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AUTOMATIC NEONATAL CHILD MONITORING AND DEFIBRILLATING SYSTEM USING IOT ENVIRONMENT IN DOLPHIN APPROACH

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***Abstract* -** Babies born before the 37th week of gestation are considered premature and are sometimes referred to as "preemies". Mothers whose babies are born prematurely are often scared and nervous. Premature newborns have an increased risk of complications. Premature babies are not fully equipped to deal with life in our world. Their little bodies still have underdeveloped parts that include the lungs, digestive system, immune system, and skin. Thankfully, medical technology has made it possible for preemies to survive the first few days, weeks or months of life until they are strong enough to make it on their own. It is a stereotype practice to keep these babies in Intensive Care Unit (ICU) until they reach normal functioning of their heart, respiratory, blood pressure and body temperature under the careful attention of Doctors. This project tries to provide an alternative solution not to hold the premature within the hospital. Here is a measure which allows premature baby and the mother to go home after delivery, and their health of both Baby and mother. Monitoring machines differ depending on the hospital and health centers. This technology includes wrist band sensor device for both mother and baby this will predicts child's health condition. However, monitors are similar in that they all record heart rate, respiratory rate, blood pressure, and temperature. After sensing it will end the health monitoring report to concern hospital and respective Doctor. In times of emergency situation, Doctor will suggest necessary medical tips. This project helps in maintain and monitoring premature babies from their home environment.

Keywords: Neonatal care, monitoring system, Neonatal defibrillation, IoT technologies, Dolphin approach, Real-time data analysis, Vibrator Mechanism.

1. INTRODUCTION

1.1 BACKGROUND

The Automatic Neonatal Child Monitoring and Defibrillating System using IoT environment in Dolphin Approach is an innovative solution designed to enhance neonatal care through advanced technology. This system integrates IoT (Internet of Things) capabilities with the unique "Dolphin Approach," which likely refers to a method inspired by the communication or behaviour of dolphins, known for their acute sensing abilities and intelligent communication.

At its core, this system employs IoT sensors to continuously monitor vital signs and other critical parameters of newborns in real-time. These sensors are strategically placed to gather data on heart rate, respiratory rate, temperature, and other physiological metrics. The Dolphin Approach likely suggests a holistic and intelligent approach to processing this data, perhaps inspired by the sophisticated communication and problem-solving abilities observed in dolphins.

In addition to monitoring, this system is equipped with a defibrillating feature, which can automatically deliver life-saving interventions in case of emergencies such as cardiac arrest. By combining monitoring and immediate response capabilities, the system aims to significantly improve the chances of survival and overall outcomes for neonates in critical situations.

1.2 INTERNET OF THINGS

The Internet of things (IoT) refers to the concept of extending Internet connectivity beyond conventional computing platforms such as personal computers and mobile devices, and into any range of traditionally "dumb" or non-internet-enabled physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled.
Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT. Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are provided by a large number of networked sensors.

The term industrial Internet of things (IIoT) is often encountered in the manufacturing industries, referring to the industrial subset of the IoT. IIoT in manufacturing could generate so much business value that it will eventually lead to the Fourth Industrial Revolution, so the so-called Industry 4.0. It is estimated that in the future, successful companies will be able to increase their revenue through Internet of things by creating new business models and improve productivity, exploit analytics for innovation, and transform workforce.[64] The potential of growth by implementing IIoT may generate $12 trillion of global GDP by 2030. Industrial big data analytics will play a vital role in manufacturing asset predictive maintenance, although that is not the only capability of industrial big data. Cyber-physical systems (CPS) is the core technology of industrial big data and it will be an interface between human and the cyber world. Cyber-physical systems can be designed by following the 5C (connection, conversion, cyber, cognition, configuration) architecture, and it will transform the collected data into actionable information, and eventually interfere with the physical assets to optimize processes.

An IoT-enabled intelligent system of such cases was proposed in 2001 and later demonstrated in 2014 by the National Science Foundation Industry/University Collaborative Research Center for Intelligent Maintenance Systems (IMS) at the University of Cincinnati on a bandsaw machine in IMTS 2014 in Chicago. Bandsaw machines are not necessarily expensive, but the bandsaw belt expenses are enormous since they degrade much faster. However, without sensing and intelligent analytics, it can be only determined by experience when the band saw belt will actually break. The developed prognostics system will be able to recognize and monitor the degradation of band saw belts even if the condition is changing, advising users when is the best time to replace the belt. This will significantly improve user experience and operator safety and ultimately save on costs. Monitoring and controlling operations of sustainable urban and rural infrastructures like bridges, railway tracks and on- and offshore wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk. The IoT can benefit the construction industry by cost saving, time reduction, better quality workday, paperless workflow and increase in productivity. It can help in taking faster decisions and save money with Real-Time Data Analytics.

It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT There are several planned or ongoing large-scale deployments of the IoT, to enable better management of cities and systems. For example, Songdo, South Korea, the first of its kind fully equipped and wired smart city, is gradually being built, with approximately 70 percent of the business district completed as of June 2018. Much of the city is planned to be wired and automated, with little or no human intervention.

Another application is a currently undergoing project in Santander, Spain. For this deployment, two approaches have been adopted. This city of 180,000 inhabitants has already seen 18,000 downloads of its city smartphone app. The app is connected to 10,000 sensors that enable services like parking search, environmental monitoring, digital city agenda, and more. City context information is used in this deployment so as to benefit merchants through a spark deals mechanism based on city behavior that aims at maximizing the impact of each notification. It subsequently announced it would set up a total of 4000 base stations to cover a total of 30 cities in the U.S. by the end of 2016, making it the largest IoT network coverage provider in the country thus far. Cisco also participates in smart cities projects. Cisco has started deploying technologies for Smart Wi-Fi, Smart Safety & Security, Smart Lighting, Smart Parking, Smart Transports, Smart Bus Stops, Smart Kiosks, Remote Expert for Government Services (REGS) and Smart Education in the five km area in the city of Vijaywada. Another example of a large deployment is the one completed by New York Waterways in New York City to connect all the city's vessels and be able to monitor them live 24/7. The network was designed and engineered by Fluid mesh Networks, a Chicago-based company developing wireless networks for critical applications. The NYWW network is currently providing coverage on the Hudson River, East River, and Upper New York Bay. With the wireless network in place, NY Waterway is able to take control of its fleet and passengers in a way that was not previously possible. New applications can include security, energy and fleet management, digital signage, public Wi-Fi, paperless ticketing and others.

