

# In18-IT-EN3992 Industrial Training

@ L.E. Robotics (Pvt.) Ltd.

Bimalka  
(Former Engineering Intern)

Supervised By  
Prof. J.A.K.S. Jayasinghe

Engineer In-Charge  
Miss. J.A.L. Jayasinghe

<http://www.lerobotics.lk/>

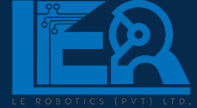


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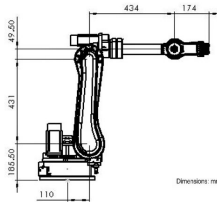
# Description of the Organization



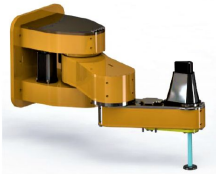
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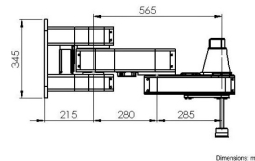
Robot Dimensions



LE 4 R565



Robot Dimensions



- L.E. Robotics (Pvt.) Ltd. is a local R&D facility located in Minuwangoda, Sri Lanka.
- Offers fully customisable robotics solutions for various automation needs
- Established in 2005 by Prof. J.A.K.S. Jayasinghe who is a senior professor in ENTC
- Products manufactured:
  - **6 DOF Robots** - Robots with six degrees of freedom
  - **4 DOF Robots** - Robots with four degrees of freedom
  - R&D of the related technologies (servo motors and their drivers)

# Familiarization work carried out

**Project Plan**


**A**

- Motion planning, Path planning (Welding, Drilling)
- computer vision, perception (Picking from a moving conveyor)
- Multi Processor Robot Controllers (Modify the present design using FPGA/CPDL Pulse generator such that precision welding and real-time picking is possible)

**B**

- Advanced Servo Drives -CAN (Ethernet to CAN bus interface + Drivers)
- Advance Servo Drive -Ethercat (Ethercat servo drive PCB + Firmware)
- Industrial PC Based Robot Controllers (Develop IPC software incorporating CAN/Ethercat servo drives)

**I**

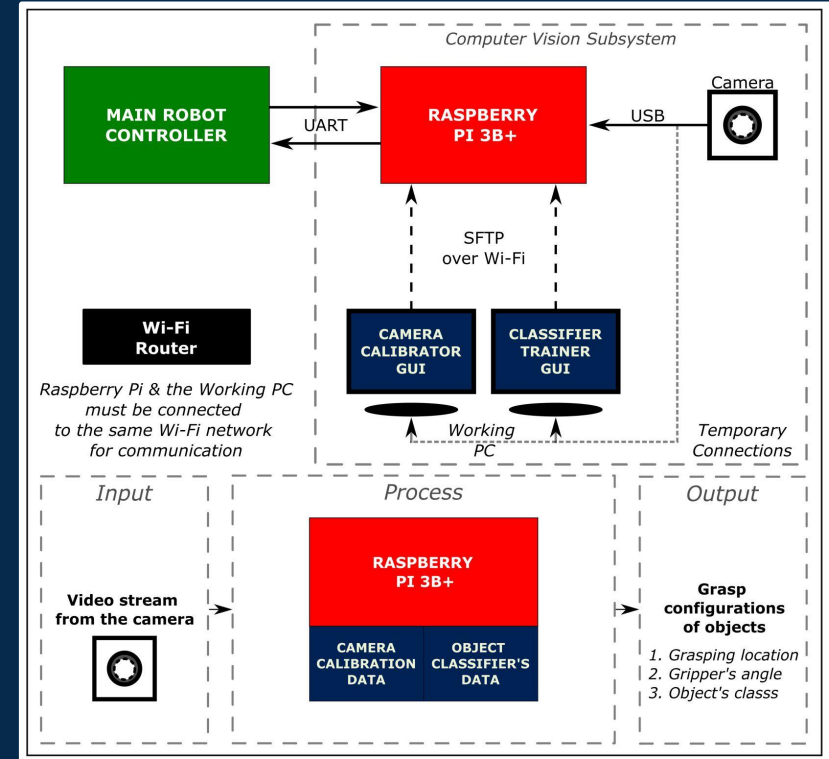


Bimalika Piyarawan Thalagala | Kapila Jayasinghe | Kalana Jayalath | 180534N - Achintha Rathnayake

