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PROJECT "DIVINA!" FOR DANTE'S 700TH DEATH ANNIVERSARY

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Abstract

The "Divina!" project stems from the collaboration with the Tuscany Regional Council to celebrate the Supreme Poet and his opus in the seven hundredth anniversary of his death. The project conceived and implemented a contemporary statuary installation that exploits the Divina commedia to prompt viewers to a technological meditation on the importance of preservation, of keeping firm roots in the evolutionary and innovative path, in communication and disclosure.

Keywords

Divina Commedia, interaction of technologies, facial recognition, contemporary statuary installation

1. *Introduction*

Year 2021 marks the 700th anniversary since the Supreme Poet passed away in Ravenna, where he lived as exile, between 13 and 14 September 1321.

On this occasion, many initiatives have been put forward locally, nationally and internationally to celebrate the memory of Dante's voyage, and many more are going to follow to mark this special death anniversary. For all of those, the main actors have been and will be art, entertainment and culture, in a joint effort for reminding to treasure the Poet's experience in crossing the many dark forests of our existence and making it to the ultimate goal, «L'amor che move il sole e l'altre stelle» (Paradiso, XXXIII, v. 145).

The greatness of the Commedia lies in the language in which it is written (which is still our own language, because Dante is actually, as we have been taught in school, the father of Italian language). Its greatness also lies in the feasible world created by Dante, a world in which everything is fantastic (the voyage in the afterlife, the encounters with souls, devils, monsters, angels, and the eventual direct sight of God) but at the same time exceptionally real, because Dante is a poet of reality, who shows emotions and nature, and explains stories and notions (Grimaldi, 2017).

The project Divina!, carried out by the ASTRO (Scientific and topographic applications for operative surveying) laboratory of DICI (Department of Civil and Industrial Engineering) of Pisa University in collaboration with the Tuscany Regional Council, brought together a quite diverse team (Italian linguistics experts, surveying engineers, specialists in the production of installations and platforms for digital content fruition, specialists in the production of creative concepts) with the shared goal of celebrating the modernity of the Divina commedia through the ages.

"Divina!" is an artistic and technologic, or rather a contemporary statuary installation, celebrating the Supreme Poet and his immortal opus of seven hundred years. To both we owe the foundation of our Italian language and the establishment of many prominent references to math and geometry.

Divina! indirectly puts an accent on the relationship between Dante and technology, which, although often overlooked, is anyway easily recognizable in his opus, actually adding yet another element to the global appeal of the Commedia and its ability to be abreast of the times. In fact, on occasion Dante lingers on the exact description of the operation of contemporary machines and technological processes. As an example, the Commedia contains the first ever written reference to the mechanical clock.

"Divina!" also provides real food for thought as regards the importance of preservation, communication, divulgation and innovating while keeping firm roots in evolution. In this perspective,

Divina! aims to shift the viewers' focus on the central role that each person plays in the growth and development of their language, as agent of divulgation.

For these reasons, we tried to replicate, with a contemporary twist, the way in which the Divina Commedia has spread since the fourteenth century until our times: from copyist to copyist, and from people to people.

The goal was to reinterpret both the opus and the poet in a digital reality, with a gaming rationale of immersive media experience contributing to its interactive dynamic propagation: with the subtle irony of the Dante character, it is easy to imagine that, had the Divina Commedia been conceived nowadays, it would most probably have been a video game environment (Caroti et al, 2021).

Divina! includes cross skills, the foundations of which have been shared to bring to life, in this installation, the spirit of everyone involved in the project, all the while keeping the due philological respect.

The team whose joined efforts led to "Divina!" includes:

- Foll.ia Lab, in the persons of Marco Cisaria and Michela Belli, experts in producing creative concepts and artistic installations enacting in users experience and analogue approaches concealing hi-tech content in their path, which handled artistic management of the project;

- Laboratory ASTRO, headed by Gabriella Caroti and Andrea Piemonte, provided global management of the project, also handling development of the required software, coding the Divina Commedia text, face identification, matching users with newly generated tercets and finally, the setup of the website for continuing the experience started with the fruition of the installation;

- ACAS3D Soluzioni Digitali, a spinoff of Pisa University, in the person of Federico Capriuoli, which handled technical and logistics management, thanks to their established experience in managing multidisciplinary teams to create installations and platforms for digital content fruition;

- Giuseppe Patota, full professor of Italian Linguistics at Siena-Arezzo University and member of Accademia della Crusca, who provided humanistic counselling and supervising and who validated the scientific foundations that inspired the artistic installation.

