

MobiSpray: Mobile Phone as Virtual Spray Can for Painting BIG Anytime Anywhere on Anything

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ABSTRACT

This paper presents *MobiSpray*, a novel interactive art tool for creating ubiquitous ephemeral digital art. The mobile phone is employed as a virtual spray can to spray dabs of digital paint onto the physical environment via large-scale projections. The gesture-based control of the mobile phone provides a natural pointing mechanism for the virtual spray can. Experiences from extensive field use around the world testify in favor of a successful design. Most importantly, *MobiSpray* liberates and empowers the artist to change the environment via large-scale artistic expressions.

Introduction

This work stems from our desire to change, through digital art, the appearance of the physical environment to something different, unexpected, and unpredictable, but without inflicting any permanent or illicit damage. To achieve this, we developed the *MobiSpray* art tool for imposing large-scale ephemeral digital artistic projections on the environment. They serve as a vehicle for experiencing space and time in new ways, drawing inspiration from both the artistic process itself and the final artistic outcome.



Figure 1. *MobiSpray* in action. © 2008 Jürgen Scheible.

MobiSpray combines existing technologies into a novel art tool. A mobile phone is employed as a virtual spray can. A drawing client on the mobile phone (the virtual spray can) communicates wirelessly with a drawing server on a standard PC for the purpose of painting on a virtual canvas. The canvas is projected with a video projector onto some backdrop. The projection distance and surface determine the scale, appearance and visibility of the resulting artistic presentation. *MobiSpray* is truly ubiquitous, as the equipment can be carried in a rucksack, allowing the creation of ephemeral

digital art anytime, anywhere, and on anything (Figure 1). For us, *MobiSpray* has become a creative tool to paint wherever we go (Figure 2). At times, we also take the opportunity to turn ugly-looking trash into treasure, at least temporarily (Figure 3). All projections shown in photos are projections on real buildings or objects.

Creating art with mobile phones in public spaces is an emerging form of artistic expression. While *MobiSpray* is related to light art or light graffiti (for example, *Blinkenlights* [1]), it is also a form of mobile interactive art within the field of media arts. The ephemeral projections onto the environment relate the *MobiSpray* to land art [2] or environmental art [3] (for example, *Christo* [4]), in which the landscape and the artwork are inextricably linked, and the intention of the artist is to cause no harm to nature or environment through the artwork.

The innovative aspect of *MobiSpray* lies in the provision of a novel, portable, gesture-controlled art tool for creating large-scale, full-color projections in the environment in real time. Related drawing interfaces include Cho's motion-sensitive brush [5], whose big movements result in big strokes while smaller ones produce thinner lines. In *Drawn* [6], painted ink forms appear to come to life, rising off the page to interact with the very hands that drew them. Remote interactive graffiti [7] invites distributed internet participants to "draw" via a browser-enabled interface on a common (installation based) canvas such as a white board or a projection on the sidewalk of a street.



Figure 2. Examples of *MobiSpray*'s World Tour: Potts Point Neighborhood, Sydney (upper left), Guggenheim Museum, New York (upper right), Houses of Parliament, London (lower left), Siwash Rock, Vancouver (lower right). © 2008 Jürgen Scheible.

MobiSpray employs the gesture control of a mobile phone to provide a natural interface that allows the phone to be manipulated as a spray can for painting. Related work includes *MobiToss*, a rare example of employing a gesture-controlled mobile phone as an art tool [8]. In *MobiToss*, a photo or video is first captured with a camera phone and then "thrown" onto a public display for the purpose of manipulating it with effects and gesture control. Garner, Rashid, Coulton and Edwards employed a mobile phone as a digital "spray can" for the purpose of reading and writing RFID tags attached to particular locations, as the digital age's virtual and undamaging version of the genuine spray-can graffiti [9]. The *WiiSpray* turns a real spray can into a digital spray can by placing a Nintendo *Wii* controller inside the can to create digital graffiti on a TV set [10].

