PRANAY TUMMALAPALLI

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PROFESSIONAL SUMMARY

Robotics software enthusiast with around 4 years of experience in Medical robotics and Autonomous Vehicles.
Passionate about humanoids, multi-agent robot environments, human-robot interaction. Experience and interest
robot control frameworks and architecture. 3 years of experience developing Robotic Laparoscopic surgery and
Robotic TKR. 1 Year of experience in vehicle motion control for ADAS.

SKILLSET

- **Frameworks:** eCAL, protobuf, ROS2, RTOS
- **Embedded firmware:** RP2040,STM32G4, STM32F4, STM32F3, STM32H7, ESP32
- **Peripherals:** Vehicle ECUs**,** Motor Drivers and encoders, Sensors, IMU
- **Simulation Tools:** Gazebo classic, ReRun, RVIZ

Control Systems: PID control and mathematical modeling for motors, Pure-pursuit for bicycle model cars, PID control for longitudinal control of vehicle.

Programming: C++, C, HTML/CSS

Communication protocols: SPI, I2C, UART/USART, EtherCAT, CAN, UDP/TCP, socket programming (UDP/TCP/CAN)

Version control: Git, Bitbucket

WORK EXPERIENCE

Minus Zero (Autonomous Vehicles/ADAS) (Dec 2024 - present, 12 months)
Sr. Embedded Firmware Engineer, Vehicle Control

- Design and development of a **vehicle control module** that runs on a **jetson Orin AGX platform**, as part of the **onboard software stack** for autonomous vehicles. **Tested on public roads on Tata Nexon.**
- **CAN/UDP socket programming** to interface onboard software stack with Tata Nexon Drive-by-wire system.
- Vehicle module, onboard software inspired from **Baidu's Apollo project** architecture for autonomous Driving.
- Designed and tested vehicle motion control and path planning algorithms like **pure-pursuit for lateral control and PID control for longitudinal control.**
- Thorough understanding of **system design for autonomous vehicle motion control**.
- Publisher-subscriber architecture and logging using **eCAL framework** and message framework using **protobuf 3.0.**
- Experience developing modular and scalable software.

- **Heading the Design and development** of **inhouse STM32G4 based drive-by-wire system** for Tata Nexon:
    - Since tata nexon is not an ADAS-compatible vehicle, it does not have a drive-by-wire system
    - **CAN sniffing** using SavvyCan and Peak-Can for vehicle reports and module feedbacks
    - Interface with **Steering EPAS and steering encoder** to design a closed loop PID control.
    - Interface with **throttle ECU** to send throttle percentage values using DACs on STM32.
    - Brake actuated using an external high-speed linear actuator to pull the brake pedal

through a capstan mechanism.
    - State machine architecture to ensure **SOP, fault handling, and ensuring safety mechanisms.**

- **Headed technical collaborations** with different OEMs and vendors:
    - Mercedes Benz Research and Development Institute for L3 ADAS for Indian roads on S-Class.
    - Ashok Leyland for autonomous transport for ports.
    - ARAI for drive-by-wire system for tata nexon

Meril Healthcare (Robotic Endosurgery) (Nov 2023 - Nov 2024, 1 yr)
Sr. Embedded Firmware Engineer, Motor Control

- **STM32** based solutions for **EtherCAT Slave implementation** for **ASIX58400 based in-house motor drives, RFID Data reading** etc. implemented on the system.
- **Motor contro**l code for ethercat based Motor drive from Novanta, and Maxon. Developed **multi slave code** with **Distributed Clocks** for Robot end-effector actuators.
- Used C in linux for development. Integrated with shared memory and UDP server-client architecture for sharing desired setpoint data to the motor.
- **Mathematical modeling** of motor and motor and **drive characteristics analysis** for **PID control.**

- Integrating **Surgical robotic system for laparoscopic surgery** with touchscreen, x86 single-board-computer, and **optimizing Ubuntu operating system** to run GUI.
- **Part selection** based on identified system requirements, **supplier identification** to optimize for cost, lead time and long term support. Found a long term solution with **low cost high performance** parts.
- Contributed towards the success of the **MISSO orthopedic surgical robot** and its product launch.

- **International Experience:** Part of **delegation to Shanghai to attend the CMEF 24** and identify potential partners. **Converted 2 suppliers to long term partners.**
- Part of a team to find **Chinese robotics companies** including humanoids, quadrupeds, rehabilitation exoskeletons, and autonomous vehicles to partner with for **OEM development**. Visited 15 companies across Shanghai, Beijing, Shenzhen, Longyan, Suzhou.

- **Quality and Regulatory Experience: Formulated a system BOM** for BOM based purchase system and **system versioning**. Formed **requirements for each subsystem** and implemented **test methods to ensure requirements** are met.
- **Organized Cadaver trials** for the laparoscopic and orthopedic robots and implemented **on field research for user validation with surgeons.**

E-chai Networks:
- **Organized and Hosted multiple networking events** across Bangalore with 25-30 participants from **hardware, manufacturing, medical device and robotics startups.**
- Formats included open Q&A, Panel Discussions, and fireside chats.