2. *Artistic concept*

In the installation, the Supreme Poet, the poem, the people, and the means of divulgation are reinterpreted according to the digital media paradigm (Fig. 1).

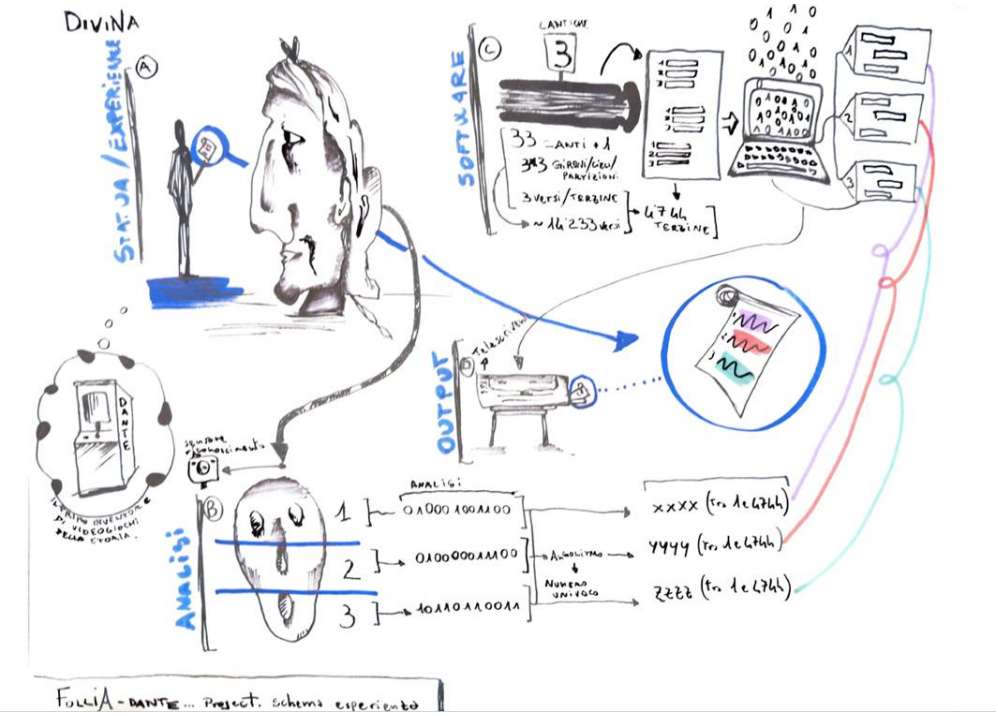


Fig. 1: DIVINA! Project

Fig. 2: DIVINA!

In order to achieve this (Fig. 2):

- Dante is present as a bust, but the usual features, as handed down through the ages, are somewhat pixelated;

- a digital copy of the Divina Commedia has been used, with each verse unequivocally coded;

- faces have been selected as custom ID for people. Face recognition is performed by a 2021 depth scanning sensor, integrated with Artificial Intelligence algorithms (Intel's RealSense ID). This surveys the user's face, recording a mesh of vertices and surfaces and establishing a mesh-user relationship. Face geometry of each user is then associated, in a matter of seconds, with its own unequivocal FaceID code;

- FaceID is subsequently fed to a processing algorithm, which randomly selects three unrelated verses from the Divina Commedia. These form a new, anomalous tercet, also univocally associated to each user.

In addition, different communication technologies, spanning from the 1940s to our days and using different languages, have been implemented thanks to a shared linguistic mediation, i.e. machine language – or binary code - the first ever programming language.

