futurelab

Welcome to the Neighbourhood **Space Signpost**

A project that makes space science accessible to everyone

"If we do discover a complete theory, it should be understandable in broad principle by everyone, not just a few scientists. Then we shall all be able to take part in the discussion of why it is that we and the universe exist."

Stephen Hawking

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Overview

Bringing space home

This project was born out of the desire to enable people – ordinary people going about their everyday lives – to feel part of space, or rather, feel that space is part of their lives just as much as their workplaces or classrooms, cities, towns or villages.

With the launch of the first Space Signpost, in Millennium Square in Bristol, browsers have the opportunity to chart their own paths through the cosmos. They can bring the solar system closer to home with real-time information and easily understandable analogies that compare life on other planets to that on Earth, all available via a touch-screen interface.

The first thing they will see on crossing the square is an actual signpost; a mechanised version of the static ones you see at tourist attractions, only with the power to reveal the cosmos, not just the location of Beijing or San Francisco. A moving arm which rotates in response to their questions, which they ask via a touch-screen interface in front of the signpost: 'How far am I from Mars?' 'Which way to Venus?' Users will generate their own enquiries – rather than being led on a pre-determined path – and the signpost will swivel to show the direction in which their chosen planet lies at that precise time, the exact distance to it, and how fast it is moving.

You can take as much or as little from the signposts as you wish. The data is displayed on an LED screen along the arm but, if you want more information, you can take a tour on screen and may be delighted to find, for example, that you would weigh approximately three times less on Mars!

Thus a bridge is built between people and their cosmos, and it is hoped that from one installation in Bristol, there will eventually be many more, in city centres and public spaces, in schools and science centres, and even at airports and on cruise ships.

We wanted to make space more immediate for people – it's right here and right now!

Context

Where science, art and education meet

People always think space is 'up' but actually it's all around us

The Space Signpost project was conceived at the point where science meets art, as a series of proposed space sculptures – visual representations of the cosmos set in perpetual motion to accurately reflect the interactions of the planets. They were intended to bridge the gap between Earth and space and to make people more conscious of the space they themselves inhabit.

When the project was adopted by Futurelab in 2003, under the original name of Welcome to the Neighbourhood, it took on a new dimension – to inspire people to want to learn more about space – and so it grew to encompass:

- **the physical signposts with their built-in interfaces** – which had to be practical, evocative and easy to use
- **celestial dynamics** – the data and programming that calculates the real-time distances, directions and visualisations of the planets
- **the interface** – the touch-screen program to take users on a virtual tour of space.

As the sculptures evolved into a science communication project, we held true to the original concept of bringing the cosmos into people's lives within a public arena. By including the touch-screen interface, the project also gained the power to take people on a more extensive journey, which they themselves could define.

Behind the complex programming and mechanics lay a very simple ambition – to create an educational tool that played rather than preached.

Crucial to Adam Nieman, project leader and specialist in science communication, was the need to encourage users' own exploration of space.

"I want people to be supported without being instructed," he says, "and this is especially crucial for adults, who often feel intimidated by science and are wary of looking stupid. I want them to go away inspired rather than turned off. Ultimately, we want to nurture thinking, rather than telling people what to think."

With this in mind, the project was trialled with a wide spectrum of people – young offenders, primary school pupils, café patrons – in order to make sure it not only met learners' needs, but prompted a desire to find out more.

The trials led to three key discoveries which further defined how the model communicates its information:

- users struggle to understand that space is all around them
- most people simply cannot process the huge distances involved
- people can be startled to discover that everything in space is in perpetual motion.

"We all know that Earth is part of space," says Nieman, "and yet it's hard to conceptualise that Saturn might be below us and not above at a given moment in time. This, as well as the huge distances involved, makes it hard to feel part of the solar system."

Thus the signposts were designed to rotate to show the true direction of the planets, and provide real-time data on their ever-changing distance from Earth. "It's like a lightbulb coming on," says Nieman. "When people see that, they want to know more. And when we realised that, we developed the Tour – a highly visual journey users can make in their own time, and find out what's most relevant to them."

By turning abstract ideas into concrete experiences, Futurelab believes that the Space Signpost project has huge potential. Not only does it help people to learn about the universe, it allows them to do so on their own terms, and so enables them to make sense of the broader context of life on Earth.

The ingredients

How we got there

Initial research

The journey from a sculptural concept to a fully interactive programme of signposts and virtual tours has been a long and interesting one. These are some of the key steps we had to take along the way...

Developing the prototype with suitable audience inclusion and participation took some planning, which we started by setting some key research objectives.

We needed to:

- understand the user
- develop the digital interface
- build the prototype, comprising a physical signpost and interactive interface.

