# PHOTOTHERAPY BASED ON INFERIAL HEALTH CHILD CONDITION USING IOT PATIENTS WITH NEONATAL JAUNDICE

A Major project report submitted
in partial fulfillment of requirement for the award of degree

**BACHELOR OF TECHNOLOGY**
in
**ELECTRONICS & COMMUNICATION ENGINEERING**
by


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# CERTIFICATE

This is to certify that this project entitled **"PHOTOTHERAPY BASED ON INFERIAL HEALTH CHILD CONDITION USING IOT PATIENTS WITH NEONATAL JAUNDICE** " is the bonafied work carried out by **K. SHRAVAN KUMAR**, **B. KARTHIK, G. RAHUL SAI and MD. ADNAN** as a Capstone Phase-I project for the partial fulfillment to award the degree **BACHELOR OF TECHNOLOGY** in **ELECTRONICS & COMMUNICATION ENGINEERING** during the academic year 2023-2024 under our guidance and Supervision.

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# ACKNOWLEDGEMENT

We wish to take this opportunity to express our sincere gratitude and deep sense of respect to our beloved Vice Chancellor, **Prof. DEEPAK GARG,** for his continuous support and guidance to complete this project in the institute.

We would like to extend our gratitude to **Dr. Ram Raghotham Rao Deshmukh**, **Professor,** the Dean of the School of Engineering, and **Dr. Sandip Bhattacharya**, **Professor** and Head of the ECE Department, for their encouragement and support.

We owe an enormous debt of gratitude to our project guide **Dr. J. Ravichander, Associate Prof.** as well as project coordinators **Mr. S. Srinivas, Asst. Prof., Dr. R. Shashank, Asst. Prof.**, for guiding us from the beginning through the end of the Major project with their intellectual advices and insightful suggestions. We truly value their consistent feedback on our progress, which was always constructive, encouraging and ultimately drove us to the right direction.

Finally, we express our thanks to all the teaching and non-teaching staff of the department for their suggestions and timely support.

# ABSTRACT

The present work is focused on developing a system to support and save the lives of infants affected by neonatal jaundice. This system integrates Arduino Uno and ESP32 microcontrollers to provide precise and effective phototherapy. Healthcare providers can input bilirubin levels using a 4x4 keypad, triggering UV light control by Arduino Uno. Simultaneously, ESP32 collects vital data such as heart rate, temperature, and weight, creating a comprehensive dataset for tailored UV light treatment. Real-time feedback on a 16x2 LCD screen provides immediate insights, while the dataset is securely uploaded to the BLYNK IoT platform. Through the BLYNK mobile app, healthcare providers and parents can monitor the child's progress, ensuring individualized and data-driven neonatal care.

Neonatal jaundice, characterized by high levels of bilirubin in infants, can lead to irreversible brain damage and kernicterus. This condition affects a significant percentage of newborns, especially preterm infants. Phototherapy is a common treatment method, which converts bilirubin into water-soluble compounds that can be excreted without further metabolism. The effectiveness of phototherapy depends on various factors, including the type of light source used. Traditional light sources such as fluorescent bulbs and halogen bulbs have been used, but recent advancements have led to the development of LED lights, which offer a more efficient and targeted approach for phototherapy.

The integration of LED lights into the phototherapy system marks a significant advancement in neonatal care. LEDs are power-efficient, portable, and have a longer lifespan compared to traditional light sources. Their narrow band of blue light overlaps with the peak spectrum of bilirubin breakdown, potentially reducing treatment time. However, prolonged exposure to UV rays can pose risks, including the development of cancer. Despite this concern, the benefits of LED phototherapy in providing safer and more effective treatment for neonatal jaundice outweigh the risks, making it an optimal choice for neonatal care.

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# LIST OF ACRONYMS

| ACRONYM | ABBREVIATION |
|---|---|
| IOT | Internet Of Things |
| UV | Ultraviolet Light |
| LED | Light Emitting Diode |

# CHAPTER 1

# INTRODUCTION

## 1.1 OVERVIEW OF THE PROJECT

Most Neonatal jaundice is a condition in infants characterized by the presence of high level of bilirubin. Increased levels of serum bilirubin cause irreversible brain damage and kernicterus in infants. Jaundice occurs in the first two weeks of life in 25% to 60% of full-term newborns, and in 80% of preterm newborns The phototherapy. It converts bilirubin into water soluble photo-products that can bypass the hepatic conjugating system and be excreted without further metabolism. The clinical response to phototherapy depends on the efficacy of the phototherapy device, as well as the infant's rates of bilirubin production and elimination. Phototherapy is the use of Ultraviolet Light (UV) for reducing the concentration of bilirubin in the body of infants. Phototherapy can be delivered using several types of conventional light sources, including daylight, white or blue fluorescent bulbs and filtered halogen bulbs.

In recent years, a new type of light source, light-emitting diodes (LEDs), has been developed and studied as possible light sources for the phototherapy. LEDs are power efficient, portable, with low heat production, not heavy and have a longer life span. Blue LEDs emit a high intensity narrow band of blue light overlapping the peak spectrum of bilirubin breakdown resulting in potentially shorter treatment time. These characteristics of LEDs make them an optimal light source for a Phototherapy device. But, exposing of child to the UV rays for long time leads to the cancer. A number of preliminary studies report inconsistent associations between phototherapy and cancer, mostly showing weak or no associations with leukemia. More recent cohort studies have been inconclusive.9,10 The most concerning findings suggest that neonatal phototherapy may be associated with 1.4 times the risk of any cancer, 2.6 times the risk of myeloid leukemia and 2.5 times the risk of kidney cancer before 1 year of age.10 However, studies have not investigated delayed effects of phototherapy, despite the possibility that cancer develops only after a latency period has passed. If an association is present, it is likely that neonatal phototherapy leads to cancer several years after exposure. Therefore, the impact of neonatal phototherapy, if any, on development of cancer later in childhood remains unclear. We sought to determine if neonatal phototherapy is associated with an increased risk of childhood cancer, and if the risk increases with greater latency.

Although there are several treatment schemes available in the clinical setting, blue light is generally the preferred choice for preventing the development of bilirubin encephalopathy or nuclear jaundice caused by excessive accumulation of unconjugated bilirubin. A high serum level of free bilirubin may cause neurotoxicity, but mildly elevated bilirubin concentrations are beneficial due to their protective antioxidant role in cell membranes, while markedly low concentrations may also be harmful. However, during the treatment of neonatal hyperbilirubinemia, the level of free bilirubin in the serum is decreased, which may weaken the protective effect of bilirubin on the cell membrane, thus making the cell membrane susceptible to injury and causing cell apoptosis. This injury may be associated with the oxidative stress induced by phototherapy, or with the upregulation of the BAX gene, which promotes apoptosis induced by phototherapy. Moreover, accumulating evidence in recent years has indicated that phototherapy may elicit a series of adverse reactions, including DNA damage, cancer risk and mortality. Since the mechanism underlying certain phototherapy-induced adverse effects remains unclear, additional in-depth studies are required. Furthermore, novel treatments must be designed to prevent serious harm to newborns.

By harnessing the potential of LED phototherapy and implementing innovative solutions to control UV exposure, your work aims to make this vital treatment even safer and more effective, ultimately reducing the risk of skin rashes or the development of cancer in neonates undergoing phototherapy. This research has the potential to significantly benefit neonatal care and pediatric healthcare practices, ensuring the best possible outcomes for infants with jaundice.

### 1.1.1 INTRODUCTION TO EMBEDDED SYSTEM

Embedded Technology is now in its prime and the wealth of knowledge available is mind blowing. However, most embedded systems engineers have a common complaint. There are no comprehensive resources available over the internet which deal with the various design and implementation issues of this technology. Intellectual property regulations of many corporations are partly to blame for this and also the tendency to keep technical know-how within a restricted group of researchers.

An embedded computer is frequently a computer that is implemented for a particular purpose. In contrast, an average PC computer usually serves a number of purposes: checking email, surfing the internet, listening to music, word processing, etc... However, embedded systems usually only have a single task, or a very small number of related tasks that they are programmed to perform.

Every home has several examples of embedded computers. Any appliance that has a digital clock, for instance, has a small embedded micro-controller that performs no other task than to display the clock. Modern cars have embedded computers onboard that control such things as ignition timing and anti-lock brakes using input from a number of different sensors.

Embedded computers rarely have a generic interface, however. Even if embedded systems have a keypad and an LCD display, they are rarely capable of using many different types of input or output. An example of an embedded system with I/O capability is a security alarm with an LCD status display, and a keypad for entering a password.

An embedded system can be defined as a control system or computer system designed to perform a specific task. Common examples of embedded systems include MP3 players, navigation systems on aircraft and intruder alarm systems. An embedded system can also be defined as a single purpose computer.

Most embedded systems are time critical applications meaning that the embedded system is working in an environment where timing is very important: the results of an operation are only relevant if they take place in a specific time frame. An autopilot in an aircraft is a time critical embedded system. If the autopilot detects that the plane for some reason is going into a stall then it should take steps to correct this within milliseconds or there would be catastrophic results.

### 1.1.2 APPPLICATION OF EMBEDDED SYSTEM

Embedded systems are used in transportation, fire safety, safety and security, medical applications and life critical systems, as these systems can be isolated from hacking and thus, be more reliable.

Telecommunications systems employ numerous embedded systems from telephone switches for the network to cell phones for the end user. Computer networking uses dedicated routers and network bridges to route data.

