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Design Thinking Based Case Study on Traffic Intensity

Subrahmanya Srinivasa Rao Motukuri[1], Bhanu Murthy Soppari[1*], Naveen Reddy Challabotla[1], Vivekananda Swamy Mattam[1], Kishore Nath Nayani[2] and Ramesh Babu Poosa[3]

[1]Department of Mechanical Engineering, VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, Telangana, India

[2]Advanced Systems Laboratory, DRDO, Hyderabad, Telangana, India

[3]Department of Mechanical Engineering, Osmania University, Hyderabad, Telangana, India

[*]Correspondence to:
Bhanu Murthy Soppari
Department of Mechanical Engineering,
VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, Telangana, India.
E-mail: sopparibhanumurthy@gmail.com

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Abstract

Design thinking (DT) is an innovative and analytical approach that promotes exploration, developing models and prototypes, data collecting, and reinvention. DT has drawn more attention in recent years as means of developing new business models. Few studies, meanwhile, have looked at design thinking's potential, limitations, and applications from a broad perspective. In this paper it focused on the concept of DT to enable and cultivate empathy for the intended user. Provide a best strategy with DT problem-solving techniques that are frequently emphasised in business courses. Developed a case study on traffic intensity in daily life include comprehending the needs of people. Considering the problem in human-centric, brainstorming, hands-on approach to prototyping and testing. The case study - traffic intensity is solved based on the sequential steps followed like empathizing the problems, using double diamond steps like divergent on the problem and using ideation tools and developed a prototype with the aid of logical programming for better results.

Keywords

Design thinking, Empathy, Ideation, Prototype and testing, Nanotechnology

Introduction

An iterative process called DT involves understanding your users, questioning assumptions, redefining challenges, and finding alternative approaches and answers that aren't readily apparent at your current level of understanding. DT offers solving problems using feasibility and liability of the solution simultaneously. It consists of a series of practical methods, ideas, and approaches. DT has been employed by great innovators in literature, art, music, science, technology, and business. It's not just the domain of designers. DT is a methodology used to solve, learn, and relate human-centred approaches to solving problems in design, business, government, and everyday life [1].

A design scientist's research topic needs to be clearly defined, including a thorough and clear description of the guiding principles of the creative process underlying design thinking and the characteristics of DT instances as cognitive activities [2]. Research shows that common project management practices do not meet the needs of customers and end users. As described in "classic project management literature, cost, time, and quality are her three most important success factors in project management. However, in today's dynamic economy, focusing on just these three factors is not always sufficient or important. Researchers advocate changing project management practices to be more users centric [3].

But embracing customer-centricity is a difficult change because it is elusive, complex, and challenging. We believe that applying design thinking skills can help project manager's transition to a user-centric approach in an innovation-driven competitive enterprise environment. DT is a cutting-edge strategy historically used to define complex problems, uncover hidden requirements, and create more compelling solutions through a collaborative, user-centred approach [4].

Industry 4.0's progress in transportation is brought about by nanotechnology. The use of nanotechnology may be the finest alternative for humanity in all regards as related ecological health and protection concerns for society. The integration of several nanomaterials, such as carbon nanotubes, titanium dioxide nanoparticles, silica nanoparticles, and carbon black, improves the overall performance of paint coatings, engines, body parts, mirrors, tires, etc. in automotive industry. The use of nanoparticles greatly improves the fire and UV resistance of aerospace materials [5].

