DEVELOPMENT OF WIRELESS INDUCTIVE MODEM CHARGER

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Abstract-The project's objective was to create an inductively coupled wireless fidelity charger which inductively charges the devices connected to it and also helps in the transmission of data to devices that have inductive charging and Wi-Fi enabled. The device is power efficient as it can switch on and off depending if the device connected to iwi-Fi, also spelled Wi-fi or Wi-Fi, is a local area wireless technology that allows an electronic device to exchange data or connect to the internet using 2.4 GHz UHF and 5 GHz SHF radio waves. Inductive charging is usually done with a charging station. Energy is sent through an inductive coupling to an electrical device, which can then use that energy to charge batteries or run the device. To prevent any data error during transmission the device would have data check and data error correction present.

Key Words-Modem , Wi-fi, Inductive charging,coupling, linking, E.M.F. , Flux,Magnetic field

I.INTRODUCTION

We live in a world of technological advancement. New technologies emerge each and every day to make our life simpler. Despite all these, we still rely on the classical and conventional wire system to charge our everyday use low power devices such as mobile phones, digital camera etc. and even mid power devices such as laptops. The conventional wire system creates a mess when it comes to charging several devices simultaneously. It also takes up a lot of electric sockets and not to mention the fact that each device has its own design for the charging port. At this point a question might arise. ―What if a single device can be used to charge these devices simultaneously without the use of wires and not creating a mess in the process?‖ We gave it a thought and came up with an idea. The solution to all these dilemmas lies with inductive coupling, a simple and effective way of transferring power wirelessly.Wireless Power Transmission (WPT) is the efficient transmission of electric power from one point to another trough vacuum or an atmosphere without the use of wire or any other substance. This can beused for applications where either an instantaneous amount or a continuous delivery of energy isneeded, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwantedor impossible. The power can be transmitted using Inductive coupling for short range, ResonantInduction for mid range and Electromagnetic wave power transfer for high range. WPT is a technologythat can transport power to locations, which are otherwise not possible or impractical to reach.Charging low power devices and eventually mid power devices by means of inductive coupling could be the next big thing

II. EXISTING SYSTEM

In the system present in India, There are currently modems that only transmit data and does not inductively charge devices connected to it. There are no proximity sensors present in modems that help us in detecting the location where the range of the Wi-Fi signals can be maximized. The modems present are not charged inductively but are charged through wire cables. The modems present today are capable of controlling certain devices but are not integrated with inductive charging and sensors. In the present world, the modems have no power efficient consumption techniques which help in reducing the power consumption.

III. PROPOSED SYSTEM

3.1. Inductively Charged Modem

Inductive charging (also known as "wireless charging") uses an electromagnetic field to transfer energy between two objects. This essentially means that there isn't any physical contact between the charger and the device. This is usually done with a charging station. Mutual induction comes to our rescue here. Energy is sent through an inductive coupling to an electrical device, which can then use that energy to charge batteries or run the device.

A Wi-Fi modem and router is usually plugged in and supplied a constant DC voltage source of roughly around 10 to 15 V. The consumption in the quiet state is in the range of a few hundred milli-amperes according to usage. The consumption at transmitting is up to a few Amperes. This is just for a single device. More devices implies greater consumption.

Now since this modem is needs to be charged inductively, the idea of an inductive charger that's already being used is implemented here with modifications. This inductive charger unit has an inductor coil, basically a copper wire wound over an iron core. The same unit is installed in a Wi-Fi modem, then when they are kept together, in contact. What actually happens is this, when there is a current through an inductor there is a magnetic flux linkage leading to magnetic field. This field if constant (if it's not changing) is unable to induce an E.M.F or current in the linked coil. Hence, there is a changing magnetic field used by changing the current in the inducting coil to induce current in the nearby coil. So, the nearby coil is linked and a potential difference is created in the coil so, there is a flow of current if the circuit is closed. This current is used to charge the device's battery.

Since the idea proposed above just eliminates the usage of wires in every aspect, it is obvious that a wireless router will be used. A wireless ADSL router serves the purpose perfectly as it has an in-built ADSL modem.

