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WIRELESS CHARGING OF PULSE OXIMETER WITH BACKUP SUPPLY

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Abstract: This paper presents a wireless medical monitoring system. The goal of this paper is the presentation of a wireless pulse oximeter patient monitoring device that is low cost, high performance in signal detection and has good battery life. wireless charging is a technology of transmitting power through an air gap to electrical devices for the purpose of energy replenishment. The recent progress in wireless charging techniques and development of a commercial products have provided a promising alternative way to address the energy bottleneck of conventionally portable battery-powered devices. Wireless pulse oximeter system has been developed to measure the temperature, pulses rate and oxygen level (oxygen saturation). For patients at risk of respiratory failure, it is important to monitor the blood oxygen level (oxygen saturation) of such individuals to ensure proper perfusion of blood in their system. The power requirement of the system is fulfilled by a lithium polymer battery which can be charged using wireless charging as well as solar power. we have also monitored parameter of wireless charging system. Wireless pulse oximeter add many advantages to the traditional wired units. They are more convenient for the patients to use, and can be more comfortable.

Index Terms **- Inductive Power Transfer, Wireless Power Transformer, Lithium Polymer, Radio Frequency radiation, , Infrared rays, Magnetic resonance coupling.**

I. INTRODUCTION

1.1 Brief Description

Wireless charging is a technology of transmitting power through an air gap to electrical devices for the purpose of convenience. The ongoing development in wireless charging technology and expansion of commercial products have provided a promising alternative way to address the energy bottleneck of conventionally portable battery-powered devices[1]. In this paper, we present a comprehensive method of wireless charging technique. In particular, with regard to biomedical applications, we have developed a biomedical monitoring device which monitors temperature, pulse rate and oxygen level[1]. The power requirements of the system are fulfilled by a li-po battery which can be charged using wireless charging as well as solar power. Additionally, we have also monitored parameters of wireless charging system. Wireless power transfer (WPT)–based magnetic resonance coupling (WPT-MRC) is an encouraging technique for medium-power medical devices and other similar applications [5]. Therefore, the efficiency of power transfer from the transmitting radiator at transmitter to the receiving radiator at receiver should be maximized to produce sufficiently DC power at the output of receiver circuit. In order to obtain high efficiency of power transfer, both radiators have to be placed close each other. transmitter radiators [6].

A) Inductive Wireless Charging Technology:

Inductive coupling is a method based on magnetic field induction that delivers electrical energy between two coils. Inductive power transfer (IPT) takes place when a primary coil generates predominantly varying magnetic field across the secondary coil which is the receiver within the field, hence due to this voltage/current is induced across the secondary coil within the field itself.[1] This voltage can be used for charging a wireless device or any storage system in necessity of electrical energy. The operating frequency of this method is typically in the range of kilohertz. This method of charging is most popularly used in charging of mobile as it offers a proximity in the short distance with key advantages of highly efficient, ease of implementation, convenient operation.[1]

B) Magnetic Resonance Coupling:

This method involves the use of two resonant coils and the transfer of electrical energy takes place between the coils through oscillating magnetic fields, which are strongly coupled and operate at same resonant frequency. With small leakage to externalities high energy transfer efficiency is achievable[1]. Also, it serves an important benefit of enabling charging of multiple devices through a single transmitter. magnetic resonance coupling typically operates in the megahertz frequency range so it can be implemented for long distance compared to inductive coupling. The advantage this method possess is to be used for long distance and the charging of multiple devices from one transmitter.

C) RF Radiation:

RF radiation also known as power beaming is implemented by radiating electromagnetic beams in far-field region such as microwave or laser beams utilizes diffused RF/microwave as a medium to carry radiant energy, over space at the speed of light, normally in line-of-sight. The typical frequency of RF/microwave ranges from around 300MHz to 300GHz. Utilization of X-Rays or Infrared rays is incorporated in such method.[1][4] Firstly, AC-DC Conversion takes place which is then followed by a DC-to-RF conversion through magnetron at the transmitter side. Then, the RF/microwave captured by the receiver rectenna are rectified into electricity again, through an RF-to-DC conversion. The RF-to-DC conversion efficiency is completely dependent on the captured power density at receive antenna, the accuracy of the impedance matching between the antenna and the voltage multiplier, and the power efficiency of the voltage multiplier which enable to convert the received RF signals to DC voltage. Besides the longer transmission distance, microwave radiation also offers the advantage of compatibility with existing communications system.

