PVBLICA

DAI Il Disegno per l'Accessibilità e l'Inclusione

A CURA DI
Tommaso Empler, Adriana Caldarone, Alexandra Fusinetti

ISBN 9788899586478

Tommaso Empler, Adriana Caldarone, Alexandra Fusinetti
DAI - Il Disegno per l'Accessaibilità e l'Inclusione - 2024

ISBN 9788899586478
Pubblicazione Dicembre 2024

PVBLICA

Dipartimenti di Architettura, Design e Urbanistica
Università degli Studi di Sassari
www.publicapress.it

PVBLICA

DAI Il Disegno per l'Accessibilità e l'Inclusione

A CURA DI
Tommaso Empler, Adriana Caldarone, Alexandra Fusinetti

ISBN 9788899586478

Il volume raccoglie i contributi, dei relatori e degli studiosi, pervenuti in occasione della conferenza DAI - Il Disegno per l'Accessibilità e l'Inclusione 2024 che si è svolto a Roma il 5 e 6 dicembre 2024. La valutazione dei contributi pubblicati è avvenuta con la modalità del double blind review.

Indice

Introduzione
Tommaso Empler 12

FOCUS 1
Il disegno per l'accessibilità e l'inclusione socio-culturale

Mani che comunicano. I linguaggi gestuali e la loro rappresentazione grafica
Valeria Menchetelli 18

***Autism friendly escape room*: un *Serious Game* inclusivo per la Sagrestia del Vasari a Napoli**
Alessandra Pagliano, Greta Attademo, Alessandra Coppola 40

Digitalizzazione e partecipazione: il PEBA di Corciano come modello di accessibilità e inclusione
Marco Filippucci, Fabio Bianconi, Simona Ceccaroni, Filippo Cornacchini, Matilde Cozzali, Rebecca Rossi 56

***HeritageMap* for accessibility and inclusivity in cultural heritage. The 'Open-air Museum of Contemporary Art Works' MAP in Faenza**
Elisabetta C. Giovannini, Jacopo Bono 72

Fruizione aumentata del patrimonio perduto: configurazione degli embrici delle cupole napoletane
Gianluca Barile, Nicola Rimella, Francesca Maria Ugliotti 90

Miglioramento dell'accessibilità e attività di tutela nella città storica: esperienze nel mantovano
Giulia Bressan 108

Segni e Disegni per rappresentare l'Architettura. Un progetto interdisciplinare di orientamento, accessibilità ed inclusione
Maria Cristina Azzolino, Michela Barosio, Giulia Bertola, Martina Crapolicchio, Rossella Gugliotta, Angela Lacirignola, Martino Pavignano, Francesca Ronco, Ursula Zich 122

La ricostruzione automatica e la fruizione aumentata dei frammenti archeologici
Gianluca Barile 146

Il coro ligneo della Basilica di San Giorgio Maggiore a Venezia. La fruizione tattile per la conoscenza culturale
Sonia Mollica, Giulia Piccinin, Antonio Calandriello 162

Microarchitetture sperimentali per la rifunzionalizzazione degli spazi nella scuola post-pandemica
Daniela Ladiana, Chiara Iacovetti 176

Spatial representation and psychological well-being: new digital perspectives on environmental psychology
Piergiuseppe Rechichi, Gianluca Sesso 188

FOCUS 2
Il disegno per l'accessibilità e l'inclusione cognitiva

***The Algorithm as Terapy. Secret Talks*, a case study of the design and development of Digital Therapeutics**
Giorgio Buratti, Yingfei Zhu 210

Museum Accessibility. A Framework based on a Didactic Studio
Dina Riccò, Weihuan Hou 226

Neurodiversità e spazi verdi urbani. Soluzioni per giardini sensoriali e terapeutici
Cristiana Cellucci 242

Percezione visiva ed emozioni. Prevenire il disagio nei soggetti affetti da disabilità intellettive
Gaia Leandri 256

Da BES a Tutor: vedere per far vedere
Ursula Zich, Laura Nicoletta Bello 268

Realtà Virtuale e possibili applicazioni in ambito didattico. Per una comunicazione più inclusiva del *Cultural Heritage*
Nicola La Vitola, Sonia Mollica 286

FOCUS 3
Il disegno per l'accessibilità e l'inclusione spaziale

Percezione accessibile delle forme geometriche del tempo
Cristina Candito, Alessandro Meloni, Ilenio Celoria 302

Cortina d'Ampezzo accessibile: un progetto di mappatura interattiva
Caterina Balletti, Valeria Tatano, Fabio Martinello, Mattia Menardi 320

Il Castello per tutti. Sguardi tattili per inedite visioni
Ivana Passamani 334

Aree gioco urbane accessibili: percezione e configurazione
Segalerba Alessia 354

Il rilievo per la fruizione degli spazi inaccessibili. Il bazar di Kruja in Albania
Gianluca Gioioso 370

Esplorazioni virtuali multilivello per la divulgazione e l'amplificazione della conoscenza del Patrimonio Architettonico
Mara Gallo 382

***Wayfinding*, interpretazione e comunicazione dei siti archeologici protostorici della Sardegna**
Enrico Cicalò, Michele Valentino, Alexandra Fusinetti 398

FOCUS 4
Il disegno per l'accessibilità e l'inclusione museale

koinESTE. Percorso digitale per tutti, progetto di accessibilità
Andrea Bruciati, Angela Chiaraluce, Lucilla D'Alessandro, Tommaso Empler, Carlo Inglese **416**

