Sensor-based secured real-time intelligent health monitoring and alert system using IoT

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***Abstract*— From the last ten to fifteen years the lifestyle of the whole human being has become so much concerned that they don't get time even to take food or sit down to relax for some moment and for this reason the well-being of every humankind gets neglected nowadays. But in this increasing era of technology, the more humankind is becoming developed day by day the more the nature around us is changing like pollution, climate change, etc. which are becoming a threat to humankind and also from 2020 a new bad time named COVID added to humans which brought a pause to human daily lifestyle. So, in this environment, humans have to take care of their health in a proper way. Then for our today's technology- based smart lifestyle we need some smarter way to look after our health and for this, we designed this device through which people can take care of their health along with their family members because some time there stays some old or paralyzed person in the home but for them always it is not possible to call or say other home members about their problems or some abnormality happening to their body so this device can help them to inform their family members to say their problems. Also, it can help doctors or nurses to monitor patients all 24 hours. Thus, this device will help the whole of mankind to superintend their and their family members' well-being.**

Keywords— Real-time, IoT, Health monitoring

I. INTRODUCTION

In this era of the twenty-first century humans are so fast and so busy from day to night. People get out of their house early in the morning and return home late at night from work. So, people also cannot get time to take care of their health. But every human being has to take proper care of his or herself and also of their family members especially of children and old persons. But maximum time in some cases all of the young family members who have to take care go out for their workplace like school, colleges, offices, etc. for an almost full day and there will no one to take care of children or old persons and also always keeping a nurse or a babysitter in the house is not possible for everyone and also getting busy in work for the whole day people who work outside, they cannot take care of their health and in this way, human healthcare comes neglected day by day. On other hand keeping ourselves healthy is most important and most necessary. Because in this current situation of COVID and also in this modern era where pollution is the most there, keeping ourselves healthy is much more important than any other work. And also, in our busy daily routine most of the time we have to take lunch, breakfast, etc. outside where food is left in the open air. So, in this situation, we have to look after our health more importantly without any fail. So, when our daily lifestyle is becoming busier and smarter day by day with high technology then we have to search for a smarter way of caring for our health. So, when there are smart appliances for every work, different types of mobile applications are there then also there should be a smart way out for health monitoring. This device is a smart health monitoring system where there will be band-like equipment where heart beat sensor, sweat sensor, oxygen level measuring sensor, measuring footstep, and calorie burn sensor will present. Also, if there will be any type of abnormality in anyone's body as soon as possible a message will be served to his or her mobile and also to his or her family members. In this way, people can take care of their own and their family members' health at any time even in between their work. Also, with the help of this device doctors or nurses can all time take care of any patients, especially paralyzed and cardiac patients. Because doctors or nurses can't take care of every patient every minute. So, this will be a smarter way to look after the well-being of every human being.

II. METHODOLOGY

A. STM32F407VGT6 M Cortex-M4 32bit MCU (Fig 1).

STM32 is the micro controller of high frequency which supports rapid data interpretation with the help of advance cortex score and enhanced data binding it contains up to 196 kb of secondary memory. It can provide two timing matric manipulation of data. The incorporated RAM of 1 Mb simulates high TensorFlow processing speed.

B. High Accuracy Temperature Sensor (Fig 2).

12C High Accuracy Temperature Sensor (MCP9808) MCP 9808 is a microchip integrated high accuracy module. It can measure temperature -40°C to 125°C and it is highly accurate. Also, through this sensor temperature can be sensed.

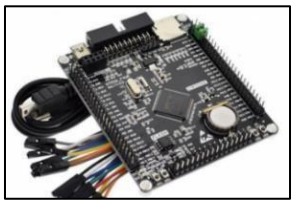

Fig. 1. M Cortex-M4 32bit MCU

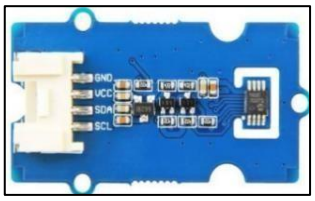

Fig. 2. Temperature sensor

C. MAX30100 Pulse Oximeter Heart Rate Sensor Module (Fig 3).

MAX30100 is an integrated pulse oximeter which can sense heart-beat. It gets its readings from two LEDs which emit two wavelengths- a red and an infrared and then with the help of photodetector measures the pulsing blood absorbance. MAX30100 can be operated in range of 1.8 to 3.3 V.

D. Pedometer Sensor Module (Fig 4).

DSPX01 can be used for 3D pedometer applications and it is made of 3 axes acceleration sensor. This sensor sense data from physical movements. At the time of walking or running it measures the steps and give the output as a high- level pulse. The output pulse is of 50ms width. This pedometer sensor works at 2.5-3.3 V.