Consumer electronics include MP3 players, mobile phones, video game consoles, digital cameras, GPS receivers, and printers. Household appliances, such as microwave ovens, washing machines, and dishwashers, include embedded systems to provide flexibility, efficiency, and features. Advanced HVAC systems use networked thermostats to more accurately and efficiently control temperature which can change by time of day and season. Home automation uses wired- and wireless networking that can be used to control lights, climate, security, audio/visual, surveillance, etc., all of which use embedded devices for sensing and controlling.

Transportation systems from flight to automobiles increasingly use embedded systems. New airplanes contain advanced avionics such as inertial guidance systems and GPS receivers that also have considerable safety requirements. Various electric motors brushless DC motors, induction motors, and DC motors use electric/electronic motor controllers. Automobiles, electric vehicles, and hybrid vehicles increasingly use embedded systems to maximize efficiency and reduce pollution.

Medical equipment uses embedded systems for vital signs monitoring, electronic stethoscopes for amplifying sounds, and various medical imaging (PET, SPECT, CT, and MRI) for non-invasive internal inspections. Embedded systems within medical equipment are often powered by industrial computers.

### 1.1.3 INTRODUCTION TO INTERNET OF THINGS

The Internet of things (IoT) describes physical objects (or groups of such objects) that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Defining the Internet of things as "simply the point in time. When more 'things or objects' were connected to the Internet than people". An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors, and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices for instance, to set them up, give them instructions or access the data.

The internet of things helps people live and work smarter, as well as gain complete control over their lives. In addition to offering smart devices to automate homes, lot is essential to business. IoT provides businesses with a real-time look into how their systems really work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

IoT can also make use of artificial intelligence (AI) and machine learning to aid in making data-collecting processes easier and more dynamic. IoT enables companies to automate processes and reduce labor costs. It also cuts down on waste and improves servicdelivery, making it less expensive to manufacture and deliver goods, as well as offering transparency in customer transactions.

# CHAPTER 2
# LITERATURE SURVEY

## 2.1 EXISTING METHODS

A survey of infant health and child condition-based phototherapy for neonatal jaundice patients involves collecting data and insights related to the use and effectiveness of phototherapy as a treatment modality for newborns with jaundice. Here is an outline of what such a survey might encompass:

**1. Patient Demographics:**

- Gather demographic information about the neonatal jaundice patients, including age, gender, birth weight, and gestational age.

**2. Diagnosis and Severity Assessment:**

- Determine the methods used for diagnosing neonatal jaundice, such as bilirubin level testing and clinical assessment.
- Assess the severity of jaundice in the surveyed infants, including the initial bilirubin levels.

**3. Phototherapy Treatment:**

- Explore the utilization of phototherapy as a treatment option for neonatal jaundice.
- Determine the types of phototherapy devices used (e.g., conventional phototherapy, LED phototherapy).
- Assess the duration and intensity of phototherapy sessions.

**4. Healthcare Provider Involvement**

- Investigate the role of healthcare professionals in the management of neonatal jaundice and the administration of phototherapy.

- Assess the level of training and expertise among healthcare providers in using phototherapy equipment.

**5. Treatment Outcomes:**

- Evaluate the effectiveness of phototherapy in reducing bilirubin levels and resolving jaundice in the surveyed infants.
- Assess any complications or adverse effects associated with phototherapy.

**6. Monitoring and Follow-up:**

- Determine the frequency of bilirubin level monitoring during phototherapy.
- Assess the provision of follow-up care and monitoring after phototherapy treatment is completed.

**7. Parental Involvement and Education:**

- Explore the extent of parental involvement in the care of neonatal jaundice patients receiving phototherapy.
- Assess parental education and awareness regarding phototherapy treatment and neonatal jaundice.

**8. Home-Based Phototherapy:**

- Investigate the availability and utilization of home-based phototherapy options for neonatal jaundice patients.

## 2.2 MOTIVATION AND SCOPE OF THE WORK

"Infant Health Child Condition-Based Phototherapy for Neonatal Jaundice Patients" stems from the critical need to address the safety and long-term health outcomes of neonates undergoing phototherapy for neonatal jaundice. Phototherapy is a well-established and effective treatment for this common condition, but concerns regarding UV exposure and the potential risks it poses to infant health have become a subject of increasing concern. While traditional phototherapy sources have been in use for decades, the emergence of light-emitting diodes (LEDs) as a viable alternative provides an opportunity to significantly improve the treatment's safety and effectiveness.

This project is driven by the following factors:

**Safety of Neonates:** Neonates are highly vulnerable, and their health and well-being are of paramount importance. The potential risks associated with UV exposure during phototherapy, including skin rashes and the long-term possibility of cancer, demand immediate attention to ensure the safety of these infants.

**Advancements in LED Technology:** The advent of LED technology offers numerous advantages, including energy efficiency, portability, and the potential for reduced UV exposure. Capitalizing on these advantages can lead to safer and more effective phototherapy treatments.

**Healthcare Quality Improvement:** This project aligns with the broader objective of enhancing the quality of healthcare provided to neonatal jaundice patients. By addressing concerns and minimizing risks, healthcare professionals can confidently deliver phototherapy treatment while safeguarding the long-term health of the infants.

It will encompass a comprehensive set of activities aimed at improving the safety and effectiveness of phototherapy for neonatal jaundice. This project will focus on the following key aspects:

**Research and Development:** Conduct in-depth research to understand about the newborn neonatal jaundice patients. And effects of UV exposure during phototherapy and the benefits of LED-based light sources. Develop and optimize LED technologies that are best suited for neonatal jaundice treatment.

**Safety Enhancement:** Design innovative shielding mechanisms and real-time monitoring systems to minimize UV exposure during phototherapy sessions. Evaluate the effectiveness of these safety measures in practice.

**Clinical Trials and Evaluation:** Collaborate with healthcare professionals and institutions to conduct clinical trials and assess the real-world impact of LED-based phototherapy on neonates with jaundice. Collect data on short-term and long-term health outcomes.

**Education and Training:** Create educational materials and training programs for healthcare providers to ensure that they are well-informed and skilled in using LED-based phototherapy devices effectively and safely.

**Risk Mitigation:** Develop strategies to minimize potential health risks and address concerns related to UV exposure during neonatal jaundice treatment.

**Technological Advancements:** Explore emerging technologies, such as improved LED light wavelengths and innovative phototherapy device designs, to further enhance the safety and efficiency of treatment.

**Policy and Guidelines:** Contribute to the development of healthcare policies and guidelines that promote the safe and effective use of LED-based phototherapy for neonatal jaundice patients.

The scope of this project is ambitious, aiming to not only address the current challenges but also significantly advance the field of neonatal care. By improving the safety and long-term health outcomes of neonates undergoing phototherapy, this project has the potential to positively impact infant health and the quality of care provided to neonatal jaundice patients.

Based on survey findings, make recommendations for improving the use of phototherapy, enhancing parental education and support, and optimizing the overall care of neonatal jaundice patients. A survey of infant health and child condition-based phototherapy for neonatal jaundice patients can provide valuable insights into the utilization and effectiveness of this treatment modality and guide improvements in neonatal jaundice management practices.

## 2.3 PROBLEM STATEMENT

Despite the proven effectiveness of phototherapy in treating neonatal jaundice, concerns surrounding potential health risks, such as skin rashes and the long-term possibility of cancer due to ultraviolet (UV) exposure, persist. The use of traditional phototherapy sources, like fluorescent or halogen bulbs, raises questions about the safety and well-being of neonates undergoing treatment. Therefore, there is an urgent need to develop and implement innovative, LED-based phototherapy solutions to reduce UV exposure and enhance the safety and long-term health outcomes of neonatal jaundice patients. This problem statement calls for research and technological advancements to ensure that phototherapy remains a safe and effective treatment for infant health conditions while minimizing potential risks associated with UV exposure. i.e., to develop a child-friendly phototherapy solution to effectively treat neonatal jaundice in infants, addressing both medical efficacy and comfort, while minimizing potential risks and ensuring ease of use for healthcare providers and parents.

**Fig. 2.1: Phototherapy treatment**

## 2.4 PROPOSED SYSTEM FOR PHOTOTHERAPHY TREATMENT

It will enhance the safety and effectiveness of phototherapy by creating a non-invasive, real-time monitoring solution that tracks vital parameters such as temperature, pulse rate and weight of the baby. This system will provide timely alerts to caregivers, ensuring protective measures to prevent side effects like skin rashes, dehydration, and overheating, pulse rate and promoting optimal neonatal care. The proposed system employs UV light sources emitting specific wavelengths to facilitate the conversion of bilirubin into water-soluble compounds, aiding in their elimination from the infant's body. The Arduino ESP32 microcontroller acts as the central processing unit, regulating the intensity and duration of UV light exposure based on real-time bilirubin level measurements. These measurements are obtained through non-invasive sensors placed on the infant's skin. IoT technology is leveraged to transmit the collected data to a cloud-based platform, allowing healthcare providers and parents to remotely monitor the infant's progress. The cloud platform also facilitates the analysis of historical data, enabling personalized treatment adjustments and early intervention if necessary.