Dall'immagine al modello: l'impiego delle mappe di profondità per la restituzione aptica di dipinti
Alberto Sdegno, Veronica Riavis, Silvia Masserano **428**

Alla ricerca di un senso. Prime riflessioni metodologiche sull'accessibilità tattile alle opere d'arte
Ivana Passamani, Massimo De Paoli, Virginia Sgobba, Nicolò Fiammetti, Anna Paolini **444**

Digitalizzazione e Inclusione: l'Intelligenza Artificiale per esperienze museali multisensoriali
Fabio Bianconi, Marco Filippucci, Claudia Cerbai, Michela Meschini, Andrea Migliosi, Chiara Mommi **462**

Comunicare la meteorologia attraverso esperienze tattili
Manuela Incerti, Raffaela Vitale, Barbara Fabbri, Anna Maragno, Grazia Zini, Paolo Lenisa, **476**

***Physical twins* per la fruizione ampliata dei beni museali: il caso studio della Dea di Morgantina**
Mariangela Liuzzo, Dario Caraccio, Laura Floriano **492**

Il ruolo dei *Virtual Tour* per l'accessibilità e l'inclusione del patrimonio museale
Noemi Tomasella, Flavia Camagni, Elena Ippoliti **508**

Rendere accessibile l'inaccessibile: percorsi per le disabilità motoria, visiva e uditiva nella Fortezza di Marciana
Tommaso Empler, Adriana Caldarone **524**

Feel the Past: una metodologia operativa per l'accessibilità sensoriale nei musei
Riccardo Cristoforo De Giorgi, Davide Mezzino, Grazia Maria Signore **538**

Accessibilità e inclusione museale a Torino: uno stato dell'arte
Francesca Ronco **554**

Strategie di rilievo digitale e produzione additiva per la fruizione aptica di opere scultoree
Andrea di Filippo, Sara Antinozzi **570**

Tecniche fotogrammetriche per la prototipazione e la fruizione del patrimonio scultoreo storico
Andrea Zerbi, Sandra Mikolajewska **584**

Un disegno per i bambini. Esperienze di inclusione socio-culturale.
Luigi Corniello **600**

Presentazione

Tommaso Empler
Sapienza Università di Roma
Dipartimento di Storia, Disegno e Restauro dell'Architettura
tommaso.empler@uniroma1.it

L'accessibilità e l'*Universal Design* sono temi che hanno acquisito una grande importanza nelle società contemporanee, riflettendo una trasformazione culturale che va oltre la semplice attenzione alle disabilità. Oggi, più che mai, la ricerca e la progettazione sui temi dell'accessibilità sono visti come una necessità fondamentale per garantire pari opportunità a tutti, senza distinzioni, favorendo la partecipazione attiva e il benessere di ogni individuo. Con il progredire delle tecnologie e dei modelli di progettazione, siamo chiamati a ripensare e migliorare costantemente gli spazi, i servizi e le interazioni che compongono la nostra vita quotidiana.

Il convegno si propone di esplorare l'evoluzione dell'accessibilità e dell'*Universal Design*, analizzando le sfide e le opportunità che caratterizzano il nostro tempo, con l'obiettivo di sollecitare i ricercatori, formare professionisti, sensibilizzare le istituzioni e cittadini riguardo alla fondamentale importanza di rendere ogni ambiente più fruibile. Il termine *Universal Design* è stato coniato negli anni '90 dal designer statunitense Ron Mace per descrivere un approccio che mira a creare ambienti, prodotti e servizi fruibili da tutti, a prescindere dalle abilità fisiche, cognitive, culturali o economiche degli utenti. L'obiettivo è quello di progettare per la diversità, non come risposta a specifiche necessità, ma come un processo che considera le esigenze di tutti gli individui fin dal principio. Non si tratta solo di adeguamenti per disabili, ma di una visione olistica della progettazione per migliorare la qualità della vita per tutti.

Nel corso degli ultimi decenni, le politiche internazionali e nazionali in materia di accessibilità sono cambiate radicalmente, influenzando le decisioni politiche, architettoniche e urbanistiche. L'adozione dell'*Universal Design* ha contribuito in modo significativo a creare ambienti e tecnologie più aperti, dove la diversità è vista come un valore e una risorsa, e dove l'inclusività non è più considerata un'eccezione, ma la regola. Questo approccio ha avuto impatti significativi non solo nel campo dell'architettura e dell'ingegneria, ma anche in ambito tecnologico, educativo, sociale e culturale.

Quando parliamo di accessibilità, l'attenzione si concentra spesso sull'eliminazione delle barriere fisiche che impediscono la partecipazione alla vita sociale. Negli ultimi anni, si è assistito a una crescente attenzione nel progettare ambienti

senza ostacoli, da edifici pubblici ad ambienti urbani, con l'introduzione di rampe, ascensori, porte automatiche, segnali visivi e sonori, e altro ancora. Tuttavia, l'accessibilità va ben oltre l'eliminazione delle barriere architettoniche: oggi si estende anche al mondo digitale e alle piattaforme online, all'accesso alle informazioni, ai trasporti, ai servizi pubblici e privati, e alla cultura.

