Cultural Control Room: CETRA addresses and exploits the IoT to innovate Cultural Heritage promotion

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Abstract. CETRA - Cultural Equipment with Transmedial Recommendation Analytics - is a comprehensive combination of IoT (Internet of Things), machine learning, recommendation, content adaptivity and Big Data Analytics applications, in line with a new concept of transmediality, aiming to close the gap between tourist-cultural promotion requirements and the need to deliver personalized, dynamic and accessible heritage content to users. The paper will describe the research results related to new technological solutions addressing the heritage experience in an era of: massive content production and massive participation by visitors who demand personalized involvement.

keywords: IoT (Internet of Things), machine learning, recommendation systems, content adaptivity; Big Data Analytics applications, transmediality, tourism, cultural promotion

1. The context
We live in an era of massive creative content production let it be video (e.g. through YouTube [1]), pictures (e.g. through Instagram or Pinterest), or social (such as TikTok), mixed textual and pictures (e.g. Wikipedia), etc. At the same time, the consumption of content grows as steeply as the offer, due to massive users' participation.

Examining cultural reports by ISTAT related to cultural tourism: in Italy only one museum out of ten (10.4%) carried out the digital cataloguing of their collections, about a third of them (37.4%) have completed the digitization process, two thirds have started the digitization activities but have covered about 50% of the goods and collections available. The use by Italian museums of interactive technologies and digital tools to enrich the visit experience and the engagement of the public still appears limited: half of the surveyed cultural institutions (44.7%) offer to their visitors up to one device (smartphone, tablet, touch screen) as visit aids such as video and / or multimedia rooms, QR codes.
Code technology and augmented reality paths. Moreover, online communication involves an increasingly large number of structures: only half of the institutes in Italy have a dedicated website (51.1%) and 53.4% have an active profile on the most important social media networks previously mentioned. A good measure of the fact that ICT can support economic growth of cultural heritage sites is the number of subjects offering the possibility to buy tickets online has doubled in three years (from 6.6% in 2015 to 14% in 2018) and we evidence the fact that museums cannot further their services just providing internal information but are expected to provide better and more enriched information about eternal services (transportation, city events, etc.): 38.4% of museum institutes publish links on the web to digital maps and / or geographic coordinates useful for the geo-location of the structure and one museum out of ten (9.9%) offers the possibility of visiting their institution virtually.

This paper explores new ways to explore massive cultural resources (e.g. collected and published by museums, archives, libraries, archives, government bodies, publishers, cultural institutions), process them, index and map them, and finally enable cultural operators to transform them in new creative narrations accessible from multiple network of IoT devices in museums, bus stations, airports, tourism information offices. Tourists needs range from cultural services (tour guides) to transportation, restaurants, sports, entertainment, shopping, localized information (e.g. health): all these services need to be flexibly interlinked in ways visitors might quickly choose, participate and finally take advantage for their best experience, as a whole.

![Figure: users’ needs range from cultural and knowledge to transportation, hotels, shopping, entertainment, etc.](image)

The research we conducted includes machine learning applications which analyses users’ anonymized content fruition and proposes personalized stories in response to their requests.

2. Current State of the Art: resolving the needs of cataloguing and promoting cultural resources

M.E.T.A. has developed many specialized platforms dedicated to cultural operators under open source licensing. Just to mention two of them:
metaFAD: Museums, historical archives, institutions, libraries can catalogue and reorganize their heritage and make it available in digital version, respecting the standards and operational indications of Istituto Centrale per il Catalogo e la documentazione Istituto Centrale per gli Archivi, Istituto Centrale per il Catalogo Unico. metaFAD is modular software to manage and catalogue archival assets, art collections and libraries in a single integrated virtual environment, allowing their immediate access through the web. A multi-standard platform with Open Source license. Cultural institutions can manage and organize cataloguing cards from acquisition to publishing, and they can expose them as linked open data (LOD). metaFAD main adopters we mention: Archivio Storico della Segreteria di Stato del Vaticano, Gallerie degli Uffizi, Museo dell'Opera di Santa Maria del Fiore (Florence), Biblioteca Nazionale Centrale di Roma, Biblioteca comunale degli Intronati (Siena), Archivi Fratelli Alinari (Florence) and Polo digitale di Napoli.