User tercets are then fed to four different output devices:

- the first one, via USB port, is the system printer, which prints the tercet on paper, along with an alphanumeric code and a QR (bidimensional matrix) code. These in turn grant access to the divina700.it portal, where the original canto for each of the verses of the user tercet can be displayed and printed out;

- the second one, via serial emulator on USB port, is a Commodore C64 gaming computer from the 1980s, which will display the tercet on-screen;

- the third one is an array of TV sets from the 1950s up to the 1970s, driven by media players acting as digital-to-analogue converters, since the TV sets have no mean to accept digital signals on their own;

- the fourth device is an Olivetti teletypewriter from the 1940s. In this case, the PC encodes the tercet as an audio signal, which is sent via the system soundboard to the teletype modem:

subsequently, the signal is decoded and printed out.

This display of technological acrobatics should prompt users to read the three cantos of the Supreme Poet's opus from which their tercet was generated, thus turning them into sort of populizers.

Divina! encompasses almost a century of scientific and technological advancements, comparing them in their full scope to bring a message of continuity and communication which, starting from the human face, widens the time dimension, from past to future, highlighting the immortality of the roots in their broader meaning.

3. Technology

The technology component is an essential part of the installation: the decision to use and interconnect communication systems dating almost a century apart has posed quite a challenge.

Current technology used in the project includes a latest-generation Intel sensor for facial recognition and a personal computer, whose processing and graphic abilities qualify as a gaming computer, and therefore also well-suited for complex photogrammetry processing.

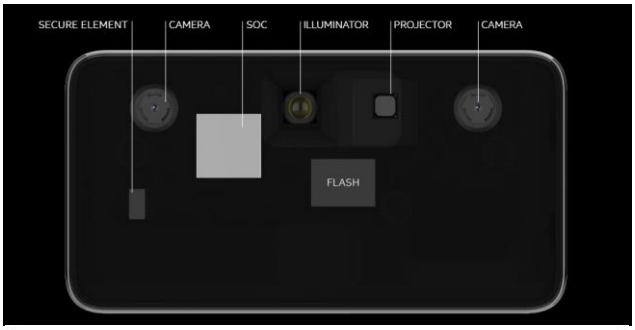
Going back in time, vintage technology includes a Commodore 64, i.e. a gaming PC/console from the 1980's, and a teletypewriter from the 1940s.

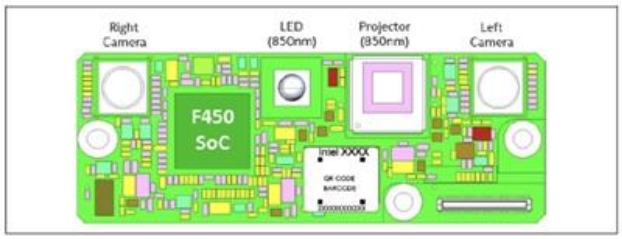
The signal generated from the contemporary Intel sensor is translated, sent over and viewed by seemingly outdated communication systems, thanks to their shared binary language root.

3.1 Current technology

The "modern" components of the system are:
- a gaming PC;
- a webcam;
- a scanning sensor;
- a programmable footswitch;
- a printer.

The gaming PC is the brain that controls the whole system. It features a 7.0GHz Intel CPU, solid state disk and RTX video cards. It hosts all the software required for the control of the various components, both modern (footswitch, face scanning sensor, webcam, printer) and vintage via USB and jack audio ports (teletypewritter). A very important part of the installation is clearly the facial recognition sensor. There are many solutions on the market, some even completely open, such as a simple webcam: on the other hand this would have most probably entailed lighting-related problems. The choice fell on the RealSense ID sensor, designed by Intel exclusively for facial scanning and claiming a recognition accuracy of 99.76% (Fig. 1). Its compact, lightweight design and form factor, allowing greater installation ease and flexibility, was also an added bonus as regards decision criteria (El Bouazzaoui et al., 2021. Li, D., et al., 2021. Celakil, T., et al. 2021).





