

An Empirical Study on Human-Centric UX Design Principles and Design Thinking Using Design Challenges

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Abstract

Do not make the user think is the fundamental design principle. The people-centred design combines analysis and creative design with research about people. Any business or profession can use design thinking as a tried-and-true method for solving issues. The design thinking procedure begins with problem definition and continues through prototyping, gathering feedback, and redefining the problem statement. It covers an individual's experience with a product and overall satisfaction with it. This research aims to demonstrate how design innovation theories and concepts—which are drawn from the principles of user experience design—can be objectively comprehended. The UX design procedure is explained using two design challenges. In-depth research is conducted on the implementation and demonstration of the known-unknown map, stakeholder mapping, journey mapping, affinity mapping, concept generation matrix, and prototyping to refine the problem statement and generate "how may we?" statements to turn those challenges into opportunities for design.

Participants - We posed a questionnaire to a diverse sample of 198 individuals of varying ages and professions. After the questionnaire, we select some individual of 72 people for direct observation. For this research, we have conducted interviews with 14 doctors, 18 pharmacists, 23 individuals and 17 senior citizens (age above 65) to dive deep into the UX research.

Keywords- people-centred design, known-unknown map, journey mapping, affinity mapping, concept generation matrix

1. INTRODUCTION

"The only important thing about design is how it is related to the people" – Victor Papanek. [1]. Victor Papanek describes the significance of a human-centred strategy in almost all industries. For instance, consider the advertising industry, advertising design consists of convincing people to purchase items they don't need with money they don't have to impress those who don't care. The failure of Pepsi Max is due to PepsiCo's marketing of the product as a low-calorie, sugar-free alternative to Pepsi and Diet Pepsi that is directly promoted to male consumers. Traditional diet soda customers are female. Male customers are less attracted to the term "diet" than female consumers. The majority of innovation in industrial design is attributable to technical factors, while

human-centred factors are neglected. We conduct an experiment in which people must utilise the elevator to descend. The elevator is on the ground level, while the user is on the sixth level and must descend to the ground floor. Before clicking the up or down sign of the elevator, we ask the user if he/she will push the down button to go to the ground floor or the up sign to call the lift up because he/she wants to go down. Furthermore, none of the users can articulate why one response is accurate and the other is incorrect.

“The main determinant of usability is the human mind and people’s needs, and not the technology” – Jakob Nielsen [2]. Design thinking should be at the core of the innovation strategy development. In the last decade, the phrase design thinking has acquired popularity in several situations outside of the conventional concerns of designers. The underlying premise is that the problem-solving skills of professional designers are valuable to companies attempting to innovate and to society attempting to effect change. The study [3] examines the roots of the phrase “design thinking” in studies on designers and its use by management educators and consultants in the context of a dynamic, globalised media economy. The paper [4] summarised research on design thinking to understand the characteristics and processes of design thinking, as well as the differences between novice and expert design thinkers, and apply the literature’s findings regarding the application of design thinking to our educational system. Design thinking employs the fundamental aspects and abilities of play, empathy, reflection, invention, and experimentation to facilitate collaboration, innovation, and the application of results [5]. The partial answer of what could design thinking brings to practitioners and organisations in other fields by considering the fundamental reasoning pattern behind the design and then looking at the core design practices of framing and frame creation can be found in research [6]. Co-creation is a critical element in the complicated sociotechnical area of design thinking in action, because when people generate ideas, they get enthusiastic, take ownership, and make commitments [7].

Design thinking is a tried-and-true problem-solving methodology that any organisation or profession may utilise to generate advantage includes. It combines creative and critical thinking. Google [8] and apple [9] use design thinking in their day-to-day operation. Design thinking should be at the core of strategy formulation and organisational transformation to foster a problem-solving culture. Design thinking may be used for any product, service, or process that requires improvement.

When comparing good and bad design, the price of bad design is just too expensive. In December 1995, American airline flight 965 departed from Miami to Cali Columbia [10]. On landing approach, the pilot has to pick the next radio-navigation selection called ‘ROZO’. He selected ‘R’, which populated the flight management system interface with all starting with ‘R’. instead of ‘ROZO’, the pilot selected the very first of its ‘ROMEO’ which is 132 miles northeast, as a result, it descends into the valley at 10,000 feet. The notion of ATMs for the elderly is presented in the study [11]. We conduct a test in which the user entering the ATM is observed. Users of ATMs are awaiting one thing: cash. So as the cash register opens, they immediately depart. People are much less likely to forget their card if it comes out before the cash; therefore, the cash must come out last. In a subsequent case of poor design, we examine the seating arrangement of a classroom. There are a total of 650 seats in a lecture hall, but

only four are reserved for left-handed individuals. The flat platform on the chair's right handle is not suitable for all users. This [12] article outlines Bad Ideas, a set of methodologies that use 'poor' or 'silly' ideas to spark creativity, investigate design domains, and promote critical thinking in interface design.

