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3D Food Printing in Museum Makerspaces: Creative Reinterpretation of Heritage

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Abstract

In recent years, studies into the production of food have broadened to include design and design methods. At the same time 3D food printing (3DFP) is emerging as a viable technology for the production of consumer quality edible products. While advances in 3DFP are witnessed weekly, its use in the context of museums has yet to be explored in depth. In this paper we propose that the museum can be used as a laboratory for engaging audiences in new/creative food production and resultant reinterpretations of heritage through their makerspaces. We explore how a traditional cuisine could be used to inspire younger generations to explore STEM (Science, Technology, Engineering and Mathematics) and, vice versa, how technology enthusiasts could be motivated to explore culinary heritage by preparing food with digital fabricators. This paper reports on the initial research undertaken with the Slovenian diasporic group in Australia. Our results from the in-depth interviews demonstrated that making traditional desserts present a challenge for younger generation. Thus it was decided that a *potica* cake would be chosen as a test case for engagement with heritage through creative 3DFP. Non-edible 3D printed visual prototypes of a jelly cake with a secret message were also trialled. Our research output offers a suitable case study for the central premise that the museum can be used as a laboratory for engaging audiences in creative food production.

Keywords: 3D food printing, makerspaces, museums, culinary heritage, creativity

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1 Introduction

In recent years, studies into the production of food have broadened to include design and design methods. In 2009 the International Food Design Society [1] was founded and in late 2015 the Scuola Politecnica di Design in Milan launched a Master's course in Food Design [2], while similar principles have been also applied by Design Group Italia at their Food Lab [3].

At the same time 3D food printing (3DFP) and other nutritionally-oriented digital fabrication technologies are emerging as viable processes for the production of consumer quality edible products. A 3D food printer is a special additive manufacturing (AM) system which enables the construction of parts using edible materials mainly from viscous materials (e.g. cheese, pate, dough, chocolate, jelly and marzipan) and powdered substances (e.g. sugar). Various standard AM technologies such as FDM, SL, LS, LM, 3DP and PolyJet have been used for food applications. [4]

3DFP is not a new technology, having been introduced in 2006 [5], but the latest development and commercialisation boom in 3D printing has the potential to deliver more applications in the future. Some recently introduced machines include Foodini, ChefJet, CocoJet, Bocusini, Barilla's the first 3D printer prototype for pasta, BeeHex and Pancake Bot (the last two are not 3D printers in a true sense, but use AM technology). Within an EU-funded project PERFORMANCE, a 3D printer for creating visually appealing personalised food for elderly with swallowing and/or masticating problems was developed. [6] The byFlow Focus 3D printers are used by chefs and designers of Food Ink, which in July 2016 in London opened the world's first 3D printing restaurant. [7] In Australia researchers are developing the EdiPulse system for encouraging physical activity with chocolate printed messages. [8]

This study contributes a current discussion about the potential of 3DFP and its possible applications. As a framework for encouraging creativity using 3DFP, museums with their emerging makerspaces (infrastructure) are considered, as well as culinary heritage (content).

2 Museum makerspaces and culinary heritage

While 3DFP technological advances are witnessed almost weekly, culinary heritage and its context within museums has yet to be explored in depth. A traditional cuisine is a rich source of creativity, as evidenced through the recent 3D food printing projects developed using the above mentioned machines. It would therefore be useful to merge making technologies and culinary heritage – having in mind that a kitchen is already a "makerspace". While many burgeoning makerspaces, equipped with rudimentary digital fabrication facilities, are located in community spaces and science/cultural centres, we are currently witnessing a rise in makerspaces are entering museums. [9] In New York, NEW INC, the first museum-led incubator demonstrates the potential for museums to act as creative laboratories. This innovative platform was established by the New Museum in 2013 to support creative professionals not only with their lab-like co-working space, but also with resources from the New Museum's collection of contemporary art. [10] An analogous approach has been established by the Australian Centre for the Moving Image with its ACMI X. [11] It is our contention that something similar could be done in terms of museums covering food and nutrition.

