Design Thinking and Innovation

II B. Tech – II Semester

Laboratory Record

Innovative Idea Proposed:
Smart Entry System

Team Members

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2. Darvemula Phanindra Giri Kumar (23471A05Fk)
3. Eedara Vignesh (23471A05FL)
4. Gonugutala Dhanush (23471A05FP)

NEC
NARASARAOPETA
ENGINEERING COLLEGE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NARASARAOPETA ENGINEERING COLLEGE: NARASARAOPET (AUTONOMOUS)

Accredited by NAAC with A+ Grade and NBA under Tier -1 Approved by AICTE, New Delhi,
Permanently Affiliated to JNTUK, Kakinada KOTAPPAKONDA ROAD,

YALAMANDA VILLAGE, NARASARAOPET-522601

2024-2025

NARASARAOPETA ENGINEERING COLLEGE: NARASARAOPETA

(AUTONOMOUS)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that Ganji Chandra Sekhar (23471A05FN), Darvemula Phanindra Giri Kumar (23471A05Fk) , Eedara Vignesh (23471A05FL), Gonugutala Dhanush (23471A05FP) have successfully completed the course in DESIGN THINKING & INNOVATION, and have effectively applied the principles in "POTHOLE INDICATOR", as part of their academic curriculum. This certificate is awarded in recognition of their dedication, creativity, and problem-solving skills in applying design thinking principles during the year 2024-2025.

Signature of Staff in-charge **Signature of Head of the Department**

Internal Examiner **External Examiner**

VISION AND MISSION OF CSE DEPARTMENT

VISION:

To become a centre of excellence in nurturing the qualityy Computer Science & Engineering professionals embedded with software knowledge, aptitude for research and ethical values to cater to the needs of industry and society.

MISSION:

The department of Computer Science and Engineering is committed to

M1: Mould the students to become Software Professionals, Researchers and Entrepreneurs by providing advanced laboratories.

M2: Impart high quality professional training to get expertize in modern software tools and technologies to cater to the real time requirements of the industry.

M3: Inculcate team work and lifelong learning among students with a sense of societal and ethical responsibilities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates of the programme are able to:

PEO1: Apply the knowledge of Mathematics, Science and Engineering fundamentals to identify and solve Computer Science and Engineering problems.

PEO2: Use various software tools and technologies to solve problems related to academia, industry and society.

PEO3: Work with ethical and moral values in the multi-disciplinary teams and can communicate effectively among team members with continuous learning.

PEO4: Pursue higher studies and develop their career in software industry.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Apply mathematical and scientific skills in numerous areas of Computer Science and Engineering to design and develop software-based systems.

PSO2: Acquaint module knowledge on emerging trends of the modern era in Computer Science and Engineering

PSO3: Promote novel applications that meet the needs of entrepreneur, environmental and social issues.

PROGRAM OUTCOMES (POs)

Engineering Graduates should possess the following:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
12. **Life- long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

CO1: Define the concepts related to design thinking. [K1].

CO2: Infer the fundamentals of Design Thinking and innovation. [K2].

CO3: Apply the design thinking techniques for solving problems various sectors. [K3].

CO4: Analyze to work in a multidisciplinary environment. [K4].

CO5: Evaluate the value of creativity. [K4]

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1. Introduction to Design Thinking

Design:

Design is the process of creating, planning, and problem-solving to develop functional and aesthetically appealing products, systems, or solutions. It involves creativity, user needs, and structured methodologies to achieve effective outcomes.

Design Thinking:

Design Thinking is a simple, creative way to solve problems by focusing on people's needs. It involves understanding the problem, brainstorming ideas, making prototypes, and testing solutions to create something that works well for users. It's all about thinking outside the box and trying things out until you find the best solution.

Innovation:

Innovation refers to the process of creating, developing, and implementing new ideas, products, services, or methods that improve efficiency, effectiveness, or value.

- **Product Innovation** – Developing new or improved goods (e.g., AI-driven drug discovery).
- **Process Innovation** – Enhancing how something is done (e.g., blockchain-based cybersecurity).
- **Business Model Innovation** – Creating new ways to deliver value (e.g., subscription-based AI models).
- **Social Innovation** – Addressing societal challenges (e.g., smart waste management solutions).

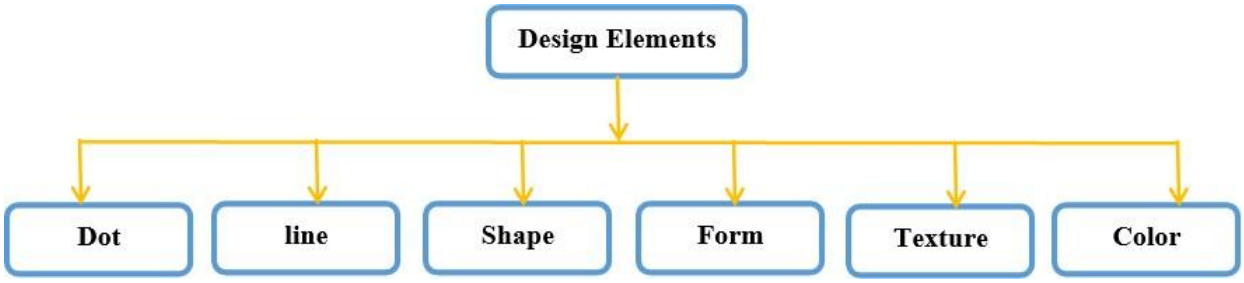
1.1. INTRODUCE DESIGN ELEMENTS

Elements and Principles of Design:

The elements of design are the fundamental components or building blocks used by designers and artists to create visual compositions. Design involves the selection and arrangement of visual images to make a pleasing presentation.

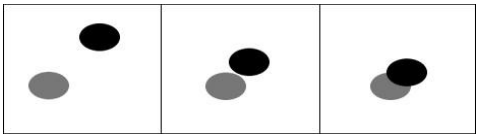
A successful graphic designer must apply the fundamental principles of design. The principles of design are the guides that govern how elements are combined. The elements are therefore the raw materials in design that must be combined successfully.

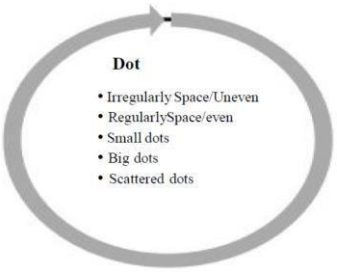
The basic elements of design are dot, line, shape, color, space, value, texture, mass/size and form.



Dot:

Dot is known as basic element of point. It is the smallest unit suggesting its presence and location. The sizes of the dots also convey a message. The bigger the dot is, the more enlarged the surface appears, and vice versa. A **dot** is a small, round mark or point in a space. It is one of the most fundamental elements in design and visual art, representing a singular point of focus or origin.

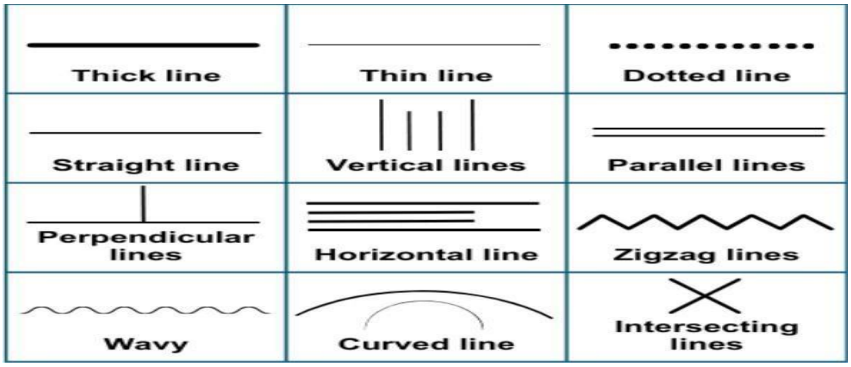




Line:

Line is the distance between two points joined together. It is a chain of dots joined together indicating direction. Line is the simplest and most important of the design elements and is incorporated into the other elements. All lines have directions, length and width. Line is the basic requirement for almost all designs. It provides the visual dimensions of length and width.

