Dr. M. Usman Maqbool **Bhutta**

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"Roboticist + Entrepreneur"

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

RESEARCH (COMPUTER VISION TECHNOLOGIES AND ROBOTICS SYSTEM)

C3 Robotics Laboratory (C3RL), Department of Mechanical and Automation Engineering — *CUHK, Hong Kong.*

POSTDOCTORAL RESEARCH FELLOW — *May. 2021 - Present*

- Supervisor: **Prof. Darwin Lau**, Director of C3 Robotics Laboratory (C3RL), The Chinese University of Hong Kong **CUHK**, Hong Kong..
- **Research in AR/VR and inspection robotics for construction**
  I'm working on several projects here
    AR/VR: Research in **AR/VR** Platform design, multi-agent mixed reality, assistive prosthetics for the handicapped persons, teleoperated robots, human-robot interaction.
    Inspection: Deep learning based research for the robotic presurface inspection for the construction.
    Multi-agent collaboration: For indoor vegetation and painting robotics application.

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   *BZU-Sahiwal, Pakistan*

Lecturer (Visiting)   *Feb 2016 - Jun 2016*

  Teaching MCS and BS-CS courses

Department of Physics   *GPGC Sahiwal, Pakistan*

CTI   *Oct. 2015 - May. 2016*

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

Department of Electronics   *QAU, Pakistan*

Instructer   *Aug. 2010 - Dec. 2010*

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

Education

Ph.D. in Robotics and AI at RAM-LAB, Robotics Institute   *HKUST, Hong Kong*

Department of Electronic & Computer Engineering, The Hong Kong University of Science and Technology   *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   *QAU, Pakistan*

Department of Electronics, Quaid-i-Azam University, Islamabad, 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   *QAU, Pakistan*

Department of Electronics, Quaid-i-Azam University, Islamabad, 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   *BZU, Pakistan*

Bahauddin Zakariya University, Multan Pakistan   *Mar. 2010 - Jun. 2012*

- Grade: 1st Division

Presentation

Teaching and Learning Innovation Expo 2021   *CUHK, Hong Kong*

Posters Presentation   *Jul. 2021*

- 'Mixed Reality in Hands-On Learning of Robotics' by Xinyan Zhao, Sabrina Lam, M. Usman M. Bhutta, Darwin Lau and Jimmy Lee.
- 'Online Robotics Laboratory Framework for Interactive and Group Hands-On Learning' by Ken Hui, Ken Kwok, M. Usman M. Bhutta, Darwin Lau and Jimmy Lee.

IEEE/RSJ International Conference on Intelligent Robots and Systems [IROS, 2020]   *Las Vegas, USA*

Presentor as author   *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) — *HKUST, Hong Kong*

Presenter as COO Lisee Technology Corporation Company Limited, 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] — *Tianjin, China*

Presentor as author — *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 — *CityU, Hong Kong*

Presenter as COO Lisee Technology Corporation Company Limited, Hong Kong. — *Jul. 2018*

- Introduced Lisee technology at IET-YPEC 2018.

Campus Challenge @ HKUST Transportation — *HKUST, Hong Kong*

Presenter as participent — *May 2018*

- HKUST got 80+ proposals for this compeitions, and arranged a roadshow. My proposal got selected for the audiance 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

TC	**Referee Service**, IEEE Transactions on Cybernetics	*2020, -21*
ICRA	**Referee Service**, IEEE/RSJ International Conference on Robotics and Automation	*2022, -21, -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 Publication

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

M Usman Maqbool Bhutta*, Yuxiang Sun, Darwin Lau and Ming Liu *Submitted*

Submitted

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

M Usman Maqbool Bhutta*, Manohar Kuse, Rui Fan, Yanan Liu and Ming Liu *Oct 2020*

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

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

M Usman Maqbool Bhutta*, Shoaib Aslam, Peng Yun, Jianhao JIAO and Ming Liu *Oct 2020*

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

Multiple Lane Detection Algorithm Based on Optimised Dense Disparity Map Estimation *Conference Paper*

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

M Usman Maqbool Bhutta* and Ming Liu *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 *Conference Paper*

M Usman Maqbool Bhutta*, Hasan Mahmood, and Haroon Malik *Jan 2015*

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

Efficient Reset Design Techniques *Journal Paper*

Qamar, Zoha, Bushra Yaseen, and Usman Maqbool *2015*

Published in Science International Lahore

Patent

Semi-Supervised Learning Approach for Smart Phone Glasses Defect Inspection *US Patent*

Muhammad Usman Maqbool Bhutta, Jianhao Jiao, Peng Yun, Yuan Wang, Xuebin Sun, Ming Liu *Jan 2020*

U.S. Provisional Patent Application No. 62/974,937, Filing Date 01/06/2020.

Automatic Surface Defect Detection System for Smart Phone Glass Based on Deep Learning *US Patent*

Yuan Wang, Jianhao Jiao, Peng Yun, Muhammad Usman Maqbool Bhutta, Xuebin Sun, Ming Liu *Jan 2020*

U.S. Provisional Patent Application No. 62/974,938, Filing Date 01/06/2020.

References

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