1.2 General Overview.

Among the methods, the most effective and efficient method is Magnetic Resonant Coupling which involves the creation of a resonance and transmission of the power without any radiation problems due to electromagnetic waves.[4]. In this paper, use of Renewable energy source which will be another main source for charging the electric vehicle, where the solar energy from the sunlight is collected by the solar cells, and these cells convert the light energy from the sun into DC electric current. In this paper, we present a hardware platform for the experimentation of a battery storage station. This platform contains a battery management system for lithium-polymer batteries built around an Arduino Nano and allows the acquisition of current, voltage measurements from PV panels and battery which can be used to study the state of the battery and help with maintenance.[1]-[3]

Every system and organ in the body needs oxygen to survive. Without oxygen within, cells begin to malfunction and eventually die and Cell death can cause severe symptoms and ultimately lead to organ failure. In such cases, Pulse oximeters are useful for people who have conditions that affect oxygen saturation. In the Covid-19 pandemic, oxygen has played a vital role as many humans suffered, and some even faced death due to deficit of oxygen. Here, pulse oximeter comes into picture. Compactness is an advantage of pulse oximeter human can carry the device anywhere and everywhere and check the level of oxygen in his/her body.[1] Our Project introduces such a pulse oximeter which detects and measures the oxygen level, temperature, and the biggest advantage it serves it can be charged wirelessly.

Wireless charging method is adopted in it, which enable the user to comfortably and at a ease charge the pulse oximeter. Also, it has a backup of solar. Solar batteries are slow charging and discharging, and they support alternating phases of loading and unloading quite well. [2] Whenever the charging through wireless is not available then, one can charge the device by this backup. So, the user is continuously available with the electrical energy within the device which enables the device to be used in any emergency condition as well.

Hence, in this paper a pulse oximeter implemented with wireless charging and with backup provided y solar energy is introduced.

II.METHODOLOGY

The system is powered by Arduino Nano which a type of the microcontroller. Wireless charging modules are used in this system in order to charge a Lithium polymer (Li-Po) Battery. The battery can also be charged using Solar Panel when there is no wireless charging source available. This is sensed by the current sensor, which senses and monitors the level of battery's charging and it's charging state. If a wireless charging source is present, the current sensor will send a signal to the microcontroller to de-energizes the relay which switches off the solar power source. Relay is used as switch, which connects and disconnects the solar panel's supply with the battery.

In the absence of wireless charging source, the relay remains energized which means battery starts charging on solar source. Voltage from solar source is monitored using voltage sensor. Depending on the threshold the solar source can be switched on or off using relay. A Li-Po Battery is used in the system. It is equipped with TP4056 module which is used to protect battery from overcharging, excessive discharging etc. Complete data is displayed over an OLED display. This system is used for biomedical application. The device uses MAX30100 for determining pulse rate and oxygen level of the user. Along with this it uses LM35 for measuring body temperature. This data is also displayed on an OLED display along with the previous data.

