



# IoT Devices for Monitoring Health Status and Vital Signs in Patients with Cancer

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**Abstract:** Worldwide, millions of people are afflicted with cancer, and its treatment often involves a complex and rigorous process. IoT technology application in medicine has brought about significant improvements in the lives of cancer patients. From early detection to personalized treatment plans, IoT has transformed the way cancer is diagnosed and managed. One of the most significant impacts of IoT on cancer patients is the early detection and diagnosis of the disease. With the help of IoT devices, patients can monitor their health status and vital signs in real-time. These devices collect data such as heart rate, blood pressure, and oxygen levels, and transmit it to healthcare professionals for analysis. This allows for the early detection of any abnormalities, which can lead to a timely diagnosis of cancer and a higher chance of successful treatment. IoT has also improved the quality of life for cancer patients. Smart home devices, such as voice-activated assistants and smart thermostats, can be connected to healthcare systems and provide patients with a comfortable and convenient living environment. This is particularly helpful for patients undergoing chemotherapy, as they may experience side effects such as fatigue and nausea, and may require a comfortable and stress-free environment to aid in their recovery. The use of IoT technology in the treatment and care of cancer patients has brought about significant improvements in the healthcare industry. Early detection, individualized treatment programs, and monitoring of patients remotely are all examples, IoT has made a positive impact on the lives of cancer patients. With further advancements and innovations in this field, more significant benefits for cancer patients in the forthcoming can be expected.

**Keywords:** IoT, Cancer, Monitoring system, Sleep pattern, Blood pressure.



## 1. INTRODUCTION-

Patient health monitoring is an essential aspect of healthcare that involves tracking and recording a patient's vital signs, symptoms, and overall health status. This process is crucial in providing timely and effective medical care, as it helps healthcare professionals identify potential health issues and make informed decisions regarding the patient's treatment.

With the advancements in technology, patient health monitoring has become more efficient and accurate. Traditional methods of monitoring, such as manual recording of vital signs, have been replaced by automated systems that use sensors and devices to continuously monitor a patient's health. These devices can be worn by the patient or placed in their environment, providing real-time data to healthcare professionals.

Among the greatest advantages of patient health monitoring is the prompt identification of health problems. By keeping a close eye on an individual's vital signs, any changes or abnormalities can be detected promptly. This enables medical professionals to take early action and stop the emergence of dangerous medical conditions.

For example, in patients with chronic diseases such as diabetes, continuous monitoring of the level of blood sugar are helpful in avoiding issues such as diabetic ketoacidosis. Moreover, patient health monitoring can also help in the management of chronic diseases. By tracking a patient's symptoms and vital signs, healthcare professionals can adjust their treatment plans accordingly. The standard of life for the patient may be enhanced by this individualized approach to care and reduce the risk of hospital readmissions.

Another significant advantage of patient health monitoring is the ability to monitor patients remotely. This has become especially crucial during the ongoing COVID-19 pandemic, where healthcare systems are overwhelmed, and patients are advised to stay at home. With remote monitoring, patients can stay in the comfort of their own homes while still receiving the necessary medical attention.

This lessens the chance of contracting the virus and also makes the burden on hospitals and healthcare facilities. Patient health monitoring is also beneficial for elderly patients or those with mobility issues. These patients may find it challenging to visit a healthcare facility regularly. With remote monitoring, they can receive the necessary care without having to leave their homes. This improves their overall well-being and independence.

Furthermore, patient health monitoring can also help in reducing healthcare costs. By detecting health issues early and preventing hospital readmissions, it can significantly lower the expenses associated with treating chronic diseases. Additionally, remote monitoring can reduce the number of hospital visits, which can be costly for patients.

However, there are also some challenges associated with patient health monitoring. The privacy is one of the main issues and security of patient data. With the use of technology, there is a risk of data breaches, which may compromise the confidentiality of a patient's information. To address this issue, healthcare providers must verify that appropriate security measures have been taken to safeguard patient information.

To sum up, patient health monitoring is a crucial aspect of healthcare that has many benefits. It can help in the early identification and management of health problems, improve the management of chronic diseases, and reduce healthcare costs. With the continuous advancements in technology, patient health monitoring is only going to become more efficient and accurate, providing better care for patients. However, it is essential to address any concerns regarding patient privacy and security to ensure that this technology is used responsibly. One of the world's most feared illnesses is cancer and the word itself is enough to strike fear in the hearts of many.

It is an illness that has no limitations along with can strike anyone, regardless of social standing, age, or gender. The journey of a cancer patient is a long and challenging one, filled with physical, emotional, and financial struggles. In this article, we will explore the life of a cancer patient, from diagnosis to treatment and beyond. The first step in the journey of a cancer patient is the diagnosis. It is a life-changing moment that turns their world upside down.

The initial shock, fear, and confusion can be overwhelming for both the patient and their loved ones. It is a time when they are bombarded with medical jargon, tests, and treatment options. The journey ahead is uncertain, and the only thing that is certain is the fight for survival. Once the diagnosis is confirmed, the patient's treatment plan is put into action.

Surgery, radiation therapy, chemotherapy, targeted therapy, and immunotherapy are among the cancer treatment options. Each treatment comes with its own set of side effects, which can be physically and emotionally draining for the patient. The road to recovery is a long and arduous one, and it takes a toll on the patient's



physical and mental well-being. In addition to the physical difficulties, cancer patients also face emotional and psychological struggles. The fear of the unknown, the uncertainty of the future, and the constant battle with their own body can take a toll on their mental health. It is common for cancer patients to experience anxiety, depression, and other mental health issues. It is essential for them to have a strong support system of family, friends, and healthcare professionals to help them cope with these challenges[1].

