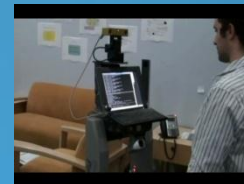


Dr. Nikolaos Mavridis

Director, Interactive Robots and Media Lab
PhD, Massachusetts Institute of Technology

From Lethe to Light, from Potentiality to Actuality: Digital Interactive Media and the Convolution of Hellenism and the East



The Ibn Sina Robot





The Emirates

Central Hub of ME, Gulf, SEAsia

Abu Dhabi & Dubai

Oil, Tourism, Trade, Services

Neutrality, Openness, Prosperity

Fast-Developing & Multicultural



The IRML Lab



+ Quite some Teaching
And project supervision!



Schlumberger
Pipe inspection
robot design award



Other Activities

In 5-person team
That brought WRO to AD



International Publicity

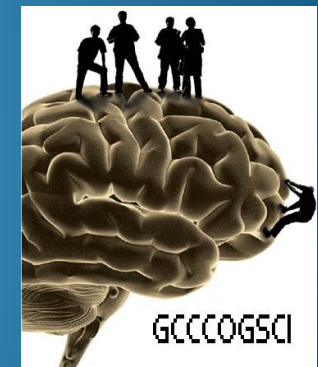
IRML International
Research Summer Schools



VIP Visits & >100 Demos

GITEX TECHNOLOGY WEEK
EMPOWERING. CONNECTING. ENTERTAINING.

Innovations'08
5th International Conference on Innovations In Information Technology
December 16-18, 2008 Al Ain, United Arab Emirates



GCCCOGSCI

What we shall see:

- A flight over the spatiotemporal map,
and a few short stops in the voyage
- The Problem and the Vision
- The New Toolchest
- A Real-World Example
- The Challenge and the Promise

Let's start our Flight!

Take notice:
How many of you have heard of...
...would like to know more about...
...would like to Live within that times?



I) Minoan/Cycladic & Egypt/Babylon/Hati

1600BC

Trade!

“...In the days of a unified Egypt and a strong Babylon, Minoan merchants were also based at Ugarit, and their so-called Kamaers pottery found its way along the trade routes to the Nile Valley...quantities of high-value items were exchanged for near-Eastern tin and Anatolian copper...Minoan connections reached out to the small kingdoms of the Greek mainland; ... Minoan influence also stretched to the coast of Anatolia through the Cyclades”

(P. Collins, From Egypt to Babylon:
The international age 1550-500BC)



II) Pythagoras in Egypt & Mesopotamia

550BC Egypt/Persia <-> Ionian Philosophy
Pythagoras Travels to Egypt & Chaldeans/Magi

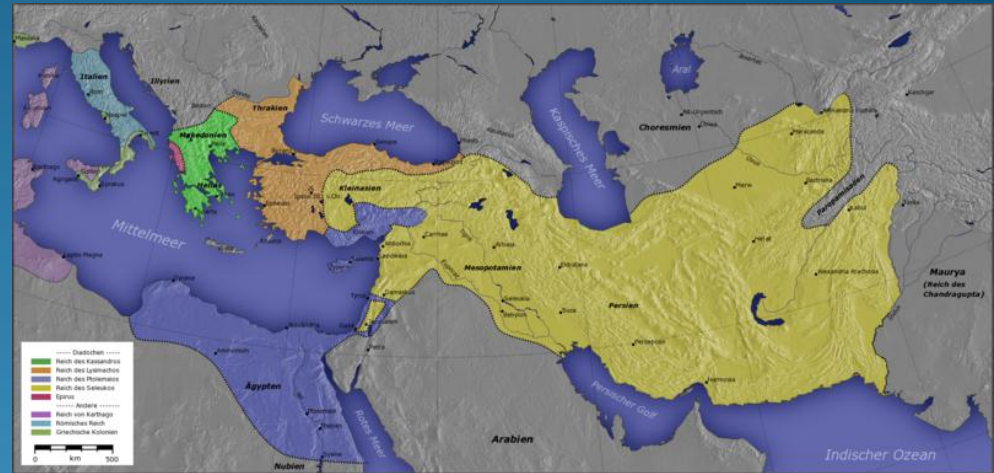


CHAPTER IV STUDIES IN EGYPT AND BABYLONIA

Here in Egypt he frequented all the temples with the greatest diligence, and most studious research, during which time he won the esteem and admiration of all the priests and prophets with whom he associated. Having most solicitously familiarized himself with every detail, he did not, nevertheless, neglect any contemporary celebrity, whether sage renowned for wisdom, or peculiarly performed mystery; he did not fail to visit any place where he thought he might discover something worthwhile. That is how he visited all of the Egyptian priests, acquiring all the wisdom each possessed. He thus passed twenty-two years in the sanctuaries of temples, studying astronomy and geometry, and being initiated in no casual or superficial manner in all the mysteries of the Gods. At length, however, he was taken captive by the soldiers of Cambyses, and carried off to Babylon. Here he was overjoyed to associate with the Magi, who instructed him in their venerable knowledge, and in the most perfect worship of the Gods. Through their assistance, likewise, he studied and completed arithmetic, music, and all the other sciences. After twelve years, about the fifty-sixth year of his age, he returned to Samos. (Iamblichus, The Life of Pythagoras)

III) Ptolemaic and later Alexandria

250BC Hellenistic <-> Egypt



“The library of Alexandria was but one part of the Musaeum of Alexandria, which functioned as a sort of research institute. In addition to the library, the Musaeum included rooms for the study of astronomy, anatomy, and even a zoo of exotic animals. The classical thinkers who studied, wrote, and experimented at the museum include the fathers of math, engineering, physiology, geography, and medicine.

