# ΑΛΘ = Φ

Composer/Researcher

**Dimitri Voudouris**

Composition

**ΑΛΘ=Φ**

Text to speech synthesis with Computer
Processing for a 24 Speaker interactive robotic ensemble
with a designed space for performance.

Performance Space

**ΘΩΡΑΞ**

Duration

**25min29sec**

Composed

**2005-2008**

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# 1 --- Neural network

**Social Networks**
The phenomenon of small-world networks seems to suggest that there is hidden principle at work that organizes our world, a combination of randomness and order that hasn't been fully explained. The concept of the small world network theory turns out to be applicable to anything from social networks and power networks to cell structure -- that is, the communication between specialized cells -- as well as the WWW.
**The Internet and WWW as Small-World Networks**
The Internet and World Wide Web are networks that have evolved without any centralized control -- potentially, everyone can connect a server to the network or create their website. The small-world architecture of these self-organizing networks suggests that this structure seems to be a form of evolutionary principle, a particularly efficient form of communication (in the broadest sense) that allows quick transmission of signals and stability of the network even if links are removed.
**The Brain as Small-World Network**
The neural network of the brain exhibits the same fundamental structure as that of social or computer networks. The brain can be understood as an assembly of distinct modules, each of them responsible for different tasks, such as speech, language, and vision. In neuroscience labs, magnetic resonance imaging techniques -- which use radio waves to probe the pattern of blood flow in the brain, revealing how much oxygen its various parts are using at any moment -- are used to see these modules in action. This process reflects the level of neural activity.
The processing centres of the brain reside in the cerebral cortex, which contains most of the brain's neurons. The modules of the brain have to communicate in order to coordinate overall brain activity. A region of the human brain no larger than a marble contains 287,400,000 neurons. Each neuron is a single cell with a central body from which numerous fibres project. The shortest fibres (dendrites) are the neuron's receiving channels; the longer fibres (axons) are the transmission lines.
Axons from any neuron eventually link up with dendrites of other neurons, and some axons link up with neurons in neighbouring brain areas. The brain also has a small number of 'long-distance' axons. Neural Networks, Evolutionary Computation, and Artificial Life and Intelligence Projects Models of brain and behavioural processes are commonly applied to computer technologies and networks in fields including computer science, neurobiology, and cognitive science.
The effort of building naturally intelligent systems has become its own area of research. Computational neural networks or neurocomputers are designed to mimic the architecture of the brain. They are information processing systems inspired by the structure of biological neural systems and mimic the functions of the central nervous system and the sensory organs attached to it. Humans are estimated to have 10 billion neurons and the largest neurocomputers currently have about a few million.

Computational neural networks are distinguished by the following characteristics:

- They are not programmed in computer languages as conventional computers are, but trained in the way we want them to.
- They communicate through neurodes, interconnections with variable weights and strengths.
- The information in neural networks is processed by constantly changing patterns of activity.

As opposed to having a separate memory and controller like a digital computer, a neural network is controlled by 3 properties:

- The transfer function of the neurodes.
- The structure of the connection among the neurodes.
- The learning law the system follows.

Neural networks have 3 basic building blocks:

- Neurodes. (Artificial models of biological neurons)
- Interconnects. (Links between neurodes)
- Synapses. (Junction where interconnect meets neurode)

Neural networks deal with:

- Sensory tasks. (Such as the processing of visual stimuli)
- Motor tasks (controlling arm movements) or the decision-making by which sensory tasks drive motor tasks.

Neural networks imitate behaviours and are better suited for processing at the cognitive level -- for example

- Motor control.
- Association.
- Speech recognition.

**Small-world Architecture in the Structure of Human Language**

Language and speech, as well as association are obviously an important area of an intelligent human system. The architecture of a small world also seems to form the basic structure of human language.

- As the products of a homogenous associative memory structure. Associationism describes the brain as a homogenous network of interconnected units, which are modified by a learning mechanism. This mechanism records correlations among frequently co-occurring input patterns.
- As a set of genetically determined computational modules in which rules manipulate symbolic representations. Rule-and-representation theories describe the brain as a computational device in which rules and principles operate on symbolic data structures. (Some rule theories further propose that the brain is divided into modular computational systems that have an organization that is largely specified genetically.)

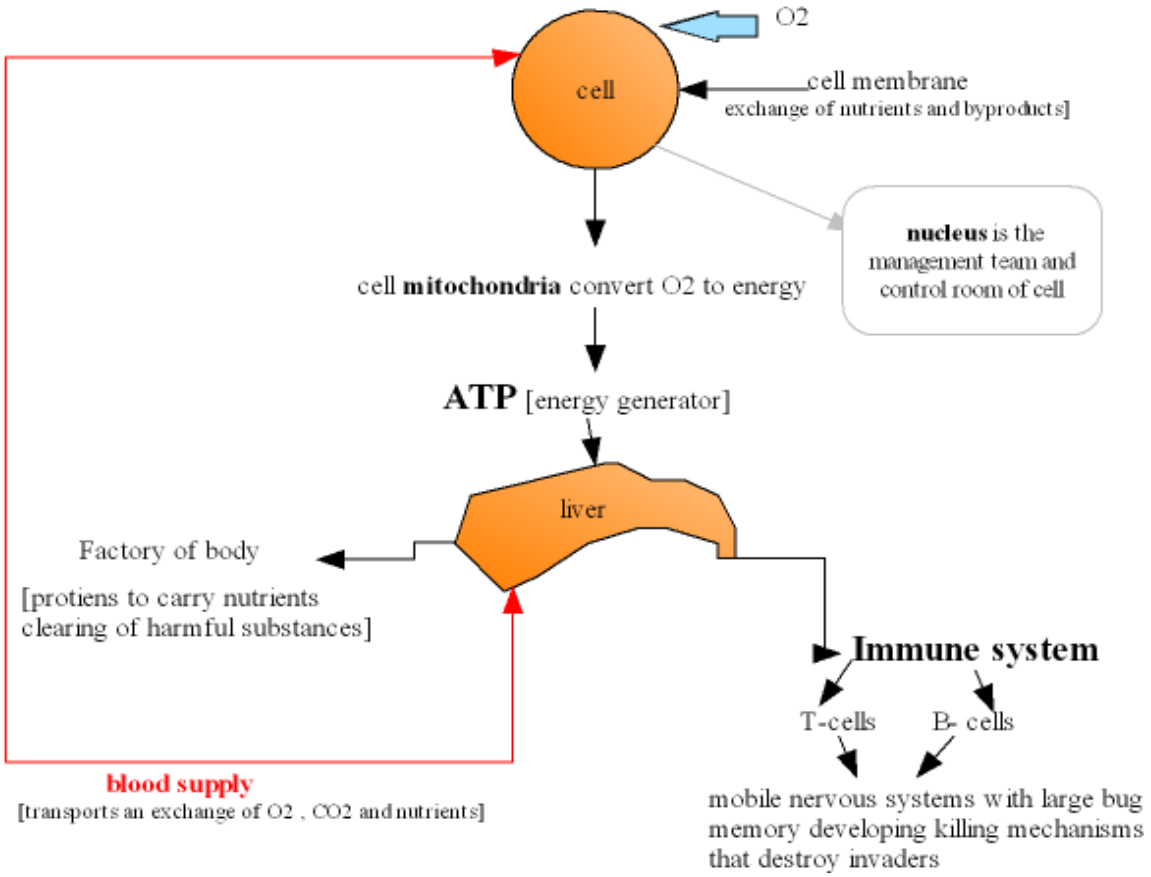
The above-mentioned two principles connect to the different models employed by neural networks (the computational kind) and Artificial Intelligence.
Neural networks basically act as an associative memory while AI attempts to generate heuristics or rules to find solutions for problems of control, recognition, and object manipulation. The underlying assumption is that problems can be solved by applying formal rules for symbol manipulation – task digital computers handle well.
Neural networks attempt to solve these problems at the level of the structure of the machine itself. In neural networks, symbolic processing is a result of the low-level structure of the physical system. While neural networks imitate behaviours with rules and symbols.
Genetic and evolutionary computing (GEA) are computer methods based on natural selection and genetics to solve problems across the spectrum of human endeavour. Evolutionary computation and artificial life are two relatively new but fast-growing areas of science. Some people believe that artificial life and evolutionary computation are very distinct areas which only overlap in the occasional use of evolutionary computation techniques such as genetic algorithms by artificial life researchers; others argue that artificial life and evolutionary computation are very closely related and evolutionary computation is an abstracted form of artificial life, since both strive to represent "solutions" to an environment, deciding which "solutions" get to reproduce and how things reproduce.

