

*Please visit my portfolio @ senthilpalanisamy.github.io.to see some of these projects in action

Senthil Palanisamy

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EDUCATION

Northwestern University

Master of Science in Robotics - 3.9/4

Evanston, Illinois

Aug 2019 - Dec 2020

Anna University

Bachelor of Engineering in Electronics and Communication - 8.53 / 10.0

Chennai, India

2012-2016

KEY SKILLS

- **Languages:** Python (intermediate), C++ (beginner), C (beginner)
- **Libraries:** Python- Numpy, Scipy, Matplotlib, CV -OpenCV, Scikit-Image, ML/DL - Keras, Tensorflow
- **Others tools:** Vim, Linux Bash, Git

ACADEMIC PROJECTS

Baxter, the lego builder

Northwestern-Dec 2019

- For this project, Baxter assembles a Mega Bloks pyramid from the blocks provided by the user. The flow is:
 - The Blocks that can be picked up are detected on Baxter's camera image using OpenCV
 - Among all detected blocks, a block is chosen at random and its 3D location is estimated
 - The block is picked up and moved to the drop location using position control in Moveit
 - The block is pressed against the plate by using force control in Moveit and finally, as a double check, the gripper hand is pushed against the block to ensure that the block is pushed in.
- **My contribution:** I implemented the whole node for computer vision, which detects AR blocks, red lego blocks and does inverse projection to find the 3D location of a point on a known plane corresponding to a pixel on the camera. I also setup the RoS pipeline for the whole project and integrated my node into our RoS pipeline

Object Manipulation using Youbot in Simulation

Northwestern-Dec 2019

- I implemented a PI feedforward controller for a 4 wheeled mobile robot with a 5 dof arm for an object manipulation task.
- The arm has 5 degrees of freedom and the wheels add 4 degrees of freedom making this a redundant robot with 9 degrees of freedom.

ML/AI Projects

Northwestern-Dec 2019

- A Star planner with PID controller
- Rapidly Expanding Random Tree
- Unscented Kalman Filter
- Locally Weighted Linear Regression

Servo Controlled Ball Tracking

Northwestern-Dec 2019

- I assembled and controlled a two Degree of Freedom Pan-tilt mechanism that uses Computer Vision for tracking and following a Blue cube

Automated Robotic Moisture monitoring in Agricultural field

Anna Univeristy-2015-16

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- ISet up a small study lab. Implemented graph search based robotic path planning by processing images taken by an aerial camera.
- Investigated an image processing based soil moisture estimation procedure. Interfaced and controlled a servo-mounted camera pod.
- Designed circuits for establishing communication between moisture sensors and robotic kit.

Smart Mobile Phone Usage restriction by extending mobile phone circuitry - An alternative to jamming

Anna Univeristy-2014-15

- Designed a system to lock a mobile phone's keypad and loudspeaker as soon as the phone enters a silent zone by extending its circuitry.

EXPERIENCE

TartanSense

Bangalore, India

Developer/Lead - Weed detection and distance estimation

Apr 2019-July 2019

Detect if a weed is present in the image and estimate its distance from the rover which captured the image

- Detect weeds present in image by training deep learning models using Tensorflow object detection API
- The camera is mounted at a known angle with respect to the ground plane. Estimate the extrinsic and intrinsic parameters of the camera using checkerboards placed on ground.
- Develop algorithm that estimated the distance of a given 3D point that corresponds to a pixel from the rover assuming that the inverse projections of all pixels lie on the ground plane. Estimated the distance of the weed from the rover using the algorithm

Project Manager - Data Collection for Weed Detection

Apr 2019-July 2019

Managed a team for building, testing and deploying a data collection rover, which collected image data of weeds from farms across 10 locations in India. This data collection drive was for critical for developing deep learning based weed detection model later on.

- Made scrum based project plan for 3 months.
- Oversaw and managed progress across weeks
- Developed Rigorous test cycles for testing the prototype before hitting the fields
- Owned the whole of Camera selection process. From developing specs about camera based on field requirements to developing test plans to verify if the camera will meet our expected performance.

Soliton Technologies

Bangalore, India

Developer - Optical Character Verification(C++, CV)

2018

Verify if certain characters are present in an image.

- Image Alignment: Estimate a Euclidean transformation to align the input image with a template image by matching ORB features
- Verify if desired characters are present in the aligned input image by subtracting the image from the template image.
- Perform algorithmic optimization to verify about 40 characters under 90 ms in Soliton Smart Camera (an ARM processor-based) platform.

Mentor - Card Reader (CV, Python)

2018

Read the data present in a given government ID card.

