

Chapter 2: Artificial Intelligence and Its Applications

Artificial Intelligence is making our lives better, faster, and more efficient. Most of the time you don't realize it. AI helps us make better decisions and improves processes, which is quietly transforming our lives.

Have you ever thought about how your phone knows what you say, how online games change their difficulty based on your skill level, or how your emails are automatically sorted into spam and important? It is AI that actually works behind the scenes to make systems smarter and more responsive.

In today's digital world, AI plays a crucial role in solving many of society's major concerns. In this chapter, four key applications will be explored, where AI is making a significant impact:

- Environment
- Automation
- Healthcare
- Education

AI for Environmental Problem Solving

Several serious environmental issues that require immediate attention and action are plaguing the globe. Problems such as plastic pollution, air pollution, soil degradation, deforestation, poor waste management, and loss of wildlife are not limited to one country but affect the entire globe. These issues impact human and animal health, the environment, and the future of life on Earth.

AI provides powerful tools for protecting the environment such as tracking ocean plastic trash, monitoring deforestation, tracking biodiversity, and so on by analysing the vast amount of data.

Some of the most common environmental issues are:

- Plastic Pollution
- Air Quality Problems
- Waste Management Challenges
- Wildlife loss
- Soil Degradation

Let us discuss these in detail

Plastic Pollution

Most of us may think visiting the beach will look like a scenic walk along the sandy shoreline filled with seashells. Instead, you have plastic bottles and bags and wrappers everywhere. As heartbreaking as it is, this has become a frequent sight in many coastal areas today.

Plastic pollution is among the direct environmental threats facing the world. India generates nearly 3.5 million tonnes of plastic waste every year, half of which enters rivers and oceans. Plastic breaks down over centuries. Many animals such as fish and other sea creatures often think these tiny pieces of plastic are food. It could hurt or kill them. Plastics basically do not biodegrade but break down into the micro plastics, which enter the food chain and are found in foods that we eat.



How AI Helps

AI can play a significant role in reducing remove the plastic pollution. AI systems can analyse satellite images to detect the areas where plastic waste is dumped. In 2023, 70 plastic dumps were identified in Himachal Pradesh using satellite imagery by the Department of Environment Science and Technology (DEST). This helps authorities and environmental organisations take faster action to remove the waste.

Air Quality Problem

Take a deep breath. What is actually in the air you just inhaled? In many cities, the air contains harmful pollutants from vehicles, factories, and the burning of crop stubble in nearby agricultural areas. During winter months, some cities often experience severe air pollution, with the air quality index reaching hazardous levels. Every year, millions of people worldwide die as a result of air pollution.

Poor air quality affects everyone, but children and the elderly are particularly at risk. It can cause breathing difficulties, trigger asthma attacks, neurological and immune system disorders. It may also reduce cognitive ability and cause mental fatigue in a child. Students living in highly polluted areas may find it harder to focus on their studies and impair students' academic performance.



How AI Helps

AI systems can analyse data from air quality monitoring stations spread across a city. By studying patterns in pollution levels and combining this with weather data, AI can predict when and where air pollution will increase. This allows authorities to take preventive measures, such as:

- Advising schools to cancel outdoor activities
- Alerting hospitals to prepare for more patients with breathing problems
- Temporarily restricting vehicles in highly polluted areas

- Informing farmers about weather conditions suitable for stubble burning

The first air quality monitoring and early warning system was launched in Ahmedabad, Gujarat, in May 2017 by the Ministry of Earth Science. Initially, this system was not based on AI. It relied on traditional methods of collecting and analysing environmental data, such as pollutant levels and weather conditions.

In recent years, several Indian cities have begun implementing AI-based air quality forecasting systems. These systems help municipal corporations issue health advisories to citizens, especially when pollution levels are at their peak. Commuters can check air quality apps to decide whether to wear masks or take alternative routes with cleaner air.

Waste Management Challenges

Have you ever noticed where your household waste goes after the garbage truck collects it? In many Indian cities, waste ends up in landfills, massive dumping grounds where trash accumulates for years. These landfills release harmful gases, produce unpleasant odours, and sometimes catch fire. They also contaminate groundwater, affecting the health of nearby communities.