## 2 --- Pathways ın communication

Different levels of communication take place around us on the micro – second. Below I will demonstrate this phenomenon in three different examples.

**Example one:**
The cell

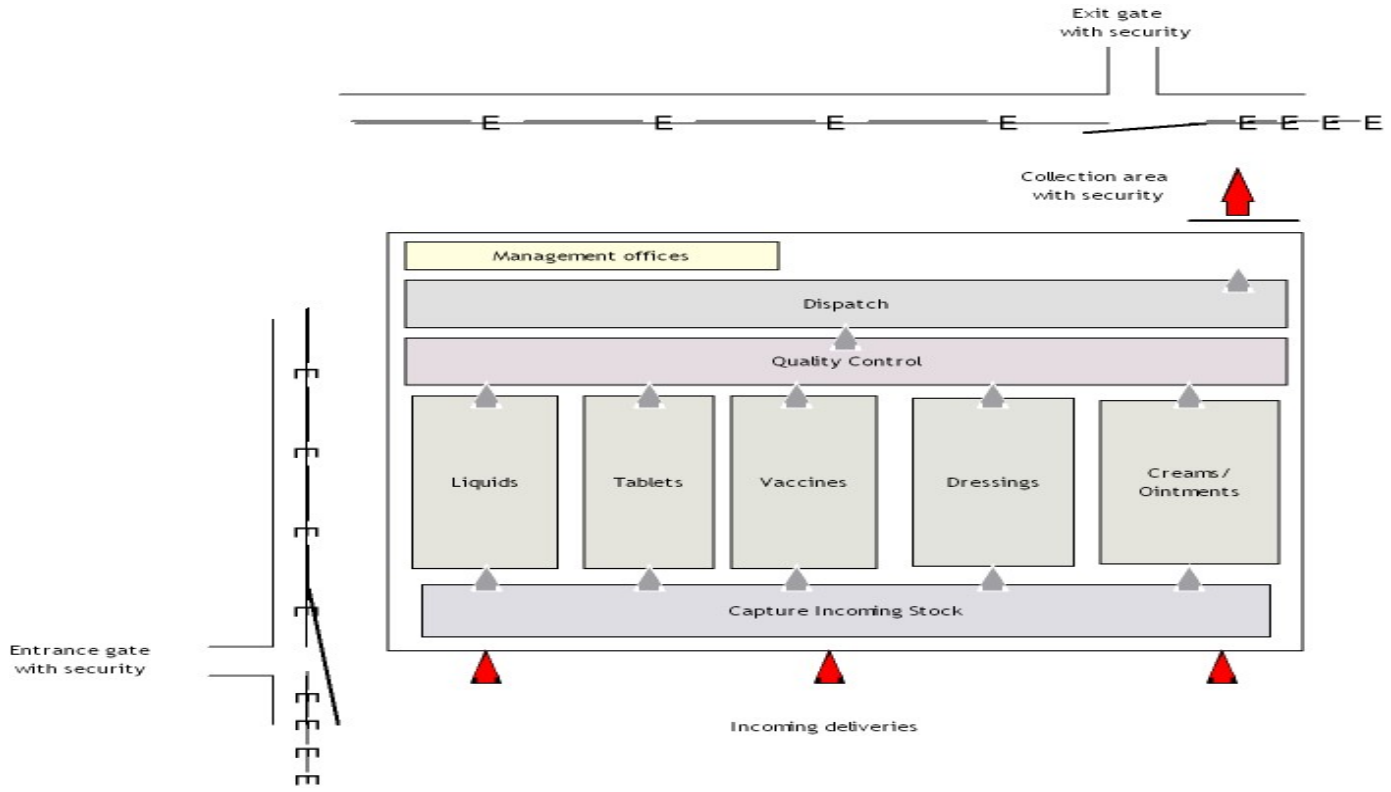
The roads of the body are the blood vessels. The blood vessels deliver the products to the cells in the form of macronutrients or micronutrients.
Cell-to-cell communication represents how cells coordinate their physiological behaviours so as to create a cooperative whole, one that is greater than the sum of their cellular parts. When cell-to-cell communication is unsuccessful, a result can be a harmful absence of cooperation, defection, which between cells within a multicellular organism we might recognize as tumours or cancer, as adult-onset diabetes, as developmental abnormalities.
Pathways of communication are through chemical signalling – hormones, by products, local regulator, signal-transduction pathway, reception, transduction, response, G-protein-linked receptors, Tyrosine-kinase receptors, protein kinase etc.