2. PEOPLE-CENTRED DESIGN

The people-centred design combines analysis and creative design with research about people. The design is not about how it works on the inside or what is technology used, it is about how it works on the outside where a person comes in contact with it and has to work with it. Historically, the evolution of computer systems has been predominantly driven by technology, with engineers thinking that "users can adapt" to it. Different user-centred design concepts and particular techniques may improve the user's interaction with the product; user-centric design can also improve the user's performance [13]. Duque and Ezequiel undertook a systematic literature review to have a better understanding of how these procedures are accomplished with the involvement of the elderly. 51 publications published between 2013 and 2018 at ACM Digital Library, IEEE Xplore, and Science Direct are analysed and information is retrieved about how and why people-centric design has been applied to elderly people [14].

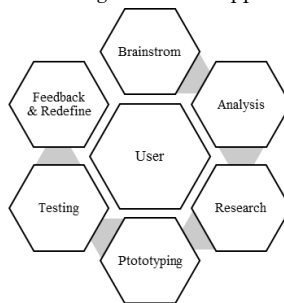


Figure 1 user-centric design

Fig (1) shows the design thinking cycle. The user experience extends beyond the product interface. The whole procedure begins with problem definition and continues through prototyping, gathering feedback, and redefining the problem statement. It covers an individual's experience with a product and overall satisfaction with it. Sometimes design and innovation are considered the same term. Design is more than the aesthetics and artefacts associated with products. Companies are increasingly embracing design processes as a primary innovation practice driver. Design processes aid businesses in developing innovations with high user, economic, and company value [15]. It's a strategic function that focuses on what people want and need and dream of, the crafts experiences across the full brand ecosystem that are meaningful and relevant for customers. The process involving a people-centred design methodology is shown in fig (2).



Figure 1 People-centered design methodology.

There is a strong relationship between the company, technology and the end user, as shown in fig (3). For business, the design innovation must be a feasible invention on the other hand the feasibility of the innovation is the essential factor when considering technical elements. While considering people or end users the desirability of the innovation is vital. If we look at the convergence of the end-user and technology factors functional innovation is required. While process innovation requires commercial and technology considerations, the business wants to establish a connection with the user and employs several marketing strategies to do so. If we evaluate the business, technology and end-user at one time, the experience innovation may be discovered in the convergence of these three. The experience innovation may be done by employing the design thinking method taking user experience as the core of the innovation.

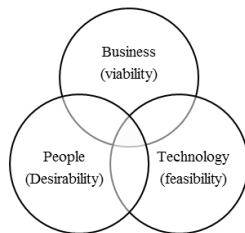


Figure 2 Relationship between business, technology and end user.

3. UX STUDY

The purpose of user experience analysis and assessment methodologies is to enhance customer satisfaction via the utility, convenience of use, and quality of interaction with applications, services and goods. The attention to the user experience design can benefit the organization [16]. Fernando Almeida explains the use of UX principles for web designing in detail in his research [17]. Rethinking UX entails identifying empirical research patterns to determine how the discipline has progressed. [18] This research answers that demand by examining over 400 academic empirical papers published during 2000—2016. Amandeep Dhair uses UX principles to evaluate the prototyping in augmented reality games [19]. UX concepts may be followed in a variety of applications which includes gaming, e-commerce, product design, etc. As the Internet of things, mobile computing, and cloud computing technologies have advanced, interface technologies have evolved into CUI, GUI, and NUI, and it is anticipated that another kind of UI/UX will be produced in the future [21]. During the field testing of the Tribler peer-to-peer file sharing programme, the research conducted an informal comparison of several kinds of User Experience (UX) metrics and procedures [22]. The state of robotics and human-robot interaction research is maturing. In the work [23], the UX approach was effectively used in an exploratory field study including the trial deployment of a

commercially accessible, sociable humanoid robot at an airport. On the other hand, talking about the use of UX design principles in technology-driven industries Current research on User Experience (UX) integration seldom analyse or reflects on the transformation firms undergo from building solely Graphical User Interfaces (GUI) to addressing usability and, more recently, UX. UX integration may include a combination of planned and emergent activities and is affected by a number of interconnected events. Different choices made beyond the authority of UX practitioners have an inescapable influence on whether UX integration is enabled or prevented [24].