We also needed to establish the extent to which creating direct, visual and easily understandable references to the cosmos would help users to make sense of what they were seeing.

Understanding these key objectives made us realise that, above all, the project had to:

- have a broad appeal
- be truly interactive in a hands-on sense
- provide a non-threatening environment for people to explore space in their own ways.

Through trials and research, we therefore arrived at a concept that would appeal to a wide range of audiences, incorporating a visual 3D tour, data on the distances and timescales, and digestible nuggets of information.

Aims

Inclusion was a key principle behind this project in order to appeal to a wide audience. Our primary goal was for parents and children, workers and students, people with formal or informal education, to all have equal access to what we see as their space, their cosmos, and the means to define it according to their own needs.

A direct experience of space was our secondary goal. We felt the need to remove the layers of packaging you find in the academic environment, in order to communicate the passion and the wonder of the cosmos, cutting through scientific jargon which alienates or terrifies the public.

Relevance was our next consideration. Space can seem indigestible so, to retain people's interest, we needed to always be mindful of the question: 'What's in it for me?' To make it easier for people to relate space to their own experience, we made a point of using everyday comparisons and analogies to communicate space without being patronising.

An authentic experience was also vital to our objectives, and we felt this would come only out of eliciting the genuine response which comes when people feel comfortable with asking their own questions in their own time. This, we thought, would best be achieved through playfulness – enabling visitors to take their time to enjoy space.

Bearing all these elements in mind, we trialled our ideas with an audience of Year 6 primary students, workers and clients from a local charity for low income households (SOFA), and random patrons of the Watershed Café and Wildwalk-at-Bristol, as well as people in the street, to get the broadest possible feedback.

We wanted to help users make sense of what they were seeing

"Oh wow wow wow – wheeeee! That's immense! We're flying straight into the sun!"

Trials

The development of the project revolved around feedback from user research, to make sure it was relevant to the people intended to benefit from it, and would give them the confidence to ask what they wanted to know. Elements of the trialling and research included:

- detailed activity-based interviews with staff and clients of the SOFA project (a charity in Bristol providing low cost furniture to low income households)
- once the first prototype was made, videos recorded the experiences and reactions of 70 people at four sites across the city
- Year 6 students at Charborough Road Primary School in Bristol had the opportunity to play with the prototype and give feedback and reactions to it
- patrons of the Watershed Café were similarly shown the system and invited to experiment and comment
- random citizens were asked what expectations they had of space and what they most wanted to know.

In the development of the project, it was never forgotten that we would have to bear in mind some of the users' misconceptions, with the aim of helping them understand the basics of the solar system without preaching, in order to maintain their interest and enthusiasm.

Most participants' interest in space took two forms:

- on the one hand, they had questions about how space relates to Earth: 'Could we live on Mars?'
- on the other, they addressed big philosophical questions: 'What is infinity?' 'How can time begin?' 'Is there a purpose to life on Earth?'

We found little in between these two extremes. When we used early prototypes, however, this seemed to support people to engage with a much wider range of questions. At the same time, most people who played with the prototype found it 'very cool', with typical comments including:

"The giganticness of it... it's mind-boggling. We have to wonder where we all started... it's a very powerful thing."

"I don't want to stop! I want to know more. Just to be in the solar system – it would be amazing!"

With reactions like these, we soon realised we were being given a chance to bridge that vast gap between the Earth-bound insular questions and the almost imponderable philosophical and scientific ones raised by the concept of space.

Findings

Once trials were underway, some more key conclusions jumped out at us, which informed all subsequent work:

- there is definitely a need for more resources to communicate science publicly – outside the arena of schools, universities, science centres and museums
- people with less formal education are more likely to take an interest if there are free resources in public spaces, such as the signposts and interactive kiosks
- they are also more likely to be attracted to science if it is playfully presented
- adults are wary of being made to feel foolish, so have to be given the opportunity to build a picture of the solar system in their own way, in their own time
- visual representations are vital in overcoming the barriers space presents, as is information which helps relate space to life on Earth.

As the work progressed, we were able to refine our findings further. With our user groups, we assessed more precisely how our visual and virtual representations were enabling the understanding and exploration of the solar system, and how we might make this process easier for them.

These findings in turn helped develop the final model, and a wider survey will be carried out on the use of the first installation.

Final results will take into account wider research into the public understanding of astronomy, but meanwhile we hope and trust that the Space Signpost project will find many uses in everyday life.

The Space Signpost

The first visible evidence of the project to the person wandering across Millennium Square in Bristol, or any other public place with a Space Signpost, will be the arm of the signpost itself.