**Pathways of communication in micro and mezzo levels in the human body *Figure 1***

**Example two:**
The factory

In a factory there is an entrance that faces the road. Trucks enter the factory from the road to the delivery area. The raw materials to be processed are delivered to the appropriate parts of the factory and the workers in the factory use various machines to manufacture particular products.
The factory needs a constant and reliable power supply. It also has strong, sturdy walls to protect against the weather and robbery. The management team headed by the boss work in separate offices in the factory so regular, consistent instructions can be given to the workers. The quality control section is also housed in the in the management offices. There is a health and safety surveillance team along with security to maintain the well being of the workers and to ensure that the workers, the property and the products are safe. There is also a cleaning and maintenance team that ensures the factory is spotless and any waste products are transported out of the factory and taken to an areaway from the factory for adequate disposal. The management team also has to organize the regular delivery of products to the factory. It is the job of the management team to ensure the factory has an adequate, though not excessive or depleted, supply of raw materials to ensure maximum efficiency within the factory.
There are many factories supplying similar and different goods. There is also and integrated smooth communication between all the factories in one area and between all the areas of one region and between all the regions of one city and between all the cities of one country.
The pathways of communication between micro, mezzo and macro levels are interdependent for the system of the factory to function and survive.




**Pharmaceutical Factory**
***Figure 2***

**Example three:**
An accident and a robbery.

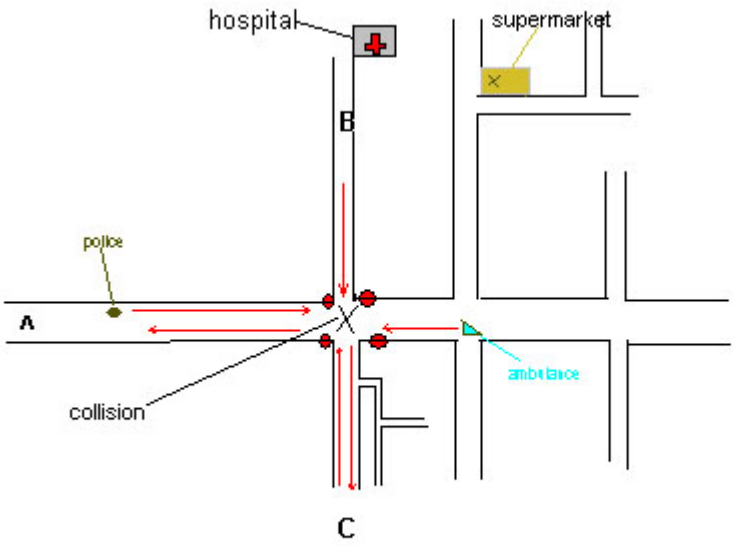
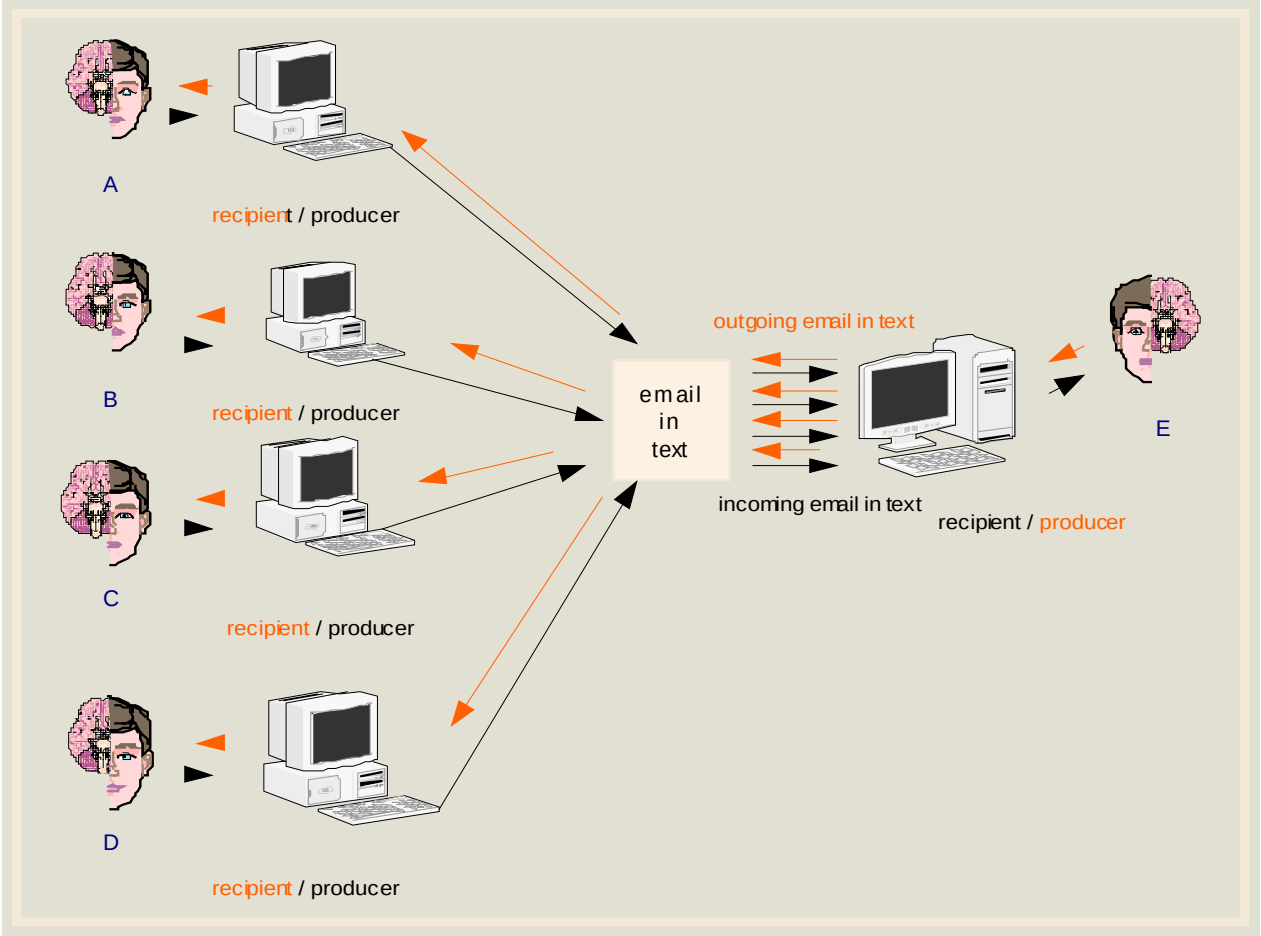



