Add RTEMS Framework to PlatformIO

Google Summer of Code Program 2024 Project Proposal

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Project Abstract.

PlatformIO is an IDE used widely for Embedded C/C++ Development, providing support for a large number of boards from different manufacturers and architecture types. Currently supporting around 20 different Frameworks, including many RTOS.
Addition of RTEMS Framework to Platform IO will be highly desirable, facilitating adoption of RTEMS in the Embedded Domain and attracting developers and interest in the Project.

Project Scope.

Large (approx. 300 hours)

Project Description.

The ticket number #4992, adding RTEMS framework to PlatformIO IDE. The ticket was generated on 16 Feb 2024, so it is a fairly recent project and not much prior work has been done for this integration.
The project aims to write a prototype framework on PlatformIO that can support and build for a few(at least one) similar boards on PlatformIO on a Linux host operating system.

Firstly an initial base set of capabilities will be decided and implemented, it can be extended by adding support for different targets or adding functionality.

In future support for Unit testing, Debugging, and Static Code Analysis can also be Implemented.

Project Deliverables

- May 27 (coding begins)

  - GitHub repo for the Custom Development Platform, and share the access with mentors and RTEMS Organization administrators.
  - Board/Target to be used for the project.
  - Initial list of base functionalities to be implemented.
  - Compilation of reviews, feedback, and suggestions from the mentors.

- July 8 - July 12 (Midterm Evaluation)

  - List of required(published and unpublished) package files, and publishing of unavailable package files to the PlatformIO Package Registry.
  - PlatformIO Core CLI configuration for the selected Target/Board.
  - JSON Structure for the Target/Board.
  - Creation of Manifest File(platform.json) and Build Script(main.py) File, The crux for custom Platform development in PlatformIO core(CLI).

- August 19 - August 26 (Final Evaluation)

  - Operationality/stability of the implemented functions on the Target.
  - Extend the support to similar Target/Boards.(if the initial base functionalities are achieved)
  - Interpolation of Value Implemented to smoothen the support for new Targets/Boards.
  - Examples of "platformio.ini"(Project Configuration File) generated.

- September 3 (Final Results Announced)

  - Comment the code using Doxygen format.
  - Compile additional resources needed to further extend the project.

- Post GSoC

  - Continue the development for adding new Targets/Board.
  - Work on enabling support for Unit Testing, Debugging and Static Code Analysis.
  - Use the RTEMS on PlatformIO for Personal Projects like other open frameworks.

Proposed Schedule

March 14 - March 24 (Application Period)

Getting familiar with RTEMS, completing the "Hello World" assignment provided in the RTEMS Documentation. Deciding the project to contribute to according to my interest and expertise. Preparing the project proposal.

March 26 - April 22 (Acceptance Waiting Period)

Familiarize myself with the PlatformIO Core CLI(command line interface). Make a list of Options for choosing the first Target/Board to be used.

April 23 - May 23 (Community Bonding Period)

Gain knowledge of build system of the PlatformIO as well as RTEMS, set up the GitHub repo for the Custom Development Platform, and shared the access with mentors and RTEMS Organization administrators.
Decided the board to be used for the project, and decided the initial set of functionalities to be implemented. Joined the PlatformIO community for developers.
Get helpful reviews and suggestions from the mentors.
Find resources for porting a framework to PlatformIO.

May 24 - June 26 (First Half)

Publishing of the required package files to PlatformIO package registry, preparing the JSON Structure for the Target/Board, working with the PlatformIO Core CLI, and mainly creating the manifest file(json) and Build Script(python) file is the main files required for building using a framework in the PlatforIO Core CLI.

June 27 - August 23 (Second Half)

Use the manifest file and Build Scripts created to Build application for a Target/Board, upload the application to the target and stability and operationality of the application verifying it, if all the base-functionality targeted are achieved, more functionality can also be implemented and manifest file and Build Scripts can be extended accordingly.

Extend the support for more similar boards if time is remaining, Interpolation of values is a way to abstract the information of the board in the manifest file and build script, they can be modified to support it.