Lines can be used to create shapes, patterns, textures, and movement in a composition. Types of Line: Straight, Curved , Zig Zag, Diagonal, Wavy, Spiral, Dotted, Perpendicular, Thick, Thin



Shape:

Connection of lines forms a shape. A shape is defined as a two-dimensional enclosed space. It can be geometric, like circles, squares, and triangles, or organic, featuring irregular, freeform, or natural designs.

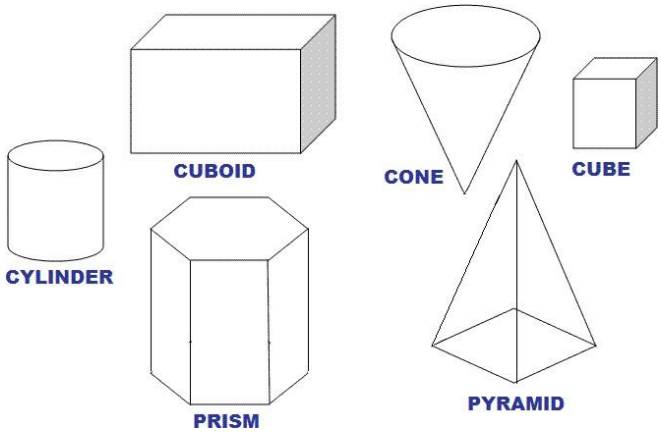
- Shapes have both physical and psychological effects based on the lines surrounding them. Space within the shapes and separating the shapes also has an effect.

- The word "shape" usually suggests geometric shapes and there are many shapes such as flat ones with equal sides - square, circle, pentagon, hexagon, and octagon; with unequal shapes such as oval, triangle, rectangle, diamond; equal sides three-dimensional shapes such as sphere and cube.

Form:

A form adds a dimension to a shape. A circle is a flat, two-dimensional shape. Add the shading that transforms the circle into a sphere, it takes on three-dimensional form. Basic forms are three-dimensional figures, including spheres, cubes, cylinders, pyramids and cones.

- Forms are generally created by combining two or more shapes. A form is a shape that has three dimensions: height, width, and depth.



Texture:

Texture is the element of design that describes surface appearance and feel understood by sight as well as by touch. It also means the appearance of the fabric. It is quality of roughness or smoothness, dullness or glossiness, stiffness or softness. Some words to describe the texture of fabrics are: rough, smooth, dull, shiny, firm, crisp, fuzzy, bulky, dull, etc.

1. **Physical Texture** – The actual feel of a surface (e.g., rough, smooth, soft, hard).

2. **Visual Texture** – The appearance of texture in images or designs, even if the surface is smooth (e.g., patterns in paintings or digital graphics).

Textures play a crucial role in art, design, architecture, and even scientific fields like material science and computer graphics.



Color:

Color is a visual element that results from the way light interacts with an object and is perceived by the eye. It consists of three main properties: hue (the name of the color, such as red or blue), saturation (the intensity or purity of the color), and value (the lightness or darkness of the color).

Color has three main characteristics:

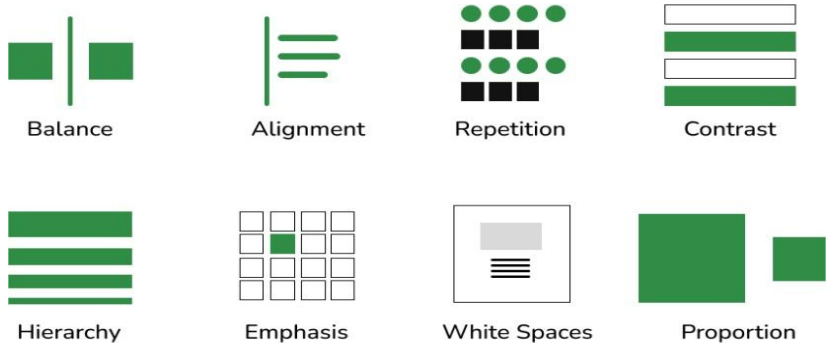
- Hue: Red, green, yellow, blue, etc. — each of these is a hue.
- Value: How light or dark the color is.
- Intensity: How bright or dull the color is.

They can be categorized into:

1. **Primary Colors** – Red, Blue, Yellow (traditional for painting) or Red, Green, Blue (RGB for digital screens).
2. **Secondary Colors** – Created by mixing primary colors (e.g., Green, Orange, Purple).
3. **Tertiary Colors** – Formed by mixing a primary and a secondary color (e.g., Blue-Green, Red-Orange).

1.2 PRINCIPLES OF DESIGN

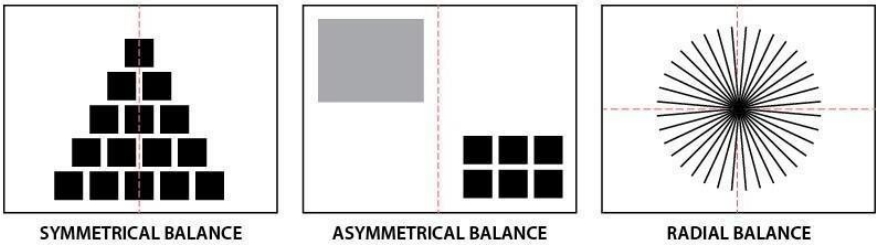
The principles of design provide a framework for organizing and arranging the elements of design in a way that creates visually attractive and effective compositions.



Balance

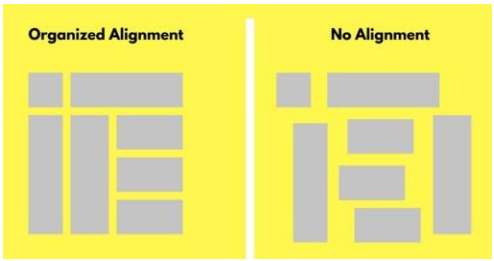
Balance in design refers to the distribution of visual weight within a composition to create stability and harmony.
There are three types of balance:

- **Symmetrical Balance**: Both sides of a design are identical or similar.
- **Asymmetrical Balance**: Different elements are arranged to create balance through contrast, size, or position.
- **Radial Balance**: Elements radiate from a central point, like in a circular design.



Alignment

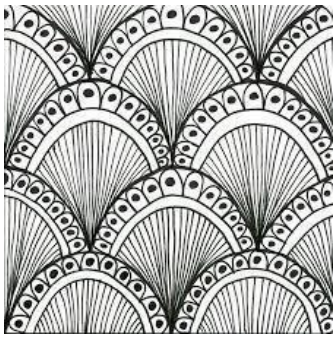
Alignment in design refers to the arrangement of elements along a common edge or axis to create a sense of order and organization. It helps to create visual connections between elements, reduces clutter, and improves readability and clarity. Proper alignment ensures that every element is visually linked, making the design appear more structured and balanced.



Repetition:

Repetition in design refers to the repeated use of elements such as colors, shapes, patterns, or textures to create consistency and unity within a composition. It helps to reinforce the overall

theme, establish a rhythm, and create visual interest. Repetition can make a design feel cohesive and organized, preventing it from feeling disjointed or chaotic.