Figure 3 UX design process

A user-centred design philosophy was followed where the needs, goals, and limitations of the system's end user are given utmost importance and attention at each stage of the design process. Fig. (4) shows the design process, which begins with primary research by meeting the user, determining his demographical location, the culture he shares, his age, and his educational background, and describing the user's purpose and difficulties. In the second step, we start empathizing with the user. To find the core solution we create a user persona, user scenario, user testing, and user journey map. After the second step, the insights are drawn. Using insights 'how might we?' questions are formed. Step three involves a simple wireframe, mood boards, mock-ups, and a style guide for finding the answer. Using data, we develop prototypes in the fourth stage, beginning with low-fidelity prototypes before integrating them into medium- and high-fidelity prototypes. In the last phase, the solution is developed. Stick to the data and develop a prototype based on the data. In the fourth phase, we conduct usability testing, review matrices, and observe user behaviour flow.

The user study in detail is described using two design challenges. The first design challenge is an attempt to solve the "How to efficiently use leftover medications." Using design principles. The second example is Osteoarthritis, which presents as walking problems, and is one of the major issues faced by senior people. By doing user experience (UX) research on the user, we were able to resolve this problem.

4. DESIGN CHALLENGE 1

To facilitate comprehension of the UX design process, we provide an example. The problem statement for the 24-hour design challenge is "How to efficiently use leftover medications." UX design specialists oversaw the UX research. The design challenge consists of three phases. In the first round of brainstorming, we attempt to answer questions such as, "What problem are we attempting to solve?" Additionally, explain several aspects of the problem description.

Participants

To determine the current status of leftover medicines, we posed a questionnaire to a diverse sample of 198 individuals of varying ages and professions. After the questionnaire, we select some individual of 55 people for direct observation. For this

research, we have conducted interviews which include 14 doctors, 18 pharmacists and 23 individuals to deep dive into the UX research.

4.1 Known Unknown Mapping

The known and unknown mapping enhances comprehension of the conceptual framework and enables the formulation of the design problem. Table (1) displays the known and unknown matrices of the problem statement about the effective use of unused medications. To introduce the design statement, we may utilise an alternate form of the four-category known-unknown map. 'known unknowns' contains the topic you are aware of, but know very little about. 'known knowns' contains both the things which you are aware of and also has information about it. 'unknown unknowns' comprise the things of which we are unaware and about which we have no knowledge. To get to the root of the issue, further study in this domain is required. It is essential to transform "unknown unknowns" into "known unknowns." 'unknown knowns' include everything understood but of which one is unaware. If the topic falls within the realm of 'knowns', we should already have access to sufficient reliable study or data.

Known	Unknown
Half-used medicines cannot be returned	Who needs the leftover medicine?
Environmental risk of disposing of the medicine without proper disposing methods	Reselling the cost of the medicine
Category of medicine	Condition of the medicine
Absence of the inventory	How to resell leftover medicines
Alternatives of the medicines available	How to dispose of the leftover medicine
It gets wasted if stored in the house	How to reach the donor
Health risk	Why the medicines are left
Type of medicine	Will, the person buy the leftover medicine
Cost of the medicine	Gaining the trust of the buyer
Use of the medicine	Side effect on the buyer
The expiry date of the medicine	How to maintain leftover medicines for a longer time
Medicines are left over	How to evaluate the condition of the leftover medicine.

Table 1 Known and unknown mapping

Iteration 1

After each successive phase, the design challenge is revised. Based on the known and unknown mapping, three pain points are identified. Which are the environmental impact of the disposed medicine, the need for a certified and trustable body, and legal issues for selling the medicines.

4.2 People and Context Research

In the second phase of people-centred design, we integrated research on people and context. This section addresses topics such as who are we creating for and what is their context of usage. To answer this question, one must first determine what individuals are already doing to address the problem and what their explicit and unstated requirements are.

