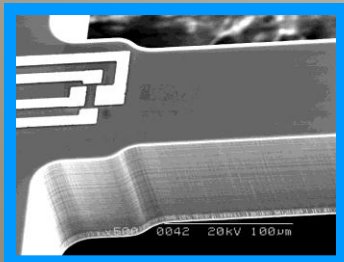
# 2D MEMS Tarayıcı: Manyetik Eyleyici (Rekor performans)

**Horizontal Scanning Flexures  
(20 KHz)**

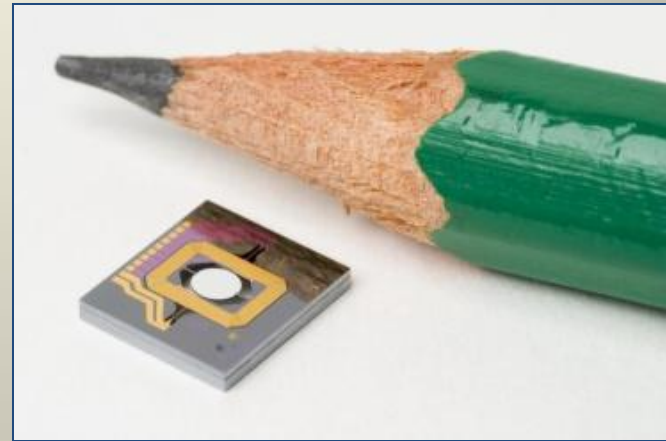


**Vertical Scanning Flexures  
(60 Hz)**

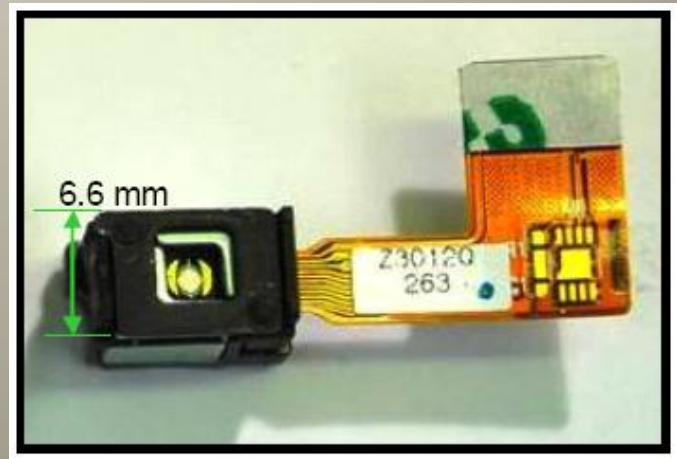
**Integrated PZR Position Sensor**



**Si Die**

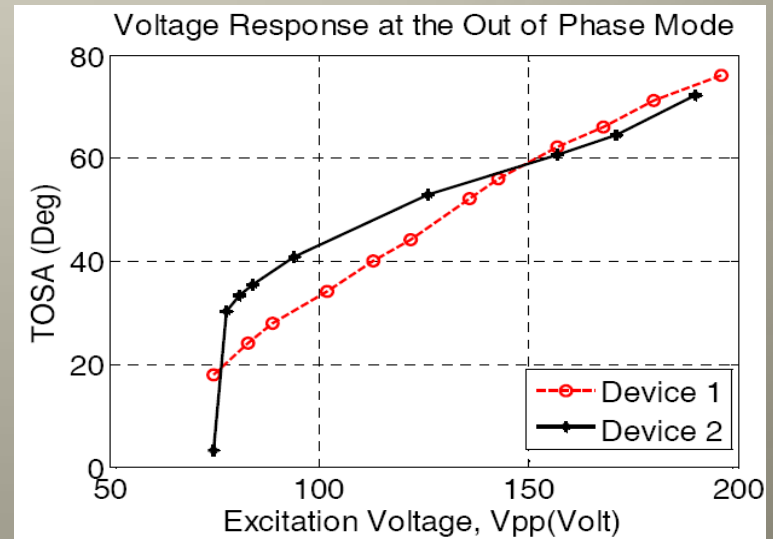
