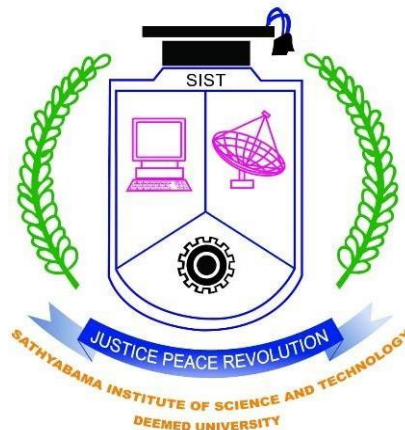


WIRELESS CHARGER FOR IMPLANTABLE PACEMAKER INTEGRATED WITH ANDROID APPLICATION

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology degree in Biomedical Engineering

By

J. GODWINSON (37240025)



**DEPARTMENT OF BIOMEDICAL ENGINEERING
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2021



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BONAFAIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **Godwinson J (37240025)** who carried out the project entitled "**Wireless charger for implantable pacemaker integrated with android application**" under my supervision from **September 2020 to March 2021**

Ms.**SINDU DIVAKARAN**,M.E.,(Ph.D.,)

Guide and Supervisor

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Head of the Department

Submitted for Viva voce Examination held on _____

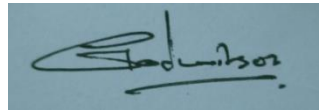
Internal Examiner

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DECLARATION

I, **GODWINSON J (37240025)** hereby declare that the Project Report entitled “**Wireless Charger for implantable pacemaker integrated with Android Application**” done by me under the guidance of Ms. **Sindu Divakaran**, M.E., (Ph.D.), Department of Biomedical Engineering the is submitted in partial fulfillment of the requirements for award of Bachelor of Technology Degree in Biomedical Engineering.

1.

A handwritten signature in black ink on a light blue background. The signature appears to be 'Godwinson J.' with a horizontal line underneath.

DATE:

PLACE:

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

We are pleased to acknowledge our sincere thanks to **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. we are grateful to them.

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ABSTRACT

The transcutaneous power transfer for the pacemaker of the heart can be done by the principle of mutual induction. The primary coil and secondary coil present in this transformer should be positioned in such a way to enable the transfer of power from transmitter section to the receiver section wirelessly. The mutual induction process will take place when we keep both the coils parallel. The receiver coil should be positioned inside of the body and transmitter coil should be positioned outside of the body. The voltage regulator will provide or regulate the required output voltage. The Bluetooth technology is used here to observe the charging level of the battery. The inductive power transfer method eliminates the should risk of infection caused due to surgery

Keyword : Microcontroller , mutual induction , pacemaker , inductive power transfer

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LIST OF ABBREVIATION

Abbreviations	Full form
Arduino IDE	Arduino Integrated Development Environment
ECG	Electro Cardio Gram
IOT	Internet of Thing
Rx Coil	Receiver Coil
Tx Coil	Transmitter coil
Wi-fi	Wireless fidelity

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

A Pacemaker can recognize a drag together with your heart's rhythm and send its own electrical pulse to form your heart beat regularly and on time it's made from computer chips and a little , but long-lived battery during a sealed case(Monti.G, De Paolis M.et al). The Pacemaker is surgically implanted within the upper chest. the heart beat it generates is shipped through special wires called leads, normally placed inside the guts . The leads also help the Pacemaker sense the heart's rhythm. this is often important because the device must send its pulse at a particular moment. the guts generates its own electricity, which causes it to contract and relax within the proper timing sequence, in order that it can pump blood to the body. Electrical signals can become blocked or irregular causing the guts to beat too slowly. A Pacemaker provides electrical stimulation when the guts doesn't beat or beats too slowly. The Pacemaker can sense the heart's rhythm. It are often "programmed" to either send a pulse or to attend for the guts to beat on its own. Pacemakers have the potential for his or her settings to be adjusted by your physician so as to supply appropriate support for a good range of lifestyles and activities. Some Pacemakers also sense the patient's activity for example; climbing stairs or exercising that it can speed up or hamper the guts rate. Your doctor can help provide you with a tool that meets both your medical and lifestyle needs Modern pacemakers usually have multiple functions. The most basic form monitors the heart's native electrical rhythm. When the pacemaker wire or "lead" does not detect heart electrical activity in the chamber - atrium or ventricle - within a normal beat-to-beat time period - most commonly one second - it will stimulate either the atrium or the ventricle with a short low voltage pulse. If it does sense electrical activity, it will hold off stimulating. This sensing and stimulating activity continues on a beat by beat basis and is called "demand pacing". In the case of a dual chamber device,

when the upper chambers have a spontaneous or stimulated activation, the device starts a countdown to ensure that in an acceptable - and programmable - interval, there is an activation of the ventricle, otherwise again an impulse will be delivered. Pacemakers are not a cure for heart disease. They don't treat the causes of slow or irregular heartbeats. But because they can maintain proper cardiac rhythm, Pacemakers can greatly improve the quality of life for people.

Temporary pacing is usually used if a person's cardiac rhythm is extremely unstable and it's not safe to attend to place during a permanent pacemaker. For instance, it's going to be used as an emergency measure when someone develops a severe bradycardia (a very low heart rate), or serious Adams-Stokes syndrome, often thanks to an attack. Sometimes, temporary pacing is employed during a planned way – for instance, as a short lived measure during surgery.

There are two main ways of doing temporary pacing – external temporary pacing which is completed from outside the body, and internal temporary pacing which is completed inside the body. External temporary pacing – also called transcutaneous pacing – is completed by employing a special pacing function on a defibrillator machine. This sends regular electrical impulses through the chest wall to the guts to act as a pacemaker. If the person is conscious, they'll need sedation and pain relief. This is often a really temporary measure utilized in a sudden emergency. Internal temporary pacing – also called transvenous pacing – is done by inserting a pacing wire into the right side of the heart by passing it through a vein in the groin or the neck. This is done using local anesthetic, along with sedation if necessary. This wire stays in the vein and is connected to a pacing box that stays outside the body. This is usually done as an emergency procedure because a person's heart rhythm has become unstable for example, following a heart attack. A permanent pacemaker is then sometimes needed if the heart rhythm does not return to normal.