***Figure 3***

At 7am there is a collision at point X this has resulted in serious traffic congestion
Indicated by the red arrows [pathway A is a two-way road, pathway B is a one-way and pathway C is a two-way road].
The traffic has come to a stand still for one hour; no vehicles have been able to cross the intersection in this time.
On the micro level pathway A has a police vehicle which cannot move out of the situation the policeman is communicating with the station he is frustrated for he needs to get to the supermarket up the road that has been held up by robbers this is at the mezzo level as more than one person is involved in the robbery the accident is also on the mezzo level.
The ambulance needs to get to the intersection to attend to the injured. It also cannot get through [the crew are at the micro level] the hospital has contacted a helicopter to land in the seen of the accident at level X.
The pathway of communication used by the police and ambulance is by cell phone or radio route, this will involve more police vehicles both at the scene of the accident and at the place of the robbery and a rescue helicopter at the scene on the accident.
The drivers in the vehicles held up by the accident are communicating via cell phone with the areas of destination.
On the macro level the helicopter, vehicles held up, robbery, ambulance, injured people held up both in accident and robbery including bystanders are delayed in reaching their point of destination. This example reflects on how a situation of obstruction can lead to delay in the pathways of communication when each level is interdependent on each other.




**An interactive network of communication via email [involving chemical, electrical and digital processing]—*Figure 4***

## 3 --- Components of symbolic representation in thinking

Images, Concepts and Language are three symbolic components that represent our way of thinking.
I will focus on Language as AΛΘ=Φ was constructed around the impact that language has on the way the computer and we think and the control that it has over emotional change.
The mechanics of language involves a system of symbols that are employed for making sense of our world and for others – *The intercommunicative function of language.*
When we intercommunicate via words we reveal that we are thinking and what we are thinking about this also leads us to another aspect that of internalising speech as a means of ordering and clarifying our thoughts and feelings about something, this aspect of internalising allows us to reflect, explore and understand situations better- *inner and implicit speech.*
Inner speech differs from the explicit use of language [inner speech is fragmentary consisting of key words and phrases and simple grammatical constructions]. Inner speech is a by-product of thinking and it is not itself a thought process.
Grammatical sensitivity involves prepositions and conjunctions [and, however, therefore, but and if] also functional signs [comma, full stop, question mark, semi colons, exclamation marks and accent signs] e.g. man has applied this notion of language to music scores. Grammatical sensitivity thus allows us to learn, remember and manipulate more complex concepts therefore thinking and linguistic competences are identical.

Concepts are learned pre-verbally thus words refer to or serve as symbols for concepts, and they cannot be said to be the same as concepts they are rather representative of concepts, concepts are more comprehensive than words.
Concepts can be extensional [*connotation*] or intentional [*denotation*] the experience there of and the result will differ from person to person.
*Denotative* meaning of words e.g. send me an email has a standardized meaning were the members of a language community can understand one another and would act accordingly. The denotative meaning of the word is based on generally accepted rules.
*Connotative* meaning of words are subjective e.g. pain, love are words serving as symbols of concepts that the individual has created subjectively built up meanings from own experiences.

**Relationship between language and reality: -**

Words are not identical with the reality they represent, and that the relationship between language and reality is similar to the relationship between a map and the territory it represents.

**Emotional Tension Threshold: -**

The term emotional tension threshold refers to the amount of emotional tension a person can endure or cope with before his effective functioning becomes impaired **.**It corresponds to the meaning of the term elasticity limit**.**
The person's basic tension level is dependent on homeostatic regulation in the autonomic nervous system. The greater the degree of autonomic homeostasis or balance, the lower will be the intensity of emotional tension and the higher will be the emotional tension threshold.
Other influences are namely: 1] **emotional liability** 2] **temperament**

- **Emotional Liability –** refers to the ease [speed and intensity] with which homeostasis in the sympathetic and parasympathetic divisions of the autonomic nervous system becomes distributed because of synaptic malfunctioning at various levels of the nervous system. Impinging stimuli are converted at receptor level to electrochemical impulses that are then conducted along afferent paths to hierarchically higher levels in the nervous system. In the nervous system every synapse offers a degree of resistance to impulse transmission. In some people the inhibition is greater than in others if the inhibition is low the impulses are transmitted more rapidly, to result in a *quick and intense reaction* by the person. People with a labile nervous system react with greater speed and intensity to a stressor than to people with a stable nervous system. People with a labile nervous system have a high basic tension level and a low emotional tension threshold .The reverse applies to people with a stable nervous system. Various other factors influencing the liability of a person are the different stages in endocrine development, physical exhaustion [fatigue, heavy workload, lack of sleep, illness, chemical stimulants such as drugs, etc]
- **Temperament:** - refers to the relatively consistent and characteristic emotional nature, general mood and reaction pattern of a person this can be an inherited attributes of the nervous and endocrine systems. There are four dimensions of temperament.
  ***General activity level,*** with the extremes of high activity and high passivity. ***Emotionality,*** with the extremes of high emotional perturbability and high emotional imperturbability.
  ***Social disposition,*** with the extremes of gregariousness and detachment. ***Impulsiveness,*** with the extremes of self-control and lack of self –control**.** Socialization and learning can regulate the manifestations of the person's temperament potential. The interaction between the person's genotype and environmental influences depends largely on how temperament tendencies are manifested. For the computer network sensitivity of speaker receptors can vary.

# 4 --- Alexithymia [ΑΛΕΞΙΘΥΜΙΑ]

Definition: A condition where a person is unable to describe emotion in words.

We do not need to search for extreme examples to understand that there is a division between thought and language. We experience such events every day. Writing papers, we struggle to find the perfect words to convey ideas; feeling an intense passion for another person, we struggle to find simple words to express our depths of emotion. In the wake of horrendous tragedy, we are without words to describe the pain of the "horrible sights [we] have witnessed." The way in which we experience the world and how we choose to communicate those experiences are two very different aspects of the human mind. An inability to find words doesn't make us stupid or inarticulate or even less likely to experience "human enjoyment," it merely makes us human.

There are two types of alexithymia ***Primary*** a physical cause such as a genetic abnormality or due to injury and ***Secondary*** which occurs in reaction to severe psychological trauma, whereby a patient suppresses painful emotions as a temporary defence against trauma; when the psychological stressor is removed, the alexithymia disappears.
It is in ***Secondary*** alexithymia were my research lies which led me to analyse the socio-cultural implications that society might have on an individual.
Many people in society as a whole have difficulty in talking about there feelings whether they are alexithymics or not. Materialism – money, appearances, grades, test scores are examples that Man places high value on but not on feelings. Feelings of people from school level up to the workplace need to be valued. Our society is so dysfunctional and we are in so much pain most of the time that we could not handle it if we stopped to either really feel our pain or really talk about it.
People know they can't handle their real feelings. So they learn not to talk about them. Adults don't talk about them, so how could we expect children or teens to learn to? Living in a progressively engaged alexithymic society Man constantly alienates himself from emotional engagements. An area were the computerized world that he has created is a mere mirror image, the extended self of Man. This computerized world is emotionless e.g. when text to speech programs read text they read with no emotion yet Man is continually striving to create emotion in these programs. Does this action mean that Man is trying to find answers within or trying to combat and even reduce alexithymia?
I identify alexithymia more as a psychological state of mind. The physiological state can rather be termed aphasia an inability to express oneself and understand. I have chosen language, as a tool of failed communication were language fails emotion in self-expression.