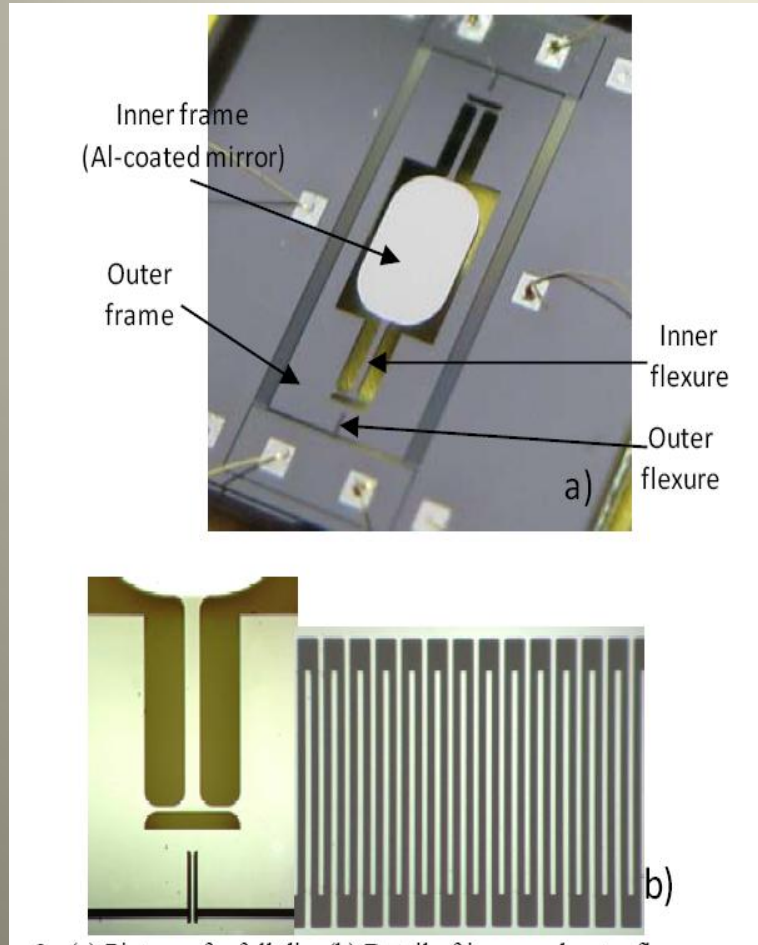


**Packaged Device**



Yalcinkaya et al,  
JMEMS, 2006

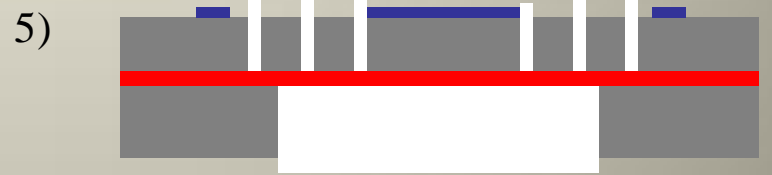
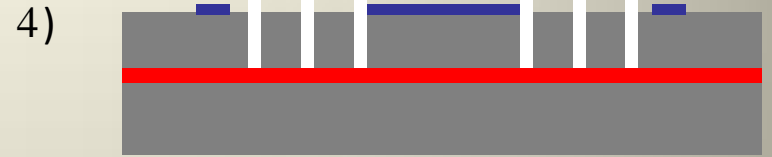
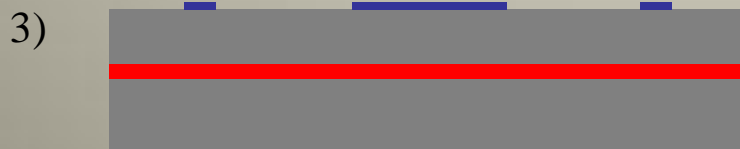
# Elektro-statik Tarak Yapısı İle Sürülen MEMS Tarayıcı