MOVIO: is a storytelling platform for curators of museums and libraries (working for public institutes, foundations and cultural enterprises), gallerists, archivists, librarians, teachers (schools at various levels, universities and professional institutes), tourist guides. It is a multifunction platform for the creation of multimedia exhibitions and storytelling as well as exhibition guides. It is based on open source technology, can be easily integrated with existing platforms and complies with access standards. MOVIO enables museum curators to create virtual exhibitions and digital extensions of real exhibitions. It guides the visitor by means of theme pages, and enables the publication of multimedia galleries, timelines, slide-shows and interactive geographical maps.

These are just two of the many applications realized by GruppoMeta (M.E.T.A.) and address each just specific needs expressed by GLAMs (Galleries, Libraries, Museums) and cultural institutions in general. The challenge is to set up new integrated models capable to do cataloguing, management, digital preservation, valorisation, monitoring, promotion of heritage resources. More than just combining technological solution, as the complexity increases, we aimed at extending he user side experience.

3. Museum ‘control room’

How might IoT solutions and digital signage support the Cultural Heritage Innovation need for content distribution?

3.1. The concept

The project intends to offer value-added tourist storytelling services. We want to improve the tourist enjoyment of the user, who today is not very "experiential and personalized", and perfect the visit experience by not focusing only on the "points of interest" of a place. The goal is to go beyond the predefined paths of the tourist guides and abandon the usual description criteria that are often too conventional. It aims to revolutionize content creation thanks to the potential of digital content engineering solutions and to suggest different ways of accessing information. CETRA (Cultural Equipment with Transmedial Recommendation Analytics) activates content related to the visit, for an increasingly demanding tourist, conveying, for example, today's places through the narration of travel stories, chronicles and magazines of centuries of history, to involve the user and enrich his experience. This "mirror heritage" will connect places, famous and less famous than the urban fabric, preserving the emotional continuum of the visit.
The idea is to meet the new needs of modern cultural tourism, increasingly a tourism of discovery, making the user experience unique, personal and shareable.

CETRA (as a complement technology to M.E.T.A.’s established platforms) has been designed as a ‘Control Room’ to convey content, photo galleries, interactive applications to digital devices (totems, interactive screens, digital signage) of the museum of the Institute or to devices at info point.

Cultural managers can create and publish collections expositions, video or multimedia animations on predefined public locations (in the museums, in churches, in transport stations or in other public spots) on specific devices.

CETRA takes advantage of digital signage: using IoT we aim at offering one stop solution to cultural institutions, a single box ‘all in one’ system with a preinstalled applicative solution for devices management, and application software for content distribution. The devices receive museum’s content and will offer predefined set of functions (e.g. interactive multimedia displays, multimedia player, interactive visualization of timelines or geographical maps). We believe that more than museums all public sectors might take advantage of ready to use devices: put them on and play. Imagine public offices (e.g. in municipal and government buildings); exhibition bodies (e.g. fairs, exhibition centres, airports, large campuses etc.). In a short time, the cultural manager or the curator can have the devices installed and choose which visual content to display, which dynamic and interactive multimedia contents make accessible to visitors.

The interconnected devices are managed by a simple and intuitive graphical interface (during the experimentation the learning time is less than 30 minutes / 1 hour). The contents distributed by content producers and archives, are searchable from within the application.

3.2. The services
After you installed CETRA on networked (or even off-line devices), we will be able to offer value-added services, including:

1) the personalization of branded templates according to the models requested by the customers (benefits: strong customization at low cost - the devices can be updated and remotely maintained with vertical offers-). This is particularly valuable for luxury hotels who care about cultural furniture.

2) Visitor flow tracking services for planning visits (for example, to identify bottlenecks or low flow and to offer groups of visitors or school groups access at a discounted price in less crowded periods (optimization of visitor flows), new location based services or spot based functions –i.e. QR code next to artworks etc.), risk analysis services (in the event of a fire there are risks of traffic jams at the escape entrances).

3) Services for accessing multimedia content and creating personalized guides for the visitor.