This involves the use of special UV lamps placed above or around the baby, usually in a neonatal incubator or under a phototherapy lamp. The baby is undressed and protected with eye shields to prevent exposure to the UV light. Fiber-optic phototherapy blankets or pads contain fiber-optic strands that emit UV light directly onto the baby's skin, increasing the surface area exposed to the light. Fiber-optic phototherapy blankets or pads contain fiber-optic strands that emit UV light directly onto the baby's skin, increasing the surface area exposed to the light. During phototherapy, healthcare providers closely monitor the baby's bilirubin levels, skin color, and vital signs to ensure that the treatment is effective and safe. The duration and intensity of phototherapy are adjusted based on the baby's response and bilirubin levels. Infants undergoing phototherapy wear special eye protection, usually in the form of adhesive eye shields or goggles, to shield their eyes from the UV light. In some cases, when the baby's jaundice is mild and stable, phototherapy can be administered at home under medical supervision. This allows the family to be involved in the baby's care while ensuring the necessary treatment is provided.

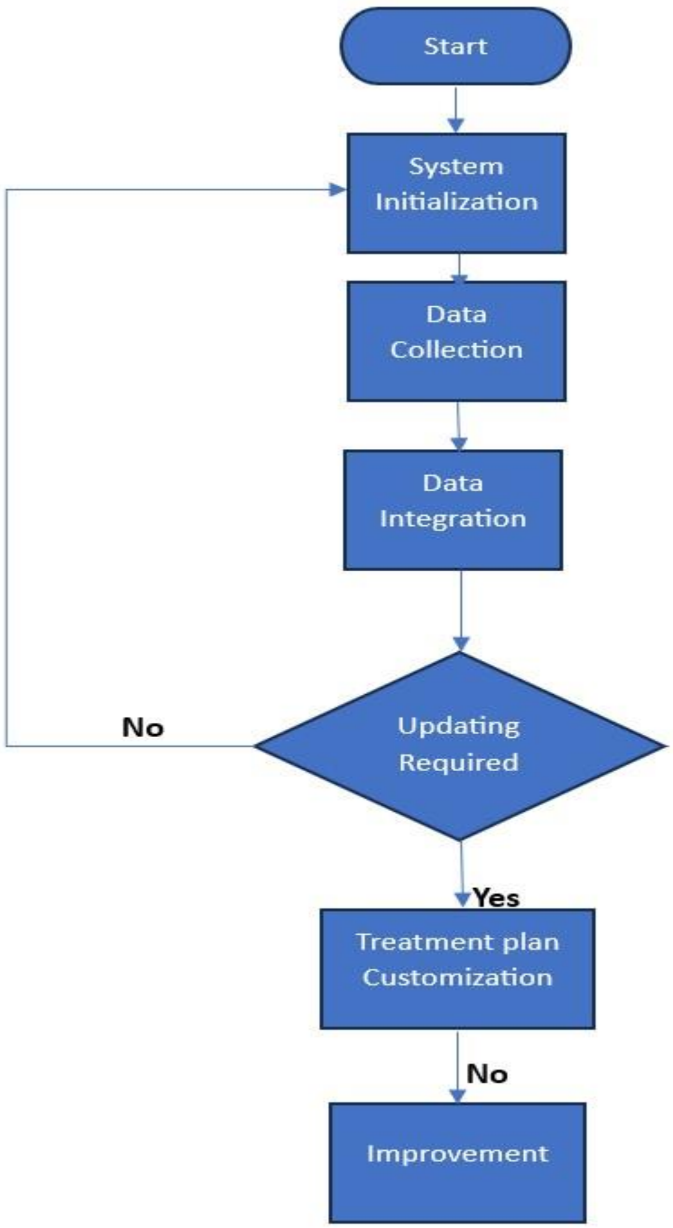


**Fig. 2.2: Flow chart**

## 2.5 PROPOSED METHOD

The discovery solves a crucial issue in the management of neonatal jaundice, a medical disorder that causes a newborn's skin and eyes to turn yellow because of high bilirubin levels in their bloodstream. Serious health issues might arise from inadequate newborn jaundice management. Creating tailored treatment plans for each neonate while considering their distinct health profiles, age, weight, and the degree of jaundice is the main goal of this innovation. The skin of the newborn is exposed to light wavelengths as part of phototherapy, a widely established therapeutic approach for neonatal jaundice. But due to a variety of circumstances, phototherapy's effectiveness differs across neonates, leading to a spectrum of outcomes. The goal of the innovation is to determine the ideal light intensity, duration, and color to solve this unpredictability. The idea uses advanced diagnostic instruments to continuously assess the neonate's state and real-time monitoring capabilities to enable this personalized approach. This real-time feedback system gives medical personnel the ability to modify the phototherapy plan as soon as necessary, ensuring that bilirubin levels fall at the optimal rate. Although phototherapy is successful, it should be noted that there are some possible adverse effects, such as skin irritability and dehydration in newborns. The invention is aware of these factors and uses techniques to lessen negative effects, protecting the infant's skin health and general comfort during the therapeutic procedure. The proposed innovation is painstakingly created to provide infants with jaundice with the highest caliber of care. By modifying treatment strategies to meet each patient's specific needs, this approach will act as a vital safeguard against the emergence of serious health issues resulting from untreated newborn jaundice.

The invention addresses a critical challenge in the management of neonatal jaundice, a medical condition characterized by the yellowing of a newborn's skin and eyes due to elevated bilirubin levels in their bloodstream. Failure to manage neonatal jaundice effectively can lead to severe health complications. The primary objective of this innovation is to develop individualized treatment protocols for each neonate, considering their unique health profiles, age, weight, and the severity of jaundice. Phototherapy is a widely accepted therapeutic modality for neonatal jaundice, involving the exposure of the infant's skin to specific light wavelengths. However, the efficacy of phototherapy varies among neonates due to a range of factors, resulting in differing responses. To address this variability, the invention strives to ascertain the optimal light intensity, duration of exposure, and frequency of phototherapy sessions for each neonate, thereby ensuring the expeditious and safe reduction of bilirubin levels. To facilitate this tailored approach, the invention incorporates real-time monitoring capabilities and employs advanced diagnostic tools to provide continuous assessment of the neonate's condition. This real-time feedback mechanism empowers healthcare professionals to make immediate adjustments to the phototherapy regimen as required, ensuring that bilirubin levels decrease at the desired rate. It is worth noting that phototherapy, while effective, is not without potential side effects, which can include skin irritation and dehydration in neonates. The invention is attentive to these considerations and employs strategies to mitigate adverse effects, thereby safeguarding the infant's skin health and overall comfort throughout the treatment process. This proposed innovation is meticulously designed to deliver the utmost standard of care for neonates with jaundice. By tailoring treatment plans to the unique requirements of each neonate and utilizing cutting-edge technology for real-time monitoring and adjustment, the invention strives to optimize treatment efficacy while ensuring the infant's safety and well-being. Ultimately, this approach serves as a crucial preventive measure against the development of severe health complications stemming from untreated neonatal jaundice.

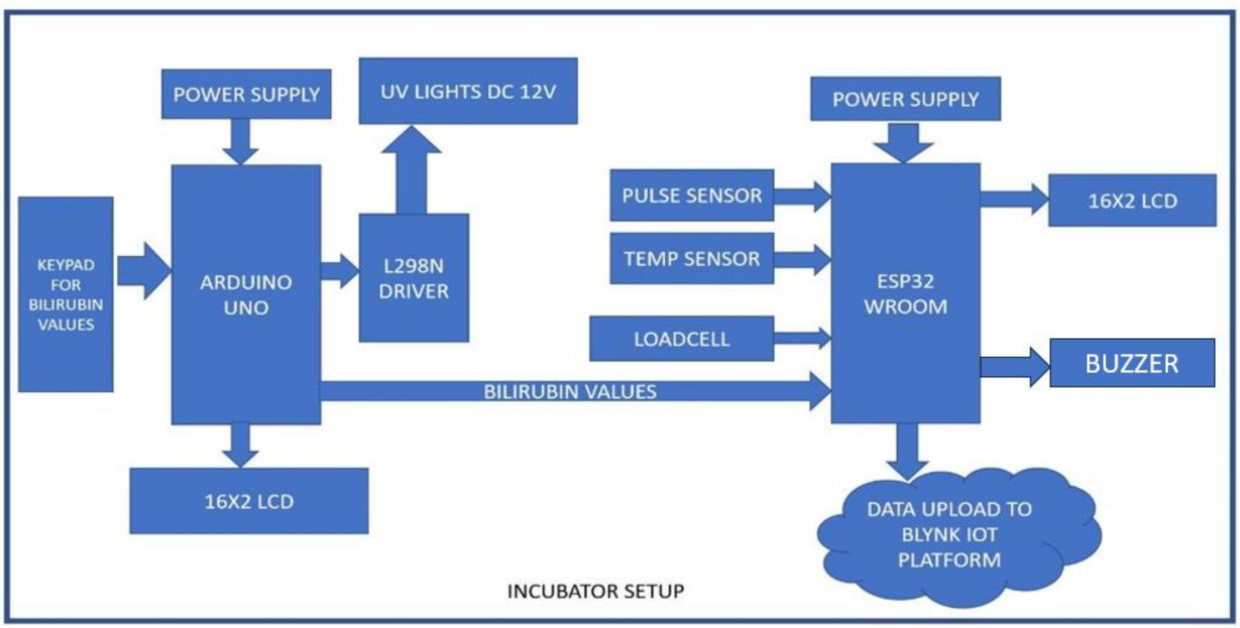


**Fig. 2.3:** Block diagram

# CHAPTER 3

# OBJECTIVES

The main objective is to provide neonates with effective and individualized treatment for neonatal jaundice while optimizing the efficiency and safety of care. The project prioritizes the health and well-being of newborns and seeks to reduce the impact of jaundice on both the infants and their families. The key objectives include:

**1. Customized Treatment:** Child condition-based phototherapy allows healthcare providers to customize the treatment plan based on the baby's specific needs. This individualized approach ensures that the intensity and duration of phototherapy are appropriate for the baby's bilirubin levels and overall health.

