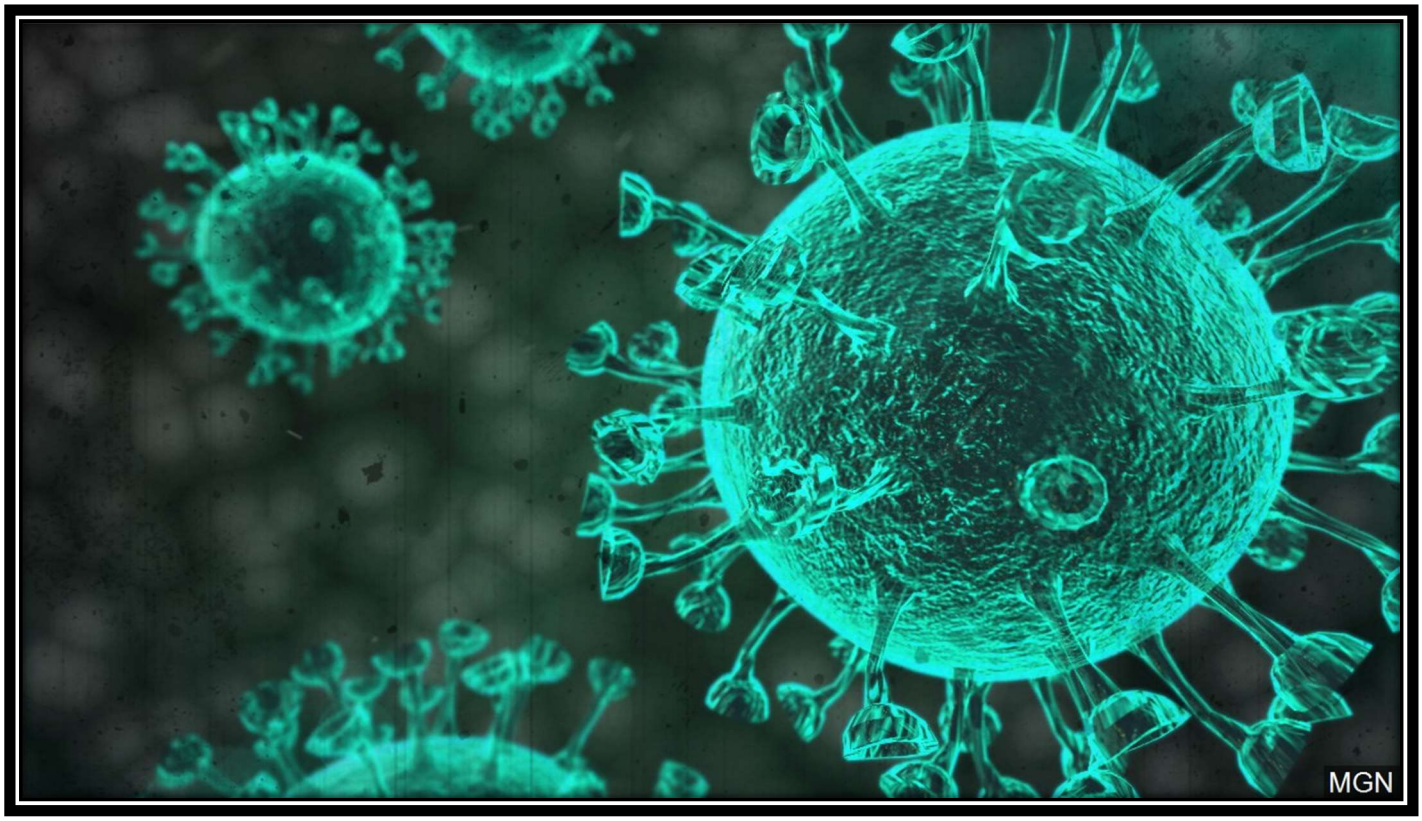
PROJECT IOT 2020/2021

Rapport

Covid 19 Patient Monitoring



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Summary

Introduction:

The World Health Organisation (WHO) has declared the coronavirus disease 2019 (COVID-19) a pandemic[1]. A global coordinated effort is needed to stop the further spread of the virus. A pandemic is defined as “occurring over a wide geographic area and affecting an exceptionally high proportion of the population.”[2].