4.3 Stakeholders

A stakeholder map is a visual depiction of who is involved in the UX research and how they are interconnected. There are six phases involved in the creation of the

stakeholder map. In the first stage, it is essential to explain the extent and depth of the problem statement, which is its focal point. The second phase begins with the creation of a list of the study's stakeholders. Consider the individuals who will have an influence on the problem statement. Define the significance and impact of each stakeholder in the third stage. Which of these stakeholders are vital and indispensable, and which are not? In the fourth step, illustrate the stakeholders' significance on the stakeholder map. The more their significance, the greater their valuation on the stakeholder map. The fifth stage begins by identifying the stakeholder relationships. Stakeholders have a definite connection with each other. They exert either direct or indirect effects on one another. What one stakeholder offers the other, create the lines and arrows to illustrate their link. In the last step, we analyze by taking each stakeholder's perspective.

With the information gained from known and unknown mapping, we question why it is a problem in the first phase. With the secondary research of the current state of the art, two prime stakeholders are identified. The first is the donor and the second one is the receiver. Doctors, pharmacists, attendants, nurses, outsiders, family members, patients, delivery boys, and quality auditors might be identified as additional stakeholders in the design challenge via study. We conducted interviews with doctors, pharmacists, donors, delivery boys, and patients in order to comprehend the need and characteristics of the stakeholders involved. Table (2) shows the personas of the people involved. There are three categories of people. The thoughtful people who care about the environment, people and will empathize with the problem are selected in the first category. Poor people who can not afford the medicine and are helpless to the problem are selected. In the third category, ignorant and lazy people are selected. After differentiating into groups, their behaviour, motivation, and frustration are studied.

	Thoughtful Nilay	Poor Kisan	Ignorant Piyush
Behaviour	Courteous Thoughtful	Saving money. Doesn't visit the doctor.	Too lazy. Don't to any effort.
Motivation	Someone needs my unused medicines. Reduce environmental damage.	Cheap medicines. Awareness in society.	Social media addiction. Earn money by easy way.
Frustration	Don't want to throw the medicine. A lot of money will be wasted. Safe disposal of medicine.	Don't have money to buy medicine. Uneducated for online platforms. Unaware of any means.	Difficult in accepting the facts. Wasting time doing social work.

Table 2 Personas

4.4 Journey Map

When working in user experience design, and usability testing, one almost certainly encountered the use of personas to facilitate communication among members of a cross-functional design team about the effects that design choices will have on a specific user demographic [25]. A journey map is a visual representation that shows the phases someone follows to complete a task. The value of the journey map and the analysis in design thinking projects is explained in brief in the research paper [26]. Liedtka Jeanne explains that a journey map is a visual representation that shows the phases someone

follows to complete a task [27]. The purpose of the [28] article is to demonstrate the importance and relevance of the mapping process for any library user experience.

After the personification, in the next step, the journey of the donor, receiver and pharmacist is mapped. From table (3), table (4), and table (5) the different phases to complete the task is represented in the column. The donor's realisation that the recipient needs the medicine and he has some leftovers is the beginning of phase one. The donor returns the medication to the pharmacist in the second step, and the recipient purchases discounted remaining medications from the pharmacist. Pharmacists evaluate and store the medication in the third phase. In the fourth and final stage, both the donor and the recipient make pleasant returns to their homes. Table (3) depicts the donor's journey, including what he is doing, thinking, and feeling as he completes his task in each of the four phases. Similarly, table (4) and table (5) depict the journey of the pharmacist and the receiver respectively, including what they are doing, thinking, and feeling as they complete the task in each of the four phases.

	Pre-need	Going	Returning	Ending
Doing	Examining the expiration dates of any unused medications and searching for any remaining medications.	Giving medicines to the pharmacist or donor-collector bank in charge.	The pharmacist checks the medicine expiry and the quantity of the medicines.	Returning home with a smile.
Thinking	These medicines may be useful for another person.	I will give it to someone needy otherwise dispose of it properly.	he is the guy with the knowledge.	Someone going to benefit from these medicines.
Emotions	Worried sad	happy satisfied	Happy Satisfied	Happy Satisfied

Table 3 Donor journey map

	Pre-need	Going	Returning	Ending
Doing	Wait for the donor.	Take medicine from the donor.	The pharmacist checks the medicine expiry and the quantity of the medicines.	Segregating medicines into groups.
Thinking	Wastage of medicines is increasing day by day.	The donor is a responsible citizen.	Some of the medicines can be used and some are expired.	Some types of medicines can be resale.
Emotions	Worried sad	Glad satisfied	Happy Thinking	Happy Satisfied

