

CAPTIVE EYE DETECTIVE HITS THE INNEREYE OF COVID19 TO WIN THE SCREENING BY THERMOGRAM

Kushal Nandi*, Dr. Dhruvo Jyoti Sen and Dr. Beduin Mahanti

Department of Pharmaceutical Chemistry, School of Pharmacy, Techno India University, Salt Lake City, Sector-V, EM-4, Kolkata-700091, West Bengal, India.

***Corresponding Author: Kushal Nandi**

Department of Pharmaceutical Chemistry, School of Pharmacy, Techno India University, Salt Lake City, Sector-V, EM-4, Kolkata-700091, West Bengal, India.

Article Received on 08/03/2020

Article Revised on 29/03/2020

Article Accepted on 19/04/2020

ABSTRACT

All objects emit infrared energy, known as a heat signature. An infrared camera (also known as a thermal imager) detects and measures the infrared energy of objects. The camera converts that infrared data into an electronic image that shows the apparent surface temperature of the object being measured. An infrared camera contains an optical system that focuses infrared energy onto a special detector chip (sensor array) that contains thousands of detector pixels arranged in a grid. Each pixel in the sensor array reacts to the infrared energy focused on it and produces an electronic signal. The camera processor takes the signal from each pixel and applies a mathematical calculation to it to create a color map of the apparent temperature of the object. Each temperature value is assigned a different color. The resulting matrix of colors is sent to memory and to the camera's display as a temperature picture (thermal image) of that object. The thermal screening by infra red imaging is being implemented among the public by maintaining social distancing between individual to individual so that contagious contamination of COVID19 can be minimised. The infected persons are being kept in isolation followed by quarantine period to overcome the viral attack in mass population.

KEYWORDS: Thermal imaging, Thermogram, Temperature gun, Stefan–Boltzmann law, Social distancing, Isolation, Quarantine.

INTRODUCTION

An infrared thermometer is a thermometer which infers temperature from a portion of the thermal radiation sometimes called black-body radiation emitted by the object being measured. They are sometimes called laser thermometers as a laser is used to help aim the thermometer, or non-contact thermometers or temperature guns, to describe the device's ability to measure temperature from a distance. By knowing the amount of infrared energy emitted by the object and its emissivity, the object's temperature can often be determined within a certain range of its actual temperature. Infrared thermometers are a subset of devices known as "thermal radiation thermometers". Sometimes, especially near ambient temperatures, readings may be subject to error due to the reflection of radiation from a hotter body—even the person holding the instrument — rather than radiated by the object being measured, and to an incorrect assumed emissivity.^[1]

Mechanism: The design essentially consists of a lens to focus the infrared thermal radiation on to a detector, which converts the radiant power to an electrical signal that can be displayed in units of temperature after being

compensated for ambient temperature. This permits temperature measurement from a distance without contact with the object to be measured. A non-contact infrared thermometer is useful for measuring temperature under circumstances where thermocouples or other probe-type sensors cannot be used or do not produce accurate data for a variety of reasons.

All objects above absolute zero (-273.15°C) emit infrared radiation (IR) in proportion to their temperature and wavelength. Thermal vision cameras consist of a lens that allows only IR radiation to pass through (such as a doped germanium lens) and impinge upon a thermal detector (such as Mercury cadmium telluride: **Hg_{1-x}Cd_xTe** or indium antimonide: **InSb**) sensitive to the IR wavelengths being measured (usually 8–13 microns or 3–5.6 microns). This IR radiation is then changed into an electronic signal and digitally processed to a screen where the signals are displayed as a visible image digitally colorized to reflect the intensity of the infrared radiation impinging on the IR detector. Infrared radiation from an object of interest is focused with a lens onto a Microbolometer where it heats and changes the electrical resistance of an array of pixels. The values from the array are read out in a similar manner to a

visible light image from a digital CCD camera. The image has of itself no colour component, being just a monochrome intensity map in the detection band of the

array, but the image is usually rendered in false colour (**red=hot, yellow=warm, blue=cold, green=cool**) to make temperature changes more obvious.