India faces a significant challenge in waste management because much of our waste is mixed, and wet organic waste is thrown together with dry recyclable materials. This mixing makes recycling difficult and reduces the value of recyclable materials.



How AI Helps

AI can improve waste management in several ways:

- Smart sensors in bins can monitor waste levels and optimize collection routes. The Pune Municipal Corporation has integrated AI-driven technologies to modernize waste management. They have developed an AI-powered mobile application that helps citizens report waste dumping in their neighbourhoods. Citizens can take photos of garbage piles and upload them through the app. The AI system identifies the location and type of waste, then automatically generates a work order for the nearest cleaning squad. This has significantly reduced response times and helped keep neighbourhoods cleaner.
- AI-powered sorting systems at waste processing facilities can identify and separate different types of waste automatically. In Indore, waste processing plants are using AI-based automated sorting machines which help to segregate the plastic, metal, and organic waste efficiently.
- Image recognition technology can help citizens identify whether an item is recyclable or not. Nowadays, mobile applications are available where users can scan the object and check whether an item is recyclable or not.

Wildlife Loss

Did you know why dinosaurs vanished from the Earth? This occurred many years ago due to a natural disaster and environmental changes. Similarly, some previous studies show that an increasing number of cell phone towers in cities is reducing bird populations. This means that when living conditions change significantly, species may not survive. Even today, many animals are becoming rare or disappearing completely.

Loss of wildlife is a growing problem, with many animal and plant species declining due to habitat loss, poaching, and human-wildlife conflict. As forests shrink and human settlements expand, animals lose their homes and sources of food. Poaching remains a serious concern. Despite strict laws, poachers continue to hunt endangered species for their skin, bones, and other body parts, which are sold illegally.



How AI Helps

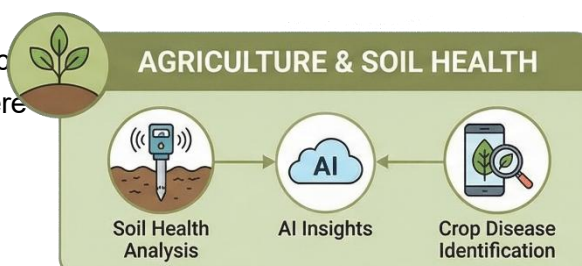
AI is becoming an invaluable tool for wildlife conservation:

- Camera traps with AI capabilities can automatically identify animal species and send real-time alerts when endangered animals are spotted. **Trail Guard AI cameras** have been deployed in many tiger reserves in India. This system detects animals like tigers and other species, identifies them, and shares the information with officials in real time.
- AI systems can analyse satellite images to detect changes in forest cover and identify areas where habitat loss is occurring. In India, the **Forest Survey of India (FSI)** collects the Indian forest satellite images annually and automatically detects deforestation, degradation and forest cover changes based on image processing with AI.

Soil Degradation

Ever thought about why some soil can't grow crops like it once did? This happens due to the degradation of soil over time. Nowadays, soil degradation is a major environmental issue worldwide. The factors affecting soil degradation are mainly unsustainable farming practices, excessive use of chemical fertilisers, deforestation, and industrial pollution. Degraded soils are less productive, making it harder to grow crops and threatening food security.

Soil degradation also affects the soil's ability to absorb carbon dioxide from the atmosphere after harvest, which adds to air pollution. If the soil were naturally.



How AI Helps

AI can assist farmers in understanding and improving soil health:

- AI systems analyse soil data from sensors to provide recommendations on fertiliser use, irrigation, and crop rotation. In the 2026 Union Budget, the Indian government announced an **AI-powered platform called Bharat Vistaar** to help farmers with localised information including soil conditions, weather, pest detection, and expert advice in their own languages. This aims to give crop and soil recommendations that could include fertiliser and irrigation guidance.
- AI-powered mobile applications allow farmers to take photos of crop problems and receive instant advice. The **Indian Ministry of Agriculture and Farmers** launched the **CROPIC**, which stands for 'Collection of Real Time Observations and Photo of Crops.' It is a mobile app that farmers can use to share shots of their crops at different stages of growth. This system checks the health of crops, finds signs of stress or damage, and allows real-time tracking.