Il concetto di accessibilità si è evoluto da un'ottica di necessità per persone con disabilità, a una visione che riconosce la variabilità delle esigenze umane, considerando che ognuno, in momenti diversi della propria vita, può incontrare difficoltà di accesso, che siano temporanee o permanenti. Ad esempio, una persona che inizia a utilizzare un dispositivo mobile per la prima volta o una persona anziana che affronta problemi di vista o udito ha bisogno di un design pensato per facilitarne l'uso. L'accessibilità non riguarda solo le persone con disabilità, ma tutti gli individui, considerando i vari aspetti della vita quotidiana.

In quest'ottica, l'accessibilità implica un miglioramento del design e delle soluzioni tecnologiche, affinché siano adeguate a garantire a ciascuno la piena partecipazione alla vita sociale, culturale ed economica, contribuendo a un ambiente realmente inclusivo. A tal fine, le innovazioni tecnologiche hanno svolto un ruolo fondamentale, portando alla creazione di *software* e hardware che rispondono alle diverse esigenze, come i *software* di lettura per persone non vedenti, le interfacce utente semplificate, le applicazioni di traduzione in linguaggio dei segni, e molto altro.

L'*Universal Design* si differenzia dall'accessibilità tradizionale per il suo approccio proattivo e universale. L'*Universal Design* non si limita a rispondere alle necessità di una minoranza, ma intende anticipare e risolvere le difficoltà di accesso fin dalla fase di progettazione, in modo che il prodotto o lo spazio sia funzionale per chiunque, senza bisogno di modifiche o adattamenti successivi. Questo approccio non si applica solo agli spazi fisici, ma si estende anche ai sistemi tecnologici, ai servizi, alla comunicazione e all'informazione, cercando di integrare soluzioni che siano intuitive e fruibili da tutti.

Un buon esempio di *Universal Design* è l'adozione di dispositivi tecnologici che, senza adattamenti specifici, possono essere utilizzati da persone di diverse età e con diverse

abilità. L'utilizzo di design minimalista e intuitivo, di interfacce accessibili e di opzioni di personalizzazione, come il contrasto elevato o la modalità ad alto contrasto per chi ha difficoltà visive, sono tutte soluzioni che si riflettono in un design universale.

Le linee guida di *Universal Design* stabiliscono che ogni progettista dovrebbe pensare in termini di inclusività, cercando soluzioni che non solo soddisfano le esigenze immediate degli utenti, ma che possano essere apprezzate da una gamma più ampia di persone. Ciò implica l'adozione di un linguaggio progettuale che si avvicina il più possibile all'esperienza umana universale, rispondendo a bisogni che spaziano dall'accesso fisico alla fruizione digitale, dall'inclusione sociale alla partecipazione culturale.

Nonostante i progressi, molte sfide restano ancora aperte, dalla scarsità di risorse destinate alla creazione di spazi accessibili, alla resistenza al cambiamento di alcuni settori. L'inclusione non riguarda solo l'adozione di tecnologie, ma implica un cambiamento culturale profondo. L'inclusività deve diventare parte integrante dei valori di una società, che si misura sulla capacità di adattarsi a tutte le diversità umane, non solo per una parte della popolazione.

Negli atti del convegno vengono approfondite queste tematiche, offrendo un'occasione di riflessione e discussione su come l'accessibilità e l'*Universal Design* siano strumenti fondamentali per una società più equa e facilmente fruibile, in grado di rispondere in modo adeguato alle esigenze di tutti i suoi membri, senza lasciare indietro nessuno.

FOCUS 2

Il disegno per l’accessibilità e l’inclusione cognitiva

The Algorithm as Terapy.
Secret Talks, a Case Study of the Design and Development of Digital Therapeutics

Giorgio Buratti, Yingfei Zhu
Politecnico di Milano
Dipartimento di Design
giorgio.buratti@polimi.it

terapeutica digitale
VR
tecnologie sanitarie digitali
medicina digitale

Le tecnologie digitali hanno trasformato la società cambiando le modalità di comunicazione, accesso alle informazioni e influenzando profondamente lo stile di vita delle persone. Allo stesso modo, la trasformazione digitale sta interessando il settore sanitario. Le tecnologie di rappresentazione ampiamente utilizzate nelle discipline del progetto, capaci di promuovere nuovi settori come il Digital Heritage e il Digital Entertainment, sembrano sancire il passaggio da una sanità "centrata sul consumatore" a una "centrata sulla persona". Grazie a interventi terapeutici guidati da programmi software basati su evidenze scientifiche, ottenute attraverso studi clinici metodologicamente confermati, è oggi possibile prevenire, alleviare o curare un ampio spettro di disturbi e malattie. Lo sviluppo e l'implementazione della Terapeutica Digitale è un'opportunità essenziale per la disciplina del Disegno e della Rappresentazione, depositaria di metodi in grado di definire i codici spaziali e i linguaggi figurativi più adatti al trattamento delle diverse patologie. Attraverso l'analisi di un caso studio, questo articolo propone un quadro tassonomico, seppur in continuo aggiornamento, di quello che si preannuncia come un significativo cambio di paradigma in campo medico-farmaceutico.

digital therapeutics
VR
digital health technologies
digital medicine

Digital technologies have transformed society and people's lives, changing how people communicate, transfer money, access information and plan. Similarly, digital transformation is affecting the healthcare sector. Representational technologies widely used in design and modelling, to the extent of creating new sectors such as Digital Heritage and Digital Entertainment, seem to sanction the shift from 'consumer-centred' to 'person-centred' healthcare. Thanks to therapeutic interventions guided by software programs based on scientific evidence obtained through methodologically confirmatory clinical trials, preventing, alleviating, or treating a broad spectrum of disorders and diseases is now possible. The development and implementation of Digital Therapeutics is an essential opportunity for the discipline of Drawing and Representation, a repository of methods capable of defining the spatial codes and figurative languages most suitable for treating different pathologies. Through the analysis of a case study, this paper proposes a taxonomic framework, albeit one that is constantly being updated, of what promises to be a significant paradigm shift in the pharmaceutical-medical field.