The signpost is about three metres tall and features two 1.4 metre-long LED displays which are moved by motors connected to a computer. A computer program calculates the location of the chosen object, sending the coordinates to the motor controllers and the object's distance to the LED displays. Meanwhile, the journey to that object can be viewed on the integrated screen, which is part of the space signpost kiosk.

In addition to the in-situ signposts, we have also developed a portable version which can be used in a wide variety of ways.

JULIAN NIEMAN

How it works

With so many elements to it, the signpost system required complex programming, engineering and integration. The full chain of events from the moment a user walks up to the Space Signpost is:

- the user tells the computer where they want to go via the touch-screen
- the computer calculates where the selected object is
- the computer also tells the motors which way the sign should point and updates the direction every second
- meanwhile, the name of the selected object and its current distance from the signpost is sent to the LED displays and updated every second
- on the touch-screen 3D graphics illustrate the user's virtual journey to the selected object
- on 'arrival' the user can move around the selected object and change the rate at which time passes to watch, for instance, moons orbiting planets.

The arm of the signpost itself moves in two dimensions, registering elevation (the angle the object makes with the horizon – above or below it) and compass directions – north, south, east and west.

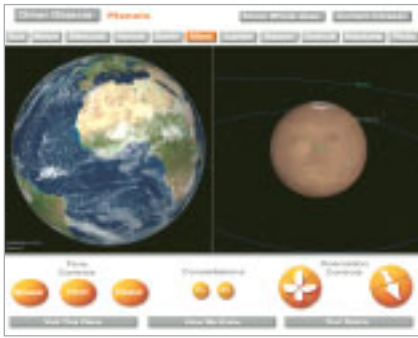
"We had several major challenges," says Mike Hoddell of Springboard Design Partnership, who built both the large Space Signpost and the portable version. "We had to make sure the signposts would be usable by everybody including primary school children, six-foot adults and people in wheelchairs, so the scale and ergonomics were interesting! And we had to make it vandal-proof."

The interactive interface

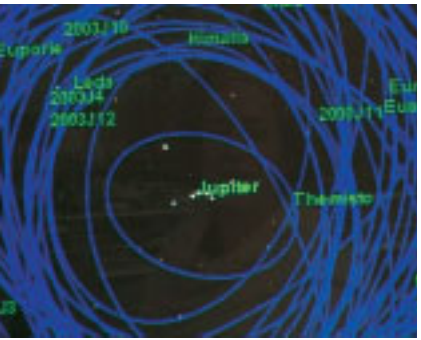
The Space Signpost aims to put users in control and allows them to explore space for themselves, which is where the interactive interface comes in. The visitor to the site will approach the signpost, where he or she can decide where to go via a touch-screen. What they will see as they press a button on the screen is an animated, 3D journey to the planet, asteroid, satellite or spacecraft of their choice, illuminated by a virtual sun. Their journey will be displayed at the same time as the signpost slews round to find the object and the LED displays show the changing distance between the object and the signpost.

One side of the screen shows a view of Earth from the direction of the space object they have chosen – strengthening the relationship between Earth and the solar system. The other side shows the planet (or other chosen object in space) as viewed from Earth from the same distance. Showing the two on the same screen bridges the physical and metaphysical distance, literally bringing space closer and making it more accessible. It also provides a sense of scale – for example, when Mars is selected, the user can see that it's just over half the diameter of the Earth.

On 'arrival' at their destination, users can navigate around the object, making connections and appreciating the parallels and dissimilarities with the environment on Earth. The interface is fully supported by realistic 3D visuals and imagery. Users can also control the rate at which time passes in their 3D representation of space, which allows them to observe the passing of day and night, the motions of the planets and their moons, and many other phenomena.



The screen displays bridge the gap between Earth and the cosmos



Users will be able to reference space in the context of what they know about Earth – for example, if Earth weighs a penny, the sun weighs about as much as a Ford Ka

'Visit this Place' and 'Tour Space'

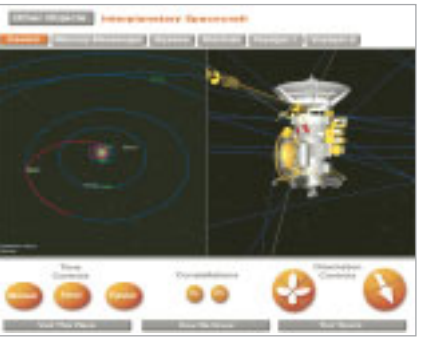
Further resources were needed to enable people to find out what they most wanted to know, in the way they most wanted to find out, whilst also taking into account the partial and sometimes confused information they already have. The 'Visit this Place' and 'Tour Space' functions were developed to make this possible.