Fig. 3. Pulse Oximeter Heart Rate

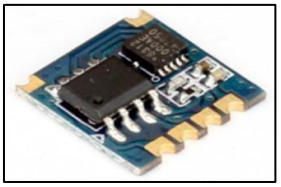

Fig. 4. Pedometer sensor Sensor.

E. Mini cellular GSM module (Fig 5).

Mini cellular GSM GPRS module helps us to access the internet connectivity and as well as the location. GSM module is a cellular based module.

F. 3.7V 5000mAH (Lithium Polymer) Rechargeable Battery Model (Fig 6).

This battery is thin, powerful and light and widely used in Bluetooth speaker, power bank, MP4 player, IoT and other industrial applications.

Fig. 5. Mini cellular GSM module

Fig. 6. 5000 mah battery

G. Sweat sensor (Fig7).

This sensor detects metabolize and biomarkers that is present in human sweat execrated by the skin and it automatically calculates the salt and humidity ratio of our skin. A higher version of this device may determine sweat glucose and blood glucose level of the investigating patient. This integrated circuit performs very efficiently with low voltage microcontrollers.

H. M131Loudspeaker (Fig 8)

It is an Arduino compatible speaker. It requires quite low power but gives high sound. It will be used as an alarm or buzzer here.

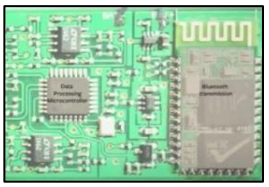

Fig. 7. Sweat sensor

Fig. 8. Loud Speaker

III. WORKFLOW DIAGRAM

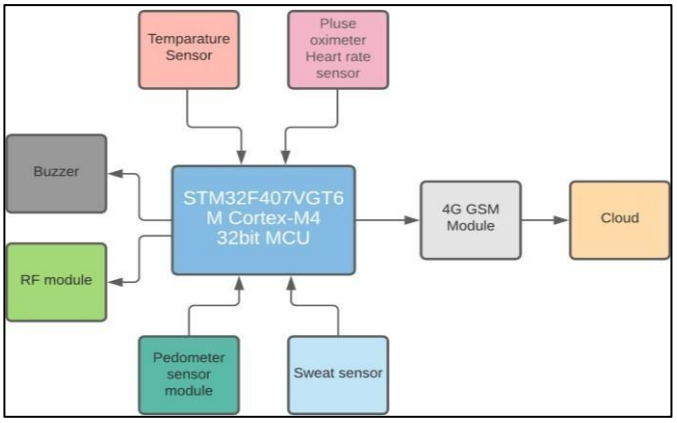

Fig. 9. Work Flow diagram

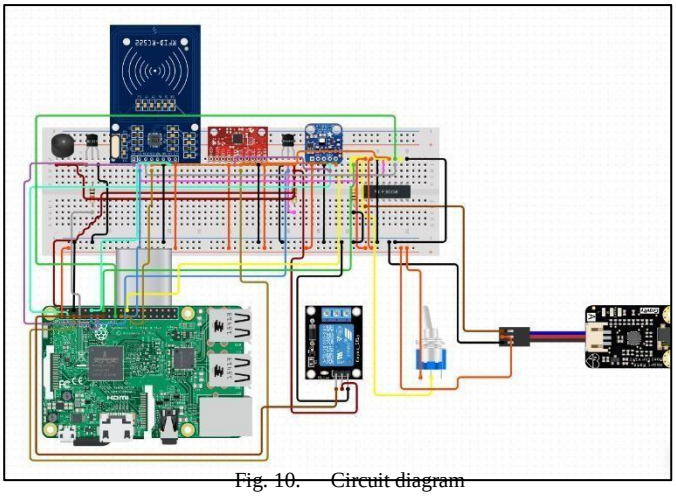

Fig. 10. Circuit diagram

IV. WORKING PRINCIPLE

The microcontroller used here is STM32F407VET6 Arm Cortex-M4 which will gather all the information body parameters from the attached sensors. The handy sensors like body temperature sensor, sweat analyzer, and BPM sensor will obtain power from the microcontroller and pass accurate digital values of sensors to the microcontroller and will process all the data with machine learning reinforcement algorithms which can interpret even the lowest suspicious data among large ratio. If the system will compare the incoming data with predefined values. If any abnormality is detected then the buzzer will come to action and thus will predict the upcoming danger. The module is also connected with could along with a 4G GSM that will provide the network. In the end, we can find all the details just by logging in to the cloud with any device authorized by the out network.

