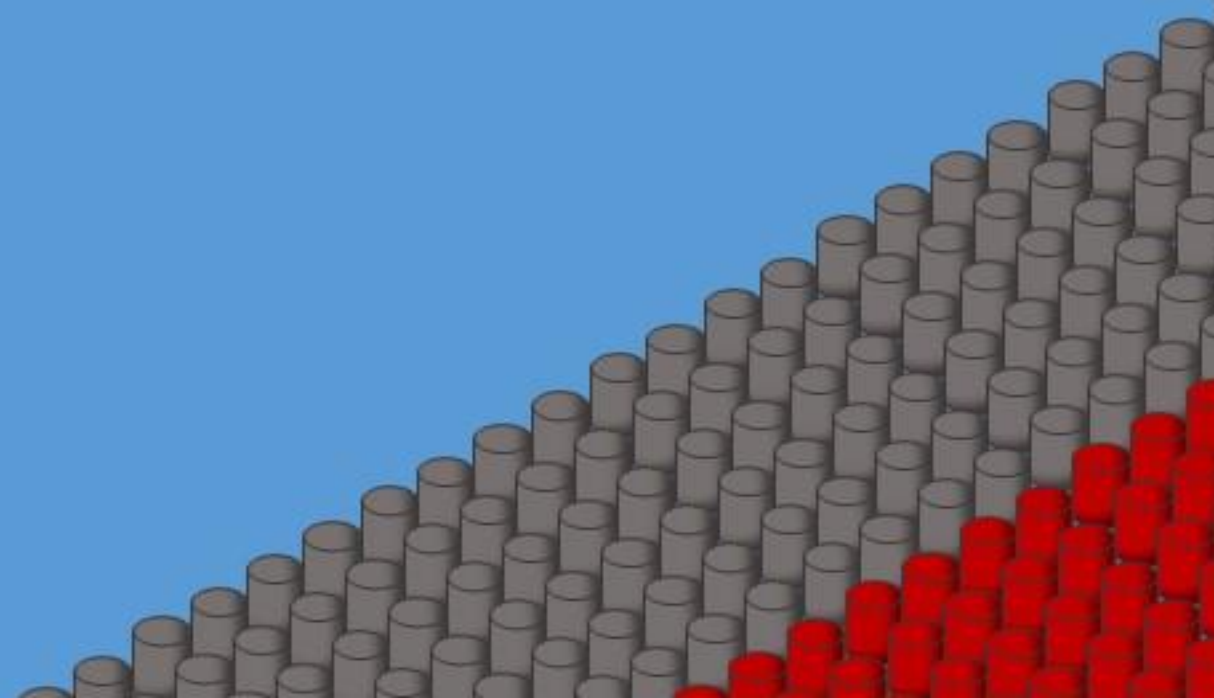
Addibots

Addibots®

Making the World a Workspace

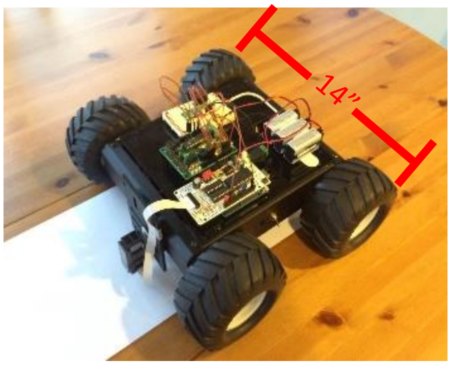


Prototyping and R&D

With 2+ years of R&D, four successful prototype iterations using the Addibot® concept have been completed, with work on a fifth prototype underway.

Prototypes I and II: 2D Image Printing

As an initial proof of concept, the first two prototypes use ink cartridges to function as 2D Addibots.