Arslan et al, JMEMS 2010

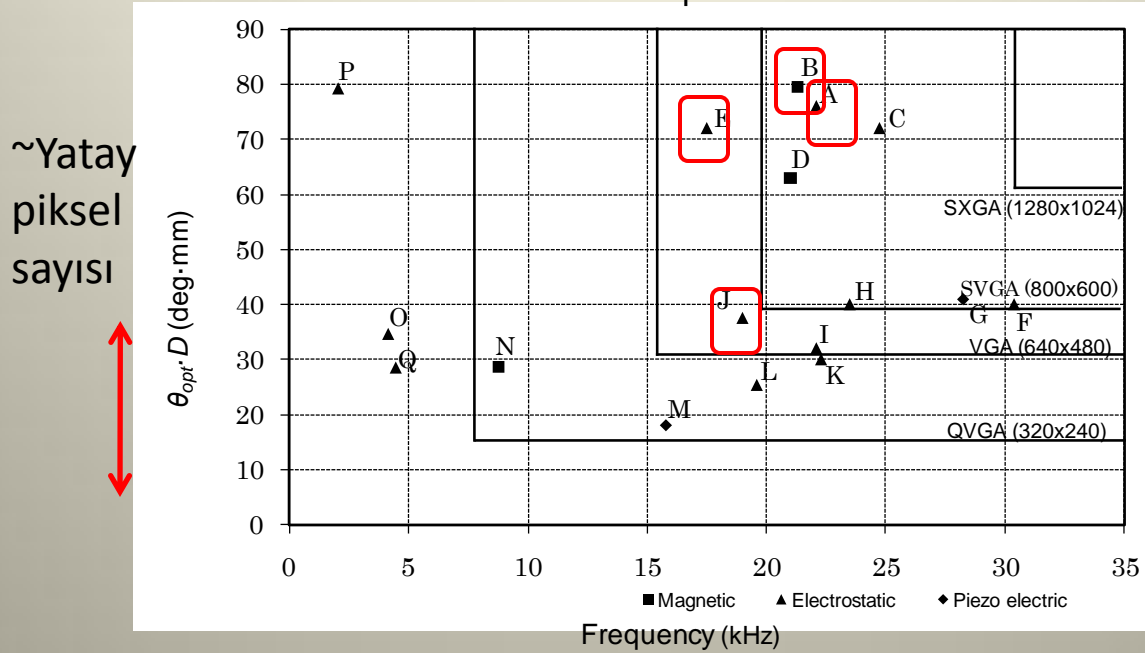


# SOI Mikrofabrikasyon Süreci



# Rekor MEMS Tarayıcı Performansı Elde Edildi

Scanner comparison

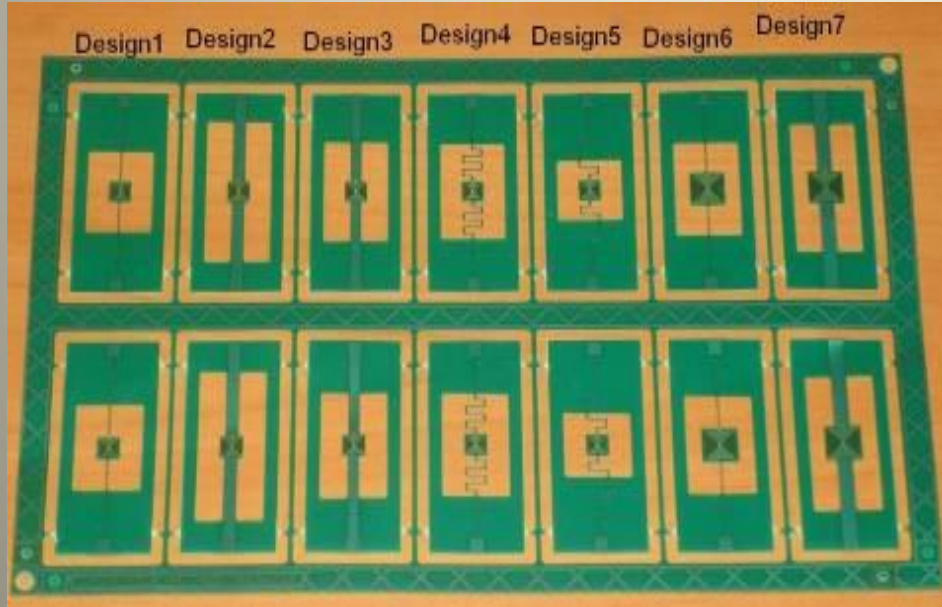


~Düşey piksel sayısı

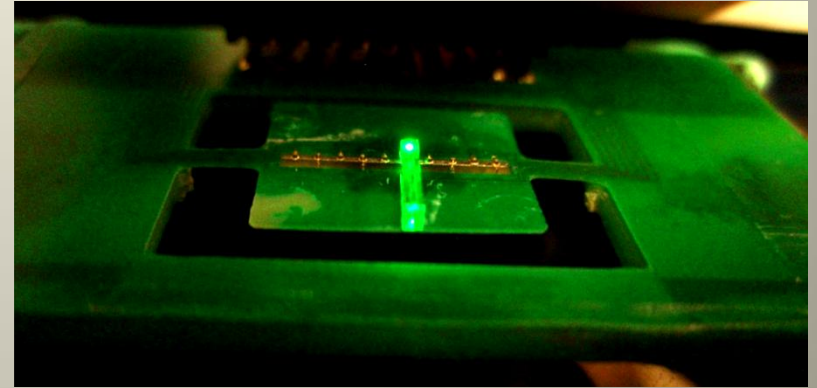
A) Arslan [JMEMS'10]	B) Yalcinkaya [8]	C) Cho [9]	D) Torashima [10]
E) Urey [11]	F) Hsu [12]	G) Park [13]	H) Kuijpers [14]
I) Ko [15]	J) Wine [16]	K) Yoda [17]	L) Ji [18]
M) Lebedev [19]	N) Ji [20]	O) Kim [21]	P) Jung [22]
Q) Milanovic [23]			

