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Original Article

The Innovation for Smart Patient Screening Platform via IoT System

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Abstract – *COVID-19 pandemic has a huge impact and can cause problems all the time. Therefore, patients who need to be treated at the hospital are required to undergo an initial at the outpatient department (OPD), and this screening must not come into contact with the staff, nurses or doctors to prevent spreading germs to each other. Based on this, this research is to develop the innovation for smart patient screening platforms via the Internet of Things (IoT). The action research instrument was divided into four functions and automated patient screening such as systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse oximeter digital fingertip (SPO2), temperature and scall between weight and high for patients. The conclusion is that for evaluating the functionality of the tool and patients, a total of 30 patients will use a questionnaire that has passed the standard of ISONORM 9241/110. This research method makes it possible to send real-time data through the mobile phone with IoT line applications and confidence in the use of more than 99.83% and also does not cause infection disease with each other, as well as convenient and easy to use in hospital for screening patients.*

Keywords — *Internet of Things, Automatic patient screening, Environment monitoring, Smart OPD.*

I. INTRODUCTION

Currently, COVID-19 cases have emerged and have spread across all countries, causing the World Health Organization (WHO) to campaign to prevent this virus from spreading from person to person. But at the same time, there will be an increasing number of patients and patients who need to go to the hospital for treatment. But the protection of the many patients to come to the hospital for treatment at the OPD department, it is necessary to do a preliminary screening of patients in order to screen the patients from beginning germs into the community and the rapid spread of germs [6]. We have attempted to create a comprehensive conceptual model to represent the factors to be designed and considered assistive technology (AT) or when developing a service delivery system. Our model is to help humans, technology, the environment, assistance, and activity. Research has a policy for AT, and the design has been processed to risk denial the hospital. Technology is used by AT to accomplish some task or to perform an activity. Activity is a key factor in determining participation in society. Nearly all of us need assistance at some point in our lives. After ever a little service delivery experience, people learn quickly that families and, in some cases, paid assistants are necessary for a significant number of people with disabilities. Smart patient screening has preliminary patient screening tools such as temperature measurement pressure measurement as well as the weight of the patient. Currently, there is no way to prevent infection because the patient work and transmission of information is still taking notes and touching the patient, allowing the existing germs to spread in a timely manner. Therefore, this research aims to prevent the transmission of pathogens while patients are screened [4]. However, smart patient screening invented and developed the work of screening patients through the IoT system. When the patients come to the screening machine, and then the machine can work automatically and then the machine operation of the process will send data via anto.io and transfer to firebase with IoT system [2],[3]. So that staff or nurses do not have to directly contact the patient and can get accurate information as well as be able to keep the history of all patients as well. The results of the testing of the device on patients at the hospital. The tests were divided into two types, namely, testing with a test machine and having the patient test with a questionnaire to find out how much error the machine was using. The test was divided into a total of 30 patients. Patients were divided into 15 males and 15 females, and this assessment was based on ISONORM 9241/110 standard and tests showed that 98% of patients and the tests via questionnaire showed up to 99% then the results of the test and the satisfaction of the tester with the most satisfaction. In the proposed system, the patient will scan the QR code from the patients mobile phone, after which the patient history will be transferred from the system through th online system to the hospital machine. The patient stood at the machine to the hospital machine. The patient stood at the machine to weigh, height measure, temperature and check blood pressure. The machine can record the work immediately, making it convenient, quickly and without touching each other, preventing the spread of disease. The results in the highest quality and most effective tools for patient screening. This research can be used to expand the machine in various hospitals to reduce the number of infections and transmission of germs in the future.

This paper is presented as follows. In section II, the research method of the innovation smart patient screening platform via IoT system is presented. Anto.IO and Firebase, IoT and control system are presented in section III, and In section, IV presents evaluation, results and conclusion are presented.

II. RESEARCH METHOD

A. Hardware Design

The structural design of the patient screening cabinets is designed for ease of access. It is designed to be suitable for both male and female patients. It will be a structure with a cabin size 1200 * 1200 mm. and 2000 mm. high. The side is composed of clear glass on 3 sides. The bottom section can be divided as follows, No.3 contains a load cell to weigh the patient. No1 is a sensor to measure the patient. No.2 is divided into a blood pressure and pulse oximeter digital fingertips. No.4 is an LCD display area and sends real-time values through the IoT system to display the mobile phones of patients and hospital staff.

