ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME

ERCIM
European Research Consortium
for Informatics and Mathematics

Scientific Report

First name / Family name	Nikita/Singh
Nationality	Indian
Name of the *Host Organisation*	RISE SICS Västerås
First Name / family name of the *Scientific Coordinator*	Mats/Tallfors
Period of the fellowship	01/10/2019 to 01/10/2020

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During my period in RISE SICS Västerås, I worked in 3 projects. My main task on these projects consisted on the use of image processing, Machine Learning and AI to improve industrial activities. Another important task in these projects was the interaction with partners in the industry.

A very important activity of the RISE in which I participated was to transform the requirements of the industry partners in functionalities, as well as documenting each task performed.

The first project is **Explainable Artificial intelligence (XAI)**, SK Funded project-2019. In this project I worked with RISE partners. The purpose of this project to Enhance competence on technical process of (X)AI in general. In this project, I present use case: AI in Alzheimer's disease (Healthcare application) to defining the importance of alzheimers disease patterns and different stages using deep learning CNN framework. The main object

was to give tutorial and knowledge sharing to AI group in RISE, interested colleague and Mälardalens university Västerås, Sweden and how to include XAI in a project application and EU project call.

The second project is **AUTOINSPECT- Develop automated quality control of die-cast and hot-pressed metal components, based on images.** In this project I worked with Dr. Mats Tallfords and other industrial partners. My task in project to develop a model for a computer to automatically decide if the produced metal components does have defect/faults or not. In this project I worked on annotations (data Labelling), computer vision based deep learning object detection Faster RCNN methodology for the detection of metal component defects/faults detection and predictive analysis (confusion matrix) that define true positive, false positive, true negative and false negatives results of metal image components.

The third project is **Smart Automation Living Lab for Process Industry (SALLPI)**. In SALLPI, I worked in the use case #6 "AI based quality control of battery manufacturing process". In this project I worked with Dr. Mats Tallfords and industrial patterns Nilar battery manufacturing company Sweden. My task in project to Inspect and detect the battery leakage problem, fault in separator, position fault, missing negative electrode and other faults. In this project I worked on 2 parts: i). battery image analysis and ii) Battery image anomaly detection.

1. Firstly, Remove unwanted part and extract from battery modules: contact plate, biplate, electrode and separator and Find peak area (fault) in the image using my Ph.D proposed localization technique.
2. Second, Scale invariant feature transformation (SIFT) are used for battery image features identification. I used SIFT extrema volume Key point localization features for Autonomous anomaly detection (k-std threshold based) algorithm to finding anomalies as a fault.

Other Scientific Activities:

During my 1 year in RISE I present a seminar/lecture to interested industrial patterns and colleagues at following places:

1. Seminar on Explianable AI (XAI) in **RISE and Mälardalen University**-2019.
2. Seminar on Industrial Application of Computer Vision and AI at **Mälardalen Industrial Technology Center AB (MITC)** Eskilstuna-2020.

3. Visited at **GNOSCO AB (Healthcare startup)** for Knowledge Sharing AI in healthcare, Gothenburg-2020.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

I am working on 1 paper that I must submit to the Journal before December.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

Due to the covid-19 situation I was only able to attend digital workshop named as:

- Women in AI Global Summit, September 8th 2020 by Hoping: Workshop leading by global AI Experts that cover topics: **AI in healthcare, AI in Ethics, Business, Education, Culture**, and more.

I also attend 1-day physical workshop at steam hotel with RISE colleagues, February 2020:

- RISE GATEWAY 2020: Aim: To talk about Research Plans, Needs and Contribution in Different Research Areas, RISE in February 2020.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

Due to covid-19 situation not able to visit REP institute. I was only able to attend REP digital meetings.

During REP, I had the opportunity to present myself and seminar/lecture to Prof. Tamas Sziranyi and Researchers from SZTAKI (Institute for Computer Science and Control) Budapest, Digitally (online).

For lecture, I prepare a one Abstract with Title for seminar/lecture presentation including background, lecture on computer vision and image analysis applications areas name as: industrial and medical application and RISE project work and conclusion.

Title: Research Exchange Program (REP) Talk on Computer Vision Applications Area.

Abstract: Computer vision is the automatic extraction of information from images and helps to utilize the digital input and output mechanical components or samples in an industrial process where it is necessary to execute the image analysis. Inspection of mechanical components or samples using Computer Vision Technologies such as Machine Learning and Deep Learning schemes provides solution for diagnostic performance and quality checking. Nowadays, various applications of computer vision

technologies are healthcare, packages (inspection) and process control extremely motivated. These applications concerned with the engineering or medical part of mechanical-electronic-software systems for evaluating objects/region of interest (ROI) and materials or disease, human artifacts, process control using image processing and computer vision, in order to inspect detect disease or defects/fault and improve quality, performance, efficiency and cost reduction.

During this lecture we were discuss about the different application interests related to Computer Vision and Image Processing state of art approaches with solutions including RISE projects results and benefits.