Projections have been widely used for creating artistic installations as interventions in physical and social space. Artists discard barricades and insert themselves into streets, laneways, alleys and shopping centers [11]. For example, Sinatti has used a 40-inch touch-screen display to paint and project on huge surfaces [12], and Wodiczko has created large-scale video projections of politically charged images on architectural façades and monuments worldwide [13]. Some projection-based installations involve different interactive techniques. For example, GRL's *Laser Tag* tracks a green laser pointer across the face of a building, generates graphics based on the laser

pointer's position, and projects them back onto the building [14]. Tagtool is a VJ tool and drawing instrument that utilizes a graphics tablet and controllers to create animated graphics for video projections [15].

A particular artistic movement that builds heavily on video projections is “guerilla art” known through artists like Banksy [16]. It is closely related to urban street art, a subtopic of the emerg-



Figure 3. Trash to treasure. © 2008 Jürgen Scheible.

ing research field of urban computing, which studies the integration of computing technologies into everyday urban settings and lifestyles [17]. Due to their complex ownership and legal ramifications, urban settings are challenging places for experimentation and deployment, as the installation and operation of an application or an art piece typically require permissions from many stakeholders. Thus it is no surprise that the inherent freedom of playful arenas combined with intimate ubiquitous technologies such as video projection has led to a new breed of guerrilla performances [18]. For example, Digital Fringe's *Mobile Projection Unit* supports guerrilla art by providing a car, a projector, and batteries to various Melbourne “pixelists” [19]. The painter, architect, and sculptor Hundertwasser is known for expressing his artistic vision in pictorial art on façades [20].

The *MobiSpray* Art Tool

System components

MobiSpray is a simple client-server application comprised of three components (Figure 4, left): a mobile drawing client, a simple drawing “server” operating on a PC, and a video projector for projecting the current drawing onto some surface. The mobile drawing client (Figure 5) is implemented with Python for an S60 Symbian camera phone with a built-in motion sensor for the gesture-controlled pointing mechanism (for example, Nokia N95) [21]. Keyboard keys are used for controlling the drawing tools. The client communicates with the server using the UDP protocol over a WLAN (IEEE 802.11b/g) connection. WLAN provides sufficiently low latencies for real-time interaction and allows communication over much greater distances than Bluetooth.

The drawing server programmed with Pygame receives drawing commands from the client and renders them accordingly on the drawing canvas displayed on the PC's screen [22]. The video projector projects the screen (the current drawing) onto some surface or backdrop. If no electricity plug is expected to be found in the drawing location, a portable petrol-driven generator or a battery with a DC/AC converter can be brought along.

Gesture-controlled pointing mechanism with a zoomable navigator

The current drawing area is indicated with a black rectangular navigator placed within the

drawing canvas corresponding to the white region in Figure 5. The size of the navigator can be changed with a keyboard key, ranging from the full canvas to the minimum size of 100 x 100 pixels. In this way the level of detail can be changed dynamically, from painting on the entire canvas to inserting tiny details, such as the character “3” and the word “by” in Figure 4 (right). The location of the navigator within the canvas is controlled with the phone’s navigation key.

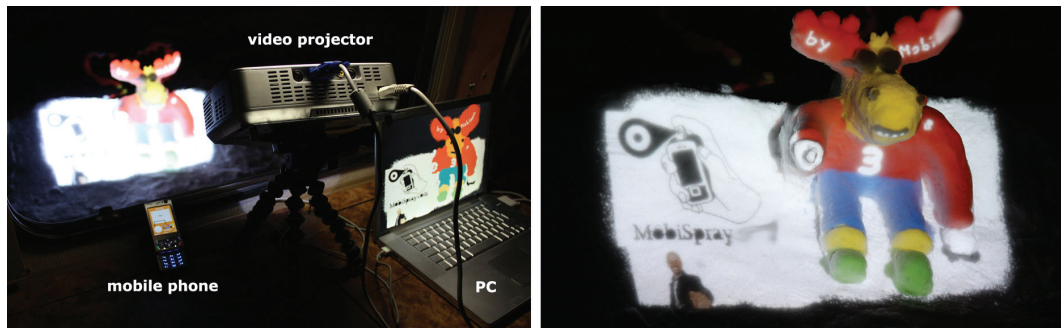


Figure 4. *MobiSpray* system components (left), painting on a snow sculpture (right). © 2008 Jürgen Scheible.