## 5 --- **AΛΘ=Φ**

**A= lack**
**Λ= word [lexis]**
**Θ= emotion [thymos]**
**Φ= sound [phone]**

AΛΘ=Φ is a comparative study of pathways in communication between Man and Machine and is composed using fragments of processed speech synthesis [TTS], the reason is due mainly to speech quality which is a multi-dimensional term and the evaluation method must be chosen carefully to achieve desired results. I created pre-linguistic expressions rather than actual words in the areas of emotion i.e. pain, frustration, anxiety, confusion, love etc. that is not pre determined by language but is a pre cursor an expression that language fails to address.
AΛΘ=Φ attempts to attach a language to emotions an area that normal language fails, at the same time attempting to address an emergency in a world where imperfection is becoming less tolerable due to social pressure, were perfection is measured on a materialistic and superficial level. At this level both man and machine are interdependent on each other.
Has man become psychologically weak, is man not developed enough to survive this ongoing pressure that both society and technology has to offer? To attempt to answer those questions we need to look at another question. How can man remove himself from this reality when his state of conflict is created by non-other than himself?

# 6 --- TTS-Text to speech synthesis

**TTS**, short for Text-To-Speech, is the creation of audible speech from computer readable text.

**ΑΛΘ=Φ** used the following text to speech synthesis programs:

**Mbrola**

The aim of the MBROLA project, initiated by the TCTS Lab of the Faculté Polytechnique de Mons (Belgium), is to obtain a set of speech synthesizers for as many languages as possible, and provide them for non-commercial applications. The ultimate goal is to boost academic research on speech synthesis, and particularly on prosody generation, known as one of the biggest challenges taken up by Text-To-Speech synthesizers for the years to come.
Central to the MBROLA project is MBROLA, a speech synthesizer based on the concatenation of diphones. It takes a list of phonemes as input, together with prosodic information (duration of phonemes and a piecewise linear description of pitch), and produces speech samples on 16 bits (linear), at the sampling frequency of the diphone database used (it is therefore NOT a Text-To-Speech (TTS) synthesizer, since it does not accept raw text as input). This synthesizer is provided for non-commercial, non-military applications only. Diphone databases tailored to the Mbrola format are needed to run the synthesizer. French voices have been made available by the authors of MBROLA, and the MBROLA project has itself been organized so as to incite other research labs or companies to share their diphone databases.

**Demosthenes speech composer Version 2**

DEMOSTHeNES Speech Composer is a general-purpose multilingual and polyglot software text-to-speech (TtS) system that supports the Greek language. DEMOSTHeNES targets to the delivery of intelligible and human-like speech from a wide variety of e-text sources. Its open and component based architecture offers great flexibility, customization and expandability.
DEMOSTHeNES is appropriate for multimedia applications (spoken encyclopaedias, presentations etc), voice technology applications (e.g. telephony services) and aids for the disabled, while it can be embedded or linked to others providing a spoken output. Its novel design is very efficient (approx. **200** times realtime, in version 2), and thus it can offer many channels on server applications. Moreover, the support of several interfaces like MS-SAPI provides easy linking to other applications.

**Praat**

A program for speech analysis and synthesis written by Paul Boersma and David Weenink at the Department of Phonetics of the University of Amsterdam

**b --- Text modelling:**

Text was typed into Mbrola and Demosthenes TTS programs and the results were imported into Praat.

**c --- Problems encountered in TTS processing:**

***Numerals***

Digits and numerals must be expanded into full words so must fractions and dates are also problematic

***Abbreviations***

Abbreviations may be expanded into full words, pronounced as written, or pronounced letter by letter. For example kg can be either *kilogram* or *kilograms* depending on preceding number, St. can be *saint* or *street*, Dr. *doctor* or *drive* and ft. *Fort*, *foot* or *feet*.

***Acronyms***

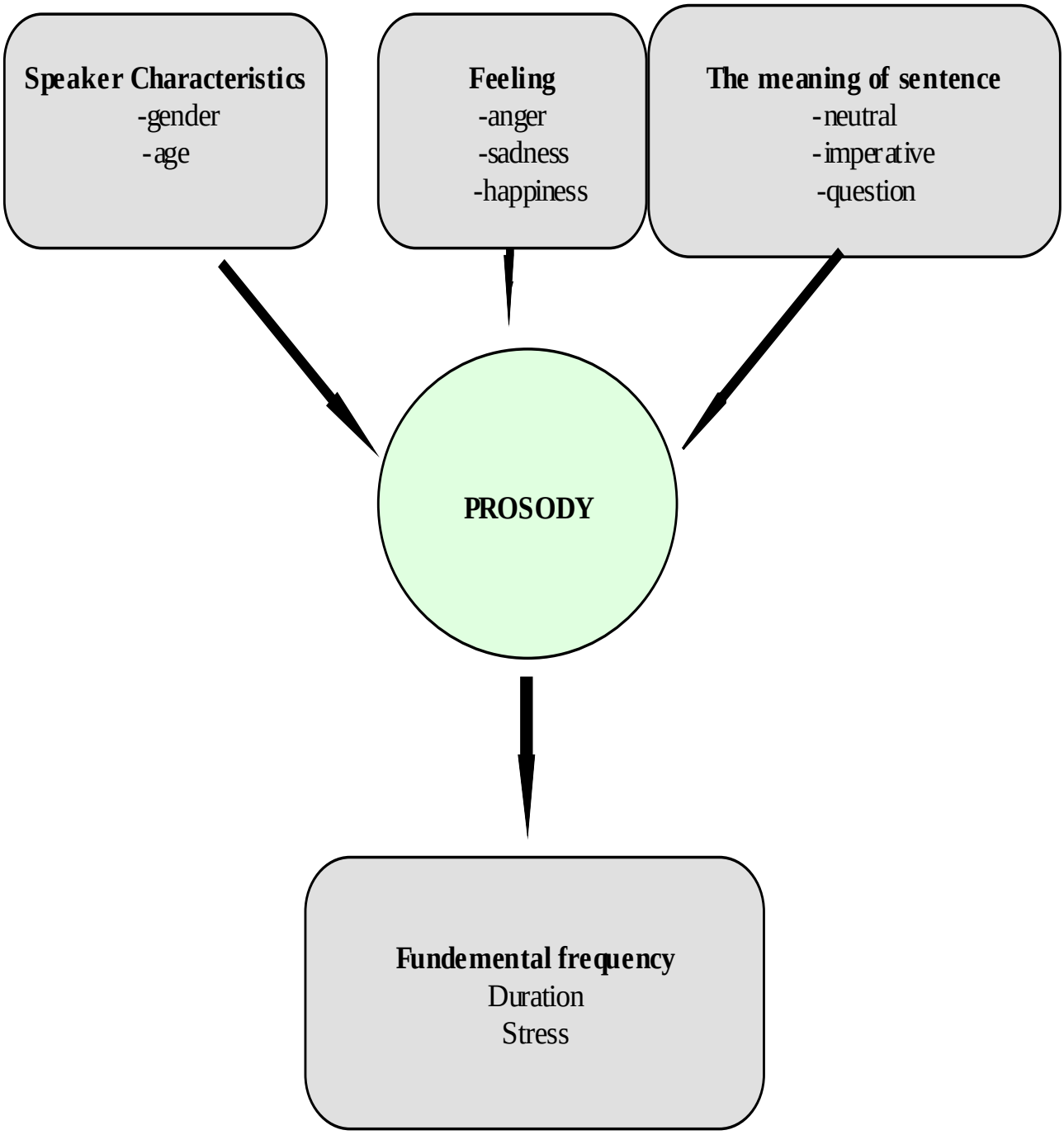
Special characters and symbols, such as '$', '%', '&', '/', '-', '+', cause also special kind of problems. In some situations the word order must be changed. For example, *$71.50* must be expanded as *seventy-one dollars and fifty cents* and *$100 million* as *one hundred million dollars*, not as *one hundred dollars million*.