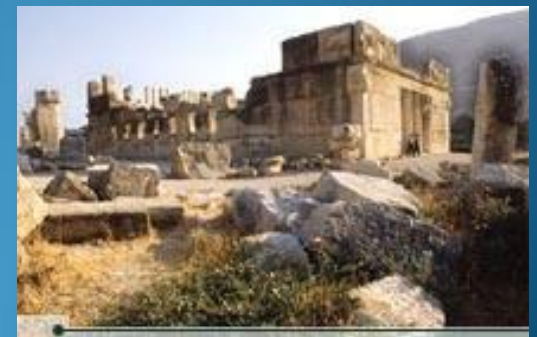
Notable thinkers such as:

Euclid, Archimedes, Eratosthenes, Herophilus, Erasistratus, Hipparchus, Pappus, Hypatia, and Aristarchus of Samos.”

IV) Hellenistic Jordan and Syria

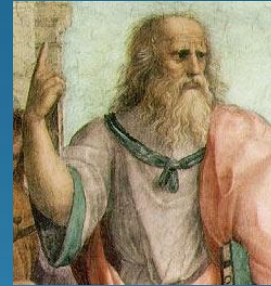
200BC

“Although the influence of Greek culture had been felt in Jordan previously, Alexander the Great’s conquest of the Middle East and Central Asia firmly consolidated the influence of Hellenistic culture. The Greeks founded new cities in Jordan, such as Umm Qais (known as Gadara) and renamed others, such as Amman (renamed from Rabbath-Ammon to Philadelphia) and Jerash (renamed from Garshu to Antioch, and later to Gerasa). Many of the sites built during this period were later redesigned and reconstructed during the Roman, Byzantine and Islamic eras, so only fragments remain from the Hellenistic period. Greek was established as the official language, although Aramaic remained the primary spoken language of ordinary people.”



V) Plato's Academy in Persia

530AD



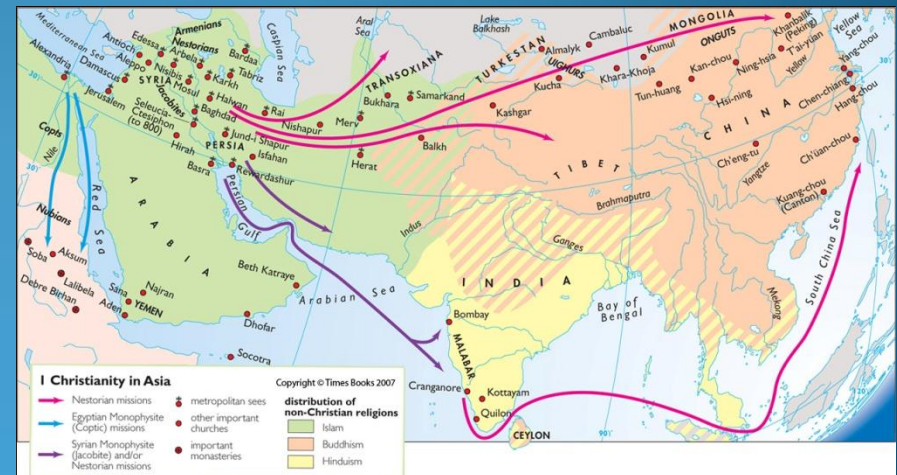
“At a date often cited as the end of Antiquity, the emperor Justinian closed the school in 529 A.D. (Justinian actually closing the school has come under some recent scrutiny^[32]). The last Scholarch of the Academy was Damascius (d. 540). According to the sole witness, the historian Agathias, its remaining members looked for protection under the rule of Sassanid king Khosrau I in his capital at Ctesiphon, carrying with them precious scrolls of literature and philosophy, and to a lesser degree of science. After a peace treaty between the Persian and the Byzantine empire in 532, their personal security (an early document in the history of freedom of religion) was guaranteed.

It has been speculated that the Academy did not altogether disappear.^{[30][33]} After his exile, Simplicius (and perhaps some others), may have travelled to Harran, near Edessa. From there, the students of an Academy-in-exile could have survived into the 9th century, long enough to facilitate the Arabic revival of the Neoplatonist commentary tradition in Baghdad.^[33]”

VI) Nestorian, Syrian, Coptic Christianity

650AD

“The church grew rapidly under the Sassanids, and following the Islamic conquest of Persia, it was designated as a protected dhimmi community under Muslim rule. From the 6th century, it expanded greatly, establishing communities in India (the Saint Thomas Christians), Central Asia (where they had evangelical success among the Mongol tribes), and China, which was home to a thriving Nestorian community under the Tang Dynasty from the 7th to the 9th century. In the 13th and 14th century the church experienced a final period of expansion under the Mongol Empire, which had influential Nestorian Christians in the Mongol court.”

