Dr. M. Usman Maqbool **Bhutta**

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"Roboticist"

Summary

With the rise of autonomous systems, being a researcher and entrepreneur, my research direction is their deployment to the real world. For any autonomous mode of the robot, a 3D map is essential to navigate and operate at any place. I work to tackle the problems related to scale difference and loop closures for large scale 3D mapping. I've 7+ years of experience specializing in robotics R&D and project management. I previously owned an IT company, and I've been part of several startups since 2011. My full profile can view here (`https://usmanmaqbool.github.io/`).

Work Experience [7+ Years]

RESEARCH (Computer Vision technologies and Robotics System)

Robotics and Multi-Perception Lab, Robotics Institute — *HKUST, HK*

PhD — *Sep 2016 - Feb 2021*

- PhD Supervisor: **Prof Ming Liu**, Director of Robotics and Multi-Perception Lab (**RAM-LAB**)
- **Research Contributions as First Author**
    - **Place Recognition**: Our work makes a leap towards hierarchical deep learning-based place recognition for multiagent SLAM systems.We introduce a probabilistic layer to constrain the local representation along with the global representation of images. The global description of the pre-trained model and the local consistency introduced in our work enables the system to yield good performance at large-scale.
        - *Development Using:* MATLAB, Python, Jupyter, Nvidia CUDA, Docker, Deep learning, Matconvnet
    - **Multi-Agent SLAM**: I've produced Loop-box for the multi-Agent Direct SLAM Triggered by Single Loop Closure for Large scale semi dense 3D reconstruction /large-scale structure from motion. This work is accepted for publication in IEEE Transactions on Cybernetics (IF= 11+)..
        - *Development using:* C++ 11, ROS, OpenCV, OpenGV, Paraview, EVO, UGV, LSD-SLAM, Monocular Camera.
    - **SLAM**: I've worked mainly for the multi-agent SLAM system. To find the scale difference and excellent relative transformation between difference agents. I've produced PCR-Pro work. This work got best student paper finalist award at IEEE-CYBER 2018.
        - *Development using:* C++ 11, ROS, OpenCV, OpenGV, Paraview, EVO, Monocular Camera, Plotly
    - **Automation (Inspection)**: For smartphone glass inspection, I've introduced Smart-Inspect work. This work is accepted in IROS 2020. The patent is also under-review in the US.
        - *Development using:* Python, Jupyter, Nvidia CUDA, K-Means, Docker, Machine learning (ML)

Autonomous Systems Lab (ASL) — *ETH Zürich, Switzerland.*

Academic Guest — *Oct. 2019 - Mar. 2020*

- Supervisor: **Prof. Roland Siegwart**, Director of Autonomous Systems Lab (ASL), ETH Zürich, Switzerland.
- Co-Supervisor: **Dr. Cesar Dario Cadena Lerma**, Senior Researcher at ASL, ETH Zürich, Switzerland.
- **Research in Place Recognition**: I've worked for making the better place recognition for the better scene understanding. Furthermore, I've also introduced light weight representation of key-frames for better channel utilization.
    - **Development using:** MATLAB, Python, Jupyter, Nvidia CUDA, Docker, Deep learning, Matconvnet

Department of Electronics — *QAU, Pakistan*

MPhil Candidate — *Mar. 2010 - Jun. 2012*

- M.Phil. Supervisor: **Prof Hasan Mahmood**, Department of Electronics, QAU.
- **Research in Image Processing (CNN)**: I've introduced CNN-based license plate recognition of Pakistani's Cars. This work has been published in IEEE-ICALIP 2014.

INDUSTRY AND ENTREPRENEURSHIP

Lisee Technology Corporation Limited — *Central, HK*

COO — *Jan 2018 - Jan 2021*

- Won funding support for company | TSSSU Support HK$ 300,000 (Jun 19 - May 20).
- Indoor Navigation for Libray using Lisee Technology | PCF Support HK$ 160,000 (Jun 18 - May 19).