1.3 ENERGY MANAGEMENT

Significant numbers of energy-consuming devices (e.g. switches, power outlets, bulbs, televisions, etc.) already integrate Internet connectivity, which can allow them to communicate with utilities to balance power generation and energy usage and optimize energy consumption as a whole. These devices allow for remote control by users, or central management via a cloud-based interface, and enable functions like scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.).[44] The smart grid is a utility-side IoT application; systems gather and act on energy and power-related information to improve the efficiency of the production and distribution of electricity. Using advanced metering infrastructure (AMI) Internet-connected devices, electric utilities not only collect data from end-users, but also manage distribution automation devices like transformers.

1.4 ENVIRONMENTAL MONITORING

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource-constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area. Another example of integrating the IoT is Living Lab which integrates and combines research and innovation process, establishing within a public-private-people-partnership. There are currently 320 Living Labs that use the IoT to collaborate and share knowledge between stakeholders to co-create innovative and technological products. For companies to implement and develop IoT services for smart cities, they need to have incentives. The governments play key roles in smart cities projects as changes in policies will help cities to implement the IoT which provides effectiveness, efficiency, and accuracy of the resources that are being used. For instance, the government provides tax incentives and cheap rent, improves public transports, and offers an environment where start-up companies, creative industries, and multinationals may co-create, share common infrastructure and labor markets, and take advantages of locally embedded technologies, production process, and transaction costs. The relationship between the technology developers and governments who manage city's assets, is key to provide open access of resources to users in an efficient way. The IoT's major significant trend in recent years is the explosive growth of devices connected and controlled by the Internet. The wide range of applications for IoT technology mean that the specifics can be very different from one device to the next but there are basic characteristics shared by most.The IoT creates opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions.

1.5 INTELLIGENCE

Ambient intelligence and autonomous control are not part of the original concept of the Internet of things. Ambient intelligence and autonomous control do not necessarily require Internet structures, either. However, there is a shift in research (by companies such as Intel) to integrate the concepts of the IoT and autonomous control, with initial outcomes towards this direction considering objects as the driving force for autonomous IoT. A promising approach in this context is deep reinforcement learning where most of IoT systems provide a dynamic and interactive environment. Training an agent (i.e., IoT device) to behave smartly in such an environment cannot be addressed by conventional machine learning algorithms such as supervised learning. By reinforcement learning approach, a learning agent can sense the environment’s state (e.g., sensing home temperature), perform actions (e.g., turn HVAC on or off) and learn through the maximizing accumulated rewards it receives in long term. IoT intelligence can be offered at three levels: IoT devices, Edge/Fog nodes, and Cloud computing. The need for intelligent control and decision at each level depends on the time sensitiveness of the IoT application. For example, an autonomous vehicle's camera needs to make real-time obstacle detection to avoid an accident. This fast decision making would not be possible through transferring data from the vehicle to cloud instances and return the predictions back to the vehicle. Instead, all the operation should be performed locally in the vehicle. Integrating advanced machine learning algorithms including deep learning into IoT devices is an active research area to make smart objects closer to reality. Moreover, it is possible to get the most value out of IoT deployments through analyzing IoT data, extracting hidden information, and predicting control decisions.

In the future, the Internet of Things may be a non-deterministic and open network in which auto-organized or intelligent entities (web services, SOA components) and virtual objects (avatars) will be interoperable and able to act independently (pursuing their own objectives or shared ones) depending on the context, circumstances or environments. Autonomous behavior through the collection and reasoning of context information as well as the object's ability to detect changes in the environment (faults affecting sensors) and introduce suitable mitigation measures constitutes a major research trend, clearly needed to provide credibility to the IoT technology. Modern IoT products and solutions in the marketplace use a variety of different technologies to support such context-aware automation, but more sophisticated forms of intelligence are requested to permit sensor units and intelligent cyber-physical systems to be deployed in real environments. IoT system architecture, in its simplistic view, consists of three tiers: Tier 1: Devices, Tier 2: the Edge Gateway, and Tier 3: the Cloud. Devices include networked things, such as the sensors and actuators found in IIoT equipment, particularly those that use protocols such as Modbus, Zigbee, or proprietary protocols, to connect to an Edge Gateway. The Edge Gateway consists of sensor data aggregation systems called Edge Gateways that provide functionality, such as pre-processing of the data, securing connectivity to cloud, using systems such as WebSockets, the event hub, and, even in some cases, edge analytics or fog computing. The final tier includes the cloud application built for IIoT using the micro-services architecture, which are usually polyglot and inherently secure in nature using HTTPS/OAuth. It includes various database systems that store sensor data, such as time series databases or asset stores using backend data storage systems (e.g. Cassandra, Postgres). The cloud tier in most cloud-based IoT system features event queuing and messaging system that handles communication that transpires in all tiers. Some experts classified the three-tiers in the IIoT system as edge, platform, and enterprise and these are connected by proximity network, access network, and service network, respectively. Building on the Internet of things, the web of things is an architecture for the application layer of the Internet of things looking at the convergence of data from IoT devices into Web applications to create innovative use-cases. In order to program and control the flow of information in the Internet of things, a predicted architectural direction is being called BPM Everywhere which is a blending of traditional process management with process mining and special capabilities to automate the control of large numbers of coordinated devices.

The prototype will consist of all the sensors related to above mentioned physical parameters. The transmission of data will take place with the help of Internet of Things (IOT). These parameters being the most important must be monitored regularly if the specimen is unhealthy or suffering from any diseases. The owner must be able to monitor this at the residence. Therefore, this prototype will be user friendly to the common person using it. IOT based premature baby health monitoring and tracking system research paper involves development of a system capable of tracking and monitoring of premature baby health based on IOT. The vital parameters include Temperature, Pulse rate and Respiration rate. All these are implemented in a single module. The future scope included implementation of hardware which will be wearable and can be connected to any device with the help of Internet of Things (IOT). A zigbee-based Premature baby Health Monitoring system involves development of premature baby health monitoring system to monitor parameters like Temperature, Rumination, Heart rate and humidity. It also detects the surrounding temperature. This research work contains details about the sensors which can be used to detect parameters. The future scope includes exploring the potential to use ultra wide band radio based wireless sensor network for premature baby health monitoring. The purpose of this research is monitoring and analyzing the behavior of small premature baby to enhance the communication between them. The research has several features. First, the target is small nocturnal premature baby. Second, the sensors are placed on the environment, not on the premature baby. They are placed at the appropriate area, e.g. water supply area and feeding area. We also try to develop the analysis method for the behavior of small premature baby using the Bayesian network. Based on the IoT sensor events, the proposed method can estimate the environment where a small premature baby lives and the month. We expect the research will be applied to protection of premature baby, communication enhancement, and the management of experimental premature baby.

