

# Wireless Power Transmission for Dynamic Charging of Battery Appliances in Multipurpose Smart Solar Bag



V.Senthil Nayagam, L. Premalatha

**Abstract:** As the world is leading towards smartness in all the working aspects with this modernization, smart solar bag which performs many applications has brought a new application specific product in to the society. Smart means intelligent, with the usage of solar energy and wireless charging its smartness raised a step ahead. It is intelligent enough to perform various tasks in our everyday life. It can be user friendly product to students, employee's and even to military soldiers as well. Arduino UNO is the brain of the solar bag has a capability of controlling multi-tasking features. The power supply for the equipments to be charge will be obtained from solar panel which is fixed in the front portion of the smart bag. The Electromagnetic field detector (RFID) will be used in order to identify the objects kept in the bag using RFID tag so that forgetfulness can be avoided. There will be an emergency buzzer button which will send the location of the victim to the nearest police control room in the case of emergency. There will be a light attached in the bottom left side of the smart bag which will be used as torch light in the night time. There will be another feature used for tracking our phones and bags in case of the theft by using Bluetooth and GPS.

**Index Terms:** Arduino, Solar Panel, RFID, Wireless Power Transmission, GSM, GPS.

## I. INTRODUCTION

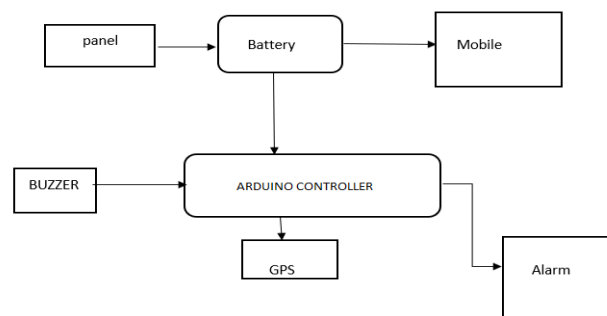
In Modern era people around the world is more depends upon smart phone for their daily activities it behaves like third hand for all age sector. But due to the more usage of mobile phones its battery is getting discharge sooner than what we expect. So people started using battery bank for this issue but it leads to unnecessary additional weight and costlier which will be another form waste after few years which are danger for earth. Instead of showing research concentration on battery bank for the appliances better focusing on solar system [1] with wireless power transmission for charging the equipments will be a better solution. Mainly the wireless charging is most needed for the military and army people because for them every second is most vital so they no need to plug and charge any equipment

by wasting time. Instead they can simply throw the equipments to be charge inside the bag which will be charged automatically and wirelessly by Inductive charging method. Moreover this smart solar bag is consist of a facility which will avoid forgetfulness of all age sector mainly for army people there won't be any chance of forgetting the important things to be kept in their bag while going for any war, this can be achieved by RFID [2] sensor tag and its Reader, this also power up wirelessly using inductive method of charging by taking supply from solar panel kept in the bag outer part.

Nowadays around the world women's security [3] is a big question mark so due to the advancement made in the smart solar bag we use GPS and GSM module in the smart bag which also can be powered by solar energy wirelessly using wireless charging method also secret button is placed in the bag if it is pressed the person who is under trouble can be intimated by the GSM and GPS module so others can track the location of the person who is under trouble. Similarly Theft action on various electronic gadgets available in the bag can be easily by the smart solar bag using GPS and GSM module.

## II. EXISTING SYSTEM OPERATING PRINCIPLE

The figure 1 shows the Existing system which is used only for charging and location tracking; these two are the only tasks that can be performed with normal charging mode, due to this overcharging of battery is happened therefore its lifetime will be reduced, in order to make it better a new system is proposed which will do multi-tasking as well as smart charging with wireless technique.



**Fig.1: Existing System ( Normal Charging System ) Block Diagram**

The above block diagram consists of solar panel for power up the entire control system also for the various appliances available in the smart bag.

Revised Manuscript Received on October 30, 2019.

\* Correspondence Author

**V.Senthil Nayagam\***, Research scholar ,EEE Department, School of Electrical and Electronics, Sathyabama Institute of Science and Technology (Deemed to be University), Chennai, India. sensribala@gmail.com.