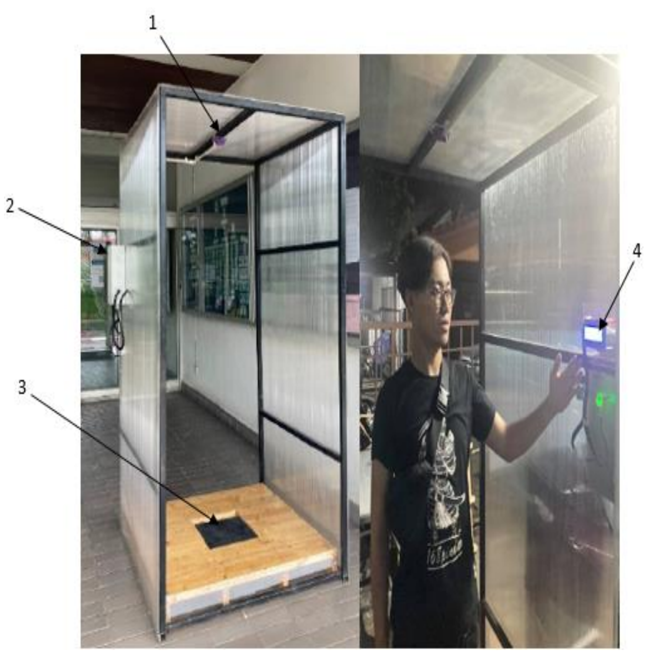

Fig. 1 Smart Patient Screening Platform

The smart patient screening platform has consisted of detail below:

1. sensor for detecting the height of the patient
2. blood section
   - systolic blood pressure (SBP)
   - diastolic blood pressure (DBP)
3. pulse oximeter digital fingertrip (SPO2)
4. loadcell for detecting the weight of the patient

Loadcell is a sensor measuring weight and mechanical action or the amount of load that need to be known by using the strain gauge to be installed in the area that has changed the shape of the load cell when the force acts on the load cell will cause the strain gauge stuck in the areas of deformation. Stretch of shrink, causing the resistance valve at the strain gauge to change.

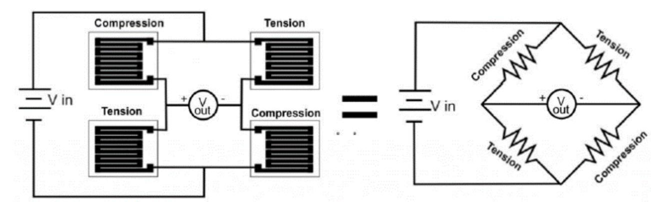

Fig. 2 Wheatstone bridge

As shown in the picture, the point where the strain gauge receives a lot of pressure will cause the strain gauge to shrink together, and at the point of tension will cause the strain gauge to be stretched, causing the resistance value of the strain gauge to change [9]. The four strain gauge on the load cell, as shown in the picture, then the point where the strain gauge receives a lot of pressure are connected together in the manner of the wheatstone bridge circuit.

B. Microcontronller and Electronics Devices

For control unit, it consists of a microcontroller and various electronic devices.

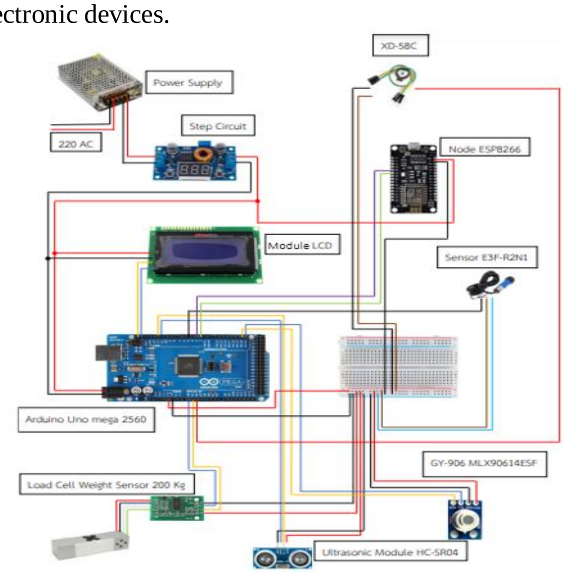

Fig. 3 Control system of the smart patient screening platform

This microcontroller in the system uses Arduino MEGA 2560 as a control unit for the whole system and will control the input and output parts [7]. The input consists of an Arduino ESP8266 to display the IoT system, sensor and load cell can check temperature, height and weight of a patient, a blood section, a patient blood pressure and a pulse oximeter digital. The patient finger the trip, the output side consists of an LCD display.

Table1. System Hardware Components

Hardware Name	***Hardware Description***
1. Arduino MEGA 2560	- Operating voltage: 5V - Digital I/O pins: 54 - Analog input pins: 16
2. Arduino ESP8266	- Micro-USB, 3.3V, GND, Vin - GPIO1 to GPIO16 - I2C Pins
3. Loadcell	-Weight sensor 200 kg -Wheatstone Bridge
4. sensor	-Ultrasonic HC-SR04 -Distance:2-80 cm.
5. Module LCD	-LCD 20*4
6. Step drive	-Step down -IC78xx/317
7. Power supply	-5VD, 12VDC
8. Pulse hard rate	-XD-58C - Operating voltage:3V,5V

C. Internet of Things

Currently, writing software in the IoT system is transmitted through firebase medium, with has a feature that is real-time and can record data. In applications, firebase is an online database service. Most applications require a database to do this. As for the API, firebase is not based on a specific language. If any language does not have a library available, the rest APIs can be used to request data (GET) or send data (PUT).