1.2 OUTLINE OF THIS PROJECT

Wireless charging method for implantable pacemaker is worked on inductive coupling power transfer between the two coils has been proposed in this system the receiver coil is to be placed on the body while transmitter coil is to be placed inside the body. Transmitter and receiver coil can transmit the power wirelessly, and receiver circuit will receive the AC current and convert it into DC current for the battery of the implantable pacemaker The Bluetooth utilized here will transmits the re-energizing rate to the android app. There is a pulse sensor combined to the microcontroller and it is used to measure the pulse rate of heart. This method of communication will be utilized for re-energizing the battery

.

CHAPTER 2

LITERATURE SURVEY

Qazi Saeed Ahmad Tarana et al 2015 planned a Wireless energy transfer or wireless power is that the transmission of electricity from an influence source to an electrical load without a conductive physical connection. Wireless transmission is beneficial in cases where interconnecting wires are inconvenient, hazardous, or impossible. A pacemaker is employed to treat a heart that beats too slowly. The pacemaker is implanted under the skin of your chest with wires attached into the guts . It monitors your heartbeat and provides electrical stimulation when it beats too slowly or stops. Its power is supplied by A battery that has got to periodically get replaced . The aim of research is meant to charge a chargeable battery wirelessly for the target . this is often formed out of an ac 230 volt 50Hz to ac 20 KHz at 12 volt circuit .The output is fed to a tuned 2KHz coil forming as primary of an air core transformer. The secondary winding develops a voltage of 20 KHz at 12 volt while it's kept over the first coil where air is employed because the core. The output of the secondary is given to a high frequency bridge rectifier that delivers dc which is then regulated to take care of a continuing charging current to a NiCd (Nickel Cadmium) rechargeable battery. Normally these batteries have an extended lifetime of 7 years. Thus the patient's operation time are often deferred to every 7 year after for replacement of the battery because the charging are often finished 7 years externally (Qazi Saeed Ahmad Tarana, A.Chandel, et al., 2015)

Hasmah Mansor et al 2015 proposed a portable pulse monitoring system which is a component of a project called Home-smart Clinic. Home-smart Clinic is developed so as to attach medical personnel and patients remotely. Remote health monitoring system is useful to the patients and society where the implementation of such system will save hospital bill, waiting time and reduce traffics within the hospital. The prime objective of this paper is to style and develop

pulse measurement device that real time data might be observed by the doctor via internet. History data could even be acquired; therefore the doctor can interpret the trend of the info to spot the conditions of the patients. within the proposed health monitoring system, pulse and blood heat wireless sensors were developed, however this paper only specialized in pulse monitoring system. the most components involved during this project are pulse sensor, microcontroller (Arduino with Ethernet shield) and wireless communication device (Xbee). The portable pulse measurement device was tested to a gaggle of voluntary students. Results showed that the real-time pulse reading successfully monitored locally (at home) and remotely (at doctor's computer. (Hasmah Mansor, Siti Sarah Meskam, Nasiha Sakinah Zamery; et al 2015)

Puneet Bansal et al., 2018 Heart rate that's given by the amount of times heart beats per minute may be a crucial health parameter that indicates soundness of the human health. During this project, a real-time pulse measurement technique called PhotoPlethysmography (PPG) is implemented using simple infrared transmitter and receiver circuit. Arduino Uno board has been used for calculating the guts rate from the fingertip. The obtained pulse values are initially displayed on a liquid Display (LCD) and sent serially to Raspberry Pi which is employed as an internet of Things (IoT) gateway. The values are then sent to the cloud through Message Queuing Telemetry Transport (MQTT) protocol. The designed system updates the user with their pulse through electronic message (email), Short Message Service (SMS) and real-time plots and provides name and address of a close-by prominent hospital just in case of an emergency (Puneet Bansal et al., 2018)

D.Shiva Rama Krishnan, et al., 2018 showed that Health-care Environment has created science and information upheld Wireless-Sensing hub Technology arranged. Patients face a dangerous circumstance of unanticipated end on account of the exact explanation of heart issues and assault which is because of nonexistence of brilliant clinical support to patients at the required time. this is frequently for uniquely observing the adulthood patients and advising specialists and friends and family. So we are proposing a creative task to evade such extra time rates by utilizing Patient Health Monitoring that utilizes sensor innovation and utilizations web to address the friends and family if there should be an occurrence of issues .This framework utilizes Temperature and heartbeat sensor for following patients wellbeing. Both the sensors are associated with the Arduino-uno.

to follow the patient wellbeing miniature regulator is progressively interfaced to a LCD show and Wi-Fi association with send the data to the web-worker (remote detecting hub). simply if there should be an occurrence of any sudden changes in persistent pulse or blood heat alert is dispatched about the patient utilizing IoT. This procedure likewise shows patients temperature and heartbeat followed live information with timestamps over the Internetwork. Consequently Patient wellbeing observing framework upheld IoT utilizes web to viably screen patient wellbeing and helps the client checking their friends and family from work and saves lives. (D.Shiva Rama Krishnan, et al., 2018)

Progressive shrinking of CMOS device sizes has permitted reductions in power consumption and miniaturization of electronic devices. In parallel, modern pacemakers implemented with advanced technologies have proved to be more sensitive than earlier models to soft errors induced notably by external radiations. Traditionally, the analysis of the impact of sentimental faults (SFs), like those induced by single-event upsets, on the behavior of pacemaker devices, has been administered by dynamic radiation ground testing and clinical observations. However, these techniques are expensive. they will only be done very late within the design cycle, after the planning is manufactured and partially after it's implanted.