SECTION	DESCRIPTION
SOC	System on Chip
Right Camera	Full HD Camera
Left Camera	Full HD Camera
Projector	850nm IR
LED	850nm IR
Host Connector	IPEX 20708-050E Plug (50pin)
Crystal	24MHz
Flash	512Mb Storage

Fig. 3: Intel RealSense solution, module and component list

In detail The Real sense ID is composed by:
- Optical system (OS).

The OS consists of two rgb cameras and an Infrared (IR) system:

- the rgb system (mono fov). It features different field of view values (HFOV 59°; VFOV 80°; DFOV 90°), and captures images from different perspectives for the purpose of 3D triangulation

- the IR optical system. It includes an IR LED for face illumination in low or non-uniform lighting conditions, and an IR dot projector for 3D triangulation.

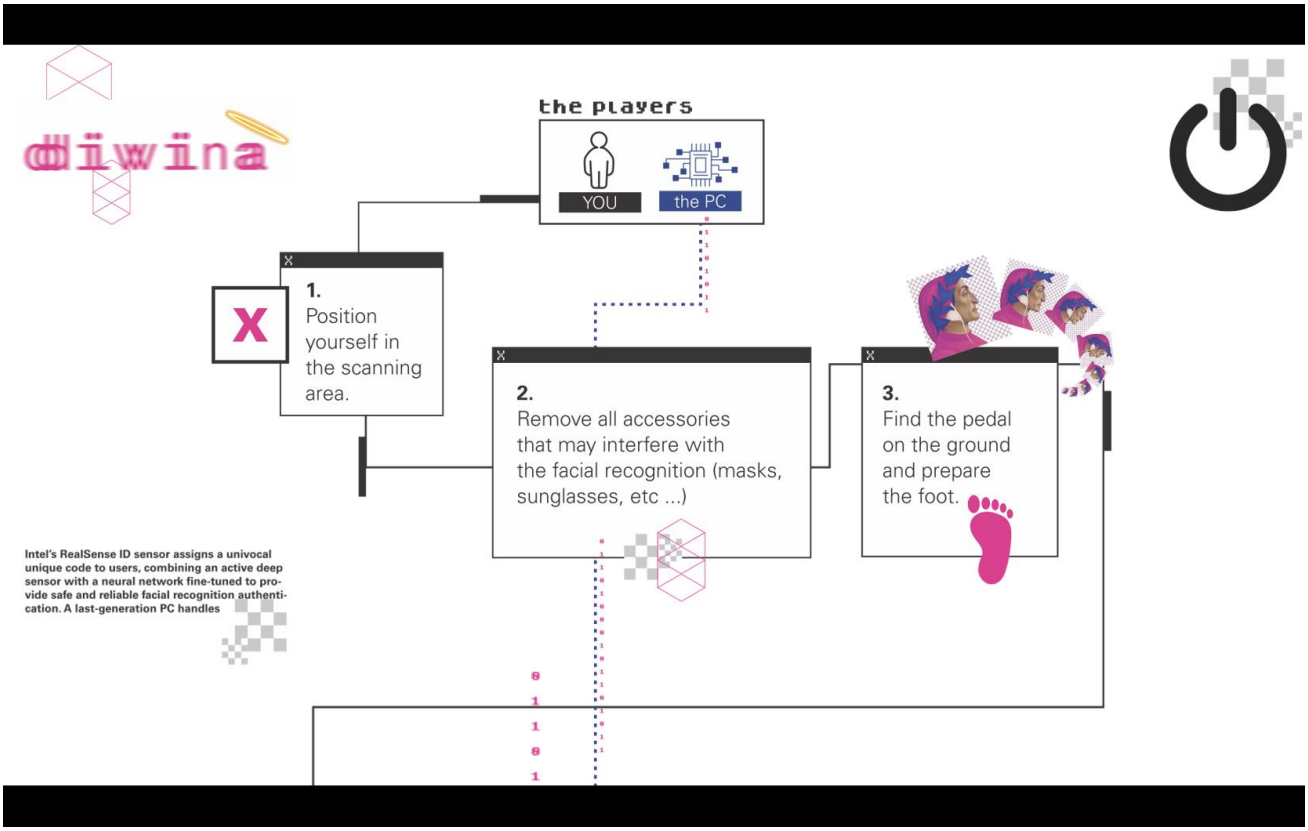
Multiple acquisition systems (RGB + IR) enable for operation in different light conditions, without having to provide an ad hoc background or a

