Enabling future oriented functionalities for motor control solutions

By Suad Jusuf, Renesas Electronics

Smart... home... wireless... connected... IoT... control... opening not only new revenue sources but also new customization skills, adaptation capability and efficiency, high quality, user friendliness and minimized efforts. This is just part of the complex, feature-oriented solution development within the Industry 4.0 and Smart Home world which has already started.

Welcome to modern, feature-oriented productivity and growth with its own modern functionality like omnipresent wireless communication and IoT ability. This demand has to be considered, added and fulfilled as a requirement automatically within the solution development phase. It’s a mandatory step that enables manufacturers to accelerate the development of new competencies and increase their ability to become more agile, efficient and predictive. Growing innovation, reinforcement of the request-oriented and customer-centric approach are the requirements for rapid return and new revenue sources. The end development of a complete solution also requires simplified but effective maintenance, support and services during the solution warranty and lifetime. Those attributes as a differentiator, combined with the skill of customized and user friendliness, are very important factors that influence the successful outcome of the solution and the satisfaction of the end user and customers nowadays. Renesas provides reference designs which are able to fulfil the needs of fast and cost-optimized solution development. This includes modern state of the art add-on features that enable future oriented functionalities within the motor control solutions area. The attributes of the reference designs delivered include sophistication and complexity moving towards simplicity, targeting higher efficiency, quality and flexibility with the implementation of new modern add-on features. Products include the YROTATE-IT-RX23T, YROTATE-IT-RX24T and YROTATE-IT-S5D9. All three reference design kits are available for single/dual motor control (PMSM, BLDC, AC induction).

The main characteristic related to the control methodology is as follows: speed and torque control, sensorless Field Oriented Control (one- and three-shunt method), usage of Hall sensors and/or encoder unit ability, auto tuning, identification and calibration functionality, intuitive PC graphical user interface (PC-GUI), interface for an external high voltage/high current power stage (up to 1.5KW), proprietary debug Interface E1, and safety compliance Self-Test library IEC60730, and certificate by VDE.

Included within the control methodology of the available reference designs, the following modules and functionalities expand the development options and enable more agility and smartness: ALSTC (Adaptive Low Speed with maximum Settable Torque Control), ASO (Adaptive Speed Observer), ABC (Adaptive Boost Control (patented method by Renesas)), Wireless PMOD interface enabling usage of BLE, BT and Wi-Fi technology, Smart APP for iOS and Android based devices (YROTATE-IT), Exchange Data by Email, SMS and Cloud Services is also possible. With one of the mentioned reference designs in the laboratory, developers can learn fast and familiarize themselves with the appropriate device as a component and the methodology behind the entire system. The possibility of a rapid prototype development and the ability to concentrate on the specific add-on functions of their own solution automatically lead to faster development and time to market.

Moving on to the next step, Renesas provides additional sources of feature sets and functionalities with the YROTATE-IT-XXX reference designs. These enable the implementation of wireless communication ability by enabling rapid test and evaluation through data capturing and sharing. These capabilities are easy to apply within the evaluation process and can be expanded with additional functionalities within the framework and end-development process.

The capability of wireless communication has been accomplished by integrating the PMOD adapter interface. This enables the implementation of PMOD-based devices by supporting one of the wireless communication technologies like BLE, BT or Wi-Fi. The YROTATE-IT-RX23T and –S5D9 reference kit now supports the Bluetooth low energy (BLE) wireless com-
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The Renesas PMOD BLE module used is the RL78/G1D based on the RY7011 device with 256KB program flash, 8KB data flash, 20KB SRAM and with the lowest power consumption of 4.3mA RF transmission mode and 3.5mA RF receiving mode in the industry.

While this describes the appropriate hardware capability of wireless communication, we can now turn to the next logical step of implementing the appropriate communication protocol and control software. The communication protocol software is based on predefined rules and interface specifications that must be complied with. Renesas protocol stack software takes over and simplifies the implementation of the BLE protocol. It also delivers a standard profile and custom profile mountable API on the top. Selectable configurations like embedded and modem mode (virtual UART) can be used. It is a good idea to define the approach before starting work on the storyboard. This could involve answering questions on the goal to be achieved and requirements that need to be fulfilled. The target that Renesas aims for, with its wireless capable motor control reference design, is to have a flexible system reference design solution that allows customized and easy start-up, evaluation and development. It does this by incorporating all the attributes and needs of a modern compact motor control solution, offering and keeping in background all the flexibilities and options for further feature implementation and development adaption.

The requirements can be defined by clarifying which features are must-haves and which are nice to have – then finding a balance between the two. This can be clarified from the reference design point of view beforehand. The first step is to select and define the important data and parameters to be shared, monitored and manipulated so that understanding of the overall context of the solution process can be created and followed. The user friendly and customization options also need to be included.

Having done that as a first step, the definition of the main requirements and the characteristic of the smart control software have been delivered. Next comes the definition of the exact storyboard flow with all mandatory selections of the visualization and representation. This includes event processing, state machine flow and error handling. It is important to remember that user friendliness has a high priority as it is one of the main attributes defining the important final touch overall. All in one, a very complex process method with lots of mandatory steps that cannot be ignored or avoided.

Here we come now to the offered wireless motor control capable software as a smartphone APP Yrotate-IT. Based on the defined requirements and characteristic, following attributes and functionalities are available and offered: search and list valid devices, connection with one from the user selected external device available on the list, and menu bar which includes Run page, History page, and Set-Up page. Run page enables to set-up rotational speed, to monitor battery, current, load and actual rotational speed, allows Start/Stop running and changing rotational direction. History page is responsible for monitoring the reactional behavior of the system by visualizing the flow of the parameter: voltage, current, load and speed. Selection between the depicted flows of the parameters is also made as well as amplitude depiction and monitoring selectable Set-Up page. On Set-up page you can get the available motor, current and speed control parameter and set or identify the motor parameter. Set the

![Figure 2. YROTATE-IT-Deliverables characteristics](image)

![Figure 3. Application development using a host microcontroller](image)

![Figure 4. Storyboard visualization and presentation art process](image)
current and speed control parameter torque response and speed response. Finally, you can save or send the Set-up file via Email or Short Message into the Cloud.

For first impressions and capabilities of the YROTATE-IT-XXX reference design, all developers need is the demo reference kit based on their preferred device from their local supplier. They can then install the available YROTATE-IT smart app for free. It allows for immediate commissioning and provides developers with an initial experience of the reference control system and its characteristics. They can run a first evaluation, test and customization using their own motor with no need to spend time to get familiar with the control hardware system and/or control software. Flexible support before, during and after the development is achievable and executable. Different settings and achieved results are shareable within the team and could be available as a database source of various types of information that can then be used for further tasks like service and maintenance, update, controlling, etc. beforehand and afterwards. The Renesas smart motor control app YROTATE-IT is available and can be downloaded/installed from the appropriate stores like, APP Store and Google Play for IOS and Android based devices accordingly.