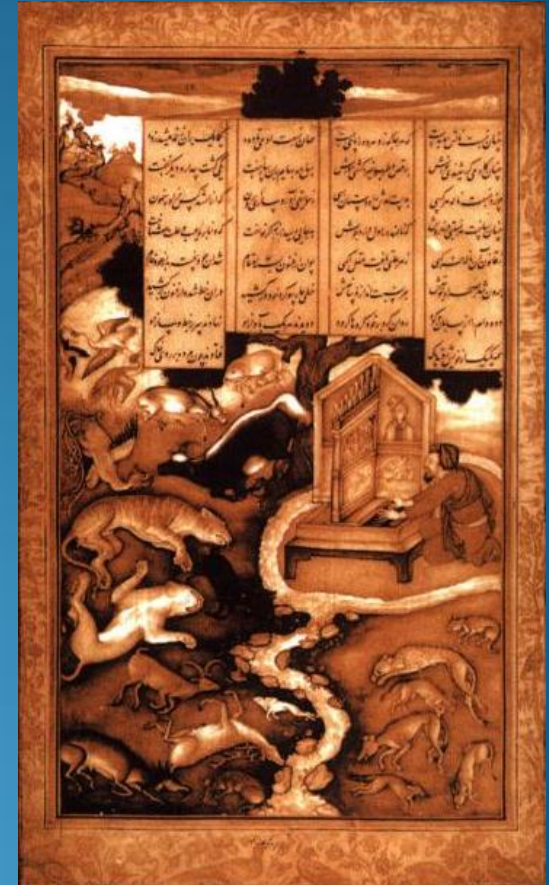


VII) Baghdad & Translation Movement

820AD

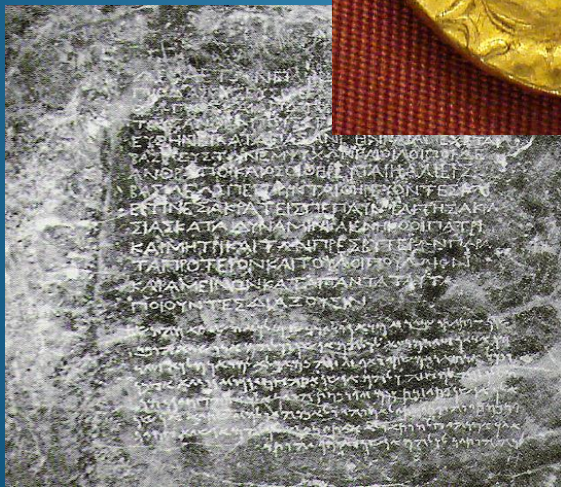
“..from about the middle of the eighth century to the end of the tenth, almost *all* non-literary and non-historical secular Greek books that were available throughout the Eastern Byzantine Empire and the Near East were translated into Arabic. What this means is that all of the following Greek writings, other than the exceptions just noted, which have reached us from Hellenistic, Roman, and late antiquity times, and many more that have not survived in the original Greek, were subjected to the transformative magic of the translator’s pen: astrology and alchemy and the rest of the occult sciences; the subjects of the quadrivium: arithmetic, geometry, astronomy, and theory of music; the entire field of Aristotelian philosophy throughout its history: metaphysics, ethics, physics, zoology, botany, and especially logic—the *Organon*; all the health sciences: medicine, pharmacology, and veterinary science; and various other marginal genres of writings, such as Byzantine hand-books on military science (the *tactica*), popular collections of wisdom sayings, and even books on falconry—all subjects passed through the hands of the translators” (Gutas 1998, “Greek Thought, Arabic Culture”)

- Not ephemeral: Two and a half centuries
- Supported by the whole of Abbasid Society
- Huge undertaking with rigorous scholarly attitude



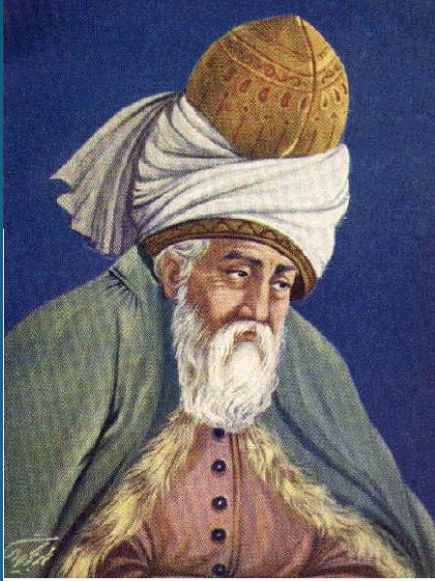
VIII) Hellas in Central Asia

Greco-Bactrians (Afghanistan),
Greco-Buddhism (India and beyond);
Kushan Empire (All the way to China)



IX) Neoplatonism & Islamic Mysticism

1250AD



“In the work of Rumi there are multiple Neoplatonic elements. This is probably caused not only by the proximity of Greek with Islamic philosophy, but also by the close contact that he had with Greek intellectuals in Iconium, ranging from Architects to the Clergy. Aflaki describes the philosophical discussions of Rumi with the monks of the Monastery of Saint Chariton (which he mentions as “Deire Aflatun”, i.e. the Monastery of Plato). Some Poems of Rumi , and especially of Sultan Valed, his son, were written in the Greek language using Arabic script”

X) From the Tocharians to Ibn Sina

1000AD



“...the Hellenistic tradition in Afghanistan and the Transoxiana region never totally diminished. In spite of the many invasions and immigrations passing through the region and political and religious changes there, Greek, Persian, and Indian academic traditions survived.

