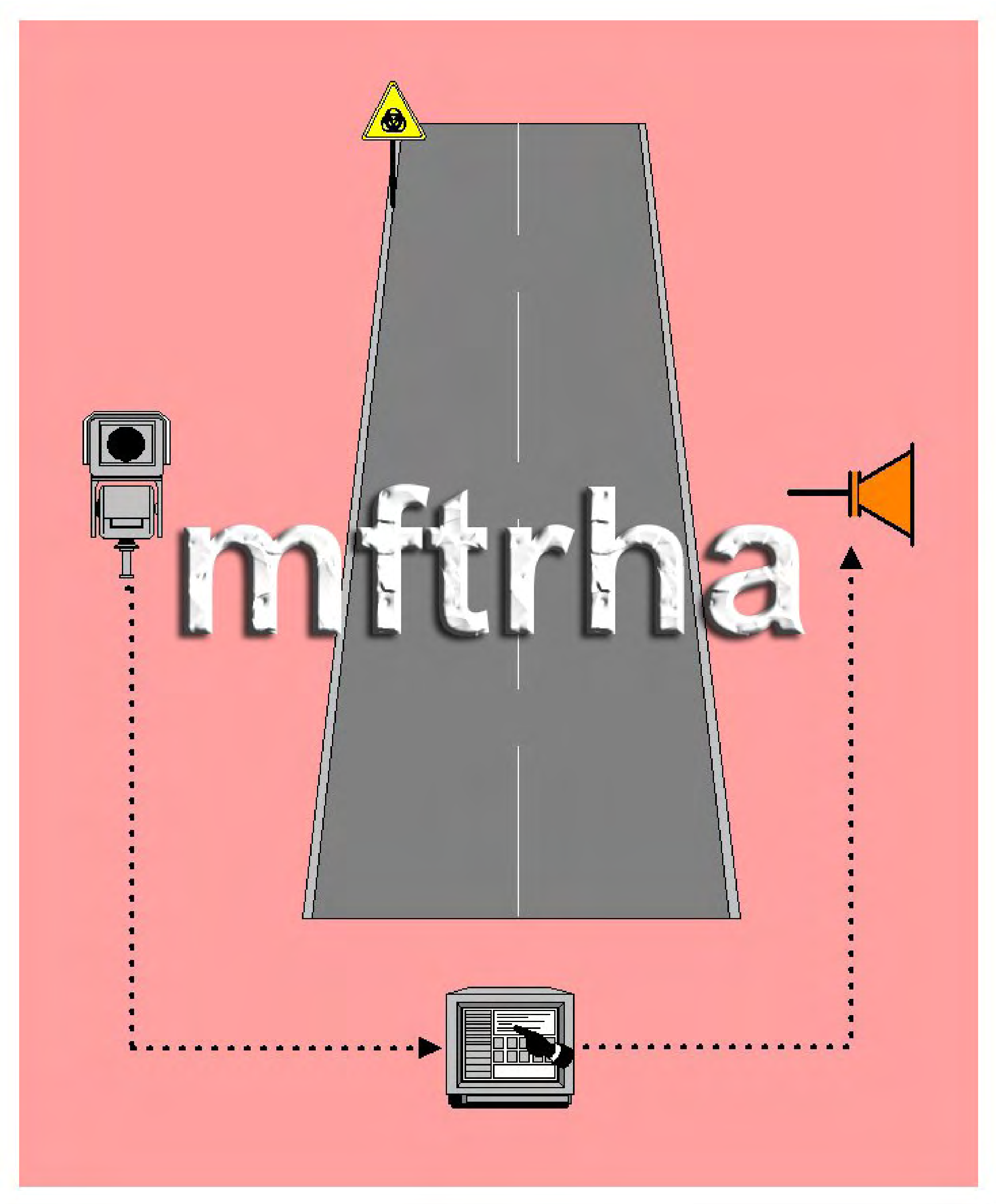
mftrha

Composer/researcher:

Dimitri Voudouris

Composed:

[2011-2013]

Duration:

23 min 25 sec

Composition:

mftrah

for:

Text to speech and singing (TTSS) synthesis

4 female, 3 male, 2 children voices

with

Pseudo environments mimicking (TTSS)

Created with the use of
Computer assisted processing

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Examining behaviour of traffic in a uni-directional (2) - (1) - (2) - (3) lane system flow:

mftrah [Golden Highway / N1 – Interchange]
Date- 03 March – 26 April 2011
Time – 19h00 – 20h00 and 05h00 – 06h30
Weather – clear and dark.
Speed, overtaking and change of lanes caused by vehicle traffic during non-peak hour in uni-directional traffic flow.

