Designing Energy Partnership Between Users and Intermittently Powered Device

Bao Baihong

Master Thesis - Appendix

Designing Energy Partnership Between Users and Intermittently Powered Devices

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Content

Appendix A

Design Brief

DESIGN FOR our future

4068

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IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Bao
initials:
given name: Baihong
student number: 4842863
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): IPD / ★ DfI / SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: Honours Programme Master
specialisation / annotation: Medisign / Tech. in Sustainable Design / Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Gerd Kortuem — dept. / section: IoT
** mentor: Elisa Giaccardi — dept. / section: HICD
2nd mentor:
organisation:
city: country:

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

comments (optional)

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair: Gerd Kortuem — date: 07 - 04 - 2020 — signature: [signature]

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 30 EC

Of which, taking the conditional requirements into account, can be part of the exam programme: 30 EC

List of electives obtained before the third semester without approval of the BoE

★ YES — all 1st year master courses passed

NO — missing 1st year master courses are:

name: J. J. de Bruin (SPA-IO) — date: 09-04-2020 — signature: JdB

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ✓ APPROVED / NOT APPROVED

Procedure: ✓ APPROVED / NOT APPROVED

Remark: title too long, please adapt the title in due course at your application form for your MSc - examination

comments

name: Monique von Morgen — date: 28-04-2020 — signature: MvM

Initials & Name: Bao — Student number: 4842863

Title of Project: Designing energy partnerships between users and intermittently powere

Personal Project Brief - IDE Master Graduation

Designing energy partnerships between users and intermittently powere — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 07 - 04 - 2020 — 25 - 08 - 2020 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

With the spread of smart-products and wearable devices, the need for changing and charging batteries will become greater and greater. This growing number of batteries is not only bad for the user experience but even worse for the environment. Energy harvesting technology, which energy is harvested from the surrounding environment through light, vibration, temperature gradients and radio frequencies, could help resolve some of these challenges. For the foreseeable future, smart-projects and wearable devices could completely powered by the ambient energy sources without the need of battery.

However, the current designed human-energy interactions are based on the existence of batteries, including:
- battery percentage indicator (icon and percentage number)
- low-power mode switch
- low power hints
- charging behavior
- battery management
- other self-forming energy management

Apparently, these human-energy interactions will either not applicable or need redesign for the future battery-less devices. Also, these devices will require aggressive power management schemes which are likely to introduce new user experience issues.

Therefore, a new energy partnership between human and battery-less devices needs to be defined. New user experience or interfaces of battery-less regarding to energy also need to be redesigned.

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Personal Project Brief - IDE Master Graduation

introduction (continued): space for images

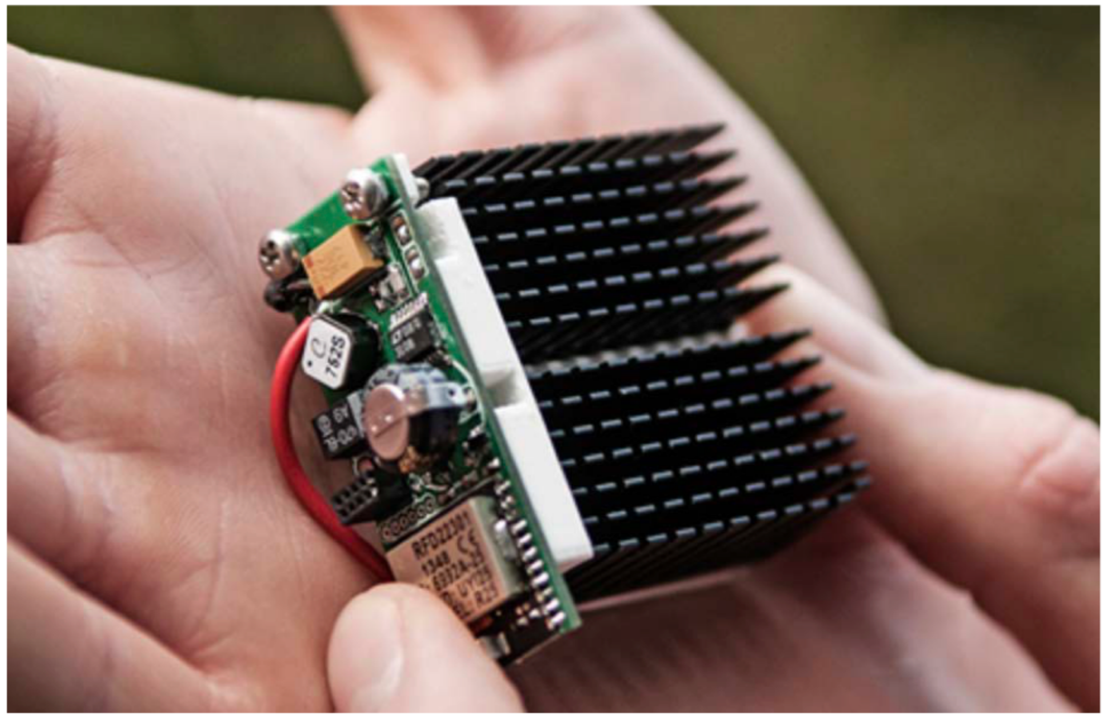


image / figure 1: A thermal energy harvesting device. Source: Delta

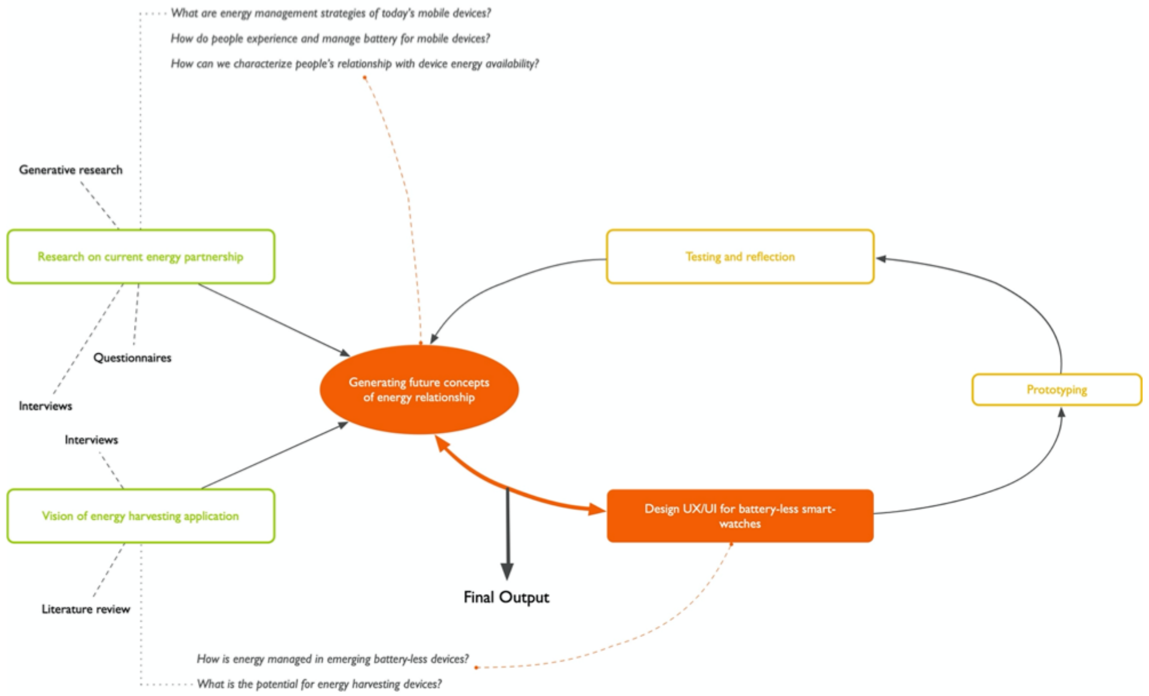


image / figure 2: Research structure of this graduation project

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

With the diverse use of smart devices and growing user expectations for the device, battery life has progressively become an important issue. To solve this, different ways of interaction between users and smart devices have been developed, including battery management interface, battery percentage indicator, low power hints and so on. These elements on the interfaces, can be said to mediate users' perception of and relationships with energy.

Energy harvesting technology, on the other hand, provides devices another way of requiring energy, harvesting energy from the surroundings. Therefore, in the future, smart portable devices will no longer treat a battery as the only source of energy. But such technology will also cause user experience problems. At a deeper level, it will reshape smart device users' perception and relationships with energy.

The key question that this graduation project want to tackle is to formulate a brand-new human-energy relationship between users and intermittently powered devices (devices that utilizing energy harvesting). In order to accomplish that, two main research tasks and several research questions need to be done:

1. Mapping the current human-battery interactions and human-energy relationships
   With the following research questions:
   - What are energy management strategies of today's mobile devices?
   - How do people experience and manage battery for mobile devices?
   - How can we characterize people's relationship with device energy availability?
2. Visioning the application of energy harvesting to conceive the future scenario of intermittently powered devices
   With the following research questions:
   - How will energy harvesting be working in the future scenario?
   - What is the potential for energy harvesting?

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This graduation project will deliver the following outcomes:
1. A research about current human-battery interactions and relationships, and the future scenario of intermittently powered devices
2. A design of future human-energy relationship and detailed user experience (interfaces) on a specific use cases

Since the core question of this graduation project is to formulate a new human-energy relationship regarding to energy harvesting technology, a research will be conducted with two main research tasks above. According to the research, a new concept of human-energy relationship will be designed. To test if this concept is feasible, a much more detailed user experience (interfaces) on a specific type of device will come along. With a iterative design cycle (design, prototype and test) a final design result including high fidelity design and prototypes will be delivered as proof of success for the new concept.

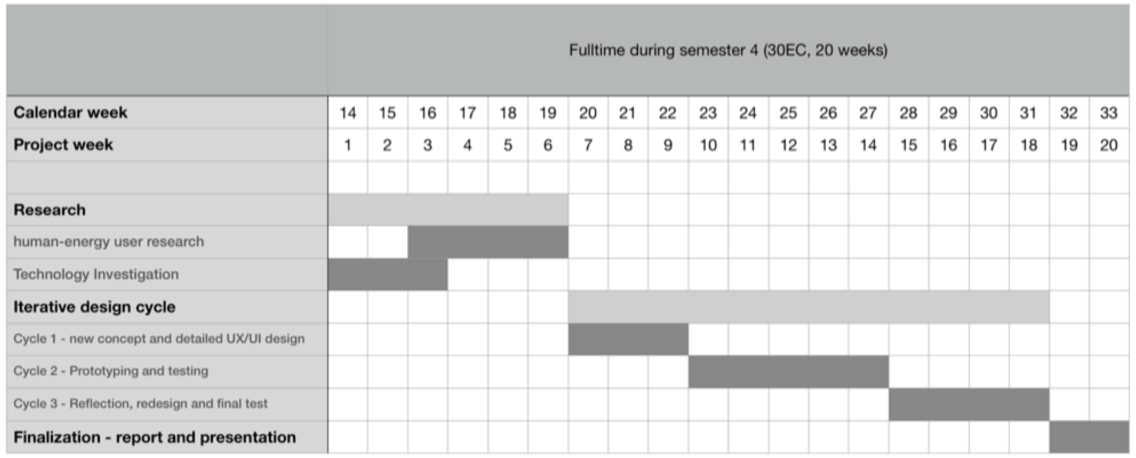
Tangible graduation project outcomes:
1. a report with all the details of research and design activities and results.
2. a user experience or user interfaces design on a specific type of device.
3. Prototypes as proof of success for the concept.
4. (if possible) a video demonstrating the concept and UX/UI design.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 7 - 4 - 2020 25 - 8 - 2020 end date

Gantt Chart



Overall, the approach of this graduation project could described as research through design. With such approach, the design itself is the means to explore and understand the relationship between the future intermittently powered devices and users.