Another noteworthy obstacle for cancer patients is the financial burden that comes with the disease. The cost of treatment, medications, and hospital stays can be exorbitant, and many patients struggle to afford it. In some cases, the patient might have to give up their job due to their illness, adding to the financial strain. The high cost of treatment for cancer can be a major source of stress for patients and their families, making the journey even more challenging[2].

However, despite the physical, emotional, and financial challenges, cancer patients are some of the strongest and most resilient individuals. They fight every day with courage and determination, never giving up hope. The support and love from their family and friends play a crucial role in their journey, giving them the strength to keep fighting[3]. Among the most important factors of a cancer patient's journey is the importance of early detection. Frequent examinations and screenings can be beneficial in the early detection of cancer, increasing the chances of successful treatment. It is also essential for individuals to adopt a healthy lifestyle to reduce their risk of developing cancer.

The journey of a cancer patient does not end with the completion of treatment. It is a lifelong battle, with the fear of recurrence always looming. Many survivors face physical and emotional challenges even after treatment, and it is essential for them to have a strong support system to help them through this phase[4].

In all, the journey of a cancer patient is one filled with challenges, but also with hope and resilience. They are an inspiration to us all, teaching us to never give up and to cherish every moment of life. As a society, it is our responsibility to support and uplift cancer patients, spreading awareness about the disease and providing them with the care and love they deserve. Let us all come together to fight against cancer and make this journey a little easier for those who are battling it every day.

In the quick-paced world of today, technology has made its way into almost every aspect of our lives. From smart homes to self-driving cars, it has greatly improved the quality of our lives. One area where technology has shown immense potential is in the healthcare industry. With the rise of Internet of Things (IoT), the healthcare industry has been revolutionized, particularly in the monitoring and treatment of diseases like cancer[5].

One of the main causes of death in the world, cancer claims millions of lives each year. People being diagnosed with it every year. For cancer patients, regular monitoring of their health is crucial in managing the disease and ensuring timely intervention in case of any complication. This is where IoT-based cancer patient health monitoring comes into play.

It describes the body's aberrant cells growing out of control, which has the potential to spread to other body parts and cause serious health complications. With advancements in medical technology and treatment options, the survival rates of cancer patients have significantly increased. However, cancer treatment can take a toll on the patient's health, and constant monitoring is crucial to ensure their well-being[6].

One of the most common methods of health monitoring for cancer patients is through regular check-ups with their oncologist. During these check-ups, the doctor will perform physical examinations, review the patient's medical history, and conduct relevant tests to assess the patient's overall health. These check-ups also provide an opportunity for the patient and their family to discuss any concerns or symptoms they may have. The doctor can then make necessary adjustments to the treatment plan to ensure the patient's well-being[7].

Apart from regular check-ups, cancer patients may also use various monitoring devices and technologies to track their health at home. For instance, blood pressure monitors, pulse oximeters, and glucose meters are commonly used by cancer patients to keep track of their vitals and detect any abnormalities. These devices are easy to use and can provide real-time data, allowing patients to take immediate action if needed[1].

Another innovative technology that has revolutionized cancer patient health monitoring is wearable devices. These gadgets, which include smartwatches[2] and fitness trackers, can track a number of health-related variables, such as heart rate, sleep habits, and physical activity. They can also track the patient's medication schedule and remind them to take their medication on time. Additionally, these devices can be connected to a smartphone, enabling patients to share their health data with their doctors for a more accurate assessment of their health.

The use of technology has also led to the development of telemedicine, which allows cancer patients to consult with their doctors remotely. This is particularly helpful for people who reside in isolated places with restricted access to medical facilities. Through telemedicine, patients can have virtual appointments with their doctors, discuss their symptoms, and receive necessary medical advice. It not only saves time and money but also reduces the risk of exposure to infections for patients with weakened immune systems[5].



Apart from physical health monitoring, mental health monitoring is also crucial for cancer patients. The emotional and psychological toll of cancer and its treatment can be overwhelming for patients, leading to anxiety, depression, and other mental health issues. It is essential to address these concerns and provide patients with the necessary support and resources. Regular counseling sessions, support groups, and mindfulness practices can help patients cope with the emotional impact of cancer and improve their overall well-being[6].

IoT-based cancer patient health monitoring involves the use of connected devices to continuously collect and transmit patient data to healthcare providers. These devices can range from wearables like smartwatches and fitness trackers to implantable sensors, all of which are capable of tracking vital signs and other health parameters.

One of the main advantages of using IoT devices for cancer patient monitoring is the ability to collect real-time data. This means that doctors can have access to a patient's health information at any time, allowing for better and more timely decision-making. This is especially crucial for cancer patients, as their condition can change rapidly, and early detection of any complications can be life-saving[1].

IoT devices can also provide a more comprehensive and accurate picture of a patient's health. Numerous health parameters, like as blood pressure-BP, heart rate, SO<sub>2</sub> levels, and even sleep patterns, can be monitored by these devices. By continuously monitoring these parameters, doctors can get a better understanding of a patient's overall health and how the cancer is affecting their body.

In addition to real-time data collection, IoT devices also offer remote monitoring capabilities. This means that patients do not have to constantly visit a hospital or clinic for routine check-ups. Alternatively, patients can communicate their health information to their doctors from the convenience of their individual homes. This is particularly advantageous for cancer patients who might have weakened immune systems and are more susceptible to infections.