Ghaith bany hamad , et al 2018 presents a replacement model-based analysis of the impact of SFs on the behavior of cardiac pacemakers at a system level. it's performed by:1) introducing a replacement probabilistic timed automata (PTA) model; 2) verifying this model against a group of functional properties to make sure it meets its specifications under normal conditions; 3) applying a replacement methodology to inject SFs at a particular time within the PTA model of the pacemaker and to verify their impact on the pacemaker's

behavior is introduced; and 4) identifying different scenarios for SFs which will cause malfunction, including over sensing, under sensing, and output failure. The reported formal modeling is completed in PRISM and therefore the analysis is completed with the Storm model checker(ghaith bany hamad , et al2018)

Wei Vivien Shi,et al,2016 proposed an overview of the body sensors applied in pacemakers and exceptional advances in current pacemaker frameworks. New highlights of late pacemakers that are economically accessible are momentarily portrayed. Body sensors fused in pacemakers are shown with their reasoning's, detecting signals, benefits, limits and applications (Wei Vivien Shi,et al,2016).

Hassnaa Mustafa Abdul-jabbar, et al 2020 planned that internet of things is becoming increasingly popular within the field of remote monitoring also because the increasing number of patients with cardiac pacemakers, especially those that need a pacemaker. During this research, a replacement method of monitoring ecg has been developed for patients who are implanting pacemakers. the develop system is that the ability to transfer of the monitor that exist within the special website (www.thinger.io) by using the Wi-Fi protocol, also, helping them to transmit their data over long distances and different places in real time counting on internet objects (iot). The system helps to transfer the ecg, temperature and therefore the detector of magnetic flux across the web site to unravel the matter of the lack of the doctor to watch the patient from home continuously, also as within the case of a doctor in another country. within the end of paper the system are going to be reliable to display ecg data with 70 beats, temperature with 37.12c and warning within the sort of light if a magnetic flux comes near the system, which may help facilitate patient follow up after implantation of the pacemaker.(Hassnaa Mustafa Abdul-jabbar, Jameel Kadhim Abed,et al, 2020)

Vani Yeri,et al, 2020 proposed that customary sensor based analysis in clinical field requires more number of sensors and human endeavors in the event that it is handled in an enormous scope. It is a troublesome assignment because of the lack of clinical experts and framework arrangement. To defeat this issue an IoT based medical care application is proposed in the examination work. The proposed framework comprises of the web and versatile application dependent on constant remote checking of patients. The goal is paper is to execute an ease framework and send the patient indispensable signs in crisis circumstances. Sensors are being utilized for estimating the patient essential signs by utilizing the remote organization. The sensors information are gathered and sent to the cloud for capacity through Wi-Fi module associated with the regulator. The information is prepared in the cloud and criticism steps are taken on the broke down information which can be additionally examined by a specialist distantly. Far off survey decreases weight to specialists and gives the specific wellbeing status of patients. In the event that the patient requirements earnest consideration, a message is shipped off the specialist

CHAPTER 3

AIM AND SCOPE

3.1 AIM

The aim of the project is to replace the pacemaker implanted patient's surgery by introducing a wireless power transfer method for recharging the battery

3.1.1 Existing System

- Existing system follow the battery cannot be recharged because it can be used only once. It will be very difficult for the patients to afford high - cost for the surgery each time at the time of battery replacement. Battery level is unknown to the patient because there will not be any record maintained about the pacemaker's battery after the surgery (Qazi Saeed Ahmad Tarana et al 2015)

3.1.2 Disadvantage of existing system

- The existing system consists of complex and periodic surgeries for the recharging process. The varying transformer values make the control very difficult in order to gain output voltage regulation when the load varies. There is no visible efficiency and rechargeable batteries are used here. Surgery is unavoidable

3.1.3 Proposed method

- we proposed a Battery is rechargeable and can be used multi times. It is a single surgery process and doesn't need to do any surgeries afterward for recharging battery as this can be done wirelessly and transcutaneously and there is less cost for surgery as it is a single process
- Through Bluetooth feature , we can continuously monitor the battery health level

3.1.4 Proposed system advantages

- The pacemaker's battery charge level is monitored continuously through android application
- the mobility of the patient is increased by charge the pacemakers battery in one time