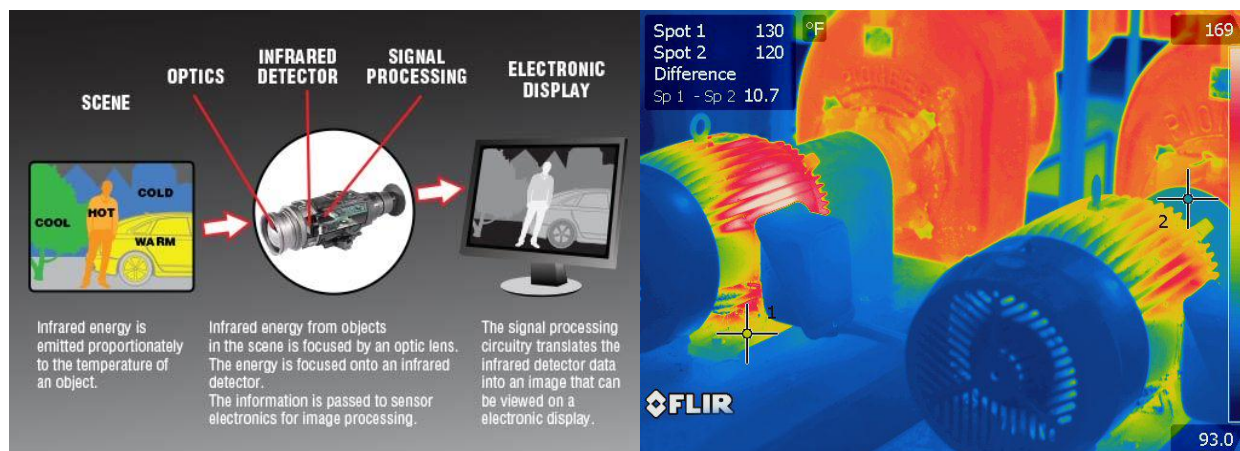


Figure 1: Thermal imaging.

The image may have more than 256 levels of brightness, which would map to more than the 8-bits of intensity in a regular greyscale JPEG.

The design essentially consists of a lens to focus the infrared thermal radiation on to a detector, which converts the radiant power to an electrical signal that can be displayed in units of temperature after being compensated for ambient temperature. This permits temperature measurement from a distance without contact with the object to be measured. A non-contact infrared thermometer is useful for measuring temperature under circumstances where thermocouples or other probe-type sensors cannot be used or do not produce accurate data for a variety of reasons.^[2]

Examples of use: Some typical circumstances are where the object to be measured is moving; where the object is surrounded by an electromagnetic field, as in induction heating; where the object is contained in a vacuum or other controlled atmosphere; or in applications where a fast response is required, an accurate surface temperature

is desired or the object temperature is above the recommended use point for contact sensors, or contact with a sensor would mar the object or the sensor, or introduce a significant temperature gradient on the object's surface.

Infrared thermometers can be used to serve a wide variety of temperature monitoring functions. A few examples provided include detecting clouds for remote telescope operation, checking mechanical or electrical equipment for temperature and hot spots, measuring the temperature of patients in a hospital without touching them, checking heater or oven temperature, for calibration and control, checking for hot spots in fire-fighting, monitoring materials in processes involving heating or cooling, and measuring temperature of volcanoes. At times of epidemics of diseases causing fever, such as SARS coronavirus and Ebola virus disease, infrared thermometers have been used to check arriving travelers for fever. There are many varieties of infrared temperature-sensing devices, both for portable and handheld use and as fixed installations.^[3]



Figure-2: COVID19 pandemic.

Accuracy: Infrared thermometers are characterized by specifications including accuracy and angular coverage. Simpler instruments may have a measurement error of about $\pm 2^{\circ}\text{C}$ or $\pm 4^{\circ}\text{F}$. The distance-to-spot ratio (D:S) is the ratio of the distance to the measurement surface and the diameter of the temperature measurement area. For instance, if the D:S ratio is 12:1, the diameter of the measurement area is one-twelfth of the distance to the object. A thermometer with a higher ratio of D to S is able to sense a more-specific, narrower surface at a greater distance than one with a lower ratio. A 12:1 rated device can sense a 1-inch circle at a distance of one foot,

whereas a 10:1 ratio device achieves the same 1-inch circle at 10 inches, and a wider, less-specific circle of 1.2 inches at a distance of 12 inches. The ideal target area should be at least twice the size of the spot at that distance, with smaller areas relative to distance resulting in less accurate measurement. An infrared thermometer cannot be placed too close to its target, or this proximity causes heat to build up in the thermometer's housing and damages the sensor. Measurement error generally only decreases with too much distance because of the effects of reflectivity and the inclusion of other heat sources within the sensor's field of view.