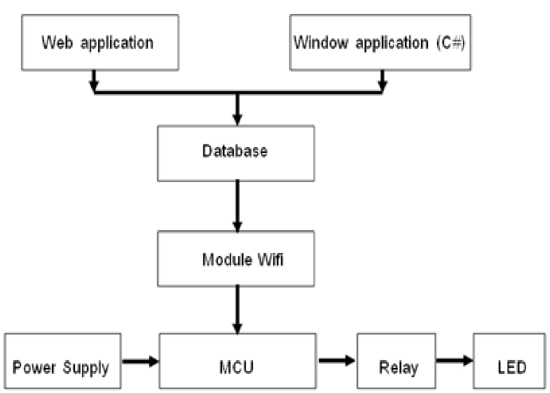

Fig. 4 Shows the Browser Interface and Controls

As for the firebase console, it uses 3 languages to write software to be passed to firebase and can communicate to control devices such as hypertext mark-up language (HTML), Cascading Style Sheets (CSS) and JavaScript (JS).

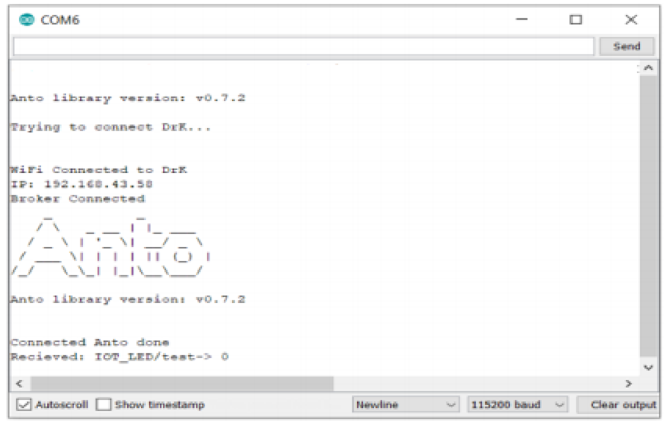

Fig. 5 Software connected with Anto.IO platform

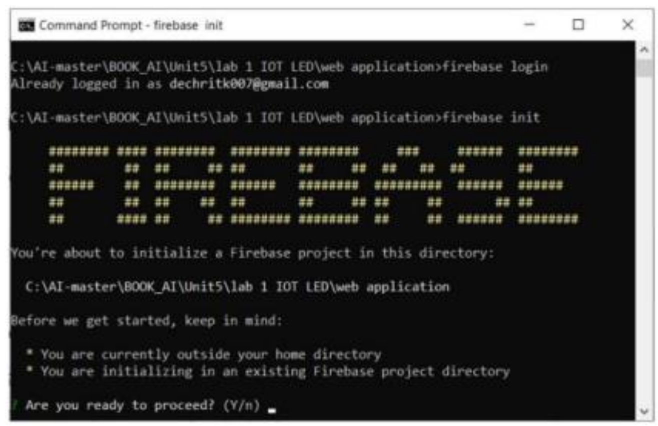

Fig. 6 Software connected with firebase platform

a) LCD **b) Mobile Phone**

Fig. 7 IoT System

