Unlocking the Wireless Smartphone Charging Potential

Rahul Anand and Harsh Gupta

Abstract--- In this paper we introduce to the current State-of-the-art in Wireless Sensor Network charging for Smartphones in automobiles, the technology that will sit alongside with features such as touch-screen and Natural Voice Recognition (Text-to-Voice). It can offer charging for iPhones and some Android devices based on Qi (inductive power standard). An automobile's Qi system is based on Wireless interface standard for inductive electrical power transfer over distances of up to 4cm (1.6 in) comprising a power transmission pad and a compatible receiver on top of which a mobile device is placed. The rubberized Power mat wireless charging pad will be positioned inside the storage bin of a car's center motorized instrument panel faceplate. It will also have built in NFC tags which can automatically execute tasks on your smartphone (like placing and receiving calls) when mounted and launch alarm clock or Google Maps by illuminating LED lights when a device is nearby. The proposed Qi enabled devices would replenish the batteries with a power transfer capability of around 0.5W at a maximum distance of 2.5cm to address energy efficient lifetime bottlenecks in sensor networks.

Keywords--- Wireless Smartphone Charging, Qi Standard, NFC, Electromagnetic Power Transfer

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I. AN INTRODUCTION TO WIRELESS CHARGING: CHANGING THE WAY WE THINK ABOUT POWER

Smartphones are changing the way we live our lives, both online and off. With each new model, we are used to getting more processor speed, new features and programs, and entire new ways of using them. Despite increased capabilities, battery life simply hasn't kept up. For most users, phones are sending out sad bleeps by lunchtime, signaling a low battery. Wireless charging is set to change this. We want to eradicate the problem of the dead battery.

Imagine sitting down for a cup of coffee, and placing your phone on the table. The phone lights up, and starts to automatically charge – without connectors or cables. You could simply grab your phone on your way out in the morning, and charge it wherever you needed to – at home, the office, the library, the local coffee shop.

It would be even better if you didn't ever need a charger. We could simply forget about USB cables, chargers and, when Traveling adapters. We wouldn't have to worry about recycling old chargers, or labelling each different charger that goes with a different device.

II. THE TECHNOLOGY

Although wireless charging might sound like the stuff of science fiction, this is not a far-fetched vision of the future. The technology and theory behind wireless charging have been around for a long time – the idea was initially suggested by Nikola Tesla, who demonstrated the principle of wireless charging at the turn of the century. The technology is also closer to you than you may think: it is already a reality in such devices as electric toothbrushes and surgically implanted devices, like artificial hearts.

Wireless charging, also known as inductive charging, is based on a few simple principles. The technology requires two coils: a transmitter and a receiver. An alternating current is passed through the transmitter coil, generating a magnetic field. This in turn induces a voltage in the receiver coil; this can be used to power a mobile device or charge a battery.

Wireless charging is already available for low-power applications (up to 5 Watts), suitable for mobile phones and other devices. However, medium- and high-power applications are also being developed, and in the future your kitchen appliances may very well be wireless.

Since wireless charging is set to become so ubiquitous with applications ranging from cell phones to home appliances, there is a real need to ensure that charging is standardized. This is why the Wireless Power Consortium developed Qi – the standard for interoperable wireless charging. With Qi, we want to ensure that your device can be charged wirelessly, no matter where you go, and no matter what brand charger you are using.

III. Qi: THE GLOBAL STANDARD

The idea behind Qi is simple: all devices with the Qi logo will work with all Qi chargers. That's it. No need for separate chargers, no need for cables, and no need for adapters when traveling. Qi is a global standard – this means that your device can be charged wirelessly wherever you are.

Qi is the proven leader in wireless charging. Qi has unrivalled reach, delivers the best user experience, and is moving the fastest to bring new wireless charging innovations to market.

With Qi you no longer have to carry separate chargers for each of your devices. Take your Qi-enabled devices with you, and simply find your closest charging station when you're low on power – you'll find them in offices, hotels, airports, railway stations and coffee shops. Qi charging stations are set to become as ubiquitous as Wi-Fi hotspots, and soon the Qi logo will become a major consideration for consumers looking to buy a new device

Qi takes its name from the traditional Chinese concept of intangible flow of power; the word literally means ―vital energy‖. The logo is a guarantee that your device can be wirelessly charged wherever you go. The logo is simple yet noticeable – you'll find it on all kinds of portable devices and packaging.

IV. MAKING WIRELESS TRULY WIRELESS

Wireless power is not a new technology. Different embodiments have been in development for over 180 years with differing degrees of success. However, until recently, with the invention of the microprocessor, wireless power has not been a viable solution for the challenges facing wired technologies due to inefficiencies and lack of control, causing safety and other issues. Several companies and institutions of higher learning have recently presented solutions to the challenges delaying the introduction of efficient wireless power for mass adoption, but this positive development has brought with it a new set of challenges including the problem of proprietary solutions versus the creation of an interoperable global standard. Consumer research suggests that a universal standard is the preferred solution, so it is now up to the companies interested in developing and manufacturing these solutions to develop a standard that will allow consumers around the world to power their devices across a broad range of brands and power needs under a single, interoperable standard. This solution will, like the Wi-Fi Alliance did for wireless networking, create a new protocol for how people interact with power

V. THE SOLUTION-COLLABORATION IN CREATING A WIRELESS POWER STANDARD

Wireless power is a lifestyle technology. Like Bluetooth and Wi-Fi, it radically changes the way people are able to live their lives, offering new levels of mobility, convenience and safety. It has the ability to add value and create greater flexibility in the development and use of products across a

wide range of power needs and industries. As such, it is imperative that a standard application of the technology be introduced to create the greatest opportunity for mass adoption and integration into consumers lifestyles. Questions on the possibility of a universal standard that will allow consumers a convenient source to power their devices without the inconvenience of adapters and power cords, no matter what the brand, are at the front of the wireless power conversations happening around the world, and without a universal standard, this will continue to be a challenge.