Table 4 Pharmacist journey map

	Pre-need	Going	Returning	Ending
Doing	Search for cheap medicine options.	Go to a donor or pharmacist for cheap medicines.	The pharmacist gives medicines of the donor at lower rates.	Buy unused medicine of the donor at a lower cost.
Thinking	I don't have enough money to buy the medicines.	Maybe at the donor bank, I can buy the medicines at cheap rates.	All these medicines are available at lower rates.	I saved a lot of money today.
Emotions	Crying sad	Sad Worried	Happy Joyful	Happy Satisfied

Table 5 Receiver journey map

4.5 Affinity mapping

The result of affinity mapping is an affinity diagram, which is often referred to as a cluster map to organise information. When examining qualitative data or observations, affinity diagrams are very helpful in grouping similar information into categories. It can be challenging to comprehend people's needs when it comes to UX. Beyond usability testing, a variety of sources, including support tickets, customer care chats, and

interviews, are used to get user insights or feedback. The affinity map is used to funnelling down the data into categories to be reduced to a single figure or statistic that can be compared to the Key Performance Index (KPI). From the information collected from the interviews, personification and the journey map, the affinity map is created. The information collected is grouped into three i.e. wastage, quality and disposal as shown in table (6). Not all unused medications can be sold or used again. There are many reasons for this, including the fact that the details are not printed on the package and the expiration dates. People can respond differently to the same medications. All of this leads to the conclusion that most of the leftover medications are wasted. On the other hand, it is challenging to determine the quality of the leftover medication due to a lack of analysis techniques. The consumer finds it challenging to believe in the quality of the leftover medication. Although the medicine's expiration date has not passed, its deterioration is also taken into account. The proper disposal of any leftover medication is crucial. The right disposal method is required because of the negative effects on humans and animals as well as the environment.

Wastages	Quality	Disposal
Not all unused medicines can be resold or reused.	Lack of medicine testing types of equipment.	If a medicine's packaging is cut, it is challenging to distinguish the medications.
Testing and packaging are not feasible.	Despite the fact that a medicine's expiration date has not lapsed, its quality remains crucial.	Stock clearance.
Details and expiry date visibility.	Creating a consumer-oriented system.	Disposing of in an eco-friendly manner.
Individuals might respond differently to the same medication.	Gaining the buyer's credibility is essential.	Different medications need different conditions for storage.
Alternative use of medicine.	The deterioration of the unused medication.	Testing and disposal norms.

Table 6 Affinity mapping matrix

Iteration 2 - How might we

Redefining the problem statement comes after affinity mapping. Reframing key insight statements to form 'how might we?' questions to turn those challenges into opportunities for design. The problem statement is further redefined in the second iteration, and the following five how might we questions are posed.

1. Establish the recipient's confidence in purchasing the leftover medicines of another donor.
2. Raise public awareness about how to effectively use leftover medicines by giving them to a pharmacist or disposing of them in an eco-friendly way.
3. Store the quality of the leftover medicine.
4. Authenticate the testing of leftover medicine.
5. Create a supply chain and connect the donor, pharmacist and receiver.

4.6 Concept Generation Matrix

Based on the results of the design challenge 'how might we?' phase, the early concept ideas for the specified issue using the Concept-Generating Matrix are developed. The technique also encourages a broad mentality for the development of many various methods to solve problems. The brainstorming procedure is also organised, comprehensive, and well-founded. The Concept-Generating Matrix is a two-dimensional table that, at its intersection locations, generates new concepts by fusing two values.

Table (7) shows the concept generation matrix, actors which are donor, buyer and pharmacist as column heading and technique, enabling solution, and value

proposition as a row heading. From the research 4 value propositions are found which are the expiry date of medicines, quality of the medicine, accessibility and the process involves in a complete cycle. The intersection of each actor with the value proposition is studied and the final problem statement is formed.

	Donor	Buyer	Pharmacist
Expiry	Check the medicine manually and Donate before the expiry date. Checking expiry through Mobile application.	How to check. How to trust.	Selling at a discounted price. Distribution to a needy person. Dispose to the factory.
Quality	Avoid the package and medicine tempering. Store in a prescribed manner and preserve the details on the package.	Quality testing assurance. Expiry verification.	Consult the legal authorities. Quality testing equipment.
Accessibility	Pickup from home and store dropoff. GPS location tracking. Use social media.	Store check-in. Order medicine online.	Tracking donor and buyer.
Process	Online platform Personal store drop.	use an online platform that locates the nearby stores.	Database management.
Random	Development of med-bank in local areas. Online sharing platform.	Visit the med-bank.	Connecting with the doctors, social workers and government.