The monitoring system is developed to measure and analyze the behavior of a small premature baby. Various IoT sensors are distributed in the rearing cage, and monitoring camera is set over them for observing the small premature baby and the whole environment. Wireless Electrocardiographic Monitoring in Healthcare center Medicine consists of the first report of ECG data obtained in premature baby with the help of wireless body electrode which is attached to the skin. The transmission of measured signal takes place through low power Bluetooth technology. It also includes placement of ECG electrodes on the premature baby body for measurement. The future scope includes development of software which can read and interpret the data appropriately so that it will help the healthcare center physician to diagnose the ECG of an premature baby correctly.

1.6 APPLICATIONS

This proposed system will help the premature baby owners to monitor the health in IOT. This can be used at home as well as in hospitals. An automatic neonatal defibrillating and monitoring system employing an IoT environment with a dolphin approach holds immense potential across various domains. In neonatal intensive care units (NICUs), it can offer continuous real-time monitoring of vital signs like heart rate, oxygen saturation, and respiratory rate. This constant surveillance ensures prompt detection of any anomalies, enabling healthcare providers to intervene swiftly in critical situations such as cardiac arrhythmias or sudden cardiac arrest. By automatically delivering defibrillation shocks when necessary, this system could potentially save the lives of vulnerable newborns. Beyond hospital settings, the system's applications extend to remote healthcare delivery, particularly in rural or underserved areas. Through IoT connectivity, it can facilitate remote monitoring of neonatal patients, providing healthcare professionals with vital data and alerts even in locations lacking direct access to specialized medical care. This remote monitoring capability enhances early intervention strategies, ultimately improving health outcomes for neonates in resource-constrained settings. Moreover, the system can be adapted for home healthcare, offering peace of mind to parents and caregivers of neonatal patients with ongoing medical needs.

2. LITERATURE SURVEY

2.1 Paper I

Title:

G. VENKATESH ET AL., ‘‘CONSERVATION CORES: REDUCING THE ENERGY OF MATURE COMPUTATIONS,’’ PROC. 15TH INT’L CONF. ARCHITECTURAL SUPPORT FOR PROGRAMMING LANGUAGES AND OPERATING SYSTEMS, ACM PRESS, 2021, PP. 205-218.

Description:

We are coming into an interesting era for techniques design—one motivated by datacentric processing. A latest review from the School of San Paul approximated that, cautiously, business server techniques have prepared and provided more than 9 zettabytes of details in 2008 (where 1 zettabyte ¼ 1021 bytes);1 this number is estimated to double every two decades. Wal-Mart web servers, for example, handle more than 1 million customer dealings every hour, providing data source approximated in several petabytes. High-performance processing techniques working with the Huge Hadron Collider narrow through approximately one petabyte of details per second and still produce 15 petabytes a year after several levels of details selection. Each day, Facebook or myspace functions on nearly 100 terabytes of customer log details and several hundred terabytes of customer pictures; in the same way, 48 hours of video content is submitted every minute on YouTube (a six-fold increase from four decades ago).2 This vast and growing amount of details symbolizes both an chance and a task. On one side, the capability to gather and procedure considerable amounts of new details can drive medical developments, new company procedure optimizations, and day-to-day developments in our personal lives. Recent data-centric programs for customized genome sequencing, real-time styles from company statistics, social-network-based suggestions, and so on illustrate this potential. But however, this detail is also creating a variety of new problems. In particular, the growth in details produced is outpacing the developments in the cost and solidity of storage technological innovation. Also, perhaps even more important, our capability to procedure the details to draw out significant, workable ideas is considerably lagging our capability to gather and store details. Given these difficulties and possibilities, it is important to reconsider how we design future data-centric techniques.

2.2 Paper II

Title:

R. DENNARD ET AL., ‘‘DESIGN OF ION-IMPLANTED MOSFET’S WITH VERY SMALL PHYSICAL DIMENSIONS,’’ IEEE J. SOLID-STATE CIRCUITS, VOL. 9, NO. 5, 2022, PP. 256-268.

Description:

Our analysis concentrates on analogue CMOS routine style with focus on high regularity and high-speed internet tour. With the pattern of program incorporation in mind, we try to create new routine methods that allow the next steps in program incorporation in nanometer CMOS technological innovation. Our analysis financing comes from industry, as well as from government companies. We aim to find essential alternatives for realistic issues of incorporated tour noticed in industrial Rubber technological innovation. CMOS IC technological innovation is determined by maximum cost and efficiency of digital tour and is certainly not enhanced for nice analogue actions. As analogue developers, we do not have the impression of being able to change CMOS technological innovation, so we have to “live with it” and fix the issues by style.

2.3 Paper III

Title:

J. SAMPSON ET AL., ‘‘EFFICIENT COMPLEX OPERATORS FOR IRREGULAR CODES,’’ PROC. 17TH IEEE INT’L SYMP. HIGH PERFORMANCE COMPUTER ARCHITECTURE, IEEE PRESS, 2023, PP. 491-502.

Description:

The Complex fat operators are important contributors to the efficiency of specialized hardware. This paper introduces two new techniques for constructing efficient fat operators featuring up to dozens of operations with arbitrary and irregular data and memory dependencies. These techniques focus on minimizing critical path length and load-use delay, which are key concerns for irregular computations. Selective De-pipelining (SDP) is a pipelining technique that allows fat operators containing several, possibly dependent, memory operations. SDP allows memory requests to operate at a faster clock rate than the Datapath, saving power in the Datapath and improving memory performance. Cachelets are small, customized, distributed L0 caches embedded in the Datapath to reduce load-use latency. We apply these techniques to Conservation Cores(c-cores) to produce coprocessors that accelerate irregular code regions while still providing superior energy efficiency. On average, these enhanced c-cores reduce EDP by 2× and area by 35% relative to c-cores. They are up to 2.5× faster than a general-purpose processor and reduce energy consumption by up to 8× for a variety of irregular applications including several SPECINT benchmarks.

2.4 Paper IV

Title:

M. FIORE, F. MININNI, C. CASETTI, AND C.F. CHIASSERINI, "TO CACHE OR NOT TO CACHE?" PROC. IEEE INFOCOM, PP. 235-243, 2022.

