Towards On-the-wall Tangible Interaction

Using Walls as Interactive, Dynamic, and Responsive User Interface

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Abstract

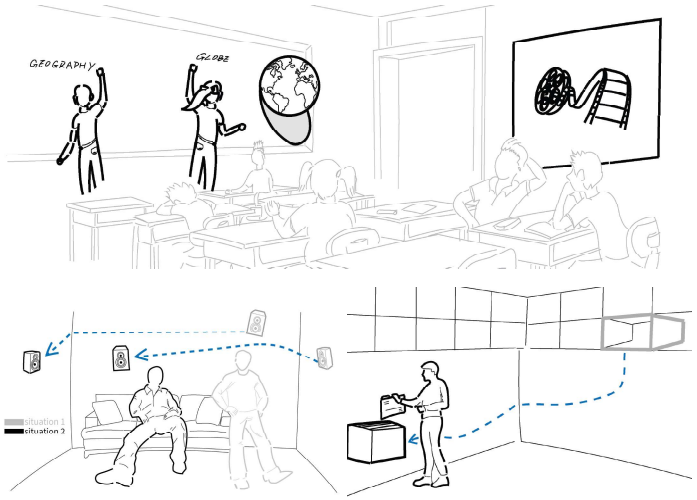
This paper presents our vision of on-the-wall tangible interaction. We envision a future where tangible interaction can be extended from conventional horizontal surfaces to vertical surfaces; indoor vertical areas such as walls, windows, and ceilings can be used for dynamic and direct physical manipulation. We first discuss the unique properties that vertical surfaces may offer for tangible interaction and the interaction scenarios they imbue. We then propose two potential paths for realizing on-the-wall interaction and the technical challenges we face. We follow with one prototype called Climbot. We showcase how Climbot can be used as an on-the-wall tangible user interface for dynamic lighting and as a wall switch controller. We conclude with a discussion of future work.

Beyond Just Walls

Walls are ubiquitous in modern lives. They serve as the foundations to hold up construction and as placeholders for various household essentials such as lightings, mirrors, switches, and TV displays. Although walls have not been used much for tangible interactions, we see the great potential that can make walls beyond passive building infrastructures.

- **Ubiquitous in Indoor Environments**
- **Lack of Tangible Interaction**
- **Placeholder for Essentials**
- **Structural Foundation**

Ultimate Tangible Interaction on the Wall



We believe the ultimately developed wall-based tangible interaction can create new experiences and influence the way people utilizes indoor surfaces. We demonstrate how vertical tangible interfaces can be blended into one's life with both residential and workspace contexts. We also showcase scenarios where TUI on the wall can be beneficial for health care and education.

Challenges for Realization

We mainly consider two potential approaches for on-the-wall tangible interactions: 1) make the walls substrate smart with shape-changing capabilities, and 2) use on-the-wall robots to introduce mobility to existing wall fixtures. And each faces particular challenges along path of realization.

Making Wall Substrate Dynamic

- **Safety**
- **Space**
- **Load and Gravity**

Making Wall Fixtures Dynamic

- **Payload**
- **Tetherless**
- **Mobility and Noise**

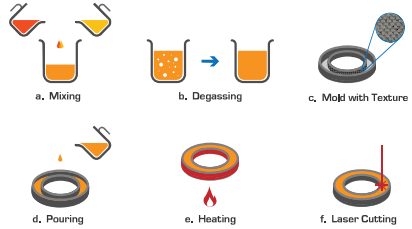
Climbot

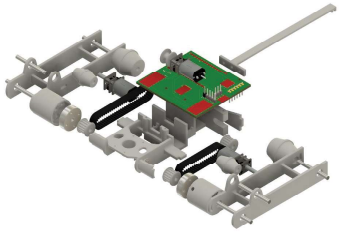
As the first step towards the ultimate on-the-wall tangible interaction, we present an on-going work that uses an on-the-wall robot to make wall fixtures dynamic. We propose a mobile robot prototype – Climbot, to accomplish dynamic on-the-wall tangible interactions confronting the challenges described above.

Design

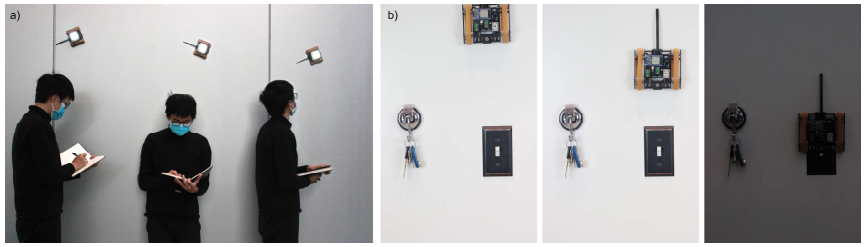
- **Stable Mobility**
- **High Pay-load**
- **Low Noise**
- **Suitable Size**

The Climbot is an on-the-wall tangible interaction prototype to introduce mobility to sensors, actuators, and existing on-the-wall fixtures. Following the design criteria mentioned above, we decide to use dry adhesive treads as the primary climbing mechanism. Specifically, our robot design is inspired by Tankbot, which utilizes sticky treads to travel freely on the walls and can make far less noise compare to vacuum-based robots.





Applications



To demonstrate the function and extendibility of the Climbot, we present two simple applications. Figure a) shows a light carried by the Climbot that is dynamic and can follow the user indoors. Figure b) shows another example where the robot goes to a switch to turn a lamp off on-demand. Collaborative jobs can potentially be done by synchronizing multiple bots.