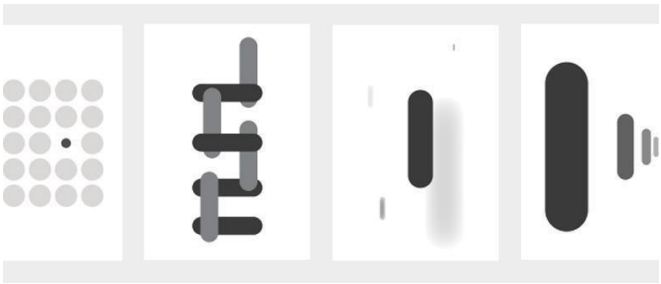
Contrast

Contrast is a design principle where we try and differentiate one or more elements/visuals from others by differentiating them by help of colors, fonts, typography, repetition, alignment, or anything else.

Hierarchy

When creating designs that hold data in a serial order, comprising of the principles of design is crucial for sectionalizing the topics accordingly in a hierarchical form. Hierarchy is the control of visual information in an arrangement or presentation to imply importance. Hierarchy influences the order in which the human eye perceives what it sees. Visual hierarchy is a broad principle designers use to organize elements in their work and show order of importance or create visual flow. In design, hierarchy is used to:

- Add structure, create visual organisation, create direction, Add emphasis,
- Help a viewer navigate and digest information easily



Emphasis:

When creating visuals, applying the principles of design is critical to improve the visual appeal and significance of your work. Minimum text, and hence maximum graphics and images. Use borders to emphasize the posts, and use frames to add images to them.

White Spaces:

White space (also called **negative space**) refers to the empty or unmarked areas in a design that are not filled with content or visuals.

It's not necessarily "white" in color— it can be any empty space within a layout. White space is an essential design principle used to create balance, clarity, and emphasis in a composition.

Proportion

Proportion defines the size and scale between two elements in a design. Having Proportions in Design helps in giving a unique identity to the elements in design. Keeping elements proportionate to each other helps defining their relationship better. Example: A **basketball** and a **baseball** differ in **scale** (size), but they share the **same proportion** in terms of their **shape** (both are spheres) and their **relative design features** (e.g., stitching, paneling).

Definition of Design Thinking:

Design thinking is a term used to denote a set of strategic, conceptual, and practical processes in which design concepts are developed (product proposals, structures, equipment, communications, etc.). Many key concepts and aspects of design thinking have been identified through studies, across all different design fields, design concepts and design work in both laboratory and environmental contexts.

Design considerations are also linked to the establishment of products and services within the business and social environment. Some of these guidelines have been criticized for simplifying the design process and undermining the role of technical knowledge and skills.

History of Design Thinking:

Design ideas as they exist today have evolved collaboratively in various fields and industries. Over 50 years, and even more have emerged and merged into the quasi-Darwin system of natural selection. These have been integrated, documented, and promoted by leading design firms (such as IDEO and Frog) and educational institutions (such as Stanford's d.school, and Rotman School of Management), and have been increasingly accepted by the industry. While these evolutionary and experimental design experiments have led to methods process in the form of design thinking tools and methods.

1963: The idea of using Design as a way of solving complex problems in a simplified manner in sciences originated in the book 'The science of the Artificial' authored by Herbert A. Simon

1973: The idea of design was achieved for Design Engineering by the book 'experiences in visual thinking' authored by Robert McKim

1982: Design methodology is defined by "cross" the study of the principles, practices and procedures of design are developed .and includes the study of how designers work and think

1987: Peter Rowes Book Titled "design thinking" describes methods and approaches that planners, designers and architects use

1980s to 1990s: The work of Robert Mckim was consolidated by Rolf Faste at Stanford university during this period 1991 David M Kelly Founded IDEO and adapt Design thinking to business interests

2009: The design thinking process itself is human centered, offering methods for inspiration, ideation and learning to designers –Brown

2012: Apply the study of design thinking principles in engineering.
2015: Verbal protocol analysis, cognitive ethnography, controlled laboratory experiments, and other formal methods from cognitive science have been rigorously applied in engineering

2017: Design thinking reflected in many applications like prototyping, solution-based method is often useful way to encourage inspiration, ideation and organization learning and human centered methods

New materials in Industry:

The integration of new materials in industry, particularly within the context of design thinking and innovation, is revolutionizing how products are conceived, developed, and manufactured. Design thinking, a human-centered approach to innovation, emphasizes empathy, ideation, prototyping, and testing, and the use of new materials can significantly enhance each of these stages. Here's how new materials are influencing design thinking and innovation in various industries:

1. **Advanced Composites**
   - **Applications**: Aerospace, automotive, sports equipment.
   - **Impact**: Advanced composites like carbon fiber-reinforced polymers (CFRP) offer high strength-to-weight ratios, enabling lighter, more fuel-efficient vehicles and aircraft. Designers can now create structures that were previously impossible with traditional materials.
2. **Smart Materials**
   - **Applications**: Wearable technology, healthcare, construction.
   - Impact: Smart materials, such as shape-memory alloys and piezoelectric materials, can change properties in response to external stimuli (e.g., temperature, pressure). This allows for innovative product designs that adapt to user needs or environmental conditions, enhancing functionality and user experience.
3. **Biodegradable Materials**
   - **Applications**: Packaging, consumer goods, medical devices.
   - Impact: With increasing environmental concerns, biodegradable materials like PLA (polylactic acid) and PHA (polyhydroxyalkanoates) are being used to create sustainable products. Designers are now prioritizing eco-friendly solutions, aligning with the growing demand for sustainability.
4. **Graphene and Other 2D Materials**
   - **Applications**: Electronics, energy storage, water filtration.
   - Impact: Graphene's exceptional electrical, thermal, and mechanical properties are driving innovation in flexible electronics, high-capacity batteries, and advanced filtration systems. Designers can leverage these properties to create next-generation devices with enhanced performance.
5. **Metamaterials**
   - **Applications**: Telecommunications, optics, acoustics.
   - **Impact**: Metamaterials are engineered to have properties not found in naturally occurring materials, such as negative refractive index. This opens up new possibilities in designing ultra-compact antennas, cloaking devices, and advanced optical components.

6. **Self-Healing Materials**
    - **Applications**: Automotive, construction, electronics.
    - Impact: Self-healing polymers and composites can autonomously repair damage, extending the lifespan of products and reducing maintenance costs. This innovation is particularly valuable in industries where durability and reliability are critical.
7. **Nanomaterials**
    - **Applications**: Medicine, coatings, energy.
    - Impact: Nanomaterials, such as quantum dots and carbon nanotubes, offer unique properties at the nanoscale. They are being used to develop targeted drug delivery systems, ultra-durable coatings, and high-efficiency solar cells, pushing the boundaries of what's possible in design and functionality.
8. **3D Printing Materials**
    - **Applications**: Manufacturing, healthcare, fashion.
    - Impact: The advent of new 3D printing materials, including metal powders, biocompatible resins, and conductive inks, is enabling rapid prototyping and custom manufacturing. Designers can quickly iterate and test ideas, accelerating the innovation process.
9. **Transparent Conductive Materials**
    - **Applications**: Touchscreens, smart windows, solar panels.
    - Impact: Materials like indium tin oxide (ITO) alternatives (e.g., silver nanowires, conductive polymers) are making it possible to create flexible, transparent, and conductive surfaces. This is driving innovation in wearable devices, smart homes, and renewable energy solutions.
10. **High-Performance Ceramics**
    - **Applications**: Electronics, medical implants, industrial machinery.
    - Impact: High-performance ceramics offer exceptional hardness, thermal stability, and biocompatibility. They are being used in cutting-edge applications such as semiconductor manufacturing, dental implants, and high-temperature engines.