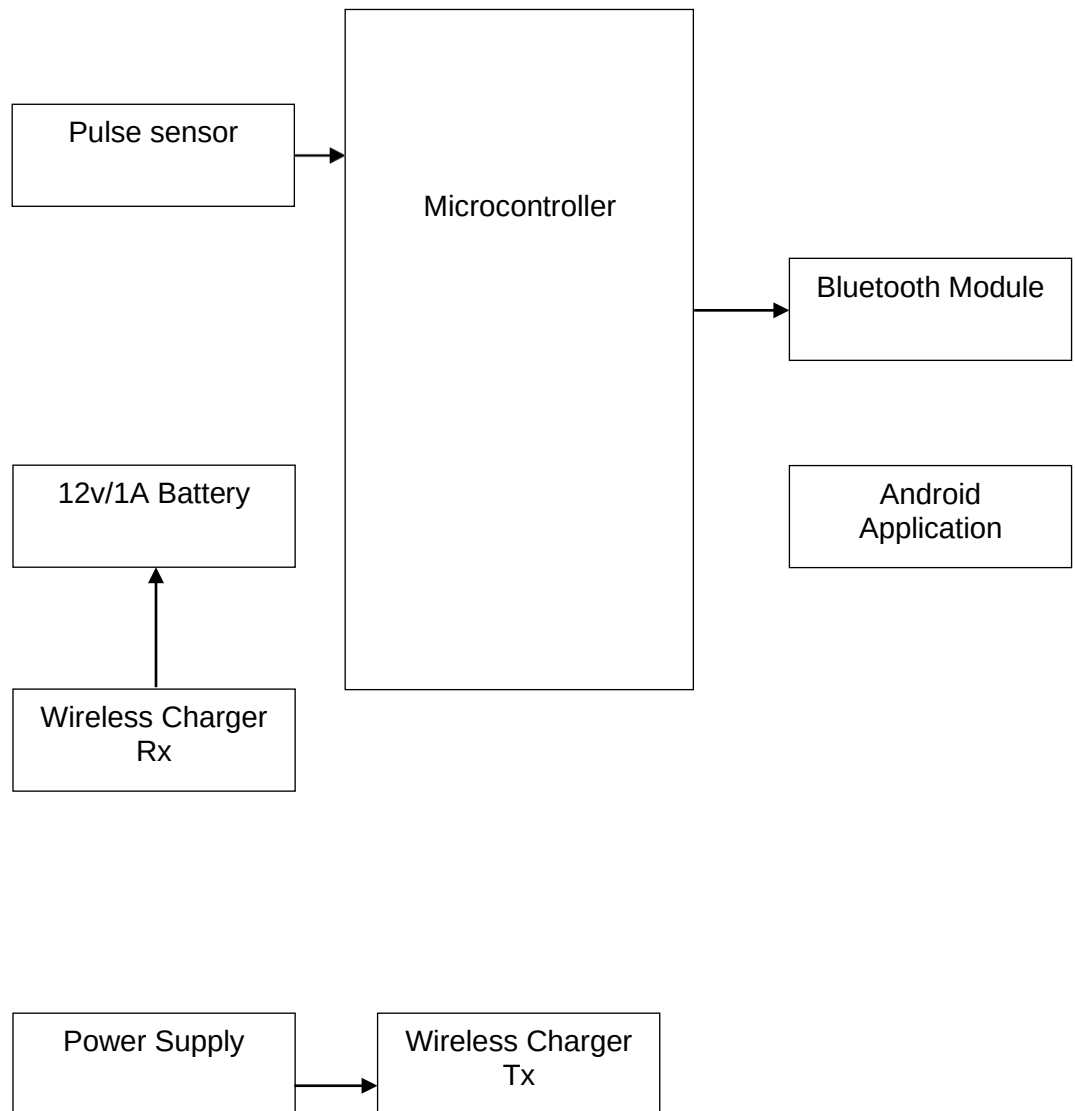
3.4 SCOPE

Wireless charging of medical devices has the potential to take the application of these devices to a whole new level, paving the way for a bright and promising future for the healthcare sector. The industry has been continuously experimenting with the technology, exploring the scope technology in smart wearable's and other medical devices.

CHAPTER 4

MATERIAL AND METHODS

4.1 BLOCK DIAGRAM OF PROPOSED WORK



4.1.2 Block diagram methodology

Wireless charging method for implantable pacemaker is worked on inductive coupling power transfer between the two coils has been proposed in this system. The receiver coil is to be placed on the body while transmitter coil is to be placed inside the body. Transmitter and receiver coil can transmit the power wirelessly, and receiver circuit will receive the AC current and convert it into DC current for the battery of the implantable pacemaker. The Bluetooth utilized here will transmit the re-energizing rate to the android app. There is a pulse sensor combined to the microcontroller and it is used to measure the pulse rate of heart. This method of communication will be utilized for re-energizing the battery.

4.1.3 Block diagram explanation

In the block diagram, there are two sections: transmitter coil section and a Receiver coil section. The transmitter section consists of power supply, bridge rectifier, filter, Transformer and transmitter coil. The transmitter coil provides an AC current and it creates a magnetic flux and the bridge rectifier helps in the conversion of AC input to DC output. The AC current will be converted into 12V DC current using bridge rectifier. The 12V DC current is supplied into the circuit and it converts 12V DC to 9V DC is supplied into the battery. The magnetic flux from the transmitter section will be received by the receiver section. The Bluetooth used here will transfer the recharging rate to the mobile phone. There is a pulse sensor attached to the microcontroller and it is used to measure the pulse rate.

4.2 HARDWARE COMPONENTS

4.2.1 Transformer

A transformer depends on a straightforward reality about power: when a fluctuating electric flow courses through a wire, it creates an attractive field (an undetectable example of attraction) or "attractive motion" surrounding it. The strength of the attraction (which has the fairly specialized name of attractive transition thickness) is straightforwardly identified with the size of the electric flow. The bigger measure of current, more grounded the attractive field. At the point when an attractive field varies around a piece of wire, it produces an electric flow in the wire. So in the event that we put a second loop of wire close to the first, and send a fluctuating electric flow into the main curl, we will make an electric flow in the subsequent wire.

The current in the main loop is typically called the essential current and the current in the subsequent wire is the auxiliary current. What we've done here is pass an electric flow through void space starting with one loop of wire then onto the next. This is called electromagnetic enlistment in light of the fact that the current in the principal curl causes (or "actuates") a current in the subsequent loop. We can make electrical energy pass all the more proficiently from oneloop to the next by folding them over a delicate iron bar

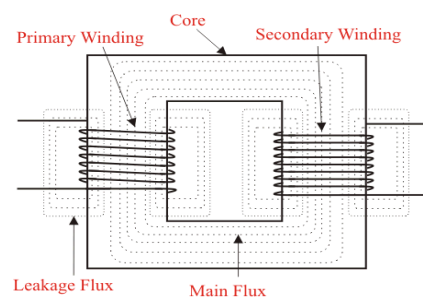


fig 4.2.1 Transformer

4.2.2 The rectifier circuit

Rectifier circuit is utilized to change over the AC input is changed over to DC. The full wave connect rectifier utilizes four diodes organized in a scaffold circuit to give full wave correction without the requirement for a middle tapped transformer. An extra benefit is that, as two diodes are directing at any one time, the diodes need just a large portion of the opposite breakdown voltage ability of diodes utilized for half and regular full wave correction. The scaffold rectifier can be worked from independent diodes or a consolidated extension rectifier can be utilized (Mansor H, . Meskam S.S et al).