From the mid-8th to the mid-11th centuries, the land of cultural crossing nurtured many versatile brains who either went to Baghdad or stayed there to explore knowledge. Some of them made essential contributions to the culture of the Islamic world, and left great legacies to the intellectual history of the entire world.

...Therefore, in Tukharastan, the written language could not be anything else but Greek. Literary tradition impressed Xuanzang to the extent that he claimed that the literatures were even more numerous than in Sogdiana, the homeland of the famous trading community of Central Asia. Thus the region, by the mid-seventh century, was still a stronghold of Greek literature. “

(Xinru Liu, “Hellenistic Residue in Central Asia under Islam”, 2004)

So, what are your answers?

Take notice:
How many of you have heard of...
...would like to know more about...
...would like to Live within that times?



Thus, the problem is manifested: *Historical Lethe*

One underlying issue:

Traditional Media

(Museums, Video etc.)

are not participative –

Furthermore, Museum presentations often de-contextualize objects from their surroundings, and rituals

A Solution:

Exciting Participative Experiences

Facilitated around Interactive Media



Interactive Media for Digital Cultural Heritage

The New Toolchest - Many exciting possibilities!

Digital Kiosks

Virtual Worlds

Virtual Museums

Augmented Reality

Role-Playing Games

Immersive Environments

Machinima and much more

...and recently: Interactive Robots!



Interactive Media for Digital Cultural Heritage

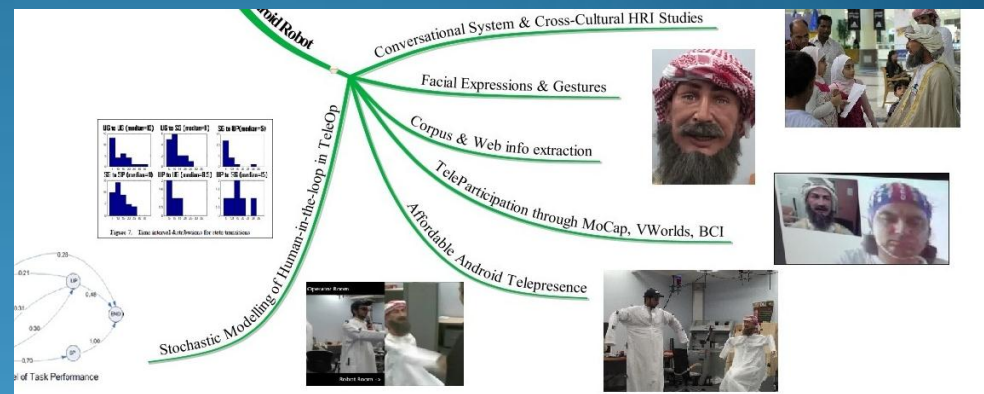
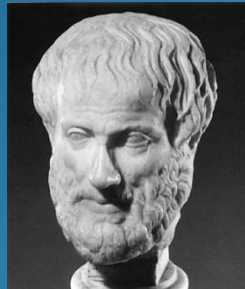


Some taxonomical axis:

participative / interactive / passive
single- vs. multi-character
collocated physical,
physical/virtual (+online/offline long-term)
human vs dedicated human vs. AI chars

Where Humans, Robots, and Virtual Worlds meet:

The IbnSina Theatre



The key notions of ibn Sina's system are very clear: 'Being-qua-being' (hasti, wujūd) {ancient persian hasti~ ancient greek εστίν} corresponds to Aristotle's notion of 'being-qua-being' in *Metaphysica* 1002a 20 (τὸ ὄν ἢ ὄν) and E. Moody's reading of Ockham's use of 'ens' in *Summa Totius Logicae*. (4) It signifies the most determinable concept. 'Non-being' is meaningless. We should note that all mental concepts (actual or not actual) signify a being. For this reason 'being' is different from 'existent'. 'Existent' (mawjūd) signifies actual entities, Aristotle's notion of first substance (πρῶτη οὐσία).

The Ibn Sina Robot



Robots, Τέχνη, and Πολιτισμός!

Well, consider:

Robots can have human-like, animal-like, or other *forms*.

Robots can have scripted, planned, partially autonomous, or even teleoperated *behaviors*

Remote humans can inhabit robotic bodies through telepresence.

Potential interaction with physical humans and objects – but also with *online virtual worlds, characters, video feeds, movies, and pictures...*

Robots and Theatre



Robots and Theatre

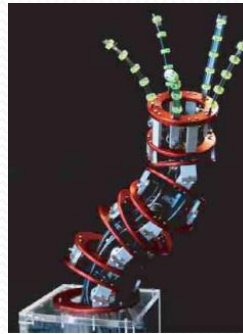
Historical underpinnings: Puppets – Automata

More recently: Animatronics – Game Characters



Ullanta troupe: mobile bots

Cynthia's Anemone
(Breazeal '03)



Non-humanoid,
limited interactivity

Rony Kubat's AUR "Confessor"



Hayashi Rob2Rob
And Philip K. Dick

But is all this just ... A frivolous application?

Robots and Theatre

No, it is certainly not just entertainment!

