# Internet of Things
Developing an optimal wireless power transfer system for a real-world low power LED wristband application

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**Abstract**

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## 1 Introduction

introduction

## 2 Related work

related

## 3 Prior knowledge

prior

## 4 Description of the proposed idea

decription idea

## 4.1 Working towards a realization

Our major goal is to provide with an efficient solution that meets the challenges in battery charging systems using wireless power transfer the best. Those challenges include:

1. Charging the battery as quickly as possible. Though batteries can store a large amount of charge, there is a limit to how fast a battery can be charged. This limit gets smaller with the size, or capacity of the battery. If the battery is smaller, the charging current limit will also be smaller. Exceeding this limit will deteriorate the battery's life. To overcome this difficulty we propose adding a super capacitor in parallel with the battery. Super capacitors are known to to hold a less amount of charge then same sized batteries, but they are capable of charging much faster[4].
2. Providing a longer battery life with a large charge-to-discharge ratio. In our scenario we want to make the charging interval as small as possible which requires a need to store as much charging current as possible in a short interval. That makes the addition of a super capacitor an ideal solution to overcome the battery charging limitation. During the charging interval, a super capacitor can store a large amount of charging current. This current can be used to charge the battery with a slow pace. This provides a long battery life in terms of a large charge-to-discharge ratio.
3. Working out an efficient protocol for sharing the available charge.

## 4.2 Protocols concerning environmental impact features

The major goal of this report is to be able to develop a real-world application. In order to do this, all real-world implications need to be taken into consideration. Scenario's were developed to develop a charging protocol that accounts for all possible states. For these scenarios a user wearing a tranceiver wristband is considered. Other viewpoints for a scenario can be the user wearing a receiving wristband or the transmitting bar. However, these viewpoints are considerably easier to address and will implements parts of the protocol designed for a tranceiving system.

There are certain states in which the system can reside depending on its own battery state, the battery state of neighbour nodes and the availability of a charging bar. These states and their transmissions are displayer in figure 1. It can either be sufficiently full defined as Vfull, starving defined as Vstarve or dead which is defined by Vdead. These parameters are further specified in section 5.

A charging protocol has to be designed to account for these combinations. We considered three possibilities: an infinite network like design, a hop-to-hop

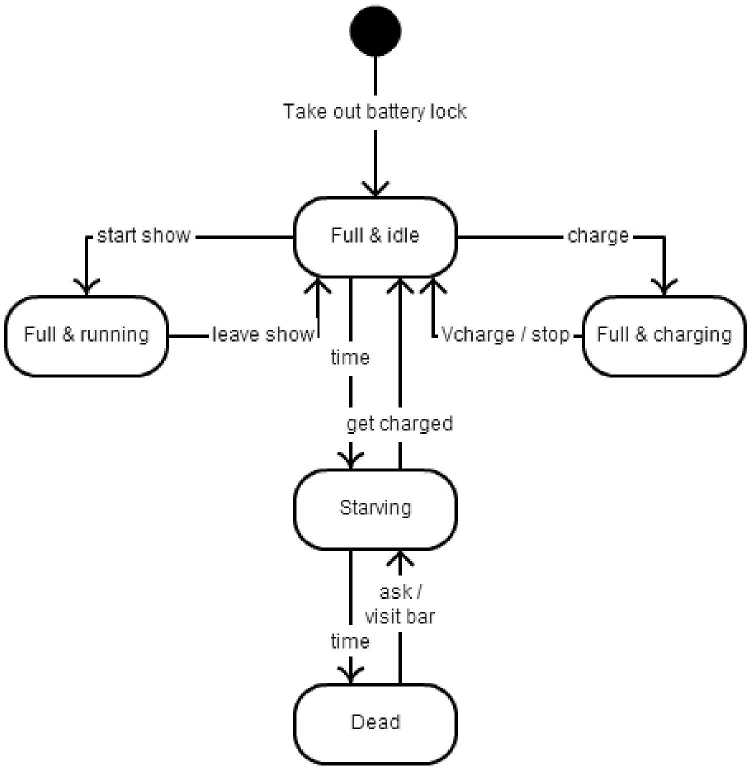


Figure 1: State diagram of a transceiving wireless power transfer system

spread of energy or an interactive behavior to selectively share energy. To stimulate interaction through this application we choose to apply a scenario where a user can choose to act upon energy requests and share with friends, or strangers.