4) Management applications (e.g. remote control of devices: turn them on, turn them off, alerts).

5) Interconnection of cultural institutions and museum networks: CETRA is predisposed through API services, to be interoperable with existing cultural platforms (e.g. metaFAD and MOVIO previously mentioned).

3.3. The processes
CETRA improves the exhibition processes through a dedicated solution for digital communication, simplifies the creative workflow. It shortens the path between the organizations and visitors: it provides information about itineraries, about access to buildings (museum map, location of the shop, refreshment and toilet services); it provides multimedia guiding at the information points; it improves the internal processes of the museum for the publishing of the catalogue, the management of resources, the archiving of media and document, the monitoring and analytics, the inventory and safety and security of people.
3.4. Innovative aspects

CETRA is a 'network system', in which a node communicates with other nodes and with the infrastructure, enabling structural efficiencies throughout the creative industry's operational flow. In the future CETRA could be adopted by tourism and urban sector organizations (municipalities, mountain communities, the Region). Let's see some innovative features of the project:

- Industry 4.0: CETRA uses devices that will be enabled for recognition and interconnection functions and will be managed remotely. Like 'Lego' blocks, the devices will interoperate through the dedicated operating system, while the Semantic Content Manager is the tool with which the contents will be processed on the different devices. Each device on which CETRA will be installed is an 'intelligent' piece: individually the CETRA devices allow person-machine interaction and are managed remotely (configured, synchronized, enriched with new content or functions). Each installation transmits its status and information on the flow of visitors.
- Intelligent content broadcasting: CETRA is set up with connections to the main cultural knowledge sources chosen during the project phase. The cultural curators might show their collections on remote totems distributed in the territory.
- Simplicity and usability: the installation kit is intended to be simple and complete, installation and configuration must take less than three hours for the basic solutions (installations such as totems or monitors with software equipment). The management of the back end and front end also want to be highly usable and accessible. Management can take place through online access. During the experimentation with operators with a humanistic background, the average learning time was less than an hour.
- Human-machine interaction: CETRA intends to be the first prototype of an intelligent museum device. The visitor, with his own movement (gesture recognition) can interact with the device, then choose options, move virtual objects, activate interactive multimedia projections (the devices can be of different types: projectors, monitors, touch screens, smart-screens) such as for example dynamic timelines, interactive geographic maps, photo galleries, conceptual maps, cultural games, quizzes etc.).
- CETRA and sensors: we include visitor trace analysis components to create services and activate user flow processing models (BigData) and therefore predictive models on user flows at various times of the day, week and year.
- Simulation: connection simulations of visual databases of public data and heterogeneous archives such as photographs, text collections, audio and video tracks in virtualized exhibition environments.
- Horizontal / Vertical Integration: shortening the distance between production and consumption allowing in the near future, the user who admires a painting in a museum, to be able to order a print on the spot, to be found ready to take away when leaving museum or sent by post to your residence.

3.5. Future scenarios: the stakeholders

The final objective of CETRA is to make visitors’ experience be enhanced in the reality as information and promotion is on the place attracting towards the real world, the real artworks. As such, CETRA is a mirror of the heritage enabling tourists to feel comfortable and confident of high quality information.

CETRA is expandable and will be adapted to new relevant functions at the level of:

- **Public Administration**, the Regional Authorities (or other local PAs) could one day exploit the network of museums and archives, interconnecting the cultural offer and fruition services, unifying the publication of guided tour applications, integration of
services for operators’ hospitality, proposing to tourists’ itineraries, events, exhibitions, festivals, etc. CETRA could in fact become a territorial marketing tool where the contents to promote the territory were offered both by peripheral nodes and by a central institutional operator.

- **Tourism operators**: the tourist operators for the reception could present to the passing tourist, at their shops to the public: panoramic views, local events, scheduled events etc. In fact, many tourists do not have a vision of the cultural offer or of events (e.g. folk events, religious, festivals etc.). CETRA could be used to furnish restaurants and hotels with photos, videos.

- **Transport operators**: we imagine the waiting rooms, at the baggage claim, in the railway or bus stations, the digital signage devices present in addition to advertising products, presented cultural content. No more only boring advertisements but high quality cultural shows instead.

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