Automate tinyML Development & Deployment with Qeexo AutoML

Qeexo

Tina Shyuan
March 9th, 2021
Thank you!

Tweet us: @ArmSoftwareDev

Check out our Arm YouTube channel and our Arm Software Developers YouTube channel

Signup now for our next AI Virtual Tech Talk here

Attendees: don’t forget to fill out the survey to be in with a chance of winning an Arduino Nano 33 BLE board (also supported on Qeexo AutoML)
## AI Virtual Tech Talks Series

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 9&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Automate tinyML Development &amp; Deployment with Qeexo AutoML</td>
<td>Qeexo</td>
</tr>
<tr>
<td>March 30&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Thermal Vision AI – Creating TensorFlow Models for Thermal Image Classification</td>
<td>OpenMV</td>
</tr>
<tr>
<td>April 13&lt;sup&gt;th&lt;/sup&gt;</td>
<td>The First No-Code Voice AI Platform for Arm Cortex-M-based Microcontrollers</td>
<td>Picovoice</td>
</tr>
<tr>
<td>April 27&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Build smarter, Real World IoT Products with Production Quality Tools</td>
<td>SensiML</td>
</tr>
</tbody>
</table>

Visit: developer.arm.com/solutions/machine-learning-on-arm/ai-virtual-tech-talks
Tina Shyuan, Director of Product Marketing

Tina helps businesses apply Qeexo AutoML to build innovative solutions using sensor data. She has a passion for building and launching cutting-edge machine learning technologies and has launched many successful ML products during her six years at Qeexo. Tina is an advocate for running machine learning at the Edge, and actively contributes to the tinyML community.

Tina holds an MBA from Columbia University and a BS degree in EECS from UC Berkeley. Before Qeexo, she was a software consultant and facilitated the end-to-end integration of enterprise processes.
Agenda

• Qeexo introduction
• Why machine learning at the Edge & challenges
• Qeexo AutoML to the rescue!
• Demo video: single-class anomaly detection using STWIN
• Live workshop: gesture detection (ST SensorTile.box giveaway!)
• Resources
• Q&A
Who We Are

- **Founded**: Spun out of Carnegie Mellon University in 2012
- **Headquarters**: Mountain View, CA
  - Additional key locations: Pittsburgh, PA; Shanghai and Beijing, China
- **Key Products**:
  - AutoML – Intuitive machine learning platform enabling efficient development of ML applications; delivers intelligence wherever sensor data is generated
  - Qeexo-developed ML applications using Qeexo AutoML that provide strong proof points:
    - FingerSense – Input-type classification for touchscreens
    - TouchTools – Understands user intention from gestures
    - EarSense – Software-only proximity sensing solution
- **Select Partners & Collaborators**:
  - [Bosch](#)
  - [ST](#)
  - [Qualcomm](#)
  - [ARM](#)
  - [Renesas](#)
  - [Arduino](#)
Rising Market Demand for Edge Intelligence

**DRIVERS FOR EMBEDDED MACHINE LEARNING**

Embedded ML utilizes Microcontroller Units (MCUs) or other hardware embedded in devices for advanced data processing.

**BENEFITS**

- Processes time-sensitive data at the point of origin, eliminating dependency on the cloud or a centralized server
- Reduces latency, bandwidth and power usage by eliminating data transfers
- Enables smarter, more agile applications that provide better insights and faster outcomes
- Addresses privacy & security concerns
Qeexo Addresses Barriers Hindering tinyML Adoption

KEY BARRIERS TO ADOPTION OF ML/AI

• Severe shortage of skilled resources with AI/ML skillsets, and inability for academia to catch up
• End-to-end process of ML modeling to develop applications is labor-intensive, time-consuming, and costly
• ML is particularly challenging in resource-constrained environments

NO END-TO-END TOOL AVAILABLE

Most Significant Barriers to Machine Learning

<table>
<thead>
<tr>
<th>Barrier</th>
<th>% of respondents (n=207)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Skilled Labor</td>
<td>36%</td>
</tr>
<tr>
<td>Data Access/Handling</td>
<td>16%</td>
</tr>
<tr>
<td>Limited Budget</td>
<td>16%</td>
</tr>
<tr>
<td>Deployment Into Systems</td>
<td>9%</td>
</tr>
<tr>
<td>Inappropriate Algorithms</td>
<td>3%</td>
</tr>
<tr>
<td>Difficulty of Building</td>
<td>3%</td>
</tr>
<tr>
<td>Lack of Support from Leadership</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
</tr>
<tr>
<td>None</td>
<td>10%</td>
</tr>
</tbody>
</table>

SOURCES: 451 RESEARCH GROUP, 2019; FORBES, 2018; CIO, 2018
Fully Automated Machine Learning

Without AutoML

Define project e.g. classification → Select sensors and target hardware → Collect/upload data → Data cleaning/preprocessing → Feature extraction and selection → Model conversion (e.g. to C) → Compile target-specific ML package → Deploy/download ML package

AutoML

Define project e.g. classification → Select sensors and target hardware → Collect/upload data → Automated machine learning → Deploy/download ML package
Supported Sensors

Motion Sensors: accelerometer, gyroscope & magnetometer, radar, etc.