- Guide an intern to develop an application for reading government cards like PAN and Aadhar.
- Guide development of alignment module: Find four corners of the card by detecting its edges and estimate homography for transforming an input image to a predefined template view.

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- **Spread colors:** Design and implement different functions for color gradient synthesis (L2, gaussian, logarithmic and inverse logarithmic based algorithms) for background generation.
- Guide development for recognition module: Run text detection by using Stroke width transform (SWT), segment characters and recognize each character using a DL OCR model.

Developer - Depth based Image classification - Prototype (CV, DL)

2017

Categorize a given image into any of these - Too close, Close up, Medium, Far away based on the Depth level of objects present in the photo.

- Try different network architectures and hyperparameters (50+ training experiments) to get to 74% accuracy using Keras with Tensorflow backend.
- Transfer learning from ImageNet to reuse the features learned from ImageNet
- Use depth map as the fourth channel (RGBD) to get better performance (Depth map obtained from [Unsupervised Monocular Depth Estimation with Left-Right Consistency](#). Link to [Github](#) repo

Developer - Embellishment Placement (Python, Algorithm)

2017

Algorithm to embellish decorations in each page of a photo album based on a set of rules defined for each asset (a particular variety of embellishments) and to implement all rules with minimal code.

- Design and implement the rules for automatically placing 6 out of total 15 decoration objects (assets) in the pages of a photo album.
- Implement the algorithm to find minimum possible rectangles in a Rectilinear space - [Paper](#)

Developer- Other Short term projects

2016-19

- **Proposal for improving CBA:** For this Jewelry component identification system, perform ablative analysis of the system, propose changes (use Zernike moments instead of hu moments and ORB feature matching instead of pattern matching) to improve the overall system accuracy (from 55% to 80%)
- **Seat Belt Detection:** Construct a sliding window detector by training an SVM classifier on HoG features. Perform Hard Negative mining and Non-Maximum suppression (Final IoU-75%)
- **Shape Context matching as post-processing to improve Deep Learning HCR accuracy:** Use shape context matching to classify some characters inputs where deep learning HCR model was showing very low confidence. Improve system accuracy (from 90.1% to 91.2%)
- **Iris recognition:** Develop a demo for iris recognition involving Iris localization by Daugman's transform, image normalization and unwrapping, encoding by Gabor wavelets and matching by L2 distance.

WORKSHOPS CONDUCTED

- Conducted 2 Workshops as a part of Anthill Inside 2017 and 2018, one of India's largest Industrial Deep Learning and AI conferences.
 - **2017 - Machine Learning in Computer Vision:** My part includes Limitations of ML, ANN, MLP Backpropagation, CNN, applications current trends in deep learning.Link to [Github](#) repo
 - **2018 - ML and DL for Computer Vision:** My part includes Machine Learning in CV and Image Classification using ML on day-1 and Nuts Bolts classification demo on Soliton smart camera on day-2.Link to [Github](#) repo
- A **2-day workshop on "Computer Vision with Machine Learning"** at PSG Tech, Coimbatore: My part includes Apart ML DL and a few concepts in 3D Vision: Image formation, Projective Transformation Homography estimation.Link to [Github](#) repo

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PUBLICATIONS

- 1st Author, “Automated Robotic Moisture monitoring in Agricultural field”, 2018 International Seminar on Intelligent Technology and Its Applications (ISITIA), Bali, Indonesia, 2018, pp. 375-380.
- 1st Author, “Smart Mobile Phone Usage restriction by extending mobile phone circuitry - An alternative to jamming”, 2018 International Seminar on Intelligent Technology and Its Applications (ISITIA), Bali, Indonesia, 2018, pp. 425-430.

OTHER INITIATIVES

- The organizer of Engineering Lunch, a session to promote active learning within the team. Organized this session over the past 2.5 years completing three different themes: Productive Engineering Habits, Data Structures and Algorithms and Writing Clean code.
- Completed a few online courses with assignments to enhance my mathematical and CS understanding:MIT 18.06 (Linear Algebra), Stanford CS231n (CNN for visual recognition), Introduction to Probability and Statistics (MIT 18.05), Introduction to Algorithms (MIT 6.006), Machine learning (Stanford CS229)

AWARDS AND ACHIEVEMENTS

- Best Outgoing Student, ECE department for the batch of 2012-16
- Leader in Bhumi (an NGO) for educating underprivileged kids 2015-18
- Placement coordinator 2015-16
- Awarded the best project idea for my 3rd undergraduate project, 2015
- Rajyapuraskar (Governor award) recipient in Scouts during High School