2. Design Thinking Process

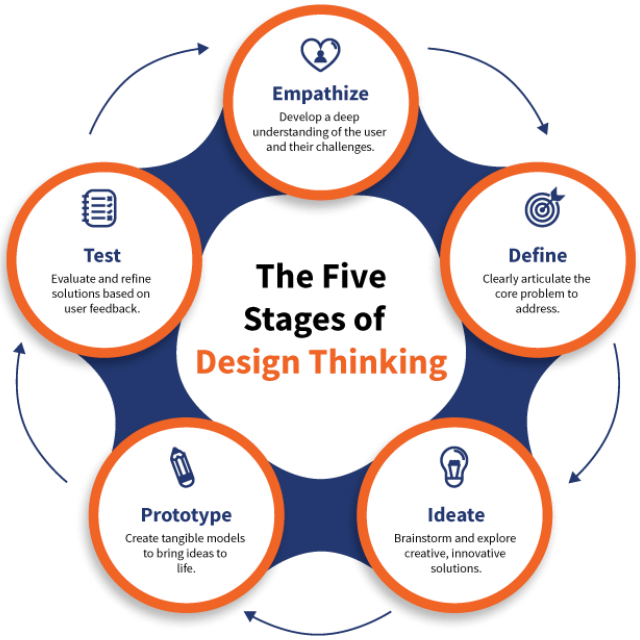
What's Design thinking and Innovation?

Design Thinking is a simple, creative way to solve problems by focusing on people's needs. It involves understanding the problem, brainstorming ideas, making prototypes, and testing solutions to create something that works well for users. It's all about thinking outside the box and trying things out until you find the best solution.

Introduction to Design Thinking Process

The Design Thinking Process is a user-centric methodology used to identify and solve complex problems innovatively. It comprises the following key stages:

1. **Empathize:** Understand the user's needs and experiences through observation and research.
2. **Analyze:** Define the problem by synthesizing information from the empathize phase.
3. **Ideate:** Brainstorm creative solutions to address the problem.
4. **Prototype:** Build a tangible representation of one or more ideas to test their feasibility.
5. **Test:** Validate and improve the prototype through real-world testing.



1. Empathize

The first stage of the Design Thinking process is to develop a deep, empathic understanding of the problem. This involves consulting experts, observing real-world practices, engaging with stakeholders, and immersing yourself in the environment to gain first-hand insights into their experiences and challenges.

Goal: Understand the scanning id card process, its challenges, and the impact on key stakeholders, including students, college rules, and the attendance.

SMART ENTRY SYSTEMS

Observation:

The existing student identification systems in educational institutions heavily rely on physical ID cards for gate entry and identity verification. However, students frequently forget their ID cards, which leads to unnecessary delays, identity verification issues, and inconvenience for both students and security personnel. The “Smart Entry System for Students” aims to address this recurring problem through a

mobile application that provides digital identification and streamlines entry verification **Interviews:**

Engage with key stakeholders to understand their concerns.

Example Interview Questions:

- Residents: "What issues do you face with forgotten of id card in your college?"
- Municipal Workers: "What are the common challenges during forgotten of id card?" Environmentalists: "How does improper id forgetting effects the student?" **Tools Used in the Empathize Phase: Journey Map**:

A **Journey Map** visualizes the user’s experience from waste disposal to collection and identifies pain points.

Example Journey Map

Stage	User Action	Pain Point	Opportunity
Arriving at Campus	Student approaches college gate	Forgot physical ID card	Introduce digital ID via mobile app (QR code or profile-based access).
ID Verification	Security checks for ID	Manual verification is timeconsuming and error-prone	Enable fast QR scanning to verify identity instantly.
Gate Entry	Student enters after check	Long queues during peak hours	Automate entry with real-time
			scanning to reduce wait times.
Attendance Tracking	Attendance taken separately	Duplication of effort and errors in manual tracking	Integrate gate entry with automatic attendance marking.

2. Define

In this stage, the core problem is identified by analyzing data from the *Empathize* phase.Patterns, pain points, and stakeholder insights are extracted to define a clear problem statement. **Example Applied:**

Problem Statement: “road potholes cause vehicle damage, accidents, and discomfort due to delayed detection and repair. A smart pothole indicator can automatically detect, map, and alert users and authorities for timely maintenance."

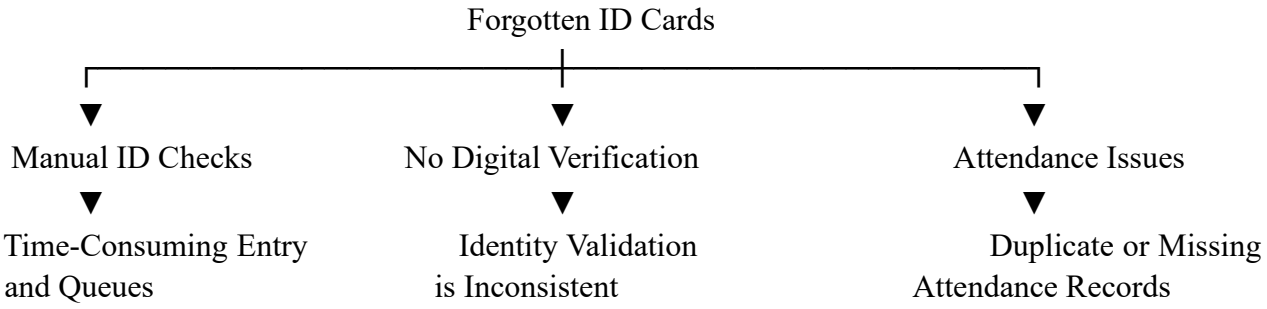
Overflowing bins result from irregular collection schedules.

- Irregular collection trucks may avoid routes with potholes, delaying bin pickups.
- Pothole-ridden roads slow down waste collection operations, causing schedule
  - disruptions.
- Unreported road damage leads to inefficient routing, increasing bin overflow incidents.

Activity: The pothole indicator detects road surface irregularities using sensors like accelerometers and GPS. It logs the pothole location and sends alerts to drivers and local authorities for timely action.

Tools Used:

Problem Statement Diagram:



Problem Identification:

1. **Problems faced in day-to-day life:**
   - Students forget or lose physical ID cards.
   - They face entry restrictions or manual checks which take time.
2. **Problems observed in surroundings (contextual):**
   - Queues build up at entry gates during peak hours.
   - Gate security struggles to verify identities quickly.
3. **Issues highlighted by feedback or suggestions from stakeholders:**
   - Security staff report difficulty in validating student IDs.
   - Admins face challenges in managing accurate attendance data.

Role: College Gate Security Guard **Age:** 40 **Background:**

- Works full-time at the main entrance gate of the college.
- Manages entry of 1,000+ students each day. ○ Has 15 years of experience in campus security. **Goals:**
- To ensure that only verified students enter the campus. ○ To reduce congestion during morning entry. ○ To avoid disputes over forgotten or lost ID cards. **Challenges:**
- Manual checking causes long queues. ○ Students often forget or misplace ID cards.
- No centralized system to check digital credentials quickly. **Needs:**
- A digital verification tool for fast identity checks.
- Training on how to use scanning tools (e.g., QR code reader).
- Support from admin in enforcing digital ID policies.
- ○ **Profile of a Student:** ○ **Profile Name:** Priya

Role: Student **Age:** 20 **Background:**

- Enrolled in 3rd-year B.Tech at the college.
- Carries a smartphone and uses college apps regularly. ○ Often attends early morning classes and labs. **Goals:**
- To enter the campus smoothly without delays. ○ To ensure her attendance is marked automatically.
- To receive notifications on important college updates. **Challenges:**
- Occasionally forgets her physical ID.
- Faces delays at the gate due to manual verification. ○ Misses attendance even after reaching on time. **Needs:**
- A mobile ID system that is secure and always accessible.
- Integration of entry system with attendance marking.

Real-time notifications and feedback from the system

3. Idea

In this phase, innovative solutions are brainstormed to address the defined problem. Teams generate creative ideas, explore possibilities, and collaborate to refine the

Objectives of Brainstorming:

- **Problem-Solving:** Identifies innovative solutions to complex challenges.
- **Idea Generation:** Encourages creativity for developing new concepts, products, or strategies.
- **Team Collaboration:** Leverages diverse perspectives and expertise.
- **Decision-Making:** Helps evaluate multiple ideas to select the most effective approach.