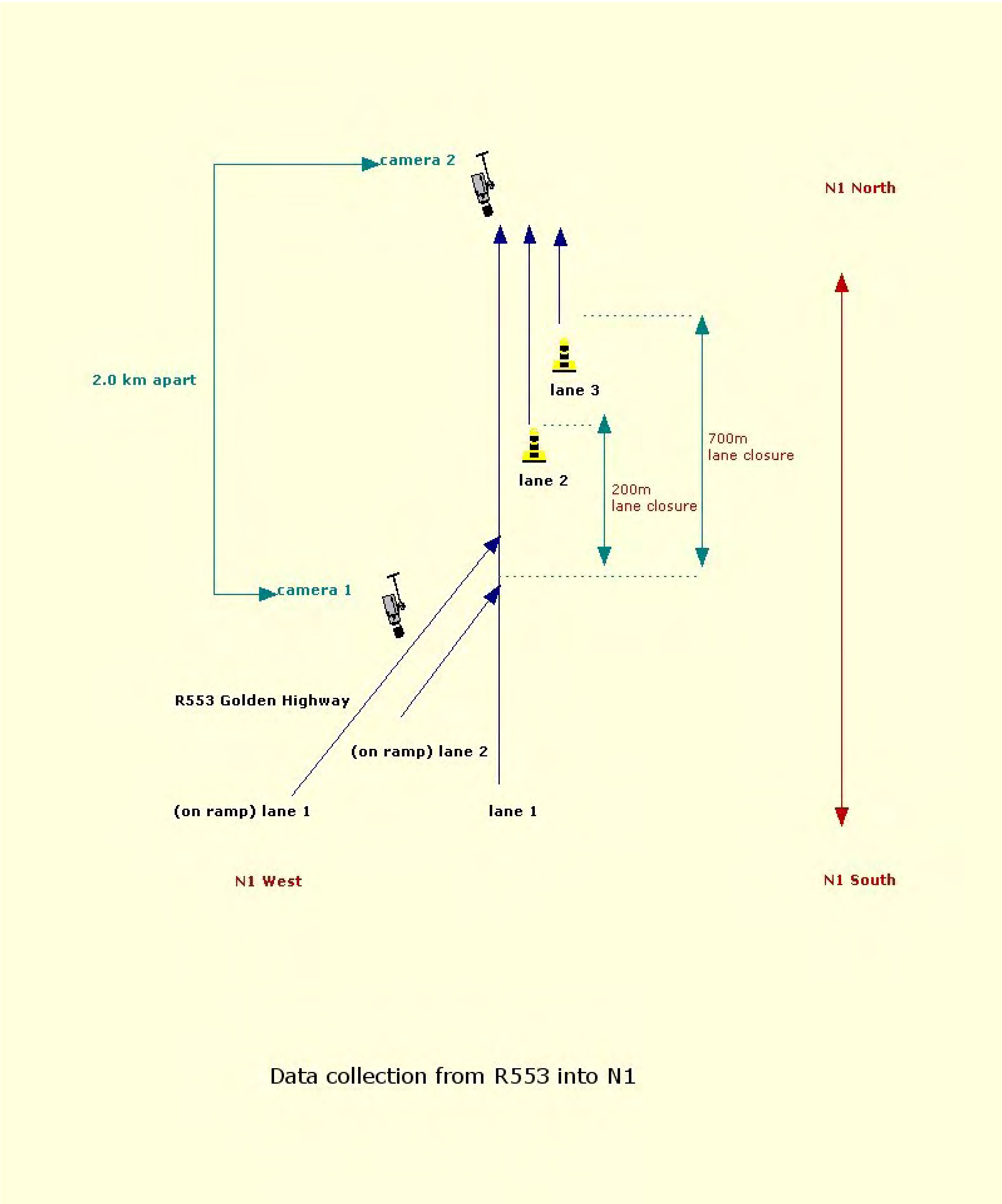


Fig: 1

Analysing / Processing data from vehicle traffic behaviour patterns

1] Graphically plot the data obtained from motor vehicle kinematic behaviour 03-26 March 2011.

2a] Isolate specific groups of vehicles travelling at specific speeds [noted acceleration and deceleration e.g. **Gr1** - *40-60km/h*, **Gr2** - *60-80km/h*, **Gr3** – *80-100km/h*, **Gr4** - *100-120km/h*, **Gr5** - *120-140km/h*].

2b] Lane changes rules relies on two main criteria - (1) the *incentive criterion:* the need or not to change lanes in order to reach one's maximum speed faster and optimise one's travel time; and (2) the *security criterion:* the possibility to change lanes if there is enough space in the target lane. A vehicle changes lane/s if there is another vehicle ahead with a slower speed and if there is enough space ahead and behind to make this change of lane possible; the "ahead" factor is analysed with different approximations. The same method can be also applied to left and/or right lanes depending on national contexts and particularities.

Vehicle behaviour – post 19h00

*a] **Reduction of speed** (keeping within speed limit of the road) – 22.5% of vehicles:*

*b] **Increase of speed** – 77.5% of vehicles:*

I) Increase of speed in changing lanes and attaining maximum speed.
II) To reach destination faster.
III) The highway has less volume of vehicles; there is a tendency to increase travelling speed.

*c] **Lane changing probability** with as the frequency of lane changes increases, [the likelihood of a collision increases. This measure can be obtained from the total lane changes divided by the total traffic volume. This measure can be used to determine the consistency of traffic flow, by examining difference in the frequency of lane changes across scenarios]. Frequency of lane changes may vary according to geometric conditions (e.g. number of lanes and physical configuration of on and off ramps).*

These approaches are generally calibrated and validated using the typical density inversion phenomena that mainly represents the fact that traffic flow increases nearly linearly with density until it reaches a maximum at 40 vehicles/km/2 – 3 lanes, from there traffic flow then decreases with increasing density. In the context of cellular automata space is represented as a uniform grid in which vehicles take decision. Behaviour of a multi-lane traffic system is based on human decisions that are taken at different levels of granularity depending on human driver profiles. Using different levels of granularities in the cellular automata model and qualitative spatial reasoning, that is, different levels of spatial relationships between vehicles acting in a multi-lane environment. Traffic events are recognised and categorised from the analysis of video inputs. A given orientation between a car of reference and an external car is associated to a specific level of abstraction, and a particular transversal location of the car of reference within the circuit. These properties are denoted as follows: ***Fig 2*** The model is illustrated and calibrated through a prototype development based on the agent-based software ***StarLogo*** developed by the MIT media Lab.

The essential features of a given cellular automaton are:

a) Its *state*, which is an array of parameters function of time or not.
b) Its neighbourhood, defined by the presence or not of other cellular automata in the nearest cells.
c) Its behaviour, which is the set of rules that define its evolution at each time step. These rules are generally derived from its current state and neighbourhood.