V. RESULT AND DISCUSSION

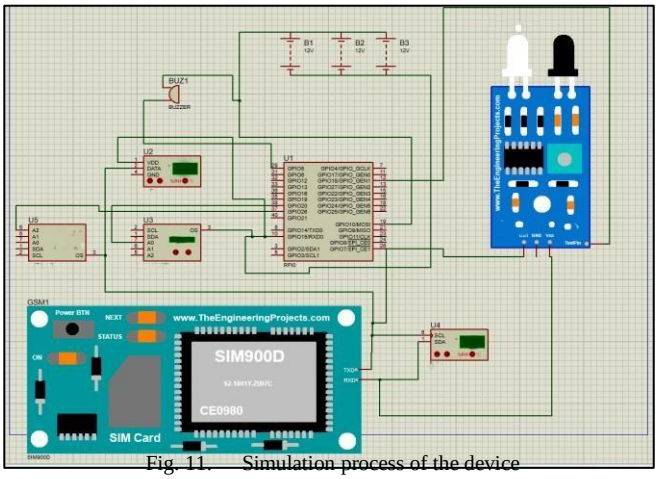

Fig. 11. Simulation process of the device

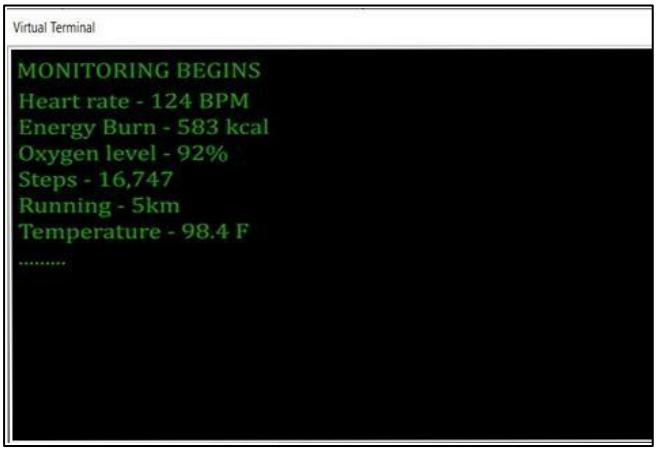

Fig. 12. Output of simulation

Sl. No.	Sub	Sample	Heart Rate	Body temp	Action
1	1	1	<60bpm	<36.1◦C	Message sent
2	1	2	<60bpm	<36.1◦C	Message sent
3	1	3	<60bpm	<36.1◦C	Message sent
4	1	4	<60bpm	<36.1◦C	Message sent
5	1	5	<60bpm	<36.1◦C	Message sent
6	1	6	<60bpm	<36.1◦C	Message sent
7	1	7	<60bpm	<36.1◦C	Message sent
8	1	8	<60bpm	<36.1◦C	Message sent
9	1	9	<60bpm	<36.1◦C	Message sent
10	1	10	<60bpm	<36.1◦C	Message sent
11	2	1	60 bpm	<36.1◦C	Message sent
12	2	2	60 bpm	<36.1◦C	Message sent
13	2	3	60 bpm	<36.1◦C	Message sent
14	2	4	60 bpm	<36.1◦C	Message sent
15	2	5	60 bpm	<36.1◦C	Message sent
16	2	6	60 bpm	<36.1◦C	Message sent
17	2	7	60 bpm	<36.1◦C	Message sent
18	2	8	60 bpm	<36.1◦C	Message sent
10	2	9	60 bpm	<36.1◦C	Message sent
20	2	10	60 bpm	<36.1◦C	Message sent
21	3	1	<60bpm	37◦C	Message sent
22	3	2	<60bpm	37◦C	Message sent
23	3	3	<60bpm	37◦C	Message sent
24	3	4	<60bpm	37◦C	Message sent
25	3	5	<60bpm	37◦C	Message sent
25	3	6	<60bpm	37◦C	Message sent
27	3	7	<60bpm	37◦C	Message not sent
28	3	8	<60bpm	37◦C	Message sent
29	3	9	<60bpm	37◦C	Message sent
30	3	10	<60bpm	37◦C	Message sent
31	4	1	65bpm	>37.2◦C	Message sent
32	4	2	65bpm	>37.2◦C	Message sent
33	4	3	65bpm	>37.2◦C	Message sent
34	4	4	65bpm	>37.2◦C	Message sent
35	4	5	65bpm	>37.2◦C	Message sent
36	4	6	65bpm	>37.2◦C	Message sent
37	4	7	65bpm	>37.2◦C	Message sent
38	4	8	65bpm	>37.2◦C	Message sent
39	4	9	65bpm	>37.2◦C	Message sent
40	4	10	65bpm	>37.2◦C	Message sent
41	5	1	66bpm	37◦C	Message not sent
42	5	2	66bpm	37◦C	Message not sent
43	5	3	66bpm	37◦C	Message not sent
44	5	4	66bpm	37◦C	Message not sent
45	5	5	66bpm	37◦C	Message not sent
46	5	6	66bpm	37◦C	Message not sent
47	5	7	66bpm	37◦C	Message not sent
48	5	8	66bpm	37◦C	Message not sent
49	5	9	66bpm	37◦C	Message not sent
50	5	10	66bpm	37◦C	Message not sent
51	6	1	>100bpm	<36.1◦C	Message not sent
52	6	2	>100bpm	<36.1◦C	Message sent
53	6	3	>100bpm	<36.1◦C	Message sent
54	6	4	>100bpm	<36.1◦C	Message sent
55	6	5	>100bpm	<36.1◦C	Message sent
56	6	6	>100bpm	<36.1◦C	Message sent
57	6	7	>100bpm	<36.1◦C	Message sent
58	6	8	>100bpm	<36.1◦C	Message sent
59	6	9	>100bpm	<36.1◦C	Message sent
60	6	10	>100bpm	<36.1◦C	Message sent
61	7	1	90bpm	<36.1◦C	Message sent
62	7	2	90bpm	<36.1◦C	Message sent
63	7	3	90bpm	<36.1◦C	Message sent
64	7	4	90bpm	<36.1◦C	Message sent
65	7	5	90bpm	<36.1◦C	Message sent