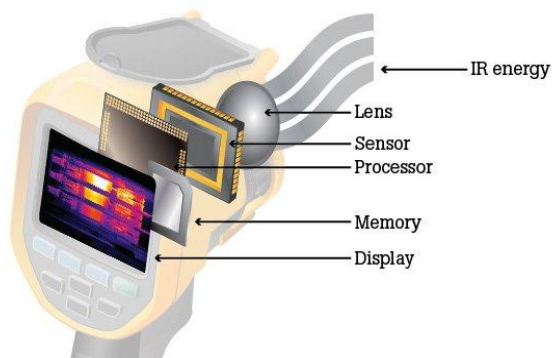


Figure 3: Parts of IR camera.

According to the Stefan–Boltzmann law, radiant power is proportional to the fourth power of temperature, so when the measurement surface has both hot and cold areas, the indicated temperature may be higher than the actual average temperature, and closer to fourth-power mean average. Most surfaces have high emissivity (over 0.9 for most biological surfaces) and most IR thermometers rely on this simplifying assumption; however, reflective surfaces have lower emissivity than non-reflective surfaces. Some sensors have an adjustable emissivity setting, which can be set to measure the temperature of reflective and non-reflective surfaces. A non-adjustable thermometer may be used to measure the

temperature of a reflective surface by applying a non-reflective paint or tape, with some loss of accuracy.

A sensor with an adjustable emissivity setting can also be used to calibrate the sensor for a given surface, or to measure the emissivity of a surface. When the temperature of a surface is accurately known (e.g. by measuring with a contact thermometer), then the sensor's emissivity setting can be adjusted until the temperature measurement by the IR method matches the measured temperature by the contact method; the emissivity setting will indicate the emissivity of the surface, which can be taken into account for later measurements of similar surfaces (only).^[4]



Figure 4: Thermal screening.

Social distancing: Social distancing means any measures taken to increase physical space between people to slow or prevent the spread of the virus. This involves avoiding public gatherings, limiting the number of visitors to your home, staying at home more often, keeping a safe distance from other people and catching up with friends and family virtually instead of in person. If you have to be around people, maintain a distance of 2 meters or 6 feet from others around you as much as possible. Not just mass gatherings, but even shopping malls, stadiums, and movie theatres can make you a target. In general, any gathering of over ten people should be avoided or conducted virtually.

Other common terminologies explained: COVID-19: Corona Virus Disease of 2019. This acronym was created by the World Health Organization or the WHO. It stands for the respiratory illness caused by the coronavirus SARS-CoV-2. Flattening the curve: Slowing a virus's spread to lower the peak number of cases, hence reducing the burden on the infrastructure and the demands on hospitals.

Incubation period: The time taken by the symptoms to first appear on an infected individual. The incubation time for COVID-19 ranges from 1-14 days, most commonly being around 5 days.

“Medium-risk” individuals: People are considered “medium risk” individuals if they have recently traveled to a country with the widespread sustained transmission of COVID-19 or have had close contact or traveled in a plane with individuals showing symptoms of COVID-19. Self-isolation is advised for people in the “medium risk” category.

PPE: PPE or personal protective equipment includes face masks, protective gowns, aprons, overalls, and respirators. Hospitals need to be adequately equipped with these items to protect healthcare workers and frontline workers.

Underlying condition: A chronic health issue such as high blood pressure, diabetes, asthma, HIV, cancer or chronic lung diseases. These health issues when present in an individual, make them more susceptible to the complications of COVID-19, when infected. Limiting face-to-face contact with others is the best way to reduce the spread of coronavirus disease 2019 (COVID-19) by social distancing by which two people with masks on 6 feet apart. Social distancing, also called “physical distancing,” means keeping space between yourself and other people outside of your home.^[5]