For the current relationship research part of this graduation project, online context mapping, crowd sourcing and online interviews would be the case due to the current situation.

As for the technology visioning, the main approach will be literature review and online communication with specialists.

Personal Project Brief - IDE Master Graduation

MOTIVATION AND PERSONAL AMBITIONS
Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

- As a DFI student, I always like to imagine how people embrace new technologies in their daily lives and work with the help of design. We designed new ways of interactions for these new technologies and products in order to balancing usability and functionality. Therefore, I would like to do a graduation project with the basis of a new tech. To see how much impact these new technology will bring, and what can a designer do to make the process as easy to use as possible.
- This project requires huge amount of coding and prototyping. I feel really excited to learn new coding skills by myself, just as we experienced in ITD. I hope to extend this skill as my competences when I'm looking for a job as a designer.

FINAL COMMENTS
In case your project brief needs final comments, please add any information you think is relevant.

Appendix B

EHT Documentation

Existing EHT

there are different ambient energy sources available for EHT. Appendix B describes various EHT categorized by the ambient energy source, which is used to produce electrical energy. The four most typical energy sources for harvesting procedures, kinetic, solar, thermal and RF energy, are analysed as follow.

Harb, A. (2011). Energy harvesting: State-of-the-art. Renewable Energy, 36(10), 2641-2654.

Kinetic Energy Harvesting

Mechanical energy can be found almost anywhere that wireless sensor networks may potentially deployed, which makes converting mechanical energy for instance from ambient vibration an attractive approach for powering wireless sensors. Mechanical energy harvesters are able to convert special kinds of mechanical energy, such as vibrations, rotation or motions, into electrical energy. There are many different options how to harvest mechanical energy, each of them based on slightly different physical phenomena. The most developed techniques are electromechanical transducers. This category includes electromagnetics, electrostatics and piezoelectric, which is probably the best developed technique for vibrational harvesting nowadays (Harb, 2011).

Kim, S. G., Priya, S., & Kanno, I. (2012). Piezoelectric MEMS for energy harvesting.

• Piezoelectric

The most developed solution to convert vibration energy into electrical energy is based on the piezoelectric effect. Piezoelectricity describes the process of internal generation of electrical charge resulting from an applied mechanical force, illustrated in Figure B.1. If force is applied on a piezoelectric crystal or fiber, the static structure is deformed, charge carriers are shifted and electrical current is generated (Kim, 2012). The probably most famous usage is a lighter. By pressing on a piezo crystal, an enough high voltage is produced and a spark is generated which ignites the gas and creates a flame. In other words, a mechanical shock is converted into electricity, as shown in Figure B.2.

Energy harvesting systems which

Beeby, S. P., Tudor, M. J., & White, N. M. (2006). Energy harvesting vibration sources for microsystems applications. Measurement science and technology, 17(12), R175.

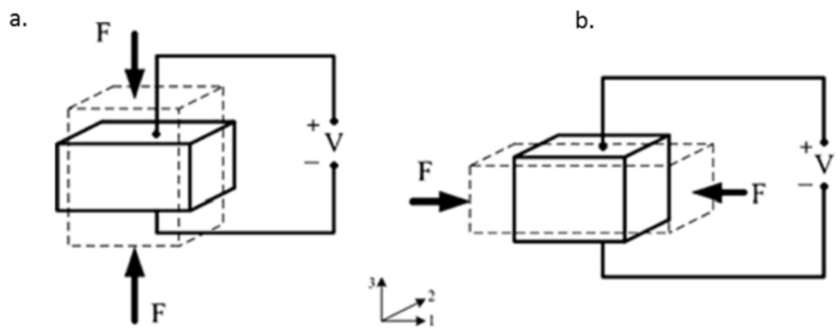


Figure B.1 - Piezoelectric generators: a. force applied form above; b. force applied from the side (Beeby, 2006).

Bhavani, G. (2014). Lighter. Physics - Make It Simple. http://physicsmakesimple.blogspot.com/2014/06/lighter.html

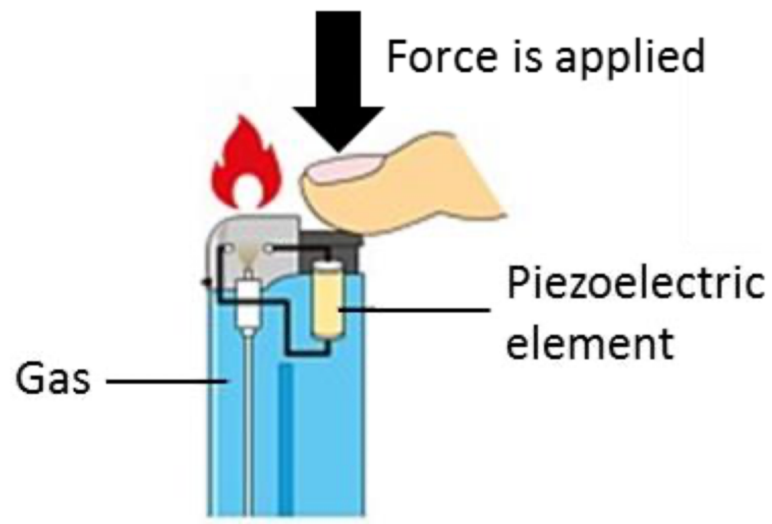


Figure B.2 - Working principle of a lighter (Bhavani, 2014).

do not rely on sudden mechanical shock make use of freestanding piezoelectric membranes or cantilevers and vibrational beams to pick up ambient oscillations.

• Electrostatic

Electrostatic transduction is a promising way to convert ambient vibrations into electricity. Its operation is based on a capacitive structure created by two standalone electrodes. The gap between both electrodes can be filled with air, vacuum, or any dielectric materials (Zhang, 2015). By moving one of the electrodes, a variation of capacitance takes place, which can convert mechanical vibration to electricity by charge-discharge cycles or electret. For the energy harvesting technology only the electret-based electrostatic generators, which can directly turn ambient vibration to electricity enabled through the electret placed on the surface of one or two electrodes (see Figure B.3). Electrets have a similar task than magnets in the electromechanic-based generators. In other words, electrets are the dielectric material with a capability of maintaining an electric field and surface potential inside the structure for years (Nabavi, 2016).

Zhang, A., Peng, Z., Luo, A., Li, S., & Wang, F. (2015, October). Electrostatic energy harvesting device with broad bandwidth. In 2015 International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO) (pp. 178-181). IEEE.

Nabavi, S., & Zhang, L. (2016). Portable wind energy harvesters for low-power applications: A survey. Sensors, 16(7), 1101.

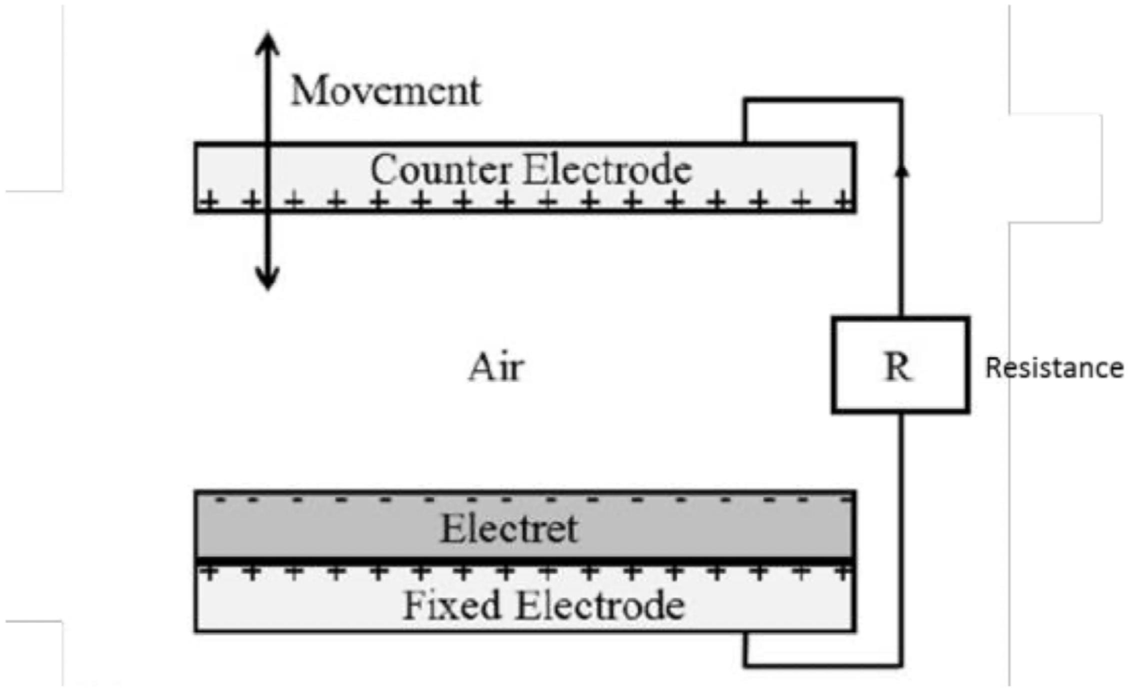


Figure B.3 - Schematic view of the electret-based electrostatic harvester (Nabavi, 2016).

• Electromagnetic

Electromagnetic induction was discovered by Michael Faraday in 1831. In an electromagnetic generator, strong magnetic fields are produced by permanent magnets and a coil is used as the conductor, which allows the flow of an electrical current in one or more directions. Either the coil or the permanent magnet is fixed to the frame while the other is attached to the moving part, respectively to the inertial mass. The vibration causes a relative displacement and thus the transduction mechanism starts working and electrical energy is generated (Kim, 2012). Figure B.4 depicts two commonly seen examples of electromagnetic generators.

Kim, A., Maleki, T., & Ziaie, B. (2012, January). A novel electromechanical interrogation scheme for implant able passive transponders. In 2012 IEEE 25th International Conference on Micro Electro Mechanical Systems (MEMS) (pp. 31-34). IEEE.

Cepnik provided an informative report titled "Review on Electrodynamic Energy Harvesters – A Classification Approach", where many different electromechanical harvester prototypes are discussed in detail.