To handle these protocols, an IC has to be added. This way whenever the battery reached Vstarve it will send out a request for energy visually by litting a red LED embedded in the wristband. Neighbouring nodes can then choose to react on this or save their own energy. Whenever the battery dies, the user either has to verbally ask for energy of visit an energy bar.

## 5 The proposed system design

The Figure The transmitter is powered up by a voltage source $V_i$ of 12 Volts capable of delivering 400 milli-Amps of $i_{in}$ current. $i_c$ is the constant current that is consumed by the transmitter circuitry and $i_s$ is the induction current which flows through the transmitter coil such that $i_{in} = i_c + i_s$ . $i_c$ is constant and depends on the transmitter inner circuitry power consumption, in our case $i_c = 100 milli - Amps$. $i_s$ depends on the distance between the two magnetically coupled coils, greater the distance smaller the $i_s$ will be. Another factor that $i_s$ could depend is on adding an iron core between the two coils, adding a core makes the magnetic coupling stronger and increases the $i_s$ which enhances an overall efficiency of the system. The receiver circuit receives an induction voltage $V_r$, rectifies it through a rectifier containing a shotkey diode $D_r$ and a capacitor $C_r$. A shotkey diode is used in order to have a good frequency response at the range of $300 - 400Khz$ the transmitter working frequency also shotkey has lower forward voltage drop. The rectified voltage is then fed to the voltage regulator that produces constant voltage $V_{reg} = 5Volts$ .

## 5.1 Analysis of the system design

The Figure shows a low level schematic of the receiver and charging circuit which will be the main focus of our project. The induction current $i_r$ induced by the transmitter through magnetic coupling will be the main source of charging current. The current $i_c$ charges the super capacitor, $i_b$ charges the battery and $i_L$ is consumed by the load including resistor $R_L$ and a light source. During the charge cycle $i_r = i_c + i_b + i_L$ . Now in analysis lets first consider the efficiency $\eta$ of the circuit. If $P_o$ is the power consumed by the receiver and $P_i$ is the power provided by the transmitter, ignoring small power drops across $D_r$ and $C_r$ then:

$$\eta = \frac{P_o}{P_i} \tag{1}$$

where $P_o = V_{reg} \times i_r$ and $P_i = V_i \times i_s$

## 5.2 The internet of things

The assignment of this report conveyed critizing and accessing system-level Internet of Things components in scientififc literature. Because the assigned paper did not include anything IoT related, we will present our own idea. In this section we will provide a short introduction to the Internet of Things and its key features, present our idea and focus on the practicality and entrpreneurial aspect of the idea.

The Internet of Things refers to uniquely identitfiable objects, or things, and their virtual representations in an Internet-like structure. [5]. The intelligent application is the key feature here. Important aspects to be taken into consideration when designing such a system are security, privacy and scalability.

The anatomy of Internet of Things is initiated by a certain event, that is detected and logged by devices that include self-properties [5]. This data is then uploaded by a ubiquitous and interoperable network. The unique feature of the internet of things is that this system is smart and can generate knowledge and by analyzing this data and understands the system. Certain events are then triggered and reported as response. The intelligence of these systems lie in the adapting mechanisms that analyse and understand the environment in order to deal with the complex dynamics of a real-world environment.

Internet of Things has already been employed at multiple festivals, while it was initially used as a ticketing solution in 2004 at the SXSW festival in Austin. It emerged in the form of wristbands and cut down significantly on gate crashing and lost tickets [6]. SXSW announced that each tag contained a unique ID code, correlated with personal information availabe by SXSW [1]. It has further been introduced at Coachella and Bonnaroo. [2] [3] RFID now even support cashlesh payments and integration with social networks, allowing people to upload pictures to facebook via the so-called "Live Click Stations"[6]. We can conlude that it safe to say that the Internet of Things hasn't reached its peak yet concerning festival and concerts.

## 6 Results

results

## 7 Conclusion

conclusion

## References


[1]

[2]

[3]

[4] ref still.

[5] Ringo Doe. This is a test entry of type @ONLINE, June 2009.

[6] A. Zauner. On tour with rfid.