Friends Corporate Technologies — *Islamabad, PK*

CEO — *Feb 2013 - Aug 2015*

50+ Projects | Electronics/ Electrical Engineering, R&D, image processing, Web Applications Development, MVC Applications

Federal Government of Pakistan — *Islamabad, PK*

Scientific Officer — *May 2012 - Feb 2013*

Electronics/ Electrical Engineering, R&D, image processing

Server4Sale, LLC — *Islamabad, PK*

PHP Developer — *Dec 2009 - Mar 2010*

Php web application development for Joomla and Zend frameworks.

ACADEMIC

Department of Computer Science
Lecturer (Visiting)

Teaching MCS and BS-CS courses

BZU-Sahiwal, *Pakistan*
Feb 2016 - Jun 2016

Department of Physics
CTI

Teaching BS physics (Electronics related courses + Labs + Projects)

GPGC Sahiwal, *Pakistan*
Oct. 2015 - May. 2016

Department of Electronics
Instructer

'PHP Web Development' (a short course) offered in Department of Electronics, Quaid-i-Azam University, Islamabad, Pakistan.

QAU, *Pakistan*
Aug. 2010 - Dec. 2010

Education

Ph.D. in Robotics and AI at RAM-LAB, Robotics Institute
Department of Electronic & Computer Engineering, The Hong Kong University of Science and Technology

HKUST, *Hong Kong*
Sep. 2016 - Feb. 2021

- PhD Supervisor: **Prof Ming Liu**, Director of Robotics and Multi-Perception Lab (**RAM-LAB**)
- Exchange Supervisor: **Prof. Roland Siegwart**, Director of Autonomous Systems Lab (ASL), **ETH Zürich**, Switzerland.
- Exchange Co-Supervisor: **Dr. Cesar Dario Cadena Lerma**, Senior Researcher at ASL, **ETH Zürich**, Switzerland.
- Got PEEF CCMS PhD scholarship from Pakistan and overseas research award (ORA).
- Research: Multi-Agent SLAM System, Place Recognition, Autonomous Car and Deep Learning for automation industry. Hand on experience on RGB-D 3D recontruction, Multi-view stereo, python and C++ development experience, multi-threaded coding.3D mesh registration, paraview and parameterizations. Moreover, I've deep understanding of data structures and algorithms. Experience with software development on Linux open-source stack. Calculus, linear algebra and geometry related courses have been taken.

M.Phil. in Electronics
Department of Electronics, Quaid-i-Azam University, Islamabad, Pakistan.

QAU, *Pakistan*
Mar. 2010 - Jun. 2012

- M.Phil. Supervisor: **Prof Hasan Mahmood**, Department of Electronics, QAU.
- Research: Signal and Image Processing
- Grade: A

M.Sc. in Electronics
Department of Electronics, Quaid-i-Azam University, Islamabad, Pakistan.

QAU, *Pakistan*
Mar. 2010 - Jun. 2012

- **2nd position** in batch
- Projects: completed 9+ projects related to C++, Verilog/HDL and Micro-controller programming.

B.Sc. in Mathematics and Physics
Bahauddin Zakariya University, Multan Pakistan

BZU, *Pakistan*
Mar. 2010 - Jun. 2012

- Grade: 1st Division

Presentation

IEEE/RSJ International Conference on Intelligent Robots and Systems [IROS, 2020]
Presentor as author

Las Vegas, USA
Oct. 2020

- Introduced **Smart-Inspect** for the micro scale localization and classification of smartphone glass defects for industrial automation.

Technology Start-up Support Scheme for Universities (TSSSU)
Presenter as COO Lisee Technology Corporation Company Limited, Hong Kong.

HKUST, Hong Kong
Jan. 2019

- Introduced Lisee technology in front of selection committee panel and won TSSSU 2019-20 funding of the amount of HK$300,000.