**2. Minimizes Risk of Complications:** By tailoring phototherapy to the baby's condition, the treatment can effectively reduce bilirubin levels and minimize the risk of complications associated with severe jaundice, such as kernicterus. This is crucial for the long-term health of the baby.

**3. Greater Comfort and Safety:** Monitoring the baby's vital signs, including heart rate, breathing, and temperature, ensures their comfort and safety throughout the treatment process. Any adverse reactions or complications can be promptly addressed.

**4. Effective Bilirubin Reduction:** Phototherapy has been proven to be highly effective in reducing bilirubin levels in neonatal jaundice patients. It works by breaking down excess bilirubin into a form that can be excreted by the baby's body, restoring a healthy skin color.

**5. Non-Invasive:** Phototherapy is a non-invasive treatment method that doesn't require painful procedures or medications. It is well-tolerated by most newborns and has a low risk of adverse effects.

**6. Improved Parental Involvement:** When phototherapy is administered in a hospital setting or at home, parents can actively participate in the care of their baby. This involvement can enhance bonding and provide parents with the confidence to care for their newborn, even after treatment.

**7. Cost-Efficient:** Shorter hospital stays and the potential for home phototherapy can lead to cost savings for families and healthcare systems, making neonatal jaundice management more affordable.

# CHAPTER 4
# HARDWARE/SOFTWARE TOOLS

## 4.1 HARDWARE DESCRIPTION

The hardware components used in this system are Arduino uno, Keypad 4x4, L298N, UV light, 16x2 LCD, 12V Adaptor, ESP32, Heart beat Sensor, DS18B20, Load cell, Buzzer.

### 4.1.1 ARDUINO UNO

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

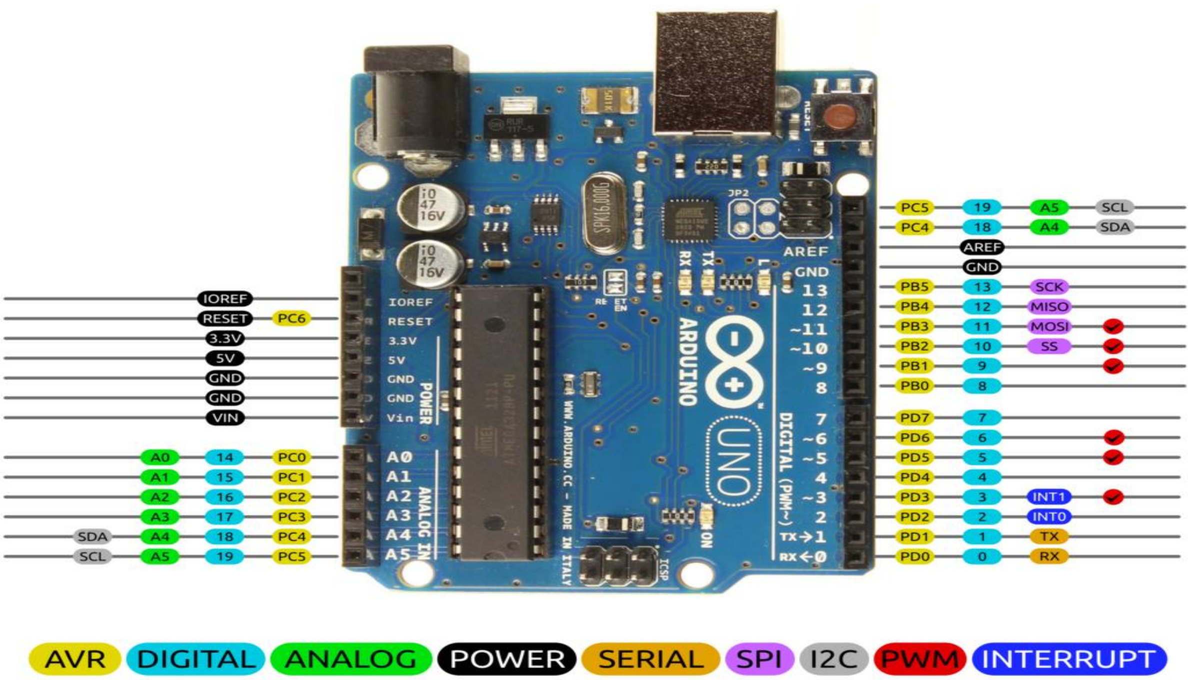


**Fig. 4.1: Arduino Uno**

It is simple and accessible user experience; Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step-by-step instructions of a kit, or sharing ideas online with other members of the Arduino community. It is Inexpensive**,** Cross-platform**,** Simple, clear programming environment**,** Open source and extensible software**,** Open source and extensible hardware

**Features of the Arduino UNO:**

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

### 4.1.2 KEYPAD 4X4


**Fig. 4.2: Keypad 4x4**

A keypad is a set of buttons arranged in a block or "pad" which bear digits, symbols or alphabetical letters. Pads mostly containing numbers are called a numeric keypad The 4x4 keypad is a user input device used for entering data or commands. It consists of 16 buttons arranged in a 4x4 matrix, providing a convenient way to interact with the system. In this project, it may be used for setting parameters or inputting data. This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications.

**Specifications:**

- Maximum Rating: 24 VDC, 30mA
- Interface: 8-pin access to 4x4 matrix
- Dimensions: Keypad: 2.7 x 3.0 in (6.9 x 7.6 cm) Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)
- Operating temp range: 32 to 122 °F (0 to 50 °C)

### 4.1.3 L298N

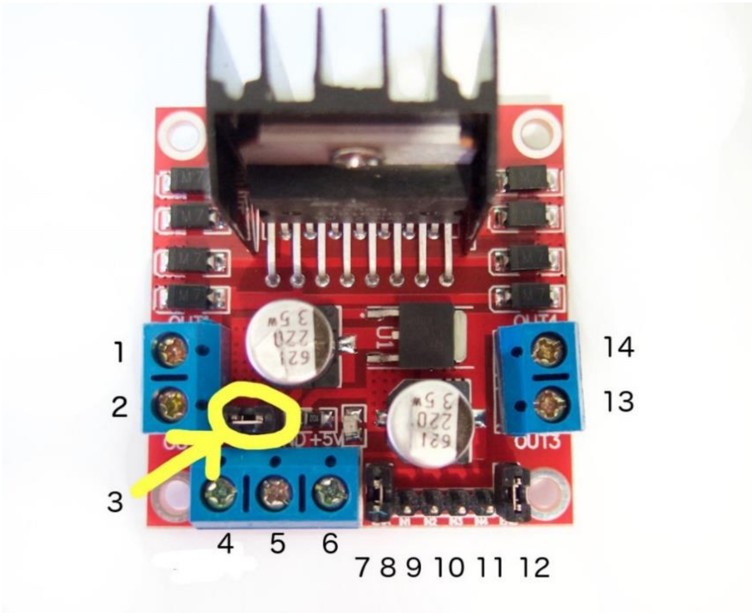


**Fig. 4.3: L298N**

Dual Motor Controller Module 2A with Arduino. This allows you to control the speed and direction of two DC motors, or control one bipolar stepper motor with ease. The L298N H-bridge module can be used with motors that have a voltage of between 5 and 35V DC.

There is also an onboard 5V regulator, so if your supply voltage is up to 12V you can also source 5V from the board. These L298 H-bridge dual motor controller modules. The L298N is a dual H-bridge motor driver module. While not explicitly mentioned in the context of neonatal jaundice treatment, it could be used for controlling motors or other components within the system. For example, it might be employed for precise adjustments of the UV light source or other mechanical elements. control one or two DC motors is quite easy. First connect each motor to the A and B connections on the L298N module. If you're using two motors for a robot (etc.) ensure that the polarity of the motors is the same on both inputs. Otherwise, you may need to swap them over when you set both motors to forward and one goes backwards! Next, connect your power supply - the positive to pin 4 on the module and negative/GND to pin 5. If you supply is up to 12V you can leave in the 12V jumper (point 3 in the image above) and 5V will be available from pin 6 on the module.

### 4.1.4 UV LIGHT

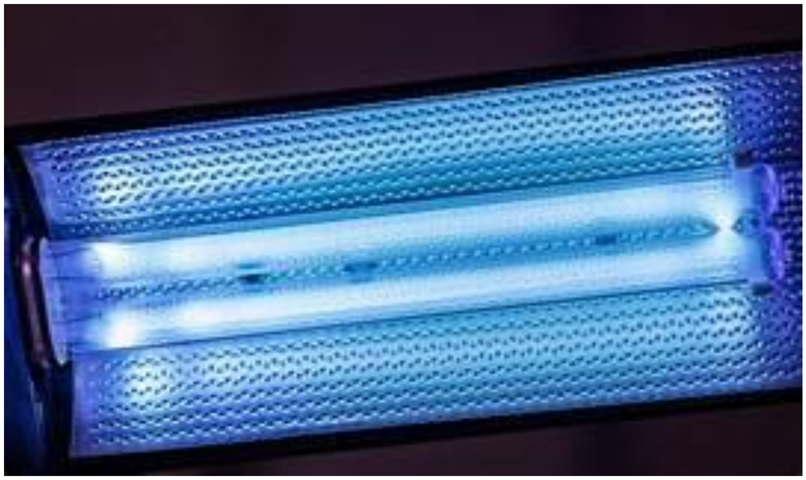

**Fig. 4.4: UV Light**

Ultraviolet (UV) light, though invisible to the human eye, plays a significant and multifaceted role in our lives. It is a form of electromagnetic radiation with wavelengths shorter than those of visible light but longer than X-rays. UV light is categorized into three main types based on wavelength: UV-A, UV-B, and UV-C, each with its unique properties and applications.