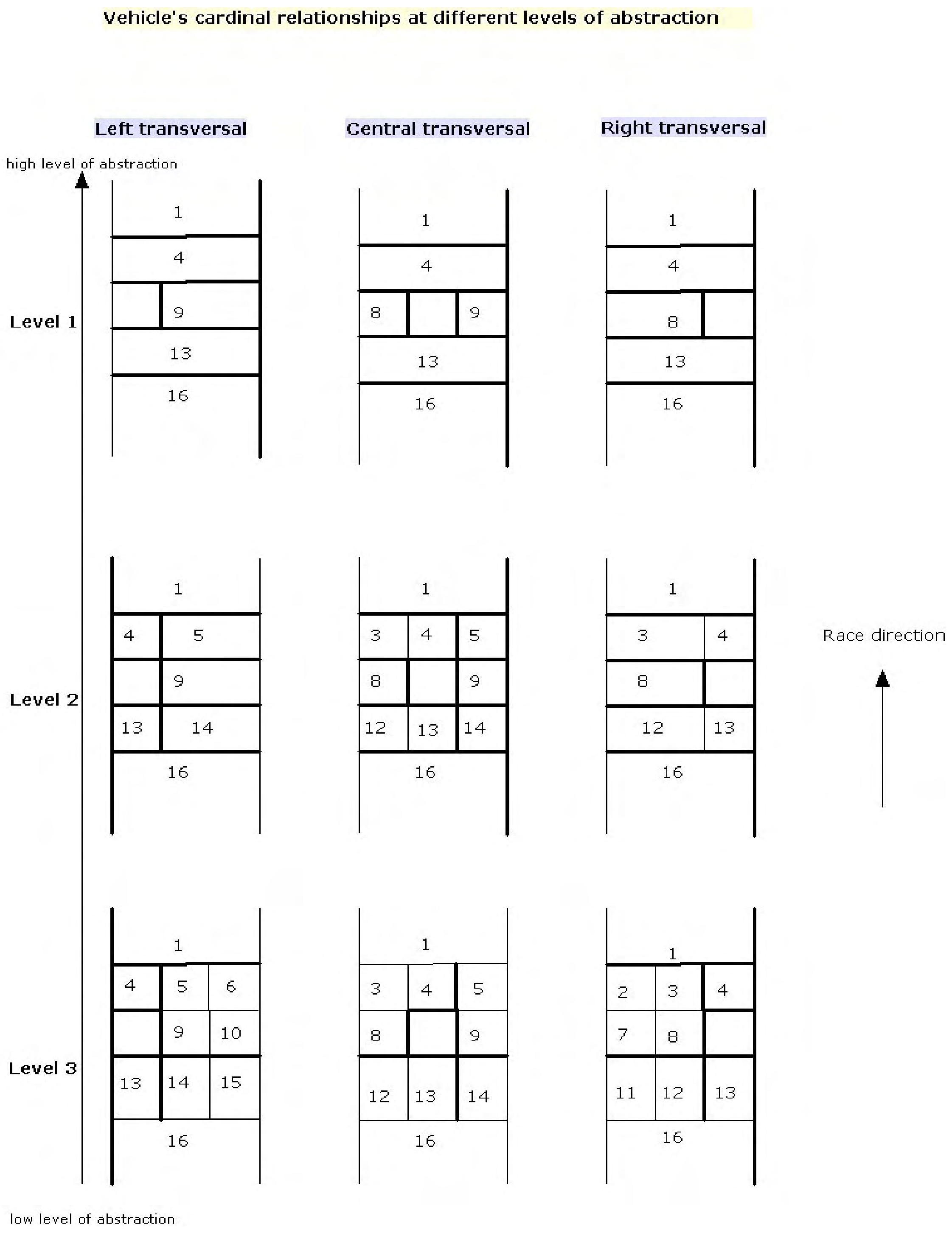


Fig 2

from Fig2 *:* ***1*** *Forward,* ***2*** *Exterior left in front,* ***3*** *Left in front,* ***4*** *In front,* ***5*** *Right in front,* ***6*** *Exterior right in front,* ***7*** *Exterior left,* ***8*** *Left,* ***9*** *Right,* ***10*** *Exterior right,* ***11*** *Exterior left behind,* ***12*** *Left behind,* ***13*** *Behind,* ***14*** *Right behind,* ***15*** *Exterior right behind,* ***16*** *Backward.*

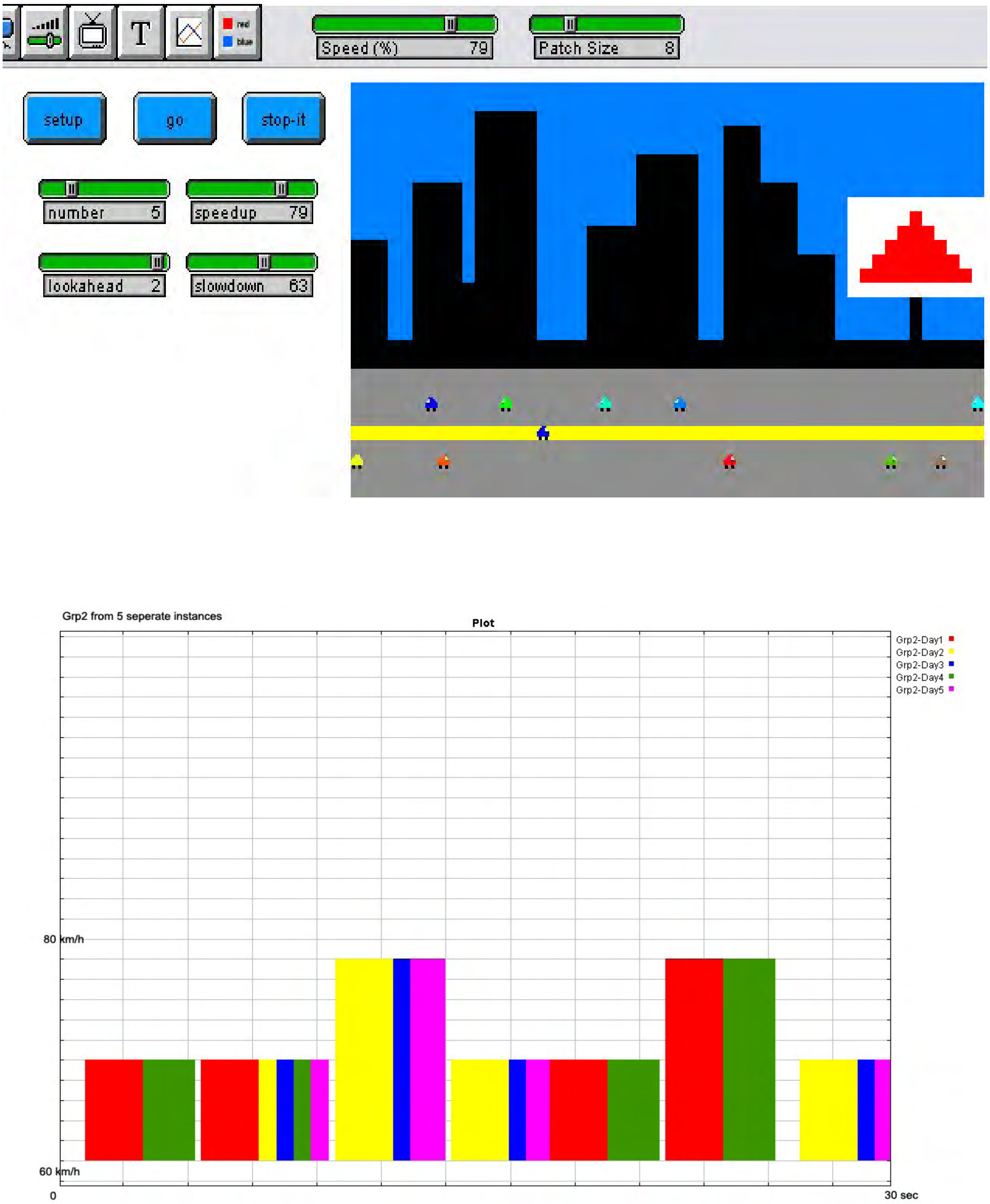


Fig 3 **- Simulation experiment interphase**

In ***StarLogo*** the simulation is interactive as the user can define several initial parameters such as the number of cars per lane, i.e., left and right and the global speed of the circuit that gives an overall speed to the simulation (***Fig 3***). The latter parameter allows us in fact to interactively change the speed of the simulation. The simulation interface is divided into a control window and a graphic window. The control window supports the initialisation of the simulation while the graphic window provides the continuous visualisation of the progression of the simulation and the cars' behaviour within the circuit. The following figure presents the layout of the circuit used for prototyping purposes R553 – camera 1, N1 north – camera 2 circuits are represented as a perpetual uni-directional Hi-way, that are cycles: cars that disappear at the left reappear at the right. The small square patches denote vehicles in the circuit. The figure below presents a typical simulation with 5 cars left, 5 cars right and circuits that support “high speeds”. Each car is initialised with a random speed limit giving then different individual speed behaviours within the circuit. Several monitors that indicate the number of vehicles that have reached their speed limit, and the total number of overtaking events over time control the overall behaviour of the environment. The controls give an assessment of the circuits' behaviour over time. The lower the number of vehicles, the more likely the circuit will reach an equilibrium state over a short period of time. The circuit presented on (***Fig 3***) is a snapshot of the initial circuit state after several overtaking decisions. A typical overtaking example is illustrated by the following two simulation sequences. (***Fig 4***) illustrates a single overtaking event that involves two cars involved (open overtaking choice) and an overtaking event with three cars involved (constrained overtaking choice).