AI-Assisted Healthcare

AI is revolutionizing healthcare globally by allowing for faster, more accurate, and cost-effective diagnosis and treatment. India's healthcare system serves over 1.3 billion people, but there is still a significant gap between healthcare needs and available resources. AI is helping to overcome this gap by assisting with early disease identification, medical image analysis, and decision support for healthcare personnel. It also supports virtual healthcare and remote patient monitoring, allowing patients to consult with doctors via telemedicine platforms and wearable devices that track vital signs in real time.

Some of the important applications in healthcare where AI is now used in real life are:

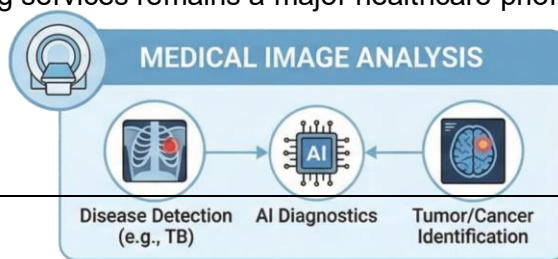
- Medical Image Analysis
- Predictive Healthcare
- Remote Patient Monitoring

Let us discuss in detail

Medical Image Analysis

Did you ever think about how a doctor determines whether a bone is fractured when someone falls and gets injured? It can be determined using the X-rays images which are the medical images. Similarly, other health issues can be diagnosed using the medical imaging technique like X-rays, CT scans MRIs and ultrasound.

In India, there is a shortage of radiologists, especially in rural areas. This means patients often have to travel long distances or wait for weeks for their reports, delaying timely diagnosis and treatment. Limited access to medical imaging facilities affects the detection of serious conditions such as tuberculosis (TB), cancers and heart diseases at early stage. Thus, improving the availability and accessibility of medical imaging services remains a major healthcare priority in our country.



How AI Helps

Nowadays, AI can analyse medical images with remarkable accuracy, often spotting details that human eyes might miss. For example:

- AI can detect early signs of tuberculosis in chest X-rays. India has adopted AI-driven tools to automatically analyse chest X-rays for TB screening. This tool is validated by the Indian Council of Medical Research (ICMR). These tools are being used across multiple states and Union Territories to screen vulnerable populations and presumptive TB cases, helping accelerate early detection and reduce diagnostic delays.
- AI can also help identify tumours or cancers with the scan images. The Telangana government has initiated a pilot programme to integrate AI into public healthcare facilities for the early detection of cancers using high-resolution imaging and reliable diagnostic analysis. This project focuses on oral, breast, and cervical cancers and aims to improve diagnosis speed and accuracy in regions with a shortage of radiologists.

Predictive Healthcare

Have you ever imagined if it's possible to foresee health problems before they actually occur? Currently, it is possible due to predictive healthcare.

Predictive healthcare uses data from our medical records, lab reports, wearable devices, lifestyle patterns and even family history to anticipate the potential illness and health risks. By analysing trends and patterns, healthcare providers can identify patients who are at higher risk, enabling timely interventions and preventive care.

In India, where healthcare resources are limited and patient loads are high, predictive healthcare can help prioritise care, reduce hospital visits, and improve overall health outcomes.



How AI Helps

AI is transforming predictive healthcare by analysing the vast dataset including medical history, lifestyle habits, real-time wearable data and family history. Manually, analysing this large amount of data is extremely difficult and time-consuming, making AI a powerful tool for identifying health risks at early stage.

Here's how AI helps in predictive healthcare:

- AI analyses the patient data such as medical history, lifestyle habits, real-time wearable data and family history to identify individuals at higher risk of diseases such as diabetes, heart disease or certain cancers. In India, under the **Ayushman Bharat Digital Mission (ABDM)**, health records of millions of citizens are being digitised, allowing AI-driven predictive tools to analyse patient data and flag high-risk individuals for timely interventions and preventive care.

Virtual Health Assistants

Have you ever thought how patients can receive medical guidance without visiting a clinic or hospital? This is now possible with the help of Virtual Health Assistants.

In India, mainly in rural areas, not everyone has easy access to a doctor. People may travel for hours to reach the nearest clinic. Even in cities, getting a doctor's appointment can take days. Virtual health assistants help bridge this gap.