**1. UV-A (320-400 nm):** This is the longest wavelength of UV light and makes up the majority of the UV radiation that reaches the Earth's surface. UV-A is commonly associated with tanning and is used in tanning beds. While it is less intense than UV-B and UV-C, prolonged exposure to UV-A can still damage the skin, accelerate aging, and increase the risk of skin cancer.

**2. UV-B (280-320 nm):** UV-B rays have shorter wavelengths and higher energy than UV-A. These rays are primarily responsible for causing sunburn and can penetrate the outer layers of the skin. However, they also stimulate the body's production of vitamin D, which is crucial for bone health.

**3. UV-C (100-280 nm):** UV-C has the shortest wavelength and the highest energy of the three types of UV light. It is entirely absorbed by the Earth's atmosphere and does not naturally reach the surface. UV-C is used for germicidal purposes, as it is highly effective in killing bacteria, viruses, and other microorganisms. UV-C lamps and devices are employed in healthcare settings, water purification systems, and air sterilization.

**UV LIGHT FOR JAUNDICE**

Ultraviolet (UV) light is used as a medical treatment for neonatal jaundice, a condition where a newborn's skin and eyes appear yellow due to elevated levels of bilirubin in the blood. This treatment is known as phototherapy, and it helps reduce the excess bilirubin in the baby's body by transforming it into a form that can be easily excreted.

Here's how UV light is used for jaundice treatment:

**1. Phototherapy:** Phototherapy involves exposing the baby's skin to specific wavelengths of UV light, typically in the blue-green spectrum. The UV light is absorbed by the bilirubin in the skin and converts it into a water-soluble form that the baby's liver can process and remove from the body more effectively.

**2. Types of Phototherapy**:

- **Conventional Phototherapy:** This involves the use of special UV lamps placed above or around the baby, usually in a neonatal incubator or under a phototherapy lamp. The baby is undressed and protected with eye shields to prevent exposure to the UV light.

- **Fiber-optic Phototherapy:** Fiber-optic phototherapy blankets or pads contain fiber-optic strands that emit UV light directly onto the baby's skin, increasing the surface area exposed to the light.

- **LED Phototherapy:** Light-emitting diode (LED) phototherapy is a more recent development. LED lights are efficient and can provide focused, intense phototherapy while consuming less energy and generating less heat.

**3. Monitoring:** During phototherapy, healthcare providers closely monitor the baby's bilirubin levels, skin color, and vital signs to ensure that the treatment is effective and safe. The duration and intensity of phototherapy are adjusted based on the baby's response and bilirubin levels.

**4. Eye Protection:** Infants undergoing phototherapy wear special eye protection, usually in the form of adhesive eye shields or goggles, to shield their eyes from the UV light.

**5. Home Phototherapy:** In some cases, when the baby's jaundice is mild and stable, phototherapy can be administered at home under medical supervision. This allows the family to be involved in the baby's care while ensuring the necessary treatment is provided.

**Benefits of UV Light for Jaundice:**

- Effectiveness: Phototherapy is highly effective in reducing bilirubin levels and resolving jaundice in neonatal patients.

- Non-invasive: It is a non-invasive and painless treatment method that does not require needles or medications.

- Prevents Complications: Phototherapy helps prevent complications of severe jaundice, such as kernicterus, which can lead to brain damage.

- Early Intervention: Treatment can be initiated promptly when jaundice is detected, preventing the progression of the condition.

**Risks and Considerations:**

- Eye protection is crucial to shield the infant's eyes from UV light.

## 4.1.5 16X2 LCD:

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

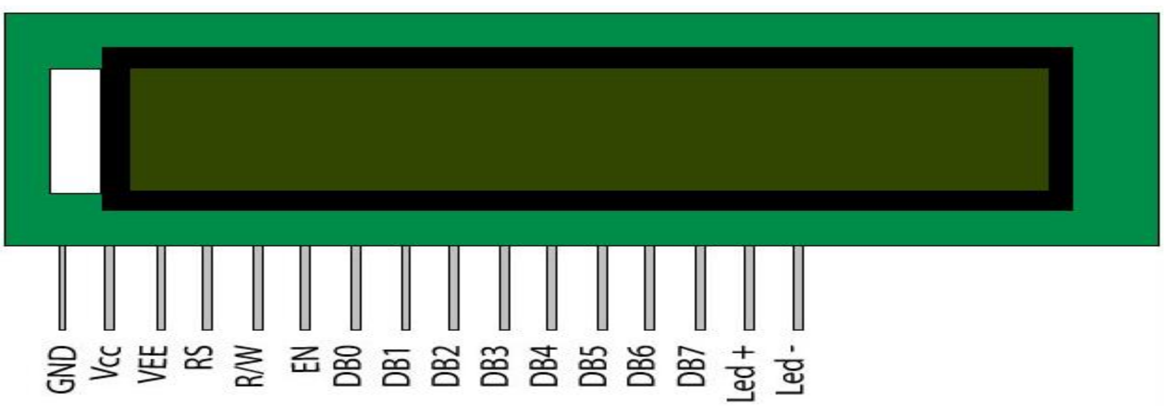


**Fig. 4.5: LCD**

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

**LCD PIN DESCRIPTION**

| Pin No | Function | Name |
|---|---|---|
| 1 | Ground (0V) | Ground |
| 2 | Supply voltage; 5V (4.7V – 5.3V) | Vcc |
| 3 | Contrast adjustment; through a variable resistor | $V_{EE}$ |
| 4 | Selects command register when low; and data register when high | Register Select |
| 5 | Low to write to the register; High to read from the register | Read/write |
| 6 | Sends data to data pins when a high to low pulse is given | Enable |
| 7 | 8-bit data pins | DB0 |
| 8 | | DB1 |
| 9 | | DB2 |
| 10 | | DB3 |
| 11 | | DB4 |
| 12 | | DB5 |
| 13 | | DB6 |
| 14 | | DB7 |
| 15 | Backlight $V_{CC}$ (5V) | Led+ |
| 16 | Backlight Ground (0V) | Led- |

The 16x2 LCD (Liquid Crystal Display) is used for visual feedback and information display. It typically consists of 16 characters in each of its two lines. In this project, it could be used to display important data, treatment parameters, or status updates.

### 4.1.6 12V ADAPTOR:

External power supplies are used both with equipment with no other source of power and with battery-powered equipment, where the supply, when plugged in, can sometimes charge the battery in addition to powering the equipment.

Use of an external power supply allows portability of equipment powered either by mains or battery without the added bulk of internal power components, and makes it unnecessary to produce equipment for use only with a specified power source; the same device can be powered from 120 VAC or 230 VAC mains, vehicle or aircraft battery by using a different adapter.


**Fig. 4.6: 12V Adaptor**

The 12V adaptor is a power supply unit that provides the necessary voltage to operate the various components of the project. It ensures a stable power source to keep the system running.

## 4.1.7 ESP32:

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Chinese company based in Shanghai, and is manufactured by TSMC using their 40 nm process.

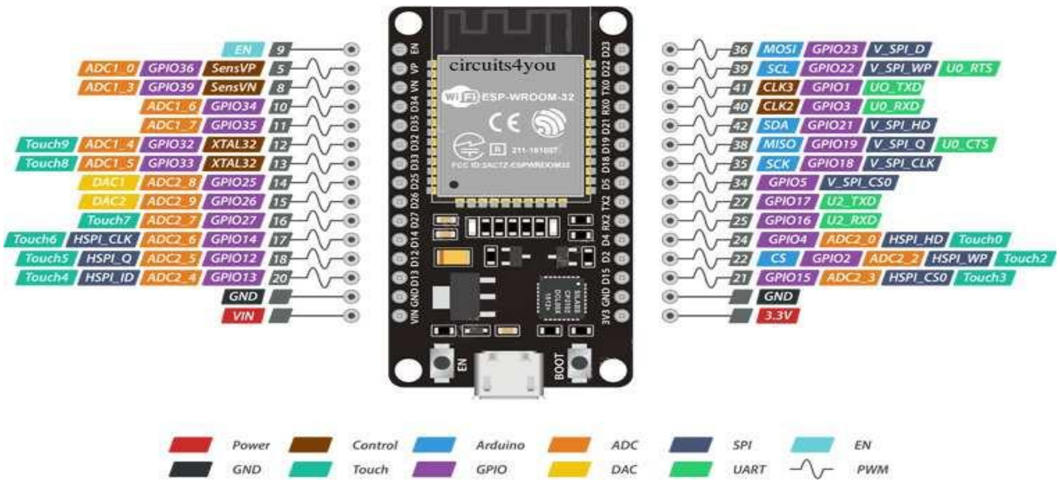


**Fig. 4.7: ESP32**

NodeMCU is an open source IoT platform It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the project, and built on Espressif Non-OS SDK for ESP8266. It uses many open-source projects.

**FEATURES OF ESP32**

- Finally, programable WiFi module.
- Arduino-like (software defined) hardware IO.
- Can be programmed with the simple and powerful Lua programming language or Arduino IDE.
- USB-TTL included, plug & play.
- 10 GPIOs D0-D10, PWM functionality, IIC and SPI communication, 1-Wire and ADC A0 etc. all in one board.
- Wifi networking (can be used as access point and/or station, host a web server), connect to internet to fetch or upload data.
- Event-driven API for network applications.
- PCB antenna.

