

## **i-SWING**

- Toyota's fourth personal mobility concept, following p.o.d., PM and i-unit
- More direct human-machine interaction, using latest robotics technologies
- Minimalist exterior shape with detachable panels give high customisation possibilities
- Artificial Intelligence system learns driver's behaviour
- Driver and vehicle can keep in constant contact through mobile telephone or personal computer

While striving for technological advances and innovations, Toyota seeks to expand personal mobility opportunities, based on people's changing lifestyles and values.

The p.o.d., shown in 2001, was a vehicle that could express different emotions, like a member of the family or friend. It showed how, by using information technology, vehicles could take on human-like characteristics and learning abilities. Following the PM in 2003, Toyota exhibited the i-unit at Expo 2005 in Japan, a concept that used the least amount of energy required to transport one person, giving both freedom of movement and strong environmental performance.

The latest in Toyota's series of personal mobility vehicles is the i-swing. With a small, flexible body, it can easily be stored at home; it gives excellent freedom of movement; and it can be changed in appearance to suit personal taste, almost like a clothes outfit. With two-way communication through a range of advanced devices, it has capabilities that are far more advanced than conventional vehicles to promote individual expression and social interaction.

### **Product concept**

The i-swing is Toyota's proposal for a new form of mobility based on more direct human-vehicle interaction. Using robotics technologies, it goes beyond the conventional view of a car as a means of transport to open up a whole new range of possibilities for self-expression.

### **Exterior design**

The vehicle body – which feels more like you are wearing it than riding in it – is styled less like a car and more like a living form. When seated in the i-swing's "minimum-size open-face body", the occupant's eye level is about the same as when standing, which means you can converse easily with anyone you meet along the way. The body is made of shock-absorbing, low-rebound polyurethane, with some sections partly covered in fabric.

### **Customisation**

The fabric sections on the exterior can be detached and changed, allowing the i-swing to be customised to suit the season or personal taste. In addition the door on the front, which opens and closes in sections, and the triangular back panel have a built-in colour LED display matrix. The user can personalize the display by loading their own video or still images, co-ordinated to suit mood or time or place.

### **Driving dynamics**

The i-swing offers two driving modes: two-wheel or three-wheel. The two-wheel mode enables confident and safe driving when moving among people around town. Three-wheel mode gives the i-swing highly manoeuvrable performance when driven on the same roads as conventional traffic. Vehicle control changes according to the mode, to give the appropriate level of comfort and dynamic performance.

As a three-wheeler, i-swing is driven through the two rear wheels, with the front wheel used for steering. Under acceleration and deceleration, the entire vehicle body tilts backwards or forwards to change the centre of gravity as appropriate.

When turning left or right, the body tilts inwards, so that the pressure on the driver is always applied downwards, along the body axis

Normally a high centre of gravity, a short wheelbase and narrow track would make a vehicle like the i-swing difficult to handle, but the centre of gravity, the balance of weight on each wheel and the power are automatically controlled, much like the natural movement of the human body when running, turning and stopping. The result is excellent dynamic performance and a natural ride feel.

In three-wheel driving, the i-swing offers two operating modes to suit the driver's skill and purpose.

In Comfort mode, two linked joysticks are all that is needed to control the vehicle. Vehicle attitude (position of the centre of gravity), front wheel steering and left-right wheel power are adjusted simply by moving the joystick in the intended direction of travel.

Lifting the joystick diagonally forwards switches the i-swing to Active mode. The driver leans forwards for more agile movement with the vehicle – the feeling is not unlike skiing, with the driver adopting the best position in sequence for accelerating, braking and turning. In this mode, the sensitivity of the joystick is increased and foot pedals can be used to control vehicle attitude. With training, drivers can even develop their control skills to make the vehicle 'dance'.

In two-wheel mode, the front wheel stows away between the rear wheels and a gyrosensor provides inverted control. The driver can switch to this mode when the i-swing is stationary, or moving at low speed. In three-wheel mode, operating the joystick moves the i-swing forwards or backwards, in the same direction as the centre of gravity. Turns are achieved through the different rotational speed of the left and right rear wheels.

As the driver's head is located centrally in respect to the vehicle axle, turning on the spot feels like a completely natural movement, just like turning your own body around. When stationary, the controller maintains the centre of gravity above the centre of the vehicle axle, so even if the driver shifts position, the vehicle will remain in place. The driver's posture also remains constant, even when the vehicle is travelling up or down gradients.

When two i-swings are brought together, they can travel side by side, with one becoming the master vehicle. Joystick inputs from the master are transmitted through short-range communications to the second vehicle, which then responds in the same way, giving perfect co-ordination of movement.

### **Artificial Intelligence communications**

The i-swing uses AI (Artificial Intelligence) technology to communicate with the driver. This takes the form of a virtual character which appears in pop-up displays at left and right shoulder level and which changes according to the driver's personality. Even after leaving the vehicle, the driver can remain linked to it via a mobile telephone or personal computer.

AI lets the vehicle learn the driver's behaviour patterns and provide the right information at the right time and place, sourced from its memory or the Internet.

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