Moreover, IoT-based cancer patient health monitoring can also improve the efficiency of healthcare services. By continuously collecting and analyzing patient data, doctors can quickly identify any changes in a patient's health and intervene before it becomes a serious issue. This can reduce the number of hospital admissions and emergency room visits, saving both both money and time for medical professionals as well as patients .

Another significant advantage of IoT-based cancer patient health monitoring is the ability to personalize treatment plans. With access to real-time data, doctors can make informed decisions about a patient's treatment based on their individual health data, rather than relying

on generalized guidelines[2]. This can lead to more effective and personalized treatment, ultimately improving the patient's overall health outcome.

The challenge is the integration of these devices into the existing healthcare system. For IoT-based monitoring to be effective, there needs to be a seamless exchange of information between the devices and healthcare providers. This requires a robust IT infrastructure and interoperability between different systems, which can be a challenge to implement[4].

In the quick-paced world of today, keeping track of our health has become more important than ever. With the rise of chronic diseases and lifestyle-related illnesses, monitoring our vital signs has become a crucial aspect of maintaining a healthy lifestyle. Thanks to advancements in technology, we can now easily track and monitor our heart rate, BP- blood pressure, SO<sub>2</sub> levels, and even sleep patterns, providing us with valuable insights into our overall well-being[5].

The number of times our heart beats per minute is known as our heart rate, or pulse. It's a vital sign that can indicate the health of our cardiovascular system. Adults typically have an allowing heart rate between 60 and 100 beats per minute. However, various factors such as age, fitness level, and medication can affect our heart rate.

By monitoring our heart rate, we can detect irregularities or abnormalities that may require medical attention. With the use of fitness trackers, smartwatches, and even smartphone apps, we can easily track our heart rate throughout the day, providing us with a better understanding of our overall cardiovascular health[2].

Blood pressure is another crucial vital sign that measures the force that blood exerts against our artery walls. It is an essential indicator of our cardiovascular health and can help identify potential health issues such as hypertension. High BP, if left untreated, can lead to major health issues like stroke and heart disease.

By regularly monitoring our blood pressure, we can take necessary measures to keep it in check, such as making lifestyle changes, taking prescribed medication, and seeking medical advice when needed. With the availability of home blood pressure monitors, we can easily keep track of our blood pressure at our convenience, without the need for frequent visits to the doctor.

SpO<sub>2</sub> levels, also known as oxygen saturation or SpO<sub>2</sub>, measures the amount of oxygen in our blood. This vital sign is particularly crucial for people who suffer from respiratory ailments like sleep apnea, asthma, and chronic obstructive pulmonary disease (COPD).

By monitoring SpO<sub>2</sub> levels, we can detect any fluctuations that may indicate a respiratory problem and take appropriate actions to prevent any potential health risks. With the use of pulse oximeters, we can now easily

measure our SpO2 levels at home, providing us with a better understanding of our respiratory health[7].

In addition to vital signs related to our physical health, monitoring our sleep patterns has also become increasingly popular. Quality sleep is crucial for our overall well-being, and disruptions in our sleep patterns can have a significant impact on our health. With the use of sleep tracking devices, we can gather information on our sleep duration, quality, and patterns, providing us with insights into our sleep habits. This information can help us make necessary changes to our lifestyle and habits to improve the quality of our sleep, leading to better overall health. In all, monitoring our vital signs has become easier and more convenient with the use of technology.

By regularly tracking our heart rate, BP, SO2 levels, & a sleep patterns, mous can learn important things about our general health, and take necessary actions to maintain a healthy lifestyle. However, it is essential to keep in mind that these devices are not a substitute for medical advice, and any significant fluctuations or abnormalities should be discussed with a healthcare professional. With the right tools and knowledge, we can take control of our health and make informed decisions for a healthier and happier life.

Chemotherapy and radiation treatment are two commonly used methods for the treatment of cancer patients. Both of these treatments aim to destroy and stop cancer cells from migrating to other bodily regions. While they may have side effects, these treatments have been proven to be effective in fighting against cancer and improving the chances of survival for patients.

Drugs are used in chemotherapy treatment to eradicate cancer cells. These drugs can be administered through a pill, injection, or intravenously. The medication enters the bloodstream and target cancer cells, either killing them or stopping their growth. Chemotherapy is frequently used in conjunction with radiation therapy or surgery.

There are different types of chemotherapy drugs, and each one has a specific function in targeting cancer cells. Some drugs work by damaging the DNA of cancer cells, causing them to die. Others prevent cancer cells from growing and reproducing. The kind of chemotherapy employed is determined by the cancer's type and stage.

A team of doctors and specialists work together to ascertain each patient's optimal course of care. Chemotherapy is typically administered in phases, with a treatment phase and a recovery phase to give the body time to heal. According to the kind of cancer along with how each patient responds to treatment, these cycles can vary in length and frequency.

Hair loss, nausea, and exhaustion are among the temporary side effects of chemotherapy that can be controlled with drugs and dietary modifications[7].

On the other hand, radiation therapy employs high-energy rays to destroy cancer cells. The radiation is targeted at the specific areas of the body where cancer is present. It works by damaging the DNA of cancer cells, preventing them from multiplying and eventually causing them to die. Radiation therapy is usually administered daily in small doses over a period of several weeks.