Table 7 Concept generation matrix.

After performing the UX study on the given problem statement we found that there could be possible two solutions

1. **Med-Bank** – Development of a local med-bank where donors may contribute leftover medications and those in need can purchase them.
2. **Online Platform** – developing an online platform where a delivery person can pick up the leftover medicine from the doorstep of the donor and deliver it to the pharmacist or the patient.

It's critical to realise that the primary goal of user experience research is to identify a credible problem statement or compelling issue. Finding a good issue description is just as important as finding a good solution.

5 DESIGN CHALLENGE 2

To facilitate comprehension of the UX design process, we provide an example. The given problem is to do a UX study on senior citizens, understand the issues they encountered in everyday life, and develop a more defined design problem statement and solution. Osteoarthritis, which manifests as difficulties walking, is one of the most significant concerns experienced by elderly individuals. By doing UX research on the user, we came up with a solution to this issue.

Participants

To determine the current status of leftover medicines, we posed a questionnaire to a diverse sample of individuals of age above 65 years. After the questionnaire, we select

some individuals of 23 people for direct observation. For this research, we have conducted interviews which include 6 doctors, and 17 senior citizens to deep dive into the UX research.

5.1 Known and Unknown Map

As discussed earlier the known and unknown mapping enhances comprehension of the conceptual framework and enables the formulation of the design problem. According to the primary research, the majority of elderly individuals experience knee pain and have difficulty walking. Osteoarthritis is the name of the condition. Osteoarthritis can be treated, and there is exoskeleton equipment like knee supports are available on the market. Conversely, there is also the possibility of surgical intervention and Hyaluronate injection. Despite this knows, the unknowns encountered are the force or pressure on the knee joint, ergonomics of the knee supporting devices, less use of passive knee supporting devices, and joint supplements. Table (8) shows the known and unknowns of the design problem statement.

Known	Unknown
Knee pain	Stabilize the knee support.
Treatment for osteoarthritis	Offloading knee brace.
Exoskeleton device	Force calculation on the knee.
Knee brace technology	The reaction on the knee in different conditions.
Surgical intervention	Converting active knee support device to passive knee support device.
Spring knee support	Ergonomics of the knee supporting device.
The pressure on the knee	No slip condition
The cartilage that cushions the knee joint starts to wear down.	Bending on the knee and its tracing
Biomechanics in knee joint	Supporting device for thighs and calves
Hyaluronate injection	compression knee support
How people suffering from knee pain use support devices	Joint supplements
Total replacement of the knee is the last option.	The real cause of knee pain is friction between bones.

Table 8 Known and Unknown matrix

5.2 People and Context Research

The primary research identifies two key stakeholders. The physician who made the aforementioned remark, "Most of the elderly come here because of knee problems." And the elderly individual who made the aforementioned remark, "Because my legs can no longer support me, I could hardly walk."

5.3 Journey Map

Instead of going to the old people and asking them about their pain, the hospital and local health centre are chosen to meet the doctors and staff. After performing primary and secondary research, the journey map for the patient and the doctor taking their happiness index into account is shown in fig (5). There are four stages to the patient and the doctor's journey. The patient is experiencing knee pain in phase one. The patient visits the hospital in the second phase to seek treatment. Phase three marks the end of the patient's treatment. The recuperation phase is the fourth stage. According to the journey, the happiness index of the doctor and the patient is separated into four phases: injury, hospitalisation, treatment, and recovery.

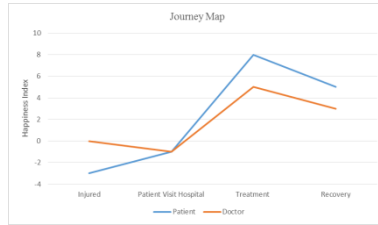


Fig 5 Journey map

5.4 Personification

After interviewing the potential user, the personas are formed. The objective of the personification is to convert user stories and problems they faced into insights through the user personas. Through the interview, the individual participants are divided into three categories. People like Mohammad Khan, who is 68 years old and has knee discomfort, are included in the first category. He has a shop for repairing bicycles. He is required to work while suffering for his daily salary. Table (9) shows the behaviour, motivation, frustration, needs and goals of Mohammad khan. People like Vimal Fulwar, who is 82 years old and she is not able to travel from one place to another without a helping hand are included in the second category. She has grandkids and she doesn't have to do work daily like Mohammad. Table (10) shows the behaviour, motivation, frustration, needs and goals of Vimal Fulwar.