The ESP32 is a powerful microcontroller with built-in Wi-Fi and Bluetooth capabilities. While the specific application is not detailed, it could be used for data transmission, remote monitoring, or connectivity in an IoT (Internet of Things) context.

## 4.1.8 PULSE / HEARTBEAT SENSOR:

The pulse or heartbeat sensor is employed to monitor the neonate's vital signs, particularly the heart rate. It ensures that the infant's heart rate is within a safe range during the treatment.

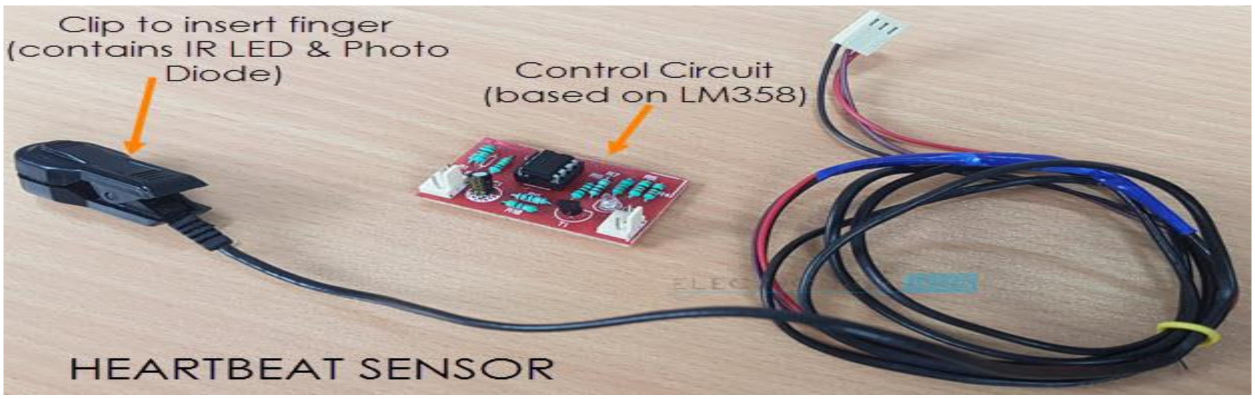


**Fig. 4.8: Heart beat sensor**

**PRINCIPLE OF HEART BEAT SENSOR**

The principle behind the working of the Heartbeat Sensor is Photoplethysmography. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ. Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor. With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor. In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver. Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

**WORKING OF HEART BEAT SENSOR**

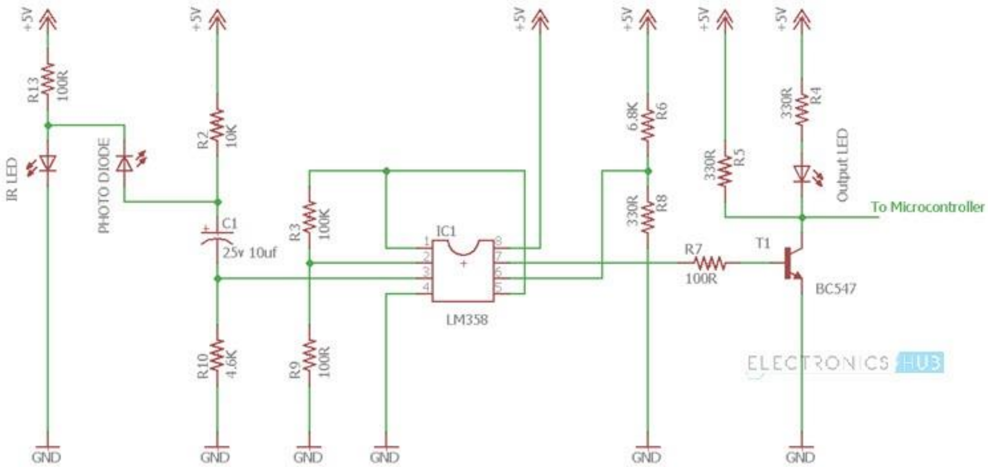


**Fig. 4.9: Circuit diagram**

A simple Heartbeat Sensor consists of a sensor and a control circuit. The sensor part of the Heartbeat Sensor consists of an IR LED and a Photo Diode placed in a clip. The Control Circuit consists of an Op-Amp IC and few other components that help in connecting the signal to a Microcontroller. The working of the Heartbeat Sensor can be understood better if we take a look at its circuit diagram. The above circuit shows the finger type heartbeat sensor, which works by detecting the pulses. Every heartbeat will alter the amount of blood in the finger and the light from the IR LED passing through the finger and thus detected by the Photo Diode will also vary. The output of the photo diode is given to the non – inverting input of the first op – amp through a capacitor, which blocks the DC Components of the signal. The first op – amp cats as a non – inverting amplifier with an amplification factor of 1001. The output of the first op – amp is given as one of the inputs to the second op – amp, which acts as a comparator. The output of the second op – amp triggers a transistor, from which, the signal is given to a Microcontroller like Arduino. The Op – amp used in this circuit is LM358. It has two op – amps on the same chip. Also, the transistor used is a BC547. An LED, which is connected to transistor, will blink when the pulse is detected.

### 4.1.9 DS18B20:

DS18B20 is a digital temperature sensor with high precision. It is used to monitor and maintain the temperature in the treatment environment. Precise temperature control is critical for neonatal care.

The DS18B20 digital thermometer provides 9-bit to 12-bit Celsius temperature measurements and has an alarm function with non-volatile user-programmable upper and lower trigger points. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area.


**Fig. 4.10: DS18B20**

**BENEFITS AND FEATURES**

- Unique 1-Wire® Interface Requires Only One Port
- Pin for Communication
- Reduce Component Count with Integrated
- Temperature Sensor and EEPROM

- Measures Temperatures from -55°C to +125°C
- (-67°F to +257°F)
- ±0.5°C Accuracy from -10°C to +85°C.

## 4.1.10 LOAD CELL:

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various load cell types include hydraulic, pneumatic, and strain gauge.

### STRAIN GUAGE LOADCELL

Strain gauge load cells are the most common in industry. Deformation of the strain gauge changes its electrical resistance, by an amount that is proportional to the strain. The change in resistance of the strain gauge provides an electrical value change that is calibrated to the load placed on the load cell.

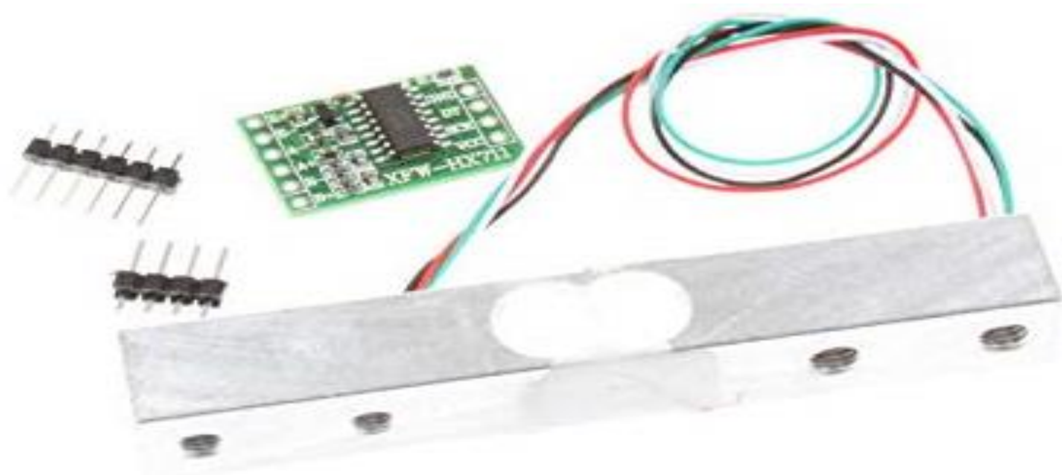

**Fig. 4.11: Load cell**

## 4.1.11 BUZZER:

The buzzer is an audible alert device. It can be used to generate alarms or notifications in response to specific conditions or events. In neonatal care, it might be used to alert healthcare providers or parents in case of emergencies.

These hardware components work together to create a comprehensive and effective system for the treatment and monitoring of neonatal jaundice, ensuring the well-being of newborns with this condition. The project's success relies on the integration and functionality of these components to provide safe and personalized care for infants.

## 4.2 SOFTWARE DESCRIPTION

### 4.2.1 ARDUINO IDE :

IDE stands for Integrated Development Environment. Pretty fancy sounding, and should make you feel smart any time you use it. The IDE is a text editor-like program that allows you to write Arduino code. When you open the Arduino program, you are opening the IDE. It is intentionally streamlined to keep things as simple and straightforward as possible. When you save a file in Arduino, the file is called a sketch – a sketch is where you save the computer code you have written. The coding language that Arduino uses is very much like C++ (“see plus plus”), which is a common language in the world of computing. The code you learn to write for Arduino will be very similar to the code you write in any other computer language – all the basic concepts remain the same it is just a matter of learning a new dialect should you pursue other programming languages.

**Fig. 4.12: Arduino IDE**

## 4.2.2 Blynk IoT Platform :

Blynk is a comprehensive Internet of Things (IoT) platform designed to simplify the development of IoT applications for controlling and monitoring connected devices. What sets Blynk apart is its user-friendly approach, making it accessible to both novices and experienced developers. The platform offers a mobile app for iOS and Android, along with a web-based dashboard, making it easy to create and manage IoT projects.