Radiation therapy comes in two forms: internal and external beam radiation. The most popular kind, known as external beam radiation, involves directing radiation toward the affected area with a machine. Known by another name, brachytherapy, internal radiation therapy entails implantation of radioactive material in the body close to the cancerous cells. This method is often used for gynecological and prostate cancers.

Similar to chemotherapy, radiation therapy can have side effects include weariness, irritated skin, and hair loss. Medication and lifestyle modifications can help manage these transient effects. The side effects usually subside once the treatment is completed[2].

Both chemotherapy and radiation therapy can be used as standalone treatments or in combination with other treatments like surgery or immunotherapy. The kind, the stage, and the location of the cancer, in addition to the patient's preferences and general health, all influence the treatment option. While these treatments have demonstrated their efficacy in handling cancer, they are not without their limitations.

In addition to causing adverse effects, radiation therapy or chemotherapy can harm healthy cells. Moreover, cancer cells can sometimes become resistant to these treatments, making them less effective. That is why continuous research and advancements in technology are crucial in improving these treatments and finding new ways to fight against cancer.

For cancer patients, chemotherapy and radiation therapy are the most frequently utilized treatments. They work by targeting and destroying cancer cells, improving the chances of survival for patients. While they may have side effects, these treatments have been proven to be effective and are often used in combination with other treatments. With ongoing research and advancements, we can hope for even more effective treatments in the future.

## 2. METHODOLOGY-

Figure 1 show the proposed system. It has monitor heart rate, BP, SpO2 levels, and an sleep patterns.

- The treatments for cancer, such as chemotherapy and radiation, can significantly affect a patient's mental and physical health. One aspect that is often overlooked in cancer treatment is the effect of heart rate on the patient. In this article, we will discuss how heart rate can affect cancer patients and the importance of monitoring it



during treatment. However, cancer patients may experience changes in their heart rate due to various factors, including the type of cancer and its location, the stage of cancer, and the treatments being administered. For instance, chemotherapy drugs can damage the heart muscle and affect its ability to pump blood effectively, leading to an increase in heart rate. One of the most significant effects of an elevated heart rate on cancer patients is the increased risk of cardiovascular complications. Research has shown that cancer patients with a higher resting heart rate are at a higher risk of developing heart problems such as heart failure, heart attack, and stroke.

- This is because a higher heart rate puts extra strain on the heart, which can cause damage to the heart muscle and blood vessels. For cancer patients who are already undergoing extensive treatments, such complications can further compromise their health and delay their recovery. Moreover, an elevated heart rate can also affect the effectiveness of cancer treatment. Chemotherapy and radiation therapy work by targeting and killing cancer cells, but they can also damage healthy cells in the body. When the heart rate is high, it means that the heart is working harder to pump blood, which can result in a reduced blood flow to other organs and tissues. This can decrease the delivery of chemotherapy drugs to cancer cells, making the treatment less effective. It can also lead to a delay in the recovery of healthy cells, causing further complications for the patient. Aside from physical effects, an elevated heart rate can also have a significant impact on a cancer patient's mental health. Many cancer patients experience anxiety and stress during treatment, which can cause an increase in heart rate. This can create a vicious cycle as an elevated heart rate can further exacerbate feelings of anxiety and stress. It is crucial to note that cancer treatment is already emotionally taxing, and the added stress of an increased heart rate can have a severe impact on a patient's mental well-being.
- Patients with cancer frequently receive a range of treatments, including radiation therapy, chemotherapy, and surgery can take a toll on their physical and mental health. Along with these treatments, managing BP is also crucial for cancer patients. Research has shown that cancer patients are more likely to have high BP compared to the general population. This is due to various factors such as the cancer itself, certain cancer treatments, and lifestyle changes.

In some cases, cancer can cause an increase in BP by affecting the hormones and chemicals that control it. Chemotherapy drugs can also damage the lining of the blood vessels, leading to an increase in blood pressure. Moreover, lifestyle changes such as stress, High BP within cancer patients may additionally be caused by an unhealthy diet and inactivity. High BP in cancer patients can have a significant impact on their overall health and treatment. It can lead to cardiovascular problems such as heart attacks, strokes, and heart failure. Cancer patients undergoing chemotherapy or radiation therapy may already have a weakened immune system, and high BP can further compromise their immune system, making them more vulnerable to infections. It can also affect the effectiveness of cancer treatments, making it difficult for the patient to recover. On the other hand, low blood pressure, also known as hypotension, is also a common problem in cancer patients. This is due to the side effects of cancer treatments such as dehydration, electrolyte imbalances, and anemia. Low BP can cause dizziness, fatigue, and weakness, making it difficult for cancer patients to carry out their daily activities. It can also lead to poor oxygen supply to the body, which can affect the functioning of vital organs such as the heart and brain. Managing BP is crucial for cancer patients to improve their overall health and quality of life. Regular monitoring of BP is essential to detect any changes and take necessary actions. Cancer patients should additionally alter their way of living to lower their blood pressure, such as eating a balanced diet, getting regular exercise, and learning how to handle stress. In some cases, medications may be prescribed to manage high or low blood pressure. However, it is crucial to consult a doctor before starting any medication, as it may interact with cancer treatments.

