Saptadeep (Sapta) Debnath

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Work Experience

- **Equipment Technologies, Inc.** — Mooresville, IN, USA
  Robotics Software Engineer — *Mar 2021 - Present (3+ years)*
  - Project in charge of the L3 Autonomy System for agricultural machines.
  - Deployed a CNN semantic segmentation network that predicts crop rows for a J1939 CAN-linked machine steering; achieved a 45% increase in f-score and 67% in IOU scores.
  - Experience building a ROS architecture from scratch, establishing a flow of messages from prediction to motion planning node to steering control manager; optimized operations and reduced response time, resulting in enhanced system performance and efficiency.
  - Designed and executed comprehensive V&V plans, including rigorous field tests on the Apache machine under real-world conditions to validate software performance.
  - Provided mentorship to interns and junior engineers, offering valuable training and insights into computer vision algorithms and ROS fundamentals.
  - Collaborated with the company's patent attorney to research existing patents, draft new claims, and ensure comprehensive protection of intellectual property rights. **(Patent pending US18/506,867)**

Skills Summary

- **Concentration Areas**: Motion Planning, Robotic System Design, Control Systems, Deep Learning
- **Tools and Technologies**: C++, Python, ROS, OpenCV, PyTorch, NVIDIA Jetson, 2D/3D Cameras
- **Leadership Experience**: Project Lead @ ET Works (2021 - Present), Team Lead @ IFOR - UAV Team (2016 - 2018)

Education

- **University of Michigan** — Ann Arbor, MI, USA
  Master of Science in Electrical and Computer Engineering (Robotics specialization) — *2019 - 2020*
- **BITS, Pilani – Dubai Campus** — Dubai, UAE
  Bachelor of Engineering in Electronics and Communication Engineering — *2014 - 2018*

Academic Projects

- **Object Tracking for Safety**: Engineered an object tracking module to detect and conclude the distance of the moving object from the camera; issued warnings based on the object's proximity to the camera. Tech: YOLO, DeepSORT, RGB-D (November '20) (link)
- **Slam and Path Planning implementation on MBot**: Explored and implemented advanced mapping, path planning, and motion control algorithms for a differential drive robot simulation model. Tech: C++, IMU, 2D LIDAR, SLAM, A-star, path planning (April '20) (link)
- **Invariant Extended Kalman Filtering for Robot Localization using IMU and GPS**: Developed an Invariant EKF-based localization system and conducted comparative analysis with Extended Kalman Filter-based localization system and a GPS-alone dataset. Tech: MATLAB, In-EKF, IMU, GPS (April '20) (link)
- **6-DOF Serial Link Robotic Manipulator**: Produced a Python codebase for autonomous operation of serially connected motors, integrating object detection using a Kinect camera suite to facilitate efficient pick-n-place operations. Tech: Python, manipulators, objection detection, OpenCV, path planning-smoothing, state machines (March '20) (link)
- **Mobile Inverted Pendulum System**: Designed a cascaded control architecture for a two-wheeled robot, achieving balance and autonomous navigation along pre-defined trajectories. Tech: C, inverted pendulum, trajectory following, IMU, PID, Beaglebone, Robot Control Library (February '20) (link)
- **Hand Gesture Control of a Robot using Intelligent Techniques**: Created a ROS pipeline enabling real-time free hand gesture translation to motion instructions for a TurtleBot, powered by an Intel Atom processor. Tech: ROS, C++, Python, RNN, TensorFlow, SLAM, TurtleBot (July '18) (link)

IFOR (UAV Team) at BITS Pilani, Dubai Campus (2014 - 2018)

- **Leadership Responsibilities**: Team Lead (2016-2018), Technical Lead (2015-2016), Hardware Systems Lead (2015)
- **International Aerial Robotics Competition AUVSI**: (link) Integrated aerial and ground robots for obstacle navigation without 3D cues, relying on touch interaction. Devised strategic solutions to prevent ground robot exit amidst dynamic movement and obstacle challenges. ('17 submission) ('15 submission)
- **SorbDrone – An Oil Spill Solution**: *(Submission for Drones for Good 2017)* A solution for modernizing the Oil Spill clean-up process. Inspection of the affected area by the UAV equipped with a thermal camera. Use special pads filled with hydrophobic oil-absorbing material, to clean oil spills. (video)
- **Smart Inspection of Solar Panels**: *(Semi-Finalist Submission for Drones for Good 2016)* Detection of faulty solar panels in a solar farm via UAVs. Use of thermal camera; geo-tagging the images and communicating to a control station. Trial and tested prototype. (video)

Publications

- **Design and Development of a Non-Linear Controller for Quadrotor type Unmanned Aerial Vehicle**: IEEE International Conference on Inventive Computation Technologies. Authors: Saptadeep Debnath and Mary Lourde R (Coimbatore, India - November '18) (link)
- **Image-based Biomechanical Case study of an International Archer**: International Conference on Sports Engineering. Authors: Saptadeep Debnath and Subir Debnath (Jaipur, India - October '17) (link)
- **Visual Odometry Data Fusion for Indoor Localization of an Unmanned Aerial Vehicle**: IEEE International Conference on Power, Control, Signal & Instrumentation Engineering. Authors: Saptadeep Debnath and Jagadish Nayak (Chennai, India - September '17) (link)

Honors and Awards

- **Winners, Drones for Good University Challenge**: Issued by Mohammed Bin Rashid Space Centre and Government of Dubai, Nov 2015
- **2nd Place, International Space Settlement Design Competition**: Issued by NASA Ames Research Center, Apr 2012