It very well may be seen that on every half cycle, inverse sets of diodes direct, however the current through the heap stays in similar extremity for both half cycles.

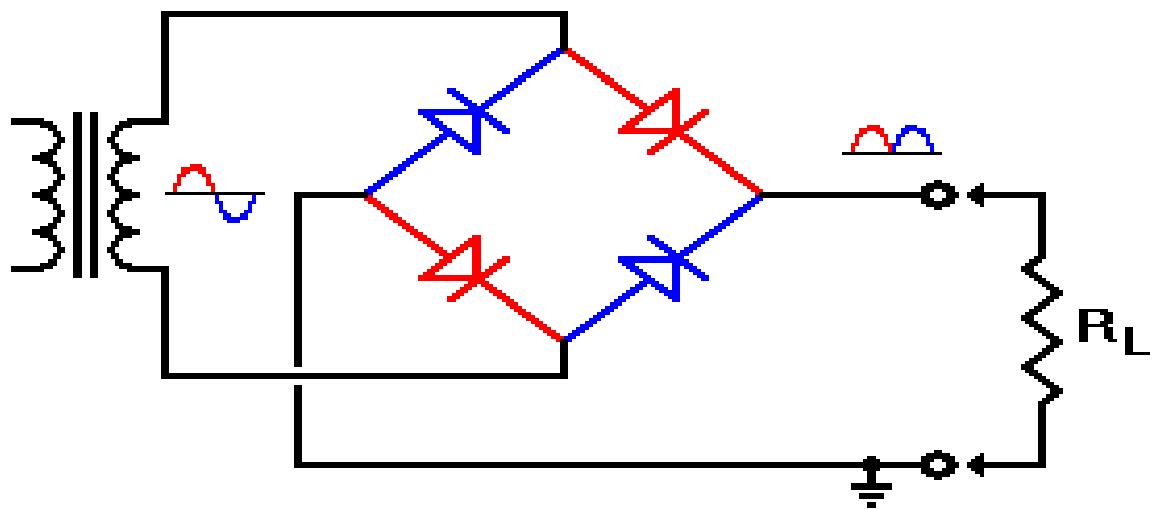


Fig 4.2.2: Bridge Rectifier

4.2.3 Voltage regulator

Voltage controller ICs are accessible with fixed or variable yield voltages. They are likewise evaluated by the greatest current they can pass. Negative voltage controllers are accessible, chiefly for use in double supplies. Most controllers incorporate some programmed insurance from exorbitant current and overheating.

The LM78XX arrangement of three terminal controllers is accessible with a few fixed yield voltages making them helpful in a wide scope of utilizations. One of these is nearby on card guideline, killing the dissemination issues related with single point guideline. The voltages accessible permit these controllers to be utilized in rationale frameworks, instrumentation, Hi-Fi, and other strong state electronic gear. Albeit planned basically as fixed voltage controllers, these gadgets can be utilized with outside segments to get movable voltages and current (Liu .C , Jiang C et al 2019)



Fig 4.2.3 VOLTAGE REGULATOR

4.2.4 Bluetooth module



Fig 4.2.4 BLUETOOTH MODULE

HC-05 Bluetooth Module is a simple to utilize Bluetooth SPP (Serial Port Protocol) module, intended for straightforward remote sequential association arrangement. HC-05 Bluetooth module gives exchanging mode among expert and slave mode which implies it ready to utilize neither getting nor communicating information.

4.2.5 12v lead acid battery

A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts. A typical 12-volt battery used in a RV or marine craft has a rating 125 AH, which means it can supply 10 amps of current for 12.5 hours or 20-amps of current for a period of 6.25 hours. Lead acid batteries can be connected in parallel to increase the total AH capacity. (Venkateswara Sarma Mallela et al)



Fig 4.1.5 Battery

4.2.6 Pulse sensor



Fig 4.2.6 Pulse sensor

The pulse sensor module has a light which helps in measuring the pulse rate. When we place the finger on the pulse sensor, the light reflected will change based on the volume of blood inside the capillary blood vessels

This change in volume between the heartbeats affects the amount of light that will transmit through these tissues. This change is very small but we can measure it with the help of Arduino (Shi, Wei & Zhou, Mengchu. (2012).

4.2 .7 Transmitter coil

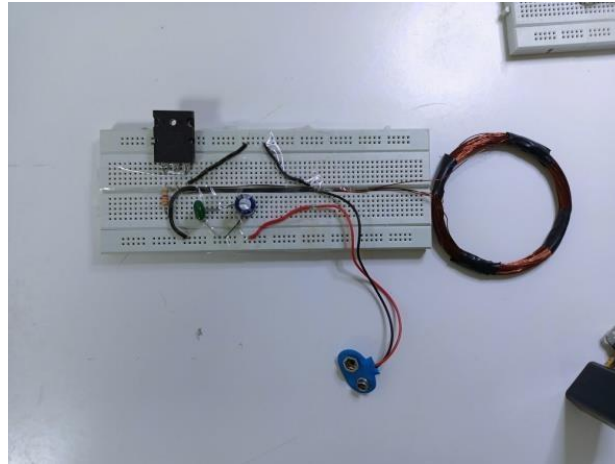


FIG4.2.7 Transmitter coil

Transmitter coil is a circular folded coil which leak alternating current in the air by energizes the coil. It consist of transformer, bridge rectifier, power cord and voltage regulator

4.2.8 Receiver coil

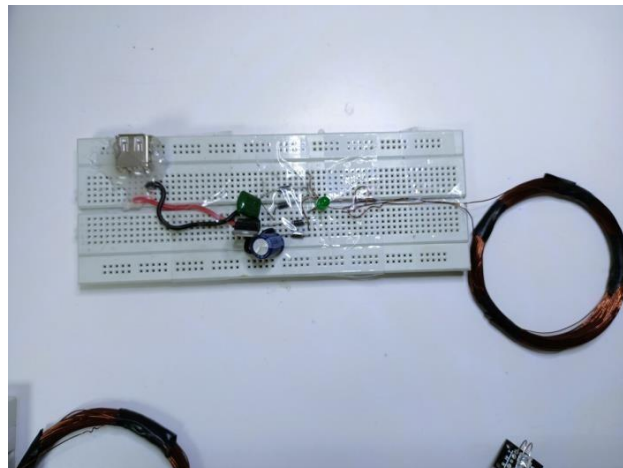


Fig4.2.8 Receiver coil

Receiver coil is a secondary coil which receives the charging voltage from transmitter coil.