It Is: Arts, Research, Education

And also: Interesting Theoretical Insights,
& Promising Avenues for Robotics / HRI:

Using Drama to create believable agents (Knight '00)

Anthropocentrism ... (Demers '08)

Four Lessons from Acting Method (Hoffman)

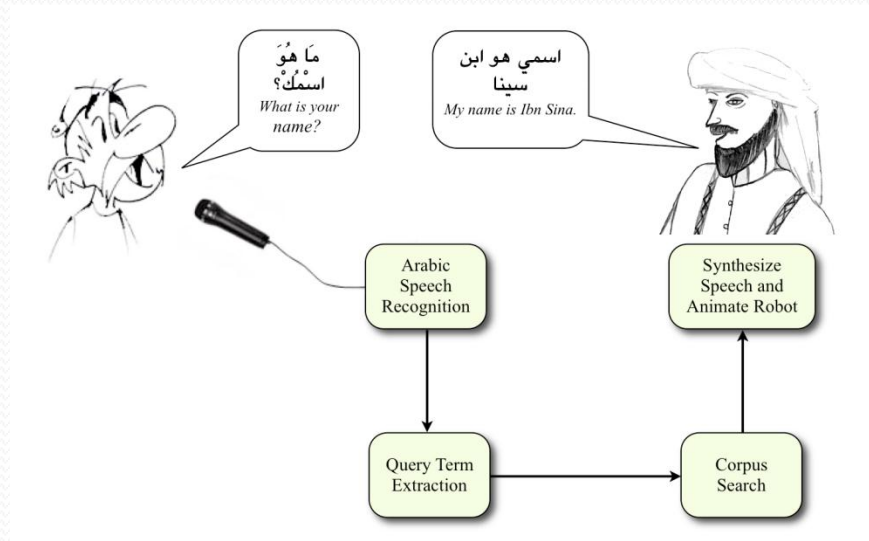
Aristotle's Poetics, Stanislavski , ... And more!

Who was Ibn Sina?



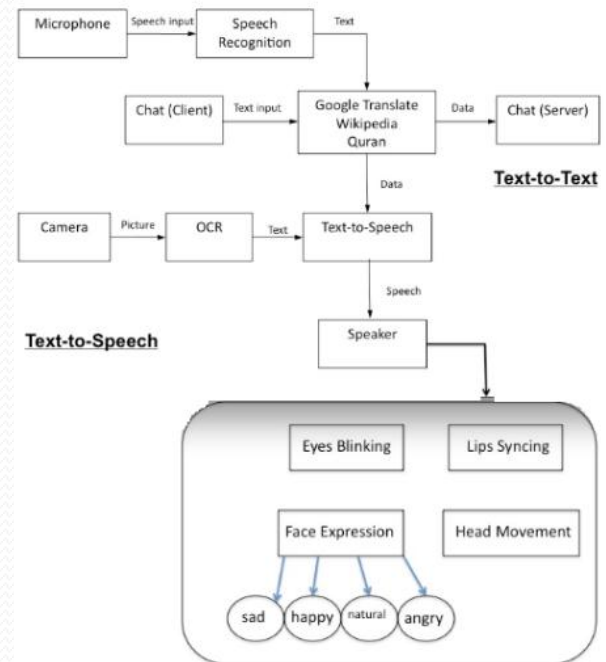
Ibn Sina Robot

Conversational System Architecture



Standalone System

Speech-to-Speech



Novel Motors Subsystem

Web-based System

Abu Ali Ibn Sina (Avicenna – Αβιτζιανός), 980-1037

A true “Πολυμαθής”

The foremost **Philosopher** and **Physician** of his times:
“Canon of Medicine”

Who also was an:

Astronomer, chemist, geologist, logician, mathematician, poet, psychologist, scientist,
and teacher, > 450 treatises

Built upon many traditions:

Greeks (Galen, Aristotle), Persian, Mesopotamian, Indian

Adventurous life with numerous turning points

Ideal Character to Artistically Build Upon

How is IbnSina relevant to the UAE?

Well-known and familiar, as one of the most important local figures of cultural heritage

The United Arab Emirates is:

- Fast developing

- Many world firsts

- Interesting multicultural nation

- Cultural identity developing

- Prototype nation for the region

IbnSina inspiring and connecting:

- A past where arts and sciences flourished

- A possible future for the region for the 21st century

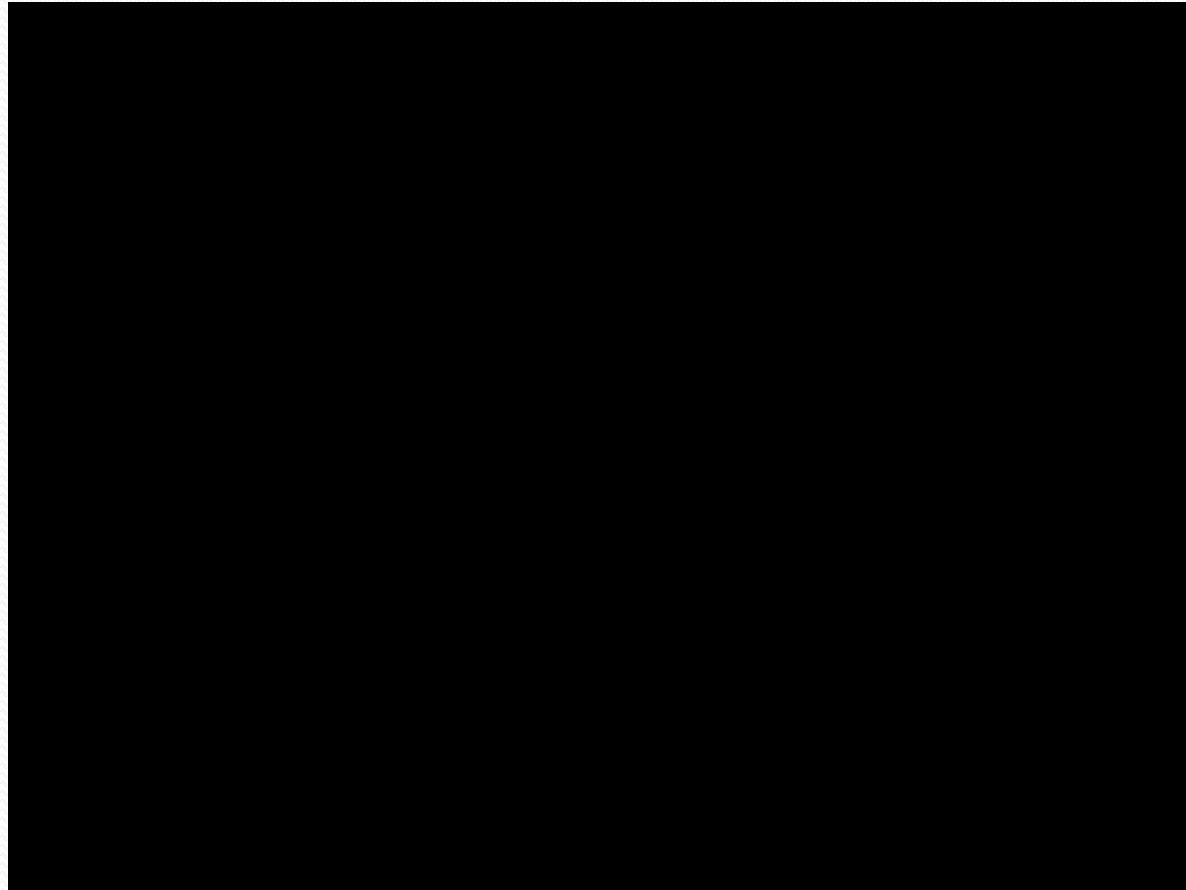
IbnSina on TV around the world



IbnSina on TV in the Emirates



Ibn Sina on BBC Arabic



Cross-Cultural HRI Studies

Do people like Ibn Sina? Yes!

- * Inspirational for Learning about Robots and History
- * Preferences for different potential application domains
- * Live shows so far:
Al Ain, Dubai, Riyadh
- * IbnSina on Emirates 1st class
- * More than 3000 people have



interacted with Ibn Sina, 1000 questionnaires, recordings, laser data etc.

*Ibn Sina Steps Out:
Exploring Arabic Attitudes Toward Humanoid Robots (AISB 2010)*

Opinions and Attitudes towards Robots in the Middle East (2011)

How does Ibn Sina feel about it?



The Robot

Statues, Portraits, Films of IbnSina
Sculpture and Mold

Flubber porous elastomer

Dynamixel/Maxon servos

DOF: Arms 2 x 14, Neck 3, Face 28

CCD EyeCams, VGA res



Purpose of the Ibn Sina Theatre

Arts

Novel interactive theatre, with varying degrees of autonomy, and multiple forms of teleparticipation; & cultural heritage preservation

Research

Ideal test-bed and setting for a lab: many possible exciting combinations for projects and open questions

Education

Highly inspiring constructionist learning

Interdisciplinary: Brings together content & code students

***And most importantly, in our case:
For re-connecting a whole region to a past
Where scientific and cultural values were prominent***

The IbnSina Interactive Theatre

The IbnSina Interactive Theatre

Where humans, robots and
virtual characters meet

Room, Stage...

13m Cone-shaped Room

10m Cylindrical Screen (1x8K proj)

Holograph (2x10K proj)