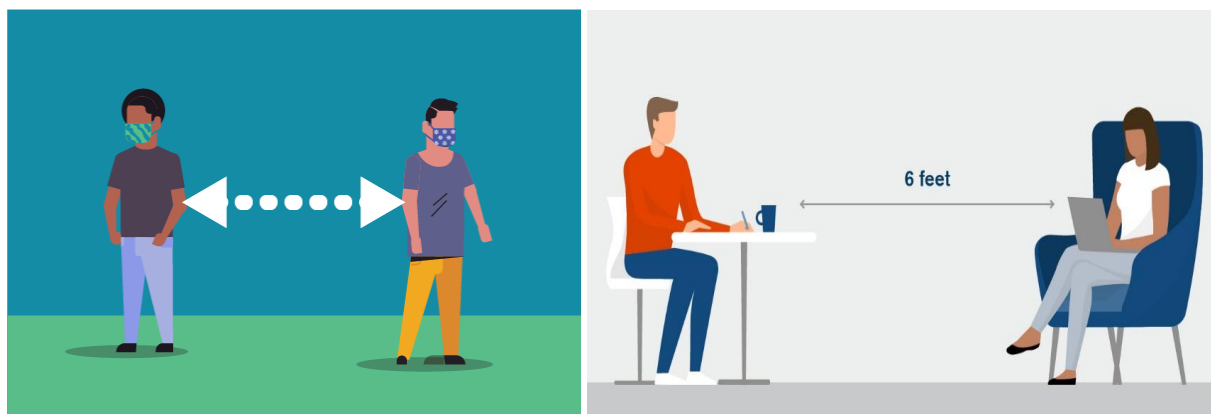


Figure 5: Social distancing.

To practice social or physical distancing: (1) Stay at least 6 feet (2 meters) from other people. (2) Do not gather in groups. (3) Stay out of crowded places and avoid mass gatherings.

In addition to everyday steps to prevent COVID-19, keeping space between you and others is one of the best tools we have to avoid being exposed to this virus and slowing its spread locally and across the country and world. When COVID-19 is spreading in your area, everyone should limit close contact with individuals outside your household in indoor and outdoor spaces. Since people can spread the virus before they know they are sick, it is important to stay away from others when possible, even if you have no symptoms. Social distancing is especially important for people who are at higher risk of getting very sick. COVID-19 spreads

mainly among people who are in close contact (within about 6 feet) for a prolonged period. Spread happens when an infected person coughs, sneezes, or talks, and droplets from their mouth or nose are launched into the air and land in the mouths or noses of people nearby. The droplets can also be inhaled into the lungs. Recent studies indicate that people who are infected but do not have symptoms likely also play a role in the spread of COVID-19.

It may be possible that a person can get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or eyes. However, this is not thought to be the main way the virus spreads. COVID-19 can live for hours or days on a surface, depending on factors such as sun light and humidity. Social distancing helps limit contact with infected people

and contaminated surfaces. Although the risk of severe illness may be different for everyone, anyone can get and spread COVID-19. Everyone has a role to play in slowing the spread and protecting themselves, their family, and their community.^[6]

Tips for social distancing

- Follow guidance from authorities where you live.
- If you need to shop for food or medicine at the grocery store or pharmacy, stay at least 6 feet away from others.
- Use mail-order for medications, if possible.
- Consider a grocery delivery service.
- Cover your mouth and nose with a cloth face cover when around others, including when you have to go out in public, for example to the grocery store.
- Stay at least 6 feet between yourself and others, even when you wear a face covering.
- Avoid large and small gatherings in private places and public spaces, such a friend’s house, parks, restaurants, shops, or any other place. This advice

applies to people of any age, including teens and younger adults. Children should not have in-person playdates while school is out. To help maintain social connections while social distancing, learn tips to keep children healthy while school’s out.

- Work from home when possible.
- If possible, avoid using any kind of public transportation, ridesharing, or taxis.
- If you are a student or parent, talk to your school about options for digital/distance learning.
- Stay connected while staying away.

It is very important to stay in touch with friends and family that don’t live in your home. Call, video chat, or stay connected using social media. Everyone reacts differently to stressful situations and having to socially distance yourself from someone you love can be difficult.^[7]



Figure 6: Isolation & Quarantine.

Isolation: Isolation is used to separate sick people from healthy people. People who are in isolation should stay home. In the home, anyone sick should separate themselves from others by staying in a specific “sick” bedroom or space and using a different bathroom (if possible).

Quarantine: Quarantine is used to keep someone who might have been exposed to COVID-19 away from others for 14 days. Someone in self-quarantine stays separated from others, and they limit movement outside

of their home or current place. A person may have been exposed to the virus without knowing it (for example, when traveling or out in the community), or they could have the virus without feeling symptoms. Quarantine helps limit further spread of COVID-19.^[8]

What should I do if I might have been exposed? If I feel sick? Or have confirmed COVID-19?

If you think you have been exposed to COVID-19, read about symptoms.

If you	Steps to take
someone in your home might have been exposed	Self-Monitor Be alert for symptoms. Watch for fever, cough, or shortness of breath. Take your temperature if symptoms develop. Practice social distancing. Maintain 6 feet of distance from others, and stay out of crowded places. Follow CDC guidance if symptoms develop.