Text Printing Addibot

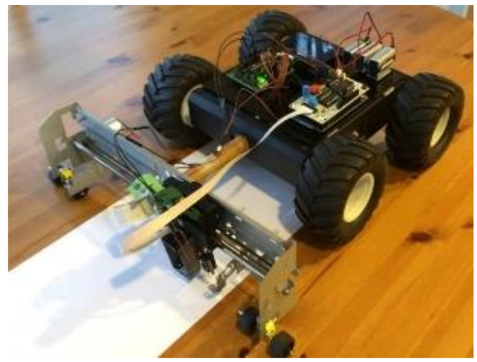
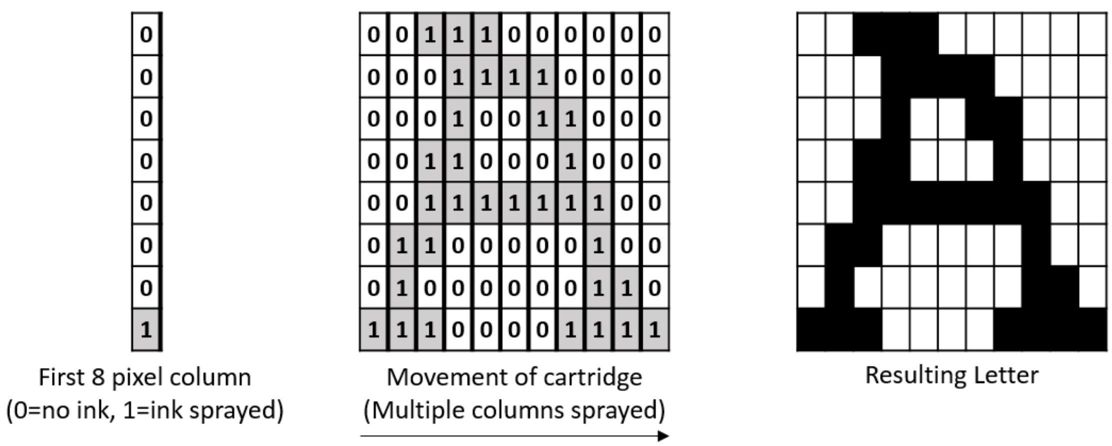
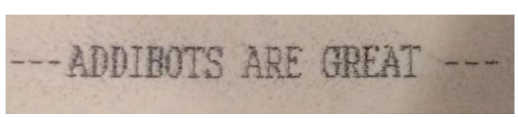


Image Printing Addibot

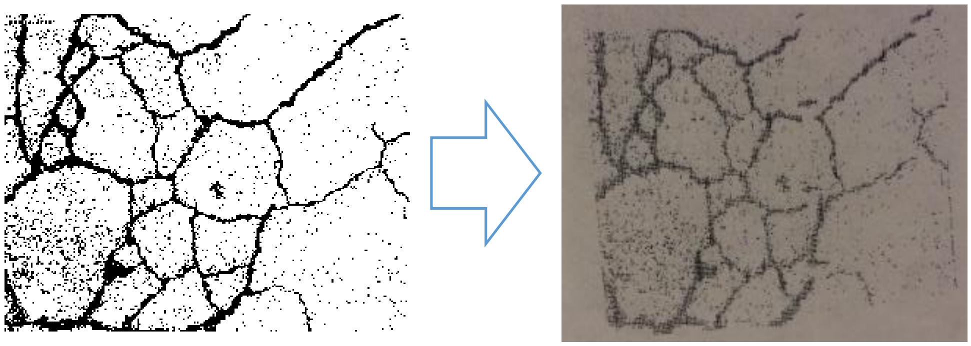
The ink cartridges used are interfaced with and directed by a microcontroller for programmable use. The cartridges contain rows of 8 pixels that each independently dispense ink. The first of the prototypes has its ink cartridge mounted directly behind it; since an 8 pixel column height is sufficient to represent letters, this prototype can move at a constant speed and dispense ink in a preprogrammed manner, to print text.



Text printing prototype process flow (above) Result from text printing prototype (below)



To print larger and more complex images, however, more than 8 bits of resolution is required. To increase the number of pixels per row, but still use the same ink cartridges, the 2D image printing prototype has its ink cartridge mounted onto a scrolling linear slide which moves the cartridge perpendicular to the Addibot's direction of motion. In printing, the process flow of this second prototype is roughly equivalent to that of the text printing prototype, but with a larger number of pixels in each column. Because of the scrolling nature of the linear slide, however, this prototype moves forward when bringing the ink cartridge over blank paper for each new row, and must stop when actually printing a row. As a result, this prototype benefits from being able to represent larger, more complex images, but may not move at a constant rate, like the text printing prototype can.