The Received voltage is stored in the battery which is connected in it. in this coil , there is microcontroller is also connected with it for purpose of monitoring the heart rate of the patient and also battery health status of the pacemakers battery

4.2.9 Arduino

An Arduino is basically a microcontroller based unit which may be either utilized straightforwardly by buying from the vendor or are often made reception utilizing the parts, due to its open source equipment include. it's fundamentally utilized in correspondences and in controlling or working numerous gadgets. it had been established by Massimo Banzi and David Cuartielles in 2005..The Arduino Uno may be a microcontroller board hooked in to the ATmega328. it's 14 computerized input/output pins (of which 6 are often utilized as PWM outputs), 6 simple information sources, a 16 MHz gem oscillator, a USB association, a force jack, an ICSP header, and a pushbutton .It contains all that expected to assist the microcontroller; basically interface it to a PC with a USB link or force it with an AC-to-DC connector or battery to start The Uno contrasts from all former sheets therein it doesn't utilize the FTDI USB-to-chronic driver chip. All things being equal, it includes the Atmega8U2 modified as a USB-to-chronic converter. "Uno" signifies one in Italian and is known as to see the approaching arrival of Arduino 1.0. The Uno and rendition 1.0 are going to be the reference variants of Arduino, pushing ahead The Uno is that the most up-to-date in an examination with past adaptations a progression of USB Arduino sheets



Fig 4.2.9 Arduino

4.3 SOFTWARE USED

4.3.1 arduino ide

The Arduino Programming Language is fundamentally a system based on top of C++. You can contend that it is anything but a genuine programming language in the customary term, however I think this aides evading disarray for amateurs. A program written in the Arduino Programming Language is called sketch. A sketch is typically saved with the .ino augmentation (from Arduino). The primary distinction from "ordinary" C or C++ is that you wrap all your code into 2 principle capacities. You can have more than 2, obviously; however any Arduino program should give in any event those 2. One is called arrangement (), the other is called circle(). The first is called once, when the program begins, the second is over and again called while your program is running. We don't have a principle() work like you are utilized to in C/C++ as the section point for a program. When you order your sketch, the IDE will ensure the final product is a right C++ program and will essentially add the missing paste by preprocessing it. All the other things is typical C++ code, and as C++ is a superset of C, any substantial C is likewise legitimate Arduino code

4.3.2 App inventor

App Inventor is a visual, intuitive apparatus for building versatile applications on the Android stage. You plan the UI (the visual appearance) of an application utilizing an online graphical UI (GUI) developer; at that point you indicate the application's conduct by sorting out "blocks" as though you were dealing with a riddle. (Roberts, P. R., & ElRefai, M. H. (2020)

The programming happens in the Blocks Editor. There you tell the application what it ought to do and give explicit guidelines for getting that going. The particular abilities are modified through associating unique pieces. Over the long haul, you will realize what each square does and discover numerous ways for them to connect with each other. The pieces that don't associate won't interface with one another—another accommodating path for novices to get a feeling of basic programming standards.

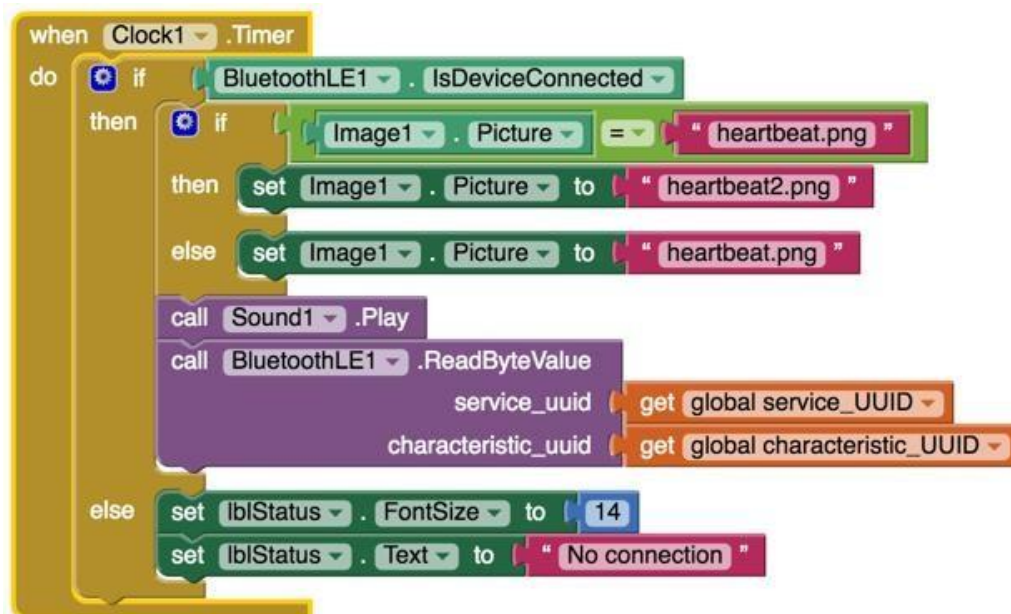


Fig 4.3.2 App Inventor

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 RESULTS AND DISCUSSION

Qazi Saeed et al 2015 proposed a Transcutaneous power transfer for the implantable pacemaker can be done by the principle of mutual induction

- Experimental results show that the proposed system is effective for real time, and The monitoring of battery level is obtained successfully using a microcontroller and Bluetooth.