One of the standout features of Blynk is its Widgets and Widgets Library. These pre-designed widgets, such as buttons, sliders, displays, graphs, and more, can be easily added to your project canvas. This drag-and-drop interface simplifies the process of creating a user interface for you IoT application, allowing you to control and visualize your devices with ease.


**Fig. 4.13: Blynk Platform**

# CHAPTER 5

# IMPLEMENTATION OF WORKING & RESULTS

The IoT-based project is implemented in a seamless process. Healthcare providers input the neonate's bilirubin levels via a 4x4 keypad, which is transmitted to both the Arduino Uno and the ESP32 microcontroller. The Arduino Uno controls the UV lights, adjusting their wavelength and intensity for phototherapy using the L298N driver. Simultaneously, the ESP32 collects additional vital data, including heart rate, temperature, and weight, through various sensors.

The ESP32 processes this comprehensive dataset to make informed decisions about UV light control, customizing the treatment to the infant's specific condition. Simultaneously, a 16x2 LCD display provides real-time feedback, and the ESP32 uploads the entire dataset to the BLYNK IoT platform, securely storing the data in the cloud.

Through the BLYNK mobile application, healthcare providers and parents can monitor the child's condition and treatment progress in real-time. This implementation ensures tailored, data-driven neonatal care, reducing the risk of complications, optimizing treatment, and providing remote access to critical information. It prioritizes the well-being of newborns with jaundice by offering comprehensive and individualized care.

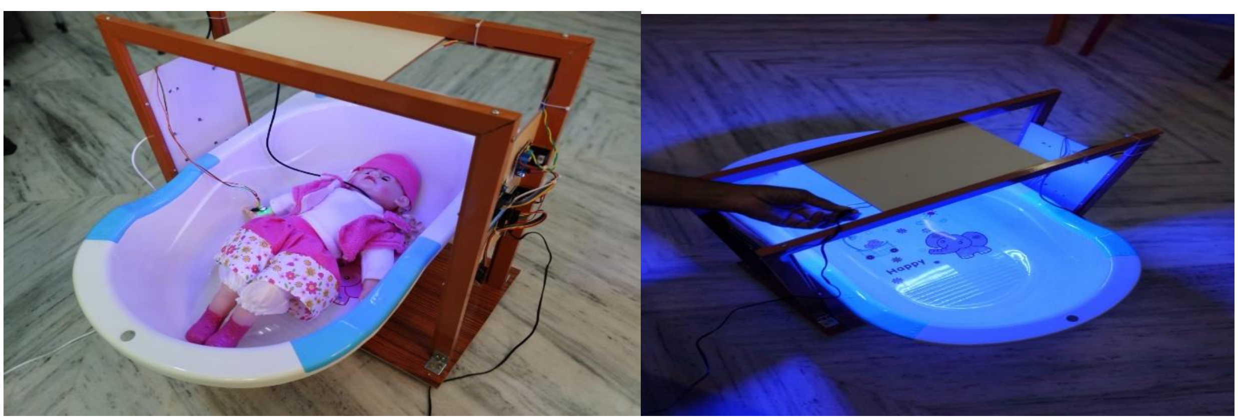

**Fig. 5.1**: Implementation of infant health child condition-based phototherapy for neonatal jaundice patient.

Steps to implementation of work:

**Step 1: Input Bilirubin Levels and UV Light Control**

**Input Bilirubin Levels:** Begin by entering the bilirubin levels of the neonate using the 4x4 keypad. The user, likely a healthcare provider, will input the specific values for bilirubin levels associated with the baby's condition.

**Fig. 5.2: Entering bilirubin level values in Keypad**

**Data Transmission to Arduino UNO:** The bilirubin values entered are transmitted to the Arduino Uno microcontroller for processing and control. The microcontroller receives this data and proceeds to make decisions based on the bilirubin levels.

**Control UV Lights:** Depending on the inputted bilirubin values, the Arduino UNO microcontroller controls the UV rays which produced from the 12V LED's, which emit the required wavelength of light for phototherapy treatment. The UV lights (commonly blue lights) are adjusted to the appropriate intensity and duration needed to treat the specific condition. The L298N motor driver module is employed to facilitate the transfer of data from the Arduino Uno to the UV lights. It ensures that the UV lights are powered and controlled according to the treatment plan.

**Step 2: Data Collection and ESP32 Control**

**Data Input and Collection:** Simultaneously, the bilirubin values which are entered are also sent to the ESP32 microcontroller. The ESP32 microcontroller acts as a central hub for collecting data related to the neonate's health and condition.

**Sensor Data:** In addition to the bilirubin levels, the ESP32 collects vital data, including the child's heart rate or pulse rate using a pulse sensor, the child's temperature with a DS18B20 temperature sensor, and the child's weight using a load cell. These sensors provide crucial health information.

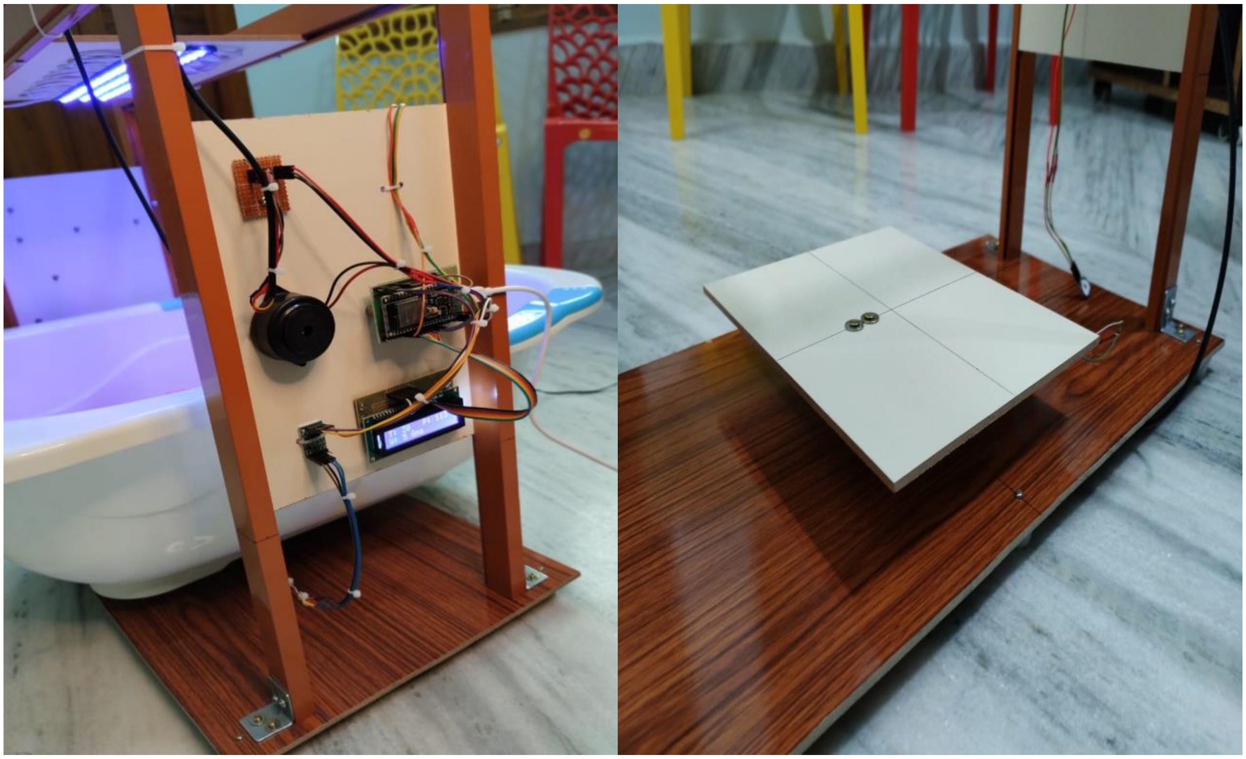

**Fig. 5.3: Buzzer and Load cell**

**Step 3: UV Light Control Based on Comprehensive Data**

**Comprehensive Data Processing:** The ESP32 microcontroller processes the comprehensive data it has collected, including bilirubin levels, heart rate, temperature, and weight. It considers all these factors to make informed decisions about UV light control.

**Wavelength Adjustment:** Based on the analysed data, the ESP32 precisely controls the wavelength and intensity of the UV lights.

**Fig. 5.4: UV Light**

**Step 4: Display on 16x2 LCD and Data Upload**

**Visual Feedback:** The 16x2 LCD display provides visual feedback to healthcare providers or parents. It can display important data related to the treatment, such as the UV light parameters, the child's vital signs, and the treatment progress.