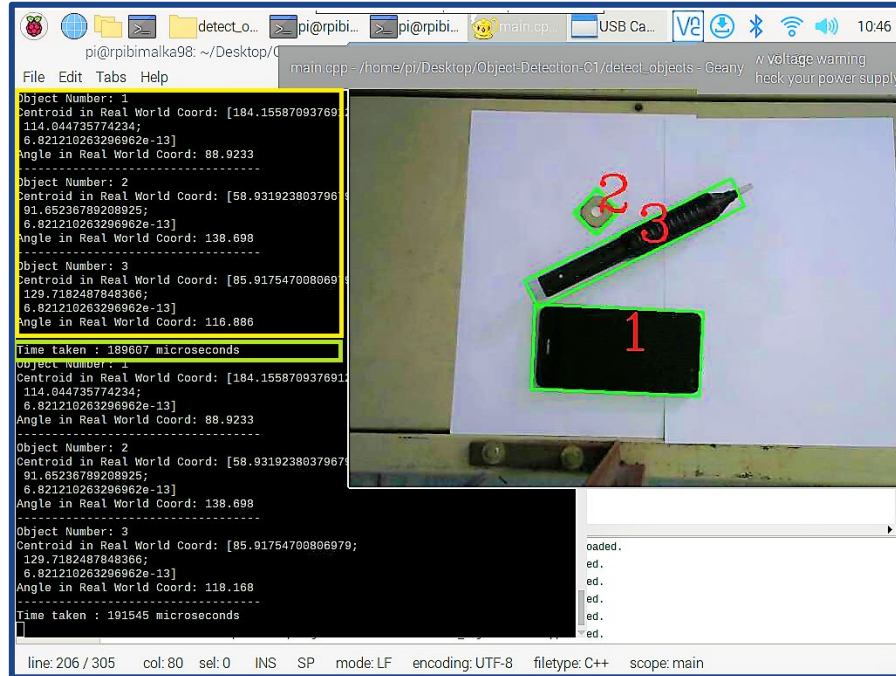
- Projects Assignment was done about a month prior to the commencement of internship
  - two project plans were offered
  - we agreed to move forward with plan A (on left)
- Facility familiarization after commencement of the internship
  - introduction to industrial robot arm designing
  - machinery required for industrial robot arm designing (CNC, Lathe,...)
- Non-Disclosure agreement

# Project Work

- By title, the project that I was assigned, was “*Machine vision based Real-time Motion Planning for an Industrial Articulated Robot Arm*”.
- My contribution to that project
  - Developed an object detection framework
  - Developed an application for camera calibration (Camera Calib. GUI)
  - Developed an application to train an object classification model (Classifier Trainer GUI)

