

# System Architecture for IIoT-based POC Molecular Diagnostic Device

I3S2021  
DRESDEN

Byeongheon Kil <sup>1,2</sup>, Ji-Seong Park <sup>3</sup>, Chan Young Park <sup>1,2</sup>, Yu-Seop Kim <sup>1,2</sup>,  
and Jong Dae Kim <sup>1,2,\*</sup>



sciforum-043150

<sup>1</sup>School of Software, Hallym University, Chuncheon-si, Korea.  
<sup>2</sup>Bio-IT Research Center, Hallym University, Chuncheon-si, Korea.  
<sup>3</sup>Biomedux, Suwon-si, Korea

## OBJECTIVES

### Existing POC Molecular Diagnostic Device Software Architecture

- Limitation of execution environment
- Inconvenience of maintenance
- Cannot operate and monitor at the same time

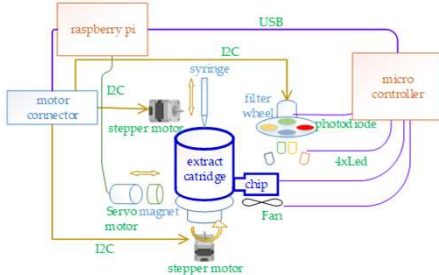


### Proposed POC Molecular Diagnostic Device Software Architecture

- Free execution environment
- Convenience of maintenance
- Can operate and monitor at the same time

## Materials and Method

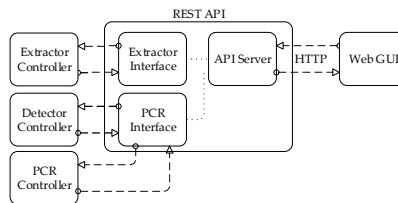
### hardware system architecture



- Nucleic acid extraction unit operates based on magnetic bead based DNA extraction protocol
- Cartridge is divided to each chamber that are placed samples, magnetic beads, reagents used in the protocol
- Up to 4 fluorescence can be obtained using Led, excitation filter and emission filter.
- Disposable PCR chip amplifies DNA by controlling the temperature.

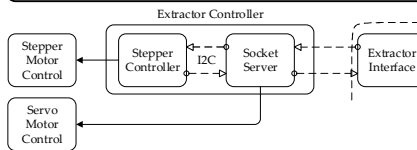
## Result

### API server software block diagram



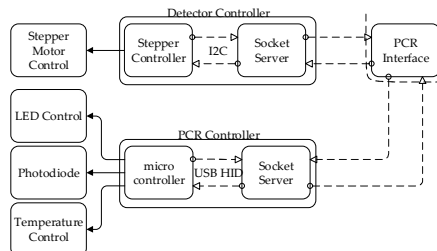
- It is divided into Extractor Controller, PCR Controller, and Detector Controller according to the function
- Each interface is an API Server thread
- API server communicates with web GUI through web API

### extractor controller software block diagram



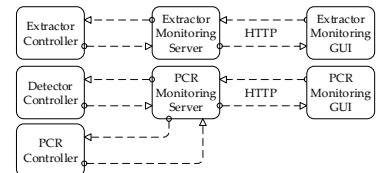
- Stepper Controller is driver of stepper motor
- Stepper Controller consists of L6470 and SC18IS602B
- Socket Server uses GPIO to control servo motor

### PCR controller and detector controller software block diagram



- Detector Controller rotates the Filter Wheel by using a stepper motor
- The PCR Controller uses a micro controller to control the temperature of the PCR chip, controls the LED, and detects fluorescence with a photodiode

### Monitoring software block diagram



- Each controller is connected to the Extractor Monitoring Server and PCR Monitoring Server according to the function
- Each monitoring server can operate independently of the API server
- Monitoring servers can use external servers such as python's Jupyter Server
- Monitoring servers can be combined or separately configured according to the situation

## CONCLUSIONS

- Web-based UI that can be used in various environments
- Easy maintenance, equipment operation and monitoring
- Independent execution of each function is possible
- It is possible to monitor the detailed functions of the equipment
- Easy migration to IIoT equipment