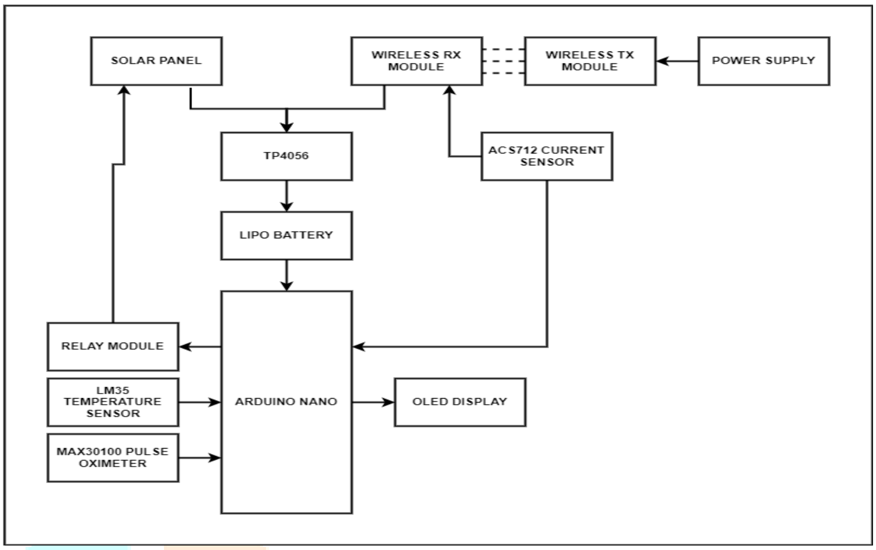

Fig 1: Block diagram

III. HARDWARE SETUP

The proposed paper uses several sensors in order to measure health parameters as well as to measure the system parameters for system balance and safety purpose. Sensor MAX30100 has been used to measure Oxygen Saturation of the blood and heart rate. It is made up of optimized optics, a photodetector, two LEDs and a low noise analog signal processing unit . This module operation starts at an Operating Voltage and Continuous Power Dissipation within 1.8 V – 3.3 V and 464 mW respectively[1].LM35 is a three-terminal linear temperature sensor , a precision IC, which produces an output voltage directly proportional to the temperature in Celsius has been used as It is better than thermistors because it shows a linear output and low output impedance with an output

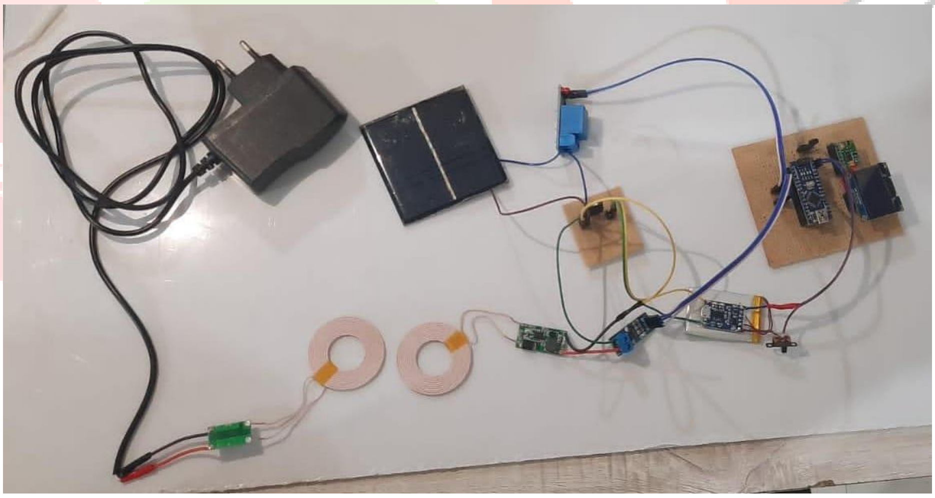
Fig 2 Hardware setup

temperature range of -55°C - 150°C[1]. We can also interface it with any Microcontroller that has an analog to digital conversion function as we are using Arduino Nano microcontroller this function of the sensor makes it suitable for the system.
A lithium polymer battery with TP4056 module is used for supplying the power to the temperature and pulse oximeter sensor , is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid polymers form this electrolyte. This battery provide higher specific energy than other lithium battery types. The Li-po battery of 1000mAh 3.7v capacity is used. The TP4056 module is attached to a single cell battery, protecting the cell from over and under charging. It also has a programmable charge current of up to 1A.Can use it to charge batteries directly from a USB port since the working input voltage range is 4V ~ 8V.
Wireless charging modules are used in this system in order to charge a Lithium polymer (Li-Po) Battery. Consisting of a transmitter and receiver coil and it is compact in size, having a rating of 12vdc input and 5vdc output with maximum current of 600mA.The solar cell used as renewable source of supply for the battery charging as a backup supply, observes the sources of energy from sunlight to produce electricity and convert AC to DC current. Then the DC direct current is directly connected to battery[7].The charging of the battery through wireless module and solar is controlled with help of single channel 5v control single-pole double throw relay board which is connected to the microcontroller Arduino Nano.
he ACS712 module uses the ACS712 IC to measure current using the Hall Effect principle. These ACS712 module can measure current AC or DC current ranging from +5A to -5A, +20A to -20A and +30A to -30A. This sensor is used to sense the continuity

of supply towards the battery from the wireless module if the continuity disturbed the sensor will give the input to the microcontroller and with help of relay the backup supply will be connected.