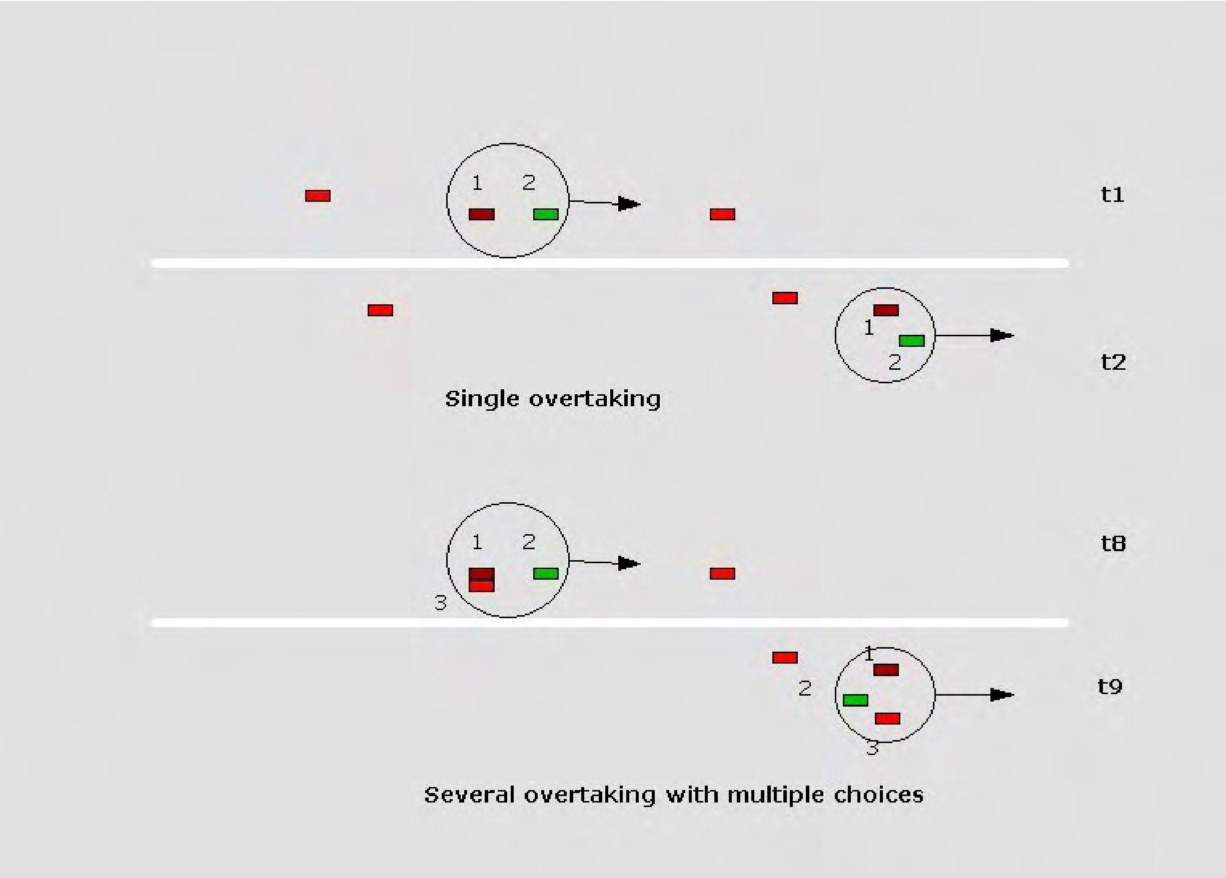


Fig 4 **– Overtaking**

The prototype provides an illustration of the benefits of spatial reasoning and an interactive interface to interactively simulate the behaviour of the represented system, using several initial conditions and different levels of abstraction.