Example:

Ideas for Smart Entry System for Students

1. **Mobile App for Digital ID (QR Code Based):** ○ A secure app that generates a dynamic QR code for each student.
   - Security staff scan the code at the gate to verify identity.
   - App syncs with college credentials for authentication.
2. **Automatic Attendance Tracking via Gate Entry:**
   - The system marks attendance automatically once a student's QR code is scanned.
   - Reduces duplication of effort and improves accuracy.
3. **Biometric Face Recognition Integration (Optional):** ○ Use facial recognition via campus cameras for touchless, fast entry (optional due to privacy and cost concerns).
4. **Push Notifications and Alerts through the App:**
   - Students ○ get alerts for events, schedule changes, or entry restrictions.

- Helps bridge the communication gap between administration and students.

Activity:

1. Mobile App with QR Code System: ○ Students log in using their college credentials. ○ App displays a unique QR code linked to their student profile. ○ Security scans the code at the gate with a handheld device or scanner.
   - If valid, access is granted and attendance is marked automatically.

2. App Integration with Attendance and Notifications: ○ Attendance records are stored in the central system. ○ Students and faculty can view attendance in real time. ○ Notifications keep students informed of updates or missed scans.
   - Students brainstorm in groups, presenting ideas on whiteboards or slides. Each student gets 3 minutes to pitch their idea using a basic wireframe, sketch, or demo of the app concept.

1.

4. Prototype

Prototypes are early models or samples of a product or system created to **test and validate** concepts or processes before final implementation. They help identify potential issues, improve usability, and refine system design.

In a **Smart Entry System for Students**, prototypes are developed to test key features such as the **mobile ID app**, **QR code scanning**, and **automatic attendance logging**.
These prototypes enable developers to evaluate app performance, user interface design, data accuracy, and the integration between the mobile app and college entry systems.
By testing prototypes in real campus environments, the solution can be refined to ensure smooth gate entry, eliminate manual errors, and provide a secure and efficient student experience

Prototype for Smart Entry System: Mobile ID App

1. **Secure Login**
   Students log in using their college-issued credentials to access their digital ID.
2. **Dynamic QR Code Generation**
   The app displays a dynamic QR code unique to the student, which refreshes regularly for security.
3. **QR Code Scanning at Gate**
   Security staff scan the QR code using a scanner or mobile device. The system instantly verifies the student's identity.
4. **Real-Time Attendance Logging**
   Once a valid scan is detected, the student's attendance is automatically marked in the central system.
5. **Cloud-Based Data Syncing**
   All entry records and attendance logs are stored securely on the cloud for admin access and report generation.

Benefits of the Prototype:

1. **Improved Entry Efficiency:** Reduces time taken to verify students during peak hours.
2. **Error Reduction:** Minimizes mistakes compared to manual ID checking**Enhanced Security:** Only students with valid credentials can generate QR codes.
   - **Better Data Management:** Seamless integration with attendance systems improves record accuracy..

2.

3.

Key Features:

5. Test

The **Test phase** ensures that the **Smart Entry System for Students** functions effectively and helps identify areas for improvement before institution-wide implementation.

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1. QR Code Scanning Test:

- Verify that QR codes are accurately scanned and validated at the gate.
- Check whether entry data is logged in real-time to the database.
- Resolve any issues like false denials or duplicate scans.

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2. Mobile App Testing:

- Ensure the app is user-friendly for both students and security staff.
- Test the system's ability to notify users about entry status and attendance.
- Check the communication flow between users (students) and authorities (admin/security).

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3. Entry Flow Optimization Test:

- Monitor how effectively the system manages peak hour entries.
- Measure reduction in entry time and queue lengths.
- Track improvements in staffing efficiency based on data-driven gate deployment.

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4. Attendance System Testing:

- Confirm the accuracy of attendance logs through cross-verification.
- Measure the consistency and speed of attendance updates.
- Test how well the app reports issues and provides solutions for missed entries.

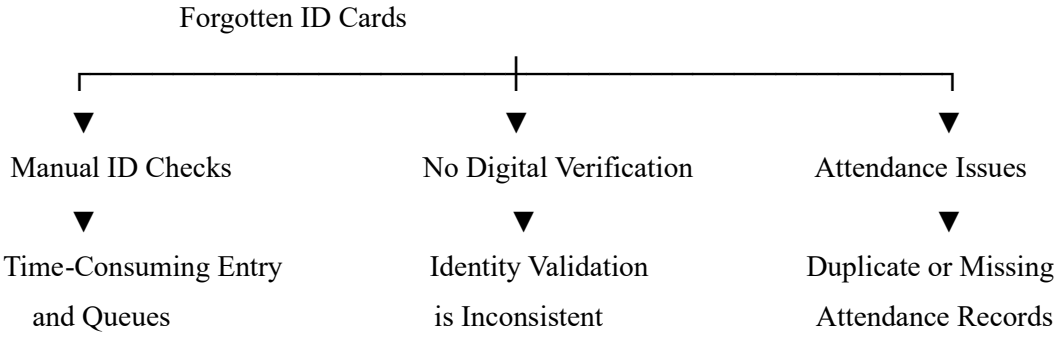
5.

Feedback & Continuous Improvements:

- Gather input from students, faculty, and security staff.
- Fix system bugs, improve usability, and implement recommended enhancements.
- Ensure the system is scalable, sustainable, and secure for long-term use.

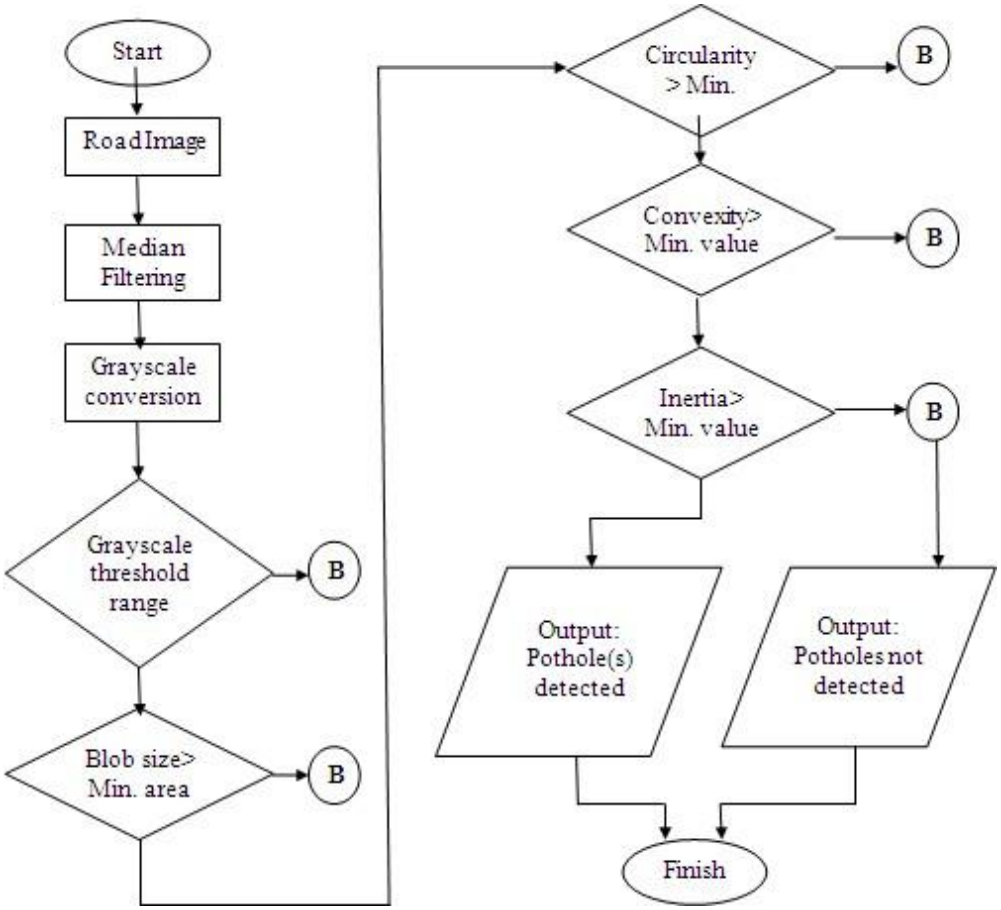
Smart Entry System Flow Chart

Adapted version of the flowchart can be illustrated as follows:



- *This visual helps highlight the core problems and sets the stage for implementing the smart system.*

SMART ENTRY SYSTEM



3. Innovation

Innovation in Smart Entry System
Innovation is creating something new (method, idea, product, or service) by finding new connections to things that already exist.