Traffic management is essential for monitoring urban expansion, and the testing phase of the system has shown it to be reliable. The information gathered is a useful tool that aids the municipality in making decisions about modifications to the infrastructure and in better comprehending the effects of the launch of a new shopping mall in the city. The volume of traffic that the roundabout see. The percentage of vehicles in each lane can also be helpful in determining which lanes to expand and how to manage traffic flow to support the city's economic development. Overall, the municipal data collection system aids in better traffic management and infrastructure adaptation decisions [6]. Concept of smart cities from all criteria like social, environmental, and economic perspectives to have safe and healthy habitat involving traffic regulation along with socioeconomical development across the cities [7]. Case study of online food-delivery system using two novel approaches "customer-oriented propositions and service-provider-oriented propositions" DT based approach responsibilities of stakeholders with ideation and finding pain point and gain points [8]. Traffic drones' are designed and developed as to analyse travel accident controlling methods and its existing consequences, brainstormed design objectives, took feedback user behaviors andsensitive changes, modernizeinterface models in travel accident situations [9]. Worked on real-time traffic data of district from Madrid, using two techniques proposed in federated edge intelligence as continual learning principles on data related to traffic sensitivity deployed sensors to maintain cities/ urban areas smart [10].

The system's brain, the Arduino Nano microcontroller, processes sensor data and controls wireless connection. The transceiver module of the vehicle gathers real-time information from on-board sensors, such as color and distance measurement sensors, to identify the existence of traffic lights. The LoRaWAN network is used to send this data to the traffic signal transceiver module. The suggested remedy advances the creation of intelligent transportation systems, laying the foundation for safer and more effective road networks in smart cities [11].

It is observed from the study on traffic intensity based smart cities are rapidly increasing with in the countries for safety and pollution free habitat, from which observed to be most of technology available can be used to create the traffic system stable, using the DT approach which connects the environment, social and verifies the feasibility, viability and sustainability of the process.

Methodology

DT approach was proposed in figure 1 from "Hasso-Plattner Institute of Design at Stanford" as follows.

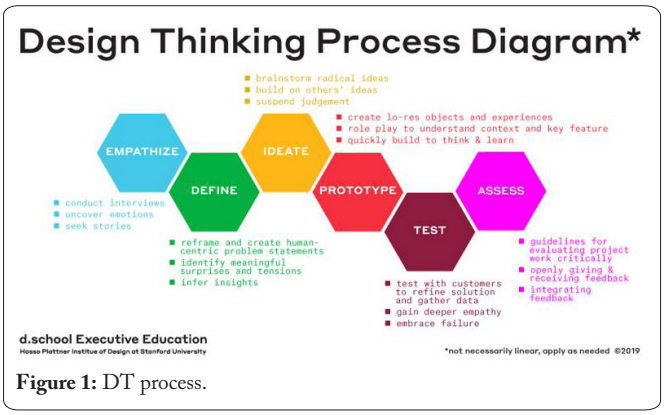

Figure 1: DT process.

Empathize

In the context of design problems, empathy mode is the effort we make to understand others. Empathy allows us to put our worldview aside and gain real insight into people and their needs, which is essential in a human-centred design process like DT. Observing what others are doing and how they interact with their surroundings give us clues to what others are thinking and feeling. However, you be prepared for the conversation to deviate from the prepared questions. Have someone demonstrate the process. Have walk through each step, explaining why you are doing it. Ask what they are thinking as they perform the activity or interact with the object.

Define

Defining is a sensory mode; a clear expression of the problem is the result. Use define mode to streamline your investigations and gain insights. Knowledge generated and accumulated during the empathy phase. We will examine and summarize our observations to acknowledge main problems identified. The theme framed so that the focus is on individuals.

Ideate

Ideation is about exploring the widest possible range of options, especially at the beginning of the design process, rather than finding just one ideal solution. Techniques such as affinity diagrams and brainstorming can be used. Once you have collected as many suggestions as possible, submit them to your team to vote. We evolved two or three of his most popular concepts for prototypes. When designers reach the third level of design thinking, they are ready to start developing concepts. Thanks to the strong knowledge base provided in the previous phases, it is possible to "think outside the box", seek out alternative perspectives on the topic, and develop creative solutions to the problem statements created.

Prototype

Prototype mode is an iterative process of creating artifacts intended to provide an answer to a problem to get closer to the ideal result. Create prototypes that are easy and cheap to develop (think minutes, cents), yet get useful early feedback from consumers and colleagues. In this experimental stage, following his first three stages, the aim is to find the optimal solution to each of the problems discovered. To test problem-solving ideas developed in the early stages, the design team builds several low-cost scaled-down replicas of the product (or specific aspects within the product).

