



“People, Robots and Their Stories”

(Application for Media Arts and Sciences, MIT)

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“Never expected this COVID-19 birthday to turn out this great surprise and this close to my family” (loosely translated from Telugu) were the words of Mrs. Devi just after talking to her family through Robots, which we developed at Invento for the covid pandemic. The smile on Mrs. Devi’s face after celebrating her birthday with her grandchildren and children through technology to whose development I contributed at Invento Robotics, reinforced my decision to delve further and streamline my energies, skill into how robotics, computer vision, and technology can augment the way we connect, interact and take decisions.

With the rise in the pandemic at Invento where I am currently a Research Engineer, I have been developing Robots to tackle the pandemic (shown in the images in the header). Unlike normal humanoid robots, we needed to undergo a research phase to understand the expectations of patients, doctors, nurses in having robots moving around and interacting with them both on the technical, ethical, and psychological front. Telemedicine has been around for a while but yet failed to penetrate hospitals. We found out that current telemedicine is restricted to video calling applications such as Zoom and Skype. This does not provide doctors with any provision to understand the patient’s vitals and suggest data-driven prescriptions. To counter this, I took up the initiative to build an interactive doctor-patient portal using WebRTC. This portal during the video call displays important health data such as Pulse Rate, Temperature, Oxygen Saturation, and Blood Pressure. The data is collected by devices that I had interfaced with the NUC on the robot. This turned out to be a great success since the doctors and nurses now did not have to get close to patients to collect vitals, saving them from the risk of infection. The system I developed has currently screened over 10,000 patients and has been deployed in leading hospital chains across India, the USA, and the Middle East. Along with Telemedicine based Humanoids, we developed UV-Disinfection robots and Food Delivery Robots. Currently, my contributions on telemedicine and navigation for COVID based robotics is under review at **IEEE RAM 2021**. Testimonials and use cases of these robots have been published in leading newspaper outlets such as the Business Standard and India Today which have a combined readership of over 9 million people.

Having spent over 6 months at Invento Robotics and deploying robots at hotels, shopping malls, and theaters, I have noticed how Kids get excited about seeing humanoid robots. A very common and funny phenomenon particular to kids of age groups 5-8 years old, is how they treat the robot as a wheeled toy and like to push the robot around themselves while the robot is navigating. Small kids pushing 70Kg robots looks cute but becomes a problem for Robotic Developers since this causes a loss in localization of the robot. This eventually leads the robot to lose its autonomous navigation capability. We had to stop kids from pushing the robot and kidnapping it to unknown locations while navigating to a particular goal. To solve this I developed a Geometry based Path execution algorithm. This algorithm takes motivation from a teacher-student based concept. Where the algorithm acts as a teacher and gives suggestions for the robot to make sure it corrects itself to stick to the path, even while children keep pushing the robot. Our

work also provides a provision for hobbyists and college students to develop autonomous navigation even without expensive synchronous motors, which is generally considered granted by open-source navigation packages. Intuitively for someone looking from the outside, the algorithm when running appears to be fighting (gently) with the kid, while he/she tries to push the robot out of track. A constant correction in the opposite direction of the kids push by the robot leads the kid to eventually giving up pushing the robot. Currently, our work on how to counter children kidnapping robots is under review at **ACM/IEEE HRI 2021**. On the sidelines, when the number of robots being deployed is limited, I continue to work in the R&D department and see how we can synergize robotics, deep learning with people in other verticals such as security, agriculture. An outcome of such research was our paper at [IEEE ICACCP 2019](#). Here we presented how Robotics can work with security services to provide more effective surveillance using ROS and Computer Vision. Our Paper went on to win the best research paper under the robotics category. Another novel outcome of such research was my undergraduate paper at TEAMC which won the best paper. Here we developed algorithms to counter Animal Crop Vandalism, using robotics and vision.

Urban cities account for over 70% of road fatalities across the globe. During my Summer internship **(2019) at GeorgiaTech, Atlanta** under Dr. Yi-Chang James Tsai we wanted to study why these numbers are against City spaces and come up with potential solutions. Studying the causes of accidents, we noticed a major chunk of accidents were associated with poor visibility or damaged traffic signs. Computer Vision-based identification and evaluating the health of traffic signs is cumbersome. Added to that, it would be very difficult to map the identified signs with the correct GPS coordinates and show them on a map just through 2D images. To counter this I managed to develop a 3D LiDAR point cloud Traffic Sign querying 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 identify traffic signs and also estimate the health of traffic signs over the entire length of any given 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. The novelty of the research work allowed Dr. Yi-Chang James Tsai's lab to win the High Impact Research Award at AASHTO, USA.

MIT over the decades has been a place where research has met empathy and compassion. My research projects, experience and internships has always directed towards helping and assisting people to augment thier experiences through technology. The vision and goals of MIT's MAS program resonate with my goals of developing interaction between humans, technology, and robots to benefit stakeholders. My papers at [ACM Multimedia 2020](#) and IEEE GLOBECOM 2020 are a reflection of how I would like people to interact with technology and give them the ability to visualize data to take meaningful decisions. My work with Dr. Yogesh Simmhan at the **Indian Institute of Science** revolves around developing contact graphs for City Spaces to prevent pandemic spread. This work is currently being used by the students of IISc to cap COVID-19 Spread. This again is a reflection on how I look to take research from labs, conferences, and journals to the people via various mediums. During my internship experience with Dr. Anil Kumar Gupta (Padam Shri Recipient), I was fortunate to visit multiple orphanages and old age homes to understand the problems people faced living alone and not having the best facilities. As a young undergraduate back then, I felt robotics and smarter living spaces could address these challenges. I did my part by grabbing onto opportunities to understand HRI, City Science, and Machine Learning. Today I feel there is a need for me to improve my skills in understanding technology with respect to humans and stakeholders and how they interact with technology. This would help me develop better solutions, build better products for the next billion people. Over the next few years, I see myself as a doctoral student trying to identify open-ended problems in the field of HRI, Urban Planning, and address them with the skills gained over the master's coursework and start the journey of entrepreneurship.

[Link To Sai Siddartha's Portfolio](#)