# Spider R&D Club - Technical Term Report 2021-22

## Foreword from the President:

Spider, the Research and Development Club of NIT Trichy is a group of people enthusiastic about technology and innovation. We pursue industry-relevant projects in the areas of Artificial Intelligence/Machine Learning, Robotics, Embedded Systems, Computer Technology along with App and Web Development. Spread across 4 domains: Algorithms, App Dev, Tronix and Web Dev, we Ideate and Innovate to take Research and Development projects to greater heights.

Spider had an eventful academic year 2021-22, with research paper acceptances in reputed International Conferences - **International Conference of Robotics and Automation (ICRA) 2022** and **International Conference on Control, Automation and Robotics (ICCAR)**; paper acceptance in IEEE Wireless Antenna and Microwave Symposium (WAMS); successful organization of **a national level hackathon (TRI-NIT Hackathon)**, successfully launching the **Lynx-NITT App**, **iNITT Portal** (Inventory Issuing, Tracking and Transcription), **OIR Portal,** amongst many other achievements.

We conducted Inductions for the B.Tech first years (2024 batch) in June-July 2021, providing them with simulation softwares for hardware related tasks, which ensured that the applicants need not go out to buy physical components.

Following inductions, the club members started brainstorming projects for this academic year. We were able to take up **23 projects** in this year, and laid foundations for some of those projects to be taken forward in the next academic year. Thus, in spite of the lack of in-person interactions, Spider R&D was able to keep up with its motto of ideation and Innovation. Our club members also participated in numerous hackathons and competitions conducted by reputed organizations, including Sangam Hardware Hackathon, Smart India Hackathon, E-Yantra Robotics Competition etc. and managed to win some of them and back respectable positions in others. The details of all the new projects and activities are described in the following sections.

## Initiatives/Projects taken up this year:

Detailed report of all projects for this academic year can be found in the link below:

# Spider Projects and Events 2021-22

A brief description of all projects is provided below.

## Tronix Projects:

### 1. Project Crowd-Tracker (Smart India Hackathon 22 , DRDO Dare to Dream 3.0 , RECAL Healthathon 2022):

A cloud based architecture involving a network of smart surveillance cameras capable of real time human and facial recognition in all visibility conditions without the need for additional hardware such as IR cameras to track the movement of people and detect intruders across large geographic areas using the concept of Multi-Access Edge Computing.
Image 1 and Image 2- Authorize a new person  with their picture and details

Image 3 - Real time intruder detection alert with option to view live feed of cameras
Image 4 - Facial Recognition in excessive darkness


### 2. Learning Discriminative Embedding for Effective Covid Prediction from Chest X Ray Images:

Chest X-rays are one of the simpler ways to detect the Covid-19 virus against the standard methods like CT scans and RT-PCR diagnosis.  Inspired by recent research that demonstrates the effectiveness of using Chest X-rays for COVID-19 diagnosis, We Developed a Novel Supervised Architecture based on Ensemble Model and Mixture of Expert Framework to Predict COVID-19 Infection from Chest X-Ray by learning Discriminative Embeddings By leveraging Both Identification loss and Verification Losses. A Cycle GAN model is used to generate synthetic dataset to Augment the Dataset to solve Data Imbalance.
The Results shows that our proposed CNN classifier architecture model ensures unbiased and high accurate predictions outperforming existing State of the Art Deep learning models for Coronavirus detection from Chest X-ray images, showing strong performance and proves to be easily deployable and scalable, which therefore increases efficiency of the process of analyzing Chest X-ray images in the detection of coronavirus.
Image 5 , Image 6, Image 7
To be converted to a research paper and aimed to be published at upcoming top international conferences.

### 3. Kin Verification using gait and facial features:

Kin verification is the task of determining whether two individuals are genetically related. Since genetic traits can be very complex, the use of Deep Learning in this field is an active area of research. Existing work has demonstrated the effect of using facial features for the task of kin-verification. As we all know that gait is a feature used for human identification nowadays, this project aims to combine facial features along with gait (a behavioral trait) to verify kin. To alleviate the dataset shortage problem in this task, we propose an end-to-end pipeline involving Stylegan type of architecture. This pipeline verifies kin as well as generates kin (both facial image and the gait video) given the type of kin relation.

