Application for MS in Robotics at EPFL

Name: Sai Siddartha Maram | Email ID: msaisiddartha1@gmail.com

"Congratulations : **Research Paper Accepted** (Robotics, Computer Vision) at **IEEE ICACCP** 2019" was the email which reflected that walking the extra mile for **research**, beyond the realm of my curriculum and interning at Invento Robotics was fruitful. Having a paper accepted at IEEE ICACCP which has a mere **acceptance of 26%** motivated me to further work on 3D Perception. This work helped me bag the position of **Research Intern** at **Georgia Institute of Technology**, Atlanta. I also filed a **patent** for an IoT and Computer Vision prototype for the problem of physical abuse. This illustrates my passion for pursuing research to create a global impact and this resonates with EPFL's vision of being a research university to create impact. I would like to delve deeper in the field of Robotics for which I am seeking admission at EPFL's reputed Robotics Graduate program.

During the summer of 2016 I interned at SRISTI-UNICEF under Dr.Anil Kumar Gupta at the **National Innovation Foundation, Government of India**. SRISTI allowed me to connect with farmers and discuss problems they faced while farming. **Empathizing with farmers**, we noticed an intricate problem they faced which is animals vandalizing crops. We started exploring Computer Vision solutions to deal with this problem. To start off my team **implemented** the Paul Viola and Michel Jones paper 'Rapid Object Detection using a Boosted Cascade of Simple Features' to develop a Haar Cascade suitable for detecting cattle. Tackling detection problems through this algorithm which took only edge and pixel intensities as features were less fruitful as even the slightest change in orientation of cattle proved to be a failure. We noticed we needed to incorporate more features for detection, for which we applied transfer learning on the Faster_RCNN_Resnet model trained initially on the COCO dataset. After training and comparing results over tuned hyperparameters, we **published** our results at TEAMC 2018, an undergraduate research paper conference, where we **won the Best Research Paper.**

A good grip on Data Structures and Algorithms along with an inclination towards research in Computer Vision has helped me get selected as a **Summer Intern** by Mr. Balaji Vishwanathan (**CEO Invento Robotics**) for my summer break 2017. This internship allowed me to get a first-hand experience with 3D mapping using LiDAR and ROS (Robot Operating System). The robots limited hardware did not allow the deployment of dense neural networks and hence initial developers had used Cloud services for object detection. This stack was highly dependent on internet bandwidth was time-consuming. I was able to achieve a **60% faster** performance than the previously established stack by choosing to train and **deploy** a less dense neural network architecture 'tiny-yolo' for detection making it suitable for embedded systems on Invento's flagship robot 'Mitra' (India's first humanoid). 'Mitra' is currently used for navigation by travelers at the Indira Gandhi International Airport, New Delhi, India and uses detection algorithms that I had developed during this internship.

My experience with Computer Vision algorithms on ROS at Invento paved the path for my next **research paper**. In this paper, we discussed how Neural Networks could be treated as ROS nodes and keep publishing outputs in the form a ROS message as a stream to the ROS base node which is used for navigation and motion. After training the Neural Network (for threat detection) node on various hyperparameters, we **published** the performance of our algorithm at **IEEE ICACCP 2019** where we **won the Best Research Paper** under the computer vision and robotics category.

I lead my team into solving the problem of physical abuse against women. We developed a cognitive textile that used Computer Vision for the **first time** to tackle such abuse against women by analyzing live camera feed through cameras embedded in it. This IoT and AI prototype has been filed for an Indian **Patent (**A personal safety device and method thereof**)** bearing application number 201911005811. This patent is a reflection of my vision of amalgamating technology and research for solving real-world problems which is a primary objective of research undertaken in EPFL.

I shared my paper at IEEE ICACCP 2019 with Prof. Yi-Chang Tsai, who then offered me a **Summer Research Internship** at **GeorgiaTech, Atlanta**. During this internship, I applied the concept of perspective transform suitable for United States interstate roads for traffic sign depth estimation through a **single 2D image**. I was able to **reduce memory consumption by 50%** than the regularly used triangulation method which requires two images. One of my novel **research outcome** as a result of this internship was that I managed to develop a 2D image and 3D LiDAR point cloud registration algorithm by using a **data structure** called **KD-Tree**. This leads to enhanced performance compared to existing work on huge LiDAR point clouds. By thresholding the LiDAR point clouds retro intensity values, I was able to accurately estimate the health of all traffic signs over the entire length of any interstate. Implementing clustering techniques such as HDBSCAN for GPS points instead of the conventional K-Means and DBSCAN allowed to eliminate computations on bogus LiDAR points making runtime quicker. Modern robots use LiDAR for navigation purposes, I am curious on how I would be able to bring research experience at GeorgiaTech on LiDAR into EPFL's reputed LASA Laboratory.

I will be interning as a **Research Assistant** at the prestigious **Indian Institute of Science, Bangalore (Spring 2020)** under [Prof. Yogesh Simmhan](#) dealing with AI for drones. EPFL is a place where research meets empathy and compassion and it has impacted millions of lives around the globe. An admit to EPFL will give me an opportunity of working with a diverse peer group under the able guidance of elite professors and undertake research in Robotics to develop solutions for global problems. I see myself as a part of research labs or academia to pursue research for overcoming challenges through technology and ensure that research results are not confined to journals and conferences but reach masses.