dedicated lighting system. In addition, these allow for relatively natural user movements. Also very important is that the facial recognition process is based on a neural network. In the specific case it is a feedforward network with supervised learning. The system is closed and access or editing is not allowed on the network, but only on the sensor management software. The presence of this network guarantees extreme speed to the process and guarantees the accuracy of 99.76 in scan repeatability.

The software process is based on three steps:

- enrolment – first recognition (the sensor generates an internal FaceID);
- registration – writing new username;
- authentication – of an already registered user.

In order to improve global usability, the user interface has been modified, and the above steps have been brought together, so that users can start the scan process on their own by simply pressing a footswitch. Upon recognition of each user, the RealSenseID generates an univocal FaceID, which is then converted into "Divina_ID", a 9-digit alphanumeric code. This is in turn fed to a randomizing algorithm, which selects three unrelated verses from the entire digitized and encoded Divina Commedia, to generate user tercets, which are printed out along with Divina_ID to allow continuation of user experience on the Web. A crucial step is to repeat the experience, so that users can check the consistency of the face-tercet association (Fig. 4).



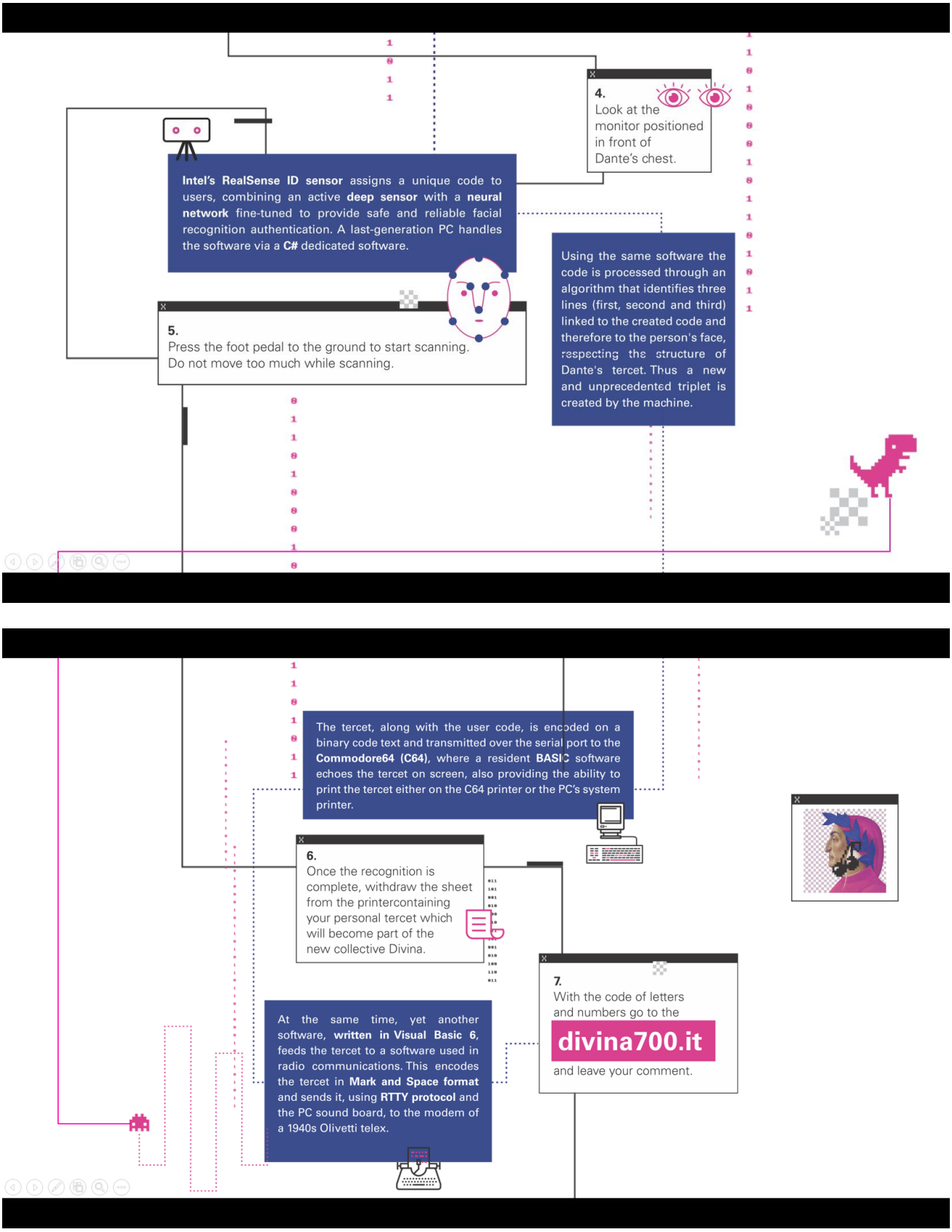


Fig. 4: DIVINA! Workflow

3.2 Vintage technology