***Pronunciation***

Some words, called *homographs*, cause maybe the most difficult problems in TTS systems. Homographs are spelled the same way but they differ in meaning and usually in pronunciation (e.g. lives). The word *lives* is for example pronounced differently in sentences "Three *lives* were lost" and "One *lives* to eat". The pronunciation of a certain word may also be different due to contextual effects Some sounds may also be either voiced or unvoiced in different context. For example, phoneme /s/ in word *dogs* is voiced, but unvoiced in word *cats*.

***Prosody***

Finding correct intonation, stress, and duration from written text is probably the most challenging problem and may be considered as the melody, rhythm, and emphasis of the speech at the perceptual level. The intonation means how the pitch pattern or fundamental frequency changes during speech. The prosody of continuous speech depends on many separate aspects, such as the meaning of the sentence and the speaker characteristics and emotions. The prosodic dependencies are shown in *figure 5*.Unfortunately, written text usually contains very little information of these features and some of them change dynamically during speech timing at sentence level or grouping of words into phrases correctly is difficult because prosodic phrasing is not always marked in text by punctuation, and phrasal accentuation is almost never marked. If there is no breath pauses in speech or if they are in wrong places, the speech may sound very unnatural or even the meaning of the sentence may be misunderstood. For example, the input string "John says Peter is a liar" can be spoken as two different ways giving two different meanings as "John says: Peter is a liar" or "John, says Peter, is a liar". In the first sentence Peter is a liar, and in the second one the liar is John.




Prosodic dependencies: ***Figure 5***

# 7 --- Modular constructive synthesis

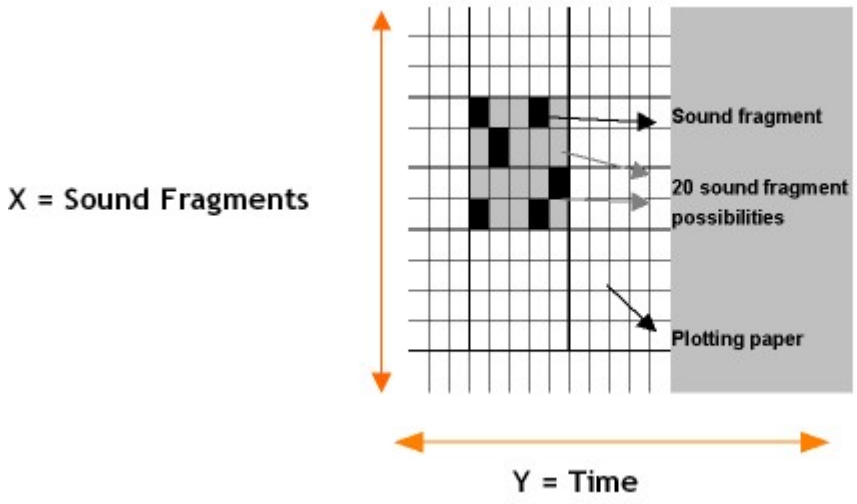
The sounds generated from the TTS were imported into a modular synthesis program

**a --- Singing and expressive sound modules**

The creation of basic Modular synthesis modules that included a granular sampler, filters, envelopes, LFO ADSH with vibrato, amplifier were used to produce singing voices in duration of 10 second – 60 second sound fragments.
Each sound fragment was analysed in **Praat** and manipulated so as to create expression and phonetics.

# 8 --- Cross mapping

Plotting paper was used to map and link sound commands were the X-axis represents sound layers as the Y-axis represents time. The plotting paper represents a puzzle were each block could contain up to 20 sound fragments.




Plotting paper with sound fragments: ***Figure 6***

# 9 --- Composing Strategies

**a --- micro, mezzo, macro sound environments**

Each one of the 20 sound fragments can have one of three possibilities assigned to them. A negotiable or non-negotiable presence can be attributed to each environment.

| micro | mezzo | macro |
|---|---|---|
| | | |
| **2** | **1** | **1** |
| **1** | **2** | **1** |
| **1** | **1** | **2** |
| | | |

Various possibilities were measured, although the result equals a numeric 4 in each row. The sound would differ in each one of the rows.

| micro | mezzo | macro |
|---|---|---|
| | | |
| **0.5** | **1.5** | **2** |
| **1.5** | **0.5** | **2** |
| **2** | **1.5** | **0.5** |
| **0.5** | **2** | **1.5** |
| **1.5** | **2** | **0.5** |
| **2** | **1.5** | **0.5** |
| **2** | **0.5** | **1.5** |