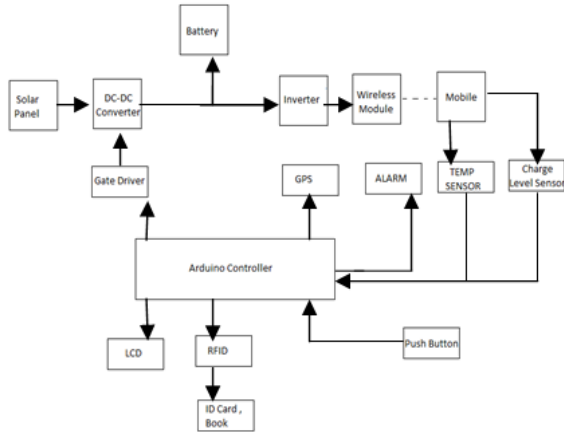
**L. Premalatha**, Professor, Faculty of Electrical and Electronics, School of Electrical Engineering, Vellore Institute of Technology (VIT) (Deemed to be University), Chennai.premaprak@yahoo.com.

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Arduino controller will get the input from the GPS and Buzzer accordingly will sense the abnormal condition and sends the signal to the user and also intimate the seriousness of the condition by alarm.

### III. PROPOSED SYSTEM OPERATING PRINCIPLE

The figure 2 describes about the block diagram of smart charging with wireless technique for the improvement of battery life associated with the smart bag.



**Fig.2: Proposed System ( Smart Charging System ) Block Diagram**

The Arduino controller will monitor the status of the mobile battery when it is getting charge, so that excess temperature increase and over charging can be avoided so that the lifetime can be improved for the battery. Here in this mode of charging the panel output is regulated and given as an input for the inverter in order to convert DC to AC, this AC supply is transmitted with the help of wireless technique so that the battery can be charged using charge controller. The smart charging system is comprising of various blocks in that the major one is the solar panel will be providing supply for the arduino controller, RFID Reader, GPS system and also for various systems. Moreover Battery capacity of this system is 12V and the battery type is rechargeable lead acid whose charging is controlled by the arduino controller by controlling the duty cycle of the DC-DC Converter. Furthermore the RFID Reader [4][5][6] is working with a frequency of 125Khz which will be used to detect the equipments availability inside the bag accurately. Those essential tags are directed to read by the reader and it simultaneously transfer data to Arduino controller. If we forgot to keep the necessary items or the reader failed to read the tags then it is displayed as item is missing in the bag. Similarly GSM and GPS module inputs are given to the arduino board which will be used to track the abnormal condition of the person who is having the smart bag like if the secret button is pressed by the victim which is placed on the top surface of the bag during emergency situations, Arduino controller is triggered activating the buzzer. GSM, interfaced with Arduino controller will transfer the information about the person under trouble as a SMS to the emergency contact stored in the mobile.

### IV. WIRELESS POWER TRANSFER

Wireless power transmission [7] is achieved in this project, where the transmitting coil  $L_1$  and the receiving coil  $L_2$  are

directly connected to the power source and the load impedance  $Z$  out,  $K_{12}$  as the mutual inductance,  $r_1$  and  $r_2$  as the equivalent AC resistance of coils. The voltage equation can be obtained as

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} r_1 + j\omega L_1 & j\omega M \\ j\omega M & r_2 + j\omega L_2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} \quad [1]$$

$$Z_{in} = Z_{11} - \frac{Z_{12}^2}{Z_{22} + Z_L} \quad [2]$$

$$Z_{OUT} = Z_{22} - \frac{Z_{12}^2}{Z_{11} + Z_S} \quad [3]$$

The power output can be derived as

$$P_L = \frac{K_{12}^2 L_2 R_L}{L_1} \frac{1}{[\omega L_2 (1 - K_{12}^2) + X_L]^2 + R_L^2} |V_1|^2 \quad [4]$$

The main purpose of the wireless transmission is dynamic charging is possible and there is no need of plugging the mobile with the charger pin.

### V. SMART CHARGING

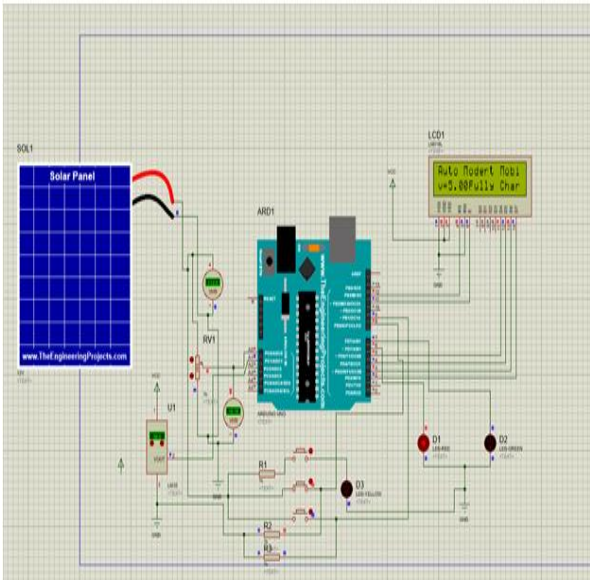
Nowadays for charging of the battery of the smart phones we all are showing more importance in order to use it continuously but we are not worrying about at what temperature it is getting charged, mostly during night while sleeping if we tries to charge the mobile battery, it may be connected to the supply for more than eight hours which may lead to overcharging and overheating of the battery therefore this will reduce the battery life drastically. Basic idea behind the smart charging is to improve the life time of the battery by checking the battery charging condition using various sensors and controller. Smart charging is consists of voltage sensor and temperature sensor these sensor will not allow the battery to charge in abnormal condition. Meanwhile this smart charging may take more time to charge the battery in order to achieve safe charging and enhancement of battery life, but if user requires charging quickly they can prefer normal charging method to charge battery quicker like as usual. Mainly this smart charging is more effective and user friendly during sleeping hours of every user. Abnormal method of charging condition can be indicated using the various sensors and controller board.

