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Embedded Software Engineer Challenge Question

Thank you for your interest in being part of the Kepler team! This challenge question is designed to assess your technical skills competencies as related to our Software Engineer position.

Please answer both of the following questions. ***Please submit your response to this challenge question within 7 days of receipt.***

1) Please complete the following in a maximum of two pages:

    a) Discuss a project you've worked on from start to finish. It can either be something you've worked on in your spare time or something you have done in the course of employment. It should be a project to which you, personally, made a significant technical contribution. We prefer that you ***not*** select a project used for professional development such as a course project. In your discussion we will be looking for:

    - A description of the project, including your role and contributions to it
    - Some design decisions that you had to make, including what the different options were and how you reached a decision. (For example, did multiple processes need to communicate with each other? If so, how? Did you use one algorithm over another for any specific reason? If you had asynchronous events, did you use interrupts or polling and why?)
    - If applicable, explain how an algorithm you used worked
    - How your project was tested

    b) If you have a public code repository account like GitHub or BitBucket, please provide any links that showcase some of your past work. If you do not have any accounts, or your accounts don't have any projects on them, please provide one or two source code files (that you own the copyright to) that highlight some of your past work.

2) This is a coding question. You may use C, or C++. Submit all your source code in a zipped archive as an e-mail attachment (please *do not* post your solution to a public code repository), including any tests you write! In addition to submitting source code, include a brief description (no more than a paragraph or two) of any design decisions or tradeoffs you had to make. Clearly state any assumptions you make.

    You are to design and implement a basic message passing library for an embedded system. In this system you should assume there are multiple threads, each with a unique identifier. These threads should be able to use your message passing library to send and receive messages to and from other threads. The message passing library is responsible for managing the memory associated with the messages. The messages themselves are a simple structure as defined below:

```
typedef struct {
      uint8_t len;
      uint8_t data[255]
} message_t;
```

Implement the message passing library using the following API:

a) **`message_t* new_message()`**: Threads call this function to get an available message struct from the library. If the library is unable to provide a free message struct then this function returns NULL.

b) **`void delete_message(message_t* msg)`**: Threads call this function to return a message struct back to the message library. After calling `delete_message` the thread will no longer use that message struct and the message library is free to give it out to other threads that call `new_message`

c) **`int send(uint8_t destination_id, message_t* msg)`**: Threads may use this function to send a message to another thread. The `destination_id` is the ID of the thread the message should be delivered to and `msg` is the message to be delivered. A response code should be returned where 0 indicates success and non-0 indicates an error.

d) **`int recv(uint8_t receiver_id, message_t* msg)`**: Threads may use this function to receive any pending incoming messages. The `receiver_id` is the ID of the thread that wishes to receive a message. The `msg` argument is an output, and the implementation of this function should set it to point to a message destined to `receiver_id` if one exists. A response code should be returned where 0 indicates success and non-0 indicates error.

What we are evaluating in your solution:

- Correctness (i.e., does it produce the correct results)
- Consideration of embedded programming principles
- Comprehensiveness of test cases
- General cleanliness of the code (i.e., consistent formatting, proper use of comments and docstrings, appropriate use of functions, ease of understanding)