Name	Behaviour	Needs
Mohammad Khan (Cycle repairing man)	He owns a cycle repairing store in IIT Kanpur. He is always ready to help the students. He is a very helpful and joyful person. His age is 68 years.	A less exothermic process. Helping hands to share some of the work. Stay fit. A device that decreases stresses on the knee and promotes more leg mobility.
	Frustration He wants to work more yet an ageing bodily component causes him agony. Unable to comfortably descend and ascend owing to knee and leg discomfort. Due to his slow repair time, many students avoid having their bicycles repaired by him.	Motivation Students' satisfaction after the cycle is repaired. More work so that he can earn more money. Less body pain while working. Fast repairing time.

Table 9 behaviour, motivation, frustration, needs and goals of Mohammad Khan (first category)

Name	Behaviour	Needs
Vimal Fulwar (housewife)	Her grandchildren are of age 10 and 15 years. Her age is 82. She loves to play with them. She wants to help with household work like cleaning and cooking.	Helping hands to help her to travel from one place to other. Stay fit. Get rid of knee pain.
	Frustration Unable to walk. Calling people for help for going from one place to another. Not able to play outdoors with grandkids. Not able to go for a trip, has to stay in the home only.	Motivation Playing with grandkids. Walking from one place to another on her own. Helping others in their work. House cleaning, cooking, going to market. Visiting temple.

Table 9 behaviour, motivation, frustration, needs and goals of Vimal Fulwar (second category)

The doctors and the helper who assist elderly folks in receiving treatment make up the third group created after the personas were divided into two categories. Interviews were conducted with the assistant and the orthopaedic doctors.

5.5 Stakeholder Mapping

A stakeholder map is a map connecting different individuals involved in the study. Figure (6) shows the stakeholder map, it involves the various personnel involved in the complete task. The doctor is the main shareholder, and several people are connected to the doctor. The thing which is taken into consideration is that the elderly person is the main character around which the stakeholder map is created. The sentence which empathizes with the stakeholder is written below the stakeholder. For example, a doctor wants to give the possible best treatment to the patient, and a family member is more concerned about the precaution that must be taken before and after treatment.



Figure 6 – Stakeholder Map

5.6 Key Insights

After conducting interviews, the user's behaviour is understood and the following insights are made. These key insights are our 'how might we?' question which we have to answer.

1. Ergonomically designed, stable knee support is needed.
2. Easy to use and passive device.
3. Decrease force on the knee joint.
4. treatment for osteoarthritis.

Problem statement

Our objective is to create a passive device that supports the knee joint and evenly distributes knee forces for osteoarthritis patients.

5.7 Ideation and prototyping

A prototype is "A simulation or sample version of a final product, which is a solution of a UX design process, used for testing before launch." The goal of a prototype is to test and validate ideas before sharing them with stakeholders and eventually passing the final designs to engineering teams for the development process. The low-fidelity prototype is developed in the first stage, floated, and the feedback from the tested users is gathered before the next version of the prototype is created. The second stage is a medium-fidelity prototype same iteration process is repeated and from the medium-

fidelity, the high-fidelity prototype is developed before actually launching the product. The high-fidelity prototype is tested with the users and the doctor's opinion is collected.

6 CONCLUSION

The brief UX design principles and design thinking approach is derived here. The importance of design thinking for any business and professional for solving the problem is studied in detail. This study compares bad and good designs and explains how we may take a bad design and turn it into a good one. The research concluded with the human mind and people's needs, are the primary determinants of usability. An empirical study of the user-centric design process with two design challenges is conducted. 72 participants are chosen for direct observation.

The known and unknown mapping enhances comprehension of the conceptual framework and enables the formulation of the design problem. Whereas people as context research addresses topics such as who are we creating for and what is their context of usage. A stakeholder map is a visual depiction of who is involved in the UX research and how they are interconnected on the other hand a journey map is a visual representation that shows the phases someone follows to complete a task. To funneling down the idea the affinity map is used. The final refine problem statement is generated, to find a probable solution Concept-Generating Matrix is used. Prototyping and gathering user feedback marks the conclusion of the design process and leads to the creation of the finished product.

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