Image 8, Image 9

### 4. Omnidirectional Hexrotor:

To improve the obstacle surmounting performance of a hexrotor with design and control of tiltable rotor platforms – thrust vectoring, which makes it omnidirectional. The frame of the hexrotor is also made deformable to change its effective size. To cope up with faulty motors or propellers, a fault tolerance control is equipped. This increases the quadrotors' performance by shutting off the motor that is diagonally opposite to the faulty motor-propeller system and the new system will work like a quadrotor with thrust vectoring.

Image 10, Image 11

### 5. Bee Bots 3.0:

A swarm robotics project that aims to explore swarm intelligence and coordination using biologically-inspired algorithms. The idea is to simulate shape recovery behaviors in a swarm after obstacle interaction.The project is completed and **the findings were written as a paper and was accepted for presentation at the 8th International Conference on Control, Automation and Robotics (ICCAR 2022).**

Image 12, Image 13

### 6. Real Time Image Processing using RISC V:

 The project aims to build a CPU core which excels at pre - processing of images with various customisable techniques like resizing, blurring , gaussian filters etc, through the concept of Vector Processing, which then can be used by other application specific DL RISC - V processors. Since a single data fetch and decode is operating on large chunks of data, the burden on IF and ID is reduced which brings down the overall power consumption and the number of clock cycles. So far,we can segregate the scalars and vectors and the problems in the scalar core which

occurred by introducing the new vector blocks were fixed.The project will be carried to the next academic year.

Image 14

## 7. RL-SLAM:

This project aims to tackle the problem of search and rescue operations in an unknown environment using mobile robots. A reinforcement learning based exploration algorithm which uses SLAM to optimize exploration is proposed to address this problem. Reinforcement learning is an artificial intelligence method based on rewarding desired behaviors and/or punishing undesired ones. Simultaneous localization and mapping (SLAM) are used in order to keep track of the bot's position and to aid the path planning.

Image 15, Image 16

## 8. Project Back-Up (Sangam Hardware Hackathon '22, SIH Finals '22):

People when working for long hours tend to slouch unconsciously leading to back-pain and musculoskeletal disorders in the future. This is a widespread and serious issue as around 568 million people suffer from lower back pain globally, directly affecting the productivity of working people and hence the GDP of the nation. To prevent this, our project aims to detect people if they are slouching (sitting in a wrong posture) through CCTV cameras present in the office using Deep Learning algorithms and send a push notification to their respective PC so that they could correct their posture.

Image 17

## 9. Project CamoScanner (Sangam Hardware Hackathon '22):

The project CamoScanner aims to detect camouflaged military enemies in real-time . It makes use of Computer Vision and Deep Learning Architectures to effectively detect camouflaged entities in real time.

Image 18

## 10. Latent Transfer between the Sensor and Image Domain:

This project is a continuation of the previous year's GISIL Sangam Project. This project now aims to develop an ML algorithm capable of making high accuracy classification of American Sign Language via latent transfer between sensor domain dataset retrieved from the exoskeleton glove and the image domain of the American Sign Language, thus bridging the gap between both the domains so that we can acquire better results even from using low quality sensor data by mapping them to their respective high quality Image latent space.

Currently nearing completion and is aimed to submit the project work as a publication at the 'Medical Imaging with Deep Learning' conference by the end of April 2022.

Image 19

## 11.   Analog MSM Array:

CMOS-based, multi-bit, analog memory circuit which can be used in applications including analog neural networks and fuzzy systems. It aims to store multiple analog values using a newly introduced circuit called Laddered Inverter Quantizer (LIQAF). It will be integrated into a 2 port 6T bitcell design with multiport capabilities.
This project aims to achieve the proposed circuit in the open-sourced 130 nm technology. This will be **a major contribution to the open-source VLSI community** of NITT which was also introduced by spider club.

Image 20

## 12.   Agribot - E-Yantra Robotics Competition:

Agribot uses an autonomous Ground Vehicle (AGV) to traverse in a simulated Greenhouse environment, find the targeted yield and correctly execute pick-&-place. The AGV is retrofitted with a customized gripper to plug yields easily, and so is the created environment ensured to compile with the gripper.
Code was tested in real-life hardware of the robot itself (made by IIT Bombay) and had successful results. This project can aid farmers in harvesting different fruits like tomatoes autonomously.

Image 21

## 13.   Instant Hemoglobin Detector (Sangam Hardware Hackathon 2022):

This project is a standalone device that measures the value of Hemoglobin non-invasively in real time and displays the value instantly in a mobile app. This is a cost-effective solution compared to medical lab invasive tests and a user friendly solution.

