Ammar Husain

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OBJECTIVE

Experienced (~8 YOE) product lead and software engineer with deep expertise in software for robotics, artificial intelligence and machine learning. Looking for new and challenging opportunities in the cryptocurrency space.

GOOGLE EXPERIENCE

EVERYDAY ROBOT PROJECT - Mountain View, CA

Product Lead, Senior Software Engineer, Robot Perception : Jan 2019 - Present

Navigation Perception

Architectural Design and Implementation of Features
- Driving the execution of the Perception For Smooth Navigation: Feature List by setting the north star and kicking off projects in service of this vision.
- Designed and implemented algorithms to enable navigating over ramps - go/proxy-ramps.
- Drove the execution, implementation & deployment of go/proxy-autolook (AutoLook), a feature that enables the robot to actively perceive the environment via moving its head to explore areas of interest. Augmented the active perception module to periodically collect data for annotation.

Framework for Field Triaging
- Demonstrated initiative and provided technical leadership, from conception to production, by kicking off an initially ambiguous but eventually fruitful collaboration. This established a procedural flywheel for addressing incidents & collecting navigation field statistics.
- Persistently pitched the idea of a principled process conducive to scaling up 10X robot hours while capturing 100X field data to leadership.
- Created a living triage protocol, taxonomy for categorizing incidents and trained several triage TVCs. Process enabled a better understanding of robot capability limitations and early spotting of system regressions. Field incidents are now being addressed & logged within 48 hours, compared with last year when the majority were never being probed.
- Shifted engineering mindset within navigation from reactive to proactive mode, eg: leveraging field experience in designing scenario evaluation use cases to build guard rails against potential future regressions.
- Led & guided the protocol for field data aggregation and the design of a dashboard for ongoing monitoring
- Proactively & consistently engaging with the Tools and Data Pipeline teams to influence the design & requirements for Viz-MkII, Log Access & Revisualization pipelines.

- Created a retrospective of [lessons learned and key outcomes](#) and [presented them at Proxy TownHall](#). Through my work on this initiative, this triage framework is now being applied Proxy-wide and I am involved in advising the effort.

Scenario Evaluation Pipeline

- [Extended Perception Scenario Evaluations](#) to work beyond just the WorldStateProto. Leveraged software design & C++ expertise to redesign the Evaluator to a [CRTP](#) class that can be [polymorphically specialized](#) for different messages. This reduces code duplication by dispatching to multiple specialized evaluators in a unified module through [variant visitation](#) while reusing metrics computations & scenario definitions.
    - Implemented an [evaluator for the navigation perception](#) occupancy grid that checks system produced outputs on free, occupied & unknown regions against several user defined assertion polygons on expected results.
- Set the agenda for the [design &](#) [creation of scenarios](#) by providing technical insights & hands on training to QA TVCs as well as help procuring necessary access and hardware.
- Improvised/adapted to the WFH situation by temporarily shifting focus and engaging with simulation to collect the requisite logs in [diverse scenarios](#), thereby continually making progress. Between Q2 & Q3'20, [20 navigation specific scenario evaluations](#) have been added to guitar and continuously growing.
- Supervised (ranging from vision setting to hands on debugging) TVCs in chaos reduction by consolidating multiple different ways that all (object detection,navigation) tests were invoked, each with their unique set of arguments, into a [configurable unified script](#). Additionally enabled a [1-click](#) debugging workflow for failing scenario tests that reduced debugging times from ~1h to <10 mins. ([I presented this at TOCC](#)).
- Guided the development of [metrics dashboards](#) for continuous monitoring.

message_sync Library (Primary design & implementer)

- Interviewed several stakeholders to collect their use cases, researched several solutions and made several judgment calls to create a design that balanced feature richness with system complexity. Gathered peer feedback through a [design doc](#) and presented it at [SW Design Review](#).
- Fully owned & implemented the library in its entirety. Added exhaustive unit test coverage for not only the [runtime checks](#) but also [compile test assertions](#) of the library.
- message_sync eliminated the need to write [boiler plate & potentially bug-ridden](#) synchronization logic and reduces [module statefulness](#). Additionally it promotes memory hygiene through its heavy adoption of [Active & WeakMsgPtr](#).
- Deprecated the usage of: [message_synchronizer](#), [TransformSyncBuffer](#) & [AsyncTransformSyncBuffer](#) by providing a unified yet powerful interface.
- Proactively augmented it to support the upcoming [Reliable IPC](#) by providing a [convenient API](#) to bind multiple subscribers with a publisher.
- Evangelized the adoption of the library through [hands on migrations](#), 1:1 trainings and extensive documentation in a [Proxy-TotW#9](#) which led to its usage in [>20 system modules](#) and growing.