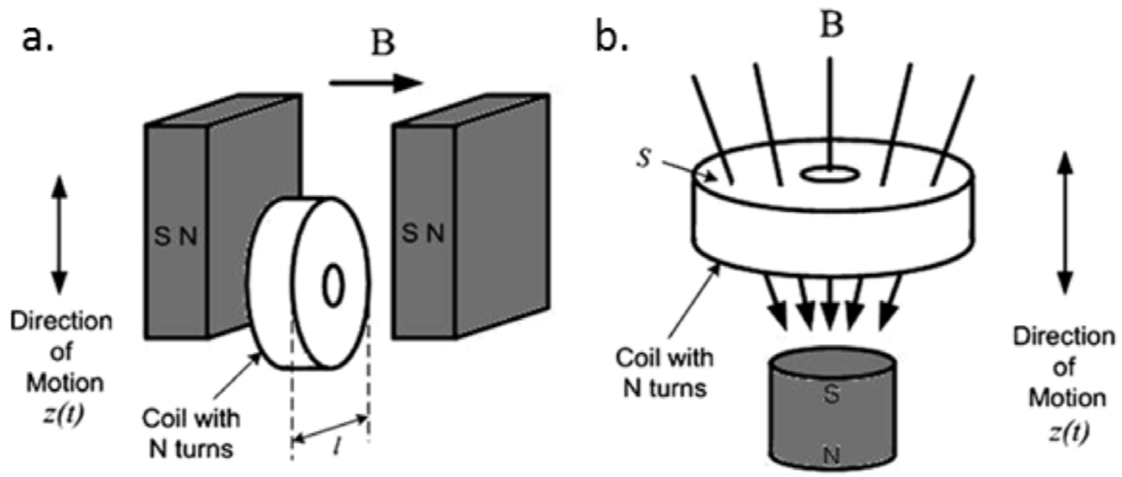


Figure B.4 - Electromagnetic generators (Cepnik, 2013).

Cepnik, C., Lausecker, R., & Wallrabe, U. (2013). Review on electrodynamic energy harvesters—a classification approach. Micromachines, 4(2), 168-196.

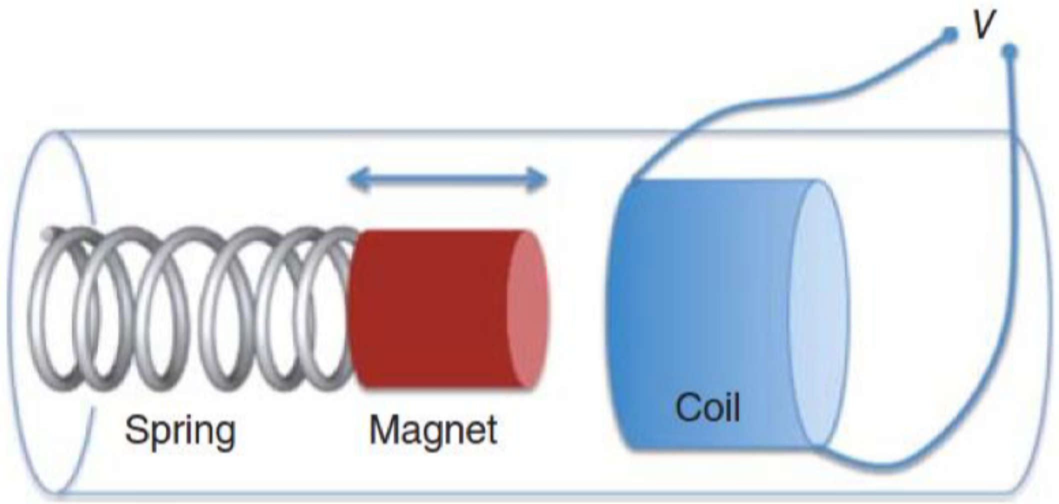


Figure B.5 - Basic scheme of an electromagnetic vibration harvester where a moving magnet oscillates with respect to a fixed coil (Fedder, 2015).

Brand, O., Fedder, G. K., Hierold, C., Korvink, J. G., & Tabata, O. (2015). Micro energy harvesting. John Wiley & Sons.

Light Energy Harvesting

Most of the energy, which is used by humans, such as oil, coal and gasoline, originates indirectly from sunlight. Sunlight is also the best energy to be harvested, if it is available as energy source. The average power density of outdoor sunlight is 100 mW/cm2 under AM 1.5 illumination spectrum. Indoor light depends on e.g. the type, size and the position of light source and may vary widely, from 0.1 to 1mW/cm2 (Guilar, 2009).

Guilar, N. J., Kleeburg, T. J., Chen, A., Yankelevich, D. R., & Amirtharajah, R. (2009). Integrated solar energy harvesting and storage. IEEE Transactions on Very Large Scale Integration (VLSI) Systems, 17(5), 627-637.

• Photovoltaic cell

Photovoltaic (PV) cell, also known as solar cell, is by far the most highly developed electrical device that converts the energy of light directly into electricity by the photovoltaic effect. There are various solar cell technologies, with a history of more than 50 years (Archer, 2001). The photovoltaic effect refers to photons of light exciting electrons into a higher state of energy, allowing them to act as charge carriers and generate an electric current. As shown in Figure B.6, a PV cell contains two different layers. n-type silicon layer, which has free electrons, and p-type silicon layer, which is missing electrons, leaving "holes" in their place. When these two materials are placed side by side inside a solar cell, the n-type silicon's spare electrons "jump over" to fill the gaps in the p-type silicon. This means that the n-type silicon becomes positively charged and the p-type silicon indicates a negative charge. Thereby, an electric field is generated and electric current is provided.

Archer, M. D., & Green, M. A. (Eds.). (2001). Clean electricity from photovoltaics (Vol. 1). London: Imperial College Press.

The efficiency varies enormous based on the technology used for the PV cell. There is an overview given (Figure B.7) from the NREL (national renewable energy laboratory) based in USA, which illustrates the different technologies and above all the improvements in efficiency of PV in recent years. There are four categories:

- Multi- and single-junction cells
- Crystalline Si Cells
- Thin-Film Technologies
- Emerging PV

Vishal, Vishal. (2016). Wireless Sensor Network Prototypes and Solutions for Energy Harvesting. 10.13140/RG.2.2.19492.48009.

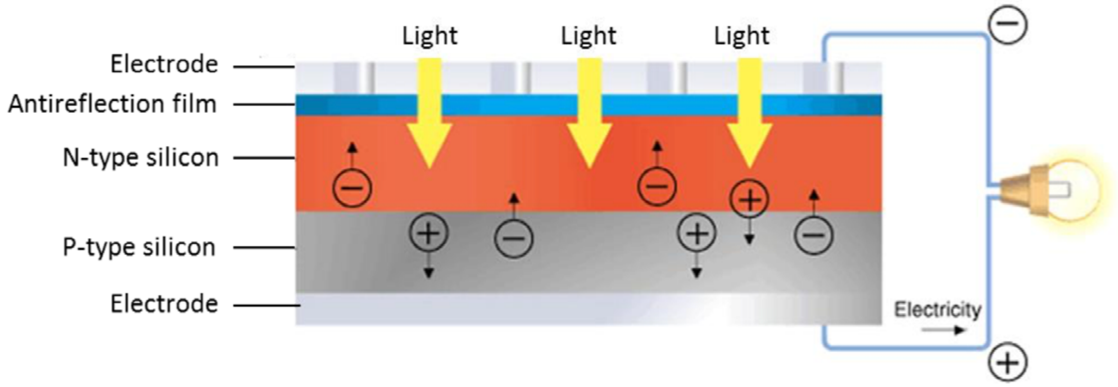


Figure B.6 - Simplified working principle of a photovoltaic cell (Vishal, 2016).

Wikipedia contributors. (2020, August 9). Solar cell. Wikipedia. https://en.wikipedia.org/wiki/Solar_cell

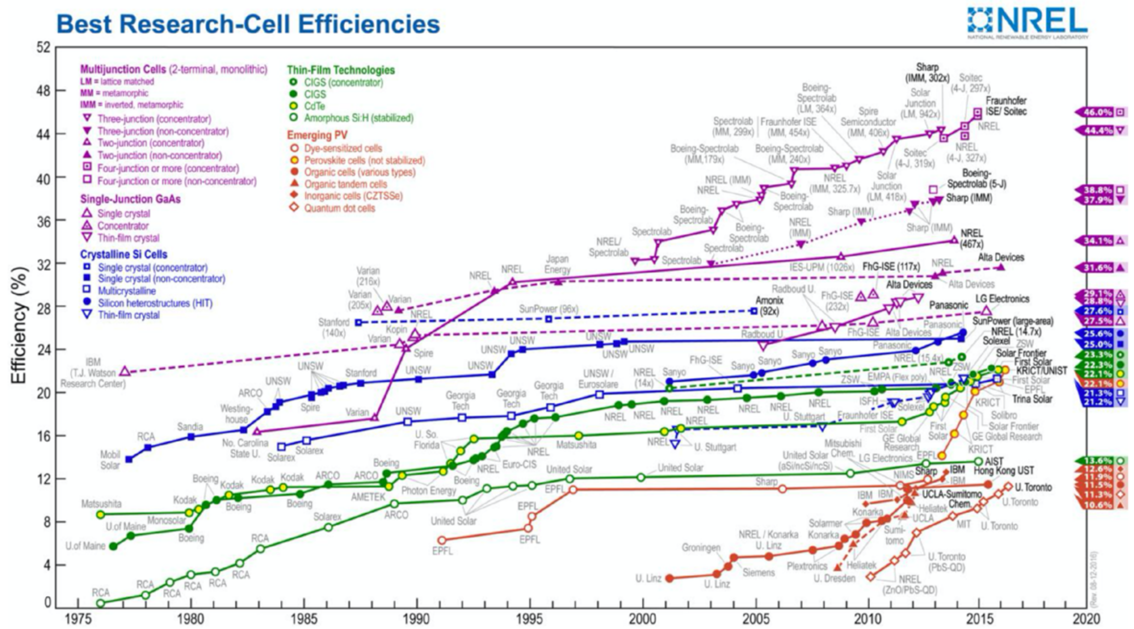


Figure B.7 - Basic scheme of an electromagnetic vibration harvester where a moving magnet oscillates with respect to a fixed coil (Wikipedia contributors, 2020).

Thermal Energy Harvesting

Bensaid, S., Brignone, M., Ziggiotti, A., & Specchia, S. (2012). High efficiency Thermo-Electric power generator. International journal of hydrogen energy, 37(2), 1385-1398.

Almost every system loses heat as waste energy. This includes all kind of industries, transportation, human body and many more. Depending on the application area the power density varies from 2 to 600 microWatt/cm2 . Existing energy harvesting techniques using thermal energy are based on the thermoelectric and pyroelectric effect,

• Photovoltaic cell

The thermoelectric effects describe the interaction between heat and electricity. Thermoelectric devices make us of the Seebeck effect to generate power from a temperature gradient. The Seebeck effect arises due to the fact that charge carriers in metals and semiconductors are free to move. When a temperature difference is applied to this type of materials, the charge carriers will diffuse from the hot to the cold side producing and electrostatic potential. Thermoelectric generators (TEG) are composed by multiple thermocouples, of p- and n- type materials connected electrically in series and thermally in parallel. When exposed to a temperature gradient, the carriers with either positive or negative charge, flow from the hot top to the cold bottom (heat flow) and induce and electrical current due to movement of the charge carriers (current flow), as illustrated in Figure B.8. The voltage of each element (p- and n-type) is added together (Bensaid, 2012).