Image 22, Image 23

## 14.   Berryminator - E-Yantra Robotics Competition:

The arena was an abstraction of a farm where different types of berries are cultivated in vertically stacked trays in different rooms. A robot navigated through these rooms and galleries of the farm and harvest berries based on factors such as: size, ripeness and quantity required. We had to learn to get the distance, color and type of the berry when it is shown in front of a small blue camera. In the image with the futuristic car, we have to get the car from point a to point b and the location of

the car is given by the QR Codes on the ground. We designed, simulated and coded our own robotic mechanism using CoppeliaSim, OpenCV, Python and CAD.

## 15. DarkNet (NCB Darkathon '22):

This project works in the field of crawling of darkweb to identify and catalog active and genuine drug markets. It also aims to identify drug traffickers on darknet based in India and the drugs they offer for sale.

# Campus Development Projects and Initiatives

# App Dev Projects:

## 1. Lynx - NITT App:

Lynx is a cross-platform mobile application that acts as a centralized platform for all Councils, Clubs, Student Bodies, and Fests to communicate directly to NITTians. The app helps to mitigate spread of rumors, fake news and misinformation acting as a bridge between students and the administration. Notification system, a calendar and reminders for events, information about clubs and events, circulars and a smooth UI are some important features of the app. The app has been made available on the play-store with all the required features implemented. The NITT student community has access to a reliable and centralized source of information about various events and news happening on campus. The clubs, student council and other student bodies have a method of direct communication through Lynx app.

## 2. Orientation '21 App:

The Orientation '21 app caters to all the needs a fresher has regarding the Orientation programme and helps ease out their way into the campus.
- The app has the flow and timetable of all the happenings and links to take the user directly to the event with just a single click.
- A map of the main hotspots of the campus, academic calendar, contact details of the Orientation team, and administration staff.
- An entertaining **Mystery Hunt game and a Squid Game themed quiz** for the Freshers **was conducted on the app**. Enabled Freshers to get a better understanding of all the clubs and fests.

Image 28, Image 29, Image 30

### 3. Sportsfete '22 App:

The official app for Sportsfete '22, the inter-departmental sports fest of NIT Trichy. Features of the app include -
- Displaying live, upcoming and completed events,
- Rulebooks of all sports,
- "Follow departments" and "Follow sports" feature (to get push notifications)
- Marathon registration.

A department and sports filter was also provided for the events. An admin app was also developed for the Sportsfete '22 organizers to update the status and scores of the events, add commentaries and send push notifications.

Image 31, Image 32, Image 33


# Web Dev Projects:

### 1. OIR Portal:

OIR Portal is an admin project developed using MERN stack which facilitates research internship applications for students within and outside of NIT Trichy for projects under NIT Trichy professors. It provides a seamless platform where students' profiles and resumes, once uploaded along with their personal details, will be sent to the professor if he applies for a project. The same can be said for the professor also where the students can see all the relevant details of the professor through the portal.  Another portal under this is a dynamic portable updatable by the admin providing the students with all the necessary information about the college and different research programs.


Image 34, Image 35

### 2. iNITT (Inventory Issuing, Tracking and Transcription) Portal:

A web application to be used by students and faculties at NITT for the purpose of issuing and tracking of inventory. It features various options for adding, issuing, depositing, and tracking of items in the inventory. Items can be requested by individuals and then approved by the org managers. Project is completed, and the first round of trials is complete.

Image 36, Image 37, Image 38

3. **Document Requisition Portal:**

   The system aims to provide an easy experience for students to request approval on documents which include bonafide, transcripts, grade cards and rank cards.
   The portal allows both students and administrators to log in using institute credentials.
   Students can send requests for documents and administrators can approve the requests. The new changes made to the portal this year include:
   - Restricting the number of incorrect login attempts
   - Redirecting to the webmail forgot password page when the number of incorrect attempts exceeds a certain limit.

   [Image 39](), [Image 40]()

4. **Mess Registration Site:**

   Maintenance works such as adding new lists of students, and recovering passwords of caterers or admins are done by the spider members, while the credentials of students are with the students only. The portal helped students register messes and thus helped automate a tedious process for the administration of allotting messes to the students.

