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Saliva Sample-based BARTLAB-MPH Robotic Testing System for COVID-19 Detection

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***Abstract*—The BARTLAB-MPH robotic testing system was created by a collaboration between the Center for Biomedical and Robotics Technology (BART LAB) and the Department of Medical Sciences, Ministry of Public Health (MPH). It was developed with the goal of reducing the risk of contracting COVID-19, which is a life-threatening epidemic that can often be detected in body secretions such as saliva and mucus, so when the epidemic conditions of the COVID-19 virus pass in the future, having this robotic viral detection system can be applied to other epidemic viral genome detection systems in pool and individual Reverse Transcrip- tion Polymerse Chain Reaction(RT-PCR) assays. addressing the need for increased speed and accuracy in service and diagnostics, including cost reduction and efficient use of human resources. It also helps reduce the costs of the government and private sector, including those of the people who use the service.**

***Index Terms*—COVID-19, Saliva Detection, Reverse Transcription Polymerse Chain Reaction**

I. Introduction

Worldwide, there are three types of COVID-19 detection, including Reverse Transcription PCR[1] , Rapid Antigen Test[3], and Rapid Antibody Test[4]. The RT-PCR will be divided into subdivisions which are the Nasopharyngeal swab, saliva collection[2], and oropharyngeal swab. Of the three methods, saliva collection was chosen by the Department of Medical Sciences as the primary method of proactive sampling in community areas at risk of outbreaks. This can help reduce the risk of healthcare professionals having to swab patients by switching to having the patient spit into a container themselves. When a sample container is delivered to the research lab for inspection, Originally, it was necessary to have specialist staff to separate and transfer saliva to test tubes until the pathogen was rendered incapable of spreading. This forced this part of the staff to work under high pressure with a high chance of infection despite being protected in a sterile cabinet. The Center for Biomedical and Robotics Technology (BART LAB) is introducing robotics to replace these high-risk procedures. by developing a COVID-19 testing system. From saliva using the ABB Yumi robot, he took over as a specialist staff member to reduce the risk.

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II. Material and Method

A. Collaborative Robots

A collaborative robot (cobot) is a machine that can securely working closely with a human or its operator. The primary consideration in the design of cobots is operator safety. So, ABB Yumi is used in this work because it is a dual-arm cobot that has lightweight padding, no pinch point, and back-drivable brakes.

B. Automatical system and Medical device controller

The newly created cap opener, tube holder, and pipette holder [Fig.1] can communicate with the ABB Yumi robot to control itself autonomously. Six servo motors and two additional linear actuators make up the cap opener and tube holder, which is powered by current and enables the bottle to be squeezed and capped on two tubes at once to aid in the transmission of saliva. Two tiny linear actuators that are current set up make up the pipette holder, which allows volumetric pressure to be supplied to the pipette that holds 300 microliters on demand.

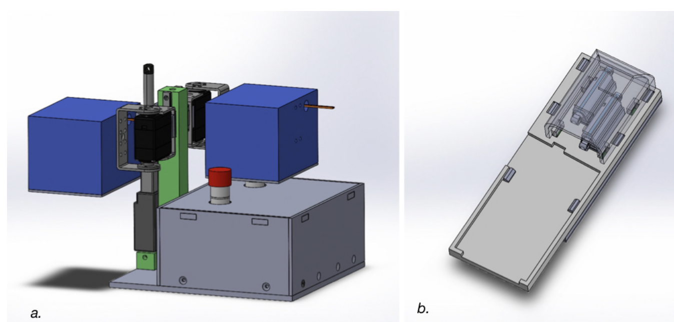

Fig. 1. Cap opener and tube holder (a.), Pipette holder (b.)

C. BARTLAB-MPH robotic testing system

The BARTLAB-MPH robotic testing system has 2 modes: pool mode and direct mode. In pool mode [Fig.3], five samples are combined into a single tube, mixed, and then pipetted into the well plate. In situations where the virus is not widely transmitted by locating sick individuals in low-intensity areas, this technique is utilized to decrease the need for chemicals. in a direct mode. When the QR code scanning tube is in place, the saliva pipette is applied directly to the well plate. This mode is useful in terms of knowing that the vast majority of people who come for testing are infected.