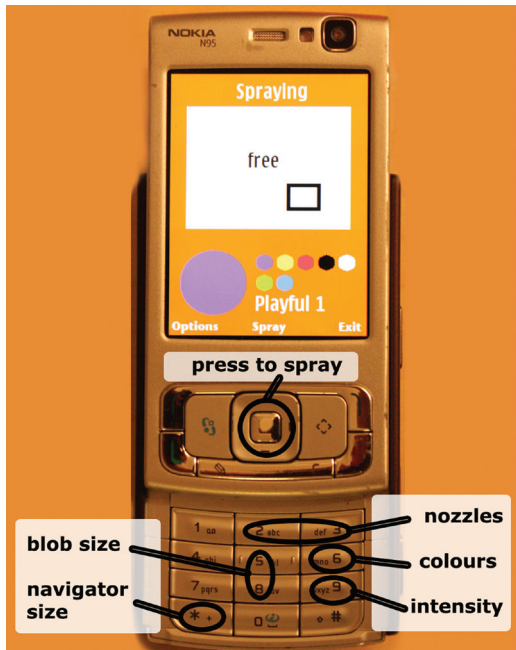


Figure 5. The user interface of the mobile drawing client. © 2008 Jürgen Scheible.

The gesture control of the pointing mechanism is implemented by mapping the phone’s motion-sensor readings onto x and y coordinates within the navigator in real time. When the phone is held flat horizontally to the ground, the motion sensor generates the value 0 for both x and y axis, and the drawing blob is placed at the centre of the navigator. When the phone is tilted between 0 and 90 degrees to the left/right or forward/backward, the values change incrementally between 0 and -50/+50 in steps of 1, and the blob is moved accordingly from the centre of the navigator towards left/right/upper/lower edge. The two major advantages of this pointing mechanism are that it does not require any calibration before use or any pointing signal receiver such as the sensor bar in *Wii* [23], or the camera in GRL’s *Laser Tag* [24].

Virtual spraying nozzles

The user can choose among four different drawing modes, each representing a virtual spraying nozzle. In the blob mode, the nozzle creates a simple color blob on the canvas consisting of a circular element with a color fill. In the brush mode, the nozzle randomly creates a multitude of pixels of the same color within a certain radius. In the image mode, the nozzle places plain images on the canvas. In the stencil mode, the nozzle places stencils on the canvas to spray on.

In the blob and brush modes, the blobs are continuously drawn on the canvas with high frequency. In idle state (when the phone’s navigation key is not pressed), previous blobs are overwritten. However, if the user presses the phone’s navigation key, which is comparable to

pressing the nozzle on a real spray can, previous blobs are no longer overwritten, but by moving the blob with hand gestures a color trace is created (Figure 6).

In the image mode, the image to be placed on the canvas can either be chosen from the image files residing on the phone, or it can be captured with the camera of the phone and sent over to the drawing server. The image can be placed either once or multiple times at any position, such as the *MobiSpray* logo and photo in Figure 4 (right). Alternatively, the image can be used for image brush painting comparable to the I/O Brush [25]. The user can also spray instantly into the image by switching back to the blob or brush mode (Figure 7).

In the stencil mode, images and related image masks can be chosen from ready-made files residing on the phone or on the server. The stencil can be moved around with gesture control and is placed at the desired position by pushing the navigation key once. Switching to the brush mode allows spraying onto the stencil's empty areas. The stencil is removed by pressing the hash key.

Multi-user mode

The *MobiSpray* can also be employed in multi-user mode, which allows collaborative drawing by up to four people simultaneously (Figure 8). The canvas can be split between the multiple users in three different ways: the full canvas accessible by all users (one user can draw on top of another user's), each user with an individual section, or user-specific sections that are partially overlapping.