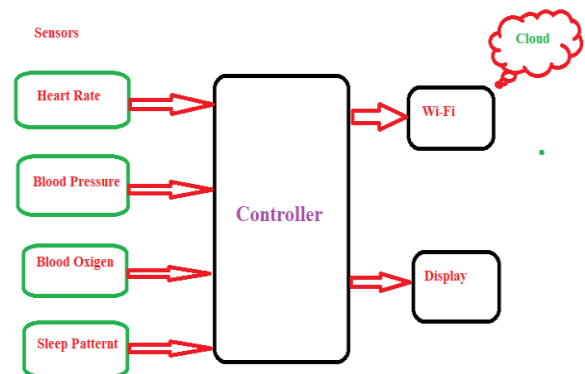


Figure 1- Proposed system

- One crucial aspect of cancer treatment is maintaining adequate SpO<sub>2</sub> levels, as it can have a significant impact on the patient's overall health and well-being. SpO<sub>2</sub> refers to the amount of oxygen carried by red blood cells throughout the body. It is essential for the proper functioning of all body organs, including the brain, heart, and muscles. In cancer patients, maintaining optimal SpO<sub>2</sub> levels is vital as it helps in the body's fight against the disease. Cancer cells thrive in a low-oxygen environment, and by increasing the oxygen levels, it becomes challenging for them to survive and grow. One of the most common treatments for cancer is chemotherapy, a procedure that uses a combination of medications to kill cancer cells. However, these medications can also damage healthy cells, leading to a decrease in the body's oxygen levels. This can cause fatigue, shortness of breath, and weakness in cancer patients, making it difficult for them to carry out daily activities. Furthermore, immune systems that are compromised in cancer patients often leave them more vulnerable to infections.
- Adequate SpO<sub>2</sub> levels are crucial for the immune system to function correctly and fight off infections. Low oxygen levels can compromise the immune system, making it difficult for the body to defend itself against infections, leading to further complications for cancer patients. Furthermore, low SpO<sub>2</sub> levels can also affect the patient's mental health. Cancer treatment is often accompanied by emotional distress, such as anxiety and depression. Low oxygen levels can exacerbate these symptoms and lead to feelings of confusion, disorientation, and irritability. It can also affect concentration and memory, making it challenging for patients to cope with the treatment and its side effects. On the other hand, maintaining optimal SpO<sub>2</sub> levels can significantly benefit cancer patients. It can help reduce fatigue, improve physical endurance, and increase overall energy levels. This can make daily tasks more manageable and improve the patient's quality of life.
- Adequate oxygen supply to the brain can also improve cognitive function, allowing patients to think clearly and make informed decisions about their treatment. One way to increase SpO<sub>2</sub> levels in cancer patients is through oxygen therapy. To raise the blood's oxygen content,

pure oxygen is inhaled via a mask or nasal cannula. This can help alleviate symptoms related to low oxygen levels, such as fatigue and shortness of breath. Oxygen therapy can also improve the effectiveness of other cancer treatments, such as chemotherapy and radiation therapy, by increasing the oxygen supply to the tumor site. In addition to oxygen therapy, cancer patients can also improve their SpO<sub>2</sub> levels by adopting a healthy lifestyle. Regular exercise can help increase lung capacity, allowing the body to take in more oxygen. A balanced diet rich in antioxidants can also help improve oxygen levels, since these substances aid in shielding cells from harm brought on by free radicals.

- One aspect that is often overlooked in cancer treatment is the patient's sleep pattern. Sleep plays a crucial role in maintaining overall health, and any disruption in sleep can have a significant impact on the body, especially for cancer patients. Cancer and its treatments can lead to various sleep disturbances, such as insomnia, sleep apnea, and restless leg syndrome. These disruptions can be caused by physical symptoms of the disease, side effects of medication, or psychological distress. Pain, fatigue, and nausea are common symptoms of cancer and its treatments, making it challenging for patients to fall asleep or stay asleep. Chemotherapy and radiation therapy can also cause hormonal changes, leading to night sweats and hot flashes, further disrupting sleep. Sleep is essential for the body to repair and regenerate itself. Cancer patients who experience poor sleep may have a weakened immune system, making them more vulnerable to infections and other illnesses. It can also affect the body's ability to heal, leading to delayed recovery from treatments and surgeries.
- Poor sleep can also increase the risk of cardiovascular diseases, obesity, and diabetes, which can have a significant impact on the overall health of cancer patients. Cancer patients often experience high levels of stress, anxiety, and depression. These emotional distresses can further worsen their sleep patterns, creating a vicious cycle. Insufficient sleep can cause irritability, mood fluctuations, and trouble focusing, making it challenging for patients to cope with their diagnosis and treatment. It can also affect their quality of life, leading to feelings of hopelessness and helplessness. Quality sleep is crucial for cancer patients as it can have a significant impact on their treatment

outcome. Studies have shown that poor sleep can affect the effectiveness of chemotherapy and radiation therapy. Lack of sleep can also lead to a higher risk of cancer recurrence and lower survival rates. It is essential for cancer patients to have enough rest and sleep to give their bodies the strength and energy to fight the disease.

Required component parts:

- MLX6014;
- MAX30100;
- ESP8266 (NodeMCU);

The list of components that are going to be utilized for this endeavor is provided here. The focal point of this project is Esp8266 (NodeMCU). It will be in charge of everything in this endeavor, sensor calibration, data transmission to a server, and programming. The Max30100 has a sensor which measures blood SPO2 levels and heart rate. The sensor emits some infrared radiation. And this aids in the sensor's information retrieval. The IR temperature sensor, model number MLX6014, uses infrared technology to measure temperature. It sends out infrared radiation, and following some post-processing, it measures the temperature. Figure 2 shows the connection of proposed system.