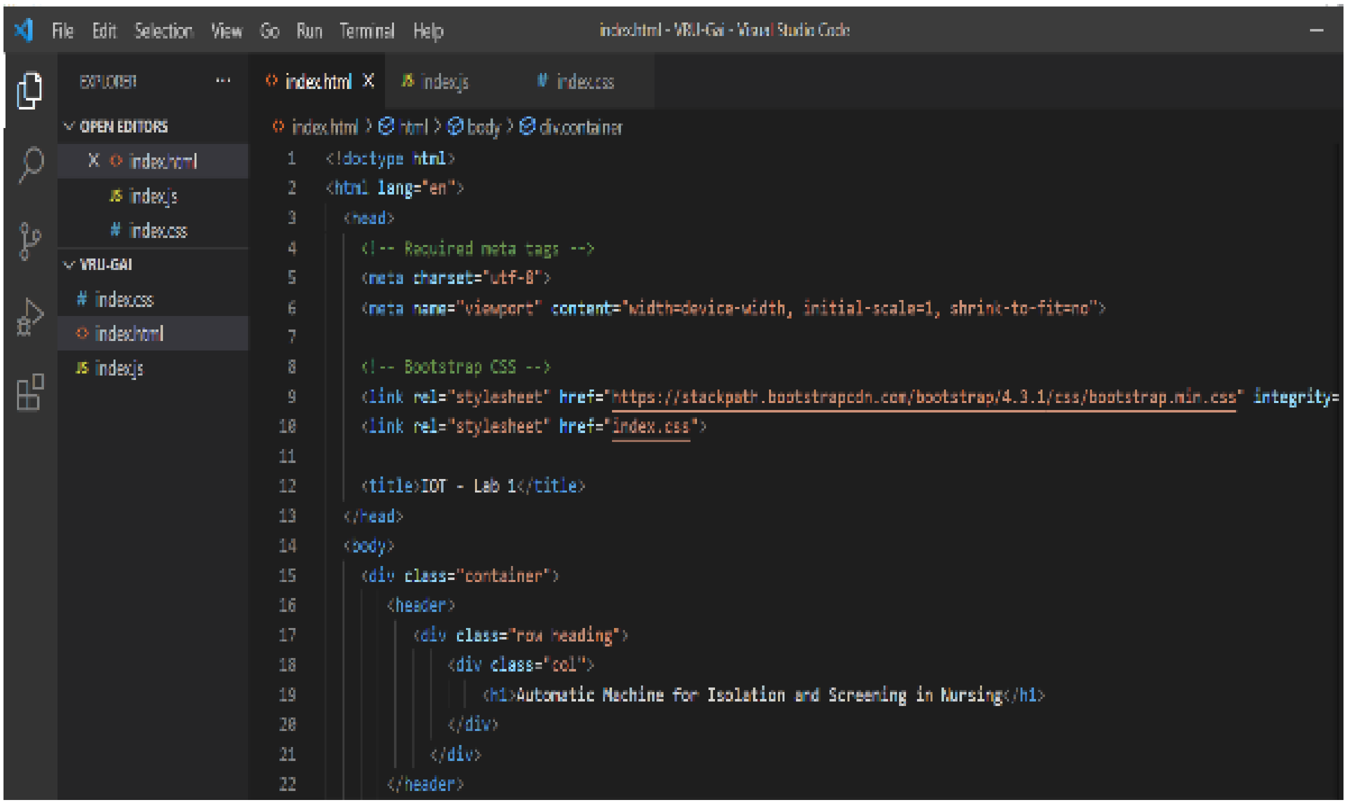

Fig. 8 HTML Language

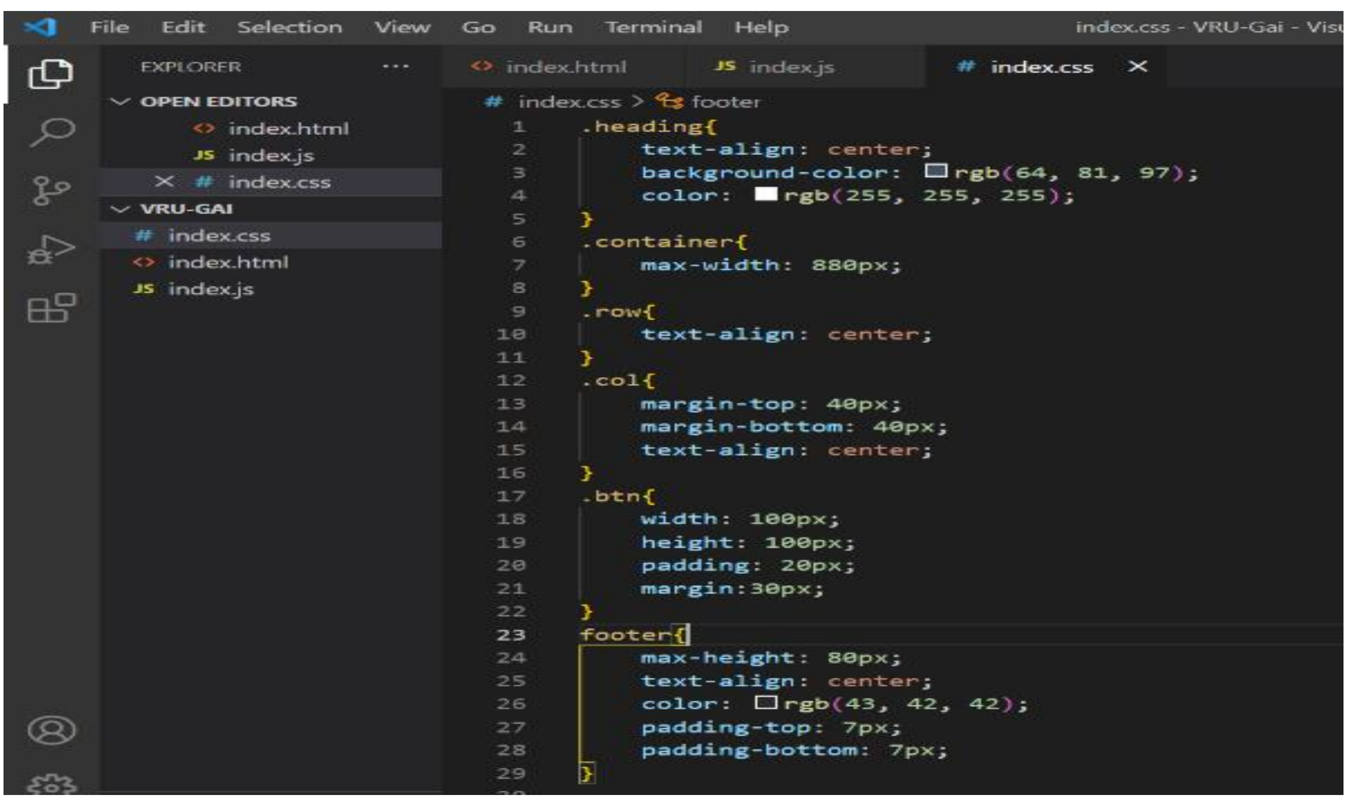

Fig. 9 CSS Language

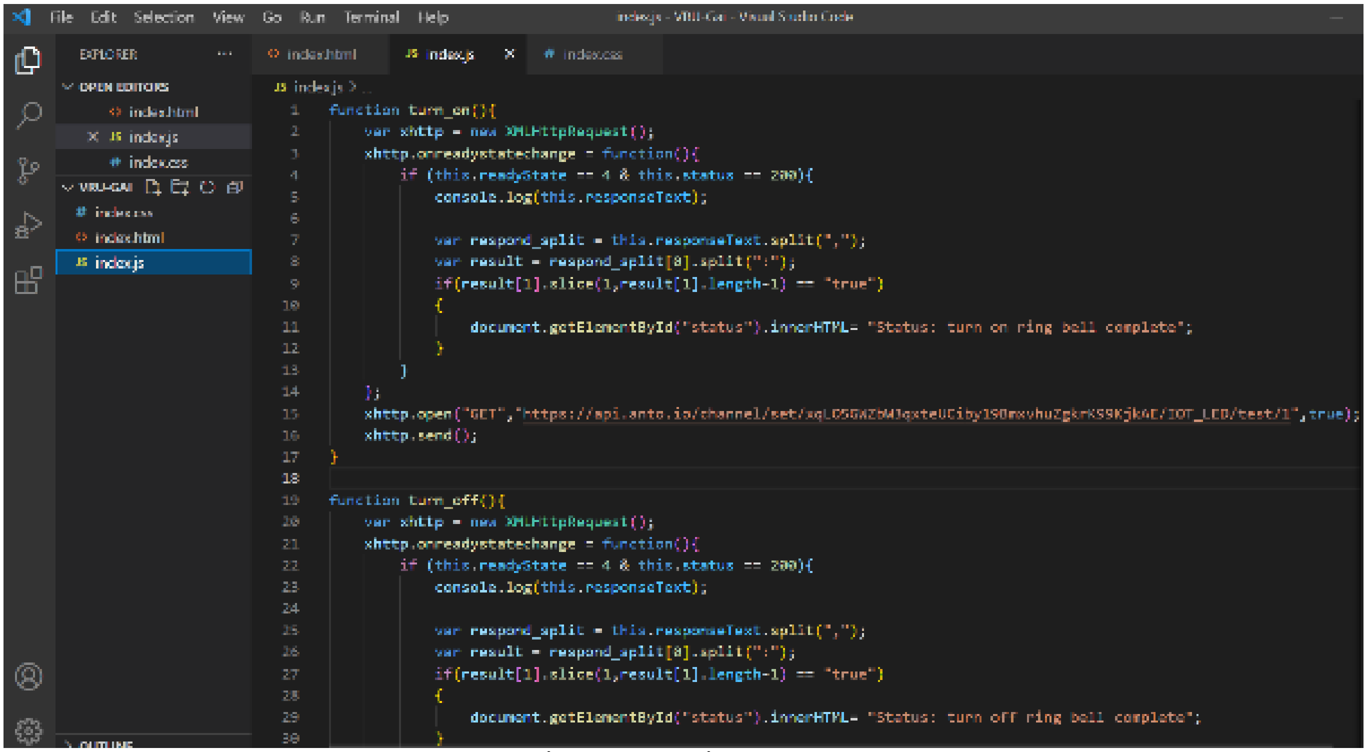

Fig. 10 JavaScript Language

Fig. 11 C++ Language

D. Patient Testing and Diagram

The basic screening test for the patient is examined as shown in Figure 8 as follows: 1) When the patient enters the cabinets, the sensor signal system will detect and send a signal to the control unit to spray the solution that the patient before walking into the closet. 2) The patient will stand at the midpoint of the screening device. After that, the patient will touch the sensor on the side to detect the temperature. At the height of the patient immediately. But if the patient is standing with his arm out of position or moving his arm back and forth, the sensor will not be able to read the value. 3) When the patient has already checked the various values must walk out of the cabinet and pass another sensor on the output side. This will cause the UV lamp to be attached to kill or clean the germs immediately.