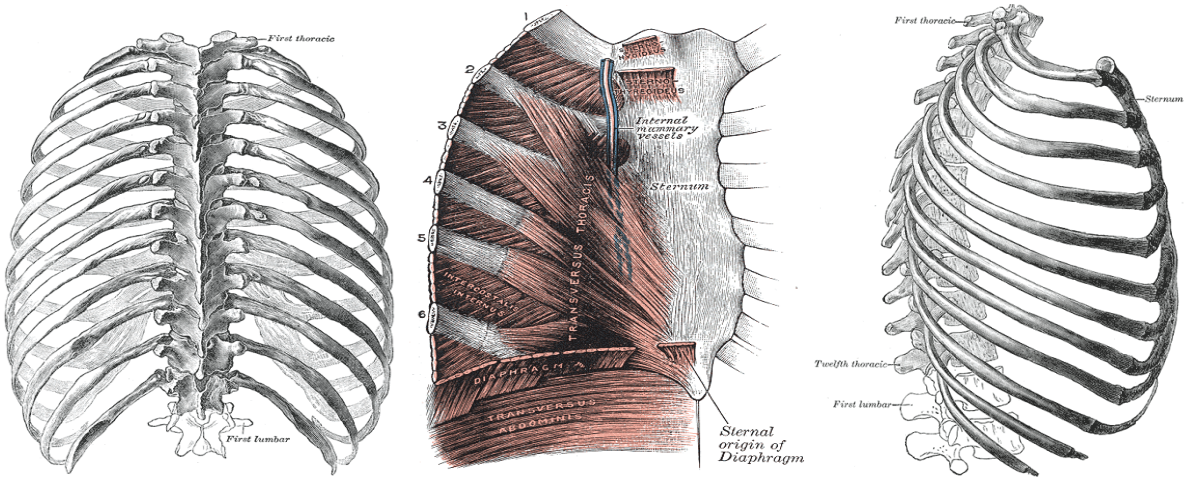
Various possibilities were measured, although the result equals a numeric 4 in each row. The sound would differ in each one of the rows.

The micro component of a sound fragment includes a mezzo and macro components. Thus if we had to increase the micro component the mezzo and macro components would differ. Similarly if we had to increase the mezzo component both micro and macro components would differ and if we had to increase the macro component both the micro and mezzo would differ. Each instant proves that each environment is inter-dependant on each other.
This exercise played an important role in the deployment and positioning of the speakers in the final instance.

# 10 --- ΘΩΡΑΞ

**a --- Origin**

**About the human thorax-**The human **thorax** extends from the head to the diaphragm the skeleton of the **thorax** or **chest** is an osseo-cartilaginous cage, containing and protecting the principal organs of respiration and circulation. It is conical in shape, being narrow above and broad below, flattened from before backward, and longer behind than in front.




**The diagram above shows us the histology and muscular dispersal of the thorax. Figure 7**

The ΘΩΡΑΞ is a spherical structure whose function it is to centralize the senses we could refer to it as an encephalic center were mechanical and cellular meet. It is a performance space which was designed for the performance of ΑΛΘ=Φ
The ΘΩΡΑΞ is not a psychological cross section of self-analysis but is a collective space that encompasses society as a whole.
Drawing a triangle from the base of the diaphragm to the tip of the skull in a human body and create 14 asymmetric spheres with a central axis not extending beyond the parameters of the triangle we develop the ΘΩΡΑΞ.

**b --- Construction**

The structural representation and mechanics of ΘΩΡΑΞ are as follows

**Dimensions:**

Length = 20meters
Width = 20meters
Height = 23meters

**Metal ring structure:**

14 metal rings of different angular placements in space with a radius of 20meters in diameter, supportive crossbars will be used to enhanced stability of the structure.

**Floor:**

An elevated surface cut to the size of the bottom metal ring
Floor = Diaphragm

**Top circle:**

The top circle represents and tips the skull. This circle is closed not allowing sound to escape.

**YMHN [membrane] to cover the ΘΩΡΑΞ:**

Fibre must consist of at least 50% rubber and 50% synthetic material a petroleum by-product

Fiber = Muscle

**About nature of structure and fibre:**

The circular shape of ΘΩΡΑΞ allows sound waves to move in a circular manner within the space.

The nature of the semi synthetic fibre is to reduce the weight of the material the fibre needs to offer some elasticity where sound is absorbed at a particular height but then released a few meters further up the structure were the structure like the function of the thorax allows for elasticity due to muscular contraction to occur thus increasing the pressure of air released from the lungs through the vocal chords and also affecting the duration of sound produced versus the lung capacity. In the case of ΘΩΡΑΞ the capacity of sound produced in the space as sound energy will vary in intensity that will be directly related to air pressure dispersion and combustion [as more molecules collide at a given time in a given space pressure will increase]

**Public seating and space layout in ΘΩΡΑΞ:**

- 50 people per performance are allowed in the performing space.
- The public is allowed to move through the space during a performance.
- All entrances and exits will be closed during a performance.
- The space will have no formal seating available.
- A few benches positioned in and amongst the partitionings in the space.
- Poles with speaker monitor attachments will be present.
- In ***figure 8*** HSDF, ISDF, OSDF will be clearly marked on the floor for the public to see were the field spatialization of the sound will be.
- The space will mainly be in the dark except for slight light illumination on the sides of the structure extending up the cone that will be manipulated by the lighting technician.