## FR4 Tarayıcılar (Standard Baskı Devre Teknolojisi)

### FR4 Kart Üzerinde Manyetik Tarayıcılar

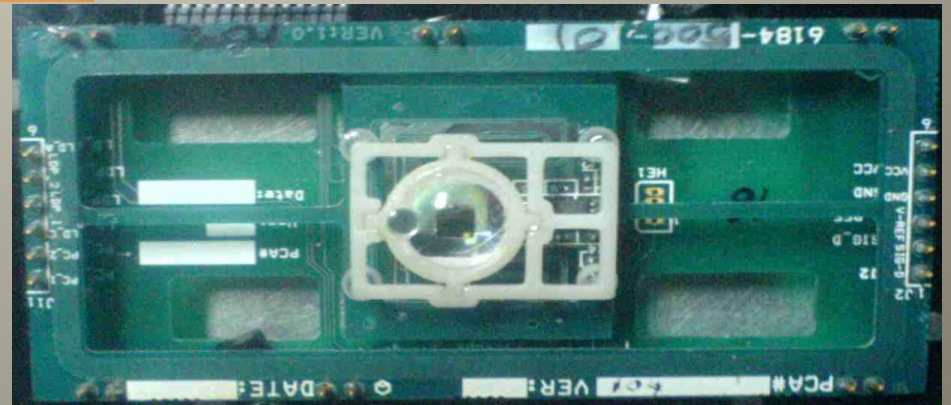


### LED / Dalga Kılavuzu ile FR4 Tarayıcı



### Geliştirilen Barkod Okuyucu

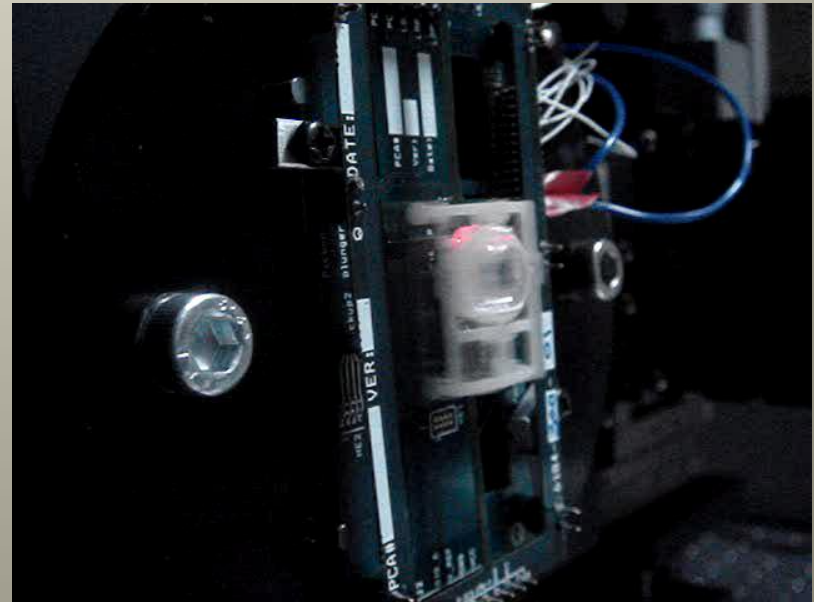
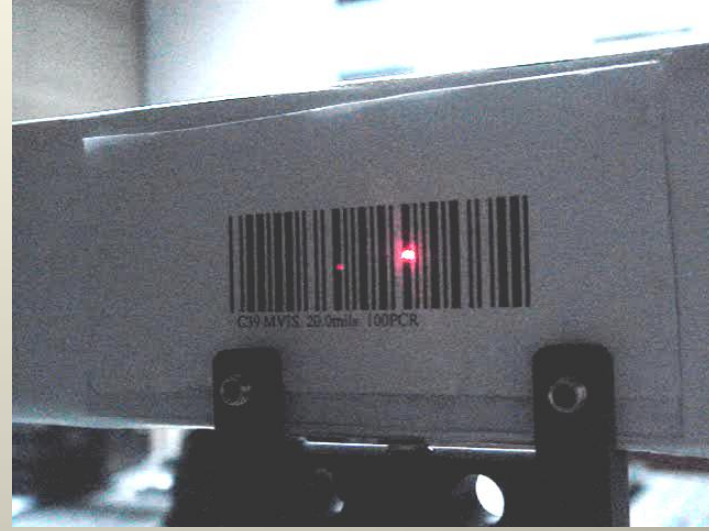
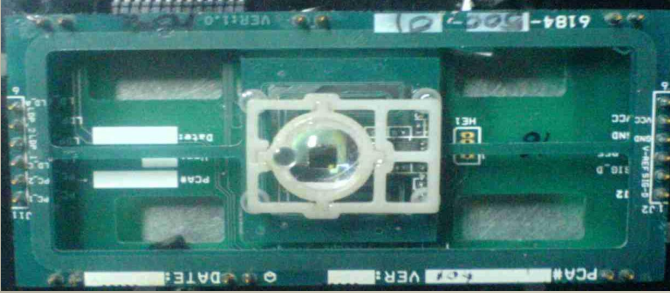