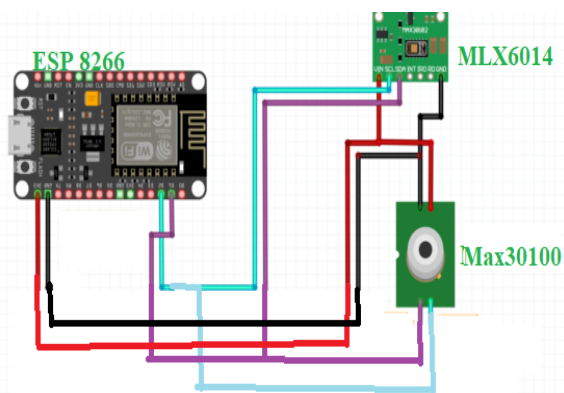


Figure 2- Proposed System

As of right now, only I2C communication is supported by the sensor. We used the sensor's SDA and SCL pins in addition to the controllers for I2C communication. The NodeMCU SDA pin, located at D2, is where we need to connect the two SDAs from the MAX30100 (the pulse sensor) along with MAX6014 (IR temperature sensor).

The SCL pins coming from both devices should also be connected to the NodeMCU's D1 pin, which is the SDA pin. Connect the Vcc of both devices to the 3v3 pin at the NodeMCU and connect all of the GND together to finish the connections for the Cancer patient health

monitoring the endeavor. Everything is shown in this circuit diagram(Figure 2).

### 3. RESULTS AND DISCUSSION –

IoT technology can help cancer patients live better lives by allowing for the continuous evaluation of their health and providing timely interventions. This has led to the development of IoT-based cancer patient health monitoring systems, which have gained significant attention in recent years.

The primary goal of these systems is to provide continuous and personalized care for cancer patients, enabling them to live a better quality of life. These systems use numerous IoT gadgets, including wearable sensors, intelligent gadgets, and mobile apps, to gather and send real-time wellness information to medical professionals.

This data includes vital signs such as heart rate, BP, SO2 levels, and activity levels, among others. Among the many noteworthy benefits of IoT-based cancer patient health monitoring systems is the ability to track a patient's health remotely. This means that patients do not need to visit the hospital frequently, reducing the burden on healthcare facilities, especially in times of a pandemic. Moreover, this remote monitoring also allows for early identification of any health problems, allowing for prompt treatment and lowering the possibility of complications.

Furthermore, IoT-based cancer patient health monitoring systems also promote self-management and empowerment among patients. With access to their real-time data, patients can actively participate in their treatment by making necessary lifestyle changes and adhering to medication schedules. This enhances not just their physical wellness but additionally their mental health as they feel more in control of their condition.

But just like with any other kind of technology, there's are certain issues that must be resolved for the effective implementation of IoT-based cancer patient health monitoring systems. The first and foremost is data privacy and security.

As these systems collect sensitive health data, it is crucial to ensure that this information is protected from any unauthorized access. Moreover, there is also a need for proper training and education for both healthcare professionals and patients on how to use and interpret the data collected by these systems. This will ensure the accurate and effective use of this technology in patient care.

Studies have indicated that the prevalence of high BP is higher in cancer patients than in the general population. This is caused by a number of things, including the cancer itself, specific cancer therapies, and modifications to lifestyle. Cancer can occasionally raise



BP by altering the hormones and other chemicals that regulate it.

Drugs used in chemotherapy have the potential to harm blood vessel lining, which raises blood pressure. Furthermore, alterations in lifestyle that include stress, poor eating habits, and inactivity can also lead to hypertension in cancer patients.

Figure 3 show BP measure for patient. Table 2 show the measure of parameters for prescribed timing and Figure 4 shows the comparison of Heart rate and Body Temperature day and date wise and Figure5 shows the BP records of patient.



Figure 3- BP measurement

TABLE 1- MEASURES OF BP, HEART RATE AND BODY TEMPERATURE

Date and Time	BP	Heart Rate	Body Temp.
12.10.2022, 3.45	132,105	64	37.2
12.11.2022, 2.32	139,100	59	37.1
12.12.2022, 12.45	135,98	72	37
12.01.2023, 1.45	136, 101	75	37.3
12.02.2023, 6.30	129,95	67	37.3
12.03.2023, 3.45	132, 103	69	37.2
12.04.2023, 4.54	136, 96	72	37.1
12.05.2023, 12.34	140, 104	72	37.3
12.06.2023, 8.45	135, 98	65	37.2