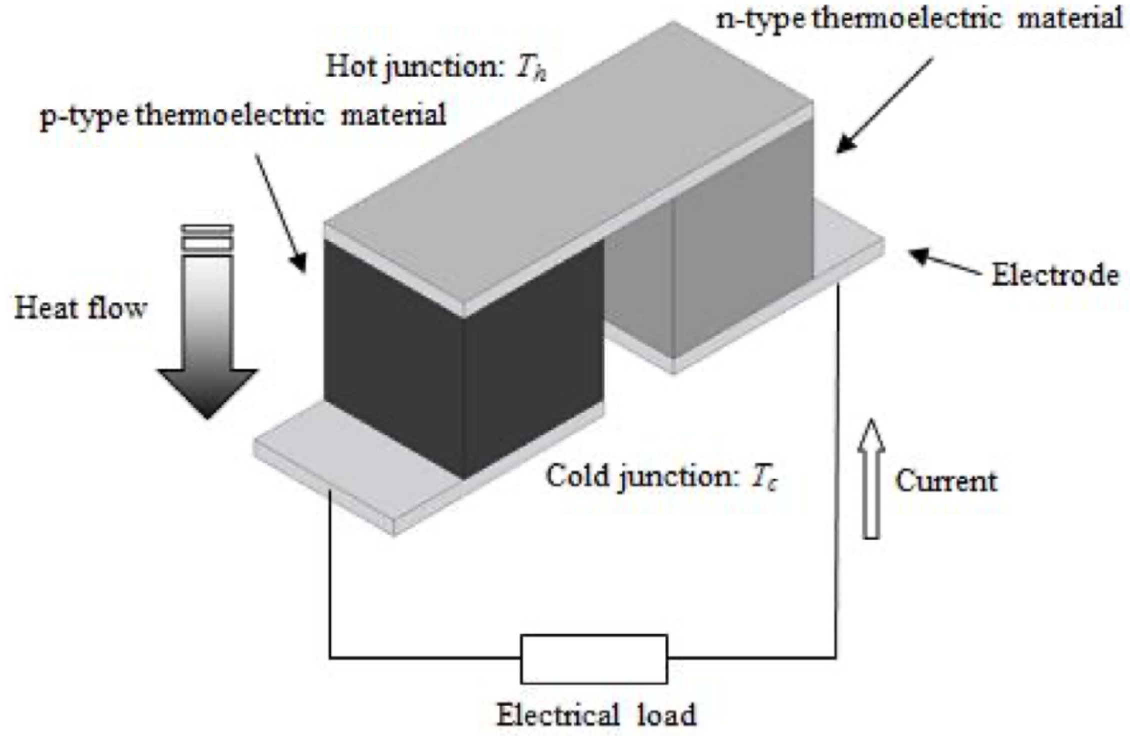


Figure B.8 - Schematic figure of a thermocouple with a n-type and p-type leg.

Radio Frequency (RF) Energy Harvesting

The RF spectrum is part of the electromagnetic (EM) spectrum and ranges from 3 kHz to 300 GHz. The biggest advantage of RF radiation as energy source is its abundance. Every urban region is covered by radio, television broadcasts, mobile telephone services and wireless local area network (WLAN), which makes RF radiation a very attractive ambient energy source. Wireless energy harvesting (WEH) has proven to be one of the most promising solutions because of its simplicity, availability and ease of implementation. The WEH receives the transmitted radio waves with an antenna and converts the received RF energy into a stable direct current (DC) energy source to supply the sensor device (Kamalinejad, 2015). The harvested RF power can generate about 1.8-4 V with a total converted power of about 100mW (Kim, 2014).

Kim, S., Vyas, R., Bito, J., Niotaki, K., Collado, A., Georgiadis, A., & Tentzeris, M. M. (2014). Ambient RF energy-harvesting technologies for self-sustainable standalone wireless sensor platforms. Proceedings of the IEEE, 102(11), 1649-1666.

Appendix C

Literature Review

Powerlet: an active battery interface for smartphones

Abstract

User research of current battery interface and Powerlet, a new battery management interface

Key Point

- Traditional approaches tried automatic policies for battery management without having to consider user intervention. (But now)The management scheme now focuses on understanding user's behavior, and subsequently changes the device usage for efficient battery management.

- The battery interface includes an indicator of the device's power status and an interface to adjust the power-related variables.

- What information should be delivered; how the interface exhibits information; and when the information should be delivered to user.

- We conducted a survey to assess users' interest, their requirements with respect to battery issues, and their experiences. The questions were distributed online through Google Drive and promoted over social networking services.

- Many users do not utilize battery interface features even though the function is provided by the smartphone operating system; They(users) were highly satisfied with the alarm features for specific situations, such as an alarm for a low battery status; They were also satisfied with power-saving features that can be switched on with a simple control, such as the power-saving mode. Users were interested in identifying the applications that waste energy rather than the hardware components.

- We found that the users greatly preferred the active interface, and that this caused user behavior to become more efficient in terms of energy usage. The results of this study demonstrate that it is possible to change user behavior patterns towards improved energy efficiency by altering their type of interaction with the battery interface.

SQ1	What action do you primarily take to save battery power?
SQ2	Have you previously used a battery interface, such as the battery item in the Settings menu on an Android phone or battery management apps/widgets that are downloaded from an app market?
SQ3	Mark X next to the battery interfaces you have used before.
SQ4	How satisfying has your experience of battery interfaces been on a scale of 1 to 5? (1: very dissatisfied, 2: dissatisfied, 3: neutral, 4: satisfied, 5: very satisfied)
SQ5	Mark X next to the factors that made your experience of battery interfaces inconvenient.
SQ6	Mark X next to the features offered by the battery interfaces that you have used.
SQ7	Mark X next to the types of information provided by the battery interfaces that you have used
SQ8	Mark X next to the features you found convenient.
SQ9	Mark X next to the types of information you found convenient.
SQ10	Mark X next to the types of features you would like to see in a battery interface.
SQ11	Mark X next to the types of information you would like to see in a battery interface.
SQ12	Describe your thoughts with regard to battery interfaces in general.

Figure C.1 - Survey Questions.

Materializing energy

Abstract

Articulate a perspective on energy-as-materiality and propose a design approach of materializing energy.

Key Point

- Emerging through these investigations we propose the notion of energy-as-materiality and further outline a simple framework for designing interactions with energy-as-materiality involving collecting, keeping, sharing, and activating energy.
• collecting energy (generating / producing)
• keeping energy (storing / maintaining)
• sharing energy (transmitting / distributing)
• activating energy (using / consuming)

- product attachment (or object attachment, or material possession attachment): focuses on people's attachment to particular material objects and, as such, is distinct from general trait materialism, product category involvement, and evaluative affect towards possessions. Rather, product attachment refers to bonds between a person and a particular thing as opposed to a general class of things.

- Singularity of process: the ways in which a particular object is or becomes unique, personalized, decommodified, irreplaceable. The singularization of objects is related to various possession rituals (e.g., using, displaying, storing, discussing, comparing, altering, etc.), through which objects can be said to provide, acquire, or mediate meaning.

- We might design for caring for our energy in the same ways that one cares for the materiality of food when gardening or preparing an elaborate meal. As a more concrete example, it may be worthwhile to design microgeneration technologies in ways that promote a form of emotional attachment to or care for energy. "The advantage with [solar power technologies installed in his home] is that it makes you think about your energy use more. You value it more..." and "I want to feel that as much electricity as I can use is my own electricity."

- it is imperative that designers aim to sustainably redefine (or "recode") our understandings of and interactions with energy through careful attention to the material-symbolic value of emerging as well as commonplace energy related technologies and the energy they materialize.

- Focal engagement, effort and energy (Borgmann & Verbeek's work): Whereas focal engagement suggests an intrinsically meaningful involvement with a thing, effort suggests a type of engagement that is not intrinsically rewarding and is done only as means to some end. Verbeek gives the example of focal engagement with an electronic keyboard or electronic sewing machine, which is contrasted with the effort involved in refilling the car with gasoline.

- In particular we outline two different yet related strategies for sustainable energy-interaction design: (i) materializing engagement with energy through engagement with energy devices (e.g., solar panels, mobile phones) and (ii) rematerializing engagement with energy as reengagement with simpler things (e.g., windows, the outdoors, the sun).

- Energy engagement +energy awareness = energy attunement: Energy engagement could be a powerful way of transforming our relationships with energy in more meaningful and sustainable ways; designers can aim to design technologies with and through which limiting the availability of energy is not perceived of as increased effort but rather as focal engagement.

- we offer the notion of energy attunement, by which we mean to suggest approaching cognitive energy awareness as an experiential materialized presence of energy that invites focal engagement.

- the concept of energy attunement suggests a conceptual shift from shouting at people about energy to inviting them to be more in touch with energy.

Exploring current practices for battery use and management of smartwatches

Abstract

Smartwatch battery usage, user's satisfaction and concerns, and recharging patterns through online survey and data analysis

Key Point

- To address these, we conduct two studies: one to examine usage behaviors of 59 smartwatch users via an online survey, and the other to analyze the battery usage data from 17 Android Wear smartwatch users.

- Our key findings reveal that 1) many users are **satisfied** with current battery life of their smartwatch or in a neutral position, 2) the drain rate of the smartwatch battery is relatively low compared to that of the smartphone even with very frequent interactions, and 3) users usually recharge their smartwatch once a day despite having sufficient battery remaining.

-- We conduct an online survey with 59 participants (including 2 females) in order to understand the following three aspects of the smartwatch: 1) its main usage, 2) concerns about its battery life, and 3) recharging patterns of its battery.

- We investigated why the participants showed different levels of satisfaction. To this end, we asked "**How often do you experience situations where you need to, but cannot recharge your smartwatch?**"; We also asked "**Do you keep wearing your smartwatch when it could not operate due to running out of battery?**"; "**Describe your level of discomfort if your smart device were to be turned off for the whole day**; To examine the sensitivity to the remaining battery, we asked about the **frequency of checking the battery level**.

- From these results, we could see that users' concerns about the current battery life of the smartwatch are relatively lower than those for the smartphone. This would be mainly because the main usage of the smartwatch so far is smartphone-dependent.

- the participants recharged their smartwatch much earlier than the battery was depleted; They stated that they recharge it habitually either when they go to bed or return home; We conjecture that this is mainly because the participants are already habitualized to recharge their smart devices on a daily basis; Unlike the smartwatch, the participants tend to recharge their smartphone whenever recharging is possible; (because)while the participants feel bothered from such frequent recharging, they try to keep their phone alive to maintain the connection with others.

Home, habits, and energy: examining domestic interactions and energy consumption

Abstract

Ways in which everyday interactions with technology in the home are performed without conscious consideration of energy consumption but rather are unconscious, habitual, and irrational.

Key Point

- energy consumption can be characterized as "the routine accomplishment of what people take to be the 'normal' ways of life."

- interactions for which conscious considerations of energy consumption are made are often irrational, a phenomenon that has been referred to as the "efficiency paradox" of energy consumption

- behaviors can be changed without necessarily first changing attitudes

- - Our study revealed that (i) people are often unaware of energy-conserving options for products and, importantly, (ii) people often ignore visible options, instead relying on habit and split-second decisions.