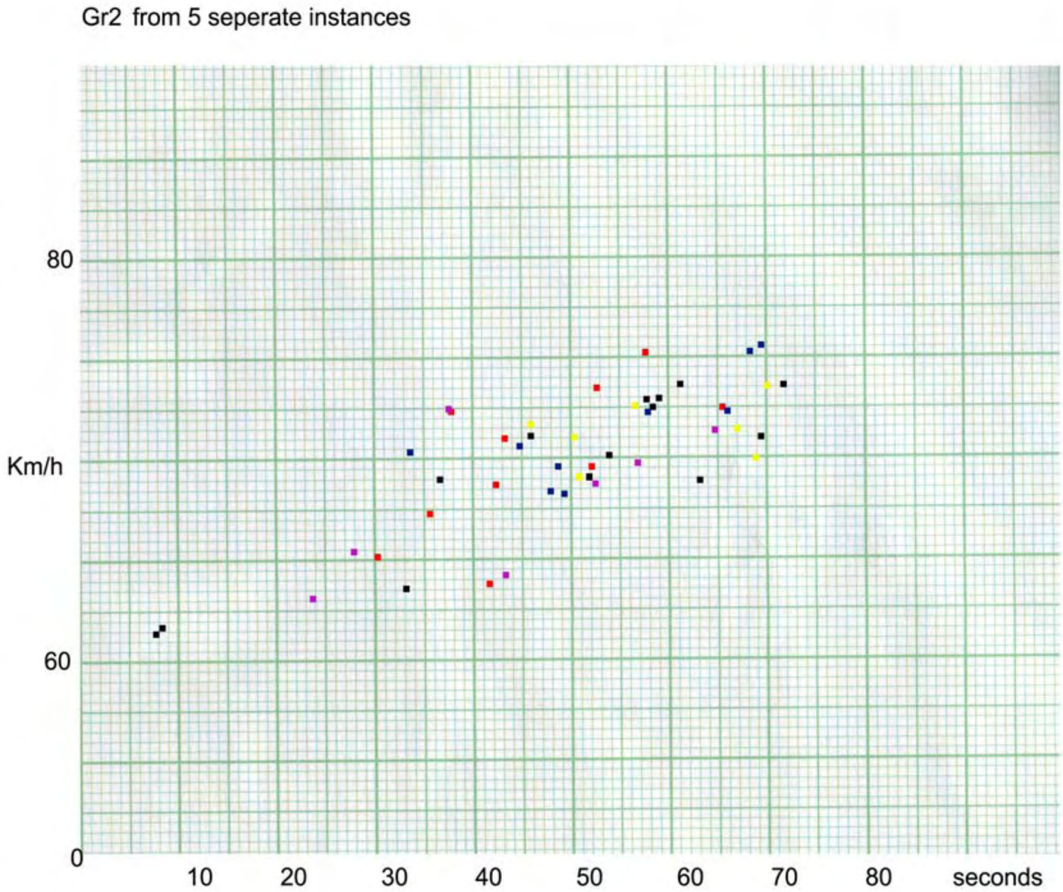

Gr2 from 5 seperate instances
80
Km/h
60
0
10
20
30
40
50
60
70
80
seconds

Fig 5

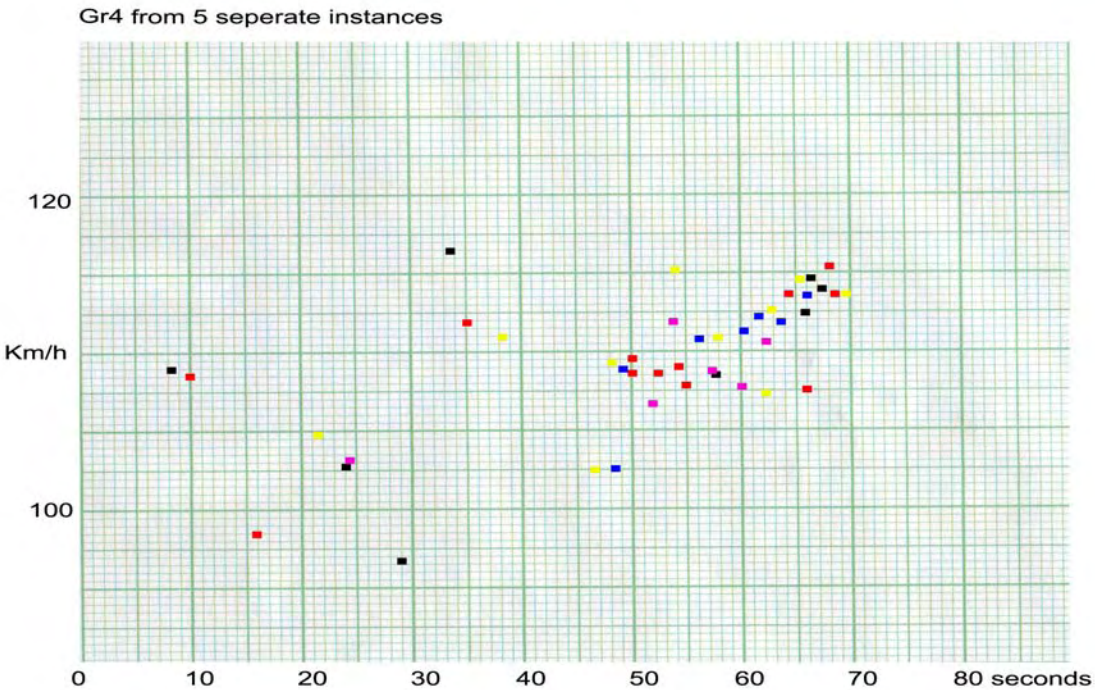

Gr4 from 5 seperate instances
120
Km/h
100
0
10
20
30
40
50
60
70
80 seconds

Fig 6

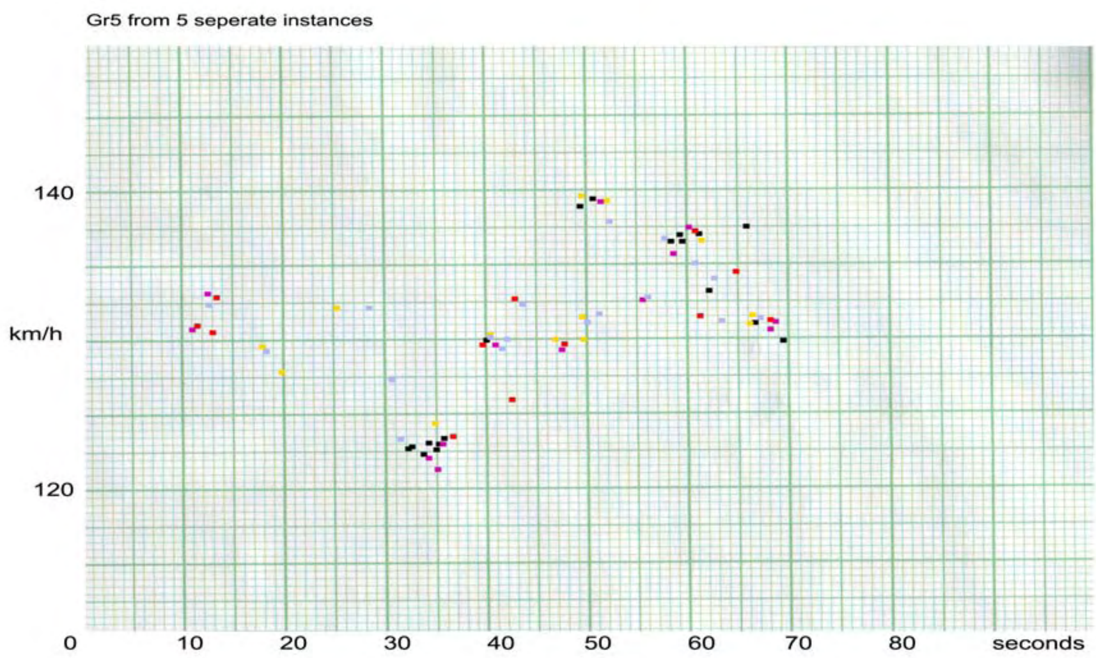


Fig 7

Field recordings were observed and data was analysed with respect to manoeuvrability. Between five and eight field recordings of data were selected per Group at various time intervals, representing between 30 - 70 seconds of information that was captured selected and used. Plotting graphs on transparencies, [5 to 8 transparencies of each specific group] super imposed on one another, this enabled for selections to be isolated and grouped according to there behavioural patterns [within each grouping there exist variations between data that have a domineering effect over other data both in the specific location of numbers that would allow for a greater volume or an accumulative selection of utterances depending on the location and position. Effect on note velocity [related to individual vehicle speed], allows for repetition of vocal phrase/s or sustained vocal utterances, vehicle velocity and the changing of lanes [with alteration in vocal selection and utterances] at a specific point in the group.

