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 place recognition, AR/VR and inspection robotics for construction**
  I'm working on several projects here
  Place Recognition: Working on the light-weight representation of images and making better use of previously trained models.
  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.

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 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 Embassay 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

RA-L	**Referee Service**, IEEE Robotics and Automation Letter	*2022*
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: Towards Boosting Previously Trained Models for Visual Place Recognition   *Journal Paper*

M Usman Maqbool Bhutta*, Yuxiang Sun, Darwin Lau and Ming Liu   *Jan 2022*

   IEEE Robotics and Automation Letters **(RA-L)/ICRA**, 2022

Scale-Adaptive Pothole Detection and Tracking from 3-D Road Point Clouds   *Conference Paper*

Wu, Rigen and Fan, Jiahe and Guo, Libo and Qiao, Lei and Bhutta, M. Usman Maqbool and Hosking, Brett and   *Aug 2021*
Vityazev, Sergey and Fan, Rui

   2021 IEEE International Conference on Imaging Systems and Techniques **(IST), 2021**

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

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   *Conference Paper*
for Industrial Automation

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   *Dec 2018*
Fan

   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   *Conference Paper*
of Information Matrix For Pose Graph SLAM

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   *Conference Paper*
styles automobiles license plates: A feature-based algorithm

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   *US Patent*
Learning

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

Prof Darwin Lau   *Postdoc Supervisor*

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Engineering, The Chinese University of Hong Kong, HK.

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Prof Ming Liu   *Ph.D. Supervisor*

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

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