Here, instead of plugging in the modem; we use inductive charging to provide voltage. It just means that a normal charger behaves as a charging station due to the addition of transmitter coil that uses high frequency AC current to create a magnetic field which extends to the receiver coil (kept at a specific distance) present in the device (modem in this case). The receiver coil converts the AC current to DC and is used to power the modem up as usually charged by using induction .inductive charging can be made possible by using an E.M.F field

3.2. Error control.

Since Wireless transmission is considered to be an unreliable communication channel. We have decided to implement a data error checking and correction module in the prototype in order to make the digital data transmitted through the wireless modem proposed be efficient without any errors. The proposed prototype device would check if the data transmitted has arrived or not using data error correction techniques. The data error checking and correction technique we have implemented in the prototype is cyclic redundancy check. A *cyclic redundancy check (CRC)* is a single-burst-error-detecting cyclic code and non-secure hash function designed to detect accidental changes to digital data in computer networks. It is not suitable for detecting maliciously introduced errors. It is characterized by specification of a so-called *generator polynomial*, which is used as the divisor in a polynomial long division over a finite field, taking the input data as the dividend, and where the remainder becomes the result. In U.S.A the most common CRC code is CRC-16. With CRC -16, 16 bits are used for block check sequence. For error correction we use Forward error Correction. Since Forward error correction is the only error – correction scheme that actually detects and corrects transmission errors when they are received without retransmission. In this bit redundant bits are added before the transmission of the data. When an error is detected, the redundant bits help in finding which bit is in error. FEC is generally used when acknowledgements are impossible.

3.3. Controlling devices using modem

The project in discussion extensively uses a Wi-Fi modem setup so it only makes sense to go with the concept of a RF (radio frequency) remote control as Wi-Fi setups also transmit radio signals at varying frequencies. This ensures that similar bandwidths can be used to connect computers and also to operate television and radio sets by the same wi-fi modem. These remote controls are also easy to operate, cheap and very common.

Instead of sending out light signals, an RF remote transmits radio waves that correspond to the binary command for the button you're pushing. A radio receiver on the controlled device (here, computers, television and radio sets) receives the signal and decodes it. The only problem with RF remotes is thesheer number of radio signals flying through the air at any given time. The greatest advantage to radio-frequency remotes is their range: They can transmit up to 100 feet from the receiver (the range for Bluetooth/Wi-Fi direct is shorter), and radio signals can go through walls.

This benefit is why you'll now find IR/RF remotes for many long distance transmission components and devices. These remotes use RF-to-IR converters to extend the range of an infrared remote.

Here, instead of using a remote, we'll just use a modem to transmit radio waves to the receivers in various devices which can be differentiated by the frequency of the radio waves emitted by the transmitter (modem). In other words, the modem is to be used as a universal remote. We will first need to establish a connection between the modem and the device to be operated. This can be achieved by macro programming a power button, as well as a switch or series of buttons to select which device the remote is controlling at the moment. A typical selection includes TV, VCR, DVD, and CBL/SAT, along with other devices that sometimes include DVRs, audio equipment or home automation devices. This actually means that a remote will be programmed into a modem so as to utilize the functions of both devices from a single setup. That is, the final modem/remote byproduct that is obtained will basically be a modem with a set of buttons that can be operated like the buttons on a remote control.

3.4. Inductively charging connected devices

Now that we've proposed the inductive charging method for the modem the next step is to use that for the connected devices. It's the next step for inductive chargers too. The inductive chargers, "wireless" chargers are actually plugged to power supply points and the inductive chargers are then kept in contact with the devices, but now that magnetic fields can be made stronger so that their field of flux can cover a bigger area.

If that can be achieved then these devices that are connected to the Wi-Fi modem can be inductively charged with the help of existing magnetic flux by coupling them inductively.

The computing device and the charging unit contain inductor coils. Basically inductor coils are copper (usually) wires wrapped around a core (preferably iron core). When the portable computing device is in the proximity of wireless network, the proximity of the coils allows an electromagnetic field to be created. This electromagnetic field allows electricity to be passed from one coil (in the charging unit) to the other (in the phone) sue to the phenomenon of mutual induction. The induction coil in the computing device then uses the transferred electricity to charge the device battery.

This additionally reduces time for connection, abolishes the messy wirings and at the same time will be very efficient in charging multiple devices simultaneously.