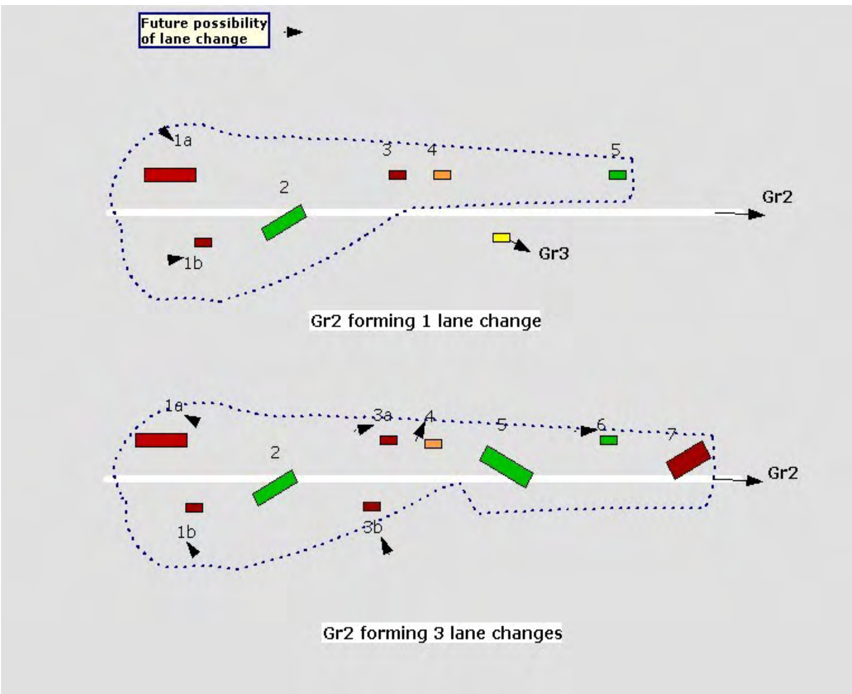


Fig 8 - lane changes on overtaking with various choices

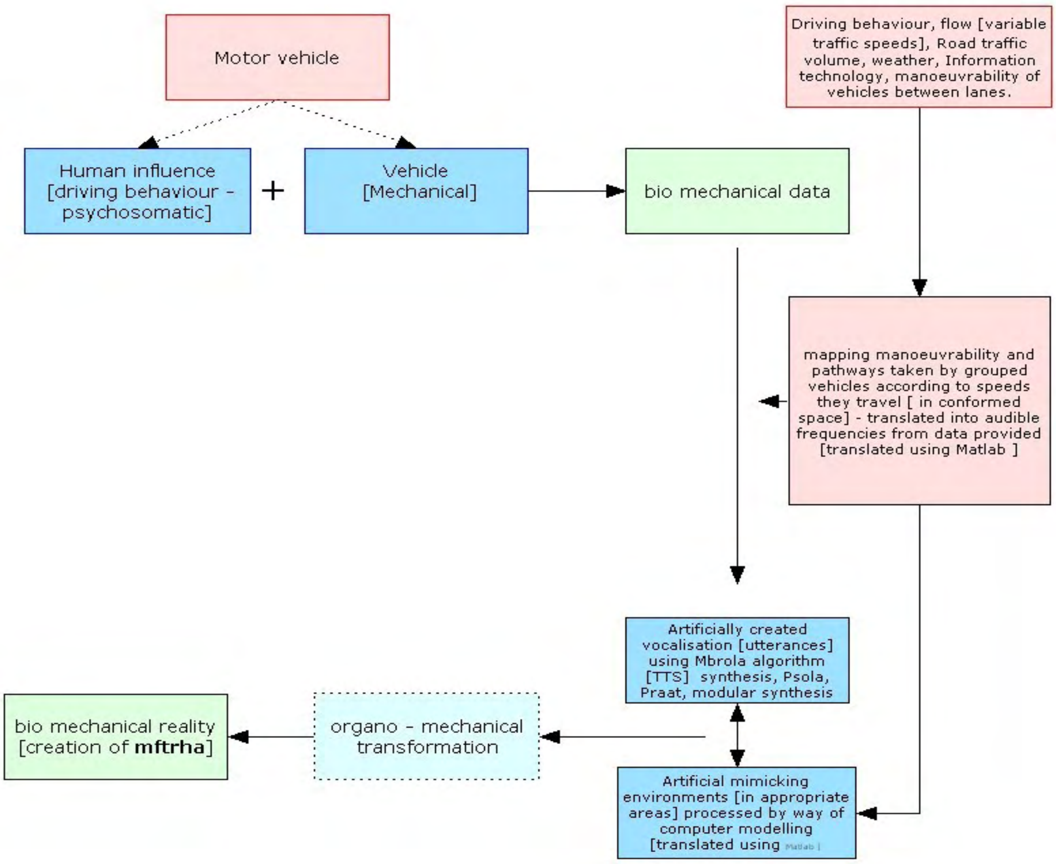
Composition:

Biomechanical principals are a primary approach in addressing the some how difficult issues in *phono*kinetic behaviour.

Multiphase programming with fixed number of tasks [***mft***]:

1] Voices constructed with the use of speech and singing synthesis.
2] Programming voices to conform to the various travelling - speed / velocities, cluster formations attained from vehicle data.
3] Random order probability - alteration in selection of voice/s and phonetic verbalisations subjected to lane changing.
4] Pseudo - environments processed by way of computer modelling were used as a path or code of communication [Hindi term - ***rah*** or path].

Kinematic behaviour of traffic was applied to methods of vocalisation and singing synthesis. First creating vocal positioning and kinetic mobility by converting the relevant data mathematically through the use of Matlab and then using Mbrola, Praat, Psola and modular synthesis to produce the desired vocalisation .In the process of constructing vocalisation the use of various voices to create word formations and utterances resulted in: 1] Various vocal alterations which were assigned to different pathways. 2] Construction of suitable background environment/s. 3] Voices that would work well together kinetically [as in cluster- platoon formation].



Graphic bio mechanical construction of *mftrha*

Fig 9

Each group would have variations of speeds in lane changing. E.g.Gr2 recorded five such instances
s = straight line, lane chg = lane change.

Recorder by camera 1+2 [4, 5, 6 March 2012]

Gr2

Vehicle	V1		V2		V3		V4		V5	
	s	lane chg	s	lane chg	s	lane chg	s	lane chg	s	lane chg
km/h	65	74	63	62	66	70	69	73	72	78