Description:

In this paper we set up essential restrictions to the advantage of system programming with regards to power and throughput in multi-hop Wi-Fi systems. Thereby we follow two well approved circumstances in the field individual multicast period and several unicast classes. Most of our results apply to irrelevant Wi-Fi system and are, in particular, not asymptotic in kind. In conditions of throughput and power preserving we confirm that the obtain of system programming of only one multicast period is at most a continuous aspect. Also, we present a lower limited on the expected number of signals of several unicast classes under an irrelevant system programming. We recognize circumstances for which the system programming obtain for power preserving becomes amazingly close to 1, in some cases even exactly 1, corresponding to no advantage at all. Remarkably, we confirm that the obtain of system programming with regards to transportation potential is surrounded by a continuous aspect _ in any irrelevant Wi-Fi system and for all conventional route models. As a corollary, we find that the obtain of system programming on the throughput of extensive homogeneous Wi-Fi systems is asymptotically surrounded by a continuous. Note that our result is more general than the previous work and it is obtained by a different technique. In summary, we show that contrary to wired systems, the system programming obtain in Wi-Fi systems is restriction by essential restrictions.

2.5 Paper V

Title:

ATTENUATED PEDIATRIC ELECTRODE PADS FOR AUTOMATED EXTERNAL DEFIBRILLATOR USE IN CHILDREN

Description:

This study reports a 3-year experience of use of pediatric pads that provide attenuated energy dosing with standard adult AEDs. Using voluntarily submitted reports, we have been able to demonstrate that the device worked appropriately and effectively. The two most common arrest rhythms, asystole and ventricular fibrillation, were identified correctly and defibrillatory shocks were given appropriately. Most satisfying is the five reported survivors in children with ventricular fibrillation. This study began immediately after obtaining market clearance for the pads and 2 years prior to the ILCOR update recommending AED use in children less than 8 years. Ventricular fibrillation, once thought to be rare in pediatric cardiopulmonary arrest, is now recognized to occur in 5–20% of prehospital cardiac arrests. Assessment of cardiac rhythm is often delayed until after advanced personnel arrive, and/or the airway and vascular access are established. Thus, the true prevalence of ventricular fibrillation may be underestimated in children. Similarly, to that which has been observed in adult pre-hospital arrest rapid recognition and treatment of pediatric ventricular fibrillation results in higher resuscitation rates and improved neurologic outcome, compared to asystolic arrests. In a review of pediatric cardiac arrest, Young and Seidel noted that resuscitation rates have not improved in the last 20 years; years that coincide with an increasing emphasis on pediatric resuscitation stressing airway management. They identified early defibrillation programs of young children as a potential improvement to pediatric resuscitation. Of eight children who had ventricular fibrillation and received attenuated shocks, all had termination of ventricular fibrillation and five survived to hospital discharge. This supports the rapid deployment of AEDs with attenuated energy doses for young children as well as adolescents and adults.

3. NEONTAL CARDIAC CARE

3.1 NEONATAL CARDIAC ARREST

Neonatal cardiac arrest refers to the sudden cessation of the heart's normal pumping function in a newborn or neonate, typically within the first 28 days of life. This is a life-threatening emergency that requires immediate medical attention. Various factors, including congenital heart defects, arrhythmias, birth complications, infections, and other underlying medical conditions can cause neonatal cardiac arrest. Effective and timely resuscitation is critical to improving the chances of survival for neonates experiencing cardiac arrest. Basic life support and advanced life support techniques, including cardiopulmonary resuscitation and defibrillation, may be necessary to restore the neonate's heart rhythm and circulation. Due to neonates' unique physiology and fragility, resuscitation in this population requires specialized equipment and training to ensure the best possible outcomes.

3.2 CURRENT RESUSCITATION METHODS

As of my last knowledge update in September 2021, the resuscitation methods for neonatal cardiac arrest were based on guidelines established by organizations like the American Heart Association and the American Academy of Paediatrics. These guidelines can change over time, so it's essential to refer to the most recent updates from these organizations or consult with healthcare professionals for the latest information. Here's an overview of the standard neonatal cardiac arrest resuscitation method:

3.2.1. Recognition of Cardiac Arrest: The first step is to recognize that a neonate is in cardiac arrest. This can be indicated by the absence of signs of life, such as breathing or movement, and abnormal or absent heart sounds or pulse.

3.2.2. A-B-C Approach:

- Airway: Ensure an open and clear airway.
- Breathing: Provide positive pressure ventilation (PPV) with a bag-mask device or endotracheal tube if the neonate is not breathing or gasping.
- Circulation: Compressions are rarely needed in neonates, but chest compressions should be initiated if the heart rate remains below a certain threshold despite adequate ventilation.

3.2.3. Medications: Medications like epinephrine may be administered as per guidelines if the heart rate remains low despite effective ventilation and chest compressions.

3.2.4. Continuous Monitoring and Reassessment: Resuscitation efforts should be continually monitored and adjusted as needed based on the neonate's response. It's important to note that resuscitation in neonates is highly specialized and requires healthcare professionals with specific training in neonatal resuscitation. The guidelines and protocols can vary depending on the specific circumstances, so healthcare providers must follow the most current recommendations and tailor their approach to the individual patient's needs.

3.3 MOTIVATION

3.3.1 High Infant Mortality Rates: The global prevalence of high infant mortality rates, especially due to sudden cardiac events and other critical health conditions, underscores the urgent need for advanced monitoring and intervention systems to improve the survival rates of neonates in critical care settings.
3.3.2 Limitations of Existing Monitoring Systems: Conventional neonatal monitoring systems often lack the capability for continuous and real-time monitoring, resulting in delayed detection of critical events and suboptimal intervention responses.
3.3.3 Shortage of Skilled Healthcare Personnel: In many regions, there is a shortage of skilled healthcare personnel, particularly in remote or resource-constrained areas.
3.3.4 Advancements in IoT Technologies: The rapid advancements in IoT technologies offer an opportunity to create interconnected systems that can collect, analyze, and transmit data in real time.
3.3.5 Advantages of the Dolphin Approach: The Dolphin approach, known for its emphasis on leveraging advanced technology and data analytics, provides a robust framework for integrating sophisticated algorithms and models into the system, enabling accurate and prompt responses to critical events in neonatal healthcare.

4. RESUSCITATION FOR CONGENITAL CARDIAC DISEASE

4.1 EARLY YEARS RESUSCITATION FOR CONGENITAL CARDIAC DISEASE IN NEWBORNS

Congenital cardiac disease poses a significant challenge in the neonatal period, often necessitating prompt and specialized resuscitative measures to optimize outcomes. This chapter discusses the principles and strategies for resuscitating newborns with congenital cardiac disease in the early years of life.