How AI Helps

Virtual Health Assistants use AI to provide personalized and timely health support, helping patients access care without visiting a clinic or hospital. For example:

- AI can remind patients to take medicines on time and schedule follow-up visits. Some mobile applications now use AI-powered assistants to track prescriptions, set reminders, and manage health records efficiently.
- AI-powered chatbots and virtual assistants provide instant answers to common health questions and guidance on managing minor conditions. The government of Madhya Pradesh launched an **AI-powered SUMAN SAKHI chatbot** to provide 24X7 health information for women, especially on *maternal care, high-risk pregnancy conditions*.

AI and Intelligent Automation

Have you ever noticed how many everyday routine tasks around us are accomplished fast and effectively with little human effort? This is only achievable with the inclusion of AI in automation. Earlier, washing machines required manual adjustments for wash duration, water level, and cycle type depending on the clothes. Nowadays, AI-powered washing machines can automatically determine the load, fabric type and dirt level. They adjust the quantity of water used, the amount of detergent used, and the time it takes to wash. This improves washing efficiency, saves water and energy and reduces the need for human effort.

In India, AI-driven automation is used across a variety of sectors, including transportation, agriculture, banking, healthcare, and home appliances. Some of the important applications of AI in automation are:

- Smart Transportation

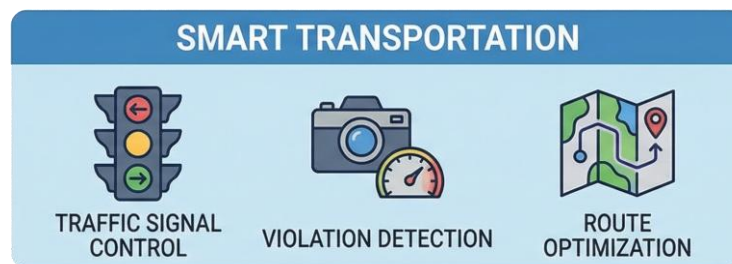
- Agriculture
- Smart Homes

Let us discuss in detail

Smart Transportation

Anyone who has travelled in an Indian city knows about traffic congestion. The hours wasted in traffic jams could have been spent studying, playing, or spending time with family. Moreover, traffic congestion contributes significantly to air pollution.

Did you ever think how traffic can be managed more efficiently in busy cities? Smart transportation uses advanced technologies to improve traffic flow, reduce congestion, and enhance road safety. By analysing real-time data from sensors, cameras, and GPS systems, transportation systems can make better decisions and respond quickly to changing conditions.



How AI Helps

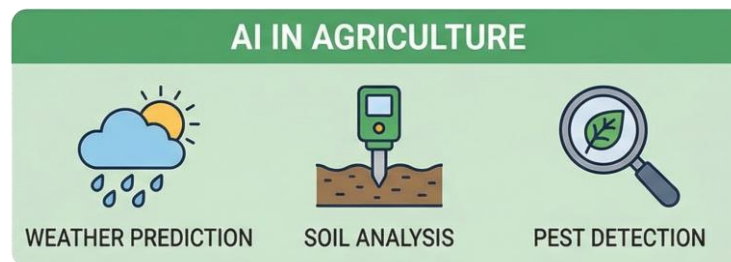
AI plays a significant role in making transportation systems smarter and more efficient. It can analyse traffic patterns using data from cameras, sensors, and GPS devices. This information helps in several ways:

- An AI-based traffic signal system can be developed instead of a time-based traffic signal system. In cities like Delhi and Bengaluru, AI has already been introduced in traffic signal systems, where signal timing adjusts based on real-time traffic conditions.
- AI-powered cameras are already installed in many cities that automatically detect traffic violations such as speeding and not wearing a helmet and issue fines accordingly.
- Nowadays, navigation apps analyse the traffic data and suggest routes that avoid traffic jams.

AI in Agriculture

In India, agriculture is labour-intensive and dependent on weather conditions. The farmers depended on manual observation and expertise to determine when to irrigate crops, apply fertilizer and manage pests. Irrigation was frequently done at predetermined intervals without regard for soil moisture levels, overwatering, or shortage of watering. It affects and sometimes destroys crops. In many cases, farmers could not identify the problems in crops early and delayed taking the necessary action.