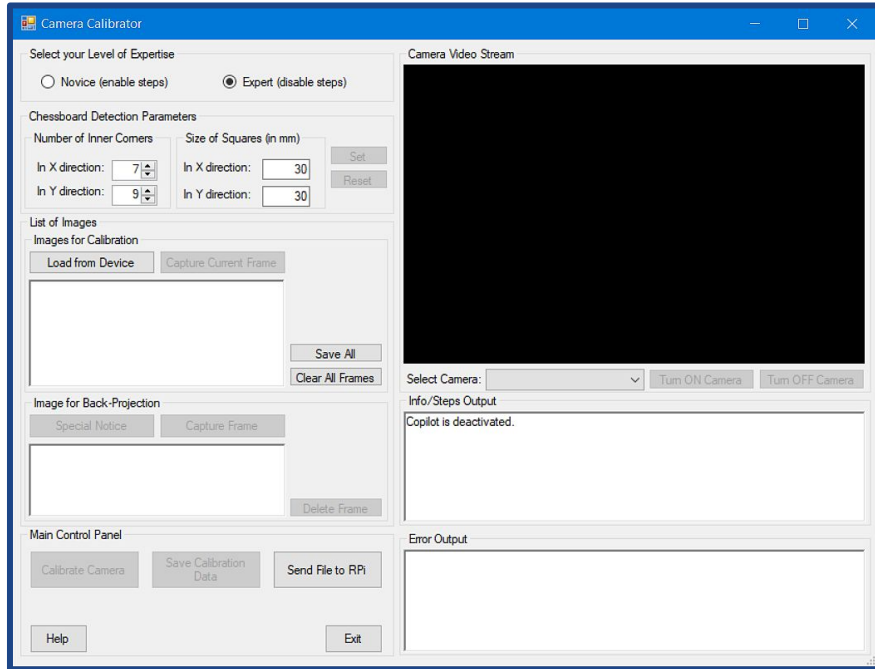


# Object Detection Framework



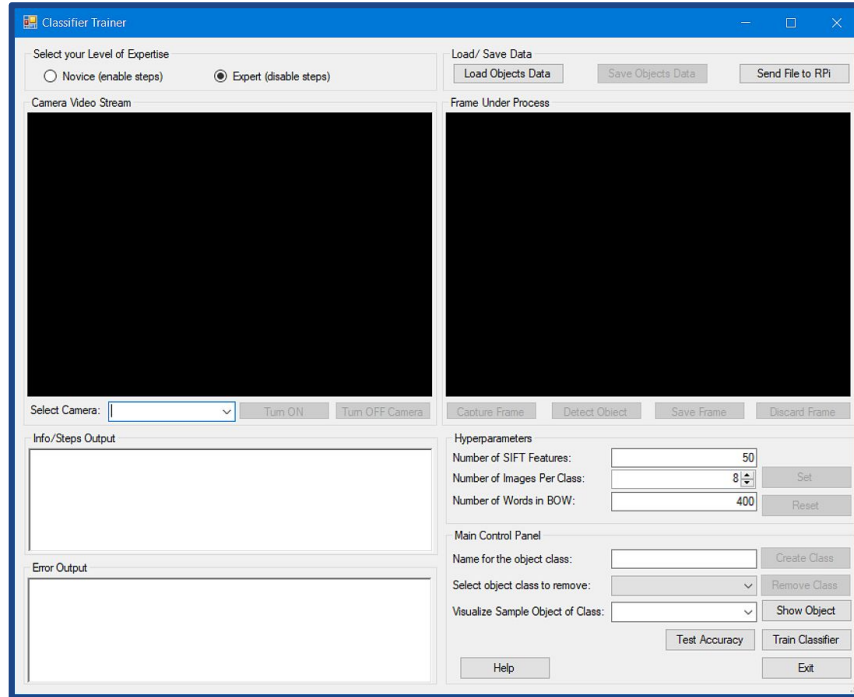
- Engineered from scratch
- Developed two associated Windows GUIs (coming up next)
- Capable of determining **grasping configurations** (location, orientation and object class) for a given object
- Implemented all the algorithms using **C++** and **OpenCV** (a traditional Computer Vision approach)
- Documented working principles and guidelines to deploy the framework to the vision subsystem of pick and place machine

# Camera Calibrator GUI



- Designed the user interface
- Developed required algorithms using **C#** and **Emgu CV**
- Composed the user manual for the software.
- Can be used to calibrate **any monocular camera** to be used in automatic pick and place machines
- Application is capable of generating required data, to remove the distortions of captured images to transform 2D image points back to a given 3D real world coordinate system with **an accuracy of  $\pm 0.5$  mm.**

