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(57) Abstract :
This invention pertains to a machine learning-based framework for the intelligent design, optimisation, and deployment of targeted nanoparticles for personalised cancer treatment. The system gathers patient-specific biological and clinical information, encompassing genomic sequences, proteomic and metabolomic profiles, histology, imaging data (CT, MRI, PET), and clinical history, to delineate tumour heterogeneity, receptor expression, and microenvironmental circumstances. The data undergoes processing and analysis through sophisticated machine learning algorithms, encompassing supervised, unsupervised, and deep learning models, to forecast optimal nanoparticle characteristics including particle size, shape, surface charge, coating material, targeting ligand type, drug payload, release kinetics, and stability. According to these forecasts, nanoparticles are engineered and surface-modified to facilitate targeted tumour localisation, regulated medication administration, and reduced systemic toxicity. Treatment outcomes are assessed in real time via imaging and biomarker analysis, with feedback integrated into machine learning models to perpetually enhance nanoparticle design and therapeutic parameters, thereby creating a closed-loop adaptive framework. This invention facilitates patient-specific, efficient, and safe cancer treatment by integrating computational intelligence, nanomaterial engineering, and adaptive treatment monitoring. It is applicable to various cancer types, marking a substantial advancement in precision oncology and personalised nanomedicine. FIG.1.

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