These times our computing (portable) devices are sucks power while connected to Wi-Fi networks, or any other network. So if charging the devices may not have their rate over consumption rates at least can equalize hence can save battery drain to a greater extent without any actual conscious efforts, happens with just the act of connection to the Wi-Fi network.

3.5. Power saver modem

Modem are all time switched on, this leads to lack of security and power loss.

Security in the sense, the data packets that the modem sends in search of the computing devices (in an effort to connect or either to upload or download) can actually be received by other devices that are unauthorized, hence its leads to security threats.

So, if the Wi-Fi network is connected to an authorized user or an administrator the other computing devices that are trying to connect can be noticed or will be notified. Hence, the best way is to having the modem on only when the admin (or authorized user. Thus, reducing the network's vulnerability due to hacking) due to is connected. This can be done by manually switching the modem off or by doing it automatically. The working goes this way, actually when a computing device is connected it either uploads or downloads, does at least any one of these at an instant.

Therefore, it means when there is no uploading or downloading it indirectly means no device is connected. This can be used to our advantage, the modem can automatically be switched off when not connected (or when there is no downloading or uploading process gong on). This saves power and data. The security and safety of the network is ensured.

3.6. Working principle

Our wireless fidelity modules are split into many modules. The first module consists of the modem which inductively charges itself. The modem basically inductively charges itself with the help of a strong electromagnetic field. The E.M, F field is used in charging the modem and also inductively charges every other device which are inductive and Wi-Fi enabled. The inductively charging of the modem enables us to place the modem at any place in the room. Once the mobile – computed devices are connected to the modem, the device will be charged once the device is authorized by the administrator. This enables us to use the connected devices anywhere instead of using near a plug point.

The second module consists of power efficiency. In the proposed prototype the modem will have a power efficient switch on /off feature .When there are no devices connected to the modem, the modem will switch off saving power. When the administrator receives a request from the device to connect to the Wi-Fi, the modem switches on (only if the administrator grants permission).

In The third module, the modem once connected to a device (mobile –computed device or a I-R device), the modem will have access to use the device (switch on and off the T.V. using the Wi-Fi signals). The modem operates various devices by using wireless signals. The modem basically acts a remote control.

The fourth module consists of Data error control. Since wireless communication is considered to be relatively unsafe to communicate / transmit data, we have employed data error control.
The data error detection is the process of monitoring data transmission and determining when error has occurred.
The data detection is done by cyclic redundancy checking. With CRC, the entire stream is considered as a long continues binary number. Cyclic block codes are often written as (n, k) cyclic codes where n= bit length of transmission and k= bit length of message. The length of block check code is given as
BCC = n-k
In CRC, modulo – 2 division is used, where the remainder is derived from the exclusive OR operation. In the receiver the data strean (including the CRC code) is divided by the same generating function P(x). If the remainder is 0, there is no error else an error is present.
Mathematically, CRC can be expressed as

$$\frac{G(x)}{P(x)} = Q(x) + R(x)$$

Where G(x) = message polynomial
P(x) = generator polynomial
Q(x) = quotient
R(x) = remainder
The number of bits in the CRC code is equal to the highest exponent of the generating polynomial.
The data error correction technique used is Forward Error correction. It is the only error –correction scheme that actually does not require retransmission. In FEC redundant bits are added in order to determine which bit is in error. In order to correct the bit, we have to complement it. The number of redundant bits required is much larger than the number of bits required to simply detect error occurs
Forward error correction are used in devices where there is no acknowledgment.
The most common used error correction code used is the hamming code.
The hamming code will correct only single bit error and not burst errors.
Hamming bits are inserted into a character at random locations. The combination of the data bits and the Hamming bits is called hamming code .The sender and the receiver must agree on the location of the hamming bits.
The formulae in order to determine the number of hamming bits is given by

$$2^n >= M+N+1$$

Where M =number of bits in each data character
N= number of hamming bits.

3.7. Advantages of the system

- Connected devices can be charged from anywhere in the room
- No data error during transmission
- The modem can be placed anywhere in the room to improve the range of the signals

CONCLUSION

We conclude by saying that by implementing our project on a large scale, devices can be charged in an inductive manner which would be cost efficient and convenient.

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