4.1.1 Understanding Congenital Cardiac Disease

Congenital cardiac diseases encompass a broad spectrum of structural and functional abnormalities of the heart and great vessels. These anomalies can range from simple defects, such as atrial septal defects, to complex conditions like hypoplastic left heart syndrome. Despite the heterogeneity, timely recognition and management are crucial for improving survival rates and reducing morbidity.

4.1.2 Anticipation and Preparation

In the delivery room, it is imperative to anticipate the possibility of congenital cardiac disease, particularly in infants with known risk factors such as maternal diabetes, genetic syndromes, or a family history of congenital heart defects. Healthcare providers should be prepared to initiate resuscitative measures promptly, including advanced interventions if necessary.

4.1.3 Early Identification

Rapid identification of newborns with congenital cardiac disease is paramount. Signs suggestive of cardiac compromise include cyanosis, respiratory distress, poor perfusion, abnormal heart sounds, and inadequate response to initial resuscitative efforts. A thorough physical examination, including assessment of heart rate, rhythm, and perfusion, should guide further management.

4.1.4 Hemodynamic Stabilization

Effective resuscitation of newborns with congenital cardiac disease focuses on optimizing hemodynamic stability. Basic interventions such as establishing a patent airway, providing adequate ventilation, and ensuring adequate circulation through chest compressions if indicated, form the foundation of management. Invasive measures such as umbilical venous catheterization and initiation of inotropic support may be necessary in severe cases to augment cardiac output and perfusion.

4.1.5 Special Considerations

Certain congenital cardiac lesions necessitate specific considerations during resuscitation. For instance, infants with duct-dependent lesions such as hypoplastic left heart syndrome rely on the patency of the ductus arteriosus for adequate pulmonary blood flow. Prompt initiation of prostaglandin infusion to maintain ductal patency is critical in these cases.

4.1.6 Collaboration and Transfer

Resuscitation of newborns with congenital cardiac disease often requires multidisciplinary collaboration involving neonatologists, pediatric cardiologists, cardiothoracic surgeons, and specialized nursing staff. Timely transfer to a tertiary care center with expertise in pediatric cardiology and cardiac surgery may be warranted for further evaluation and definitive management.

4.1.7 Family-Centered Care

Amidst the complexity of resuscitating newborns with congenital cardiac disease, it is essential to provide family-centered care. Open communication, empathy, and support for parents are integral components of the resuscitative process. Informed discussions regarding the infant's condition, treatment options, and prognosis empower families to make informed decisions in partnership with healthcare providers.

4.1.8 Long-Term Follow-Up

Resuscitation is just the beginning of the journey for newborns with congenital cardiac disease. Long-term follow-up is crucial to monitor cardiac function, growth and development, and to address any potential complications or ongoing medical needs. A coordinated approach involving primary care providers, pediatric

cardiologists, and other subspecialists ensures comprehensive and holistic care throughout infancy and beyond.
In conclusion, early years resuscitation for congenital cardiac disease in newborns requires a systematic and multidisciplinary approach.

4.2 CURRENT RESUSCITATION METHODS

As of my last knowledge update in September 2021, the resuscitation methods for neonatal cardiac arrest were based on guidelines established by organizations like the American Heart Association and the American Academy of Pediatrics. These guidelines can change over time, so it's essential to refer to the most recent updates from these organizations or consult with healthcare professionals for the latest information. Here's an overview of the standard neonatal cardiac arrest resuscitation method:

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Airway: Ensure an open and clear airway. - Breathing: Provide positive pressure ventilation (PPV) with a bag-mask device or endotracheal tube if the neonate is not breathing or gasping. 8 - Circulation: Compressions are rarely needed in neonates, but chest compressions should be initiated if the heart rate remains below a certain threshold despite adequate ventilation.

4.2.3. Medications:

Medications like epinephrine may be administered as per guidelines if the heart rate remains low despite effective ventilation and chest compressions.

4.2.4. Continuous Monitoring and Reassessment:

Resuscitation efforts should be continually monitored and adjusted as needed based on the neonate's response. It's important to note that resuscitation in neonates is highly specialized and requires healthcare professionals with specific training in neonatal resuscitation. The guidelines and protocols can vary depending on the specific circumstances, so healthcare providers must follow the most current recommendations and tailor their approach to the individual patient's needs.

5. SYSTEM ARCHITECTURE

The proposed system architecture for the Automatic Neonatal Child Monitoring and Defibrillating System using IoT Environment in Dolphin Approach consists of the following key components, each playing a crucial role in ensuring seamless and effective monitoring and intervention.

5.1 CHARACTERISTICS OF SYSTEM ARCHITECTURE

5.1.1. Neonatal Monitoring Devices: These devices are equipped with non-invasive sensors that continuously monitor vital signs such as heart rate, blood oxygen levels, and respiration rate. The monitoring devices are designed to be sensitive and accurate, ensuring reliable data collection without causing any discomfort or risk to the neonate.

5.1.2. IoT Gateway & Cloud-Based Data Processing Unit: Acting as the intermediary between the monitoring devices and the cloud-based data processing unit, the IoT gateway facilitates the seamless and secure transmission of data. It ensures that the data collected from the monitoring devices are transmitted in real time to the cloud-based processing unit for analysis and immediate action, if necessary. This unit serves as the central hub for data analysis, utilizing advanced signal processing algorithms and machine learning techniques. It processes the incoming data from the neonatal monitoring devices, detects any anomalies or irregularities in the vital signs, and triggers appropriate responses in real time. The data processing unit is designed to handle large volumes of data efficiently, ensuring accurate and timely interventions.

5.1.3. Defibrillation Mechanism: Integrated into the system, the defibrillation mechanism is programmed to respond automatically in the event of cardiac arrhythmias. It delivers a controlled electric shock tailored to the neonate's specific condition, aiming to restore the normal cardiac rhythm and prevent potentially life-threatening situations. The defibrillation mechanism is equipped with safety measures to ensure that the intervention is precise, controlled, and minimally invasive.