IV. CONCLUSION

In the paper presented, demonstration of a pulse oximeter with wireless charging was exhibited. With the growing technology, it has become important to adopt and adapt to these technologies, and implement it in a way most useful to the human kind. With the virtue of this, we have incorporated theoretical and practical analysis on the subject mentioned in the paper. The theory of wireless charging by the means of inductive coupling, which is one of the technique used in this Paper. This promising technology has significantly advanced during the past decades and has introduced a large amount of user-friendly applications. In this paper, we have presented a comprehensive method of charging with solar supply along with the wireless charging. Permitting the use of solar supply benefits in case of any emergency situation where wireless charging fails. A practical view of the hardware implemented with the technology mentioned in the paper is shown in the fig. ( ).
Through the circuit diagram, the output and the results achieved which is presented in the paper , it clearly exhibits the working state of the model. Also, with certain modifications and advanced implementation, future modifications and flexible output can be obtained.

V. RESULTS AND DISCUSSION

PATIENT NO	HEART RATE (in BPM)	SPO2	TEMPERATURE (in degrees)	MODE OF CHARGING
1	101.00	95	36.85	SOLAR
2	98.00	95	34.21	SOLAR
3	98	95	35.68	SOLAR
4	96	98	37.63	SOLAR
5	98	97	38.5	SOLAR
6	96	98	37.63	WIRELESS
7	97	93	35.19	WIRELESS
8	95	98	35.19	WIRELESS
9	92	96	34.43	WIRELESS
10	94	95	37.76	WIRELESS

Table no 1

Above mentioned are the results of different patients indicating values of heart rate, oxygen level, temperature and mode of charging. Values of 10 patients with both modes of charging was recorded and mentioned in the Table no 1.

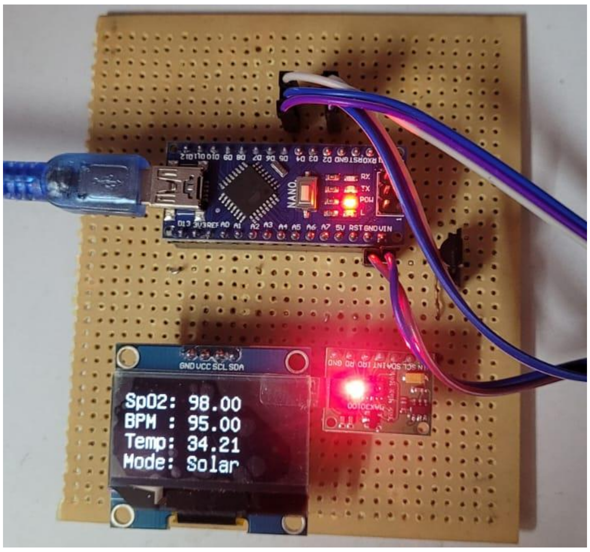

Fig 3: Results from Solar Supply

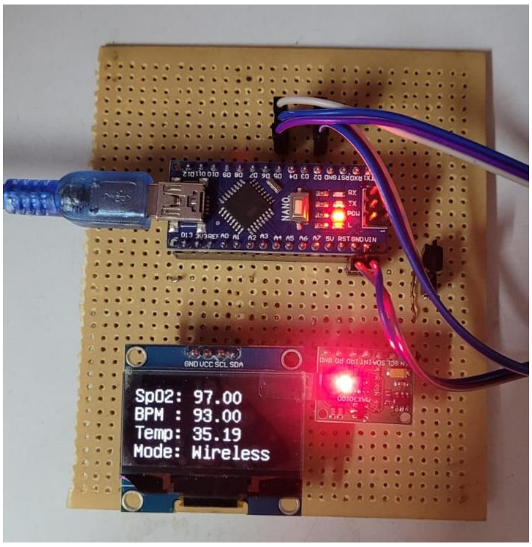

Fig 4: Results from wireless supply.

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