From drugs to Digital Therapeutics

The search for medicines to cure disease is a vocation as old as humankind. For centuries, herbs and plants were the sole sources of active ingredients in medicines, until with the birth of modern chemistry in the 18th century, technology-enabled the synthesis of new drugs based on new molecules that often did not exist in nature. Towards the end of the millennium, the introduction of biotechnological therapies promoted a further evolution in treatment. Cell-based drugs (regenerative therapies), genes (gene therapies) and tissue-engineered products implement the therapeutic effect by acting directly on DNA. Cells and genes become medicine themselves, in the form of elements that can be 'programmed' to achieve a specific therapeutic objective, sometimes in a single patient. In 2019, the year of the first commercialisations, the era of Digital Therapeutics (DTx) begins, medicines in which the active ingredient is no longer a molecule but an algorithm. DTx are software-mediated therapeutic interventions [Recchia et al. 2020] indicated for a specific disease and designed to modify a patient's behaviour to improve the outcome of their disease. These programmes are based on scientific evidence obtained through rigorous, confirmatory clinical trials to prevent, manage or treat a broad spectrum of physical, mental and behavioural conditions. Therefore, they are not simply health-related applications or telemonitoring devices but curative interventions capable of improving clinical outcomes on a par with drug treatment. Usable for a wide range of therapeutic areas, Dtx can take different 'digital forms', including apps, web-based interventions, video games and virtual or augmented reality and digital devices [Meskó et al. 2017]. The field seems ready to study the guidelines for designing virtual environments characterised by spatial codes and figurative languages suited to the specificity of different pathologies. Starting from the analysis and presentation of a case study developed by the Drawing and Representation research group of the Design department of the Politecnico di Milano, this paper frames Dtx within the large and complex category of Digital Health Technologies, intending to establish disciplinary boundaries that allow the integration of the

methods proper to the discipline of drawing and representation with medical and computer sciences.

DTx framework

Digital Therapies (DTx) are therapeutic interventions guided by software programmes based on scientific evidence obtained by methodologically rigorous and confirmatory clinical trials to prevent, manage, alleviate or treat a broad spectrum of disorders and diseases. It is crucial to distinguish DTx from other digital devices and processes affecting health and care in the broader and more complex category of Digital Health Technologies. There are numerous applications and tools aimed at diagnosis, monitoring of clinical conditions, decision support for the physician, and disease intervention.

A framework has recently been developed and published reference framework to define the technological categories related to Digital Health, Digital Medecine and Digital Therapeutics (Fig. 1), which supersede obsolete terms such as 'Telehealth' and 'Telemedicine' and promote the adoption of an internationally shared terminology. Below is the proposed taxonomy:

- Digital Health encompasses digital applications for promoting healthy lifestyles and wellness technologies and platforms capable of capturing, storing and/or transmitting health data directly to healthcare providers tools that support the management and/or delivery of health and clinical services and performances. Such products generally do not require clinical evidence or regulatory oversight, as they do not qualify as medical devices (MDs) or combination products.
- Digital Medicine is a subset of the previous one that groups evidence-based software and/or hardware products with measurement and/or intervention functions in the service of human health that precisely require evidence of efficacy, clinical benefit and safety. Specific regulatory and authorisation paths are needed depending on the category to which the product, according to its characteristics, belongs (e.g. medical device, combined product).

- DTx are a further subset of Digital Medicine: they are not simply monitoring apps or measurement software but technologies for therapeutic purposes tested in controlled clinical studies, the active ingredient of which is an algorithm. They are suitable for a wide range of therapeutic areas. They can take different digital forms depending on the platform used: apps, web-based interventions, playful applications and virtual spaces capable of providing patients with evidence-based therapeutic interventions with algorithms capable of managing or treating a medical disorder or disease.
  DTxs can be:
  a. standalone, i.e. operating independently of any other medical product such as a drug.
  b. associated (disease-specific), used in concert with drugs and devices to optimise patient care and health outcomes.
  c. combined with another specific therapy and therefore developed in combination.

Defining precise characteristics is difficult because there has yet to be an accurate conceptual frame of reference. Still, DTxs are usually unified by their independence from any drugs, their synergy with devices, sensors, or other patient-wearable instruments, and their ability to monitor and generate real-time data used to update and improve therapy constantly.

As such, DTxs must be developed through a controlled clinical trial and undergo an approval pathway for specific indications [Goldsack 2019]. At the time of prescription, a DTx therapeutic solution must guarantee efficacy and tolerability: in this context, evidence inferior to standard medicine therapy cannot be accepted. In the absence of specific indications in the European regulation, how clinical studies supporting the efficacy evaluation of DTx will be implemented is still being determined. Different methods and languages often divide the many disciplines that create such applications. Hence, a revision or adaptation concerning standard pharmacology schemes is likely necessary if an exhaustive characterisation of the risk-benefit ratio is to be achieved.