The Divina! installation is meant as a reflection on language and on the ways of communication. Description of the technological workflow has purposely been subdivided in two paragraphs, since enabling mutual communication between technological components belonging to and used by different generations, is a major goal of the project. One of the first and most popular gaming computers of the 1980s, the Commodore 64 (Fig. 5), was interfaced with the modern desktop PC in order to receive the tercet text.

Fig. 5: Commodore 64

Connecting two computers designed 40 years apart is neither easy nor immediate. First of all, current computers lack the 9-pin COM serial ports which the Commodore uses. It was therefore necessary to first build an ad hoc cable that permit to use the USB standard port in connection with the Commodore's 24-pin user port (Fig. 6).

Secondly, it was necessary to write a program for the Commodore to "listen" on the serial port and be ready to receive a text string. This program was written in BASIC, a typical coding language of the 1980s (Fig. 7).

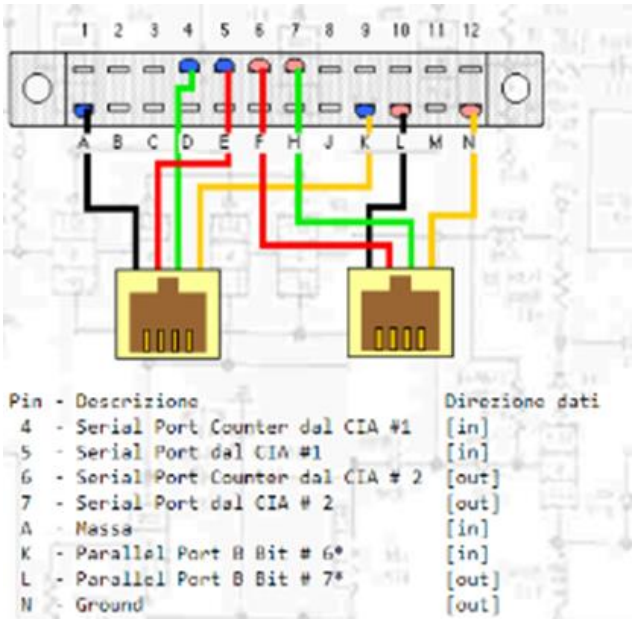


Fig. 6: 24-pin Commodore user port

Fig. 7: Appearance of BASIC code

An interesting aspect concerns the subsequent display of the tercet on the screen and on one of the TV sets of the installation. Since the Commodore was a computer from the 1980s, the video output standard was already analog via RCA coaxial cable (Fig. 8), also because, in those years, computers often used a normal CRT TV set instead of a dedicated monitor. A format converter was therefore not needed; on the other hand. intermediation of some kind was required to run a current MP4 video file residing on a USB pen drive on all the other TV sets in the installation.