If you feel healthy but:	Self-Quarantine
Recently had close contact with a person with COVID-19, or Recently traveled from somewhere outside the U.S. or on a cruise ship or river boat	Check your temperature twice a day and watch for symptoms. Stay home for 14 days and self-monitor. If possible, stay away from people who are high-risk for getting very sick from COVID-19.

If you:	Self-Isolate
Have been diagnosed with COVID-19, or Are waiting for test results, or Have symptoms such as cough, fever, or shortness of breath	Stay in a specific "sick room" or area and away from other people or animals, including pets. If possible, use a separate bathroom.

CONCLUSION

A thermographic camera (also called an infrared camera or thermal imaging camera or thermal imager) is a device that creates an image using infrared radiation, similar to a common camera that forms an image using visible light. Instead of the 400–700 nanometre range of the visible light camera, infrared cameras are sensitive to wavelengths from about 1,000 nm (1 μ m) to about 14,000 nm (14 μ m). The art of capturing and analyzing the data they provide is called thermography. Infrared was discovered in 1800 by Sir William Herschel as a form of radiation beyond red light. These "infrared rays" (infra is the Latin prefix for "below") were used mainly for thermal measurement. There are four basic laws of IR radiation: Kirchhoff's law of thermal radiation, Stefan-Boltzmann law, Planck's law, and Wien's displacement law. Infrared energy is just one part of the electromagnetic spectrum, which encompasses radiation from gamma rays, x-rays, ultra violet, a thin region of visible light, infrared, terahertz waves, microwaves, and radio waves. These are all related and differentiated in the length of their wave (wavelength). All objects emit a certain amount of black body radiation as a function of their temperature. Generally speaking, the higher an object's temperature, the more infrared radiation is emitted as black-body radiation. A special camera can detect this radiation in a way similar to the way an ordinary camera detects visible light. It works even in total darkness because ambient light level does not matter. This makes it useful for rescue operations in smoke-filled buildings and underground.

How should you practice social distancing?

- Reduce the number of people you are around – the fewer, the better, but especially avoid groups.
- Stay at least 6 feet away from people not in your household.
- Try to get supplies you need delivered instead of going out. Ask that deliveries be left outside your door instead of accepting them in person.
- If you do have to go to the store, choose a time when it is not crowded, avoid touching your face, and wash your hands or use hand sanitizer as soon as you leave.
- If you do essential work (thank you!), travel there and back in ways that avoid contact with others,

maintain 6 feet of distance with your co-workers and customers/clients, avoid touching your face, and wash your hands (or use hand sanitizer) frequently.

- Call people on the phone instead of visiting them in person.

How should you protect yourself and others in the home from COVID-19 infection?

- Wash your hands often with soap and water, or use hand sanitizer.
- Try to not touch your eyes, nose, or mouth if you haven't washed your hands.
- Try to stay away from people who are sick.
- If you are sick, stay home and try to stay away from other people.
- Always cover your mouth and nose with a tissue or your sleeve when you cough or sneeze.
- Using a mask is only recommended for someone who could have or is confirmed to have COVID-19 and their caretakers.
- Clean surfaces that people touch often like doorknobs, counters, phones, or bathroom faucets.
- Try to avoid touching commonly touched objects like elevator buttons or handrails. \Wash your hands with soap and water or use hand sanitizer immediately after touching these objects.

What is the difference between isolation and quarantine?

Like social distancing, isolation and quarantine protect the public from exposure to contagious diseases, like COVID-19 coronavirus.

- **Isolation** separates people who are sick, and showing symptoms of COVID-19, from others who are not sick. Isolation keeps people who know they are infected away from healthy people.
- **Quarantine** separates people who know they were exposed to someone with COVID-19 coronavirus, or who recently travelled to a location where the disease was spreading rapidly. Quarantines are for people who do not show symptoms, but should be kept separate because they have a higher-than-average likelihood of having been exposed to the disease. People in quarantine do not leave quarantine for at least 14 days.

When should you isolate from others?

If you are experiencing the common symptoms of COVID-19: fever, dry cough, shortness of breath, and fatigue.

- If you have mild symptoms, stay home, rest, and avoid contact with others until you feel completely better.
- Because there is no medication for COVID-19, you are safer staying home with mild symptoms than going to a place where you might expose others or be exposed to others with illness.
- Learn more about who should be tested.

When should you quarantine from others?