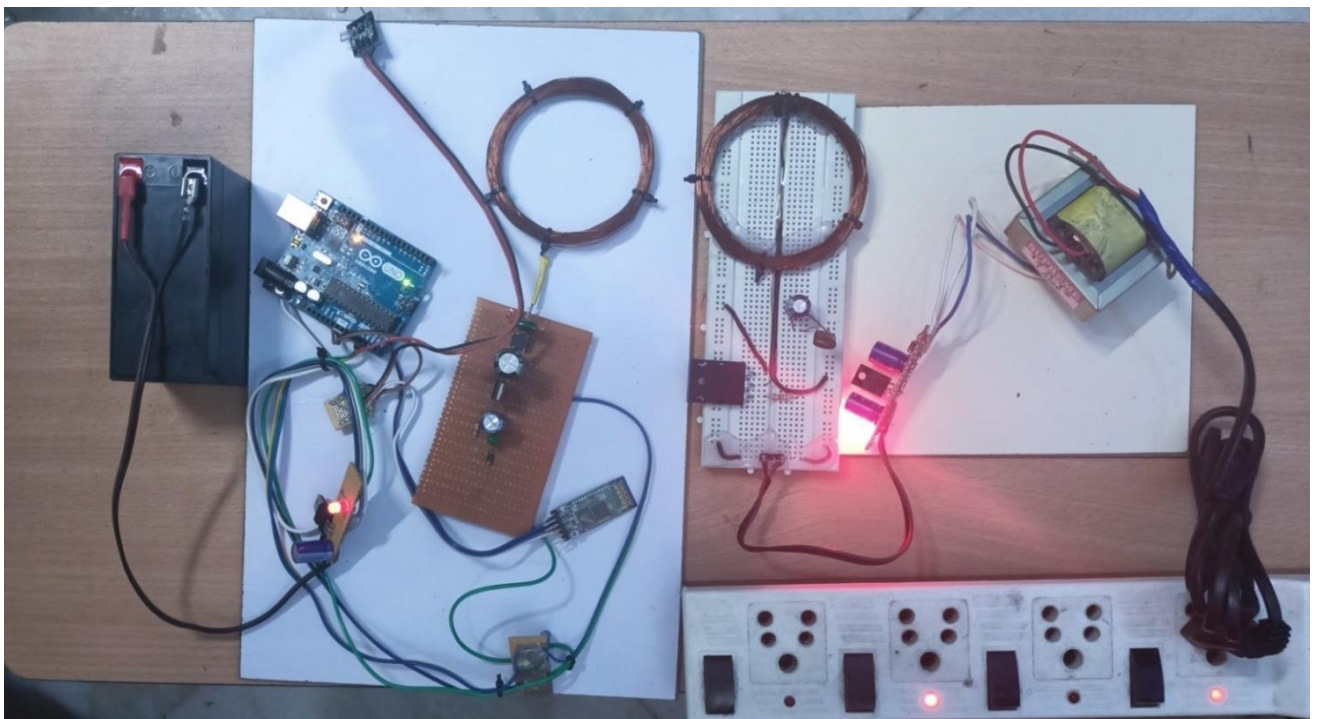


Fig 5.1 .Wireless charger

- Wireless charging method for implantable pacemaker is worked on inductive coupling power transfer between the two coils has been proposed in this system The receiver coil is to be placed on the body while transmitter coil is to be placed inside the body. Transmitter and receiver coil can transmit the power wirelessly, and receiver circuit will receive the AC current and convert it into DC current for the battery of the pacemaker.