Figure 4- Comparison chart for Heart rate and Body temperature

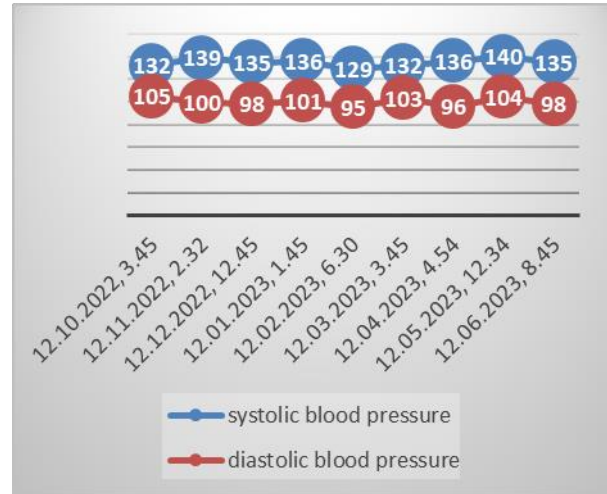


Figure 5- BP measures

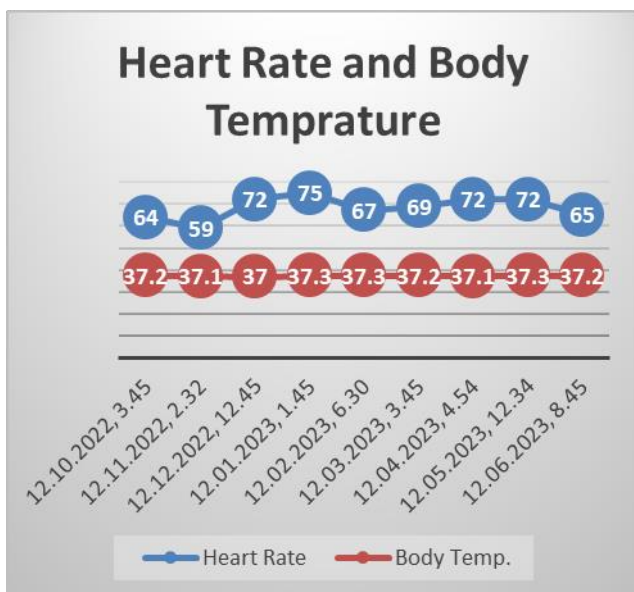
In cancer patients, maintaining optimal SpO2 levels is vital as it helps in the body's fight against the disease. Cancer cells thrive in a low-oxygen environment, and by increasing the oxygen levels, it becomes challenging for them to survive and grow. Figure 6 shows the heart rate and SpO2 level of Patient and Table 2 shows SpO2/SO2 level and Figure 7 shows the SO2 plot against data and time for comparison.



Figure 6- Heart rate and Oxygen measurement

TABLE 2- SO2 MEASURE

Date and Time	SO2
12.10.2022, 3.45	96
12.11.2022, 2.32	98
12.12.2022, 12.45	99
12.01.2023, 1.45	95
12.02.2023, 6.30	97
12.03.2023, 3.45	99
12.04.2023, 4.54	98
12.05.2023, 12.34	99
12.06.2023, 8.45	97



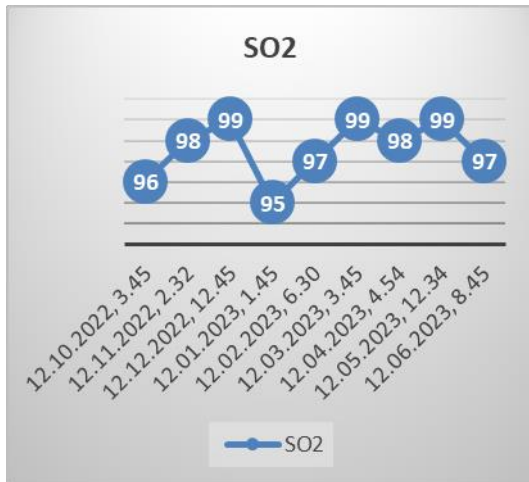


Figure 7-SO2 plot against date and time

TABLE 3- BREATHING AND FEELING RECORDS

Date and Time	Breathing (better/Worst, Same)	Feeling (Test) better/ Worst, Same)
12.10.2022, 3.45	Better	Better
12.11.2022, 2.32	Better	Better
12.12.2022, 12.45	Better	Better
12.01.2023, 1.45	Better	Better
12.02.2023, 6.30	Better	Better
12.03.2023, 3.45	Better	Better
12.04.2023, 4.54	Better	Better
12.05.2023, 12.34	Better	Better
12.06.2023, 8.45	Better	Better

Table 3 includes the records taken about breathing condition of patient and feeling condition after treatment. This conditions are maintained continuously by the feedback taken from cancer patient. This information is asked to the patient verbally. The entire experimentation is conducted in Solapur, Maharashtra by the permission of patient. We consider initially single patient who was treated after Breast Cancer and operated on August 2022 and monitors after discharge from hospital under doctor's vigilance.

Quality sleep is crucial for cancer patients as it can have a significant impact on their treatment outcome. Studies have shown that poor sleep can affect the effectiveness of chemotherapy and radiation therapy. Lack of sleep can also lead to a higher risk of cancer recurrence and lower survival rates. It is essential for cancer patients to have enough rest and sleep to give their bodies the strength and energy to fight the disease. There are various ways to improve sleep patterns for cancer patients. Firstly, it is vital to address any physical discomfort by managing symptoms such as pain and nausea.

Patients can also try relaxation techniques such as deep breathing, meditation, and mindfulness to reduce stress and anxiety. Creating a comfortable sleeping environment, with a dark, quiet, and cool room, can also

aid in improving sleep quality. It is crucial for cancer patients to maintain a regular sleep-wake cycle and avoid napping during the day. A regular nighttime ritual, like reading a book, having a warm bath, or turning on relaxing music, can also promote better sleep. Patients should also limit their caffeine and alcohol intake, which can disrupt sleep patterns.

IoT technology has also revolutionized the way cancer patients receive treatment. With the help of IoT-based radiation therapy, doctors can now deliver precise and targeted radiation to cancer cells, minimizing the damage to healthy cells. This technology also allows doctors to monitor the patient's response to treatment and make necessary adjustments for better outcomes. Furthermore, IoT-based solutions have also improved the communication and coordination between healthcare providers, patients, and caregivers. Through connected devices and telemedicine, patients can consult with their physicians virtually, which eliminates the requirement for frequently hospital stays. This lowers the chance of exposure to and saves time and money in addition to infections, especially for immunocompromised cancer patients.