Truss-mounted projectors

Four PC's with Watchout

Minimal Light System

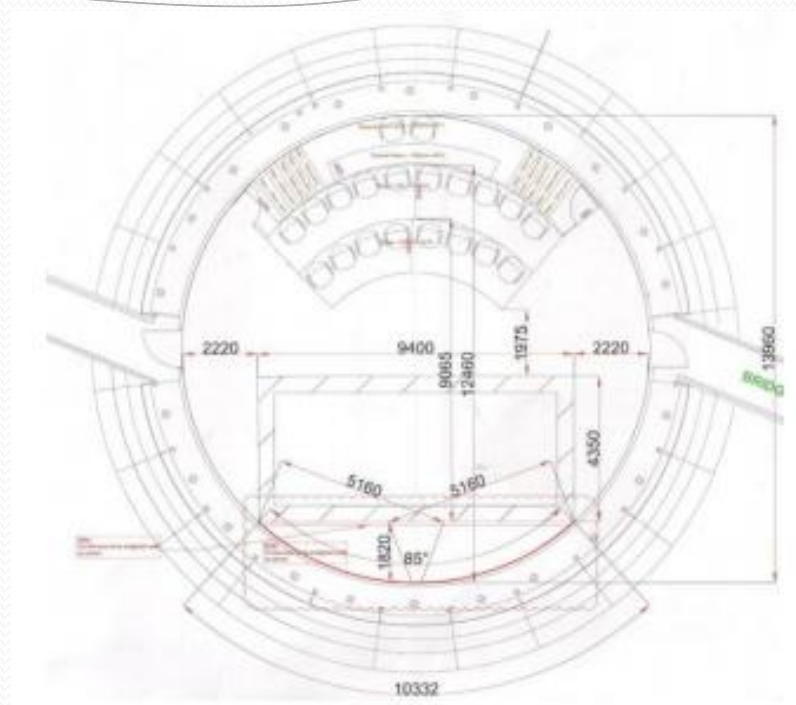
Surround Sound, Wall dumpers

Sensors:

6-cam MotionCaptor (2act, 4 x 3 area)

Liberty Latus 6-Dof

Video Camera



[“Ibn Sina Theatre” in RO-MAN 2009]

Potential interaction with physical humans and objects – but also with *online virtual worlds, characters, video feeds, movies, and pictures...*

The Dream of Ibn Sina

A theatrical Monologue – a fictional letter of Ibn Sina to Plato

Structure:

Childhood

Fight and Philosophy

Medicine

Politics

The Dreams:

The Black Bird

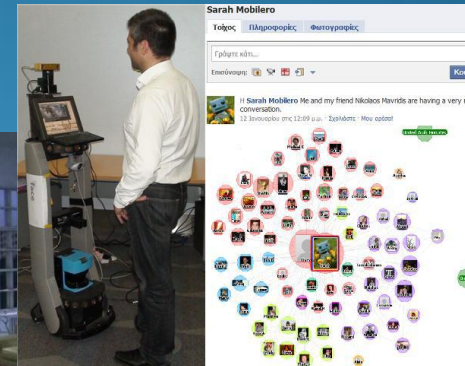
The Future

Purpose:

Connect the Past with the Future,

Show that World-Class Intellectual Activity has and can happen again in ME

Modes of TeleParticipation In the Ibn Sina Interactive Theatre

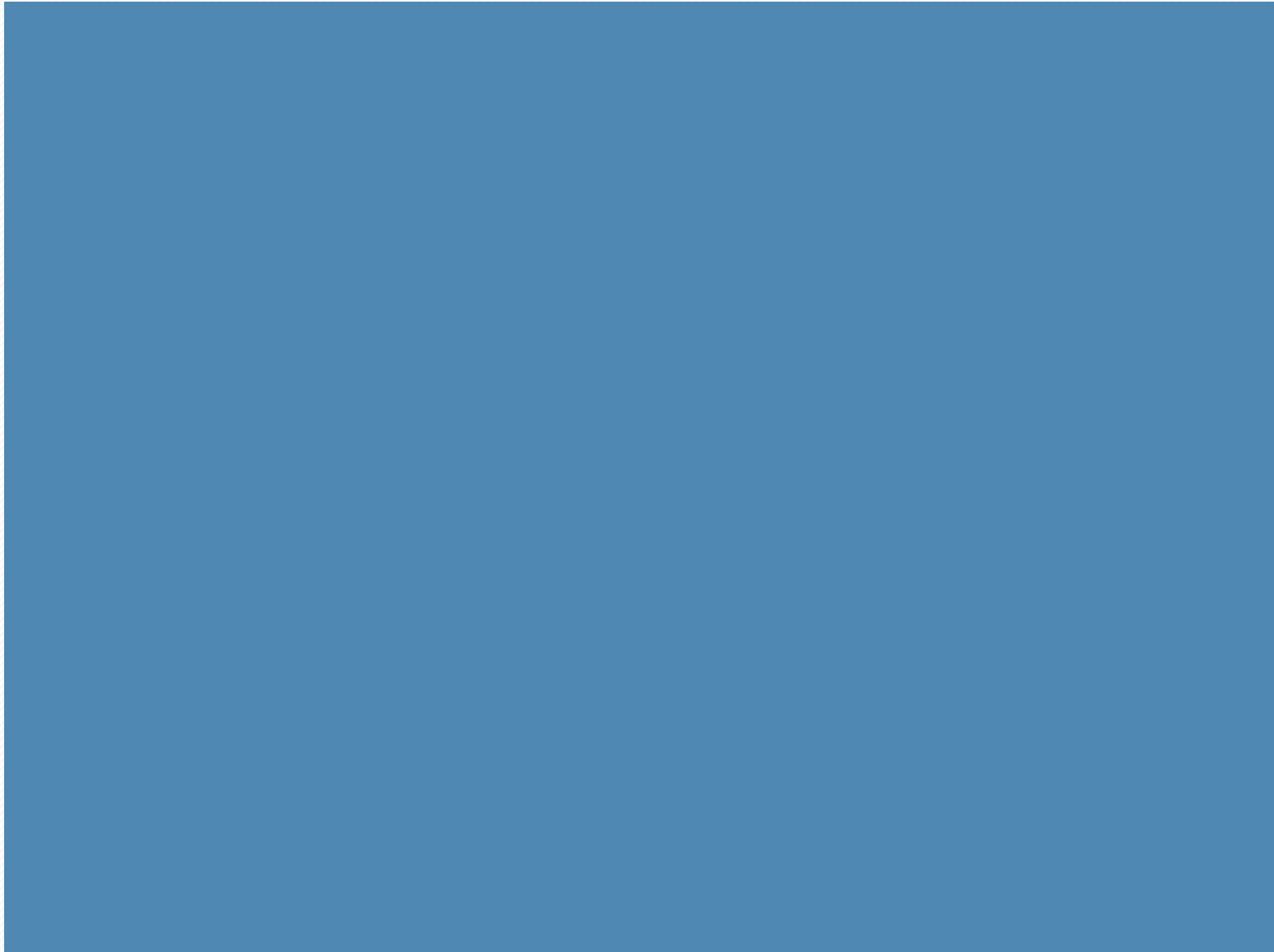


MOCAP: Motion-capture-driven Embodied TeleOperation
BCI: Brain-Computer Interfacing for control by Thought
VWORLDS: Bidirectional Windowing Between Real and Virtual Worlds
SOCIALNETS: Social Network-Assisted Online- and Offline- interactions

I. Motion Imitation through MoCap



Teleoperation through MoCap



Early teleop on IbnSina



Towards ultra-low cost Telepresence w Kinect:

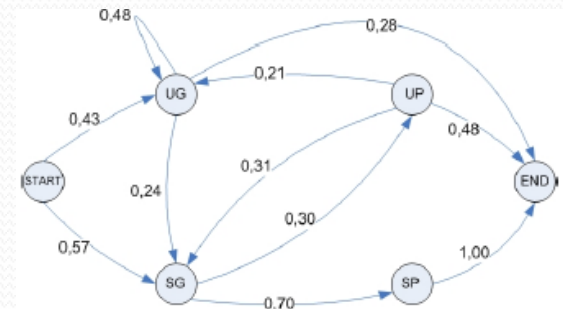


Android Telepresence



With Facial Expressions, HMD – feedback, and more!
(Mavridis, Tsamakos et. al., IEEE HRI 2011, accepted)

More about TeleOperation: Modeling Framework, and extensive evaluations



Markov Model of Task Performance

N. Mavridis, E. Machado et al.,
"Real-time Teleoperation of an Industrial
Robotic Arm Through Human Arm
Movement Imitation", IRIS 2010

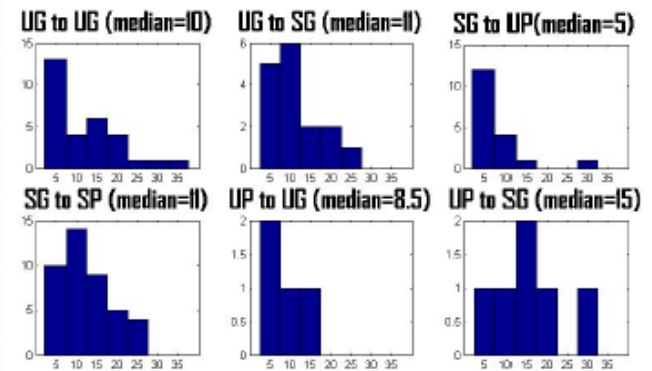


Figure 7. Time interval distributions for state transitions

Longitudinal study for learning effects:
"Probabilistic task-based Evaluation for
Tele-Operation Systems: Framework and
Case Study for a Natural Human-Arm
Imitation System", IEEE Transactions on
Systems, Man & Cybernetics, 2011



II. Humanoid telepresence through BCI



R.K.I Leaders Limited
Research - Knowledge - Innovation

R.K.I Leaders Limited
Research - Knowledge - Innovation

III. Bidirectional Virtual-to-Real window



More about BCI and Vworld teleparticipation:



C. Christoforou, N. Mavridis et al.,
"Android tele-operation through Brain-Computer Interfacing: A real-world demo with non-expert users", IRIS 2010

"The IbnSina Center: An Augmented Reality Theater with Intelligent Robotic and Virtual Characters", IEEE RoMAN09



IV. Social-information driven dialogue



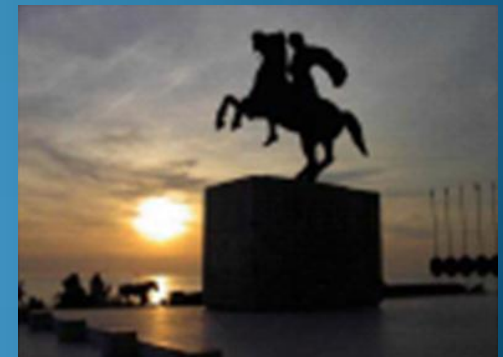
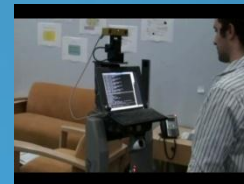
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- A Real-World Example
- The Challenge and the Promise:
Re-live the Past, to Plant the Future!
The convolution of Hellas and the East
will continue in many exciting ways,
which will benefit Humanity as a whole...

Dr. Nikolaos Mavridis

Director, Interactive Robots and Media Lab
PhD, Massachusetts Institute of Technology

From Lethe to Light, from Potentiality to Actuality: Digital Interactive Media and the Convolution of Hellenism and the East



Thank You!

