National Institute of Technology Karnataka, Surathkal

Proposal to setup "Centre for cyber-physical systems (CCPS)" at NITK Surathkal.

NITK Surathkal wishes to establish a "Centre for cyber-physical systems (CCPS)" which will promote collaborative translational research leading to practical solutions to the prevalent societal problems.

In line with the Government of India's visionary initiatives in bringing about revolutionary changes in urban and rural ecosystems, modernizing physical systems by a synergistic fusion with cyber systems is seen as a crucial driver. The proposed **Centre for Cyber-Physical Systems (CCPS)** at NITK Surathkal will enable researchers collaborating with academia, industry, national/international laboratories to deliver practical, translational, and societal solutions through Data Science driven CPS. The following subdomains in Data Science and Big Data Analytics are identified as major areas of research, innovation and product development as per the expertise available with the members of CCPS team and Faculty at NITK.

1. Healthcare for All
2. Smart Agriculture and Fisheries
3. Cybersecurity for Secure CPSs
4. Disaster Management through Environmental Monitoring
5. Smart Cities and Smart Manufacturing for Industry 4.0

Overall Budget:

Sl. No.	Research and application development infrastructure	Cost (in lakhs)
1.	Supercomputing facility	2000
2.	NVIDIA DGX A100 5 petaFLOPS AI system with most advanced accelerator, the NVIDIA A100 Tensor Core GPU	210
3.	Supporting infrastructure	425
	Sub total	2635
4.	Contingency (5%)	132
	Total Cost	2767

Envisaged Outputs and Outcomes:

Translational research leading to practical, field usable prototypes in healthcare, agriculture, fisheries, disaster management, cybersecurity, smart city and smart manufacturing.

1. Developing Artificial Intelligence(AI) and Natural Language Processing based intelligent solutions for early disease onset prediction, diagnosis, population analytics, epidemiology modelling etc. Enabler for Ayushman Bharat Yojana and National Digital Health Mission.

2. Proteomics solutions to protein fold mapping and novel drug discovery.

3. Design and development of a compact ultra-wideband antenna (3.1GHz to 10.6GHz) for efficient power and data wireless transmission.

4. Prototype of digital Stethoscope with intelligent health monitoring, decision support assistant for detection of wheezing and diagnosis of Bronchospasm.

5. Design and development of a prototype of portable, wearable chest sound observation system for continuous health monitoring.

6. An AI based health monitoring system to diagnose wheezing and Diagnosis of Bronchospasm.

7. Prototype of portable, wearable chest sound observation system for continuous health monitoring.

8. Mobile application to store and monitor patient's chest/lungs sounds.

9. Design and prototype development of low power, wireless, intelligent digital Stethoscope

10. Models for advance understanding of the global and local demand for farm products. An AI based decision model for area-wise prediction of rainfall for use by farmers in Western Karnataka.

11. Automated precision agriculture ecosystems for
    a. Disease management of local yields - coconut, paddy, green chilli, ground nut, sweet potato, cotton etc.
    b. For supporting decisions like harvesting time of underground crops based on maturity.

12. Data Science applications for crop yield prediction from hyperspectral images using vegetation indices and climatic parameters.

13. Developing AI, Machine learning and Natural Language based intelligent solutions for enhancing the income of farmers and fishers by adopting efficient science and

technology based practices.

14. Satellite linked more accurate and real-time information on potential fishing zones (PFZ), high wind and high current alerts, difference in PFZ and non PFZ areas with reference to major species caught, environmental factors, etc., in local language to the costal fishers directly to their smart phones on a timely basis.

15. Underwater remotely operated Sensor-equipped drones and robots to identify breeding and nursery grounds, based on the availability of Juveniles in the coastal areas to help the authorities to declare these grounds as marine protected areas.

16. Estimation of the carbon footprint of fishing vessels and their impact on the fishery to help to improve fuel efficiency and to minimize impacts on the coastal environment.

17. Data analytics on migratory routes, breeding and nursery grounds of most of the large pelagic fishes and endangered species like sharks in Indian waters for the judicious and sustainable management of pelagic sharks and large pelagic fishes.

18. Intrusion detection Systems for malicious attack prevention, offensive/hate speech detection models in social networks.

19. Remote, real-time monitoring, detection and early warning systems for landslide disasters.

20. Real-time temperature monitoring and analysis for temperature behavior during drilling by tool-rock combinations.

21. Deep Learning based forecasting models for solar energy production in satellites using dust, aerosols, fog, and clouds sensory information.

22. Automated, intelligent monitoring and real-time analytics for smart CPS environments, energy modelling, traffic management.

23. Robust communication framework with focus on energy efficiency and accuracy in CPS.

24. Design of Visual Feature-based localization techniques for autonomous vehicles along with the other sensors like global navigation satellite system (GNSS) and Wheel Odometry.

25. AI frameworks for Industry 4.0 to maximize resource utilization and throughput using process mining, 3D visualization, analysis, inter-process communication, and system coordination.

26. Customized systems solutions for all CCPS focus areas - developing system software modules, customized hardware accelerators for applications.