   To solve the issue with login functionality due to Spider's proxy server's limitations, we started working on an authentication system that uses OTP login as a way to authenticate a student.
   [Image 41](), [Image 42](), [Image 43]()

5. **Resources : Getting Started Portal for Freshers:**

   The project aimed to create a resources portal for aspiring students who wish to join the club. The resources help new people get started working in various domains that are actively pursued by the club members here at spider. The portal is very active around the time when inductions for new members take place. Using it, many students get an opportunity to delve into the various domains and better prepare for the tests and tasks given to aspirants in inductions.
   [Image 44](), [Image 45]()

# External Competitions participated and results:

- **Google Kickstart 2021** AIR 4 and Global Rank 27 and 86

- **Google Kickstart March 2022** - Global Rank 125
- **Google Hashcode 2021** AIR 8 and Global Rank 97
- **1st Place - MUL MediHack Hackathon** - University of Lodz
- **Google Code Jam** Global Rank 132 and AIR 2
- **Shaastra 2022, IITM** - Won 2nd place in APC and 3rd place in PCB design challenge
- 2 teams Qualified for **ACM ICPC Regionals**.
- Won 2nd Place in **Sangam Hardware hackathon** (Project - Back-up), within the Healthcare Domain.
- 3 Teams qualified for **Smart India Hackathon (SIH) '22 finals**.
- 1 Team into **E-Yantra Robotics Competition Finals.**
- Research Paper Acceptance:
- ❖ Oral Presentation - Paper accepted at *International Conference of Robotics and Automation (ICAR) 2022* : *RepAr-Net: Re-Parameterized Encoders and Attentive Feature Arsenals for Fast Video Denoising*
- ❖ Paper Accepted at *International Conference on Control, Automation and Robotics (ICCAR)* : *Decentralized shape formation and force-based interactive formation control in robot swarms.*

# Events Conducted and Related Info:

1. **Tri-NIT Hackathon '22:**

   The debut edition of the National Level Tri-NIT Hackathon was held on the 29th and 30th of January 2022 and was conducted by the technical clubs of three of India's most eminent NITs; Spider R&D (NIT Trichy), **ACM NITK Surathkal** and **NIT Warangal CSEA**. This 24-hour long hackathon was designed to give the participants a platform to showcase their innovation, creativity, and skill to discover new solutions to existing real-world problems in the fields of education, healthcare, finance, and more.

   Participants could register in teams with a maximum limit of 3 members per team. Registration was free and amazing prizes, an informative website and well-known sponsors ensured that the competition was able to pull in undergraduate students from colleges all over the country, and from different years as well. Like many other hackathons, we had multiple problem statements in **4 different tracks - Development, Machine Learning, Blockchain, and Digital Electronics, with a total of 14 problem statements**. The problem statements

catered to various real-life situations and required innovative and efficient solutions.

The hackathon got off to a great start, **receiving over 2000+ registrations from various private and govt colleges across India**. The registrations ranged from beginners wanting to try their hand at hackathons to final year veterans itching to show off their skills, and they were allowed to participate without any sort of prior screening.

<p align="center">Image 46</p>

## 2. codeNITe Algo Cup:

Algo-cup was an inter-college coding contest based on algorithms, data structures and problem solving. It was conducted under NIT Conclave.  It was a team contest with a maximum of 3 members, conducted on Codechef. Participants were given 10 problems of varying difficulties to solve in 2.5 hours. The contest was organized and conducted smoothly. 73 teams from different colleges in India registered for the contest.

## 3. Web Development Workshop:

A workshop on the fundamentals of web development was held in online mode, primarily for first-year students to provide them with an overview of the field. It was part of a series of events conducted by vortex, technological symposium of the CSE department, se
NIT Trichy. Using HTML, CSS, and JavaScript, a live Wordle website was created through the course. Client-Server Architecture, How the Internet Works, HTML, CSS, and JavaScript were topics covered in the session.

## 4. Spider Bootcamp '22:

Conducted a weeklong Spider Bootcamp for B.Tech first years(2025 batch), where we had a series of workshops teaching the basics of different domains within Spider. Five sessions on Tronix covering the following topics were conducted: Arduino Programming, Computer Vision (OpenCV), Robot Operating System (ROS), and Machine Learning.
  - **Dark i -** 2 sessions - CV (OpenCV) Basics and building a Night Vision Spyware.
  - **Nintendo-uino:** 2 sessions - Arduino programming basics and building a gaming console on an LCD.
  - **Balencobot:** 1 session - Self-balancing bots

Followed by this, We had an hour-long session on basics of Web development called '**Weaving Web'** and assigned mentors to first years to get them started.