- If you were recently exposed to someone with a positive test for COVID-19 coronavirus.
- If you were recently exposed to someone with symptoms of COVID-19.
- If you recently travelled outside of Philadelphia and may have come into contact with an infected person.
- If you have travelled to an area with a high number of cases.
- If you have travelled to a high-risk country within the last 14 days.
- If you have travelled to New York City or the surrounding counties (Nassau, Westchester or Suffolk counties in NY or Bergen County in NJ) within the last 14 days quarantine and monitor for symptoms for 14 days.

How long should you quarantine?

Stay home for 14 days from the time you left an area with community spread of COVID-19, or from the time you may have been exposed to an infected person.

How can you prepare if you are told to stay home for 14 days?

- Talk with your primary health care provider and pharmacist to see if you can have a 90-day supply of prescription medications for yourself and other household members.
- It's also a good idea to maintain a supply of over-the-counter medications, such as fever-reducing medications like Tylenol, or other medications that household members use regularly.
- Think about storing extra water or non-perishable food at home, so you'll have some if you can't go grocery shopping.
- It's a good idea to have enough essential household items, like cleaning products, detergent, pet care items, and diapers, if you have young children.
- The Philadelphia Office of Emergency Management has tips on which essential items you should store at home in preparation for any emergency.
- Talk to your employer to find out about working remotely and about sick leave.
- If you have elderly parents or relatives, consider how you will care for them if they get sick. If they

rely on a caregiver, make back-up plans in case that caregiver becomes sick and is unable to work.

What should I do during quarantine and isolation

- Monitor your health and take your temperature with a thermometer twice a day.
- Stay home and avoid contact with others.
- Practice social distancing. Do not take public transportation, avoid crowded places, and keep your distance from others.
- Clean surfaces that people touch often like doorknobs, counters, phones, or bathroom faucets. Be sure to follow the label instructions.
- Have necessities like groceries delivered to your house.
- Wash your hands often with soap and water.
- Cover your mouth and nose with a tissue when you sneeze or cough.
- Avoid touching your face if you haven't washed your hands.
- Avoid sharing drinks and eating utensils like forks and spoons.

How can others in the home can protect themselves if someone is sick with COVID-19?

- People who aren't sick should sleep in a different room away from the patient and should avoid close contact, like kissing.
- Don't share personal items like toothbrushes, utensils, or drinks.
- Everyone in the home should wash their hands often, using plenty of warm water and either bar or liquid soap.
- Alcohol-based hand sanitizer can be used in addition to handwashing, or if the person taking care of the patient can't wash them with soap and water right away.
- Whoever is taking care of the patient should wear a surgical mask. Masks should fit snugly around the face and should not be touched or handled during use. The mask should be changed at least daily, or sooner if it gets wet or dirty.
- If gloves are worn by the person taking care of the patient, they should still wash their hands often. Immediately after the gloves are removed, they should be thrown away and the person should wash their hands. Gloves must never be washed or reused.
- Surfaces that are frequently touched by the patient should be cleaned with a household disinfectant at least daily. The person who performs the cleaning should wear rubber gloves.
- The bathroom used by the patient should be cleaned daily, if possible. Rubber gloves should be worn during the cleaning process.

REFERENCES

1. W. Herschel, "Experiments on the refrangibility of the visible rays of the sun", Philosophical Transactions of the Royal Society of London, 1800; 90: 284–292.
2. Barr, E. S. The infrared pioneers—II. Macedonio Melloni. *Infrared Physics*, 1962; 2(2): 67-74.
3. Langley, S. P. "The bolometer". *Proceedings of the American Metrological Society*, 1880; 2: 184–190.
4. Barr, E. S. The infrared pioneers—III. Samuel Pierpoint Langley. *Infrared Physics*, 1962; 3: 195-206.
5. L. Bellingham, "Means for detecting the presence at a distance of icebergs, steamships, and other cool or hot objects," US patent, 1: 158,967.
6. Parker (R.D.)- Thermic balance or radiometer. U.S. Patent No 1,099, 199, June 9, 1914.
7. Barker (G.A.) – Apparatus for detecting forest fires. U.S. Patent No 1,958,702 May 22, 1934.
8. Dr. Dhrubo Jyoti Sen, Dr. Sudip Kumar Mandal, Arpita Biswas, Dipra Dastider and Dr. Beduin Mahanti; Corona is culprit of ridiculous offensive nonsense air: *World Journal of Pharmaceutical Research*, 2020; 9(4): 503-518.