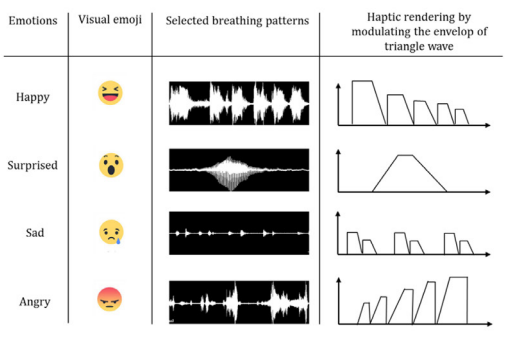
To have digital therapies that can bring real benefits to patients and healthcare systems, a design method appropriately adapted to the characteristics and needs of the

Copertina
Secret Talks project: creating a treatment DTx to manage SAD (Social anxiety disorder)

Fig. 01
A summary of the evidentiary requirements for and regulatory oversight of different digital health products. (Digital Medicine Society, https://dimesociety.org/)

Fig. 02
Chosen emotions with corresponding vibrations.

	DIGITAL HEALTH	DIGITAL MEDICINE	DIGITAL THERAPEUTICS
DEFINITION	Digital health includes technologies, platforms, and systems that engage consumers for lifestyle, wellness, and health-related purposes; capture, store or transmit health data; and/or support life science and clinical operations.	Digital medicine includes evidence-based software and/or hardware products that measure and/or intervene in the service of human health.[1]	Digital therapeutic (DTx) products deliver evidence-based therapeutic interventions to prevent, manage, or treat a medical disorder or disease.[2]
CLINICAL EVIDENCE	Typically do not require clinical evidence.	Clinical evidence is required for all digital medicine products.	Clinical evidence and real world outcomes are required for all DTx products.
REGULATORY OVERSIGHT	These products do not meet the regulatory definition of a medical device[3] and do not require regulatory oversight.	Requirements for regulatory oversight vary. Digital medicine products that are classified as medical devices require clearance or approval. Digital medicine products used as a tool to develop other drugs, devices, or medical products require regulatory acceptance by the appropriate review division.	DTx products must be reviewed and cleared or certified by regulatory bodies as required to support product claims of risk, efficacy, and intended use.

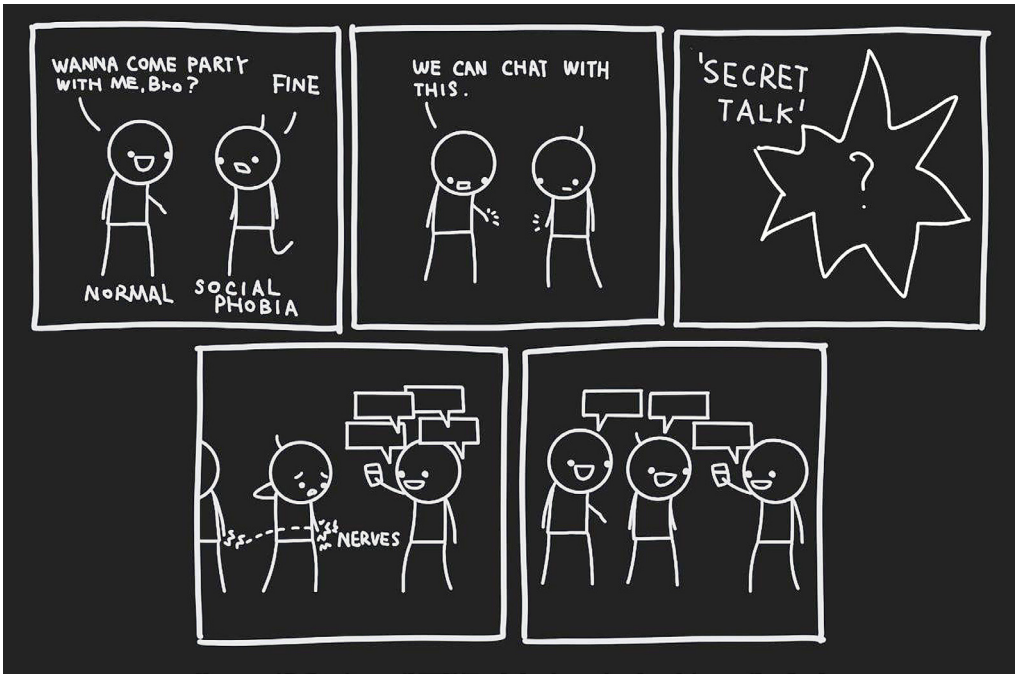


patients to whom the digital treatment will be addressed is needed. The User Experied methodologies typical of the discipline of Design, which envisage the early and structured involvement of users in the design, make it possible to maximise the efficacy and safety potential of the technology, enabling a more appropriate assessment of its characteristics and orienting the therapeutic services to respond to the needs most felt by patients.