IEEE Int. Conf. on CYBER Technology in Automation, Control, and Intelligent Systems [IEEE-CYBER 2018]
Presentor as author

Tianjin, China
Jul. 2018

- Introduced PCR-Pro for the estimation of information matrix and scale difference for pose graph SLAM.

IET-Young Professionals Exhibition and Competition (IET-YPEC) 2018
Presenter as COO Lisee Technology Corporation Company Limited, Hong Kong.

CityU, Hong Kong
Jul. 2018

- Introduced Lisee technology at IET-YPEC 2018.

Campus Challenge @ HKUST Transportation
Presenter as participent

HKUST, Hong Kong
May 2018

- HKUST got 80+ proposals for this compeitions, and arranged a roadshow. My proposal got selected for the audience award after getting maximum votes.

High Tech Innovation and Entrepreneurship *HKUST, Hong Kong*

PRESENTER AS ENTREPRENEUR *Dec. 2017*

- Introduced my study related to the flying cars.

World First Youth Robotics Developemnt Forum 2017 *Shangri-La Shenzhen, China.*

PRESENTER AS AUTHOR. *Nov. 2017*

- Introduced my work related to multi-agent SLAM system.

Honors & Awards

INTERNATIONAL

July, 2018	**Best Student Paper Finalist Award**, IEEE Int. Conf. on CYBER Technology in Automation, Control, and Intelligent Systems	*Tianjin, China*
May, 2018	**Audience Award**, Campus Challenge - Transportation, HKUST	*HKUST, HK*
Nov, 2017	**Best Mapper Award**, Robotics and Multi-Perception Lab, HKUST	*Shenzhen, China*
May, 2017	**Completion Award**, The Graduate Teaching Assistant Training, HKUST	*HKUST, HK*
Dec, 2016	**Best External Award**, Robotics and Multi-Perception Lab, HKUST	*Shenzhen, China*
Nov, 2016	**Completion Award**, Author Workshop, Elsevier Publishing Campus	*HKUST, HK*

DOMESTIC

Sep 2016	**CCMS PhD Scholarship**, Won Chief Minister Marit Scholarship (CCMS) scholarship award by Punjab Government (PEEF), Pakistan for pursuing my PhD studies at HKUST, HK	*Lahore, PK*
Sep 2013	**Participant**, Painting for peace (Pakistan-India-Afghanistan) event, a part of the Harmony initiative	*Islamabad, PK*
Apr 2013	**Participant**, Case Spark in business plan competition	*Islamabad, PK*
Apr 2013	**Participant**, Case EPICA	*Islamabad, PK*
Apr 2013	**Participant**, How to be a Better Playwright Workshop by PNCA and US Embassy Pakistan	*Islamabad, PK*
Oct 2012	**Participant**, Punjab Youth Festival	*Lahore, PK*
Oct 2011	**Participant**, Int'l Youth Conference and Festival	*Islamabad, PK*
Sep 2011	**Participant**, Asian Youth Conference and Peace Festival	*Lahore, PK*
Apr 2011	**Completion Award**, Acting and Directing Theater Workshop by PNCA and US Embassay Pakistan	*Islamabad, PK*
Dec 2011	**Participant**, National Drama Festival	*Islamabad, PK*
Dec 2010	**Instuctor of short Course**, PHP Web Development' at the Department of Electronics, QAU	*Islamabad, PK*
Apr 2013	**Completion Award**, Running River Rafting course by Adventure Foundation of Pakistan	*Mansehra, PK*
Apr 2013	**Completion Award**, Paragliding course by QAU Adventure Club	*Islamabad, PK*
Dec 2008	**Award of Honor**, Finance Secretary of Electronics Student Society (ESS) at QAU	*Islamabad, PK*