Following this, a series of 3 sessions on **Competitive Programming**, covering the following topics: C++ Programming Basics, STL, Time Complexity, Data Structures and Algorithms were held.

Spider bootcamp saw **more than 600 registrations** from B.Tech first years, thus introducing them to the world of technology and allowing them to explore different domains for them to figure out their interests, before the induction process starts.

## 5. ICY Cup:

An intra-college coding contest based on algorithms, data structures and problem solving, conducted under Spider Bootcamp '22.  It was an individual contest with prizes exclusively for 1st years. It was conducted on Hackerrank. Participants were given 10 problems of varying difficulties to solve in 10 hours.

## 6. Web Wednesdays - Medium Article Series:

A medium article series, where every wednesday an article
was released on our medium page. A total of 12 articles were released, primarily focusing on new and emerging technologies like WebRTC, GeoJSON, Digital art, QR Code working, Facial detection, Web Speech API etc.

## 7. Algos Weekly - Medium Article Series:

A medium article series, focussed at outlining important concepts relevant in Competitive programming was started, with a total of 4 articles covering these topics : C++ STL Library, Sorting Techniques, Mathematical Algorithms.
All Medium articles published by Spider can be found at our [Medium Page](#).


# Collaborations:

- Collaborated with [**ACM NITK Surathkal**](#) and [**NIT Warangal CSEA**](#) to organize the **Tri-NIT Hackathon**. We also collaborated with reputed startups for smooth conduction and sponsorship of the Hackathon:
    - ➢ **Dare2Compete (D2C)**
    - ➢ **Salt**

- ➢ **BharatX** - also provided a problem statement in the Development track, with the winners directly being offered an interview for a software developer role in the company.
  - ➢ **Skill-Lync**
  - ➢ **Klapz**
  - ➢ **Geeks For Geeks**

- **Web Wars:**

  [Web Wars](#) was a web development contest, conducted under Pragyan '22, to test the participants' web designing and developing skills. The event had 2 rounds. Round 1 was a multiple choice quiz on Web development basics (HTML, CSS and JavaScript). Round 2 was a website designing contest on a given problem statement using HTML, CSS and
  Vanilla JS only.

- **Circuitrix:**

  [Circuitrix](#) is an event conducted as a part of Pragyan, in association with Spider to test the design and debugging skills of circuit enthusiasts. It was a team event and it had 3 rounds of varying difficulty. The event was open-to-all. Every year, Spider helps the Pragyan Events team in formulating problem statements and evaluating submissions, and we continued the same in the academic year 2021-22.
  Top 3 submissions were awarded by Pragyan Events team on the valediction day of Pragyan 2021. Spider coordinated with Pragyan Events Team and contributed questions/problem statements for all the three rounds and also judged the submissions in round 2.
  Over 100 active participants were a part of the event.

- **M-Decoder website:**

  M-Decoder is a mathematics competition in Pragyan conducted by Spider and Maximus. The event consists of a set of questions released everyday for 3 consecutive days, participants can attempt them for 3 hours in a day. Leaderboards are also updated dynamically based on the points scored by participants. Admin portal was developed for the same event through which the maximus team and pragyan team uploaded the questions and managed the event.

  [Image 47](#)

# Core Members:

**President** - KUMAR GAURAV SINGH (ECE 4th year, ph: 8210982383)

**Treasurer**  - SUDHARSAN S (ECE 4th year, ph: 9600897202)

**Joint-Treasurer**- THRISHIK SENTHILKUMAR (ICE 4th year , ph: 9791827821)

**Algos Head** - HARSHIT AGRAWAL (CSE 4th year, ph: 7016004637)

**App Dev Head** - NAREN (CSE 4th Year, ph: 9791131673)

**Tronix Head** - S P SHARAN (ECE 4th Year, ph: 9176910007)

**Web Dev Head** - JERRY J (CSE 4th Year, ph: 7092622767)

## Faculty Advisor:

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# Social Media Handles:

Medium: https://medium.com/spidernitt

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Instagram: https://www.instagram.com/spider_nitt/

LinkedIn: https://www.linkedin.com/company/spider-r-d/

YouTube: https://www.youtube.com/channel/UC0JTWs8r33HNaUgypshwpFA

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