Innovative Solutions:

1. **Smart Entry with QR Code Authentication**

   Students generate QR codes via a mobile app.

- Real-time scan data is sent to admin dashboards.
- Helps prevent unauthorized entry and tracks attendance instantly.

2. **Mobile Apps for Students and Staff**

- Students can report issues (e.g., denied access) or check attendance.
- Staff can manage scan logs, entry alerts, and notify users.
- Provides tips for system usage and updates.

3. **Dynamic Entry Flow Optimization**

- Gates respond to student inflow with dynamic allocation.
- Saves time, reduces congestion, and improves flow.
- Supports smooth and efficient access for large volumes.

4. **Attendance and Reward System**

- Integrated attendance marking upon entry.
- Students earn rewards for punctuality and consistency.
- Encourages attendance compliance and time management.

5. **Data Analytics and Dashboards**

- Track attendance trends and entry behavior.
- Plan security and gate allocation based on insights.
- Helps administration make evidence-based decisions.

Benefits of Innovation in Smart Entry System

 Smooth, secure, and fast student entry.

- Improved attendance records and campus discipline.
- Efficient use of staff and infrastructure.
- Better student experience and transparency.
- Long-term administrative cost reduction.

Innovation in Organizations for Smart Entry System

Organizations are using innovation to make campus entry systems smarter, faster, and more secure. Instead of old manual ID checks, they are adopting new technologies and creative ideas to solve problems like forgotten ID cards, attendance mismatches, and gate crowding.

Role of Organizations:

1. **Educational Institutions**

- Implement QR code and biometric access systems.
- Use entry logs and real-time analytics to monitor students.
- Set attendance policies and student access rules.

2. **Startups**

- Build secure mobile ID apps and QR-based access platforms.
- Offer AI-based entry analytics and behavior prediction.
- Help institutions reduce human errors and system lag.

3. **NGOs (Educational NGOs and Digital Literacy Promoters)**

- Conduct awareness drives on digital attendance systems.
- Train students and faculty in smart entry usage.
- Bridge the gap in under-resourced schools and colleges.

4. **Private EdTech and Security Firms**

- Deliver integrated access and attendance solutions.
- Offer cloud platforms and app maintenance services.

- Work with campuses to implement secure infrastructure.

Teams for Innovation

Teams for Innovation play a critical role in turning creative ideas into real-world smart entry solutions. In the context of Smart Entry Systems, these teams are essential for designing, developing, testing, and improving campus access and student tracking technologies.

1. Technical Experts
Who? Engineers, app developers, data scientists **Role in Smart Entry System:**

- Develop QR-based ID apps and scanners.
- Build real-time dashboards for attendance tracking.
- Use AI to predict entry patterns and optimize gate management.
  Example: A developer designs an app that alerts students when their attendance is logged after scanning.

2. Design Thinkers
Who? UX/UI designers, system architects **Role in Smart Entry System:**

- Ensure the app interface is simple and intuitive.
- Design user-friendly workflows for login, scanning, and feedback.
- Make sure the system is usable by all students and staff.
  Example: A designer creates a gate scanner interface that uses color (green = allowed, red = denied).

3. Domain Specialists
Who? Faculty, IT administrators, security officers **Role in Smart Entry System:**

- Understand academic and security needs.
- Ensure tech aligns with institution policies.
- Guide integration with existing student information systems.
  Example: A campus admin advises on the best timing and layout for scanner deployment at entry gates.

4. Creative Thinkers
Who? Innovators, product ideators **Role in Smart Entry System:**

- Propose new ideas like gamified attendance challenges.
- Think of low-cost QR systems for budget-constrained campuses.
  Example: A creative thinker proposes giving badges or certificates for 100% attendance through the app.

5. Community Engagement Leads
Who? Teachers, mentors, communication experts **Role in Smart Entry System:**

- Educate students on using the system responsibly.

- Gather feedback for continuous improvement.
- Organize awareness sessions about the benefits of the system.

Example: A teacher holds sessions to help new students use the digital entry system properly.

Debate Topic

"Is technology the ultimate solution to student entry and attendance problems?" Points For (Yes):

- QR and mobile-based systems eliminate manual errors.
- Apps allow real-time updates and notifications.
- Automated attendance tracking increases data accuracy.
- Gate congestion is reduced with dynamic entry solutions. **Points Against (No):**
- Requires regular maintenance and tech support.
- Not all students have smartphones or stable internet.
- Institutions without IT infrastructure cannot implement it effectively. Training and awareness are necessary for successful adoption.

Debate Topic: "Is Smart Entry System a Priority Only for Developed Institutions?" Yes (For the Motion):

- Systems require funding and technical infrastructure.
- Leading institutions have the digital capacity to implement.
- Others may prioritize basic facilities or staffing first. **No (Against the Motion):**
- Attendance and access are critical across all campuses.
- Affordable digital solutions are now available.
- Campus safety and time savings benefit every institution.

Debate Topic: "Is Attendance Management the Responsibility of Individuals or the Institution?" Individuals (For the Motion):

- Students should ensure they scan and verify their entry.
- Accountability improves punctuality and academic behavior.
- Self-responsibility builds digital discipline. **Institution (Against the Motion):**
- Schools must provide working systems and timely support.
- Clear policies, training, and backups are institutional responsibilities. Without infrastructure, students can't manage on their own.

4. Product Design

Problem Formation in Smart Entry System for Students

Identifying the key problems in current student entry and attendance systems that affect educational institutions and students.

Common Problems:

- **Students forgetting or losing physical ID cards.**
- **Manual ID verification causes delays and long queues.**
- **No real-time tracking of student attendance.**
- **Attendance duplication due to separate entry and class logging.**
- **Poor communication between students, security, and administrative staff.**

Problem Statement:

"Educational institutions face operational inefficiencies and entry delays due to manual ID checks and separate attendance systems, affecting punctuality, student experience, and administrative accuracy."

Product Design

The process of creating a useful product that solves a student entry management problem, considering function, appearance, and user experience.

Smart Entry System Product Design Includes:

- **Mobile ID App – For generating and scanning QR codes linked to student identity.**
- **QR Code Scanners – For quick entry validation at gates.**
- **Attendance Sync System – Automated attendance logging upon gate scan.**
- **Notification Tools – Alerts for students about entry status or missed attendance.**

Design Goals:

- **Improve entry efficiency.**

- **Reduce congestion at gates.**
- **Save time and minimize manual errors.**
- **Provide a user-friendly interface for students and staff.**

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1. Product Strategies for Smart Entry System

Product strategies define the direction and approach for developing smart entry solutions. It helps to align product development with student needs, academic policies, and institutional goals.