Isikman et al, Opt. Exp. 2009



© Hakan Urey 2011, Optical Microsystems Laboratory

# Barkod Tarayıcı Sistemi(2008)

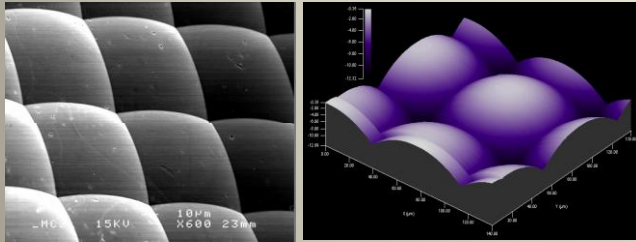
Koç Ü., NEST (Hindistan),  
Microvision (ABD) Ortaklığı



Operates on Standard 9V battery

# Endoskopik Lazer Kamera Geliştirilmesi

microlens arrays



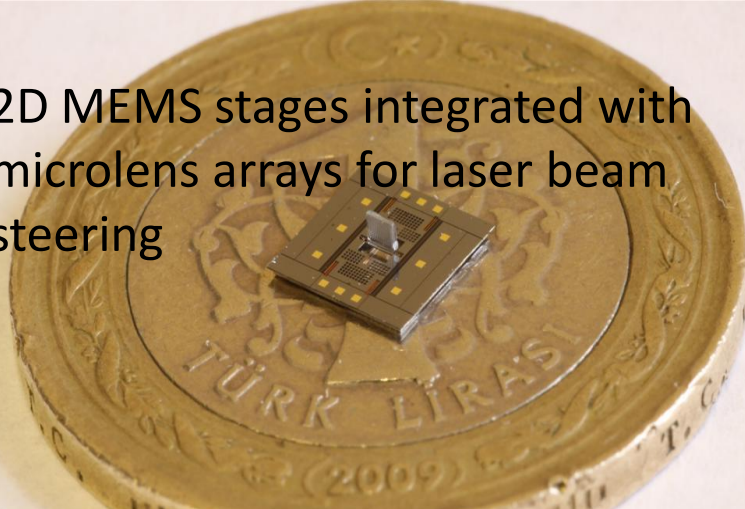
(a)