- Instead of highlighting "energy efficient" settings on, for example, washing machines, designers might instead highlight a "high-energy" cycle, reversing descriptive normative messages to imply that the high-energy option is not "normal" usage.

Appendix D

User Studies of Current EP

Question List of Online Survey

How do you perceive the energy of your mobile phone?

*Required

Hi there, I'm Bao Baihong, a design student from TU Delft. I'm conducting user research about the relationship between people and the energy of their mobile devices. This questionnaire is about your daily mobile phone usage and it will take around 3 minutes. Thanks for your corporation!

1. Your age, please? *

____

2. First, I would like to know your daily care about energy level of your mobile phone. Please choose one of the descriptions below you think fits you (A short description is welcomed If you have something more to say!) *

Mark only one oval.

- ◯ I always check the battery status actively to see if I need to charge my phone.
- ◯ I just check the battery level by glimpsing on the battery percentage when I'm on my phone.
- ◯ I seldom check the battery actively unless it notifies me to recharge.
- ◯ Other: _______________

3. How do you feel about the battery level below? Scale your comfort level from 1 to 5. (5 is the most comfortable,1 is the least comfortable) *

Mark only one oval per row.

	1	2	3	4	5
100%	◯	◯	◯	◯	◯
70%	◯	◯	◯	◯	◯
50%	◯	◯	◯	◯	◯
30%	◯	◯	◯	◯	◯
20%	◯	◯	◯	◯	◯
10%	◯	◯	◯	◯	◯
5%	◯	◯	◯	◯	◯

4. Next, I want to know what battery level will trigger you to charge your phone? Write down the percentage that makes you want to charge immediately. (If you don't care you can also write it down) *

Mark only one oval.

- 5%
- 10%
- 15%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%

5. You've reached the end of this section! How will you feel if your phone run out of power during the day but you can't charge it instantly? Scale your discomfort level from 1 to 5. (1 is the least discomfort and 5 is the most discomfort) *

Mark only one oval.

1	2	3	4	5
○	○	○	○	○

How do you charge your mobile phone?

6. I would like to know how do you charge your phone under different conditions. So please view the options below and choose what fit you. You may choose multiple choices here. *

Tick all that apply.

- [ ] I carry a power bank during commuting
- [ ] I use cable chargers when I'm at home or office
- [ ] I use wireless chargers when I'm at home or office

Other: [ ] ______________________

7. Describe your experience about the way of charging, 1 is the worst, 5 is the best and 0 is no experience. *

Mark only one oval per row.

	0	1	2	3	4	5
Powerbank	○	○	○	○	○	○
Typical cable charger	○	○	○	○	○	○
Wireless charger	○	○	○	○	○	○

8. When do you usually charge your phone on a typical weekday? Choose multiple options that fit you or write your own answer. *

Tick all that apply.

- [ ] I charge it at night when I'm sleeping
- [ ] I charge it after getting up
- [ ] I charge it on and off during the day
- [ ] I charge it in a settled time slot
- [ ] I charged it after getting back home

Other: [ ] ______________________

9. I'm sure many people have formed their own charging routine. Could you describe it if you have your own plan for charging? You could skip this question if you don't have a routine of charging

How do you manage the energy of your mobile phone?

10. Have you ever changed the way of using your phone to trade for an extension of battery life? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

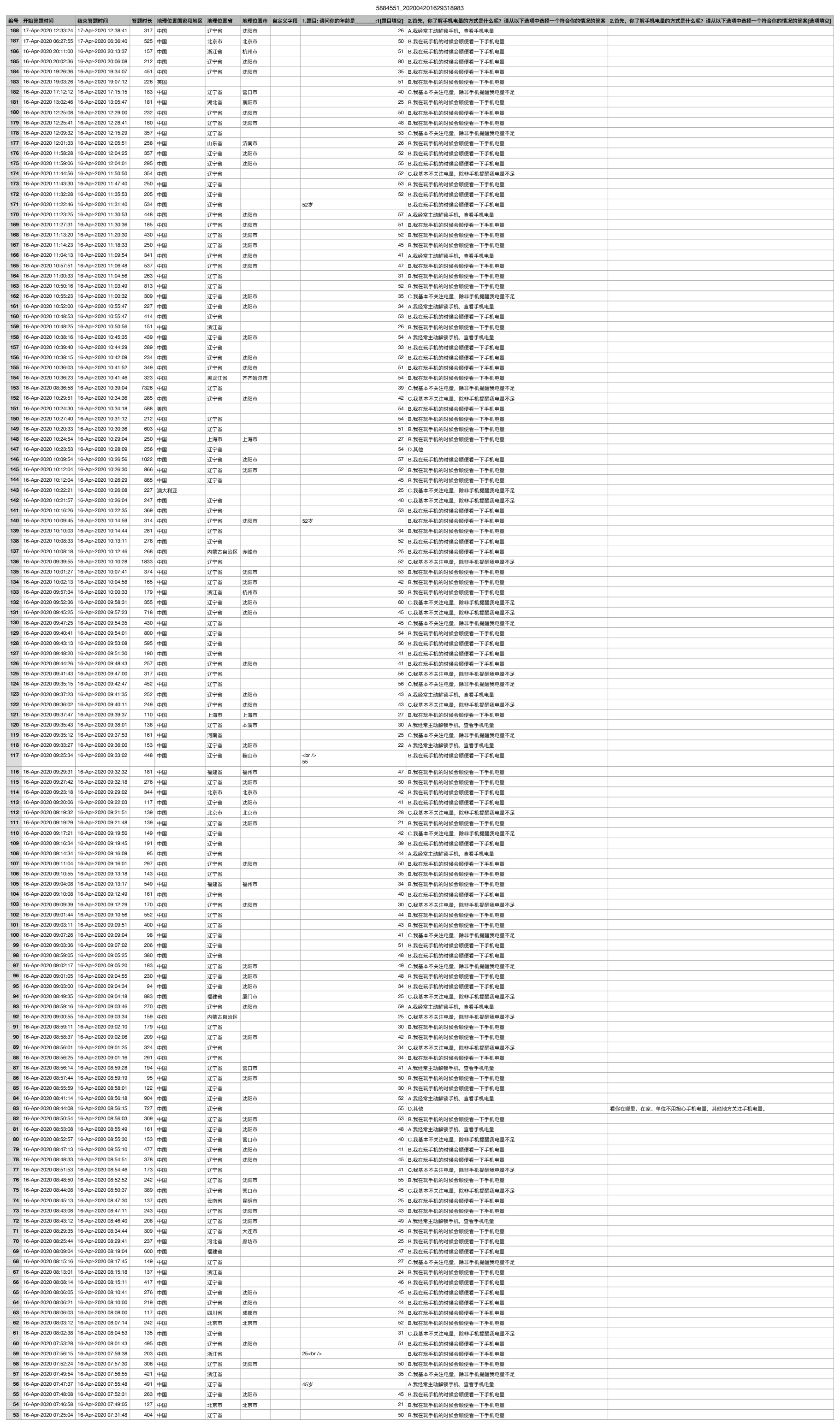
11. Now let's turn to some hard situation. What will you do if your phone is about to shut down but you cannot charge it instantly? *

Tick all that apply.

- ☐ I'll continue use it and try to find a way to charge it as soon as possible.
- ☐ I'll turn on Low power mode and try to extend battery life
- ☐ Let it go. I have other things to focus on.
- Other: ☐ ____________

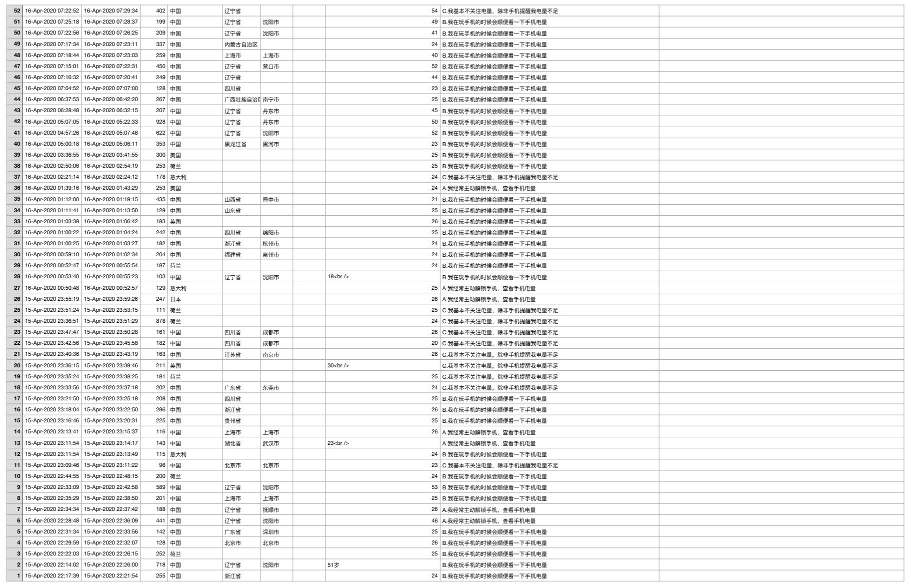
12. How does it feel when you experience the previous situation? You could use a short sentence to describe your feelings.

Data Sheet of Online Survey



5884551_202004201629318983

编号	开始答题时间	结束答题时间	答题时长	地理位置国家和地区	地理位置省	地理位置市	自定义字段	1.题目: 请问你的年龄是________:1[题目填空]	2.首先，你了解手机电量…
188	17-Apr-2020 12:33:24	17-Apr-2020 12:38:41	317	中国	辽宁省	沈阳市		26	A.我经常主动解锁手机，…
187	17-Apr-2020 06:27:55	17-Apr-2020 06:36:40	525	中国	北京市	北京市		50	B.我在玩手机的时候会顺…
186	16-Apr-2020 20:11:00	16-Apr-2020 20:13:37	157	中国	浙江省	杭州市		51	B.我在玩手机的时候会顺…
185	16-Apr-2020 20:02:36	16-Apr-2020 20:06:08	212	中国	辽宁省	沈阳市		80	B.我在玩手机的时候会顺…
184	16-Apr-2020 19:26:36	16-Apr-2020 19:34:07	451	中国	辽宁省	沈阳市		35	B.我在玩手机的时候会顺…
183	16-Apr-2020 19:03:26	16-Apr-2020 19:07:12	226	英国				51	B.我在玩手机的时候会顺…
182	16-Apr-2020 17:12:12	16-Apr-2020 17:15:15	183	中国	辽宁省	营口市		40	C.我基本不关注电量，除…
181	16-Apr-2020 13:02:46	16-Apr-2020 13:05:47	181	中国	湖北省	襄阳市		25	B.我在玩手机的时候会顺…
180	16-Apr-2020 12:25:08	16-Apr-2020 12:29:00	232	中国	辽宁省	沈阳市		50	B.我在玩手机的时候会顺…
179	16-Apr-2020 12:25:41	16-Apr-2020 12:28:41	180	中国	辽宁省	沈阳市		48	B.我在玩手机的时候会顺…
178	16-Apr-2020 12:09:32	16-Apr-2020 12:15:29	357	中国	辽宁省			53	C.我基本不关注电量，除…
177	16-Apr-2020 12:01:33	16-Apr-2020 12:05:51	258	中国	山东省	济南市		26	B.我在玩手机的时候会顺…
176	16-Apr-2020 11:58:28	16-Apr-2020 12:04:25	357	中国	辽宁省	沈阳市		52	B.我在玩手机的时候会顺…
175	16-Apr-2020 11:59:06	16-Apr-2020 12:04:01	295	中国	辽宁省	沈阳市		55	B.我在玩手机的时候会顺…
174	16-Apr-2020 11:44:56	16-Apr-2020 11:50:50	354	中国	辽宁省			52	C.我基本不关注电量，除…
173	16-Apr-2020 11:43:30	16-Apr-2020 11:47:40	250	中国	辽宁省			53	B.我在玩手机的时候会顺…
172	16-Apr-2020 11:32:28	16-Apr-2020 11:35:53	205	中国	辽宁省			52	B.我在玩手机的时候会顺…
171	16-Apr-2020 11:22:46	16-Apr-2020 11:31:40	534	中国	辽宁省			52岁	B.我在玩手机的时候会顺…
170	16-Apr-2020 11:23:25	16-Apr-2020 11:30:53	448	中国	辽宁省	沈阳市		57	A.我经常主动解锁手机，…