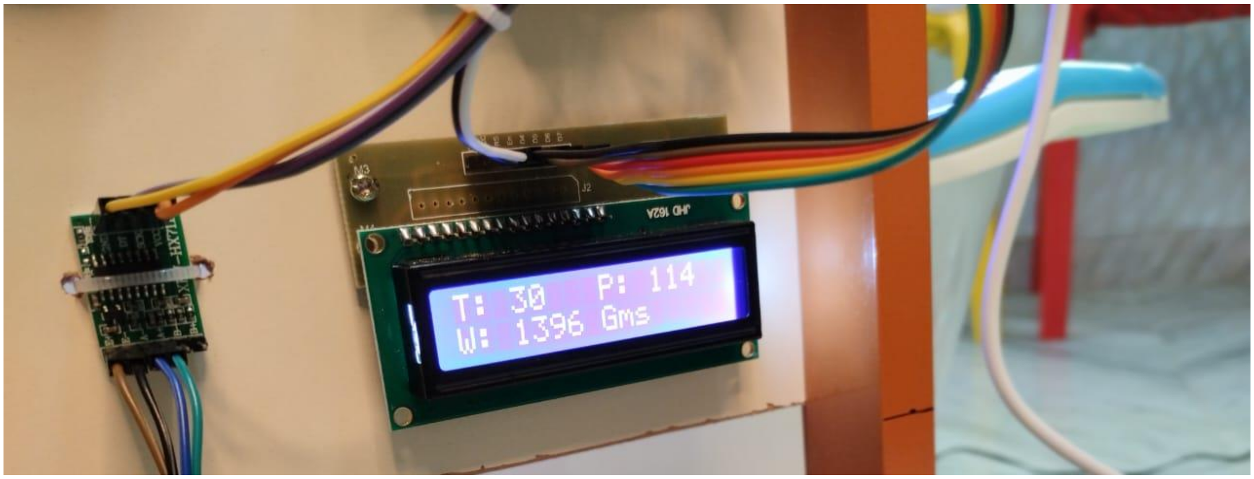


**Fig. 5.5: LCD**

**Data Upload to BLYNK Cloud:** Simultaneously, the ESP32 WROOM uploads the child's entire dataset, including bilirubin levels, heart rate, temperature, and weight, to the cloud using the BLYNK IoT platform. This data can be securely stored and accessed remotely.

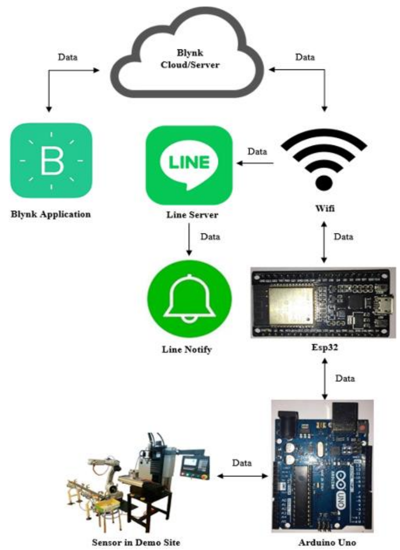


**Fig. 5.6: Block diagram of Blynk working**

**Step 5: Monitoring via BLYNK Mobile Application**

**BLYNK Mobile Application:** Healthcare providers and parents can monitor the child's data through the BLYNK mobile application. BLYNK provides a user-friendly interface to access real-time and historical data related to the neonate's condition and treatment.


**Fig. 5.7: Readings of Sensor**

# CHAPTER 6

# CONCLUSION & FUTURE SCOPE

## 6.1 CONCLUSION

In conclusion, the fusion of UV lights, Arduino ESP32, and IoT technology represents a groundbreaking pathway toward the enhancement of neonatal jaundice treatment. This approach is poised to redefine the landscape of infant health monitoring, offering a novel and advanced method that promises a higher standard of care for neonates affected by jaundice. In doing so, it not only addresses the immediate healthcare needs of these vulnerable infants but also paves the way for improved health outcomes during the critical early stages of life.

The Blue LED UV Light Treatment, which is a form of phototherapy, emerges as an efficient and cost-effective alternative to traditional treatment methods. The efficacy of this treatment is further underscored by its ability to expedite the recovery process in neonates, significantly reducing the duration of hospital stays and the discomfort associated with jaundice. Its ease of use and adaptability extend beyond the confines of neonatal care, as it has the potential to benefit patients across all age groups, highlighting its versatility and broader application in healthcare.

What makes this innovative approach truly transformative is the seamless integration of IoT technology and the Arduino ESP32 platform. The IoT infrastructure facilitates remote monitoring of patients, allowing healthcare providers, whether they be doctors or nurses, to access and analyze crucial patient data with unparalleled convenience. Through the use of Wi-Fi modules, this data can be accessed via laptops or smartphones, enabling real-time tracking and decision-making.

As we forge ahead into a future driven by advanced technologies, this integrated approach holds the potential to revolutionize neonatal care and usher in a new era of healthcare. By providing more efficient, cost-effective, and technologically advanced solutions for neonatal jaundice, we not only alleviate the burden on healthcare systems but also improve the health and well-being of our most vulnerable infants.

## 6.2 FUTURE SCOPE

This project represents a significant step towards redefining neonatal care by integrating UV lights, Arduino ESP32, and IoT technology. Looking ahead, the future of this project holds immense potential for enhancement through the incorporation of Artificial Intelligence (AI) technology. The integration of AI into infant health care is poised to usher in transformative advancements that encompass predictive algorithms, personalized treatment, telemedicine, complication detection, continuous monitoring, parental engagement, and data security.

**Personalized Treatment Plans:** AI can further optimize treatment outcomes by tailoring therapy to an infant's specific condition and genetic makeup. Personalized treatment plans can be dynamically adjusted based on the infant's unique needs, leading to more effective and efficient treatment.

**AI-Powered Telemedicine:** Telemedicine enhanced by AI can facilitate remote consultations, enabling healthcare professionals to provide guidance and monitor neonates from a distance. AI-driven analysis of vital signs and diagnostic data can aid in early complication detection, thereby enhancing the overall safety of neonatal care.

**Continuous Monitoring and Machine Learning:** Continuous monitoring, coupled with machine learning, can refine and adapt treatment protocols in real-time. By analyzing a wealth of data, AI can help healthcare providers make data-driven decisions and ensure better outcomes for neonatal patients.

**Parental Engagement:** AI can empower parents with educational tools and smart phototherapy devices. These devices can autonomously adjust treatment parameters while providing parents with insights into their infant's progress. This proactive engagement ensures that parents are informed and actively involved in the care of their newborns.

**Data Security and Integration:** As AI becomes more integrated into neonatal care, robust data security measures and seamless integration with electronic health records will be essential. Ensuring data privacy and facilitating care coordination are paramount in the AI-enhanced neonatal care landscape.

Collaboration with AI researchers and experts will be crucial to drive innovation and bring about these AI-enabled advancements. By doing so, neonatal care can become even more effective, personalized, and secure. This forward-looking approach promises to revolutionize the treatment of neonatal jaundice, ultimately ensuring healthier outcomes for infants and providing greater peace of mind for their caregivers. In summary, the future of AI in infant healthcare promises transformative advancements across multiple dimensions, including predictive algorithms, personalized treatment, telemedicine, complication detection, continuous monitoring, parental engagement, and data security.

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# PATENT PROOF

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INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

| Application Details | |
|---|---|
| APPLICATION NUMBER | 202341080231 |
| APPLICATION TYPE | ORDINARY APPLICATION |
| DATE OF FILING | 25/11/2023 |
| APPLICANT NAME | SR University |
| TITLE OF INVENTION | JAUNDICE DETECTION SYSTEM AND METHOD |
| FIELD OF INVENTION | BIO-MEDICAL ENGINEERING |
| E-MAIL (As Per Record) | patent.ipo@ipqrate.com |
| ADDITIONAL-EMAIL (As Per Record) | |
| E-MAIL (UPDATED Online) | |
| PRIORITY DATE | |
| REQUEST FOR EXAMINATION DATE | -- |
| PUBLICATION DATE (U/S 11A) | 22/12/2023 |

| Application Status | |
|---|---|
| APPLICATION STATUS | Awaiting Request for Examination |

View Documents

Filed → Published → RQ Filed → Under Examination → Disposed

In case of any discrepancy in status, kindly contact ipo-helpdesk@nic.in

# PAPER PROOF

## Submission Summary

| | |
|---|---|
| Conference Name | 2024 Intelligent Systems and Machine Learning Conference |
| Paper ID | 270 |
| Paper Title | Infant Health Child Condition Based Phototherapy for Neonatal Jaundice Patient |
| Abstract | The wellbeing of new born is extremely important for parents. Many new born babies suffer from neonatal jaundice<br>which may lead to death. A high level of bilirubin is one of the symptoms of neonatal jaundice in babies The present<br>work is carried out to support and save lives of infants from neonatal jaundice. Around 25% and 60% of full-term<br>babies and 80% of preterm babies experience jaundice in their first two weeks of life, respectively, and phototherapy<br>is one of the most effective ways in modern medicine to manage this illness. The phototherapeutic approach<br>converts bilirubin into water-soluble photo-products that can be excreted without passing through the hepatic<br>conjugating system. Phototherapy uses ultraviolet light (UV) to lower blood bilirubin levels in infants. A system is<br>developed here that can automatically control the intensity of UV light based on the severity of neonatal jaundice.<br>The Arduino Uno and ESP32 are integrated into the neonatal jaundice phototherapy system. The healthcare<br>providers enter bilirubin levels to start the Arduino Uno UV light control system. The ESP32 gathers essential<br>information such as weight, temperature, and heart rate, generating an extensive dataset. Based on the infant's state,<br>ESP32 uses this data to precisely customize the UV light treatment. Immediate insights are obtained through real time feedback through a 16x2 LCD, and the complete dataset is safely transferred to the BLYNK IoT platform. The<br>practitioner and parents can monitor the child development by using smartphone App. |
| Created on | 12/20/2023, 12:52:43 PM |
| Last Modified | 12/20/2023, 12:52:43 PM |
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| Submission Files | Infant Health Child Condition Based Phototherapy-1.pdfInfant Health Child Condition Based Phototherapy-1.pdf (291.9 Kb, 12/20/2023, 12:51:54 PM) |