Tuff Torq — Screening Questions

Candidate: Arjan Gupta

October 15, 2023

- **Question 1:** Can you tell me about your relevant experience for this position?

  - **Answer:** Absolutely. First off, I have a Bachelor's degree in Computer Engineering from the University of Kansas, and 6+ years of experience as a software engineer. I am also working towards a Master's degree in Robotics Engineering from Worcester Polytechnic Institute, with a specialization in autonomous vehicles.

    My current position involves building a semi-autonomous motion system for an enormous agricultural machine called an irrigation pivot. I improve the system's ability to navigate the field including path planning, GPS dead-reckoning, and obstacle detection using on-board sensors. I mainly do this by writing C/C++ code for a complex embedded system on the machine. I write test scripts for the system in Python.

    Furthermore, in my Robotics Master's degree program, am working with a variety of robotics frameworks and libraries including ROS2, Gazebo, and TensorFlow. I am developing machine learning, deep learning, and reinforcement learning for both academic and personal projects. Here, I use Python extensively.

    I am also a Co-founder of a very early-stage company where I use PyTorch, OpenCV, and YOLOv7 to help daycare workers keep track of children that might have been left unattended. In this position, I write Python and JavaScript.

    Other notable and related experience includes my work with biometric facial recognition systems, which relied on a pipeline of computer vision and machine learning algorithms. Also, at a previous company, I have contributed to the 3 degree of freedom (DOF) motion planning of a robotic arm that used a LiDAR sensor to estimate the volume of grain in a silo.

- **Question 2:** What Specific Skills do you posses that make you a strong candidate for this role?

  - **Answer:** I have a strong background in software engineering and robotics. I am able to write C, C++, and Python code proficiently to develop software for various applications.

    I am comfortable with designing and implementing machine learning models, neural networks, and reinforcement learning algorithms. I can solve vision and path planning problems using OpenCV and ROS2. Because of my Master's program, I am familiar with SLAM (Simultaneous Localization and Mapping) techniques. Because of my experience in embedded systems, I have a strong understanding of sensors and sensor fusion.

    I am well-versed in using Git for version control, writing requirements and design documents, and writing unit tests for my code. I also mentor junior engineers and interns, and I am comfortable communicating with both technical and non-technical stakeholders.

- **Question 3:** How do you approach problem solving or handling challenges in the workplace?

  - **Answer:** I approach problem solving by first understanding the problem and its context. For example, if I am tasked with debugging a GPS dead-reckoning algorithm, I would first understand how the algorithm is being used on the system as a whole. I would collect information about the problem by asking what the unexpected and expected behaviors are. Then, I would formulate a hypothesis about the problem and test it. If the hypothesis is incorrect, I use what I've learned in testing the system so far to formulate a new hypothesis, and then repeat the process.

    However, sometimes the problem is not well understood, and the challenge is to understand the problem itself. In this case, I would use a similar approach, but I would also do research to understand the problem better. Sometimes this can involve studying a technology or sub-field of engineering that I am not familiar with. However, when I am comfortable with a certain level of understanding, I re-assess the problem and formulate a hypothesis on where to look next.

- **Question 4:** Can you provide an example of a project or accomplishment you are proud of?

  - **Answer:** I am proud of my work on the irrigation pivot project where I built a semi-autonomous motion system for an enormous agricultural machine. I collaborated with other engineers to build many

parts of this system. I wrote drivers for sensors and the network stack, so that information about the system could be communicated to the control system. I heavily improved the motion planning algorithm, which involved writing a path planner that can intelligently decide when to energize the motors to move the machine. This takes into account checking relays, checking the state of the machine, and checking the state of the motors. A mapping of the field is also used to determine the best path to take. Furthermore, I also wrote a GPS dead-reckoning algorithm that can estimate the position of the machine when GPS is not available.

- **Question 5:** How do you stay updated and continually improve your knowledge and skills in your field?

  - **Answer:** I have several ways of keeping my knowledge current. First of all, I am currently pursuing a Master's degree in Robotics Engineering, so taking new courses is one way I continually improve my knowledge and skills. However, my desire to learn new things extends beyond the degree. I have taken Coursera courses on machine learning and deep learning, and I have also taken Udemy courses on YOLOv7 and YOLOv8. I also read research papers on a variety of topics, including reinforcement learning, robot dynamics, and computer vision. My sister is also a PhD student in Neuroscience, so I often discuss research papers with her, even if they are not directly related to my field.

- **Question 6:** Describe a situation where you had to work collaboratively as part of a team to achieve a goal.

  - **Answer:** I have a few examples of working collaboratively as part of a team, but I will use the instance where I worked with a team of engineers to build a 3 degree of freedom (DOF) robotic arm that uses a LiDAR sensor to estimate the volume of grain in a silo.