On 31 December 2019, a cluster of cases of pneumonia of unknown cause, in the city of Wuhan, Hubei province in China, was reported to the World Health Organisation. In January 2020, a previously unknown new virus was identified [3], subsequently named the 2019 novel coronavirus, and samples obtained from cases and analysis of the virus’ genetics indicated that this was the cause of the outbreak. This novel coronavirus was named Coronavirus Disease 2019 (COVID-19) by WHO in February 2020. The virus is referred to as SARS-CoV-2 and the associated disease is COVID-19.

Keeping track of the health status of Covid 19 patients at home is a difficult task during this period of sanitary emergency. Especially old patients should be periodically monitored. Positive people to the virus need to monitored their heart rate, blood oxygen level and body temperature in the eventuality of an increase or decrease of these conditions.

It could be useful to know how to build a device that allows you to monitor the health conditions of the forbearing via IoT, which is rapidly revolutionizing the healthcare industry. The device gives us the chance to track the patient health using Web server.

The aim of the Covid 19 patient monitoring is to check:

- Heart rate of the patient;
- Blood oxygen level of the patient;
- Body temperature of the patient;
- Temperature and humidity of the room in which is the patient. [20]

State of the art

i. Evolution of the products

The first non-invasive oximeters, that appeared, were the ear oximeters, around 1935, when it was proved that the transmission oximetry could be applied to the external ear. However, the major inconvenient of ear oximetry was revealed to be the inability to differentiate light absorption due to arterial blood from that due to venous blood and tissues. Due to the volume of the components involved, the high cost of instrumentation, and the development of technology to solve many of these problems, the ear oximeters is no longer commercialized.

Laser oximetry is a new non-invasive method to evaluate determine the oxygen saturation on targeted areas of tissue, through a continuous wave optical spectrometer operating in the near-infrared spectrum. Nowadays, there are small oximeter for measure the oxygen saturation on extremities of human body such as finger. A modern pulse oximeter incorporates the electronics and sensor into one single unit.

In recent months, the oximeter has jumped to the forefront of the news because it has proved invaluable towards the Covid-19 subjects under observation. Through the test (oximetry) it is in fact possible to suspect a severe complication, that is to say that if a drop in oxygen concentration in the circulatory stream should occur it would be the unequivocal signal that a patient is harbouring interstitial pneumonia, therefore a sign that the subject monitored is worsening to the point that ambulance transport with access to the emergency room or intensive care is required. In fact, the most used one is the pulse oximeter that also measures the body temperature. In exceptional cases, this last can contain also a room thermometer. [10][13][16]



Related to the body temperature, there are different kinds of thermometer. The most used in this virus period is the infrared thermometer, which doesn't need to be touched. Some countries use it to monitor the people health in public places.

The first thermometer was 30 cm long and taking a patient's temperature could take up to half an hour. Subsequently the thermometer assumed the dimensions it has today, allowing an accurate and at the same time rapid measurement. We used analogic mercury thermometers until 2009, then they were withdrawn due to the toxicity of the mercury itself. The latter, accurate and reliable, had the only drawback of being tiring enough to lower after the measurement. In recent

years, the need to reduce the time required for measurement has become widespread. In fact, digital electronic thermometers are faster in temperature measurements and the digital display is easier to read. While, infrared thermometers measure the heat generated by surfaces and cavities. The main advantage of this type of thermometers is their speed; it only takes a few seconds to measure the temperature. [12]

ii. Market study

On the healthcare market, many devices are available to monitor these states:

- Pulse oximeter, which is a non-invasive medical device, that measures the oxygen saturation in the peripheral arterial blood and at the same time the heart rate, those helping to identify the possible presence of the first signs of pneumonia, one of the most serious symptoms of Coronavirus.
- Thermometer, which is a measuring instrument, that measures the body temperature. High fever, in fact, is one of the most common symptoms of Covid 19.
- Hygrometer thermometer, which measures the room temperature and humidity. Many diseases are related to humidity: asthma, general respiratory diseases, often depend on the quantity / quality of the air.

