LEGOWorld: Repurposing Commodity Tools & Technologies to Create an Accessible and Customizable Programming Environment

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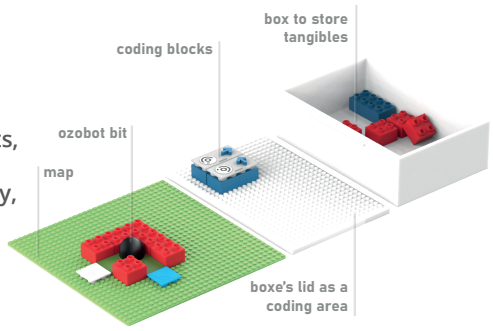
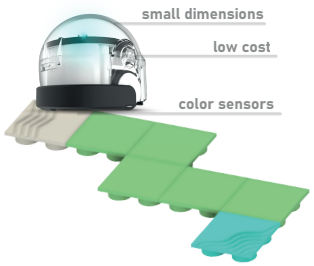
LEGOWorld

an accessible and customizable programming environment for children with visual impairments, that repurposes the use of commodity tools and technology, such as LEGO and Ozobot Bit.



Ozobot Bit

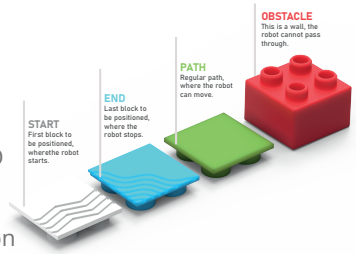
The Ozobot Bit robot moves in a path of 3D-printed LEGO caps surrounded by LEGO blocks assembled over a LEGO base plate.



The tangible environment is composed of a LEGO plate and blocks, and path LEGO-alike caps.

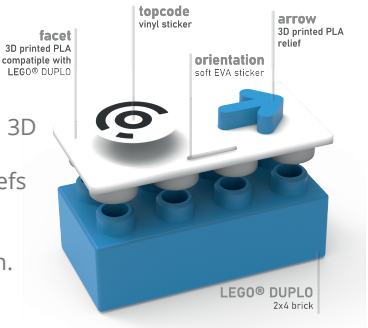
Tactile Path

The robot moves in a path of 3D printed LEGO caps surrounded by LEGO blocks assembled over a LEGO base plate. The 3D Path caps have rich tactile properties and different colors to facilitate their discrimination by touch and/or vision.



LEGO blocks

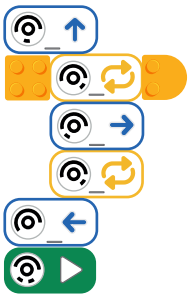
The blocks are composed by a 3D printed cap compatible with LEGO, it has 3D patterned reliefs affording children with visual impairments to identify the block's corresponding function.



The system has two distinct interaction modes to move the robot, Tangible programming and the Voice Programming. There is a voice assistant in the app that helps the child throughout the game in both modes.

Tangible Programming

the programming blocks are assembled to build a sequence of instructions and the camera in the device recognizes the TopCode markers.



Voice Programming

the user indicates verbally each instruction step by step. To guide this interaction, the app asks specifc questions, step by step. Firstly, the app asks to which direction should the robot move. Secondly, it asks how many times should the robot move in such direction.

Discussion and Future Work

We conducted a survey with educators to understand their perceptions of the accessibility of the environment and how it could foster blind children's inclusion and development.

The tangible environment made with LEGO, and 3D caps was very well received due to its rich tactile information and visual colors, making it accessible to children with visual impairments.

Educators believe the map and the robot give an opportunity to train laterality concepts and spatial orientation. They found the system appropriate for learning programming in the context of a classroom as well as at home.

They also mentioned that tangible programming allows children to access the sequence of instructions anytime, ease memory resources, comprehension and debugging. Qualities such as the ease for young children to verbalize instructions and to have feedback step by step were also emphasized.

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