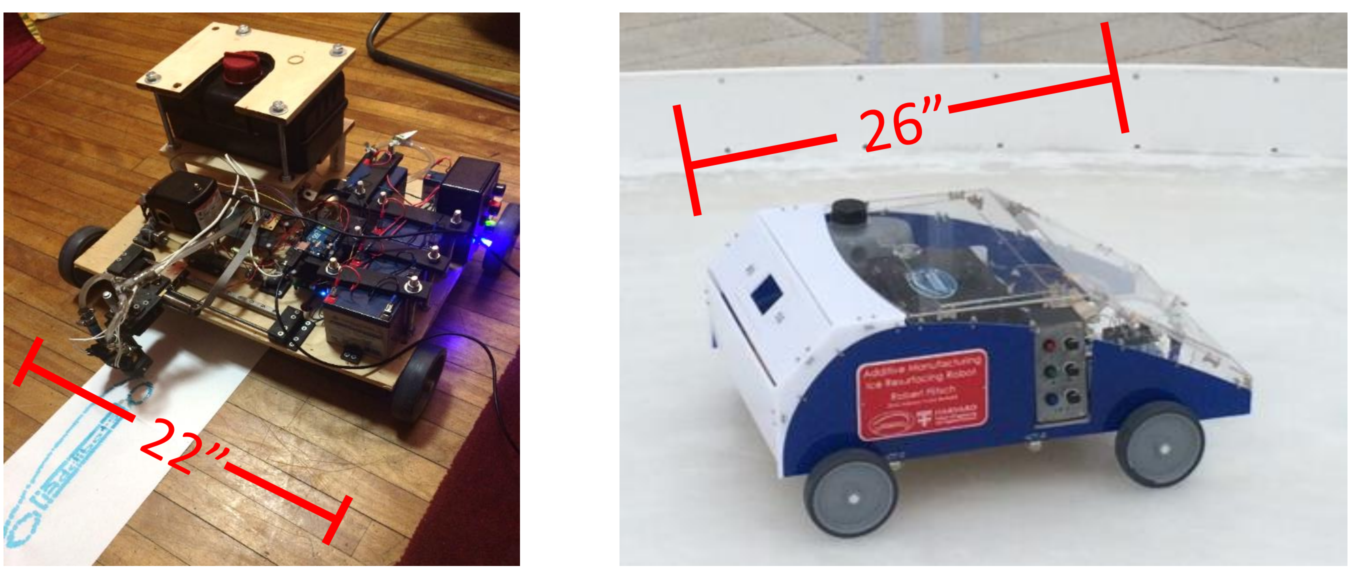


Input (left) and result (right) of image printing prototype (~75 pixel column height)

These prototypes illustrate proof of concept in 2D, demonstrating how an Addibot may be used for highly controlled distribution of material in X-Y, and may even represent different patterns or images with the utilized materials. These prototypes also demonstrate how an Addibot may travel at a constant speed when printing, if the material distribution array has a large enough column height to represent the desired result.

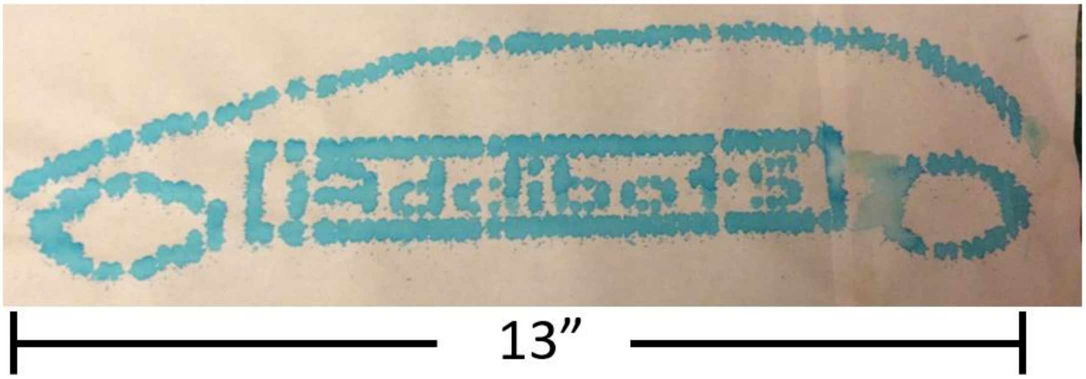
Prototypes III and IV: Ice Resurfacing/ 3D Printing of Ice

From this initial progress, subsequent prototypes were desired with the use of a similar material to expand the results from 2D to 3D. As such, water, possessing similar fluid characteristics to the previously dispensed printing inks as well as an ability to freeze for extrusion, was chosen as the new material and applied to the application space of ice resurfacing, to make an Ice Resurfacing Addibot. To reproduce the results of prototypes I and II with this new material, a 2D water printing Addibot was developed as prototype III. This prototype design was then refined and given thermal processing capabilities to constitute prototype IV, a 3D ice printing Addibot.