Test

The final product is carefully tested by our designers or reviewers using the best options found during the prototyping process. Although this is the final stage of the model, iterative techniques such as DT often use the results to redefine one or more additional problems. The designer then can go back in time and make further changes, iterations, and refinements to rule out other possible solutions. Feedback on prototypes created in test mode. By exposing your design to users, you can create even more empathy for your target audience. The best test environment is one that mimics the user's actual environment. Create scenarios in environments that accurately reflect real-world situations. Be aware of their opinions and possible questions.

A case study on density based traffic controlling system

Road traffic flow is a problem of congestion, which is sadly increasing by the day. Traffic congestion is a major problem in urban areas and can lead to delays, increased pollution, and frustration for drivers. The proposed system uses advanced technologies such as sensors and microcontrollers to detect vehicle density on the road and control traffic lights accordingly and are explained step by step in figure 2 and for developing a prototype component are mentioned in table 1.

Discover and define module

The survey conducted by interacted with the user group to identify their needs and the following are the questionnaires asked for the user group using – user survey empathy tool and map is shown in figure 3.

- Have you ever been late to your work or college due to traffic?
- What is the problem generally you feel during traffic time?
- What you think the reasons for traffic?
- Do you an alternate solution or any suggestions?

User needs

Engaging users to learn about their issues, procedures, objectives, and preferences is the process of capturing user needs.

Primary needs

- Proper roads should be laid and need to maintain by an individual body.
- Restrict heavy vehicles enter city during no-entry hours.
- Prior information regarding road maintenance or closure.

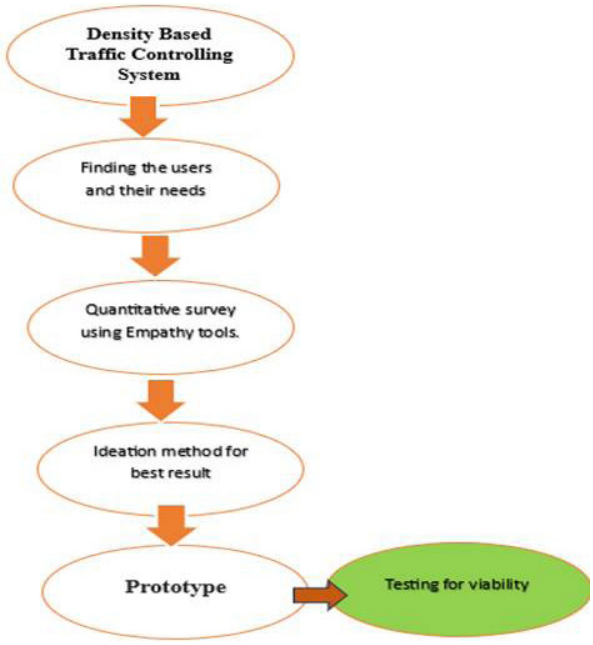

Figure 2: Methodology.

Table 1: Components list.

S. No.	Component/Part	Quantity
1	Arduino Mega 2560	1
2	Ultrasonic sensors	4
3	Red LEDs	4
4	Green LEDs	4
5	Yellow LEDs	4
6	220 ohm resistors	12
7	Jumper cables	-
8	Breadboards	1

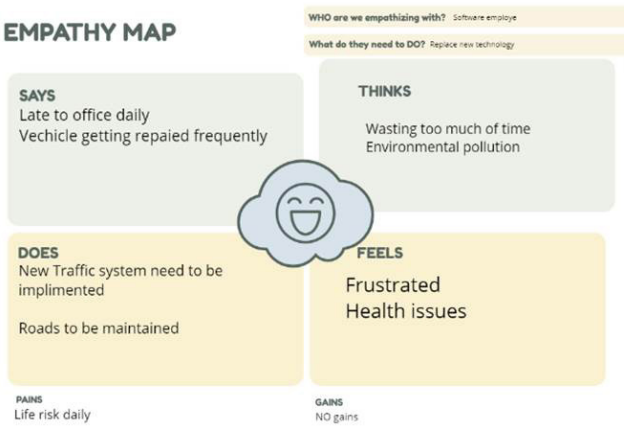

Figure 3: Empathy map.