#### Modes of operation:

They are two modes of operation for safeguarding the device.

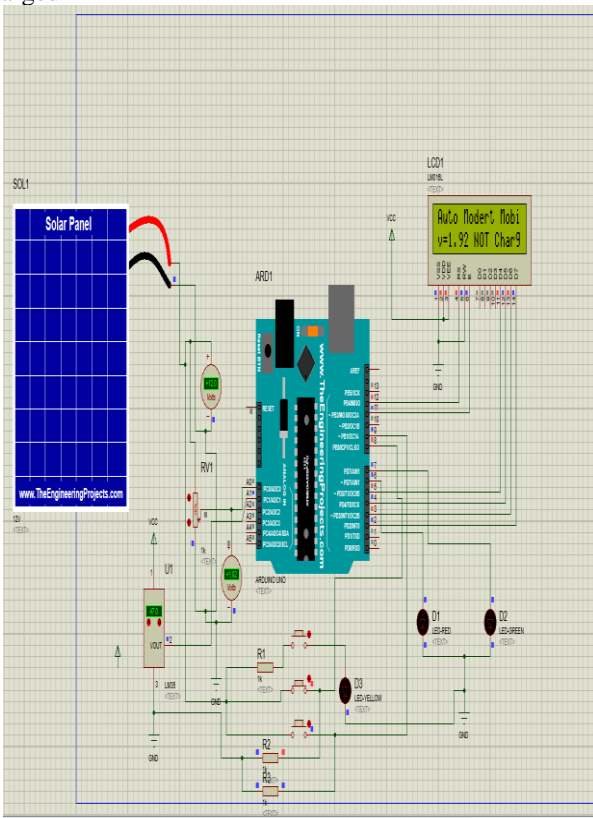
**1. Normal mode:** In this stage, the figure 3 shows that, it will not consider the temperature of the phone and it suits best in normal way of battery charging mode. If voltage=5V, then the phone gets charged at full voltage level.





**Fig.3: Simulation diagram showing mobile getting charged at full voltage in normal mode**

In normal mode if voltage < 4V, then the phone will not get charged

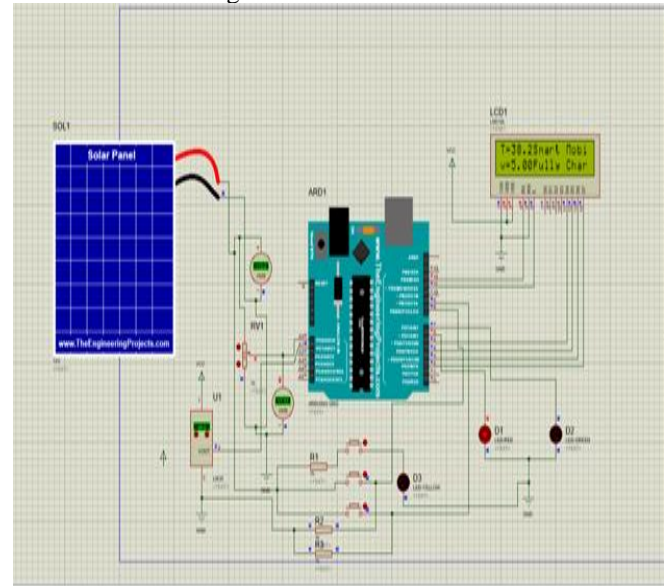


**Fig.4 Simulation diagram showing mobile not getting charged at in normal mode**

If battery input voltage is between 4-5V, then phone will get charged in a normal way at normal voltage level. It is clearly indicated by the figure 4 that the voltage level of the battery input reaches 1.92 V therefore automatically the battery will not be charged.