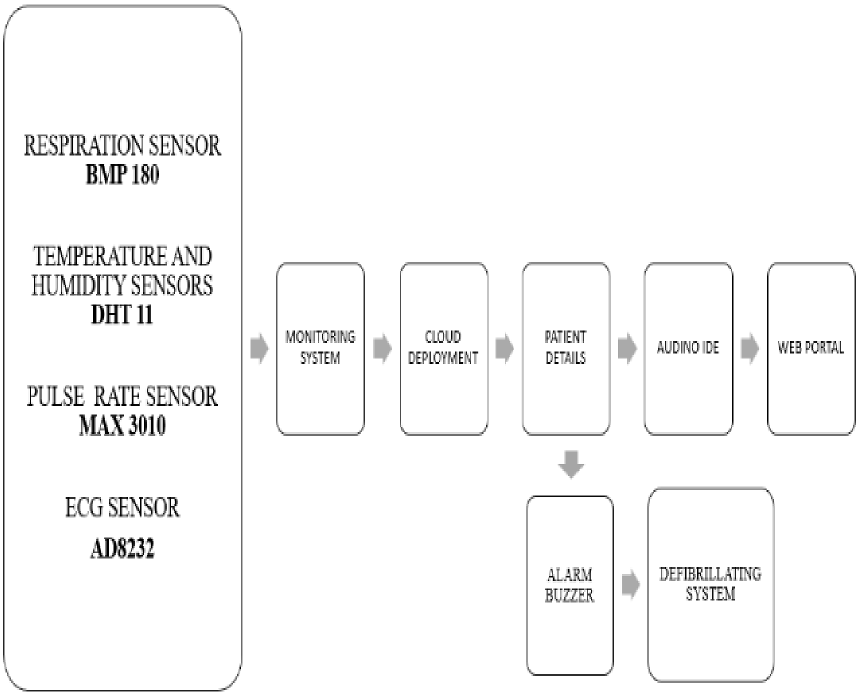

Fig.5.1: Block Diagram

The image (Fig.5.1) shows a block diagram of a system that includes components such as a respiration sensor, temperature and humidity sensors, monitoring cloud, patient system, deployment details, Arduino IDE, web portal, pulse rate sensor, ECG sensor, alarm, defibrillating buzzer, and more. The diagram is labelled with various components and their connections.

5.2 METHODOLOGIES OF SYSTEM ARCHITECTURE

The methodology for implementing the Automatic Neonatal Child Monitoring and Defibrillating System using IoT Environment in Dolphin Approach involves a comprehensive approach integrating advanced signal processing algorithms, machine learning models, and cloud-based data management.

Data Acquisition and Preprocessing: The neonatal monitoring devices collect continuous data on vital signs, including heart rate, blood oxygen levels, and respiration rate. The collected data are pre-processed to remove any noise Data acquisition is a critical component of the Automatic Neonatal Child Monitoring and Defibrillating System using a vibrator in the IoT environment. It involves the continuous collection of vital signs from neonatal monitoring devices.
Monitoring Devices: Utilize specialized neonatal monitoring devices equipped with non-invasive sensors. Sensors measure key vital signs such as heart rate, blood oxygen levels, and respiration rate.
IoT Integration: Integrate the monitoring devices into the IoT ecosystem for seamless data transmission. Establish a secure and reliable connection between monitoring devices and the IoT gateway.
Sensor Calibration: Calibrate sensors regularly to maintain accuracy in vital sign measurements. Implement automated calibration routines to account for variations in neonatal physiological characteristics or artifacts, ensuring the accuracy and reliability of the input data for subsequent analysis.

Real-Time Signal Processing: The pre-processed data undergo real-time signal processing using advanced algorithms to detect any anomalies or irregularities in the neonate's vital signs. These algorithms are designed to accurately identify potential life-threatening events, such as cardiac arrhythmias, and trigger immediate action if necessary.
Machine Learning Model Training: Machine learning models are trained using a combination of historical data and simulated scenarios to enable the system to make accurate predictions and decisions in critical situations.
Cloud-Based Data Management: The processed data, along with the outcomes of the signal processing and machine learning algorithms, are stored securely in the cloud-based data management system. This system ensures the accessibility, integrity, and privacy of the collected data, enabling healthcare professionals to access and review the data remotely for informed decision-making and intervention.
Defibrillation Response Optimization: The defibrillation mechanism is fine-tuned and optimized based on the analysis of historical data and real-time responses. The system adjusts the parameters of the defibrillation mechanism to deliver precise and effective interventions tailored to the specific needs of the neonate, ensuring minimal risk and maximal efficacy.

5.3 EXISTING SYSTEM

In the current system, premature baby is important part of human life and they are to be taken care of. A proper, suitable and safe environment has to be provided to them with appropriate care of their diet. A system to track and monitor the premature baby remotely is required. This system should be intelligent enough to message the parents of the child with the current situations, it should be able to requires amount of food and water, maintain the room temperature favored by the child's, live streaming of movement and behavior and should also be able to locate premature baby at a remote distance. Here we have developed the system with all these above-mentioned features. In the intricate tapestry of human existence, the delicate thread of premature birth weaves a poignant narrative. Premature babies, fragile and vulnerable, represent a profound intersection of hope and fragility in the journey of life. Nurturing these tiny souls demands not just care, but a meticulously orchestrated symphony of support, where every note resonates with precision and compassion.. Furthermore, the system must possess the ability to pinpoint the infant's location at a remote distance. In moments of exigency, where every second is imbued with urgency, this functionality assumes critical significance. Whether in the crucible of a medical emergency or amidst the tumult of logistical challenges, the ability to locate the premature baby with precision becomes a beacon of hope, guiding caregivers through the labyrinth of uncertainty with unwavering resolve.

In summation, the system designed to cater to the needs of premature babies represents a testament to the indomitable spirit of human ingenuity. It is a manifestation of our collective commitment to safeguarding the most vulnerable among us, inscribing their journey with a narrative of care and compassion. Within its intricate architecture lies the promise of a brighter tomorrow, where every premature baby is embraced in the warm embrace of technology-enabled care, ushering them into a world brimming with possibility and promise.

DISADVANTAGES

Less complex circuit and: Modules used are smaller in size and also lightweight so that they can be carried around.

All children should be tagged or implanted with RFID; it should affect their lifetime should be decreased.

6. PROPOSED SYSTEM

Nowadays, many advance technological techniques in real world operations are generated by scientists and engineers. One of the advance technical innovation streams is incubator automation. Daily needs of human system are fulfilling by using many of the premature baby. It is related to remote automation and indirectly to the child. To increase their life span, it is required to take care of health of the child and also use various operation of premature baby automation which is not harmful for environment. Premature baby health monitoring system with automatic defibrillator is current research topic in incubator automation. Many advance technical devices like mobiles and wireless sensor networks are available to monitoring any system. The proposed monitoring system includes the infrastructure, hardware, software and representative physiological instruments. Many hospitals contain large number of children. Therefore, it is too difficult to take care of them and to monitor routinely the health of premature baby.