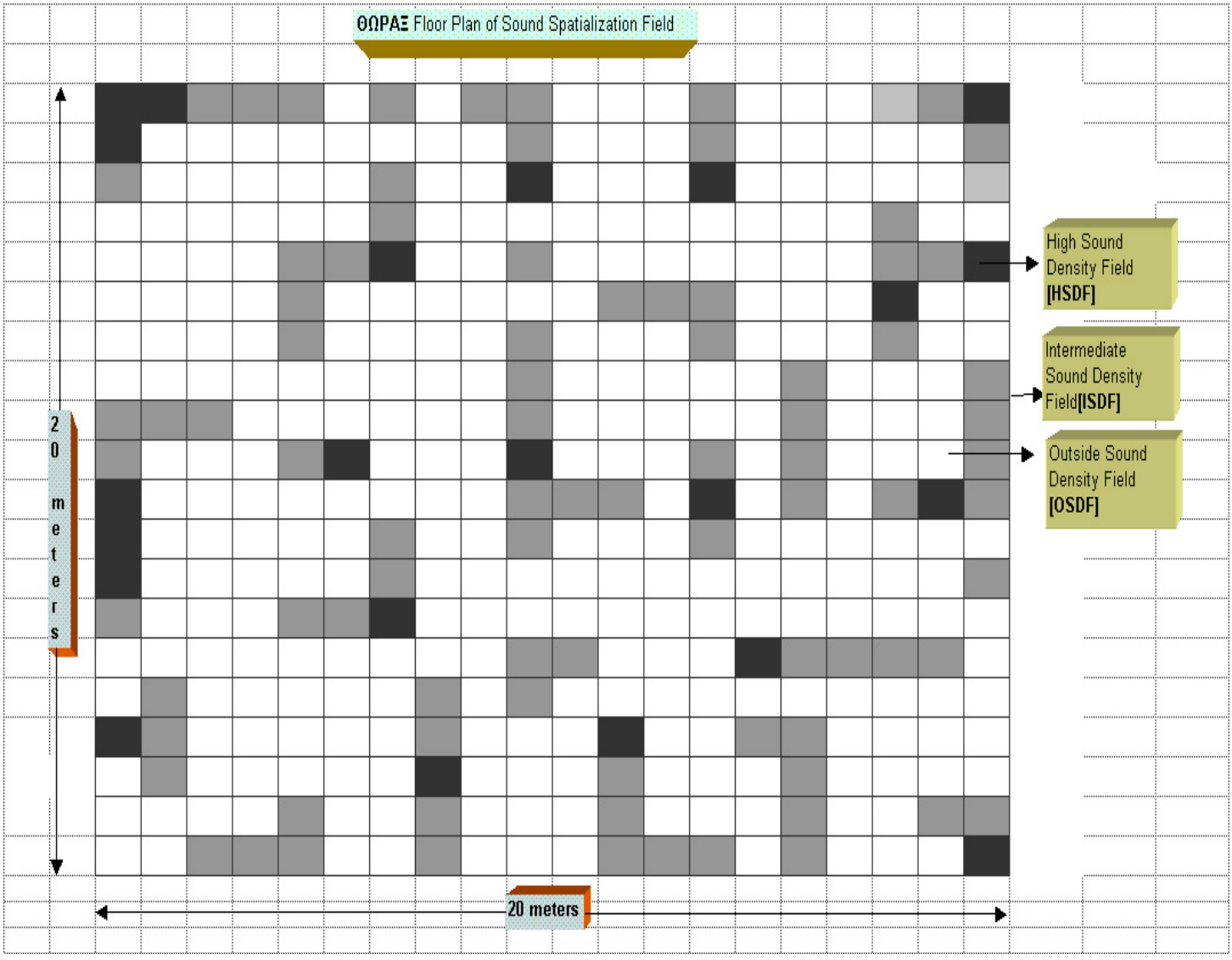

ΘΩΡΑΞ Floor Plan of Sound Spatialization Field
High Sound Density Field [HSDF]
Intermediate Sound Density Field[ISDF]
Outside Sound Density Field [OSDF]
20 meters
20 meters

***Figure 8***

**Deployment of robots:**

In ΘΩΡΑΞ the ground plan for the deployment of the robots is conducted by means of a network, shown in *figure 9*

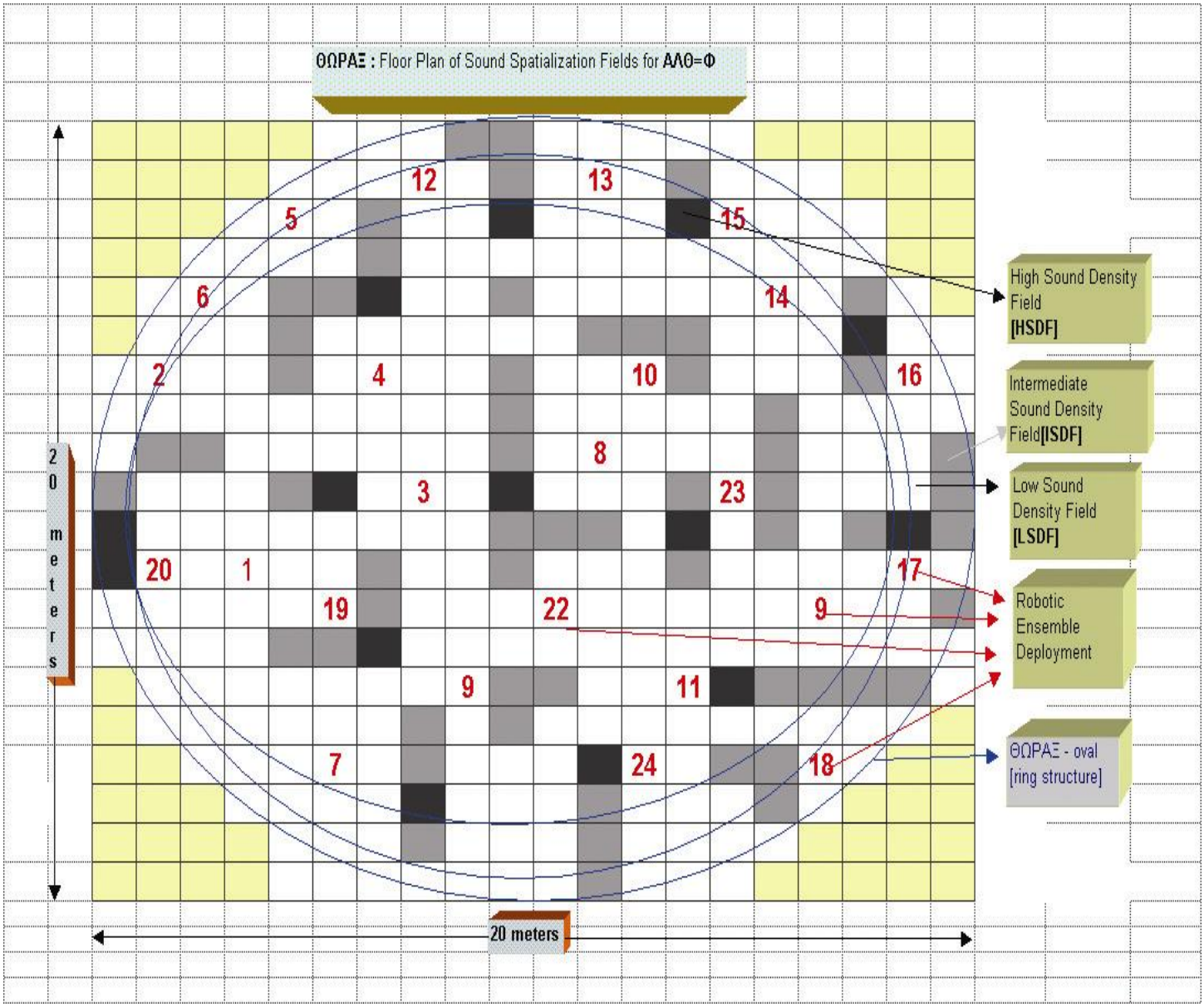



***Figure 9***