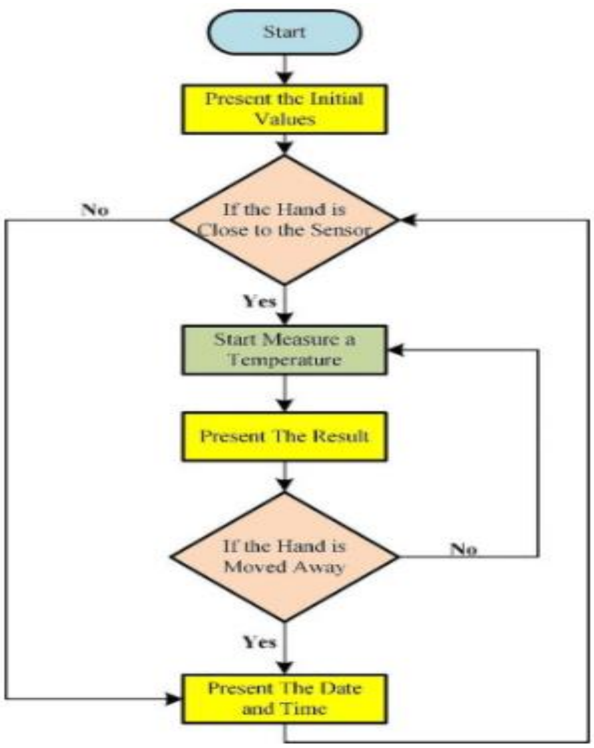

Fig. 12 The operating of smart patient screening

III. EXPERIMENTAL AND RESULTS

This patient screening tested the functionality of the instrument to ensure the instrument reliability, and the actual measured values were compared with repeated testing to get the value for this tool. The test can be divided into several characteristics are follows: 1) temperature measurement test of both meal and female patients, as shown in Figure 14-15. 2) test measuring the height and weight of both male and female patients, as shown in Figure 16-19. 3) test group of people temperature, as shown in Figure 20 4) test pulse oximeter digital finger trip (SPO2), as shown in Figure 21. 5) test systolic blood pressure (SBP) and diastolic blood pressure (DBP), as shown in Figure 22-23.