Articulus Surgical Pvt. Ltd, Bengaluru (Jan 2023 - Oct 2023, 10 Months)
Systems Engineer:
- incharge of day-to-day R&D with a multidisciplinary team, feature pipelining for Patient Cart, Endoscopic vision and Surgeon's console
- Incharge of **multidisciplinary design of Surgeon's console** including **usability, electronics, master-slave forward kinematics** using DH Parameters**, ergonomics** etc.
- **PID based control system** for BLDC control with magnetic encoder.
- Implemented ESD, EMI/EMC protection in the PCBs
- **Requirements engineering** for the product and usability design, preliminary design for verification and validation tests, and MDR compliance
- **End-user validation** with Ob/gyn, Urology and GI surgeons.
- Basic understanding of **harmonized MDR standards** including **IEC 60601, ISO 14971 etc.**

Articulus Surgical Pvt. Ltd, Bengaluru **(Nov 2021 - Jan 2023, 1 yr 2 Months)**
Mechatronics & Industrial Design Lead:

- Part of the **founding team** and contribution toward early stage development of **Robotic Surgery System.**
- Developed a prototype for the **Surgeon's Console:** design and physical analysis of **gravity compensation** mechanism for a **7-DOF console manipulator;** integration with **rotary encoders** for joint positions; **angular monostable positioning of joints**

- **Platforms and Skills:**
  - **Autodesk Fusion360** - CAD design for complex multi-body assemblies, joint designs, simulations and FEM, rendering tool.
  - **FDM 3D Printing:** Prusa I3 Mk3, Creality ender 3 v2, CR10Max. Prusa and Cura slicer.
  - **SLA 3D Printing:** Elegoo Mars 3 and slicer
  - **Industrial Design** - work samples on www.articulussurgical.com
  - **DFM -** 3 axis milling, Lathe/turning, SLS for Titanium, FDM Plastic 3D Printing

Akshar Bionics (Funded by Ministry of Education), New Delhi **(Jan 2021 - Oct 2021, 9 Months)**
Co-Founder

- Used Biomimetic design methodology to develop fully **3D-printed and actuated upper-body robotic arm**
- Developed Joint mechanisms and calculated **inverse kinematics** using DH-Parameters.
- **Patents** for Software integrated system and robotic arm design for the project pending.
- The project **won Smart India Hackathon 2018 (Hardware Edition)** and subsequently was **granted funding from MOE, GOI.**

Product Internship, Trestle Labs, New Delhi: **(Feb 2020 - July 2020)**

- Designed a phone stand to enable visually impaired users to scan and convert hardcopy documents and books into audio format (audiobooks) using Trestle Labs' Kibo XL app.
- Carried out **User research and validation testing** at NGOs in New Delhi

PROJECTS

Latty, A ROS based tricycle platform

- A front wheel drive non-holonomic tricycle platform to develop and experiment with different path planning algorithms
- urdf/xacro model definitions for Gazebo Classic
- Lower level controllers for joint state publishers and reports that interact with the /controller_manager
- ROS2 node for joint control:
  - Publishers to the joint state topics
  - Subscribers for interfacing with the robot and reading model state
- State estimation and localisation techniques for robot pose estimation:
  - Euler and exponential map integration for yaw estimation from IMU.
  - Linear Kalman Filter and EKF with IMU and wheel odometry.
- Pointcloud data from LIDAR for mapping.
- ReRun for visualisation.

Vocol, Akshar Bionics

- Vocol is a system that converts speech input to American Sign Language and Indian Sign Language on a Life-Scale humanoid robot designed using **biomimetic design methodology** for its joints and limb movements. **Servo** actuated joints and **I2C** networked servo controllers controlled by an **STM microcontroller**.

LoRa Sensor Network for Accident Prevention, PriorFire

- A Sensor network between multiple cars that classify a car as a danger if the driver doesn't drive properly, and then informs the other cars from a long distance that there is a dangerous driver nearby, increasing their reaction time.
- Used **LoRaWAN** protocol, **Image Processing** for drowsiness detection, lane detection using **openCV**, and **position encoder** to calculate steering wheel deviation. **NodeMCU, LoRa RA-02, LCD, Raspberry pi 3B**
- Won **1st prize in Hardware Productathon**, E-Summit 2020, IIT-Roorkee

Smart Object Detection and Guidance Device for Visually Impaired, Raah

- A two stage haptic feedback based algorithm to guide a blind person to an object. It uses object recognition

in OpenCV using tensorflow and deep learning.

EDUCATION

Bachelor of Technology in Electronics and Communications **(Aug 2017 – July 2021)**
Bharati Vidyapeeth's College of Engineering, New Delhi

- **Awarded Best Student (ECE1), Batch of 2017**
- (CGPA - 7.36)