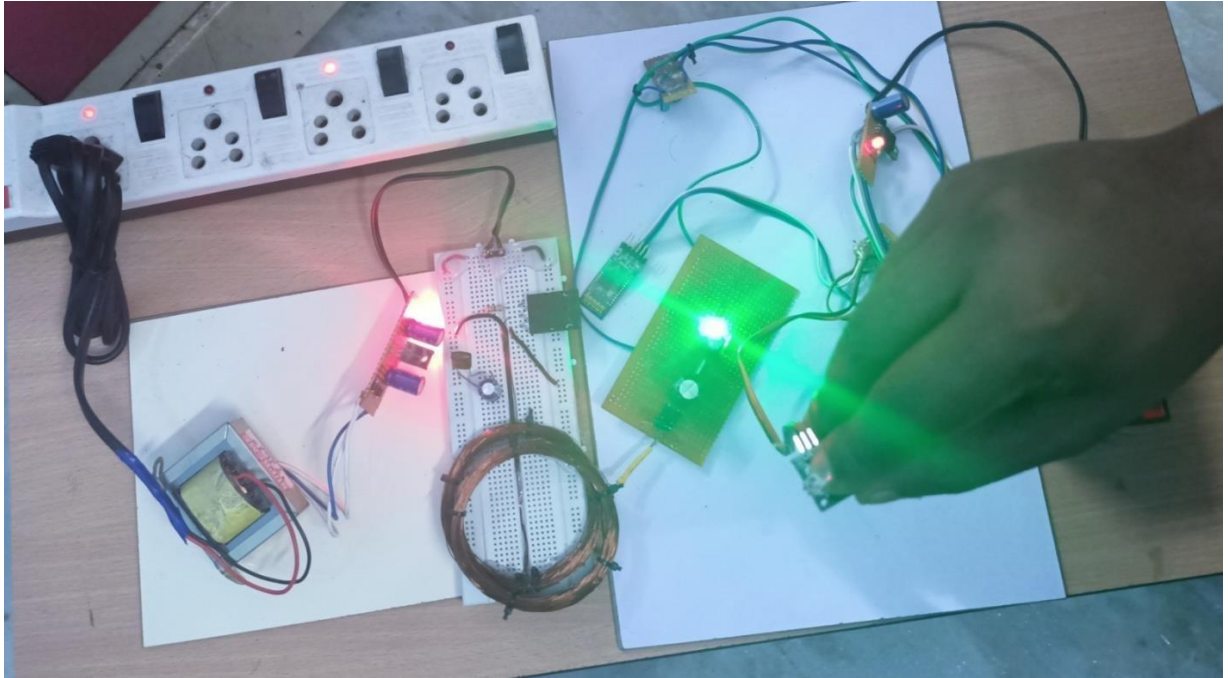


Fig5.2 working of wireless charger

- The Transmitter section of wireless charger circuit consists of a AC power supply, bridge rectifier, filter, transformer and transmitter coil. The transmitter coil provides an ac current and it creates a magnetic flux and the bridge rectifier helps in the conversion of ac input to dc output.
- The receiver section consists of receiver coil, rectifier circuit and a voltage regulator IC. The AC current flowing through the transmitter coil creates a magnetic field. When we place the receiver coil with in a small distance from this transmitter coil, the magnetic field in the transmitter coil extends to this receiver coil,
- it induces an AC voltage and generates a current flow in the receiver coil of the wireless charger. The rectifier circuit in the receiver section converts this AC voltage in to DC and the voltage regulator helps to provide a constant limited regulated output voltage to the load for charging the battery. In the pulse sensor, the fingertip is placed over the pulse sensor.
- The Bluetooth utilized here will transmit the re-energizing rate to the android app. There is a pulse sensor combined to the microcontroller and it is used to measure the pulse rate of heart. This method of communication will be utilized for re-energizing the battery

Wireless Charger



Select YouR Device

Incoming Data

Battery Status : Charging

Battery Voltage : 12.19 V

Charging Input Voltage : 8.11 V

Pulse Rate : 89

Fig 5.4 Android application

CHAPTER 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

This project proposes a transcutaneous power transfer to charge the pacemaker's battery done by the mutual induction phenomenon. In various clinical areas, pacemaker device is used as an implant to improve the patient's health condition, in our project gives an access to the patient by recharging the pacemaker battery. Our projects works on mutual induction phenomenon in transmitter coil and receiver coil is placed adjacent to each other, with pulse sensor is connected which patient can monitor the heart rate and this can be monitored through android application. It aids the patients to know about the battery level in pacemaker ad recharge it when necessary. Normal / usual pacemakers after a fixed period of time needs the battery replaced through the surgical procedure which is done in an hospital under sterile condition . This replacement surgery can be avoided using with our wireless charger which the battery can be recharged at home without the medical expertise. With our project, we can reduce the psychological burdens to the patients and also and financial crisis In which patients with low socio economic status. With our project, it allows the patients to have comfortable and reliable and help them to return to normal lifestyle with the ease, may also improve the quality of day to day activities. The battery status is continuously monitored and transmits to the patient's Mobile phone through Bluetooth and also shows the level of the battery charge which will be very useful to patients

6.2 CONCLUSION

Wireless charger for implantable pacemakers integrated with android application is an modern biomedical device which is used with patients with cardiac condition with the patients with cardiac conditions in which patient themselves can monitor the heart rate and battery level of the pacemakers our project works on principle of mutual induction phenomenon yet help to a greater extend in the patient in need pacemakers with advantages over usual pacemakers

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APPENDICES

```
#include "SoftwareSerial.h"
#include<LiquidCrystal.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
SoftwareSerial blue_tx_rx (3, 2);
#define splash splash1
#define enr A5
#define buz A0

unsigned int pul, pulfn, pulStat;

String IncomingData = "";

String outB = "";

void(* resetFunc) (void) = 0;
void setup() {
  // put your setup code here, to run once:
  LcDSet();
  blue_tx_rx.begin(9600);
  splash(0, "Initializing");
  splash(1, "blue_tx_rx");

  // blue_tx_rx.println("Ready");
  delay(1000);
  lcd.clear();
  Serial.begin(9600);
}

void LcDSet() {
  lcd.begin(16, 2);
```

```

splash(0, "Wireless Charger");
splash (1, "System");

delay(2000);
lcd.clear();
}
void loop() {
  // put your main code here, to run repeatedly:

  getblue_tx_rx();

  float vlc = getVolt(A1);
  float vlb = getVolt(A2);

  if (vlc > 5.5) {
    outB = "Charging";
  } else {
    outB = "Discharging";
  }
  pul = analogRead(A0);
  if (pul < 150) {
    pul = 0;
  }
  pulfn = (pul ) / (5.2 * 1.5);

  Serial.println(pulfn);
  lcd.setCursor(0, 0);
  lcd.print("B:  ");
  lcd.setCursor(2, 0);
  lcd.print(vlb);
  lcd.setCursor (9, 0);
  lcd.print("C:  ");
  lcd.setCursor (11, 0);
  lcd.print (vlc);

  lcd.setCursor (0, 1);
  lcd.print ("P:  ");
  lcd.setCursor (2, 1);
  lcd.print(pulfn);

  /*String ble_out = "Battery Voltage = ";
  ble_out += String(vlb);
  ble_out += " Charger Voltage = ";
  ble_out += String(vlc);
  ble_out += " Pulse = ";

```

```

    ble_out += String(pulfn);
    ble_out += outB;*/

String ble_out = "";
ble_out += String(vlb);
ble_out += ",";
ble_out += String(vlc);
ble_out += ",";
ble_out += String(pulfn);
ble_out += ",";
ble_out += outB;

Serial.println(ble_out);
blue_tx_rx.println(ble_out);
delay(500);

}

void getblue_tx_rx() {

}

```