a) Male Screening **b) Female Screening**

Fig. 13 Patient Screening

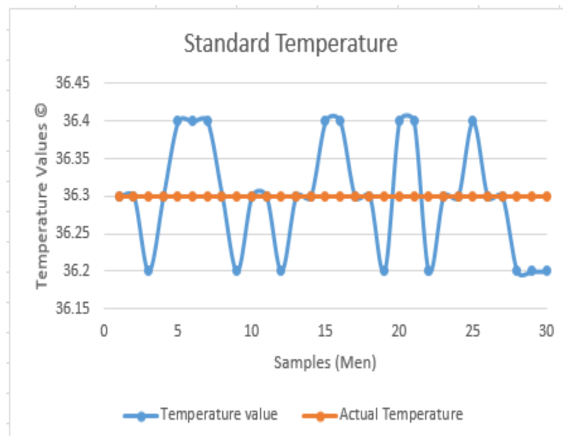

Fig. 14 Comparison Standard Temperature for Male

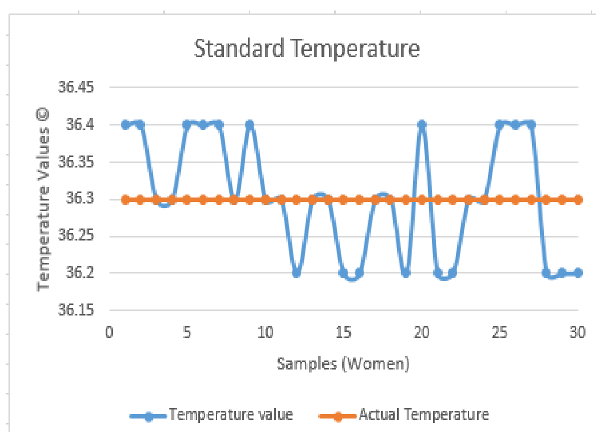

Fig. 15 Comparison Standard Temperature for Female

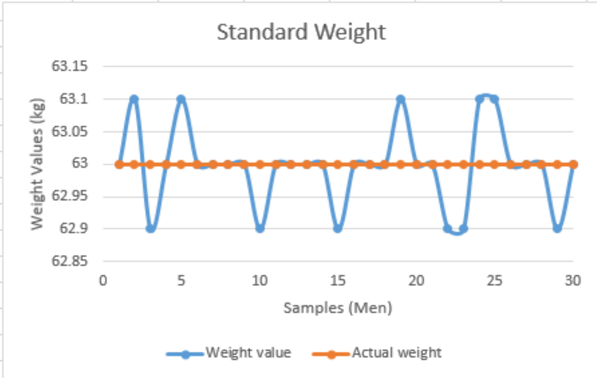

Fig. 16 Comparison Standard Weight for Male

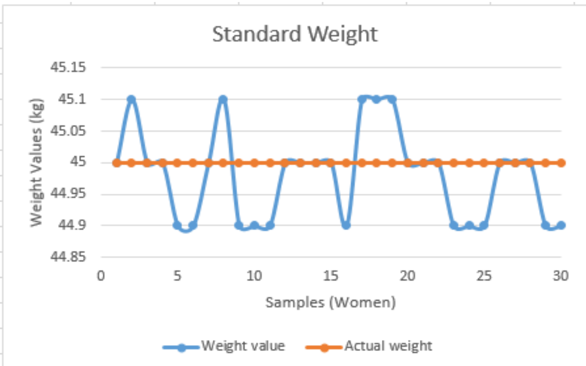

Fig. 17 Comparison Standard Weight for Female

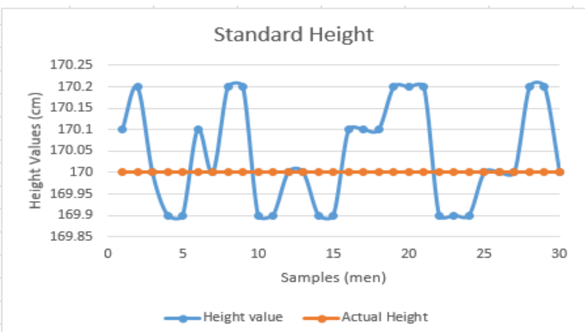

Fig. 18 Comparison Standard Height for Male

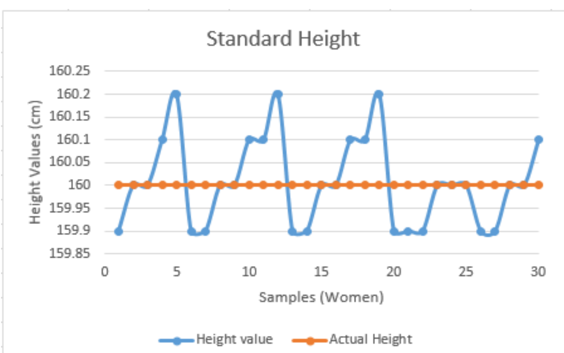

Fig. 19 Comparison Standard Height for Female

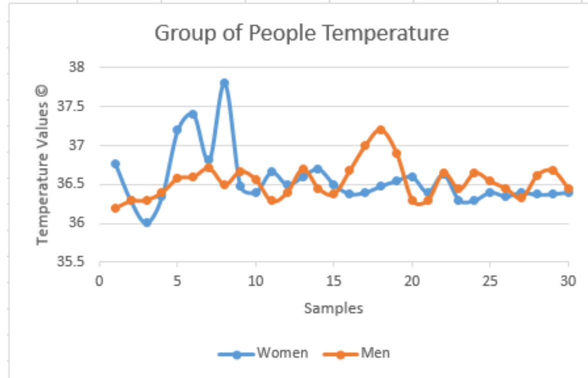

Fig. 20 Comparison Group of People Temperature

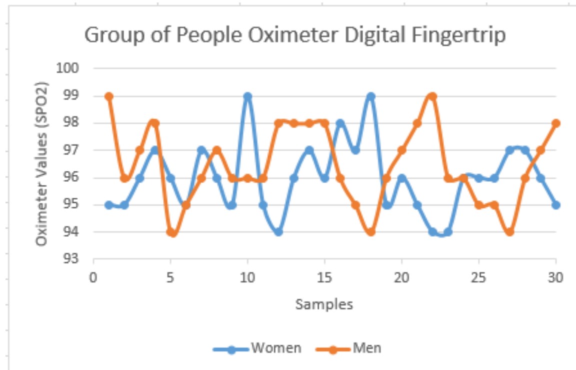

Fig. 21 Comparison Group of People Oximeter

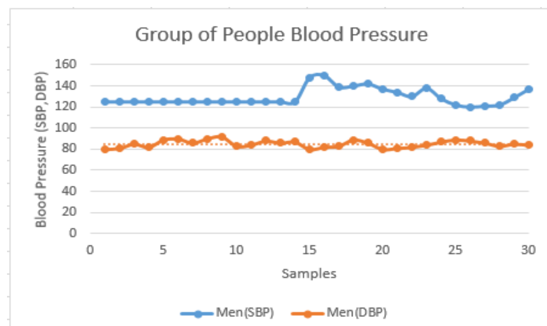

Fig. 22 Comparison Group Blood Pressure for Male

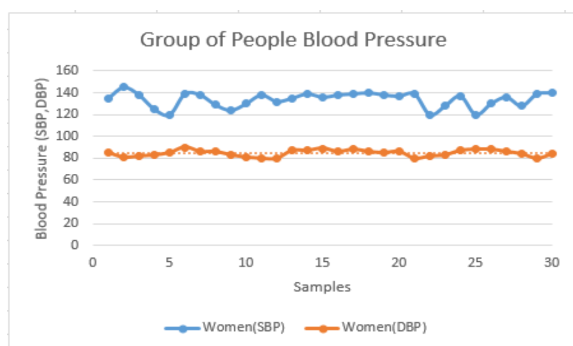

Fig. 23 Comparison Group Blood Pressure for Female

Table2. Calculation Results for Temperature

T-1	T-2	T1-M(T1)	T2-M(T2)	$(T1-M(T1))^2$	$(T2-M(T2))^2$	(T1-M(T1))*(T2-M(T2))
36.30	36.40	-0.69	0.04	0.476	0.0016	-0.0276
36.30	36.40	-0.69	0.04	0.476	0.0016	-0.0276
36.20	36.30	-0.79	-0.06	0.624	0.0036	0.0470
36.30	36.30	-0.69	-0.06	0.476	0.0036	0.04140
36.40	36.40	-0.59	0.04	0.348	0.0016	-0.0236
36.40	36.40	-0.59	0.04	0.348	0.0016	-0.0236
36.30	36.40	-0.69	0.04	0.476	0.0016	-0.0276
36.20	36.30	-0.79	-0.06	0.624	0.0036	0.0470
36.20	36.40	-0.79	0.04	0.624	0.0016	-0.0316
36.30	36.30	-0.69	-0.06	0.476	0.0036	0.0414
$\Sigma = 369.90$ M(T1):36.990	$\Sigma = 363.60$ M(T2):36.360			SUM:5.09	SUM:0.024	SUM:0.0428