Making a DTx: "Secret Talk", handheld communication device design

At the time of writing, a few research studies investigated the relationship between interface elements and therapeutic function. Digital public health education aims to disseminate different types of content through various digital platforms (websites, smartphones and tablets) to inform as many users as possible, progressively updating the learning topics [Song & Han 2019]. Differentiated in hardware, software, and interactive modes, computers and smartphones lead to different cognitive loads and decision-making behaviours [Hwang & Lee 2022], distinguishing them as profoundly different modes of iteration with distinctive characteristics. It is increasingly important to study the relationship between signs and interaction in interface development as it has been shown [Pengnate & Sarathy 2017] how appropriate design can increase user attention and improve application performance [Andersen 2017]. The correct use of visual elements can enhance cognitive ability in the learning process, help the user to understand learning content better and thus improve learning outcomes [Mayer & Estrella 2014]. Many elements in interface design (colour, layout, images, animations, etc.) can influence the user experience. Furthermore, the continuous progress of display technologies makes the evolution of Virtual Reality (VR) headsets plausible, which, having overcome some technical criticalities, allow for prolonged experience without problems of kinaesthesia, headache, ataxia or disorientation. VR can address a wide range of motor, cognitive or psychological rehabilitation domains based on the principle of interaction between a user and a virtual environment that can transmit

Fig. 03
Application operational scenario.

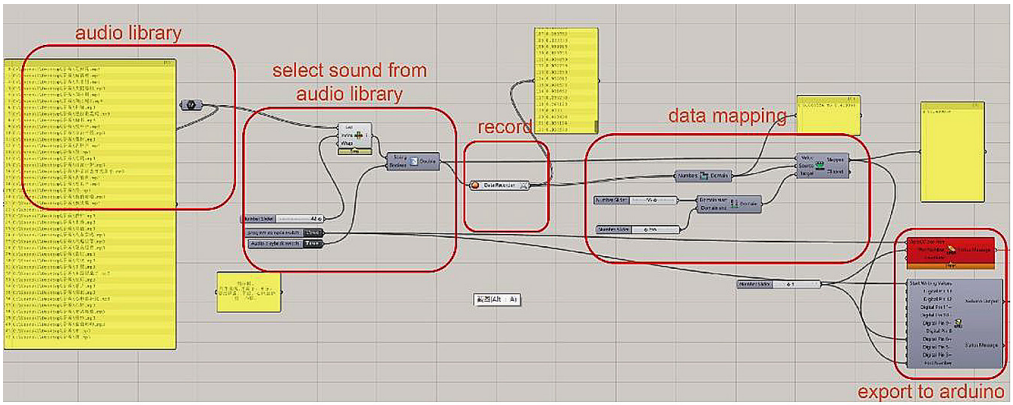

WANNA COME PARTY WITH ME, Bro?
FINE
NORMAL
SOCIAL PHOBIA
WE CAN CHAT WITH THIS.
'SECRET TALK'
?
NERVES

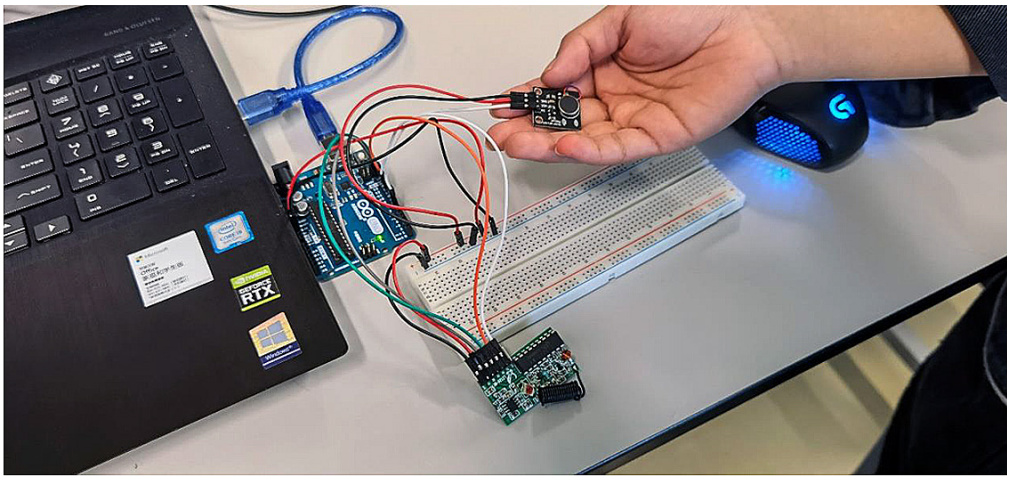
stimuli in real time. Although created on different degrees of immersiveness [Buratti 2022], VR rehabilitation applications mainly involve auditory and visual sensory feedback and indirect proprioceptive and vestibular feedback, while haptic input is still under investigation. There is growing evidence that tactile information is a beneficial adjunct for achieving specific treatment goals, such as increasing joint mobility and strength. Tactile information has also been identified as a significant signal for improving performance in articulatory tasks [Shing et al. 2003]. Based on these assumptions, the Secret Talks project shows how it is possible to create an assessment and treatment DTx that precisely controls immersive and non-immersive dynamic presentations of complex stimuli such as vibrations, within which sophisticated interactions, behavioural monitoring and performance recording are possible. Specifically, the application was developed for the management of SAD (Social anxiety disorder), a psychophysical disorder that manifests itself with mood changes, with a marked tendency to depression, often linked to seasonal trends. This condition affects people who, during most of the year, do not manifest depressive symptoms, with indicators ranging from nausea, the tendency to overeat and oversleep, and asthenia to asociality towards relatives and friends.

SAD leads to communication difficulties due to anxiety during social interactions, particularly among students aged 18 to 24. The resurgence of the coronavirus has increased the number of SAD cases, which are often not found until later stages, with symptoms such as difficulty breathing and palpitations. Treatment usually involves long-term psychotherapy and skills training.