Academic Activities

ICRA	**Referee Service**, IEEE/RSJ International Conference on Robotics and Automation	*2021, -20*
IROS	**Referee Service**, IEEE/RSJ RA-L and International Conference on Robotics and Automation	*2021,-20, -19, -18*
HKUST, HK	**Teaching Assistant**, EESM 5547 - Multimedia Signal Processing	*Spr 2020, Spr 2019, Spr 2018*
CASE	**Referee Service**, IEEE International Conference on Automation Science and Engineering	*2019*
HKUST, HK	**Teaching Assistant**, ELEC4820 - Medical Imaging	*Fall 2018*
HKUST, HK	**Teaching Assistant**, ELEC 1010 - Electronic and Information Technology	*Spr 2017*

Skills

Robotics and Computer Vision	Ubuntu, ROS, PCL, Docker, Catkin, OpenCV, OpenGV, Ceres Solver, g2o, Libpointmatcher
Machine Learning / Deep Learning	Jupyter, Pytorch, Tensorflow, Keras, CUDA
Programming	Python, C/C++, Matlab, git, LaTeX, FPGA, Verilog
Web	mkdocs, Hugo, Jekyll, PHP, MYSQL
Languages	English, Urdu

Research Publications

Why-So-Deep: Image Correspondence Verification by Probabilistic Spatial Landmarks Elevation for Visual Place Recognition

M Usman Maqbool Bhutta*, Yuxiang Sun and Ming Liu

Journal Paper

Submitted

    The IEEE Transactions on Automation Science and Engineering(**T-ASE**)

Loop-box: Multi-Agent Direct SLAM Triggered by Single Loop Closure for Large Scale Mapping

M Usman Maqbool Bhutta*, Manohar Kuse, Rui Fan, Yanan Liu and Ming Liu

Journal Paper

Oct 2020

    IEEE Transactions on Cybernetics (**IF: 11+**)

Smart-Inspect: Micro Scale Localization and Classification of Smart Phone Glass Defects for Industrial Automation

M Usman Maqbool Bhutta*, Shoaib Aslam, Peng Yun, Jianhao JIAO and Ming Liu

Conference Paper

Oct 2020

    IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS 2020**)

Multiple Lane Detection Algorithm Based on Optimised Dense Disparity Map Estimation

Han Ma, Yixin Ma, Jianhao Jiao, M Usman Maqbool Bhutta, Mohammud Junaid Bocus, Lujia Wang, Ming Liu and Rui Fan

Conference Paper

Dec 2018

    Accepted in IEEE International Conference on Imaging Systems and Techniques (**IST 2018**)

PCR-Pro: 3D Sparse and Different Scale Point Clouds Registration and Robust Estimation of Information Matrix For Pose Graph SLAM

M Usman Maqbool Bhutta* and Ming Liu

Conference Paper

Jul 2018

    Presented in IEEE Int. Conf. on CYBER Technology in Automation, Control, and Intelligent Systems (**IEEE-CYBER 2018**), and won **Best Student Paper Finalist Award.**

An intelligent approach for robust detection and recognition of multiple color and font styles automobiles license plates: A feature-based algorithm

M Usman Maqbool Bhutta*, Hasan Mahmood, and Haroon Malik

Conference Paper

Jan 2015

    Published in IEEE International Conference on Audio, Language and Image Processing (**ICALIP 2014**).

Efficient Reset Design Techniques

Qamar, Zoha, Bushra Yaseen, and Usman Maqbool

Journal Paper

2015

    Published in Science International Lahore

Patent

Semi-Supervised Learning Approach for Smart Phone Glasses Defect Inspection

Muhammad Usman Maqbool Bhutta, Jianhao Jiao, Peng Yun, Yuan Wang, Xuebin Sun, Ming Liu

US Patent

Jan 2020

    TTC.PA.1315, US Provisional Patent Application (No. 62/974,937).

References

Prof Ming Liu

Associate Professor · Director of Robotics and Multi-Perception Lab (RAM-LAB), Department of Electronic and Computer Enginneering, HKUST, HK.

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Ph.D. Supervisor

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Exchange Co-Supervisor

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Professor · Chairperson, Department of Electronics, QAU, Islamabad, Pakistan.

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M.Phil. Supervisor

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