"We knew from our research that there is a lot of confusion about astronomical terms," explains Nieman. "At first we thought we could solve this problem by providing a glossary, but we realised that this wouldn't help. There's no point in defining a 'moon' as an object that orbits a planet if your audience is confused about what a planet and an orbit is. Instead the information that users need to make sense of what they are looking at is brought together coherently, as part of the user's own voyage of discovery."

Once an object has been selected, users can ask: 'What's this place like to visit?' The answers are tailored to what our research revealed people wanted to know. They can also choose to 'Tour Space'. This option offers short multimedia accounts focusing on different topics such as 'The Earth in Space', 'Life in Space', 'Galaxies', etc.

So, in line with the project's aim of enabling people to chart their own course through space, defining their own search parameters and asking questions which feel relevant to them when they are ready to do so, the user can choose from several options on arrival at his or her chosen destination. They could find out about the breathability of the atmosphere, the gravitational pull, the natural light and gases in the atmosphere, the physical size of the planet or other object, and much more.

This part of the program does not pretend to be interactive, but it does allow users to go where they want to go, and it deliberately makes connections which will be easily understandable on Earth. Thus, if you were to live on Saturn, you would find the natural light depressingly dim (the equivalent of a 15-watt bulb per square metre).



The signpost's programming

The program which calculates the location of the chosen objects, displays them accurately on the screen, and controls the signpost and its LED display, is called 'Welcome'. It is based on an open source astronomy simulation program called Celestia.

In keeping with the ethos of information sharing which has been so central to this project, Space Signpost generates reams of data as well as visual representations of the space journeys.

'Welcome' uses this data to make the moving arms of the signposts and the 3D journeys to far-off planets possible. Infinitely expandable, it provides the coordinates of over 100,000 stars, with an exponential zoom feature allowing you to explore space across a range of scales, from galaxy clusters right down to individual spacecraft, navigating the universe to anywhere you want to go.

It provides the coordinates to over 100,000 stars

The future

We believe that this project could enhance people's understanding of the cosmos in numerous ways, all of which would be fun, approachable and digestible.

We hope, as we monitor visits to the first installation in Millennium Square in Bristol, that the idea will take root and grow. We hope people crossing the square will leave for work five minutes early or head there with their sandwiches at lunchtime, in order to stop by the signpost to find out something new. We hope they will want to take a new journey into space every day. Of course, our findings from tracking usage of the first installation will be used to develop future models.

Meanwhile, for future signposts, we suggest that:

- science centres install them outside, reaching people that can't or don't feel inclined to enter the building
- schools have their own portable signposts to support lessons at all key stages, so that children can turn the abstract into something concrete and grasp something bigger than their immediate surroundings
- airports install them to put passengers' journeys into a wider context
- cruise liners and ferries locate them at viewing points – one of the best places to appreciate space is from the open expanse of the sea since astronomy was, after all, the basis of early navigation.

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We hope people will feel able to take a new journey into space every day

The team and our partners

Adam Nieman PhD, specialist in science communication and the visual culture of space, was the project's originator while Futurelab managed the project, brought in partners and research and part-funded its development. This project could never have been realised without the invaluable help, hard work and shared knowledge of so many:

- Copus and the DTI, who also provided funding – Copus being the major provider of second stage project funding
- Alex Burton, who did much of the programming
- Justin Norton, Flash programmer
- Kate Rogers, interface graphics
- Mike Hoddell and Joseph Ottewill of Springboard Design Partnership, who designed and built the signpost
- Steve Stean, electrical engineer, of Industrial Control and Communication Ltd
- JT Engineering, who made many of the component parts
- Participants in the early trials at SOFA, the Watershed, At-Bristol, Luckwell and Charborough Road Primary Schools.

Many technologies and scripting languages also came together in the process:

- Celestia (open source space simulation software)
- Lua (the scripting language for Celestia)
- C++ (the programming language for Celestia)
- Macromedia Flash and HTML
- LED display technology
- Touch-screen interface technology
- Custom control system.

To everyone involved, Futurelab would like to extend its sincere thanks and appreciation.

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Futurelab is helping to transform the way people learn. We're using new and emerging technologies to create rich learning resources that are involving, interactive and imaginative.

By bringing together the creative, technical and educational communities, Futurelab is pioneering ways of using new technologies to enrich and transform the learning experience.

Our activity comprises three inter-woven strands: research, prototype development and communications. These core activities enable us to act as a think-tank that nurtures new ideas and gathers intelligence; as an incubator and tester of early-stage and untested concepts; and as a hub supporting the multi-directional flow of information and knowledge between practitioners, policy makers, creators and learners.

Sci5

SPACE signpost

connecting people to science
COPUS

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