Miscellaneous

- Filed Patents:
  - <u>X-51285-00</u>: Using adjustable vision component for on-demand vision data capture of areas along a predicted trajectory of a robot
  - <u>X-51286-00</u>: Generating and/or using training instances that include previously captured robot vision data and drivability labels
  - <u>X-51705-00</u>: Joint training of a narrow field of view sensor with a global map for broader context
  - <u>X-51836-00</u>: Spotting navigation regressions using logged trajectories
  - <u>X-51977-00</u>: AutoLook: Learning from demonstration for head motion
- Implemented the processing ([debayering, HDRNet](#), JPEG compression, [color correction](#), logging etc) of raw images from the new WFOV cameras on MetA. Collaborated cross functionally with [ctalbott@](#), [hiuyu@](#), [fbriggs@](#), [satat@](#), [olast@](#) to unblock dependencies for deployment.
- Drove the [simulation data generation WFOV images](#) (alongside [danielho@](#), [tigrang@](#)) by quickly getting up to speed on the rendering pipeline, testing distortion models and setting up nightlies.

PRE-GOOGLE EXPERIENCE

MARBLE - San Francisco, CA

Robot Perception Product Lead, Founding Software Engineer : June 2017 - November 2018

- Lead the overall design & architecture of the robot perception system by drafting feature lists and product roadmaps.
- Set software engineering principles like C++ standards, git version control workflow etc.
- Wrote several ROS related tools, such as:
  - Leveraging Protobufs for message transport.
  - RViz plugin for quick & dirty point cloud annotations.
- Develop algorithms for negative obstacle detection & point cloud classification.

APPLE - Cupertino, CA

Senior Software Engineer, Autonomous Systems R&D : Jan 2015 - June 2017

- Given the nature of the project, most of my specific work at Apple is highly confidential. More broadly though, I work in the core algorithms group building software libraries (in C & C++) for algorithms in fields such as computer vision, computational geometry etc. Also heavily interfaced with ROS, OpenCV, PCL & other robotics frameworks.

ROBOTICS INSTITUTE, CARNEGIE MELLON UNIVERSITY - Pittsburgh, PA

Software Engineer : Jan 2013 - Dec 2014

- ***Perceptual Boosting:*** Autonomous robots driving off-roads or at high speeds are prone to slipping. Slip is a characteristic of certain properties of the terrain in addition to the

vehicle's interaction with it. Goal was to learn models of slip for an entire terrain by driving on only 10% of it. I developed algorithms to correlate vehicle slip behavior with perceptual cues. Implemented a Naïve Bayes classifier with a Gaussian mixture assumption for supervised learning and Gaussian Mixture Models for unsupervised learning. Features included L*, a*, b* color and texton bag of words. Achieved ~30% improvement in prediction error on heterogeneous terrains and ~38% improvement on separated homogeneous terrains. This provides enormous benefits in path planning for autonomous vehicles. Software design involved processing over 10k images.

- *Mapping:* Wrote several functions for filtering point clouds using PCL through change detection, radius outlier search etc. Implemented capability to transform, align and merge different point clouds Added unit tests for several modules for mine mapping library.

BANK OF AMERICA (MERRILL LYNCH) - Chicago, IL

Software Engineering Intern : Summer 2010

- Wrote tools to automate the process of submitting and approving trades from the Front to Middle and Back offices for the capital derivatives business. Collaborated with a global team of traders and developers from London, Charlotte and Hyderabad.

GENERAL ELECTRIC (HEALTHCARE) - Barrington, IL

Software Engineering Intern : Summer 2010

- Created software tools like widgets for production planning & triggering, thereby saving time & waste. Eliminated a manual error checking process in manufacturing work orders guaranteeing over 95% accuracy up from 65%.

CATERPILLAR INC- Urbana, IL

CAD Designer at Champaign Simulation Center : Spring 2008 - Spring 2010 (Part-time)

AMERICA READS PROGRAM - Urbana, IL

Tutor at Leal Elementary School : Spring 2007 (Part-time)

EDUCATION

CARNEGIE MELLON UNIVERSITY - Pittsburgh, PA

MS in Robotic Systems Development - School of Computer Science : MAY 2013

Research Topic: Prototype an autonomous aerial search and rescue platform.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN - Champaign, IL

BS in General Engineering - Robotics (Honors) : MAY 2011

PRINCESS SUMAYA UNIVERSITY OF TECHNOLOGY - Amman, JORDAN

Undergraduate Exchange Program : SUMMER 2008

SKILLS

High: C ++, C, MATLAB, Python, Linux, Git, OpenCV, Emacs, Standard Template Library

Proficient: LaTeX, Bash, Robot OS (ROS), Point Cloud Library (PCL), CGAL, Boost, CMake, Qt, Mercurial, GDB, SQL, LISP

Familiar: Java, HTML, OpenGL, wxPython, DreamWeaver, Amazon Web Services EC2, Django, Netbeans

GRADUATE COURSEWORK

Stanford - Artificial Intelligence Professional Program

Natural Language Processing with Deep Learning : *XCS224N* ; Natural Language Understanding : *XCS224U* ; Artificial Intelligence: Principles and Techniques : *XCS221* (Ongoing)

Carnegie Mellon University

Computer Vision : *16-385* ; Machine Learning : *10-701* ; Robot Autonomy : *16-662* ; Statistical Techniques in Robotics : *16-831* ; Sensing & Sensors : *16-722* ; Manipulation, Mobility & Control : *16-642* ; WebApp Development : *15-637* ; Computational Learning Theory : *15-859(B)*

REFERENCES

Robots - Husky, HERB, ArduCopter, LAGR, Pioneer, Mobipulator, MarbleBot, EverydayRobot

Humans - Provided upon request