So, this work is very adamantine to the parents and regional authorities. The main aspect of health monitoring system is to check continuously the health of individual of child, easily diagnosis and treatment of sick child as early as possible. In that system we use sensor technology which maps the special aspects of child behavior like temperature, heart rate etc. this data is aggregating and reporting to the health care center. This reduces the minimal health inspection and long-term premature baby healthcare cost. In the sprawling landscape of technological innovation, the realm of incubator automation stands as a testament to humanity's relentless pursuit of progress. In the tapestry of modernity, where every thread is woven with the promise of advancement, the advent of automated systems for premature baby care emerges as a harbinger of hope, ushering in a new era of efficiency and efficacy in healthcare. The genesis of this technological marvel lies in the convergence of scientific inquiry and engineering prowess. Scientists and engineers, driven by an insatiable curiosity and an unwavering commitment to improving human life, have harnessed the power of cutting-edge technology to revolutionize the landscape of premature baby care. At the heart of this innovation lies the concept of incubator automation, a multifaceted approach that seeks to fulfill the daily needs of premature babies while ensuring their health and well-being. In the intricate dance of human existence, the health of premature babies assumes paramount importance. These delicate souls, born into the world before their time, require meticulous care and attention to thrive. It is incumbent upon us, as stewards of their well-being, to provide them with an environment that is not just conducive to their growth, but inherently safe and nurturing.

ADVANTAGES

The communication between devices and human has gain more demand. IOT helps in interaction of such objects over the internet. The objects can be readable, located, recognized and controlled through internet. In this paper a child caring solution is addressed which includes a smart child door and a smart child feeder. This premature baby system has improved the premature baby monitoring and also fulfills the demands of parents. Premature baby inside the incubator or area can be tracked, but does not actually need to be tracked rather they need to be monitored. Their body temperature and their health conditions can be known with these sensors. Cameras distributed over the area detects the premature baby with their motion, monitors them and their movement which help them to analyze their behavior and the part of area where they spend most of their time. The amount of food they eat and water they drink can be controlled remotely and this controlling has to be done to keep the premature baby fit and healthy. If the premature baby is in house pet then the temperature and humidity of the house or the closed area can be maintained. For example, if the weather is chilled then the heater can be on.

7. SYSTEM REQUIREMENT

7.1 HEART RATE OXYGEN PULSE SENSOR - MH877

DESCRIPTION:

ECG basically detects the electrical activity of heart. It also determines rate, rhythm and conductivity of heart. The ECG module in Fig.7.1 detects the electrical activity of the heart using three Ag-AgCl electrodes configuration. To measure this electrical activity, we have proposed to use two electrodes that are placed on forelimbs and one on left hind limb along with one reference electrode on right hind limb. The electrodes will be attached with the help of ECG pads and crocodile clip. Electrode gel will be applied between skin and electrodes to improve connection and reduce distortion

FEATURES:

- Operating Voltage - 1.8V to 3.3V
- Input Current - 20mA
- Integrated Ambient Light Cancellation
- High Sample Rate Capability
- Fast Data Output Capability

APPLICATIONS:

- Medical Oxygen measurement devices
- Wearable Devices
- Fitness Assistant systems

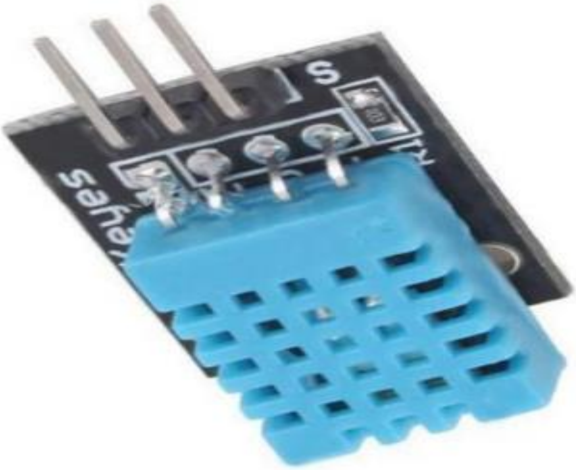

Fig.7.1: Heart Rate Oxygen Pulse Sensor - MH877

7.2 TEMPERATUIRE SENSOR – DHT11

DESCRIPTION:

The **DHT11** shown in below figure (Fig.7.2) is a commonly used **Temperature and humidity sensor that** comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So, if you are looking to measure in this range then this sensor might be the right choice for you. For measuring humidity, they use the humidity sensing component which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes.

Fig.7.2: Temperature Sensor – DHT 11

FEATURES:

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

APPLICATIONS:

- Measure temperature and humidity
- Local Weather station
- Automatic climate control

8. NEONATAL DEFIBRILLATION SYSTEM

8.1 VIBRATIONAL DEFIBRILLATION SYSTEM FOR NEONATES

8.1.1. Initial First Aid:

Traditional First Aid: In the event of a suspected heart attack in a neonate, preliminary first aid measures such as basic life support and CPR should be administered by trained healthcare professionals. This process starts when the alert vibration reaches the nurse station.

Monitoring Devices: Utilize neonatal monitoring devices to continuously assess vital signs, including heart rate and rhythm.

8.1.2. Vibrational Defibrillator System with Switch:

Design: Develop a defibrillator system that utilizes controlled vibrations instead of electric shocks. This design aims to be non-invasive and gentle on the delicate physiology of neonates.

Vibrational Mechanism: Implement a specialized vibrator system that can deliver precise and controlled vibrations to the neonate's chest area. This mechanism should be adjustable to accommodate different intensities based on the severity of the cardiac irregularity.

Activation Switch: Integrate a switch system that allows healthcare professionals to activate the vibrational defibrillator after the preliminary first aid measures have been administered and a cardiac irregularity is identified.

Safety Measures: Include safety features in the switch system to prevent accidental activation and ensure that the system is only activated when needed.

8.1.3. Automated Detection:

Sensor Integration: Integrate sensors into the system to continuously monitor the neonate's cardiac activity. These sensors can detect abnormal rhythms or pauses, triggering the need for intervention. Sensor integration is pivotal in ensuring accurate and comprehensive data collection for the neonatal monitoring system. Various sensors, such as heart rate monitors, oxygen saturation sensors, and temperature sensors, are strategically integrated into the Neonatal Monitoring Unit. These sensors work in harmony to provide a holistic view of the neonate's health status.

The integration process involves careful consideration of sensor placement, calibration, and synchronization to minimize measurement errors and ensure the reliability of the collected data. Additionally, the system employs redundant sensor systems to enhance reliability and fault tolerance.