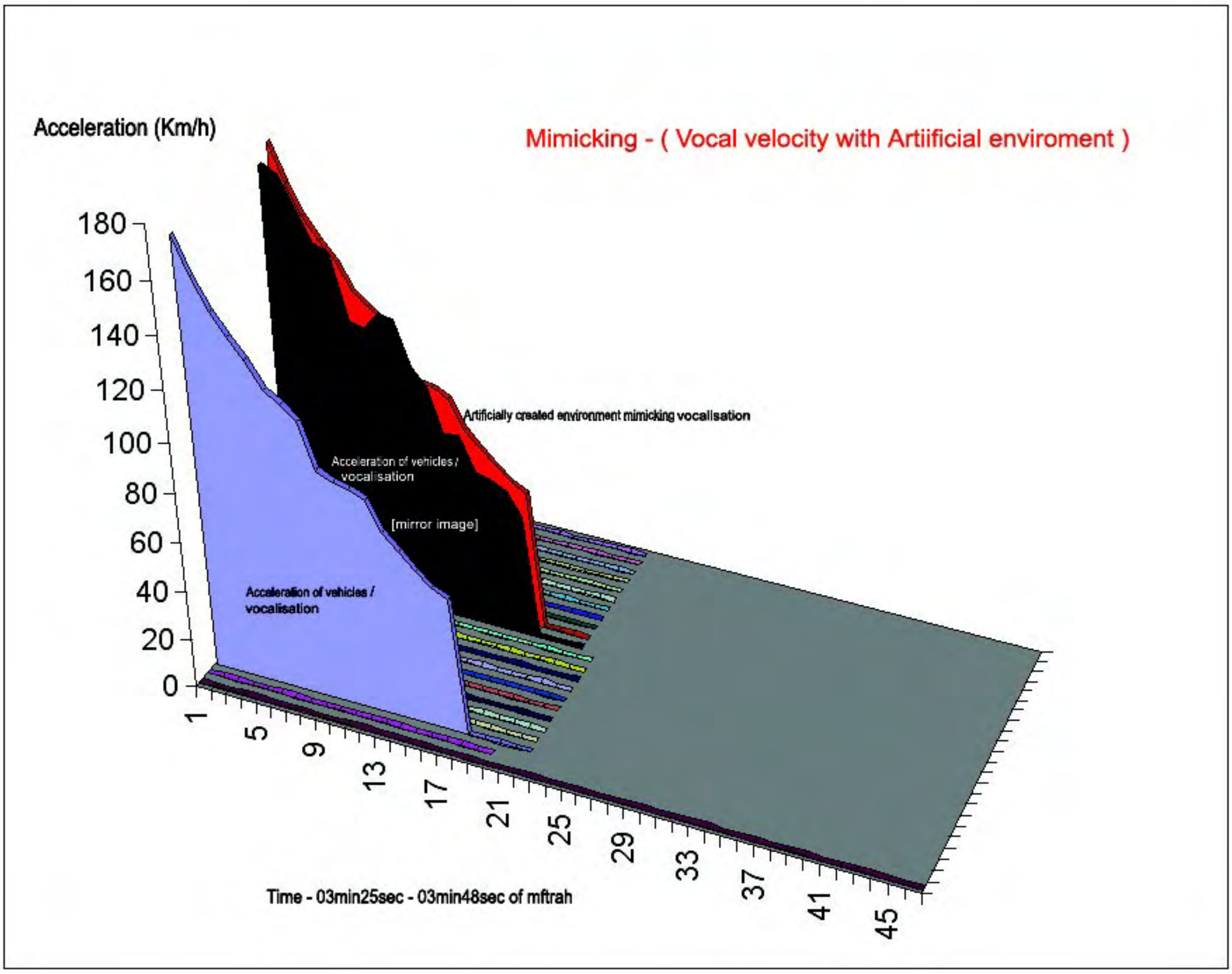


Fig 10

The variations in speed of vehicles both within a group and per group enabled the synthesis of various voice utterances and dynamics by using singing and speech synthesis within the frequency spectrum attained from vehicles in motion.

Expressive means (utterances)

The expressive means of a language are those phonetic means, morphological forms, means of word building, and lexical, phraseological and syntactic forms, all of which function in the language for the emotional or logical intensification of an utterance. The most powerful expressive means of any language are phonetic .The human voice can indicate subtle nuances of meaning that no other means can attain. Pitch, melody, stress, pausation, drawing out certain syllables, whispering, a sing song manner of speech and other ways of using the voice are more effective than any other means in intensifying an utterance emotionally or logically.
The utterances were presented in (monologue) and (dialogue) speech / singing synthesis. Syntactic patterns achieve a particular degree of expressiveness by means of using more or less stylistically marked lexis. Unlike in natural voice the emotive behaviour of children and woman was more intensified as opposed to man in digital synthesis and in artificial voice creation emotive nature of utterances was equal and needed phonetic and modular synthesis in the voice to equally attain the expression that utterances have, so that they can psychologically be recognised to be equal or more intensified to the listener.

.

Constructing vocal ranges

Speech and singing synthesis in male, female and child range was chosen to cover between 80Hz to 1100 Hz (E2 to C6) *Mimicking* environments would be constructed outside the parameters of the voice spectrum.

Groups depending on variations of speed	Data Notation spectrum
Gr1	C7- C≠6
Gr2	C≠6 -D≠5
Gr3	D≠5 – E4
Gr4	E4 – F3
Gr5	F3 - A≠2

Fig 11

Number of superimposed vehicles affecting vocal volume within group	Data Dynamic spectrum
5	100-120 db
4	80 – 100 db
3	45 – 80 db
2	35 – 45 db
1	0 – 35 db

Fig 11

Phonokinesis, determining the velocity of voice

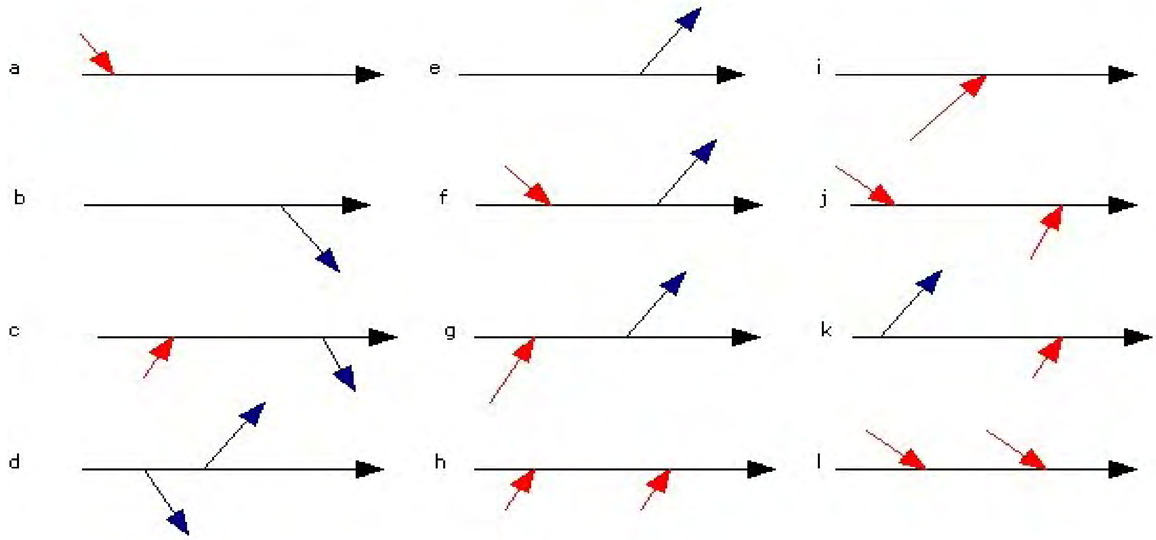
The use of glissandi would depend on the sequential directional behaviour of one or more vehicles in a specific group or in a number of groups determined by straight line ahead and changing of lane flow**.** The graphic representation of vehicle behaviour is replaced by utterances or sound points, which are in reality a particular case of sound of continuous variation .The uniformly continuous glissando, can be assimilated into the mathematical concept of speed.

$$f(v)=\frac{2}{a\sqrt{\pi}}e^{-v^2/a^2}$$

The macroscopic distribution is a modulation of sonic material in which: *a] The duration do not vary, b] The mass of the pitches is freely modulated, c] The density of sound/s at each moment is constant, d] The dynamic is pp – ff, e] The timbre is constant, f] The speeds determine a "temperature" which is subject to local fluctuations.* The distributions is Gaussian

$$r=\sum(x-\bar{x})(y-\bar{y})/\sqrt{\sum(x-\bar{x})^2}\sqrt{\sum(y-\bar{y})^2}$$

A glissando towards higher frequency can be defined as positive, towards lower frequencies as negative.



A variety of possibilities in vehicle behaviour
possible vocal glissandi formations

Fig 12

Phonokinetic behaviour has to do with the functionality of note velocity that is determined by the behaviour of cluster formations e.g. Note velocity increases < at a rate equal to the sum of travelling speed of vehicles [on *addition* of one or more vehicles in a specific group or variety of groups] incorporated into the selected predetermined pathway]. Note velocity would equally decrease > at a rate equal to the sum of travelling speed of vehicles [with *elimination or subtraction* of one or more vehicles in a specific group or variety of groups] from the selected predetermined pathway. [Glissandi occur if predetermined distance between vehicles occurs: ∆ [predetermined distance between vehicles] = the value of x. The value of x is constant.

The morphological change of voice would be determined by -

1] Existing variations of data that would either have a domineering effect over other data both in the specific location of numbers that would allow for a greater volume.
2] An accumulative selection of utterances depends on the location and position.
3] Effect on note velocity allowing for either repetition or a sustained vocal utterance.