Have you ever wondered how farming can be done more efficiently with less effort? AI in agriculture is enabling automation of many farming activities, reducing manual work and improving productivity. Tasks such as irrigation, sowing, spraying fertilizers, and harvesting can now be automated using smart machines and data-driven systems.



How AI Helps

AI empowers farmers with information and insights:

- Weather predictions help farmers decide when to plant and harvest. In India, the **India Meteorological Department (IMD)** provides weather forecasts and agrometeorological advisories to farmers. Using these predictions, farmers can decide the best time for sowing, irrigation, and harvesting.
- Soil analysis helps optimize fertiliser and water use. In India, under the **Soil Health Card Scheme**, the government tests soil samples and provides farmers with detailed reports on soil nutrients.
- Pest detection systems identify problems before they destroy crops. In India, platforms like **National Agriculture Market (e-NAM)** and apps such as **Kisan Suvidha** help farmers identify pest and disease issues by analysing crop images. Farmers can upload photos of affected crops, and the system suggests possible problems and solutions, enabling early action to prevent crop loss.

AI in Smart Homes

Have you ever wondered how homes can become smarter and more convenient to live in? AI in smart homes is making this possible by automating everyday tasks and improving comfort, security and energy efficiency. Devices such as smart lights, thermostats, security cameras and voice assistants can learn user preferences and adjust settings automatically.

Earlier, domestic equipment needed human operation, such as turning off or on a light using switches. Today, you can switch on and off a light with your voice.



How AI Helps

AI plays a significant role in making home smarter. For example:

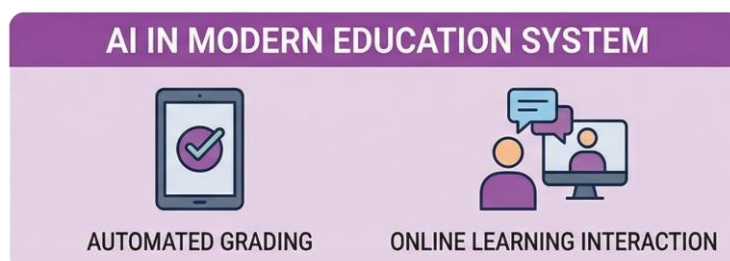
- AI can automatically control the electrical appliances such as fan, light, washing machine and air conditioning (AC) based on your voice or usages pattern.

- AI-powered cameras and sensors can detect the unusual activities at your home and share real-time alerts to the owner or nearest police station.

AI in the Modern Education System

In India, the traditional education system often relies on classroom teaching, manual assessments, and fixed schedules. Teachers have to manage large class sizes, making it difficult to give individual attention to every student. Assessments are usually checked manually, which can be time-consuming and may delay feedback. In many cases, students have to wait for days or even weeks to understand their mistakes and improve their performance.

Have you ever thought about how learning and evaluation can be made more efficient and accessible for teachers and students? AI in modern education is transforming the way students learn and teachers teach. Tools such as automated assessment systems and virtual classrooms are making education more flexible and effective.



How AI Helps

- **Automated assessment systems:** AI can evaluate assignments, quizzes, and exams quickly and provide instant feedback. In India, platforms like **DIKSHA** and government digital education initiatives use automated systems to assess student performance and help teachers track progress efficiently.
- **Virtual classrooms:** AI enables online learning where students and teachers can interact in real time from different locations. In India, platforms like **SWAYAM** and government-supported virtual learning programs allow students to attend classes, access study materials, and learn without the need to be physically present in a classroom.

Hands-On Learning with No-Code AI Tools

You don't need to be a computer programmer to build AI models. No-code AI tools allow anyone to create AI applications by simply providing examples. These tools use simple graphical interfaces where you upload data and train models with a few clicks.

Popular No-Code AI Platforms

- **Teachable Machine** (teachablemachine.withgoogle.com)
- **Machine Learning for Kids** (machinelearningforkids.co.uk)

Both platforms provide step-by-step tutorials and video guides to help you get started.

Hands-On Activity 1: Waste Classification Model

Problem: Create an AI model that can identify three types of waste:

- Plastic
- Paper
- Organic waste (food scraps, leaves, etc.)