Fig. 8: RCA coaxial cable

Tracing back further the communication workflow leads to one of the most fascinating technological components of the installation: the Olivetti teletypewriter (also referred to as teletype or TTY; Fig. 9 and Fig. 10). It is an automatic electromechanical device for receiving and writing texts. This type of equipment found widespread use in the transmission of postal messages in the first half of the XX century. In the collective imagination they are often associated with the image of communication centres of the second World War.

Fig. 9: Olivetti teletypewriter

Fig. 10: Modem and power supply for Olivetti teletype

The format in which the TTY receives a message is typical of radio transmissions: it is a two-tone audio signal transmitted on two distinct frequencies. The base frequency is 1496Hz with a shift from the other of 425Hz and a baud rate of 50bd (equivalent to 60 wpm-word per minute transmission velocity). The encoding is called Mark & Space and the protocol is called RTTY. The desktop PC, where the tercet is generated, sends a RTTY-compliant signal to the teletypewriter through the headphone output of the sound card.

In this case, two software components act as language intermediaries: the first is MixW, a software borrowed from the world of radio amateurs, which manages service messages between PC and TTY and the conversion of text files into the appropriate format (Fig. 11).

The second is a software written in Visual Basic that automates the process and, since the MixW does not provide the ability to send commands and functions from the outside, simulates a virtual operator manually using MixW, importing tercet text to be printed.

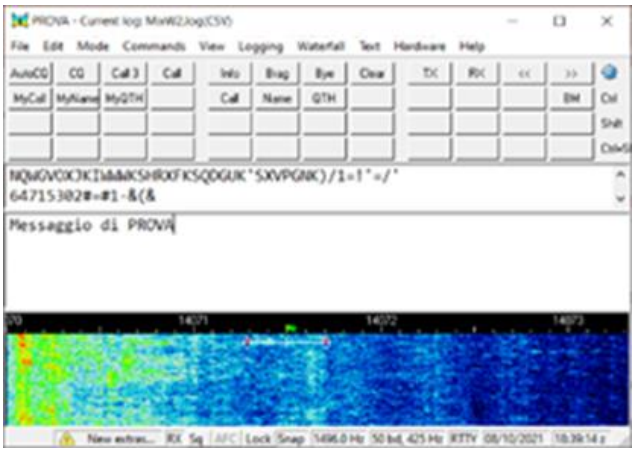


Fig. 11: MixW software interface

Without delving into the description of the technology, it is interesting to give only some suggestions on the operating principle of this equipment and in particular on the language used. As stated above, a Mark & Space type coding is used. This is very similar to a perhaps better-known language, i.e. the Morse code. The square wave transmits packets of 0 (Mark) and 1 (Space) which are nothing more than pulses that move a switch in two possible positions: "Position 0" and "Position 1". The international 5 bits coded Baudot alphabet is used (Fig.12).

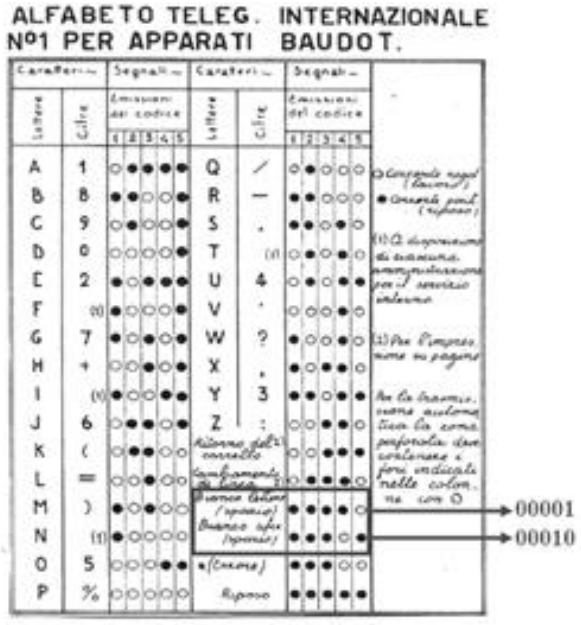


Fig. 12: Baudot alphabet

In the teletype, the positions of the switch translate into the displacement of 5 racks in 2 possible positions (Fig. 13). Considering the number of possible combinations of the positions of the bars, these are 25 (two to the power of five), i.e. 32 positions. These correspond to the 32 possible characters that the TTY is able to write for each carriage position (one for letters and one for numbers and symbols).