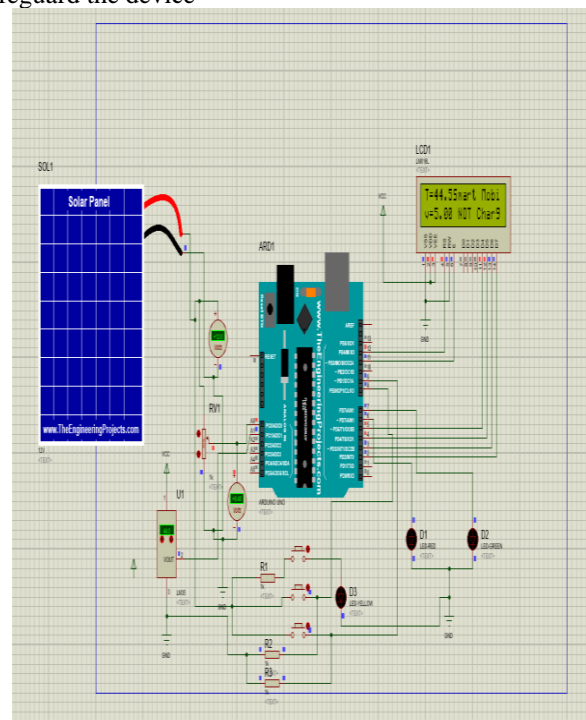
**2. Smart mode:** In this stage, the arduino controller is considering the temperature of the phone and the voltage of the battery regarding with certain Constrains it will operate. In this mode both temperature and voltage is considered & charging will be depending on the constrains, if temp < 40

then only the phone will be charged & the voltage should lie in between 4-5V or greater than 5V.



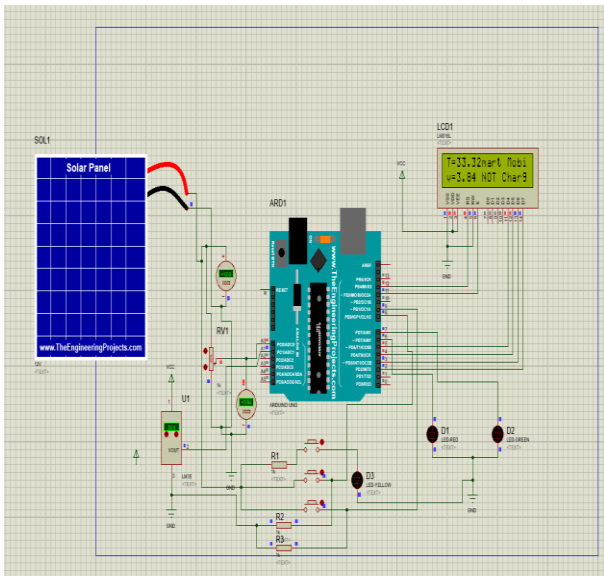
**Fig.5: Simulation diagram showing mobile getting charged at full voltage by satisfying both constrains in smart mode**

In the figure 6 even though the voltage = 5V, the battery is not getting charged because of temperature constrain in order to safeguard the device



**Fig.6: simulation diagram showing mobile not getting charged in smart mode due to failure of temperature constrain**

In case if both voltage & temperature does not satisfy the constrains, then the phone will not be charged which is indicated by the figure 7.



**Fig.7. simulation diagram showing mobile not getting charged in smart mode due to failure of both the constrains**

## VI. HARDWARE COMPONENTS AND ITS IMPLEMENTATION WITH RESULT ANALYSIS

The Heart of this Smart bag hardware system is Arduino controller, this will monitor the battery charging condition with the use of various sensors, instead of other microcontrollers, mainly arduino is preferred because programming of a arduino is easier than other controllers. To power up the controller solar panel is used. The next important hardware component is RFID sensor and tag also a emergency button is placed in order to ensure the safety of women. Arduino controller has a inbuilt memory capacity of 32 kilo bytes of flash memory and 2 kilobytes of static RAM which will be used store the program as well as to contain the sensors data.

Previously we use bar coded object for tracing applications but now the RFID tracking [8][9][10] really a growing market. It is similar to the bar code theory but the tag need not to be in the line sight of the reader instead of that it can be embedded in the tracked object.