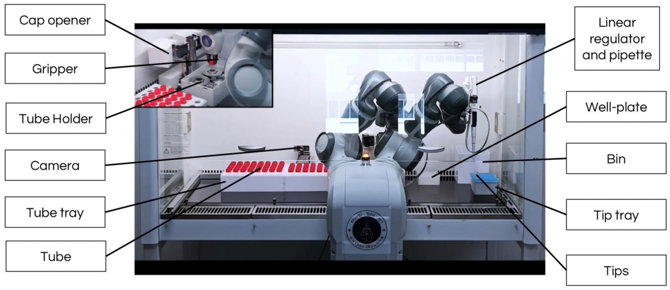

Fig. 2. BARTLAB-MPH Robotic Testing System Components

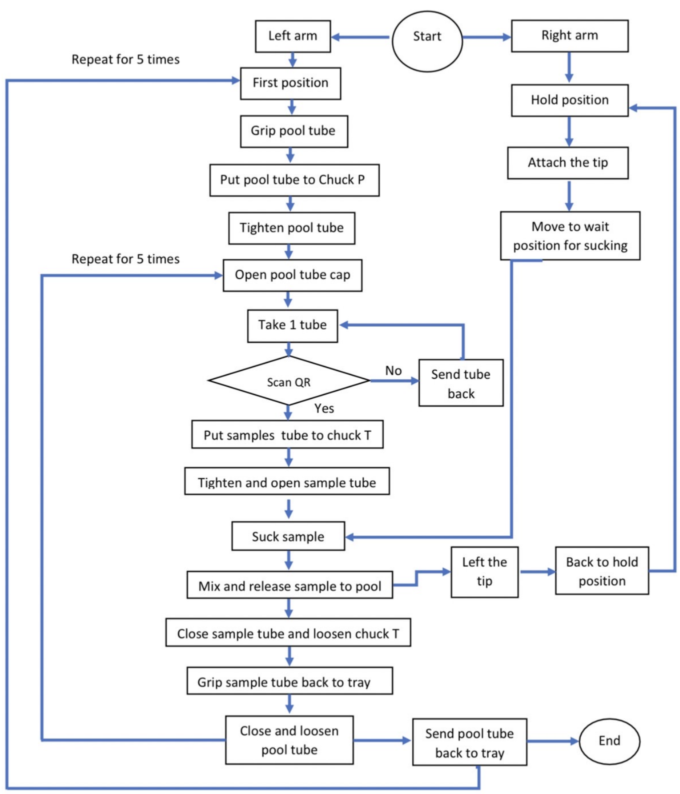

Fig. 3. The process of the pool mode.

D. Experiment Setup

At this point, we take an experiment setup at the department of Medical Sciences, MPH, Thailand from 4th January to 26th April 2022. which separated the tasks of this evaluation into 3 tasks, including Task 1 is Error Detection, Task 2 is Time-Consuming between the traditional way and BARTLAB-MPH, and Task 3 is Total percent of System Reliable overall for BARTLAB-MPH.

III. Result and Discussion

The BARTLAB-MPH robotic test system was evaluated and described in the Department of Medical Sciences. The Ministry of Public Health, Thailand, from January 4 to April 26, 2022, a total of 240 cycles, and the results showed that the system was reliable for overall operation. It has a success rate of 64.17 percent on average, and system errors are typically less than 10 percent. This technique also reduces the total process time by about 30 to 40 percent.

IV. Conclusion

The BARTLAB-MPH robotic testing system may be another option at this time to help the medical community and improve the effectiveness and rate of COVID-19 detection from saliva in Thailand, but it still has some long-term maintenance requirements because it has some unique mechanical parts that are difficult to find for a replacement.

Acknowledgment

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