1	5	4	4	3
4	1	3	2	3
4	1	3	2	3
5	1	3	2	4
5	1	3	2	3
3	1	2	2	3
3	1	2	2	3
3	1	2	1	3
5	2	4	3	4
3	3	3	1	3
4	1	3	2	3
5	1	3	2	4
4	1	3	2	3
5	1	5	2	5
5	1	3	2	4
4	2	3	3	4
1	1	1	1	1
4	1	2	2	3
4	3	4	3	4
5	1	3	2	4
5	2	4	4	4
4	1	3	2	3
4	1	2	2	3
4	1	2	1	3
5	1	2	1	4
4	1	2	2	3
4	1	3	2	4
5	1	2	2	4
4	1	4	2	3
5	3	3	3	3
4	2	3	3	3
5	1	4	4	5
5	3	3	1	3
4	1	2	2	3
4	1	2	2	4
4	1	2	2	3
3	3	3	3	3
4	2	2	2	3
4	1	1	1	3
4	1	2	2	3
5	1	2	1	3
5	1	3	2	4
3	1	1	1	1
4	1	3	2	3
4	2	3	3	3
4	1	3	2	4
5	1	3	2	4
4	1	2	1	3
3	2	3	2	3
4	1	2	2	3
4	1	3	2	3
5	1	2	2	3

3.看到以下手机电量，你的感受是什么呢？请根据你的心理感受评价:100%	3.看到以下手机电量，你的感受是什么呢？请根据你的心理感受评价:10%	4.题目: 看到你的手机处于_______% 及以下的电量，会让你想要给手机充电[题目填空]	4.题目: 看到你的手机处于_______% 及以下的电量，会让你想要给手机充电
5	2	30	A.小于 5
5	1	50	G.40
5	2		C.10
5	2		C.10
5	1		E.20
5	1		I.60
5	2		E.20
5	1	50	H.50
5	2		D.15
5	2		D.15
5	2	5	A.小于 5
5	1		E.20
5	1	20	C.10
5	1		F.30
5	2		G.40
5	1		F.30
5	1		G.40
5	1		G.40
2	5		E.20
5	1		G.40
5	1		E.20
5	1	50	G.40
1	5		C.10
5	1	40	G.40
5	2		E.20
5	1	50	E.20
5	1	15	D.15
1	4		G.40
5	1	20	E.20
5	1	30	F.30
5	4		F.30
5	1		F.30
5	2		H.50
5	1		E.20
5	2		F.30
5	1		D.15
5	2	5	A.小于 5
5	1		E.20
4	3		G.40
5	1		F.30
4	1		E.20
5	1	71	A.小于 5
5	2	30	F.30
5	1		F.30
5	1		F.30
5	2	20	E.20
5	1	20	E.20
5	1		E.20
5	1		H.50
5	1		F.30
5	2		H.50
5	1	10	C.10
5	2	10	C.10
5	2		C.10
5	1	40	G.40
5	2	20	E.20
1	1	10%	A.小于 5
5	2		C.10
5	2		B.5
5	1		C.10
5	1	50	H.50
5	2	10	C.10
5	1		E.20
5	1		F.30
5	1	10	C.10
5	1	50	H.50
5	3	5	B.5
5	1	40	G.40
5	1	70	L.90
5	4	5	A.小于 5
5	1	30	F.30
5	1		F.30
5	1		H.50
5	1		G.40
5	1		E.20
5	1		G.40
3	3		F.30
5	1		C.10
5	1		H.50
5	2		E.20
5	1		G.40
5	1		E.20
5	2	20	E.20
5	1	30	F.30
5	2		C.10
4	3		E.20
5	1		L.90
5	1	30	F.30
5	1	15	D.15
5	1		H.50
5	1		H.50
5	2		C.10
5	1	70	H.50
5	2	30	F.30
5	2	25	F.30
5	1		E.20
5	3	1	A.小于 5
5	2		F.30
5	1	20	E.20
4	1	10	C.10
5	1		D.15
4	3		H.50
3	3		F.30
1	1		A.小于 5
5	1		E.20
3	3	30	F.30
5	1		E.20
5	1		H.50
5	1	20	E.20
5	1		E.20
5	1		E.20
5	1	20	E.20
5	1		D.15
5	1		D.15
5	1	30	F.30
5	2		I.60
5	1	30	F.30
5	1		E.20
5	2		I.60
5	1	50	H.50
5	2		C.10
5	2	15	D.15
5	1		I.60
5	1	50	H.50
5	1		H.50
5	1	60	I.60
5	1		E.20
5	1		F.30
5	1	50	F.30
5	3		H.50
5	1		H.50
5	1		E.20
5	1		F.30
5	1	20	E.20
5	2		F.30
5	2		G.40

1	5	15	A.小于 5
5	1		E.20
5	1	20	E.20
5	2	20	E.20
5	2		E.20
5	1		F.30
5	1		E.20
5	1		H.50
5	2	10	C.10
3	1		E.20
5	1		F.30
5	1	10	C.10
5	1	20	F.30
5	1	20	E.20
5	1	50	H.50
5	2	10	C.10
5	1	90	L.90
5	1	15	D.15
4	3	20	E.20
5	2		E.20
5	3		D.15
5	1		F.30
5	1	10	C.10
4	1		H.50
5	1	40	G.40
5	1		A.小于 5
5	1	40	G.40
5	1	10	A.小于 5
4	3		B.5
4	3	2	A.小于 5
5	2		A.小于 5
5	3		B.5
4	3		E.20
4	1		E.20
5	1	30	F.30
5	1	50	H.50
3	3	40	G.40
4	2	20	E.20
5	1		H.50
5	1	40	G.40
5	1	30	F.30
5	2	15	D.15
5	1		E.20
5	1		F.30
5	2		C.10
5	1	30	F.30
5	2		E.20
5	1	60	I.60
5	2	15	D.15
5	1	40	G.40
5	2		E.20
5	1	30	F.30

5.假设你在地铁上，你的手机快没电了，但是短时间内你没有办法给手机充电。在这种情况下，请根据你的心理感受评价	6.第二部分关于你如何为你的手机充电。请从以下描述中选择符合你的实际情况的充电方式:我在通勤途中使用充电宝为手机充电	6.第二部分关于你如何为你的手机充电。请从以下描述中选择符合你的实际情况的充电方式:我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
4	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
4	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
4		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
5		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	
2		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	
4		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	
2	A.我在通勤途中使用充电宝为手机充电	
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
5		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
5		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
3		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
2	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
4		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		B.我在家或办公室使用有线充电器充电
1		
2		B.我在家或办公室使用有线充电器充电
1	A.我在通勤途中使用充电宝为手机充电	B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电
2		B.我在家或办公室使用有线充电器充电

6.第二部分关于你如何为你的手机充电。请从以下描述中选择符合你的实际情况的充电方式:我使用无线充电器为手机充电	6.第二部分关于你如何为你的手机充电。请从以下描述中选择符合你的实际情况的充电方式:其他	6.第二部分关于你如何为你的手机充电。请从以下描述中选择符合你的实际情况的充电方式:其他__ [选项填空]	7.请对不同充电方式的体验进行评价:移动电源
			E.5
			C.3
			E.5
			F.0
			E.5
			E.5
			D.4
			C.3
C.我使用无线充电器为手机充电			E.5
			D.4
			D.4
C.我使用无线充电器为手机充电			C.3
C.我使用无线充电器为手机充电			E.5
			F.0
			E.5
			E.5
			F.0
			F.0
	D.其他		D.4
			E.5
			C.3
			F.0
			E.5
			C.3
			D.4
			F.0
			D.4
			D.4
			E.5
			D.4
C.我使用无线充电器为手机充电			D.4
			E.5
			D.4
			D.4
			D.4
			E.5
			E.5
			F.0
			D.4
			C.3
			B.2
			D.4
			D.4
			E.5
			D.4
			C.3
			C.3
			F.0
			F.0
			D.4
			D.4
			E.5
			F.0
			E.5
			A.1
			E.5
			A.1
			E.5
			E.5
			E.5
			B.2
			D.4
			C.3
			F.0
			E.5
			E.5
			D.4
C.我使用无线充电器为手机充电			B.2
			D.4
			D.4
			B.2
			D.4
			D.4
			E.5
			C.3
			E.5
C.我使用无线充电器为手机充电			A.1
C.我使用无线充电器为手机充电			D.4
			F.0
			D.4
			F.0
			D.4
C.我使用无线充电器为手机充电			D.4
			E.5
			E.5
			C.3
			D.4
			D.4
			A.1
			E.5
			D.4
			E.5
			D.4
			E.5
			B.2
			F.0
			C.3
			D.4
			D.4
			C.3
			C.3
			E.5
			D.4
			A.1
			F.0
			F.0
			D.4
			C.3
			E.5
			E.5
			B.2
			A.1
			E.5
			C.3
			C.3
			E.5
			C.3
			C.3
			D.4
C.我使用无线充电器为手机充电			C.3
			D.4
			C.3
			E.5
			C.3
			D.4
			E.5
			C.3
			C.3
			E.5
			D.4
			E.5
			E.5
			D.4
			F.0
			D.4
			C.3

			E.5
			D.4
			F.0
			D.4
			D.4
			D.4
			C.3
			C.3
			B.2
			E.5
			C.3
			D.4
			B.2
			A.1
			E.5
			C.3
			C.3
			D.4
			E.5
			D.4
			D.4
			B.2
			C.3
			B.2
C.我使用无线充电器为手机充电			B.2
			D.4
			E.5
			C.3
			C.3
			D.4
			C.3
			C.3
			E.5
			D.4
			C.3
			C.3
C.我使用无线充电器为手机充电			C.3
			E.5
			D.4
C.我使用无线充电器为手机充电			C.3
			E.5
			E.5
			E.5
			D.4
			C.3
			C.3
			E.5
C.我使用无线充电器为手机充电			C.3
			D.4
			D.4
C.我使用无线充电器为手机充电			C.3
			D.4