Pulse oximeter

The prices of a pulse oximeter range, roughly, from about 20 euros to about 200 euros. A low-cost device will be the choice of those who will use the device occasionally, because it doesn't suffer from diseases, that require constant monitoring. Whereas a higher cost will be preferred by those users who are looking for reliability and solidity from a device they will use frequently. The choice is subjective. [10][7][8]

Pulsossimetro, Monitore di Battito Cardiaco Portatile con LED Display, FED e CE Certificato per Misurazione di Pulsazione (PR) e Saturazione di...

★★★½☆ 2

20,09€

Pulsossimetro PULOX PO-600 saturimetro portatile con sensore esterno

★★★★☆ 16

199,90€

Thermometer

Before purchasing this product, it is very important to know the different types on the market and what they stand out for. Each type has a different degree of accuracy and a specific area of use, so the most suitable purchase choice will depend on your personal needs. The prices vary from 3 euros to 1000 euros. [7][8]

Raggi Infrarossi Riconoscimento Facciale Termometro Senza Contatto Telecamera Termica Misurazione Temperatura Macchina Presenze...

999,00€

5,50 € di spedizione

Nowakk Termometro, Termometro digitale con corpo lcd in abs a testa quadrata impermeabile ad alta precisione

★★★☆☆ 1

3,28€

Spedizione GRATUITA

Generalmente spedito entro 2-3 giorni.

Sponsorizzato

Wawech Termometro febbre infrarossi 2 in 1 Termoscanner professionale per febbre Misuratore temperatura corporea Termometro...

★★★★★ 183

39,99€ (39,99 €/unità)

Online it is possible to find a pulse oximeter, which measures also the body temperature, but the prices tend to rise significantly. [9]

Pulsossimetro Saturimetro Palmare Display 2,8" LCD con Sensore Adutli a Clip, Sonda Temperatura e Batteria Ricaricabile

197,00 € (IVA escl.)

197,00 € (IVA incl.)

~~250,00 €~~ (Risparmi 21,2%)

CATEGORIA: PULSSOSSIMETRI - SATURIMETRI RIFERIMENTO: 01760

DISPONIBILE: 6 ARTICOLI

Saturimetro palmare con sensore adulti e sonda temperatura cutanea saturimetro professionale ospedaliero. Saturimetro con batteria ricaricabile e memoria interna da 90 ore.

1 AGGIUNGI AL CARRELLO

LISTA DEI DESIDERI CONFRONTARE

Hygrometer thermometer

Keeping the temperature in the house optimal is extremely important, as is constantly ventilating the room. If there are no sources of air in the most experienced areas, it is advisable to rely on the hygrometer in order to keep everything under control. The hygrometer is a very convenient, inexpensive and simple to use tool, excellent for avoiding unpleasant conditions. Especially in the presence of children, the elderly and asthmatics, keeping humidity under control is a necessity that should not be underestimated for any reason.[11]

The prices vary from 2 euros to 300 euros. [7][8]

Cosye Classic Homeuse Indoor Outdoor 2 in 1 Mini igrometro a Umido accurato Termometro di umidità Misuratore di Temperatura...

1,98€

Igrometro Monitorare Weather Station Coperta Professionista con PC Link della Famiglia Termometro Radio igrometro Pressione...

310,11€

ThermoPro TP49 Mini Igrometro Termometro Digitale Termoigrometro da Interno per Casa Monitor di Temperatura e umidità per Ambient...

★★★★½ 3.522

9,99€

Norms and regulations

Since in our project we use different devices together, the regulation of each of them are also valid for our IoT device.