To explore the application of vibration and vision in digital therapeutics for social anxiety disorder groups, the researchers applied a theoretical framework to emotional design and human-computer interaction interfaces. Four emotional interfaces (happy, sad, shocked and angry) were designed, and a database of corresponding vibrations for the four emotions was constructed (Fig.2). This approach aims to help people understand the relationship between emotional interfaces and vibrations, explore the consistency of emotional transmission between different emotional interfaces and their corresponding vibrations, and evaluate their potential application in

Fig. 04
The program is divided into five parts: first, creating an audio library, then selecting the audio from the audio library and recording the converted data, mapping the converted data to between 50 and 255, and finally converting it to Arduino's PWM port.


audio library
select sound from
audio library
record
data mapping
export to arduino



rehabilitation training focused on communication skills for people with social anxiety disorder.

In rehabilitation, individuals with social anxiety disorder often interrupt conversations due to difficulty in expressing emotions or speech, and they do not want others to notice this situation. Therefore, developing a device capable of discreetly conveying emotions through vibrations is crucial. Due to the lack of an existing vibration database, sounds with specific emotions are converted into vibrations, and their emotional consistency with the application interface was tested. Essentially, Secret Talk is a highly concealable short-range signal transmission and reception device capable of communicating with the most common multimedia devices or with a helper who is also wearing this product before the conversation to facilitate communication exercises with the help or to end the conversation (Fig. 3).

It will be worn on the inside of the sender's and receiver's palms, disguised as a ring when in use, and will send and receive up to four vibrating signals within 15m to communicate different messages.

This experiment uses Grasshopper and Firefly. Audio data is processed by Firefly and mapped to vibration frequency ranges by Grasshopper.

Then, the vibration signals are streamed to Arduino to evaluate emotional bias and record reaction times (Fig.4). Forty-two vibration sets were measured, and 630 data were collected. The final research outcomes were derived from analysing users' perception of time and emotional inclination towards the vibrations (Fig.5).

The experimental results indicate that most vibrations generated from sound can convey emotions. However, the feelings conveyed by sound do not match those expressed by vibrations, and participants could not recognise the sounds corresponding to the vibrations. Most participants' feedback was that they identified the emotions conveyed by the vibrations through amplitude and variation speed. Therefore, combining vibration patterns with amplitude may help express feelings consistent with the interface. The frequency of vibrations representing happiness is relatively low, with a slight vibration rhythm and irregular periodic variations. For anger, the vibrations increase rapidly, maintaining a high

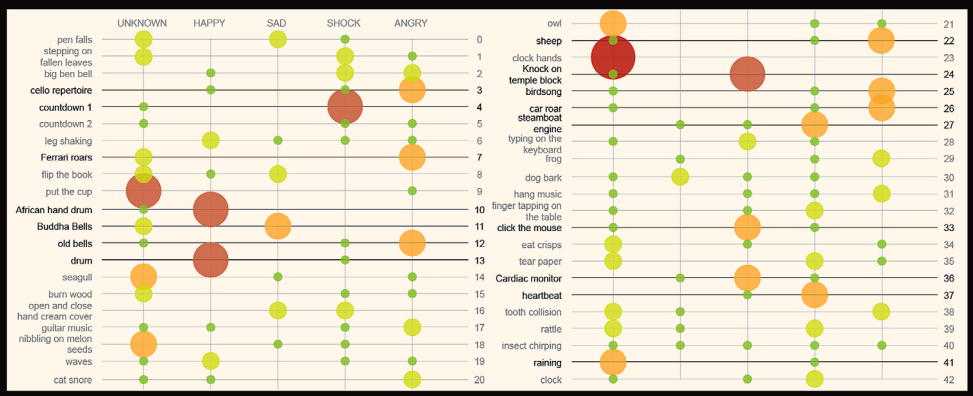
.

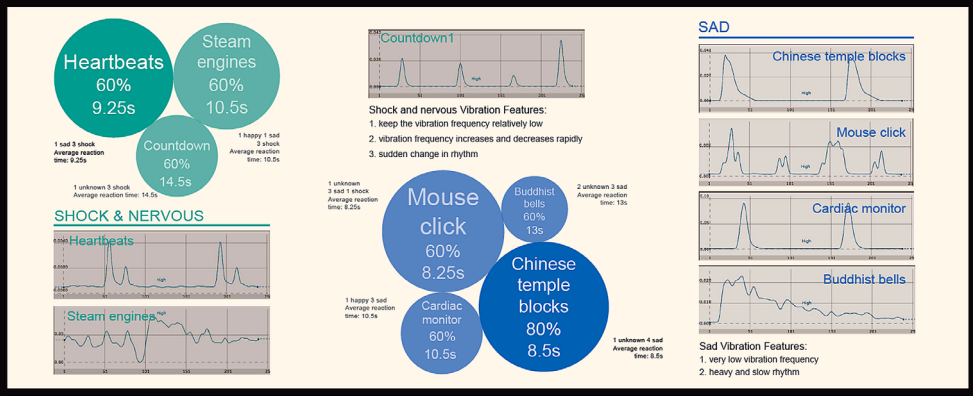
Fig. 05
Experimental results of the vibration-noise-colour association on a sample of 450-person tests.