(b)

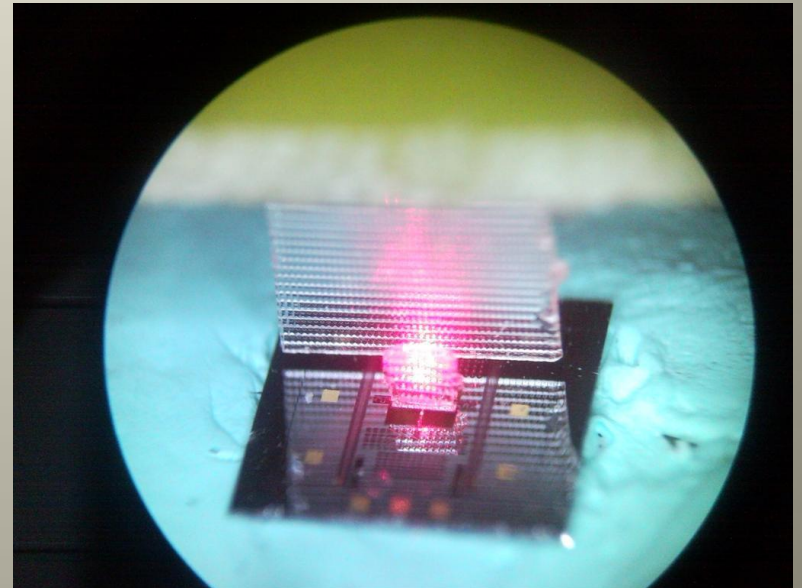
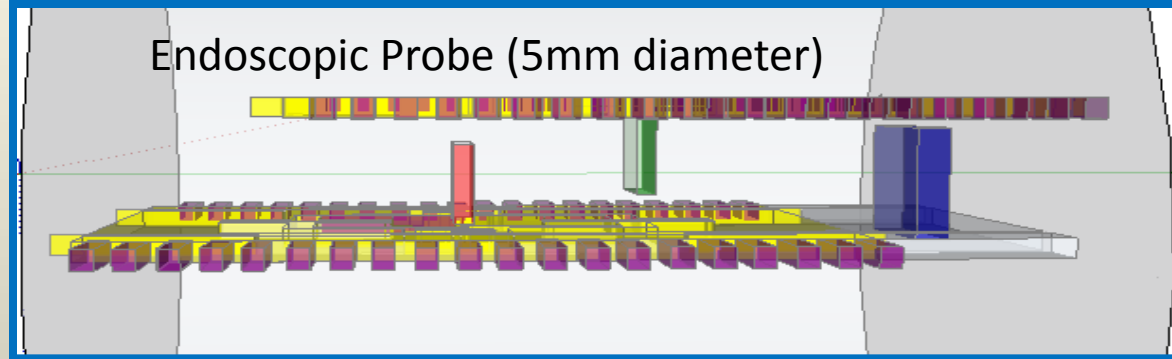
SEM picture