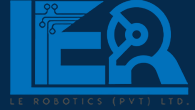
# Classifier Trainer GUI



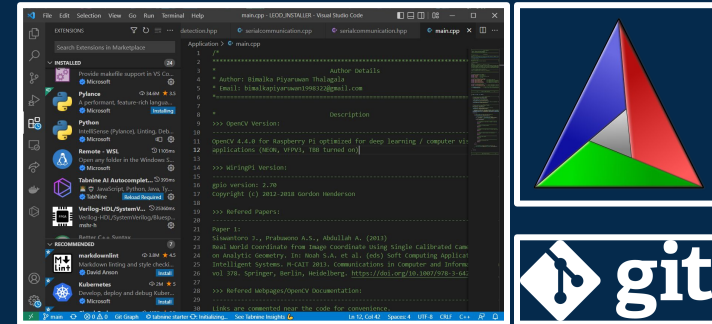
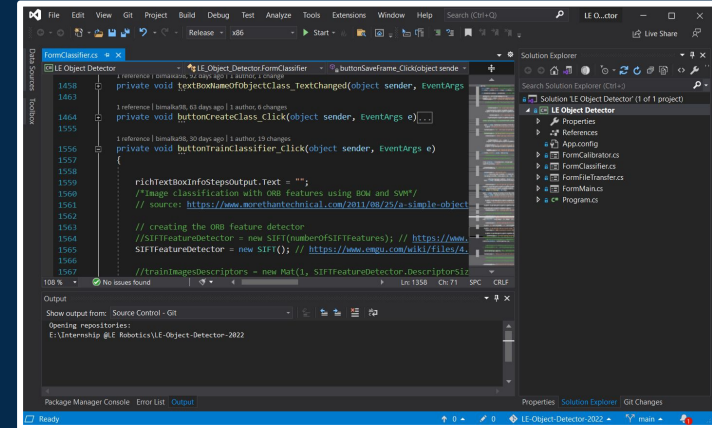
- Designed the user interface
- Implemented required algorithms using **C#** and **Emgu CV**
- Trained and tested the accuracy of the model on **industrial robot parts classification**
- Composed software's user manual
- Classification model uses, **SIFT** for feature extraction; **K-Means clustering** to create the Bag of Words (BOW); and Support Vector Machines (**SVMs**) for classification in One-vs-All approach.



# Hands-on Experiences



- LE robotics Pvt. Ltd. had no experts in the CV field. I had to learn most of the things related to my assigned projects by actually doing them.
- An ideal opportunity to learn, unlearn and relearn various technologies really fast and with minimum supervision.
- Resources for Self-Learning
  - *Google Search* • *Stack Overflow* • *OpenCV Documentations* • *EmguCV Documentations* • *Research Publications*
- Usage of Open Source Software
- Usage of Modern Tools (CV & SE related)
  - *Visual Studio 2019* • *Visual Studio Code* • *Git* • *CMake*

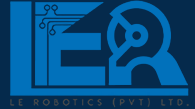


# Soft Skills Development



- **Learning a new technical skill is not a big deal** with the advancements in technology as everything is available at the fingertip
- However, **mastering a soft skill is much harder and takes time**
- LE Robotics Pvt. Ltd. was absolutely an ideal place to improve existing soft skills as well as to learn a new set of soft skills
  - **Problem-solving:** *exposure to the world of 'Research publications', exposure to entire prototype development process (idea generation, research, planning and prototyping)*
  - **Adaptability:** *Companies and working environments are different from one another, have to deal with human beings with diverse mindsets*
  - **Time management:** *Proper planning and organization of the assigned tasks depending on their priority, knowledge of modern tools was also a plus point*
  - **Professional work ethic:** *Punctuality, Trustworthiness and obeying the NDAs, Respect the Intellectual Property (IP) of others*
  - **Communication :** *project demonstrations, various presentations and technical documentation preparations*

# SWOT Analysis



## Organization

## Self

**S**

- Great vision towards “Made in Sri Lanka”
- Decades of experience in the industry
- R&D of very advanced technologies

- Can work under minimum supervision
- A team player with critical thinking abilities
- Fast learner who learns as needed

**W**

- Heavily depends on the interns
- Well-being or the career growth of the employees was not of their concern

- Underestimate myself when a new challenge is introduced

**O**

- Industrial automation is a fast growing field
- Very few competitors in the local market

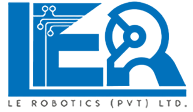
- Industrial automation is a fast growing field
- Professionals with both AI and Embedded Systems Engineering knowledge have a higher demand

**T**

- Slow product development speed in a fast moving industry
- Competitors who dominate the global market (KUKA)

- Below the average GPA in the department! (LOL)

# Conclusion



- A whole new challenge which **demanded a diverse set of technical skills as well as soft skills**
- An opportunity to experience my full potential as an engineering student and **revealed my true calibre**
- No one is there to spoon-feed you in the industry and one must build a mindset of **working under minimum supervision**
- Being a **team player** and completing the assigned tasks well in advance, is a must to be successful in product development in the current fast moving industry
- **Inner peace matters** and one should **maintain work-life balance** to be a successful professional.

# Thank You

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