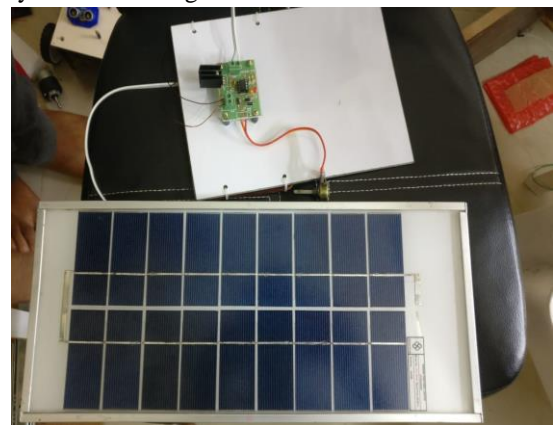
RFID reader is the main part in gathering information from a tag. In this smart bag, EM-18reader is used. It operates with any 125 KHz RFID tags. This module can directly connect to any microcontroller or a RS232 converter to PC. The specifications are 5Vdc through USB, current is <50mA whereas frequency is 125khz and its read distance is 10cm. Size of RFID module is: 32mm (length)\*32mm(breadth)\*8mm(height).

RFID technology is widely used in many applications like airplane luggage, passports, smart cards, tollbooth passes, home appliances, animal and pet tags etc.

Generally, GPS are used for tracking and mapping, actually global positioning system falls in to a group of 5 major applications namely, Exact Location finding, tracking various vehicles, Navigation ,Map making, Timing. In this paper GPS and GSM is used to share the victim's locations to their family members and nearby police station. This project gives the location details about the victim holding the bag or the bag if it's been stolen, by sending SMS through GSM module. The SMS contains the details of longitude and latitude of the location. The micro controller receives the coordinates from GPS and sends the location link to the

numbers that are pre-saved in the system. GPS modem requires minimum of three satellites to calculate the exact location. It's a one way of communication mode, it won't send any data to the satellite it just send the location to the micro controller and receives from the satellite. The functioning blocks GPS and GSM both work under 9600-baud rate. The micro controller will forward the data to the GSM-Global system for mobile communication. LCD displays are used everywhere around us. In this project a 16\*2 LCD is used, it is connected to the microcontroller. It has 8 data pins, the supply voltage will be 5v. The receiver module is connected with the copper wire, when the transmitter is imposed on the receiver copper wire then the current passes into the receiver. The receiver consists of heat sink, 4 diodes and one capacitor. These 4 diodes are mixed in to one module. The receiver module output is connected to the Arduino pins.

Moreover, voltage sensor is used to measure the voltage of mobile battery that is getting charged and sends the value to the micro controller, Temperature sensor is used to measure the temperature of mobile battery to safeguard the mobile, both these sensors are used to safeguard the mobile battery, based on the values given by these two sensors the micro controller will decide the DC-DC Converter duty cycle[11][12][13][14][15][16] so that whether the mobile battery has to be charge or not.



**Fig 8. Hardware image of Solar panel and transmitter part of wireless module.**

The figure 8 shows the input source (solar panel) of the whole circuit, this will be connected to the inverter therefore; DC converted to AC, which is used as a source for wireless module in the primary side.



**Fig.9. Hardware image of Secondary side of the wireless module and receiver part with mobile battery**

Secondary coil which is not electrically connected which makes possible the wireless charging of the battery and all other electronic devices available in the smart bag is indicated by the photo image in the figure 9. Whereas the RFID receiver also connected to the secondary side of the wireless module



**Fig.10. Outer view of solar bag**

The figure 10 clearly illustrate the compactness of the solar bag and required circuitry are kept safely in one part of the bag.

## VII. CONCLUSION

Green energy based wireless method of charging the smart bag is implemented in simulation and in hardware setup. This smart bag improves the battery life with smart charging implementation with slow charging during sleeping time. This bag will play a vital in the army sector in day today life. RFID concept and its inclusion in the smart bag which leads to avoid forgetfulness, finally women's safety is ensured with the emergency button fixed in smart bag users. Wireless less power transmission is achieved with IPT method for easy charging of the equipments present in the smart bag with smart charging method and also dynamic charging made easy with wireless charging..

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## AUTHORS PROFILE



**Senthil Nayagam.V** completed his B.E degree in EEE Department from Sri SaiRam College of Engineering, in 2009 and Masters in Power Electronics and drives from St.Joseph's Engineering College in 2011. Currently continuing his Ph.D in EEE Department at Sathyabama Institute of Science and Technology. His research Area includes E-Vehicle Battery Charging, Energy storage system,DC-DC Converters, Wireless Power Transmission.



**Premalatha.L** completed her Ph.D in EEE Department from Anna University, in 2009. She is currently working as Professor in Vellore Institute of Technology (VIT) University, Chennai, India. Her current research interests include Renewable Energy Power Systems, Application of Power Systems in Power Electronics, Electromagnetic Compatibility and Nonlinear Dynamic systems and Control.