#### Measures for Performance Evaluation:-

To assess the precision of the prediction results, a number of common metrics for performance assessment were put forth, including, mean error(ME), Mean square error(MSE), in our system.

**Mean Error(ME)-** The average value of any errors that occur in an array is referred to as the mean error, which is an informal term. In this context, a "error" refers to a measurement's uncertainty or the discrepancy between the measured and true/correct values. Measurement error, also known as observational error, is the most formally terms for error. Figure 8 shows the ME for Proposed system which is calculated by Equation (1).

$$ME = \frac{\delta}{n} \quad \text{--(1)}$$

Where,  $\delta$ - Standard deviation, and n- Number of values.

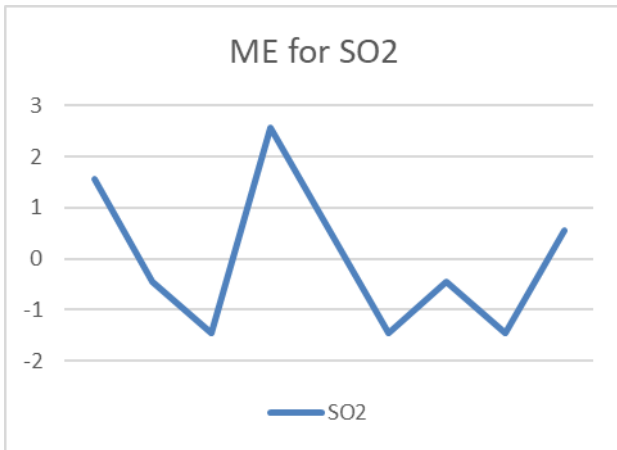


Figure 8- Mean Error for SO2

**Mean Square Error(MSE)**- The statistical model's error level is measured by mean squared error, or MSE. The average of the squared variance between the actual and projected values is evaluated. The MSE is equal to zero in a model that has no errors. The value of the model increases with the error. Another name for the mean squared error is the mean squared deviation (MSD). Figure 9 shows MSE for the proposed systems which is calculated by Equation(2).

$$MSE = \frac{\sum(y_i - \hat{y}_i)^2}{n} \quad \text{---(2)}$$

Where,  $i^{th}$  observed value-  $y_i$ , the associated predicted value -  $\hat{y}_i$ .  $n$  - number of observations

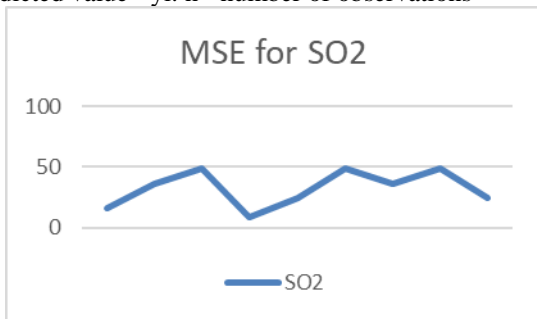


Figure 9- Shows the MSE for SO2.

#### 4. CONCLUSION-

Health monitoring is a vital aspect of cancer treatment that should not be overlooked. It provides patients with a sense of control over their health and allows doctors to detect any potential complications early on. With the help of advanced technologies and regular check-ups, cancer patients can have better health outcomes and an improved quality of life. It is crucial to encourage patients to actively participate in their health monitoring and seek medical help if they notice any

changes in their health. Together, we can fight cancer and improve the lives of those affected by this disease. In conclusion, IoT-based cancer patient health monitoring has the potential to greatly improve the management and treatment of cancer. With its real-time data collection, remote monitoring capabilities, and personalized treatment options, it can lead to better health outcomes for patients. With the patient's consent, the entire experiment is carried out in Solapur, Maharashtra. However, it is crucial to address the challenges and concerns associated with this technology to ensure its safe and effective implementation in the healthcare industry.

- The heart rate of a cancer patient is a crucial factor that should not be overlooked during treatment. An elevated heart rate can have detrimental effects on the patient's physical and mental health, as well as the effectiveness of cancer treatment. Therefore, cancer patients should be aware of the importance of monitoring their heart rate and promptly inform their healthcare provider of any changes. With proper management of heart rate, cancer patients can improve their overall well-being and increase their chances of a successful recovery.
- BP plays a significant role in the health of cancer patients. High or low BP can have a negative impact on their treatment and overall well-being. Therefore, cancer patients should be aware of their BP levels and take necessary steps to manage it. Along with proper cancer treatment, a healthy lifestyle and regular monitoring of BP can help cancer patients lead a better quality of life.
- Sleep plays a crucial role in the overall health and well-being of cancer patients. Poor sleep can have a detrimental effect on their physical and mental health, treatment outcome, and quality of life. It is essential for healthcare providers to address sleep disturbances in cancer patients and provide them with necessary support and interventions to improve their sleep patterns. With better sleep, cancer patients can have the strength and resilience to fight their disease and improve their overall quality of life.

However, like any other technology, IoT also has its limitations when it comes to cancer treatment. Privacy and security concerns are a significant issue in the healthcare industry, and the use of IoT devices can make patient data vulnerable to cyberattacks. Therefore, proper measures must be taken to ensure the security and confidentiality of patient information.



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**Conflict** – No Conflict.

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