A few examples of 3DFP in museums have already been introduced. For instance, in Sydney by Vivid Ideas 2013, the Eat the Collection project was established by the Powerhouse Museum who collaborated with ten creative industry professionals to interpret and re-use museum objects. [12] During the public event, their reinterpretations were 3D printed in chocolate and visitors were invited to eat them. This project did two things – it introduced audiences to edible 3D printed objects and it introduced them to the museum objects.

3 Culinary heritage of Slovenian migrants in Australia

In order to move this project into the heritage interpretation space and thus allow us to develop engagement strategies, the authors designed a research program which included 7 thematic interviews (and written statements) and 18 anonymous interviews which would be conducted among members of the Slovenian Australian ethnic group. Standardized, open-ended in-depth interview questions along with a few closed, fixed-response questions were developed. Interviews were analysed using applied discourse analytic approach. [13] [14] The participants were drawn from Brisbane, Canberra, Sydney and Melbourne residents who live in Australia for more than a year. Their age range was from 14 to 82. Women (72 % of all interviewees) were keener to participate as they seemed to have been more interested in culinary topics. Due to the small diasporic Slovenian population (25.000 [15]), a project was determined to function well as a pilot for other similar diasporic groups in Australia. The research used culinary heritage as one of the primary indicators of identity, offering that sharing culinary heritage brings people together and forms an important element of intangible heritage.

It was discovered that for many of Slovenian Australians traditional Slovenian cuisine is still a backbone of their lives. Since most of the dishes (especially desserts) require a great deal of preparation time, together with advanced cooking skills and knowledge, they are usually prepared by members of the older generations (grandmothers) for family gatherings during holidays or other special events. At the same time the research results demonstrated that making traditional Slovenian desserts present a challenge for younger generation. Therefore it was decided that a Slovenian *potica* cake would be chosen as a test case for engagement with heritage through creative 3DFP.

A *potica* is one of the most typical Slovenian festive cakes and according to the interviewees, one of the most popular desserts among the Slovenian Australians as well. A *potica* is made from bread dough and filling (e.g. walnut, tarragon, poppy seed). It forms a large hollow cylinder and when cut, has a nut-roll style shape in each slice.

4 The concept of 3D printing potica in a museum's makerspace

As mentioned, the characteristic of *potica* is a central spiral, but through 3DFP, a *potica* can be created in a multitude of different shapes and can incorporate forms inspired by

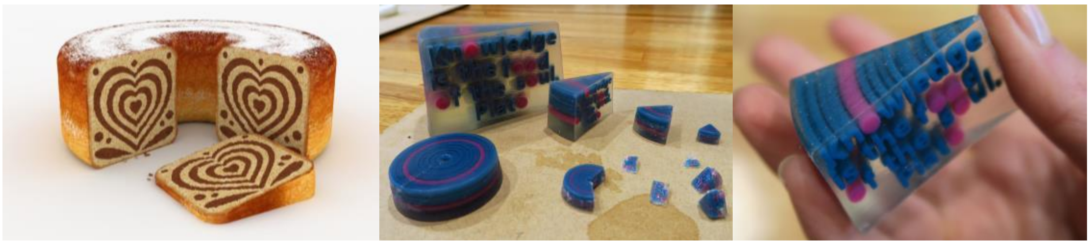

Figure 1: (LEFT) VISUALISATION (CREATED USING RHINOCEROS AND V-RAY) OF A 3D PRINTED POTICA CAKE (CONCEPT). FIGURE II (CENTRE) AND FIGURE III (RIGHT) NON-EDIBLE 3D PRINTED VISUAL PROTOTYPES OF A JELLY CAKE WITH A SECRET MESSAGE.

other Slovenian/Slavic motifs such as hearts, plants and flowers. Short secret messages (e.g. names, quotations, sayings), displayed when a slice is cut could also be created.

The research hypothesized that participants in a museum (e.g. Immigration Museum in Melbourne) could use a special app to design their own image of a *potica* slice using various resources, perhaps from a museum collection. Online collections such as Victorian Collections could be very resourceful (re-use of heritage!).