- ***Pulse oximeter:***
  Use in suboptimal conditions can lead to reading errors which can distort the displayed results. In particular:
  - the vasoconstriction (ie the decrease in the calibre of the blood vessels), of the peripheral districts, such as that of the fingers, lead to a decrease in the blood flow detectable by the probe, which therefore processes false data;
  - the pulse oximeter allows to know only the percentage of haemoglobin saturation, while it does not reveal information on which gas is bound;
  - hypotension: the reading becomes less and less reliable when the systolic level falls below 55-60 mmHg;
  - Anaemia: in patients suffering from anaemia, a possible hypoxemia condition may be hidden and not detected by the oximeter;
  - body temperature: below 35 ° C there is a reduction in the read values of the device;
  - movements of the person: they can create missed readings of the pulsatile wave that cannot verify its shape;[15][16][18]
- ***Thermometer:***
  - Do not bend the tip of the thermometer or bite it. [14]
- ***Hygrometer thermometer:***
  - The hygrometer thermometer is also used to improve energy savings through the regulations in force on the Minimum Environmental Criteria (CAM).[17]

- Do not use or store the meter in an environment of high temperature, humidity, subject to explosions, flammable or with strong magnetic fields. Operation of the meter may result deteriorated if subject to high humidity or wet.
- Do not use the meter if its surface is wet or if your hands are wet.
- Do not use the device if the environmental conditions (temperature, ambient humidity ...) do not found within the limits indicated in the specifications.
- Do not expose the probe to high humidity and high temperatures when the structure is cold because it could generate condensation which would affect the measurement results. If so, check, allow the probe to dry before taking new measurements.[19]

- ***General:***
  - Portable and mobile radio frequency communications equipment can affect the operation of the electromedical instruments.
  - All devices must be kept out of the reach of children.[14][15][18]

The devices are certified according to the following standards:

- ***Pulse oximeter:***
  EN60601-1: Medical electrical equipment Part 1: General requirements for basic safety and essential performance[27]
  EN60601-1-2 : Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral Standard: Electromagnetic disturbances - Requirements and tests[28]
  DIN EN ISO 80601-2-61 : Medical electrical equipment - Part 2-61: Particular requirements for basic safety and essential performance of pulse oximeter equipment (ISO 80601-2-61:2017, Corrected version 2018-02) [29][30] [21]
- ***Thermometer:***
  DIN EN ISO 13485 : Medical devices -- Quality management systems -- Requirements for regulatory purposes [31][32] [13]
- ***Hygrometer thermometer:***
  DIN EN 60 751 : Industrial platinum resistance thermometers and platinum temperature sensors [33] [22]

All the previous norms are European one, certified by CENELEC or ETSI or CEN. In summary, CENELEC is European Committee for Electrotechnical Standardization, which is responsible for European standardization in the area of electrical engineering. Together with ETSI (European Telecommunications Standards Institute) and CEN (European Committee for Standardization), it forms the European system for technical standardization.[23][24][25] Usually the European norms are indicated by EN. The norms DIN EN are accepted by the CENELEC and CEN.[26]

Conclusions

The Covid 19 virus is a big problem in this period of health crisis, this has led to several changes in the daily lives of all of us. One of the biggest problems is related to the monitoring of patients from home, who tested positive for coronavirus, but asymptomatic, or those at risk of contagion, such as the elderly. There are multiple solutions, but most involve a waste of time and personnel, which not all hospitals can cope with.

While on a personal level they involve the use of multiple medical devices, sometimes expensive or unavailable given the high frequency of demand on the market.

Our answer to this problem consists in a single device capable of monitoring the three main factors from which the presence of the virus in the patient can be seen, such as:

- Heart rate of the patient;

- Blood oxygen level of the patient;

- Body temperature of the patient;

A substantial variation of the latter would lead to having to check the patient's condition by a competent doctor. If no changes were found, such a visit could be avoided, saving resources and leading to priority being given to patients in greater need of help.

However, this device must comply with the standards listed above, as without this step it would not comply with European regulations and could not be used by all possible buyers.

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