Figure 6. Painting made with the brush nozzle mode.
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Figure 7. Painting into photo images.
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Some Design and Artistic Aspects of the MobiSpray

The *MobiSpray* art tool has been used extensively throughout the world, both privately— during guerilla spraying sessions in New York (painting at the Guggenheim and New Museums), Sydney (Opera House premises) and London (Houses of Parliament and the Tate Modern)— and in many public events, such as the Urban Screens 2008 festival in Melbourne or the Web 2.0 event in New York. In the following sections, we discuss various design and artistic aspects that have become prominent in the field use. We enclose some user comments in italics. They originate from three different sessions where a total of 17 people (age 13-70 years) were video-interviewed after they had sprayed. They were passers-by at Melbourne's Federation Square, where we had a fixed installation of *MobiSpray* over several days; or visitors at the London Smartphone Show evening party where an indoor *MobiSpray* setup served as entertainment; or a group of new-media enthusiasts at an ad-hoc guerilla spraying occasion in downtown Vancouver.

Natural interaction with “transparent equipment”

“It's quick to understand what you can do, and you can instantly do it.”

Although *MobiSpray*'s gesture-controlled pointing mechanism may sound clumsy, novice users typically learn it quickly and find painting with the virtual spray can natural. An important aspect of the gesture-controlled interaction is that one can draw by moving the hand without looking at the mobile phone. This demonstrates the concept of “transparent equipment” [26], in which the user “sees through” the equipment to the task at hand, such as when you sign your name, the pen is not normally your focus unless it is out of ink.

Liberating and empowering the artist

“This is fascinating, now I understand why kids do graffiti.”

“I like that it is not premade content to view.”

“This has been the biggest picture I’ve ever painted in my life.”

MobiSpray liberates and empowers the artist on many complementary levels. With the movable equipment, the artist can effectively start painting anytime, anywhere, on anything. *MobiSpray* allows artists to reach and access the surface of a building, even if they do not own it or have the keys for it. Fences, closed yards or large heights are not a problem, but in fact may present interesting opportunities for guerilla art. *MobiSpray* allows not only painting on man-made objects such as buildings, but also on nature, revealing highly exciting surface patterns (Figure 9). While painting on objects like sculptures has been done for a long time, it has not been possible to paint on nature in such a clean and eco-friendly way as with *MobiSpray*. When painting on snow sculptures (Figure 4), for example, we could even speak of 100% recyclable art. A great advantage of *MobiSpray* over traditional graffiti and painting techniques is that the artist can digitally preview the placing of a new blob, and with an undo key, the artist can always go back. Thus, with *MobiSpray*, the artist can visualize future compositions and explore the consequences of bringing a particular composition into existence. Furthermore, the artist can spray exactly the type of art desired (for example, graphics can be mixed with photos).



Figure 8. Multi-user mode. © 2008 Jürgen Scheible.

Legalizing the artist

“First I didn’t dare to do it because you have some kind of illegal feeling, but then when you do it it feels liberating.”

“I like the fact that your painting goes away, and you live the moment while you create it. It reminds me of Buddhist sand paintings.”

Whereas guerilla actions such as traditional spray-can graffiti sometimes cause damage to property or the environment, *MobiSpray* legalizes the artist since the outcome is an ephemeral digital projection that does no permanent damage to the property. Nevertheless, the question of legal implications remains, especially in urban spaces. Despite the ephemeral nature of *MobiSpray* projections, some artists confessed that they felt guilty or naughty as they “spray-painted” public buildings. Apparently, the artists should go with the street artist Banksy’s motto: “It’s always easier to get forgiveness than permission [27].”

Embodied interaction with physical objects

MobiSpray allows the artist to roam freely (walk, stand, lie) around the target object, far or near in real physical space, while looking directly at its surface to see how the painting appears in real time (Figure 10). This allows the artist to draw inspiration for a composition directly from the object itself and its context. This is a form of embodied interaction where the artist’s interaction with physical objects is augmented by computational abilities [28].