The Victorian Collections project was developed by Museum Victoria in partnership with Museums Australia (Victoria). [16] Until 7 September 2016 250 items from the Slovenian Association Melbourne are publicly available under an Attribution-NonCommercial-ShareAlike 3.0 Unported Creative Commons License (CC BY-NC-SA 3.0) which allows users to re-use the content for non-commercial purposes. Among the images a digitised hand-made Slovenian carnation pattern made in 1955 by a Slovenian immigrant Neva Roeder-Bole in Opcine, near Trieste (Italy). [17] The research project seeks to use such collection objects as inspiration for newly created images that incorporate these original and new patterns onto the *potica* slice. These are then generated as a 3D computer model (Figure I) and prepared for 3D printing.

Since a two material (two syringes for dough and filling) 3D printer is needed, we propose to use Scientist 3D printer or a similar machine from Seraph Robotics, together with their software for generating multi-material print jobs from a single standard STL file. This 3D printer also represents a further development of a Fab@Home model 2, which was successfully used for 3D printing a prism-shaped cookie with a chocolate letter “C” in the interior. [18]

4.1 Prototyping a jelly cake using non-edible materials

Following the broader idea of creative reinterpretation of heritage through 3DFP, we’ve been verifying the visual form of jelly. The motivation for replacement of dough and filling lies in better material performances for 3DFP of complex details and additional visual representations. Transparency is an interesting feature showing internal forms which can only be properly recognised when a slice is cut. Until now three “cut-off” pieces and two whole visual prototypes (cut later by a knife) of a jelly cake have been built on Connex3 Objet500, an AM machine using PolyJet photopolymers (Fig. 2 and 3). [19] For the outside shape of the cake a rubber-like translucent material (TangoPlus FLX930) was used, for filling (secret message: "*Knowledge is the food of the soul. Plato*") rigid material in colours of 100% Magenta (VeroMagenta) – for letters "o" and 100 % Cyan (VeroCyan) for all the other letters. The 3D computer models created using Autodesk Inventor. In terms of visual appearance the results of the PolyJet prototypes of jelly cakes promise a great usability in makerspaces, offering museum visitors a wide range of possibilities to trigger their creative and innovative potential. In order to build an edible jelly cake a multi-material 3D printer would have to be used. The machines such as Bocusini [20] or more advanced EnvisionTEC 3D-Bioplotter [21] have already demonstrated the possibility of printing gels. Unfortunately only 2.5D parts or 3D parts moulded into a pre-built matrix (or mould) have yet been build due to the characteristic of the material not being able to support itself. However, results from the various research projects with the goal to 3D print human organs [22] or soft robots [23] [24] [25] using gels might assist to solve self-supporting issues of jelly in 3D food printing as well.

5 Discussion

This paper offers a proposition for bringing these seemingly disparate areas together – we propose that the museum can be used as a laboratory for engaging audiences in new/creative food production and resultant reinterpretations of heritage through their emergent makerspaces. The reasons for this are simple – museums offer trusted research environments, collections, infrastructure and audiences through which to explore how a traditional cuisine could be used to inspire younger generations to explore STEM (Science, Technology, Engineering and Mathematics) and, vice versa, how technology enthusiasts could be motivated to partner to explore heritage collections and cooking processes by preparing food with digital fabricators. An implementation of edible material into a museum makerspace has also the potential to create an ecological impact since education regarding digital fabrication processes is usually more important than building useful objects. By our observation and discussions with makerspace providers 3D printed parts are rarely recycled after using or when not built properly. Thus in the context of makerspaces the use of edible materials could be a good alternative to plastic in sustainability terms.

6 Conclusion and further work

While conceptually, a 3D model of *potica* can be created and print files produced, there is much testing of dough and filling or jelly which would need to be carried out. In this way, the use of *potica* serves two purposes: it allows the researchers to explore the technological aspects which would be required to undertake such a project and; it offers a suitable case study for the central premise that the museum can be used as a laboratory for engaging audiences in new/creative food production and resultant reinterpretations of heritage through their emergent makerspaces. This paper forms the basis of the next stage of development which includes partnering with a museum in Victoria, Australia, to create a pilot project within their emergent makerspace as a proof of concept of the central proposition.

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