Types of Strategies:

1. **Student-Centric Strategy:**
    - **Focus on solving common problems like forgotten ID cards or attendance delays.**
    - ***Example:*** **Mobile app for digital ID and real-time attendance tracking.**
2. **Technology-Driven Strategy:**
    - **Use emerging technologies like QR codes, mobile authentication, and cloud sync.**
    - ***Example:*** **QR-enabled entry system with cloud-based attendance logging.**
3. **Cost-Effective Strategy:**
    - **Build affordable solutions that can be implemented across departments and institutions.**
    - ***Example:*** **Use smartphones and simple QR scanners instead of expensive biometric systems.**
4. **Sustainability Strategy:**
    - **Reduce paper use and plastic ID cards by going digital.**
    - ***Example:*** **Digital ID app that replaces printed ID cards.**
5. **Collaboration Strategy:**
    - **Engage stakeholders (students, faculty, IT teams, administration).**
    - ***Example:*** **Collaborate with student councils for awareness and onboarding.**

Product Value in Smart Entry System

Product value defines the usefulness of the system for different stakeholders:

- **Students: Fast, convenient entry and reliable attendance tracking.**
- **Security Staff: Quick identity verification and reduced disputes.**
- **Faculty/Admin: Accurate attendance records and fewer errors.**
- **Institution: Improved punctuality, discipline, and operational efficiency.**

Product Planning in Smart Entry System

Product planning is the structured process of defining how and when to build and deploy the system.

Steps in Product Planning:

1. **Problem Identification:**
    - **Manual checks, forgotten ID cards, slow entry, and attendance mismatch.**
2. **User Needs Analysis:**
    - **Students need faster access and digital attendance logs.**
    - **Staff need a reliable, low-effort verification method.**
3. **Feature Listing:**
    - **Mobile ID app, QR scanning, attendance sync, notifications.**
4. **Timeline Creation:**
    - **Phase 1: User research and feature design**
    - **Phase 2: App development and server setup**
    - **Phase 3: Pilot testing and feedback collection**
    - **Phase 4: Final deployment and training**
5. **Resource Planning:**
    - **Budget, software developers, app testers, partnerships with EdTech firms or internal IT departments.**

Product Specifications for Smart Entry System:

Product specifications define the detailed technical and functional requirements for the system and app

Feature	Specification Description
QR Technology	Dynamic QR code generated for each login session
Data Connectivity	Cloud-based sync using Wi-Fi or mobile data
Authentication	Login using college-issued credentials
Device Compatibility	Android and iOS support
Attendance Integration	Syncs directly with student information systems (SIS)
Notifications	Sends alerts for attendance status, missed entries, or gate closures
Admin Dashboard	Web-based dashboard for monitoring logs and student reports
Data Security	End-to-end encryption, secure user authentication

Mobile App Specifications:

User Roles:

- **Student – Generate QR, check attendance, receive notifications.**
- **Security Staff – Scan QR, confirm entry.**
- **Supervisor/Admin – Monitor entry logs and manage users.**

Main Features:

- **View attendance records.**
- **Generate and display QR code.**
- **Receive entry-related alerts and updates.**
- **Track scan history and entry times.**

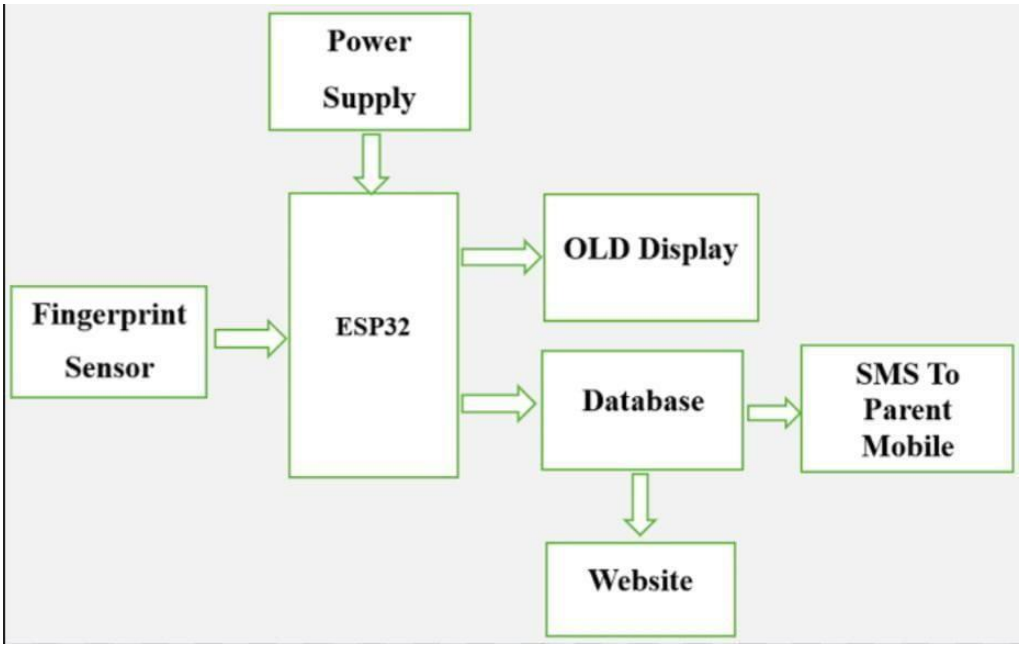
User Interface:

- **Clean, intuitive interface with multilingual support.**

- **Easy navigation for all user groups.**

Data Security:

- **Encrypted QR codes and secure cloud storage.** Authentication and role-based access control.



5. Design Thinking in Business Processes

1. Marketing Strategy for Smart Entry System for Students

Target Market Segmentation

- **Educational Institutions** – Colleges, universities, and schools needing secure student entry.
- **Smart Campuses** – Institutions embracing digital transformation and automation.
- **Private Colleges & Hostels** – Residential campuses requiring integrated attendance systems.
- **EdTech Integrators** – Firms offering tech-based educational solutions.
- **Corporate Training Institutes** – Places that monitor trainee attendance digitally.
- **Exam Centers, Events, Workshops** – Where identity verification is required at scale.

Marketing Tactics

A. Branding & Positioning

- Position the system as **secure**, **time-saving**, and **future-ready** for digital campuses.
- Build a strong identity with a brand name and slogan.
  E.g., "SmartEntry – Where Attendance Meets Innovation"

B. Digital Campaigns

- **Website:** Showcase features like QR attendance, app interface, security benefits.
- **Social Media:** Post student testimonials, before-after entry wait times, faculty feedback.
- **YouTube Demos:** Real-life walkthroughs of app usage and scanning process.
- **SEO Optimization:** Target terms like "student entry automation" or "digital attendance system."

C. Events & Exhibitions

- Participate in **EduTech expos**, **Smart Campus Summits**, and **University Innovation Challenges**.
- Set up **interactive booths** demonstrating QR code scanning and dashboard analytics.

D. Pilot Programs

- Run free trials with a limited number of students or departments. After successful feedback, move toward full-campus adoption.

E. Partnerships Collaborate with:

- **EdTech NGOs** for training and awareness.
- **Cloud solution providers** for hosting secure attendance data.
- **Campus infrastructure consultants** for seamless integration.

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2. Maintenance Plan for Smart Entry Systems

A. Hardware Maintenance QR Scanners & Devices:

- Weekly calibration and testing for scan accuracy.
- IP-rated protection for outdoor gate scanners (e.g., IP67).
- Battery checks or charging cycles for handheld devices.

Gate-side Infrastructure:

- Routine inspection of scanning stations and mounts.
- Quarterly servicing of devices, especially solar-powered terminals if any.

B.

Software Maintenance

Real-Time Monitoring Dashboard:

- Monthly updates and UI/UX enhancements.
- Automated alerts for failed scans, device offline status, etc.

Mobile App:

- User feedback-based improvements.
- Push notification engine maintenance (for attendance and alerts).
- Frequent security and compatibility patches.