3D surface profile

2D MEMS stages integrated with microlens arrays for laser beam steering



**Sponsors: TUBITAK  
FP6 (NEMO, MC2ACCESS)**

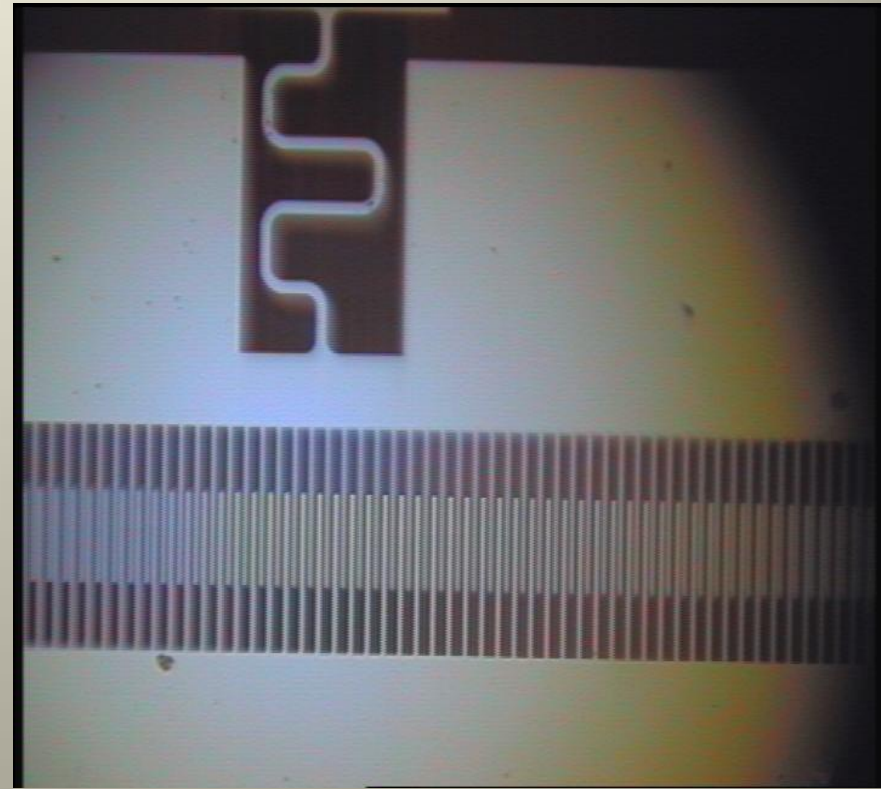
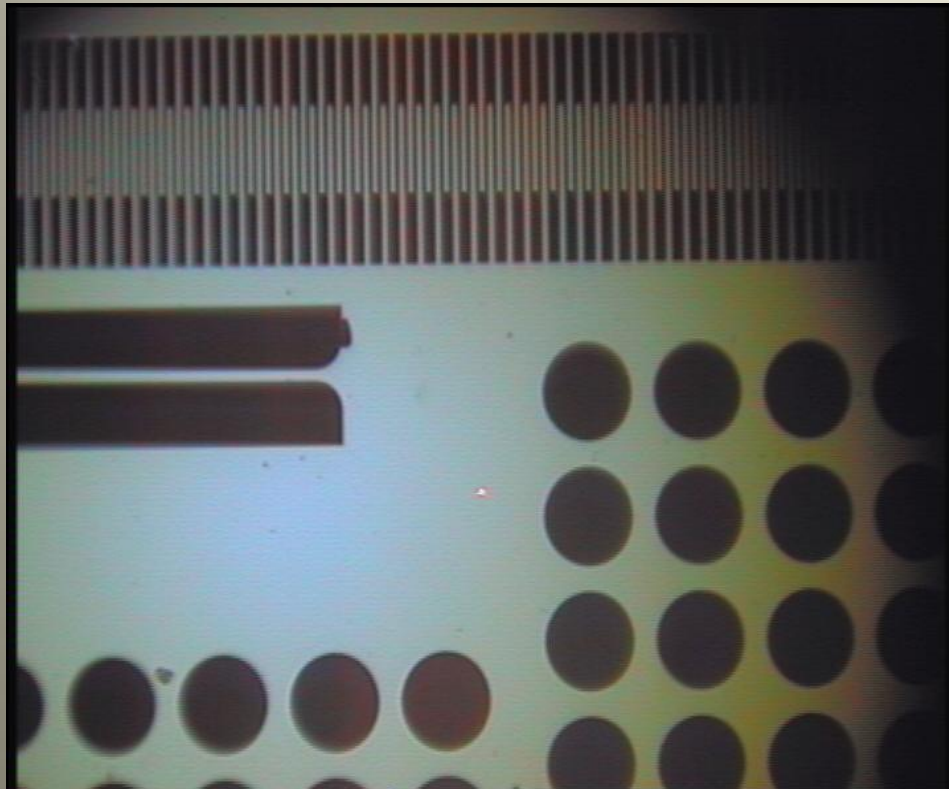


Gokce et al, JMEMS 2010

# Camera Based Measurement

MEMS Stage in-plane vibrations at 1KHz

MEMS Stage out-of-plane vibrations at 6.5KHz



50um deflection achieved for both axis (sufficient for scanning >500 x 500 pixels)

Gokce et al, JMEMS 2010