7.请对不同充电方式的体验进行评价:数据线充电器	7.请对不同充电方式的体验进行评价:无线充电器	8.请问你一般情况下，会在什么时候给手机充电呢？:我晚上睡觉的时候给手机充电	8.请问你一般情况下，会在什么时候给手机充电呢？:我在起床之后给手机充电	8.请问你一般情况下，会在什么时候给手机充电呢？:我在白天断断续续地给手机充电
D.4	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
B.2	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0		B.我在起床之后给手机充电	
E.5	D.4	A.我晚上睡觉的时候给手机充电		
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		
D.4	E.5	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电		
E.5	E.5			C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
D.4	D.4	A.我晚上睡觉的时候给手机充电		
C.3	C.3	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
B.2	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
F.0	F.0		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
F.0	F.0		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	A.1	A.我晚上睡觉的时候给手机充电		
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		
D.4	B.2	A.我晚上睡觉的时候给手机充电		
E.5	D.4	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	C.3			C.我在白天断断续续地给手机充电
E.5	C.3	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
A.1	F.0			C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
D.4	D.4	A.我晚上睡觉的时候给手机充电		
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	E.5			
E.5	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
D.4	A.1	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
C.3	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0			
E.5	C.3			C.我在白天断断续续地给手机充电
A.1	A.1	A.我晚上睡觉的时候给手机充电		
E.5	E.5		B.我在起床之后给手机充电	
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5			C.我在白天断断续续地给手机充电
D.4	F.0			C.我在白天断断续续地给手机充电
E.5	A.1	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	D.4	A.我晚上睡觉的时候给手机充电		
D.4	E.5	A.我晚上睡觉的时候给手机充电		
E.5	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
A.1	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	C.3	A.我晚上睡觉的时候给手机充电		
E.5	E.5			C.我在白天断断续续地给手机充电
D.4	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
B.2	B.2	A.我晚上睡觉的时候给手机充电		
F.0	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0			C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
F.0	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	C.3			C.我在白天断断续续地给手机充电
E.5	C.3	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	C.3		B.我在起床之后给手机充电	
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	A.1	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	B.2	A.我晚上睡觉的时候给手机充电		
C.3	C.3	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	C.3		B.我在起床之后给手机充电	
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0			
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	D.4		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
C.3	C.3		B.我在起床之后给手机充电	
E.5	F.0			
E.5	C.3	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	D.4	A.我晚上睡觉的时候给手机充电		
C.3	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
A.1	F.0	A.我晚上睡觉的时候给手机充电		
D.4	E.5			C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
B.2	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	C.3			
D.4	F.0		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
D.4	E.5	A.我晚上睡觉的时候给手机充电		
E.5	B.2	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	C.3	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	E.5	A.我晚上睡觉的时候给手机充电		
C.3	C.3			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	B.2	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
A.1	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0			
D.4	F.0			C.我在白天断断续续地给手机充电
C.3	A.1		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	D.4	A.我晚上睡觉的时候给手机充电		

A.1	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		
B.2	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	E.5		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
C.3	F.0	A.我晚上睡觉的时候给手机充电		
E.5	E.5		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
D.4	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电	B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	A.1	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	F.0			C.我在白天断断续续地给手机充电
E.5	B.2			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	C.3			C.我在白天断断续续地给手机充电
E.5	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		
D.4	C.3	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	D.4			
E.5	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
F.0	A.1	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0			C.我在白天断断续续地给手机充电
E.5	F.0			C.我在白天断断续续地给手机充电
E.5	D.4			C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0			C.我在白天断断续续地给手机充电
E.5	F.0		B.我在起床之后给手机充电	C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		
E.5	F.0	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
C.3	D.4	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
D.4	F.0	A.我晚上睡觉的时候给手机充电		
D.4	F.0	A.我晚上睡觉的时候给手机充电		
E.5	E.5	A.我晚上睡觉的时候给手机充电		C.我在白天断断续续地给手机充电
E.5	F.0	A.我晚上睡觉的时候给手机充电		

8.请问你一般情况下，会在什么时候给手机充电呢？:我在白天有一个固定的充电时间	8.请问你一般情况下，会在什么时候给手机充电呢？:我在回家之后给手机充电	8.请问你一般情况下，会在什么时候给手机充电呢？:其他____	8.请问你一般情况下，会在什么时候给手机充电呢？:其他____[选项填空]
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
		F.其他	
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
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	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电	F.其他	
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
D.我在白天有一个固定的充电时间			
		F.其他	白天电量小于10，晚上电量小于30
D.我在白天有一个固定的充电时间			
		F.其他	手机提示电量不足。
	E.我在回家之后给手机充电		
D.我在白天有一个固定的充电时间			
	E.我在回家之后给手机充电		
D.我在白天有一个固定的充电时间			
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
D.我在白天有一个固定的充电时间			
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
		F.其他	手机快没电时
	E.我在回家之后给手机充电		

	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
		F.其他	
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
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	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
		F.其他	
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
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	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		
	E.我在回家之后给手机充电		

9.很多人都形成自己的充电习惯，如果你也有固定的时间地点为手机充电，请简短地描述一下你的充电习惯	10.为了延长手机的电量而改变使用手机的方式（如关闭移动数据，调低亮度或者换用更省点的 App），请问你有过这样的经历吗？	11.如果你的手机马上没电了，但是你没有办法马上给手机充电，请问你会怎么应对?
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
不固定，没有就充，出门前会充足	A.有过	D.其他
睡觉前充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
固定地点	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
只要没电，随时充。	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
没有	B.没有过	C.无所谓，我可以做别的事
睡觉时一直充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
除非条件不允许，否则我想一直给我的手机充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	C.无所谓，我可以做别的事
晚上睡觉前充电	B.没有过	C.无所谓，我可以做别的事
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	B.没有过	D.其他
	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	C.无所谓，我可以做别的事
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉之前给手机充电。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
没电即冲	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡前充电	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
我一般我晚上睡觉前给手机充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前充电 早上起后断开	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
发现电量低的时候就充电，时间不固定	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
平时有空即用数据充电线给手机充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
晚上睡觉充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
没有固定	C.可能有过	A.继续正常使用手机，尽快找到可以充电的地方
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
我一般在晚上睡觉时给手机充电	B.没有过	C.无所谓，我可以做别的事
我一般在晚上睡觉之前给手机充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
看到电量不足，随时随地充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
在电量低于百分之二十的时候能充电就随时充，没有固定的时间	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉后充电，或者白天到单位补充充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
每天早起给手机充电，以防白天没电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉之前	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉的时候给手机充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉之前充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前给手机充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
我在晚上睡觉时充电	B.没有过	C.无所谓，我可以做别的事
一般在睡觉时充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
下班后	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	B.没有过	C.无所谓，我可以做别的事
快没电充电	B.没有过	C.无所谓，我可以做别的事
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
在有充电条件下，尽量充电。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前充电	A.有过	C.无所谓，我可以做别的事
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前	B.没有过	D.其他
我一般在晚上睡觉之前给手机充电。	B.没有过	C.无所谓，我可以做别的事
我一般在晚上睡觉之前给手机充电	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
我一般在晚上睡觉之前给手机充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
到办公室就把手机插上去	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	D.其他
	A.有过	C.无所谓，我可以做别的事
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	C.无所谓，我可以做别的事
画图的时候给手机充电，防止玩手机	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
早上	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
手机剩20-30%时候充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般晚上睡觉时充电	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
到办公室后	A.有过	C.无所谓，我可以做别的事
没电随时充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	C.无所谓，我可以做别的事
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
随时充电	C.可能有过	C.无所谓，我可以做别的事
	A.有过	C.无所谓，我可以做别的事
睡前手机充电，开车无线充电	A.有过	C.无所谓，我可以做别的事
我一般在晚上睡觉之前给手机充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
几乎不带移动电源，一般夜里充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般在晚上睡觉之前给手机充电。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	C.无所谓，我可以做别的事
回到家或者单位都会看一下电量再考虑充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	D.其他
睡觉后充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
充电器睡前充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
不一定	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般晚上睡觉前给手机充电，白天会用充电宝充电。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
没有固定时间	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
一般情况下，我会在晚上睡觉前给手机充电；如果其他时间手机电量低，我也会及时充电；我也会随身携带	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
使用一天后睡觉前充电	B.没有过	C.无所谓，我可以做别的事
	B.没有过	C.无所谓，我可以做别的事
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
一般在晚上睡觉之后给手机充电。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉前	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
在单位充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
用电脑时充电	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上十点左右	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉前给手机充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	C.无所谓，我可以做别的事
一般利用回家后的时间立即充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉前	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	A.继续正常使用手机，尽快找到可以充电的地方
睡觉充电，上班充电	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
	C.可能有过	A.继续正常使用手机，尽快找到可以充电的地方
我一般是在办公室或者晚上睡觉前充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
我每天晚上都是把手机放在床头柜上充电，已成一种习惯	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间

	A.有过	C.无所谓，我可以做别的事
睡前	B.没有过	A.继续正常使用手机，尽快找到可以充电的地方
晚上睡觉前充电	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
一般是每天到工作室坐下之后把手机充电，以及回宿舍后在桌子上充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
我一般在晚上睡觉之前给手机充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉时在床旁充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
晚上睡觉的时候充电	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
以前充电慢的手机(大概2小时左右)会在单位或者家里空闲时间充电，现在新手机充电快（大概40分钟），就	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡前充一会，不管满没满都要拔下来。上班时候手机电量一定要充满，在家没电了才充。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
白天充电 时间不定 小于20才会去充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
只要在电源附近就一直充着电	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	C.无所谓，我可以做别的事
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
没有固定时间点，根据自己手机用电情况，低于15%的情况下会充电！	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般睡前插上充电，白天电量不足或是准备出门前会充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前为手机充电，中午睡觉时若手机电量低于百分之五十，会充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前充电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
看视频时充电，睡觉时充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉之前插上电源 放在里自己比较远（安全） 但仍然是相对容易就能拿到的距离	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
不上班或上班不外出没电的时候充电外出 提前充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
手机没电时	A.有过	A.继续正常使用手机，尽快找到可以充电的地方
我使用的是苹果全家桶. 然后会携带Type C转Lighting的线 基本上可以用Macbook给其他设备应急充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
没电才充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
坐在工作桌前的时候	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	C.无所谓，我可以做别的事
	A.有过	D.其他
手机老旧，随时充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	C.无所谓，我可以做别的事
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般睡觉之前给手机充电，这样醒来就充满了	C.可能有过	D.其他
我一般在晚上睡觉前给手机充电，如果白天手机电量不足，会利用充电宝充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
低于30%时充电一次充满，或临出门之前补电	B.没有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉前充电 办公室充电	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
是用无线充电器 在办公桌前就充	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
睡觉的时候，放在床头充电	C.可能有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般在临睡前用充电线为手机充电，早晨醒后拔出充电线。	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间
一般睡前会给手机充电，第二天满电出门，这样的话白天一般能撑一天。回家之后如果在书桌前工作学习，	A.有过	B.打开「低电量模式」，尽可能延长手机的使用时间