Table3. Calculation Results for Height

H-1	H-2	H1-M(H1)	H2-M(H2)	$(H1-M(H1))^2$	$(H2-M(H2))^2$	(H1-M(H1))*(H2-M(H2))
170.10	170.10	0.08	0.05	0.006	0.0025	0.0004
170.20	170.20	0.18	0.15	0.032	0.0225	0.0270
170.00	170.00	-0.02	-0.05	0.004	0.0025	0.0010
169.90	169.90	-0.12	-0.15	0.014	0.0225	0.0180
169.90	169.90	-0.12	-0.15	0.014	0.0225	-0.0180
170.10	170.10	0.08	0.05	0.006	0.0025	0.0004
170.00	170.00	-0.02	-0.05	0.004	0.0025	0.0010
170.20	170.20	0.18	0.15	0.032	0.0225	0.0470
169.90	170.20	-0.12	0.15	0.014	0.0225	0.0270
169.90	169.90	-0.12	-0.15	0.014	0.0225	0.0180
$\Sigma = 1700.20$ M(H1):170.02	$\Sigma = 1700.50$ M(H2):170.05			SUM:0.14	SUM:0.1237	SUM:0.1398

Table4. Calculation Results for Weight

W-1	W-2	W1-M(W1)	W2-M(W2)	$(W1-M(W1))^2$	$(W2-M(W2))^2$	(W1-M(W1))*(W2-M(W2))
63.00	45.00	-0.01	0.03	0.001	0.0009	-0.0003
63.00	45.10	-0.01	0.13	0.001	0.0016	-0.0013
63.00	45.00	-0.01	0.03	0.001	0.0009	-0.0003
62.90	44.90	-0.11	-0.07	0.0012	0.0004	0.0070
63.00	45.00	-0.01	0.03	0.001	0.0009	-0.0003
63.00	45.10	-0.01	0.13	0.001	0.0001	-0.0013
63.00	44.90	-0.01	-0.07	0.001	0.0004	0.0007
63.10	44.90	0.09	-0.07	0.008	0.0004	-0.0060
63.00	44.90	-0.01	-0.07	0.001	0.0004	0.0007
63.00	44.90	-0.01	-0.07	0.001	0.0004	0.0007
$\Sigma = 630.10$ M(W1):63.01	$\Sigma = 449.70$ M(W2):44.97			SUM:0.1017	SUM:0.0006	SUM:0.0185

When considering table 2 of the standard temperature, it can all be utilized.

- $T2$ value
  $\Sigma = 363.60$
  $Mean = 36.36$
  $\Sigma(T2 - M(T2))^2 = SS(T2) = 0.024$
- $T1$ and $T2$ combined $N = 10$
  (10 values out of a total 30 averages)
  $\Sigma(T1 - M(T1))(T2 - M(T2)) = 0.00428$
- r Calculation
  $r = 0.00428 / (\sqrt{(5.09)} * \sqrt{(0.024)}) = 0.1224$

Table 3. calculation results for height is computed to be.

- $H2$ value
  $\Sigma = 1700.50$
  $Mean = 170.05$
  $\Sigma(H2 - M(H2))^2 = SS(H2) = 0.1237$
- $T1$ and $T2$ combined $N = 10$
  (10 values out of a total 30 averages)
  $\Sigma(H1 - M(H1))(H2 - M(H2)) = 0.1398$
- r Calculation
  $r = 0.1398 / (\sqrt{(0.14)} * \sqrt{(0.1237)}) = 1.063$

Then, table 4. Calculation results for weight provided.

- $W2$ value
  $\Sigma = 449.70$
  $Mean = 44.97$
  $\Sigma(W2 - M(W2))^2 = SS(W2) = 0.0006$
- $T1$ and $T2$ combined $N = 10$

(10 values out of a total 30 averages)

$$\Sigma(W1-M(W1))(W2-M(W2))=0.0185$$

- r Calculation

$$r=0.0185/(\sqrt{0.1017}*\sqrt{(0.0006)})=0.0079$$

IV. CONCLUSIONS

The innovation for smart patient screening platform via IoT system has been developed for screening patients for the COVID-19 disease, which has spread rapidly today. Currently, this machine has been used for examination at the hospital by testing the device before applying it to the patient examination with the following results: 1) temperature measurement for a male and female patient, x = 30 then efficiency was 99.83%.

2) height measurement for a male and female patient, x = 30, then efficiency was 99.70%. And 3) weight measurement for a male and female patient, x = 30, then efficiency value is 99.99%, respectively. Overall, the values can be transmitted through the IoT system as well, and the machine can be used conveniently and quickly as well as having the highest efficiency in checking the patient at all times.

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