

## Augmented Reality for Learning Programming

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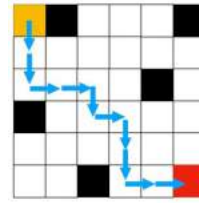
### Summary

We present an early investigation into whether the augmented reality (AR) may be leveraged to help people learn coding in an easier and more engaging way by assessing the performance of participants in completing navigational tasks in various environments.

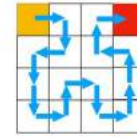
Our pilot study evaluates two AR coding environments:

- 1) **Head-mounted AR with Microsoft HoloLens**
- 2) **Mobile AR with ARKit on an iPhone**

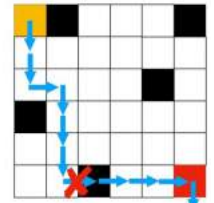
We also included a conventional 2D touch interface using Swift Playground on an iPad as baseline.



(1) Path-finding

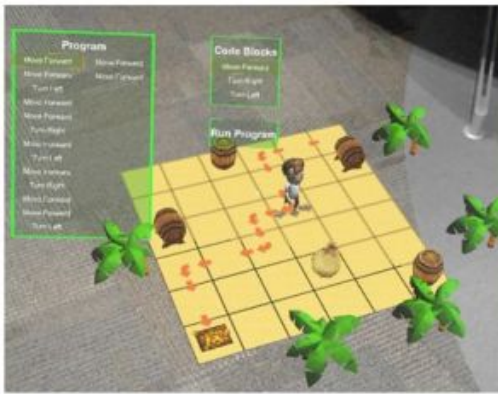


(2) Hilbert



(3) Debugging

Only one variation of each task is shown. Dark yellow box is the avatar's starting position; red box is the goal. The red "X" mark in (3) indicates the wrong path segment that the participant must fix.



(a) Head-Mounted AR



(b) Mobile AR



(c) Conventional 2D Interface

A user working on the *path-finding* task on two interactive AR environments, and a conventional 2D interface.

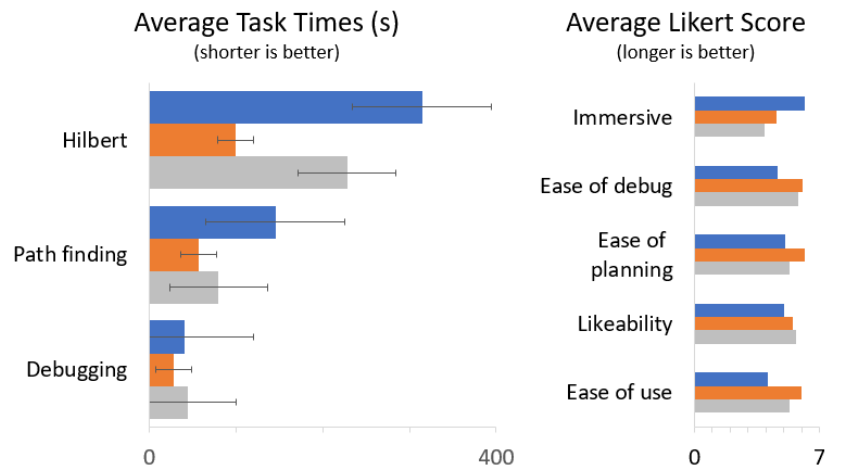
### Results

Our preliminary results show that mobile AR is the fastest environment and the head-mounted AR is the slowest. Participants also found the head-mounted AR to be the most immersive yet difficult to interact with, but found mobile AR to be the most enjoyable. They reported that the augmented reality platforms were both more immersive and intuitive than the conventional 2D touch interface due to the presence of real-time visual feedback.

### Ongoing Work

We hope to add tasks that include more complex coding concepts and tasks that require fine motor movements or audio-visual perception in a larger participants pool to further assess the effect AR in aiding the learning of such topics.

### User Study Results for head-mounted AR, mobile AR, & conventional 2D touch interface



Average task completion times and likert scores for each platform. **Mobile AR** is statistically significantly faster across all tasks.