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3. Ensuring Product Reliability

A. Technical Reliability

- **Dual Network Setup:** Operates on Wi-Fi with mobile data fallback (GSM).
- **Redundant Cloud Logging:** Attendance logs backed up on platforms like AWS or Azure.
- **Real-Time Fault Alerts:** Notify admin if scanners or app are unresponsive for over 6 hours.

B. Environmental Reliability

- Devices to withstand:
  - **High temperatures** (up to 55°C).
  - **Humidity, rain** (for open-campus gates).
  - **Minor tampering or drops.**
- Industrial-grade QR readers for durability and longevity.

C. User Reliability

- Simple, intuitive interface with visual cues (e.g., green for success, red for error).
- **Multilingual app UI** and **training resources** for students and staff.
- Onboarding via **videos, posters, and walkthroughs**.

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4. Startup Plan for Smart Entry System

A. Business Model

Software-as-a-Service (SaaS):

- Offer the mobile app and dashboard to institutions as a monthly or annual subscription.

Subscription Model:

- Tiered pricing based on student count and features (e.g., attendance analytics, report export).

One-Time Licensing:

- Sell the solution as a one-time license including setup + support bundle.

Freemium Model:

- Free app for students, premium features for admins (advanced dashboards, auto-reports).

B. Revenue Channels

1. Direct sales of app and dashboard system.
2. Annual maintenance and support contracts.
3. Analytics packages (attendance trends, entry-time reports).
4. Integration services with existing campus systems (ERP, LMS).

C. Startup Launch Plan for Smart Entry System

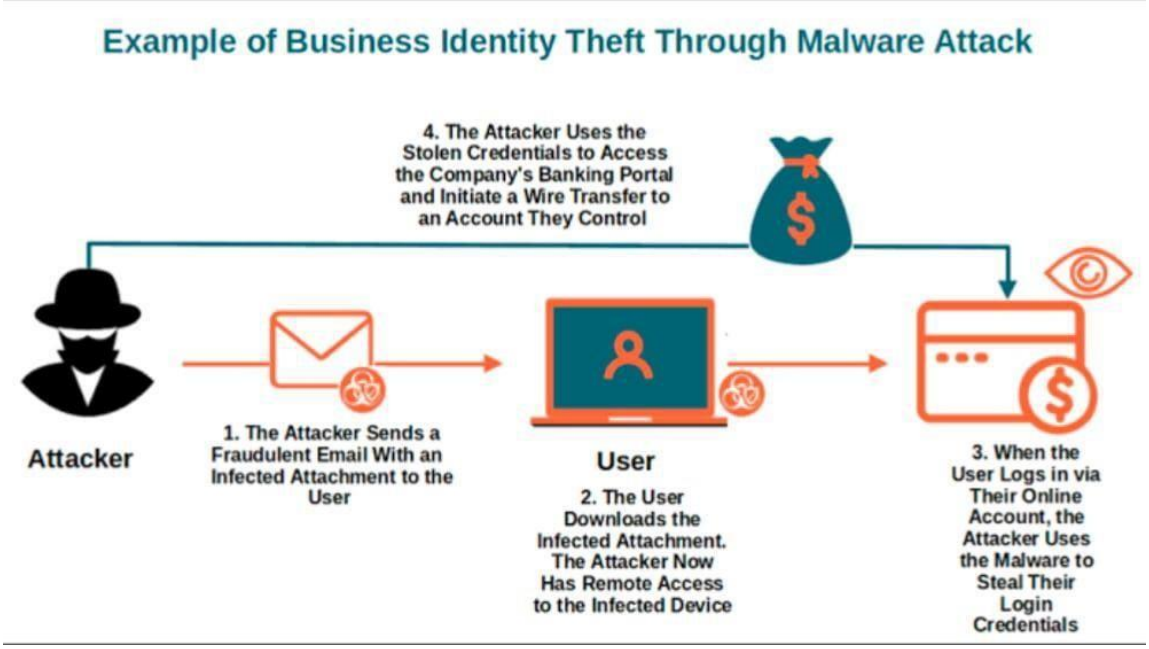
1. **Validate Idea:** Conduct surveys with students, faculty, and security staff.
2. **Build MVP:** Create a prototype app and QR scanning module.
3. **Test Prototype:** Pilot with one department; gather usage feedback.
4. **Market Product:** Promote via social media, college tech fests, and demo videos.
5. **Find Funding:** Apply for education/tech innovation grants or pitch to ed-tech investors.
6. **Plan Maintenance:** Set up ticketing system and preventive updates.
7. **Scale Up:** Expand to more colleges or multi-campus universities.
8. **Support & Improve:** Provide helpdesk support, training sessions, and regular updates.

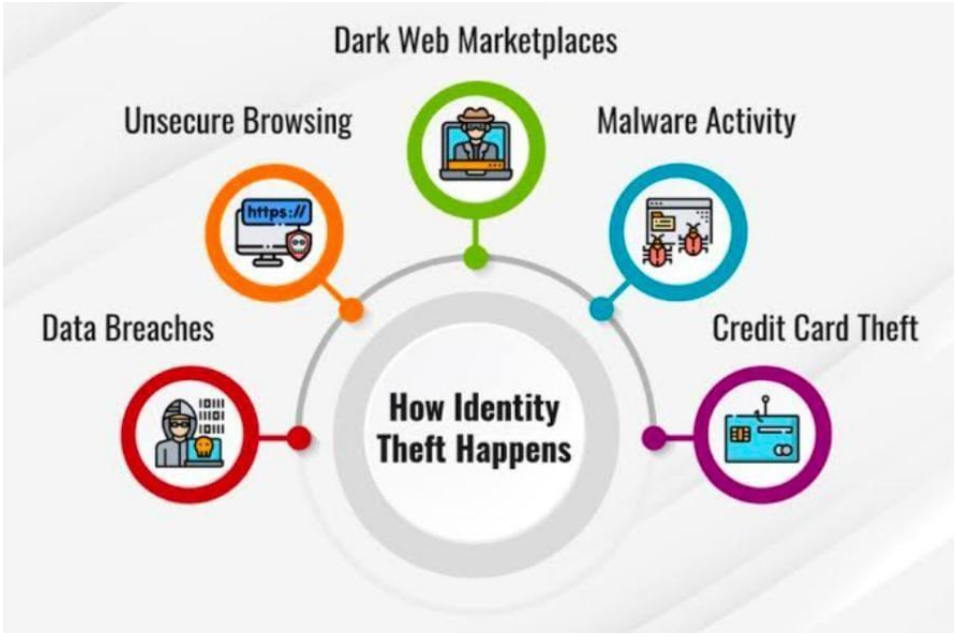
D. Operations Planning

- Hire a **technical support team** for onboarding, setup, and device maintenance.
- Partner with **hardware providers** for QR scanners.
- Build a **customer success team** for student and faculty support.

E. Funding Sources

- **Government Grants:** Initiatives like Digital India, AICTE innovation funds.
- **Startup Incubators:** T-Hub, Atal Innovation Mission, EduTech accelerators.
- **Private Investors:** Angels or impact funds supporting education, digital inclusion, or campus tech


Example of Business Identity Theft Through Malware Attack
4. The Attacker Uses the Stolen Credentials to Access the Company's Banking Portal and Initiate a Wire Transfer to an Account They Control
Attacker
1. The Attacker Sends a Fraudulent Email With an Infected Attachment to the User
User
2. The User Downloads the Infected Attachment. The Attacker Now Has Remote Access to the Infected Device
3. When the User Logs in via Their Online Account, the Attacker Uses the Malware to Steal Their Login Credentials


Dark Web Marketplaces
Unsecure Browsing
Malware Activity
https://
Data Breaches
Credit Card Theft
How Identity Theft Happens