66	7	6	90bpm	<36.1◦C	Message sent
67	7	7	90bpm	<36.1◦C	Message sent
68	7	8	90bpm	<36.1◦C	Message sent
69	7	9	90bpm	<36.1◦C	Message sent
70	7	10	90bpm	<36.1◦C	Message sent
71	8	1	>100bpm	37◦C	Message sent
72	8	2	>100bpm	37◦C	Message sent
73	8	3	>100bpm	37◦C	Message sent
74	8	4	>100bpm	37◦C	Message sent
75	8	5	>100bpm	37◦C	Message sent
76	8	6	>100bpm	37◦C	Message sent
77	8	7	>100bpm	37◦C	Message sent
78	8	8	>100bpm	37◦C	Message not sent
79	8	9	>100bpm	37◦C	Message sent
80	8	10	>100bpm	37◦C	Message sent

81	9	1	90bpm	>37.2◦C	Message sent
82	9	2	90bpm	>37.2◦C	Message sent
83	9	3	90bpm	>37.2◦C	Message sent
84	9	4	90bpm	>37.2◦C	Message sent
85	9	5	90bpm	>37.2◦C	Message sent
86	9	6	90bpm	>37.2◦C	Message sent
87	9	7	90bpm	>37.2◦C	Message sent
88	9	8	90bpm	>37.2◦C	Message sent
89	9	9	90bpm	>37.2◦C	Message sent
90	9	10	90bpm	>37.2◦C	Message sent
91	10	1	90bpm	37◦C	Message sent
92	10	2	90bpm	37◦C	Message not sent
93	10	3	90bpm	37◦C	Message not sent
94	10	4	90bpm	37◦C	Message not sent
95	10	5	90bpm	37◦C	Message not sent
96	10	6	90bpm	37◦C	Message not sent
97	10	7	90bpm	37◦C	Message not sent
98	10	8	90bpm	37◦C	Message not sent
99	10	9	90bpm	37◦C	Message not sent
100	10	10	90bpm	37◦C	Message not sent

Accuracy 98%

VI. Conclusion

Through recent years humankind has changed from normal to technology-based and till now people are developing to spend their lifestyle in smarter than smarter ways and based on mankind's demand different kinds of smart devices and mobile applications are invented almost every day. There are different mobile applications and devices for almost every type of working like grocery, shopping, etc. and so here is also a device to look after people's health like this device will measure people's heartbeat, calorie burn, footsteps, oxygen level, etc. In this way, people who always get busy in work can also take care of his or her and their family members through a band like property where almost all body parameters measuring
sensors are present and through this device also doctors and nurses can sense any types of abnormality or problem creating in patients' body.

VII. Future scope

If the more advanced sensor is used the circuit can produce a more accurate result. By applying some modification, the circuit can be made more lite therefore it can be light weight. If this circuit can be implemented in a larger scale it will be lower price. This device can also be implemented in wrist,

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