    I was responsible for relaying the point cloud data from the LiDAR sensor so that it can be transmitted to the cloud via the cellular network on-board. I collaborated with a senior firmware engineer to retrieve information from the CAN bus interface for the LiDAR sensor. I also helped with the motion planning of the robotic arm where it needed to perform a sweep of the silo to estimate the volume of grain. Here, the simulation was done with a senior mechanical engineer, so we used the path planned by the simulation to implement the motion planning algorithm. This involved PWM control of the motors, as well as sensing the angles of the motors. We also collaborated with an electrical engineer to bring up the PCB for the robotic

arm, and tested the PCB with the motors and sensors.

- **Question 7:** How do you prioritize your work and manage your time effectively?

  - **Answer:** For me, the best way to do this is by breaking down the task at hand into smaller tasks. I then prioritize these tasks in a project management tool like Jira. I also use a Kanban board to visualize the tasks that I am working on. For each task, I estimate the time it will take to complete it, and I thereby also estimate the time it will take to complete the entire project. I also plan in time for unexpected tasks that might come up. Once I have planned, I schedule focus-time on my calendar to work on the tasks.

- **Question 8:** What is the price of a Tuff Torq hydrostatic transmission?

  - **Answer:** The price of a Tuff Torq hydrostatic transmission varies depending on the product and the region in which it is sold. However, Tuff Torq products are generally priced competitively with other high-quality hydrostatic transmissions on the market.

- **Question 9:** What is the lead time for a Tuff Torq hydrostatic transmission?

  - **Answer:** The lead time for a Tuff Torq hydrostatic transmission varies depending on the product and the region in which it is sold. However, Tuff Torq products are generally available within a reasonable timeframe.

- **Question 10:** What is the availability of Tuff Torq hydrostatic transmissions?

  - **Answer:** Tuff Torq hydrostatic transmissions are available through a network of authorized dealers and distributors around the world.

- **Question 11:** What is the customer support like for Tuff Torq products?

  - **Answer:** Tuff Torq is known for providing excellent customer support for its products, including technical support, warranty service, and parts availability.

- **Question 12:** What is the recommended maintenance schedule for a Tuff Torq hydrostatic transmission?

  - **Answer:** The recommended maintenance schedule for a Tuff Torq hydrostatic transmission varies depending on the product and the operating conditions. However, regular maintenance is essential to ensure the longevity and reliability of the transmission.

- **Question 13:** What types of fluids are recommended for use in a Tuff Torq hydrostatic transmission?

  - **Answer:** Tuff Torq recommends the use of high-quality hydraulic fluids that meet the specifications outlined in the product manual.

- **Question 14:** What is the process for replacing a Tuff Torq hydrostatic transmission?

  - **Answer:** The process for replacing a Tuff Torq hydrostatic transmission varies depending on the product and the equipment in which it is installed. However, it is generally recommended that the replacement be performed by a qualified technician.

- **Question 15:** What is the process for repairing a Tuff Torq hydrostatic transmission?

  - **Answer:** The process for repairing a Tuff Torq hydrostatic transmission varies depending on the type and extent of the damage. However, it is generally recommended that the repair be performed by a qualified technician.

- **Question 16:** What is the process for troubleshooting a Tuff Torq hydrostatic transmission?

  - **Answer:** The process for troubleshooting a Tuff Torq hydrostatic transmission varies depending on the type of problem and the equipment in which it is installed. However, Tuff Torq provides detailed troubleshooting guides and technical support to help customers diagnose and resolve issues with their products.

- **Question 17:** What is the process for ordering replacement parts for a Tuff Torq hydrostatic transmission?

  - **Answer:** Replacement parts for Tuff Torq hydrostatic transmissions can be ordered through authorized dealers and distributors, or directly from Tuff Torq.

- **Question 18:** What is the process for upgrading a Tuff Torq hydrostatic transmission?

  - **Answer:** The process for upgrading a Tuff Torq hydrostatic transmission varies depending on the product and the type of upgrade. However, Tuff Torq provides detailed information and technical support to help customers upgrade their products.

- **Question 19:** What is the process for disposing of a Tuff Torq hydrostatic transmission?

– **Answer:** The process for disposing of a Tuff Torq hydrostatic transmission varies depending on the type of equipment and the local regulations. However, it is generally recommended that the transmission be disposed of in an environmentally responsible manner.

- **Question 20:** What is the future of Tuff Torq?

    – **Answer:** Tuff Torq is committed to continuing its tradition of innovation and excellence in the field of hydrostatic transmissions. The company is constantly developing new products and technologies to meet the evolving needs of its customers.