Generate some example files for platform.ini file to be used by other developers and can be used as reference.

Future Improvements

Continue the work of adding new popular targets/boards, work on enabling support for advance PlatformIO features like Unit Testing, Debugging, and Static Code Analysis.

I have been a frequent user of PlatformIO, so I will definitely keep contributing to both PlatformIO and RTEMS in future.

Continued Involvement

I would love to be involved in the continued development of the RTEMS, specially if my project to "Add RTEMS Framework to PlatformIO" is accomplished, because It definitely will attract new Ebedded Devlopers toward the Framework due to improved accessibility. I would love to mentor and help others when I become knowledgeable enough with the RTEMS framework and the inner workings of PlatformIO core.

Conflict of Interests or Commitment

There are no exams in my college during the contributing period of the GSoC, I have applied for summer internship at some startups that works with VTOL Drones which I plan to accept only if I do not make the cut for GSoC at RTEMS. Other than that there are no Conflict of Interests or Commitment.

Eligibility
I am Eligible to participate in the program as defined by the rules in 7. Contributors. 7.1 Eligibility. https://summerofcode.withgoogle.com/rules/

Major Challenges foreseen

- There are very few resources and examples available for porting a framework to PlatformIO and very little publicly available Information regarding the process, and the PlatformIO documentation on the matter is not very exhaustive.

References

- PlatformIO Documentation
- platformIO GitHub
- platformIO Registry
- SCons.org

Relevant Background Experience

- Worked with FreeRTOS and familiar with basic RTOS concepts.
- Used PlatformIO extensively while designing a DAQ system for the Formula Student Team of my college as Electronics Lead.
- Internship at a start-up as an Embedded C Developer, writing I2C and SPI Device Drivers for a new GNSS module by Wurth Electronics.

Personal

I am Pranav Gupta, in the 3rd year of my Bachelor's in Electronics and Communication Engineering Degree from Thapar Institute of Engineering and Technology. I like working on multidisciplinary projects and products with real-world use. I've been an active part of the FSAE team at my college where I learned a lot about collaborative work and real-world implementation of Electronics from designing a lot of safety circuit PCBs to Interfacing new sensors with DAQ microcontroller, figuring out sensor mounting, best practices for wire routing/strain-relief, designing wiring harness and a lot more.

I found out about RTEMS by searching for different RTOSs, then I saw the GSoC section in the Documentation which led me to apply for the project.

I am very passionate about Embedded development, control theory, and avionics. I have also indulged in multi-disciplinary research works like designing a "Shear Cell Tester" for Powder flowability tests that resulted in a commercial product and designing a low-cost Impedance Tube setup for finding the absorption coefficient of different materials.

Apart from technical work, I love skateboarding and playing a few Instruments like Guitar, Piano, and Drums.

Experience

Formula Student FSAE Team(Team Fateh):

- **Electronics and Data Acquisition Lead**: Transducer Selection, System Design, System Integration, Debugging and Troubleshooting
- **Electric Vehicle Design Engineer:** Motor & Motor Controller Selection, Accumulator Designing, Safety Circuits Designing
- **Powertrain Engineer:** Wiring Harness Design, Engine Tuning, and Maintenance

Internship:

- **TekUncorked(Start-up in Energy Sector)**: Driver Development | Embedded Linux | Checksum verification | LTE Modules | GNSS

Commercial Product:

- **Sheer cell Tester**: ESP32, Load Cell, PlatformIO, Excel Add-ons, Stepper Motor, Stepper Motor Driver

Language Skill Set

- C: Intermediate
- C++: Intermediate
- Python: Intermediate
- Rust: Beginner

Research:

- **Impedance Tube Development**: NI LabVIEW, DAQ-MX, GRAS free-field Microphone, cDAQ-9174, NI-9232, NI-9263 (Not published yet)

Reference Links and Web URLs (optional):

- LinkedIn Profile: Pranav Gupta | LinkedIn
- GitHub profile: kush924 (Pranav Gupta) (github.com)
- CV: CV Pranav Gupta