Acoustic Sensors: microphone, ultrasonic, geophone, vibrometers

Environmental Sensors: temperature, humidity, air pressure, illumination, IR, etc.

Touchscreen Sensors: capacitive & IR touchscreens

Biometric Sensors*: SpO2, heart rate, etc.

* Sensors currently under research
Demo Video: Fault Simulator with STWIN

- **Hardware platform:** STWIN SensorTile Wireless Industrial Node (STWIN)
- **Sensors:** accelerometer & gyroscope
- **Sampling rate:** 6.6 kHertz
- **Machine learning type:** single-class classification (only NORMAL data is collected)
- **Anomalies detected:** imbalanced rotor, eccentric rotor, bent rotor shaft
Single-Class Anomaly Detection for Predictive Maintenance Using STWINKT1
Qeexo AutoML Live Workshop

- Qeexo AutoML Registration: [https://automl.qeexo.com/signup](https://automl.qeexo.com/signup)
- Data CSV files: [https://qeexo-my.sharepoint.com/:u:/p/tina/EfYB3XB5V9REnPU89KcsQMwBlwQ145Q3vXYrR8u9IXsaQ?e=hIV7Ef](https://qeexo-my.sharepoint.com/:u:/p/tina/EfYB3XB5V9REnPU89KcsQMwBlwQ145Q3vXYrR8u9IXsaQ?e=hIV7Ef)
- Qeexo AutoML Web Application: [https://automl.qeexo.com/](https://automl.qeexo.com/)
- Qeexo AutoML Installer & Installation Guide: [https://automl.qeexo.com/resources](https://automl.qeexo.com/resources)

- Receive ML/AI updates from ST & Qeexo (plus the giveaway!): [https://qeexo.com/armtechtalk2021/](https://qeexo.com/armtechtalk2021/)
Qeexo AutoML Highlights

- **Automates** complex and labor-intensive processes of a typical ML workflow – no coding or ML expertise required!

- **Wide range** of ML methods - 17 different ML algorithms
  - Multi-class algorithms: GBM, XGBoost, Random Forest, Logistic Regression, Gaussian Naive Bayes, Decision Tree, Polynomial SVM, RBF SVM, SVM, CNN, RNN, CRNN, ANN
  - Single-class algorithms: Local Outlier Factor, One Class SVM, One Class Random Forest, Isolation Forest

- **Easy-to-use** interface for labeling, recording, validating, visualizing time-series sensor data

- **Optimized** for low latency, low power consumption, and a small memory footprint

- **On-device inference** - Supports Arm® Cortex™- M0 to Cortex™- M4 class MCUs
Qeexo AutoML for Enterprise Customers

- **Phase 1: Machine Learning Solution Development & Deployment**
  - Client provides ML solution requirements (e.g. detecting/predicting machine failures) and historic data (if any)
  - Qeexo provides sensor modules to attach to client machines OR integrate and use client’s preferred/existing hardware
  - Qeexo builds custom ML solution using our proprietary platform and tools (we can do this much faster than competitors because of our automated tools)
  - Qeexo implements the machine learning solution in the field (and see results!)

- **Phase 2: Qeexo AutoML Customization**
  - Qeexo customizes our existing Qeexo AutoML platform for client’s specific use case

- **Phase 3: Qeexo AutoML Hand-Off & Training**
  - Qeexo delivers custom Qeexo AutoML platform to client
  - Qeexo provides knowledge transfer and training to client so client can continue to operate Qeexo AutoML
  - Client uses Qeexo AutoML to generate new machine learning models for current and future projects (does not require previous ML knowledge)
Qeexo AutoML Resources

- Qeexo website: www.qeexo.com
- Qeexo AutoML Web Application: https://automl.qeexo.com/
- Qeexo partners page on ST website: Qeexo on ST Website
- Qeexo AutoML YouTube Channel
- Email inquiries: tina@qeexo.com
- Demo video links:
  - Qeexo AutoML Intro Video
  - Anomaly Detection Demo
  - Activity Tracking Demo
  - Intelligent Shipping
  - Fan Fault Detection
  - Interactive Wall
  - Environment-Aware Countertop
Thank you!

Tweet us: @ArmSoftwareDev

Check out our Arm YouTube channel and our Arm Software Developers YouTube channel

Signup now for our next AI Virtual Tech Talk here

Attendees: don’t forget to fill out the survey to be in with a chance of winning an Arduino Nano 33 BLE board (also supported on Qeexo AutoML)
Thank You
Danke
Merci
谢谢
ありがとう
Gracias
Kiitos
감사합니다
धन्यवाद
شكرًا
תודה