Steps to Follow:

1. Collect Images

- Take 20-30 photos of plastic items (bottles, bags, containers)
- Take 20-30 photos of paper items (newspapers, notebooks, cardboard)
- Take 20-30 photos of organic waste (fruit peels, vegetable scraps, dry leaves)
- Try to vary the background and lighting in your photos

2. Upload and Label

- Open Teachable Machine and start a new image project
- Create three classes: "Plastic," "Paper," and "Organic"
- Upload your images to the appropriate classes

3. Train the Model

- Click the "Train Model" button and wait 30-60 seconds
- Your model is now learning to recognise different waste types

4. Test Your Model

- Find new waste items that your model hasn't seen before
- Use your webcam or upload photos to see what your model predicts
- Note whether it correctly identifies each type

What to Observe:

- Which waste type does your model identify most accurately?
- Does it confuse any categories? For example, does it mistake shiny plastic for paper?
- What happens when you show it something that doesn't fit any category?

Hands-On Activity 2: Voice Command Recognition

Problem: Create an AI model that recognises three voice commands:

- Start
- Stop
- Help

Steps to Follow:

1. Set Up Your Project

- In Teachable Machine, start an "Audio Project"
- Create three classes: "Start," "Stop," and "Help"
- Add a fourth class called "Background Noise"

2. Record Training Samples

- For each command, record yourself saying it 15-20 times
- Vary your voice—say it loudly, softly, quickly, and slowly
- For "Background Noise," record 20 seconds of silence and room sounds

3. Train the Model

- Click "Train Model" (this takes a bit longer for audio)
- Wait for training to complete

4. Test Your Model

- Speak each command clearly into your microphone
- See if your model correctly identifies each command
- Ask family members to test it with their voices

What to Observe:

- › Does your model work for voices other than yours?
- › Does background noise affect accuracy?
- › Are similar-sounding words ever confused?

Points to remember:

- ✓ AI helps solve real-world problems in healthcare, education, environment, and daily life
- ✓ In environmental protection, AI helps monitor pollution, manage waste, track wildlife, and improve soil health
- ✓ In healthcare, AI assists with medical imaging, predicts health risks, powers virtual assistants, and enables remote patient monitoring
- ✓ In automation, AI improves transportation, agriculture, and home management
- ✓ In education, AI enables personalised learning, smart tutoring, and accessible virtual classrooms
- ✓ No-code AI tools allow anyone to build and train AI models without programming knowledge

Exercise

A. Multiple Choice Questions.

1. AI helps in environmental protection by:
a) Tracking wildlife population
b) Predicting pollution levels
c) Detecting plastic waste
d) All of the above

2. No-code AI tools allow users to:
a) Program AI models using coding
b) Train AI models without coding
c) Only analyse text data
d) Replace teachers completely

3. AI can predict future health risks by analysing a patient's:
a) Favourite movies
b) Medical history and lifestyle habits
c) Social media posts
d) Travel destinations

4. Which environmental problem can AI help solve by analysing satellite images of rivers and oceans?
a) Soil degradation
b) Plastic pollution
c) Air pollution
d) Water shortage

5. An example of AI in smart homes is:
a) Self-driving cars
b) Voice-controlled appliances
c) Tracking wildlife populations
d) Predicting diseases

B. Fill in the Blanks

1. AI-powered _____ can answer health questions and remind patients to take medicines.
2. Satellites and sensors help AI detect _____ pollution in oceans and rivers.
3. AI in education can provide _____ learning tailored to each student's needs.
4. Wearable devices allow AI to perform _____ patient monitoring.
5. Platforms like _____ allow students to train AI models without coding.

C. Short Answer Questions

1. Name two ways AI helps in reducing environmental problems.

2. How does AI assist doctors in medical diagnosis?
3. Give one example of AI application in smart homes.
4. What is the benefit of personalised learning in education?
5. Explain the role of AI in agriculture.

D. Think and Apply

1. Design a simple AI project using a no-code platform to help sort waste in your school. What steps would you follow?
2. How can AI predict and prevent water shortage in your area?
3. Suggest a way AI could help students struggling with mathematics.
4. If you were a farmer, how would you use AI to improve crop production and protect soil health?