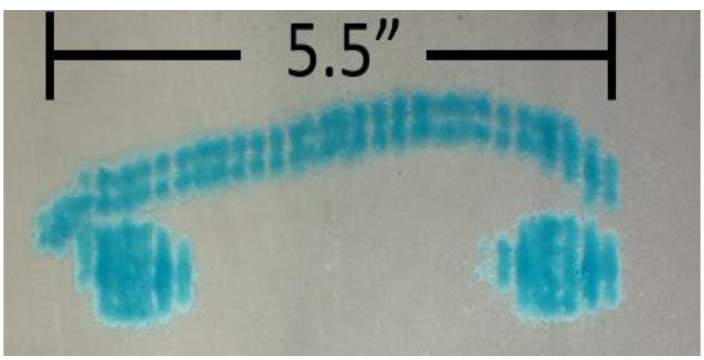
2D water printing prototype (left) and refined 3D ice printing Addibot (right)

To construct the 2D water printing prototype, a new base was outfitted with a material storage and distribution system created to handle the water, as well as drive, orientation, power, and control systems to achieve a similar process flow as prototype II.

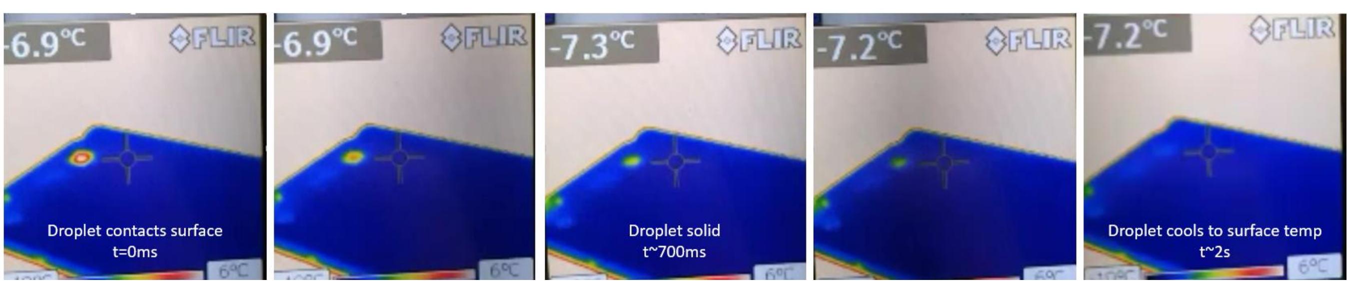


Resulting print from 2D water printing prototype (blue food coloring added to make water visible)

To construct the 3D ice printing prototype, thermal processing of the water was added to the systems already achieved with the 2D water printing prototype: water is cooled on-board the Addibot with a heat exchanger to just above its freezing temperature, at which point it is ejected onto the ice surface, solidifying on contact in ~700ms. The completed 3D ice printing prototype was then tested for performance characteristics on an actual ice rink surface, as well as a controlled testing environment that was constructed along with the prototype.



Extruded ice modified Addibots logo (above left), prototype IV in testing environment (above right), and droplet freezing viewed with IR camera (below)



These prototypes illustrate proof of concept in 3D, demonstrating how material processing added to controlled distribution of material in X-Y allows for extrusion of the material. Further control of the additive manufacturing implements in Z allows for extruding multiple layers to create 3D objects of varying size.

Ongoing Prototype Progress: Prototype V, Roadway Engineering with Addibots

Having achieved proof of concept for the Addibot in both 2D and 3D, it is now desired to expand the concept to work with different materials, as well as devise and construct a distribution array to allow for constant-speed printing at larger scales. There are many possible application spaces that could be tested with new materials, but for a few reasons, road repair and construction were chosen as desired application spaces for continued prototyping. As such, work is currently ongoing towards a distribution array using asphalt materials, as well as additional materials not currently used in typical road constructions; these additional materials may comprise communication lines or introduce additional structural integrity for new types of road surfaces, explored in Addibots' IP, called "Advanced Roadways."

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