Vibration-Emotions Tendency

(Data Visualisation1)

02
vibration-emotions experiment





vibration frequency. The vibrations representing shock maintain a relatively low frequency, with sudden changes in rhythm through increasing and decreasing frequencies. Sadness is conveyed through very low-frequency vibrations with a heavy and slow rhythm. Based on these experimental results, a physical communication aid device was designed for individuals with social anxiety (Fig.6)

Conclusion

These first promising results still need to be fully comprehensive. In this first phase of the research, all participants were residents of China, and the experiment was conducted in a Chinese context. The development of the study will investigate whether the identified correlations apply to other cultural contexts. Furthermore, the experiments were performed in acutely isolated laboratories to control for possible confounding factors. Therefore, the applicability of the conclusion in a more complicated scenario (e.g. in the context of noise in a crowd during a walk) needs to be further verified. Despite this, the design and organisation of interface information were crucial in helping users navigate content efficiently, reduce tasks and cognitive load, and solve the problem of disorientation. The mixed system based on the interaction of virtual spaces with physical objects enabled users to optimise information processing and improve task performance [Pecora 2023]. The case presented demonstrates how the hybridisation of drawing and information technology extends the application possibilities of both domains, influencing the design process at different stages and highlighting the enabling role of digital technologies in translating data into communication. In this regard, we highlight how drawing enables the attribution of meaning to qualitative and quantitative data underlying the development of products, services and systems. The proposed work highlights how heterogeneous forms of data are conjugated for design purposes using a computer application, Grasshopper, which transcends its role as a modelling application by projecting the discipline of drawing into a new domain too complex to be adequately analysed, understood and

Fig. 06
From concept to final device. It can interact with people and the software application designed.


b. WRIST
c. THENAR
e.
f. PURLICUE
A
B
C
HIGH PRAXICY
THREE BUTTONS
SILICON (SOFT)
HOLD CUPS
NOT HOLDING
CONCEPT 6
VIBRATION MOTOR
ARDUINO NANO
BATTERY
BLUETOOTH RECEIVER
BUTTON A
HAPPY
BUTTON B
NERVOUS
BUTTON C
DISGUST

described through conventional tools. A conceptual bridge is delineated between data flow, drawing and physical reality, a 'contamination' between systems, allowing inherent complexities to be overcome in translation processes involving qualitative data (related to emotions) into quantitative data (related to vibrations). Firefly, a Grasshopper plug-in, makes real-time dialogue from the physical to the digital world possible through Grasshopper's own drawing and modelling tools, setting the stage for new and deeper thinking. Lowering specialised skills could promote a generalised rise in design quality by reducing the time devoted to ancillary operations, allowing designers to focus on the emotional, functional and aesthetic essence proper to drawing. A key element in the layout design is the satisfaction of the search strategies for the selected age group, as each generation adopts different cognitive strategies. The combination of various VR features, such as dosage and intensity of customisable training, combined with real device-induced benefits comparable to drug therapies, enhances the effectiveness of treatments. Further experiments will be necessary, but the in-depth knowledge of the various visual and haptic systems' characteristics has proven crucial for developing a targeted and customised rehabilitation proposal to achieve a better outcome and minimise the risk of adverse reactions.

Bibliografia

Andersen, E., Maier, A. (2017). The Attentional Capture of Colour in Visual Interface Design: A Controlled-Environment Study. In *21th International Conference on Engineering Design* (pp. 519-528). Design Society

Buratti, G. (2022) Metaverso come opportunità di nuovi servizi di welfare per la terza età. In C., Càndito, A., Meloni (eds.) *DAI. Il disegno per l'accessibilità e l'inclusione., Atti del I convegno DAI, Genova 2-3 dicembre 2022*, Alghero: PUBLICA.

Goldsack J., (2019) Digital Health, Digital Medicine, Digital Therapeutics (DTx): What's the difference? retrieved from: <https://medium.com/digital-medicine-society-dime/> ultimo accesso:

Hwang, Y. M., & Lee, K. C. (2022). An eye-tracking paradigm to explore the effect of online consumers' emotion on their visual behaviour between

desktop screen and mobile screen. In *Behaviour & Information Technology, 41(3)*, 535-546.

Mayer, R. E., & Estrella, G. (2014). Benefits of emotional design in multimedia instruction. In *Learning and Instruction, 33,* 12-18.

Meskó, B., Drobni, Z., Bényei, É., Gergely, B., & Győrffy, Z. (2017). Digital health is a cultural transformation of traditional healthcare. *Mhealth, 3.*

Pecora, A. L. (2023). *Lo spazio rappresentato per il disturbo dello spettro autistico* (ASD) (Vol. 1). FedOA-Federico II University Press.

Pengnate, S. F., & Sarathy, R. (2017). An experimental investigation of the influence of website emotional design features on trust in unfamiliar online vendors. In *Computers in Human Behavior, 67*, 49-60.

Recchia, G., Capuano, D. M., Mistri, N., & Verna, R. (2020). Digital therapeutics-what they are, what they will be. In *Acta Sci Med Sci, 4(3)*, 1-9.

Shing, C. Y., Fung, C. P., Chuang, T. Y., Penn, I. W., & Doong, J. L. (2003). The study of auditory and haptic signals in a virtual reality-based hand rehabilitation system. In *Robotica, 21(2)*, 211-218.

Song, M. H., & Han, T. I. (2019). A study on the learning satisfaction and work utilization of the teacher safety e-learning. In *International Journal of Information and Education Technology, 9(12)*, 909-917.