Algorithmic Analysis: Implement algorithms that analyze the sensor data in real time. When an abnormal cardiac rhythm is detected, the system can automatically activate the vibrational defibrillator through the switch system. The algorithmic analysis is at the core of the system's intelligence, particularly in the Heart Attack Detection Module. Advanced algorithms are employed to scrutinize the real-time data obtained from the Neonatal Monitoring Unit. These algorithms are trained to recognize patterns associated with normal and abnormal vital signs, specifically focusing on early indicators of a heart attack in neonates. The algorithmic analysis involves machine learning techniques, where the system is trained on a dataset containing diverse neonatal health scenarios.

8.1.4. User Interface of Defibrillation System:

Alert System: The alert system in the proposed Automatic Neonatal Child Monitoring and Defibrillating System serves as a crucial component for timely response to potential health issues. It is designed to trigger notifications or alerts when deviations from normal vital signs are detected. The system employs sophisticated algorithms to analyze the collected data continuously, and upon identifying anomalies indicative of health concerns, it activates the alert mechanism.

Adjustable Settings: Include adjustable settings on the user interface to customize the vibrational intensity based on the neonate's specific condition.

8.1.5. Safety and Regulatory Compliance:

Clinical Trials: Conduct thorough clinical trials to assess the safety and efficacy of the vibrational defibrillator system for neonates.

Regulatory Approval: Ensure compliance with regulatory standards and seek approval from relevant medical authorities, such as the FDA.

9. RESULTS AND DISCUSSIONS

The Automated Neonatal Defibrillating and Monitoring System developed using IoT Environment in Dolphin Approach presents a significant advancement in neonatal care, specifically addressing the need for advanced cardiac monitoring and intervention tools in NICUs.

9.1 INTEGRATION OF IOT TECHNOLOGY

Leveraging IoT technology enables seamless communication and connectivity among system components, facilitating real-time monitoring in Fig. 9.1 of neonatal vital signs and automatic defibrillation in response to abnormal heart rhythms. This integration enhances the system's efficiency and effectiveness in providing timely interventions.

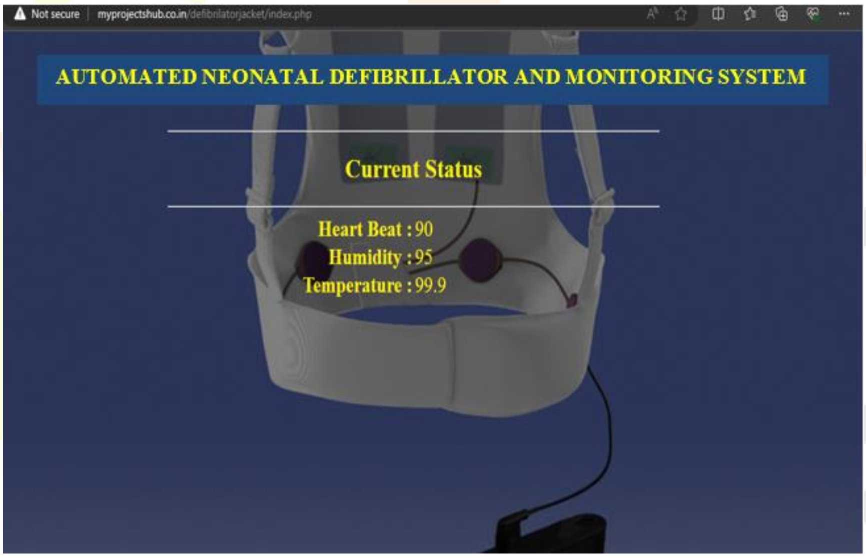

Fig: 9.1 Results of Real-Time Monitoring

9.2 COLLABORATIVE FRAMEWORK

The Dolphin approach fosters collaboration among healthcare providers, engineers, and technology experts throughout the development and implementation phases. This multidisciplinary collaboration ensures that the system in Fig. 9.2 meets the complex requirements of NICU environments and undergoes continuous improvement for enhanced reliability and performance.

9.3 ADAPTIVE INTELLIGENCE

Incorporating adaptive intelligence allows the system to learn and adapt to changing conditions and patient needs over time. Machine learning algorithms analyze data from neonatal monitoring, refining the system's algorithms to improve accuracy in detecting abnormal heart rhythms and delivering appropriate interventions.

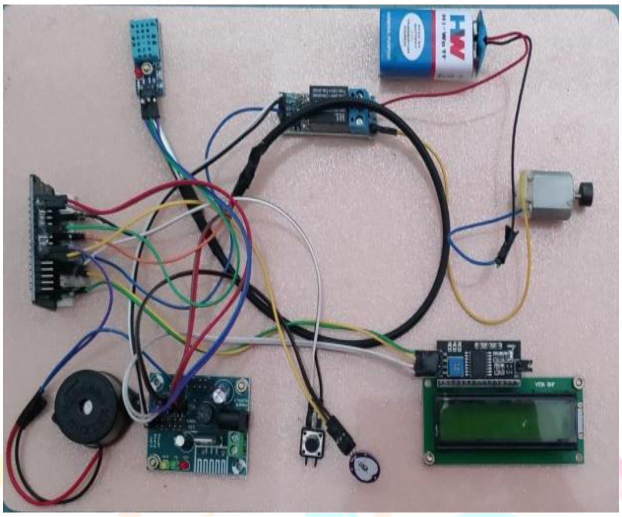

Fig: 9.2 Model of the Project

9.4 CHALLENGES AND CONSIDERATION

Despite the system's potential benefits, several challenges and considerations need to be addressed, including regulatory compliance, data privacy, security, and user training. These factors are crucial for the successful deployment and acceptance of the system in clinical practice.

10. CONCLUSION

The Embedded Technology is currently in its primary and the affluence of Knowledge offered is amazing. Embedded System is a permutation of hardware and software. Embedded technology plays a most important role in integrating the variety of functions coupled with it. Methods: This desire to bind up the variety of sources of the Department in a closed loop structure. This proposal significantly premature baby security and safety position of premature baby health anywhere in globe and also health system monitors premature baby temperature parameter.

Less complex circuit and: Modules used are smaller in size and also lightweight so that they can be carried around. So that concept of premature baby monitoring system is very useful. The future work will be extending for monitoring the more than one premature baby and monitoring the health by adding pulse rate parameter. This system will automatically broadcast the real time surroundings data. Findings: In this project we are going to observe the environment circumstances using the smart sensors in embedded technology, using this project we can analyze the climate and pollution state of our surrounding, using this data we can recover our surroundings from pollution.

This research has been undertaken in order to establish specific sensor technologies as a significant means to monitor premature baby health and to ensure premature baby well-being in the fast-changing conditions of automated farms. The leading to the need of continuously monitoring of their health to ensure their fitness as it directly affects the health of the consumers. These symptoms were then mapped to the type of sensors that would be able to measure the said behavior.

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