In addition to the challenges connected with individual organizations developing proprietary solutions, the number of market segments represented across the various power levels is another significant factor that must be considered. It is clear that technology is needed to bridge a broader range than each individual manufacturer would normally expect. The concept that a 60 watt power supply could power anything under that wattage and supply the proper device requirements was previously seen as costly. With the advent of advanced, low-cost power supply technology, this possibility is becoming reality. The adoption of this philosophy needs to align with consumers' expectations. If pursuit of a universal standard is not made the highest priority, it could certainly limit the widespread adoption of wireless power technology.

VI. How Wireless Charging Works

A quick investigation of the source code would likely reveal these apps do little more than to link the interrupt signal from the accelerometer to a progress bar indicating an alleged battery charge. A piezoelectric accelerometer could generate a small voltage secondary to deformations induced by rapid motions applied to it, however trying to use that millivolt signal to charge a battery would not be practical. In order words, shaking your smartphone isn't going to do anything but get your arm tired.

During any energy conversion there will be losses in going from one form to another. The magnitude of those losses is what dictates the practicality of any type of wireless charging. Magnetic or inductive charging, in particular has been effectively used for some time to power various kinds of biomedical implants. Presently it is the safest and most enduring method to accomplish the job of transferring power to the inside of the body. In these systems, oscillating current in an external coil of wire generates a changing magnetic field which induces a voltage inside an implanted coil. The current resultant from this voltage can charge a battery or power the device directly.

Ultrasound or solar power are being developed, for example by U beam. For the time being, however, magnetic inductive charging technologies — spearheaded by the Qi consortium and smartphones like the Nokia Lumia 920 — such have taken the stage.

VII. Future Increase in Design Freedom for Wireless Power Products

The current version of the Qi low power specifications allows a range of possible transmitter designs. The first version of the specification allowed four types of transmitters. Two multi-coil arrays, a moving coil, and fixed single coil transmitters. And each type allows different shapes and sizes where manufacturers can make their own trade-off between cost, user experience, and design.

We are now further increasing the freedom in transmitter design. These new types are added to the specification when analysis has shown that the new transmitter will not cause incompatibilities with the existing Qi power receivers.

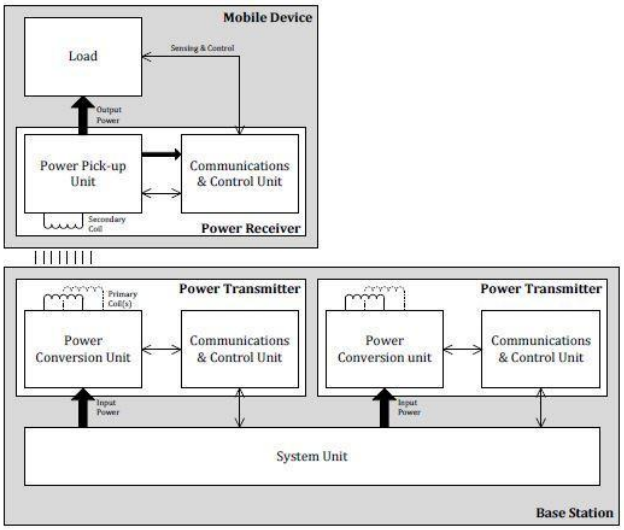

Figure 1: Block Diagram- Basic Design Overview

While a moving magnet might just as well be used to externally generate the field, an external coil is simply more practical. Apple has just filed a patent for hardware which could make the shake to charge concept a reality, at least in theory. They claim a unique design incorporating internal moveable magnets, and a flat printed circuit board coil. Current chip efficiencies will however preclude practical implementation of this scheme for some time.

Many smartphone users will be wondering wonder whether their near field communication (NFC) chip can be used to harvest power from a dedicated external source, or perhaps an ambient electromagnetic source like Wi-Fi. In theory it is possible and such systems are on the market already, however not every NFC chip would be up to the task. To achieve maximum efficiency the system should be optimized for a use at a particular separation distance, angle of incidence, phase, and frequency such that it is in a resonant condition.

Resonance in an electromagnetic system can be likened to pushing a child on swing only when the swing is at the high point. Anywhere else and the energy transferred to the child will be reduced. If the separation distance is no more than a quarter of the wavelength, such a system can operate at efficiencies up to 35%.One thing to keep in mind when considering wireless charging: If your charging system is throwing away nearly all of the 10 or so amps available from your wall outlet just to provide you with convenient at-a-distance charging, not only will charging be wasteful but it will be slow. Other wireless charging technologies relying on.

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