11.如果你的手机马上没电了，但是附近没有办法马上给手机充电，请问你会怎么应对？[文本填空]	12.请简要描述一下你的行为和心情，当你体验到上述情况的时候	
减少使用	大多时候无所谓，有时会有一点着急	
	非常焦虑	
	尽量不用	
	尽量少用，且合理使用时间	
	尽量不用	
	赶快去充电	
	[illegible]	
	着急	
	打开低电量模式 [illegible]	
	有些担心	
关机	焦虑	
	着急	
	焦虑	
	打开低电量模式并尽量不使用，以便于别人可以联系到我	
	打开低电量模式并尽量不使用，以便别人可以联系到我	
	无所谓	
	打开低电量模式并尽量不使用。	
	担心	
	我会有一些担心，打开低电量模式，并尽量不使用，以便于别人可以联系到我。	
	很慌	
	会担心，打开省电模式 [illegible]	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我	
	我会打开低电量模式以便别人可以联系到我	
	减少使用 延长时间	
	看是找到充电方法	
	看是找到可以充电的方式	
	焦虑，但能联络人联系不上我。	
	马上找充电地方	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我;	
	打开低电量模式	
	我会非常着急，想马上找到能充电的地方 [illegible]	
	很焦虑，赶紧充电	
	非常焦急	
	无所谓	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我。	
	打开低电量模式 尽量不用	
	有一点担心，尽量不使用手机	
	非常着急	
	我会有一些担心	
	会有一些担心，打开省电模式	
	会把手机打开的所有app都关掉，不玩手机	
	有点担心，低电量模式	
	我会很担心，打开低电量模式 [illegible]	
	非常担心有人联系不到我	
	尽量不使用，别人找不到我	
	担心没电，尽量少用手机	
	有点担心	
	打开低电量模式	
	有些担心	
	可以接受放弃	
	焦虑	
关机	担心	
	有点担心	
	我会非常焦虑，马上开始寻找可以为手机充电的方式	
	没关系	
	很不爽	
尽可能减少使用 但维持手机功能	尽量不做费电的事保持联系	
	尽量不使用	
	低电量尽量少看手机，尽量充电	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我。	
	有紧急的事的时候会找其他充电方式，没事的时候就不太在意	
	着急	
	希望找到充电的条件	
	会有些担心，马上找到充电点!	
	担心别人找不到我	
	没有什么重要事情，不会感到焦虑	
	正常干啥	
	焦虑	
	没关系	
	担心	
	我会非常焦虑，马上开始寻找可以为手机充电的方式。	
	[illegible]	
	会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我。	
	有一些担心，打开低电量模式，或者考虑找充电	
关闭有些软件，关屏幕	尽量不用	
	打开低电量模式尽快找到充电方电	
	关机，没啥什么重要事。	
	非常焦虑	
	打开低电量模式尽快充电。	
	[illegible]	
	比较焦虑，寻找为手机充电的方式	
	心里没底	
	会很担心，我会尽量找到可以充电的地方 [illegible]	
	有一点担心	
	有些担心，但不严重	
	挺担心，尽快找地方充电	
	我会有一些担心 [illegible] 尽量不使用，以便于别人可以联系到我。	
	担心，打开低电量模式	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我	
	可以先关闭手机	
	想要尽快回家或者找个可以充电的地方 [illegible]	
	[illegible]	
	着急	
	有一些担心，打开低电量模式	
	有些担心	
	尽量减少手机使用 [illegible]	
	担心，打开低电量模式	
	焦虑，赶紧找充电器	
	焦虑紧张	
	[illegible]	
	我会非常焦虑，马上开始寻找可以为手机充电的方式 [illegible]	
	焦虑	

	还好	
	马上寻找充电	
	要看情况，是否是我接下来要急着用手机做什么事。如果在地铁里没电了，然而出站要扫码，那就很担心。	
	尽量寻找可充电的方式，但不会因此焦虑	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我；提	
	有一些担心，打开低电量模式，减少后台运行耗电APP，然后尽量不使用。	
	一般会打开超级省电模式，或迅速寻找充电措施	
	担心	
	低电量而且短时间无法充电时会有些担心，一般会调整到低电量模式且尽量不使用，以保持手机联络畅通！	
	打开低电量模式并尽量不使用，以便别人可以联系到我	
	主要害怕，出地铁出不去怎么办。不玩手机，打开低电量模式，节约电量。尽快找移动电源补充电量	
	如果有事情需要联系会打开低电量模式延长使用时间如果没有急事儿 就let it go	
	我会有一些担心，打开低电量模式并尽量不使用，以便于别人可以联系到我	
	目前这个年龄没有太多着急要紧的事，正常用吧。如果有着急的事，少开几个app，保持联系，抓紧时间赶紧充电	
	无法及时充电的话会打开低电量模式，方便联系	
	比较担心他人联系不到我	
	还好吧先焦虑一下，如果要去哪的话提前背下地图，记住了重要的事就佛了	
	挺着尽量不让它关机	
	我会非常害怕，因为没有手机玩我会很无聊。手机已经成为生活习惯之一	
	清空应用，调低亮度，开启省电模式	
	先想办法解决，找可能性，都不行的话就算了。委屈，不服，然后发现没用，那就算了吧。	
	关机再打开手机那刻很焦虑 怕有人找我 没有油很失望	
	其他还好，比较焦虑的是忽然关机，终止我的游戏体验	
	赶快找充电的地方	
	手机会提示低电量. 这个是比较焦虑的时刻	
	如果短时间内我需要联系别人，导航地图，我会非常焦虑。其他时间无所谓	
	取决于之后的行程是不是一定要用手机了…如果不是的话，其实无所谓，如果是的话，就会开始物色充电设备了。找朋友借或者	
	不用手机	
会在手机电量很多的时候提前打开低电模式，很少出现不能充电还快没电了的情况	不太会出现这种情况	
	有点担心，会打开低电量，但关机就关机了，晚点回复也没什么关系	
锁屏	会焦虑，然后给家人或者正在等我的人说一声我手机快没电了，然后锁屏	
	会比较焦虑，尽量少用手机，然后寻找为手机充电的方式	
	会担心手机关机，打开低电量模式减少使用	
	焦虑	
	电量低减少手机使用	
	担心意外情况发生 无法使用手机进行联络	
	比较担心，怕耽误事	
	会焦虑，尽量在找到充电地方前不再玩手机	
	在有需要的紧急情况下，会积极寻找充电器，确定周围没有快速充电条件下，会调低电量模式尽量省电延长使用时间，也可能向	
	会有一些焦虑，主要怕失联，然后会尽量少看手机，减少负面情绪。	

Question list of Online Interview

Introduction

Hello, my name's Bao Baihong. I'm doing a research about the energy interactions between people and their smart devices. I'll ask some questions about your interactions between you and your devices regarding to energy. It'll take around 20 minutes.

Perceive battery level

- How often do you check the battery level of your phone? What's the feeling?
- What about other devices? Like wearable devices, tablets and computers?

Way of charging

- How do you usually charge your phone?
- Could you describe your daily routine of charging in a typical week day?
- What's the feeling of it?
- What about other devices?

Battery Management

- Have you ever experienced the situation that you have to change your way of using the phone in trade for a extension of battery life?
- How do you usually do? And why do you do that?
- What about other devices?

Appendix E

Expert Interview

Question list of Expert Interview

Introduction

Thank you for you time to take part in this expert interview. My graduation project focus on the influence that energy harvest will bring to future human-energy relationship between user and future device. I want to have a deeper understanding of this technology from a designer & researcher's perspective, so that I could be able to conceive the future human-energy relationship. I'll be asking some future-oriented questions, trying to get your opinion on how this technology will be applied and developed in future. I'll record the audio during interview, all the data will not be uploaded to any website, only for me refer back during my research. It'll be archived in repository of TU Delft.

Intermittent operation

- As far as I understand, this sudden "on and off" effect will happen hundreds of times in one second. But what will people experience this side-effect in reality? (Let's say a energy-harvesting version of smartwatch\smartphone)
  a. How long will it last?
  b.How often could people experience that side-effect?

- Does this side-effect have relation with the surrounding environment?
  a. The frequency or last time could be affected by the environment?

- Is this intermittent operation an inherent attribute that perhaps the future developers, designers and even users have to get used to? Or it will be overcome in the foreseeable future?

Capacity of energy harvesting

- I know that you've successfully managed to create a energy-harvesting version of Gameboy, which is quite impressive. Do you think it will be applied to smartphones or smartwatches in the near future?
  a. What's the (advantages and) limitations?
  b. What's the barrier?

- I know that the environment matters a lot considering the efficiency of harvesting. How big is the difference?
  a. To what extend will the environment affect the efficiency of harvesting process?
  b. Will people's actively taking part in the harvesting process make a huge difference?

- Are there any other factors that will affect the capacity of energy harvesting?

Multiple energy source and charging

- Since different energy source could be harvested, what's the difference of efficiency among different energy sources?

- Will the energy consumed immediately or it could be stored for later use?

- Is it possible to harvesting and managing multiple sources of energy in one device? (Maybe an manage system is needed)

Appendix F

Prototype Testing

Introductory Document

Who am I

My name's Bao Baihong, you can also called me Jason. I'm a design student of TU Delft who is now conducting my graduation project about future relationship between people and intermittently powered devices, which means devices powered by surrounding energy.

Appreciation

First I want to thank you for you participating my prototype test. Feel free to talk about any feelings you may feel and any doubts you have during test.

What am I doing

I'm now doing an prototype test about how user react to devices powered by environmental energy like solar energy. I want to know how will user react to the interruptions, how they feel and what do users think when reacting.

How will prototype behave

The prototype you're about to experience is a phone with Spotify interface. You can use it just as how you use Spotify or any other Music Streaming App. The different between experience prototype with your own smartphone is that this prototype is powered by sunlight. Therefore you may experience some "interruptions" when listening to the music, performing as a few seconds on and a few seconds off. When the level of sunlight changes, the level of "interruption" will also change accordingly.

Tasks

There's no specific tasks about this test. All you need to do is try to use this music player when you want to listen to music in the following 2 days and record what do you experience.

Explorative Sessions

First, let's explore how this prototype work together so you can get familiar with it.

1. You can try to play and pause music first.
2. You can also switch between each track by swiping the cover.
3. Next, let's see how does the interruption feel like.
4. The level of interruption is related to the amount of surrounding solar energy. So feel free to move around and experience.

Interview Questions

Starting with Specific Actions

- I see you doing..., could you explain what do you think when doing this?
- What makes you doing ...?
- I notice that you bumped into troubles when... what make it difficult?
- You said... during..., what do you mean by saying that?

Overall Experience

- This prototype is a simulation of what Intermittent powered device would perform. How do you describe the overall experience?
- What's the most frustrating part that you think this device will bring?
- Do you think this device is anywhere better than the device that you currently own?
- What do you feel overall?

Future Imagination

- If one of your device like phone, laptop or tablet turns into intermittently powered, which one do you want?
- What do you think your adaptation will experience?
- How will you design the futuristic UI for energy indicator?

Master Thesis - Appendix

by Bao Baihong

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