Figure 9. Painting exposes the surface patterns on a stone in a forest. © 2008 Jürgen Scheible.

Mental ownership of physical objects

A strong observation about *MobiSpray* has been that after painting on a building or some object, the artist feels a sense of ownership of the physical object. By adding something new (the painting) to something that already exists (a building or rock), a new whole is created. The experience of the creative process, which results in a deep insight of consequence, contributes to the creation of new meaning and value. This new whole is perceived as one’s own creation [29].

Aesthetics of the resulting drawings

The process that leads to the aesthetic outcome often starts with searching and selecting a designated architectural façade or object to serve as the pictorial backdrop. Creating the visual expression not only involves transforming the building or object by projecting

ready-made imagery, signs, or letters on its surface, but also, through the very colors (combinations), lines, or shapes used in the drawing, producing an aesthetic and emotional response. In this way, through some grace of line, symmetry of form or harmony of color, the designated building or object acquires new power to communicate with the artist or viewer. It becomes alive and of value on its own account, just like the trash turning into treasure (Figure 3). As a base for drawing, simple adjustable graphical elements such as a circle (blob or brush) or line are used to create the overall visual form or focus of the compositions. Whereas repetition of symmetrical rings (bull’s-eyes) and splashes give rhythm, logic, and balance, their placement is often orientated on the shape of the building or object. The drawing allows artists to break the patterns of the objects’ natural appearance, creating a new whole with its own aesthetic value.

An acquired drawing style might be explained by Parker’s claim that the drawing effects, found by chance perhaps in the first instance, would later be created consciously [30]. The question is, if the *MobiSpray* tool is given to other people, could they produce something that looked like it was not made with *MobiSpray*? When artists build the tool for themselves, they adjust that tool

to support what they want to express in the manner they want to see it. What is interesting is that while this “mannerism” is supported by the tool, it is not the tool itself. Results from our field tests show a wide variety of drawing outcomes made by different people using *MobiSpray*, which indicates that a variety of drawing styles can emerge with this tool.

Multi-user and spectator view

“This is fascinating, I have never seen something like that before.”

“We liked the abstract thing, playing with colors.”



Figure 10. Mobile drawing client allows the artist to roam freely around the object while painting. © 2008 Jürgen Scheible.

When *MobiSpray* is employed in the multi-user mode, the artists have great fun together, both collaboratively working toward a common goal and destroying each other’s contributions. For example, the group in Figure 8 met for the first time at the *MobiSpray* stand. After a short period of random painting, they started to negotiate and agreed on the themes and colors to draw collaboratively. Furthermore, our experiences from field use underline the role of the spectators in the social setting. People often gather close by, watching and commenting on the work of the artists, and contributing to the social atmosphere by laughing and shouting.

Future Work

As the current version of *MobiSpray* still needs several hundred watts of electricity, we are exploring opportunities to allow a spectator crowd to generate electricity and thus become part of collaborative artwork creation. Furthermore, by building a cluster of *MobiSpray* units with multiple projectors, we aim to paint whole neighborhoods of a city in a flash-mob manner [31]. Other concepts that could be attached to *MobiSpray* are media activism, urban-planning simulation, or theater and music performances. In order to achieve a wider variety in visual

styles, we will create additional spraying nozzles, as well as a stencil-creation functionality utilizing the phone's camera. We are also developing a lightweight implementation based on a battery-driven pico projector for creating small-scale projections.

Conclusion

MobiSpray combines a personal mobile phone, a PC and a video projector into a novel art tool for creating ubiquitous digital art. Experiences from extensive field use testify in favor of successful design, liberating and empowering artists to change their surroundings at their own will, in an ephemeral manner. An off-the-shelf mobile phone has proven to be highly attractive as an interface for a virtual spray can, not only because it is personal, ubiquitous, and wirelessly connected. It is also a freehand drawing tool for virtual color spraying, an image-capturing device, and a processing unit for handling digital stencils. Providing a high degree of freedom, it affords the luxury of painting while at the same time roaming around your target object in real physical space, near or far.

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