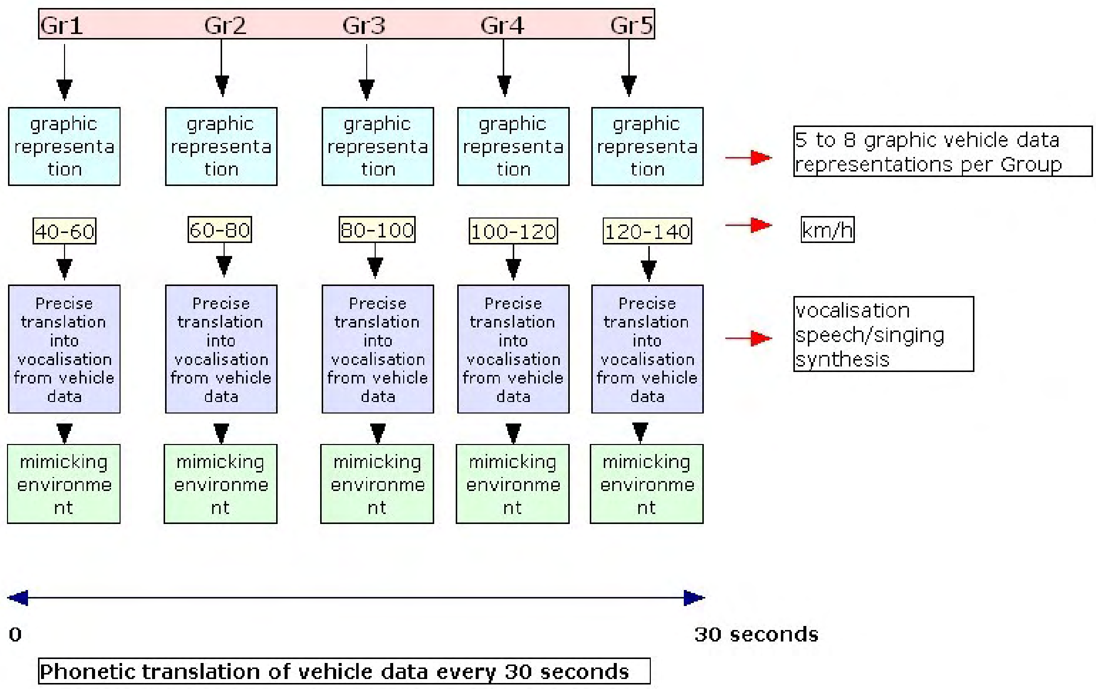


Fig 13

Vehicle speeds were captured between camera 1 and 2 on 5 to 8 separate instances [At various times within a day or on separate days - each instance is represented graphically] and were organised in each of the 5 groups [40-140km/h] per 30 -70 second time duration (***fig 13***).

mftrah incorporated both [*flow-based*] macro and [*vehicle based*] microenvironments. Pseudo environments created by computer modelling, these are applications of formants to the sound spectrum of vocalisation. They are then mapped and partially rearranged in precise time durations, to mimic the voices.

Spacial Diffusion of *mftrha* for 8-speaker diffusion

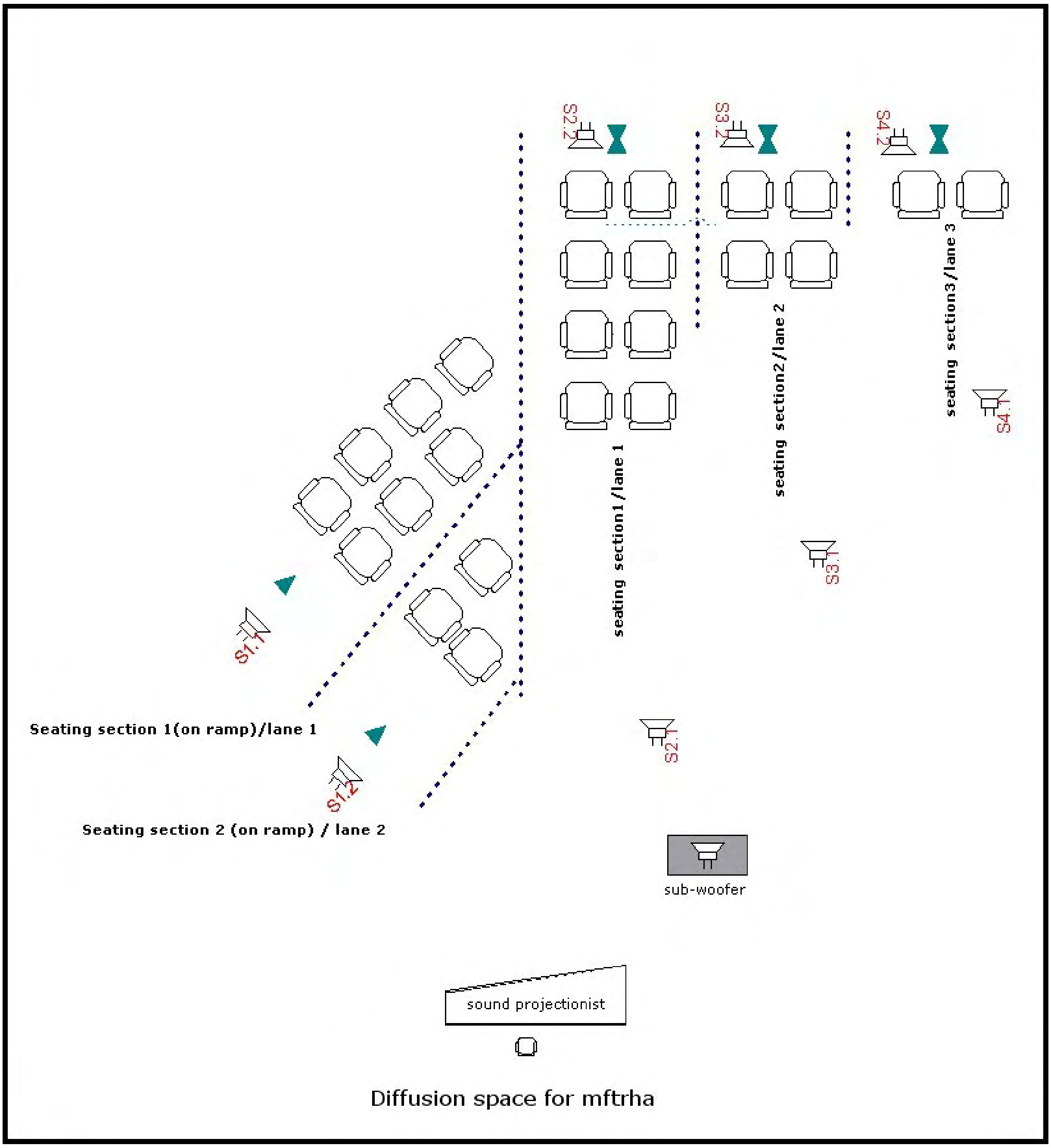


Fig 14

1] 8 active speaker monitors and subwoofer.
2] Performed in total darkness.
3] Seating plan should strictly remain unchanged, only the speakers could be changed according to the sound acoustics of the space.

References:

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4] JUN MIURA, MOTOKUNI ITO, and YOSHIAKI SHIRA - A three-level control architecture for autonomous vehicle driving in a dynamic and uncertain traffic environment. In ITS, pages 706–711, Boston, MA, 1997.

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