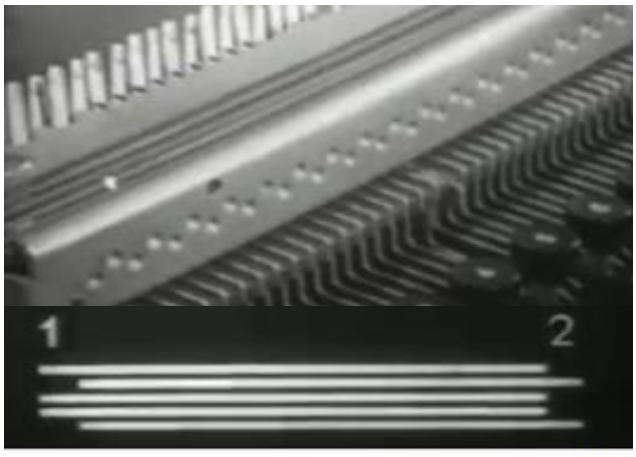


Fig. 13: Teletypewriter racks

4. Conclusions

The above description of the technological workflow and components provides ground for further elaboration.

The Divina Commedia was written more than 700 years ago by a putative father of the Italian language.

The written text of the Divina Commedia has come down to our times without intermediaries other than those relating to the transcriptions or reprints of the text as it was.

Unlike the written text, technology needs many more "linguistic" intermediate processes to ensure that contents created – and usable – on a given device remain so over time.

Finally, a big thank you to Dante, for writing a book seven hundred years ago, without which none of this would have been conceived.

Also, a special thank you to culture and education, for coming out on top still today, as surely will tomorrow.

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REFERENCES

ACAS3D Soluzioni Digitali Site. Retrieved from https://www.acas3d.com/

Alemayoh, T.T., Lee, J.H., & Okamoto, S. (2021). New sensor data structuring for deeper feature extraction in human activity recognition. *Sensors, 21 (8), art. no. 2814*. DOI: 10.3390/s21082814.

ASTRO Laboratory Site. Retrieved from https://dici.unipi.it/laboratori/laboratorio-astro/

Caroti, G., Piemonte, A., Capriuoli, F., Cisaria, M., & Belli, M. (2021). Divina! A reflection between language and technology accompanied by Dante Alighieri's avatar. *REAACH-ID 2021 Symposium.*

Celakil, T., & Özcan, M. (2021). Evaluation of reliability of face scanning using a new depth camera. *The international journal of esthetic dentistry,* 16 (3), 324-337.

Consiglio Regionale Toscana - Celebrazioni per i 700 anni dalla morte di Dante Alighieri. Retrieved from https://www.consiglio.regione.toscana.it/default?nome=avatardante

El Bouazzaoui, I., Rodriguez, S., Vincke, B., & El Ouardi, A. (2021). Indoor visual SLAM dataset with various acquisition modalities. *Data in Brief, 39, art. no. 107496*. DOI: 10.1016/j.dib.2021.107496.

Grimaldi, M. (2017). *Dante, nostro contemporaneo. Perché leggere ancora la 'Commedia*'. Castelvecchi. EAN: 9788869449253.

Intel Realsense Site. Retrieved from https://www.intelrealsense.com/facial-authentication/

Li, D., Sun, X., Elkhouchlaa, H., Jia, Y., Yao, Z., Lin, P., Li, J., & Lu, H. (2021). Fast detection and location of longan fruits using UAV images*. Computers and Electronics in Agriculture, 190, art. no. 106465*. DOI: 10.1016/j.compag.2021.106465.

Petrocchi, G. (1994). *La Commedia secondo l'antica vulgata.* Casa Editrice Le Lettere, Firenze. Retrived from https://it.wikisource.org/wiki/Divina_Commedia