Secondary needs

- Minimising or reducing as much as traffic signals.
- Based on traffic density automatic traffic duration changes.

Latent needs

- Safety camera should be installed, and an ambulance should be available at accident prone area.

Ideation tools (SCAMPER)

- Substitute: Traditional traffic lights have been replaced with a system that uses dynamic digital displays that change in real time according to traffic density.
- Combine: Combined density-based systems with other sensors such as cameras. To collect additional data with radar and adjust traffic light times more.
- Adapt: In this project adapted an existing traffic light system to integrate density-based control.
- Modify: Modifying the current design to make traffic lights more effective and efficient. We adjusted the timing algorithms, incorporated new data types, and changed the physical placement of the lights themselves.
- Put to another use: Reuse existing technology and infrastructure to create density-based traffic signal control systems. For example, he uses his existing WiFi network and cell towers to collect traffic data.
- Eliminate: By eliminating some elements of traditional lighting systems, density-based system. No more fixed schedules or pre-programmed times sequence.
- Reverse: Approached traffic light design from a completely different angle. First, we thought about how people and cars would move at intersections, and worked backwards from there to design a system that meets their needs.

Prototype

The prototype is developed by following all the step-by-step process of DT by definingof problem from the real time later empathizing of all the stake holders are (commuters, students, employees, auto drivers, traffic police, etc) finally the team has come up with alternate solution for some extent and developedusing basic components and are shown in table 1 along with circuit shown in figure 4.

Evaluation of prototype based on desirability, feasibility, and viability

- Desirability: It improves traffic low, reduces congestion, and increases driver and pedestrian safety.
- Feasibility: The technology required to develop and implement density-based traffic light control is already in place. This technology is widespread and is used in other similar systems.
- Viability: This design ability to integrate with existing traffic infrastructure.

Discussion

Essentially, "DT method is iterative, adaptable, and concentrated on user and designer cooperation", focusing on bringing perceptions to life based on how actual people think, feel, and behave. DT, problems generally are: (1) Empathising: Being aware of the needs of others, (2) Reframing and describing the issue in a "human-centric" manner, (3) Ideating: Developing more and more new ideas in 360 degrees with almost all possible areas, (4) Prototyping, and (5) Testing:

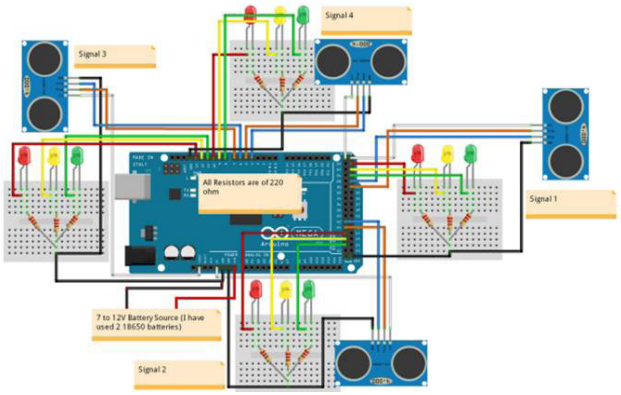

Figure 4: Traffic signal system.

Inspecting the output product developed from iteratives and finally concluding.

Conclusion

The DT process is non-linear and iterative regularly evaluate, challenge, and refine their initial hypotheses, insights, and to provide a solution with a group of teams. Any problem is influenced by each stage of the early work process. It also helps define the boundaries of the problem, allows us to restate the problem, and perhaps most importantly, gives us new perspectives for identifying potential solutions. From the prototype it is explained to be the most effective and intelligent traffic system developed to be adopted by any government for the betterment and safety of their commuters and their family.

Acknowledgements

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Conflict of Interest

None.

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